

Item No. 431S

Machine Laid Portland Cement Concrete Curb and Gutter

431S.1 Description

This item shall govern Portland cement (p.c.) concrete curb and gutter and reinforcing steel dowels, constructed in accordance with this specification on an approved base in conformity with the lines, grades, sections and Standard Detail Series 430S and 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.

431S.2 Submittals

The submittal requirements of this specification item include:

- A. Class I p.c. concrete mix design,
- B. Type of Installation (i.e. P.C. Concrete Curb and Gutter or P.C. Concrete Curb) and construction details (i.e. base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

431S.3 Materials

- A. Portland Cement Concrete (PCC)

The Portland Cement Concrete shall conform to Class I Concrete, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures".

- B. Reinforcing Steel

Reinforcing steel shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

- C. Expansion Joint Materials

Preformed expansion joint materials shall conform to Standard Specification Item No. 408S, "Expansion Joint Materials".

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing".

- E. Flexible Base

Flexible base material shall conform to Standard Specification Item No. 210S, "Flexible Base".

- F. Stabilized Base

A stabilized base identified as a Type A or B shall conform to the requirements of Standard Specification Item 340S, "Hot Mix Asphaltic Concrete Pavement".

431S.4 Construction Methods

A. Subgrade and Base Preparation

Subgrade for curb and gutter shall be excavated and prepared to depth and width requirements indicated on the Drawings, including a minimum of 12 inches (300 mm) behind the curb, unless a greater width is indicated on the Drawings. The subgrade shall be shaped to the line, grade, cross section and dimensions indicated on Standard Detail 430S-1 or the Drawings. A minimum thickness of 4 inches (100 mm) of flexible base (Standard Specification Item No. 210S) or stabilized base shall be placed, spread, wetted (flexible base only) and thoroughly compacted. If dry, the flexible base shall be sprinkled lightly with water before p.c. concrete is deposited thereon.

B. Portland Cement Concrete (P.C.C.) Curb and Gutter Extrusion

The pcc curb shall be laid by a curb extrusion machine approved by the Engineer or designated representative. The line for top of curb shall be maintained from a guideline or guide rails, set by the Contractor. Curb outline shall strictly conform to the details indicated on the Drawings. The forming tube of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine, to provide required variable height of curb necessary to conform to the established grade line. If a guideline is used, a pointer or gage shall be attached to the machine in such a manner that a comparison can be made between the curb and the guideline in order to provide a continual check on the curb grade. Other methods may be used if approved in writing by the Engineer or designated representative.

C. Portland Cement (P.C.) Concrete Placement and Finish

The p.c. concrete shall be fed into the machine in such a manner and at such consistency that the finished curb will present a well-compacted mass with a surface free from voids and honeycomb and true to established shape, line and grade.

Any additional surface finishing indicated on the Drawings and/or required by the Engineer or designated representative shall be performed immediately after placement. Weakened plane joints shall be cut to a depth of 3/4 inch (19 mm) at 10-foot (3 meters) intervals or as directed by the Engineer or designated representative.

Whenever the curb end abuts a p.c. concrete structure a 3/4-inch (19-mm) pre-molded expansion joint conforming to the curb section shall be placed between the 2 concrete surfaces.

Whenever extrusion is suspended long enough to produce a cold joint, 1/2-inch (12.5 mm) smooth dowel bars, 24 inches (600 mm) long, shall be embedded 12 inches (300 mm) into the completed curb, 1/4 curb height from top and bottom. The end of the curb at the point of suspension of extrusion shall be cut back until all remaining p.c. concrete is of a dense, well-compacted nature.

Any addition of concrete to the extruded curb is to be applied and finished before the extruded curb has achieved its initial set. The final finish shall have a gritty surface approved by the Engineer or designated representative.

D. Reinforcing Steel

The reinforcing steel, if required by standard 430S-1 or shown on approved plans, shall be placed as shown on the typical section of the Drawings. Care shall be exercised to keep all steel in its proper location during p.c. concrete placement.

E. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, 3/4 inch (19 mm) in thickness, shall be provided at intervals not to exceed 40 feet (12 meters) and shall extend the full width and depth of the p.c. concrete. Weakened plane joints shall be made 3/4 inch (19 mm) deep at 10-foot (3 meters) intervals. All joint headers shall be braced perpendicular and at right angles to the curb.

Two round smooth dowel bars, 1/2 inch (12.5 mm) in diameter and 24 inches (600 mm) in length, shall be installed at each expansion joint. Sixteen inches (400 mm) of one end of each dowel shall be thoroughly coated with hot oil, asphalt or red lead, so that it will not bond to the concrete. The dowels shall be installed with a dowel sleeve on the coated end as indicated on the Drawings or equivalent method as directed by the Engineer or designated representative.

F. Curing

When finishing operations are completed the curb shall be cured conforming to Standard Specification Item No. 409S, "Membrane Curing".

When the curb has cured a minimum of 3 days and prior to placement of the final lift of base course, it shall be backfilled to the full height of the p.c. concrete, tamped and sloped to drain as directed by the Engineer or designated representative.

In turf areas, the upper 4 inches (100-mm) of backfill shall be of clean topsoil, that conforms to Standard Specification Item No. 130S, "Borrow" and shall be free of stones and debris.

G. Seeding in Turf Areas

When turf is to be established, the preparation of the seedbed shall conform to Standard Specification Item No. 604S, "Seeding for Erosion Control".

431S.5 Measurement

Machine Laid PCC Curbs will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) of completed and accepted curb, complete in place.

431S.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lineal foot for "Machine Laid PCC Curb and Gutter". The unit bid price shall include full compensation for all work as set forth and described under payment Method A, B or C below.

A. Method A: With Excavation (Pay Item No. 431S-A)

This payment method includes all the work performed for "Machine Laid PCC Curb and Gutter", complete, at the unit bid price. The unit bid price shall include full compensation for excavation, preparation of the subgrade, furnishing and placing all base material, reinforcing steel, dowels, expansion joint materials, curing material, backfill and all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

B. Method B: With Fine Grading (Pay Item No. 431S-B)

This payment method includes all the work performed for "Machine Laid PCC Curb and Gutter", complete, at the unit bid price. The unit bid price shall include full compensation for fine grading, furnishing and placing reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

**C. Method C: included in the unit price bid for this specification item
Incidental Work (Pay Item No. 431S-C)**

This method includes all the work performed as incidental work relating to "Machine Laid PCC Curb and Gutter" as may be detailed and noted on the Drawings or included and described in the "Special Provisions" of the Standard Contract Documents.

Payment will be made under one of the following:

Pay Item No. 431S-A: Machine Laid Curb and Gutter (Excavation) Per Lineal Foot.
Pay Item No. 431S-B: Machine Laid Curb and Gutter (Fine Grading) Per Lineal Foot.
Pay Item No. 431S-C: Machine Laid Curb and Gutter (Incidental Work) Per Lineal Foot.

End

<i>SPECIFIC</i> CROSS REFERENCE MATERIALS	
Specification Item No. 431S, "Machine Laid PCC Curb and Gutter"	

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 130S	Borrow
Item No. 210S	Flexible Base
Item No. 206S	Asphalt Stabilized Base (Plant Mix)
Item No. 340S	Hot Mix Asphaltic Concrete Pavement
Item No. 403S	Concrete for Structures
Section 403S.7: Item No. 403S	Table 4: Classes of Concrete
Item No. 406S	Reinforcing Steel
Item No. 408S	Expansion Joint Materials
Item No. 409S	Membrane Curing
Item No. 604S	Seeding for Erosion Control

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
No. 430S-1	Curb and Gutter Section
No. 430S-3	Curb Expansion Joint Dowel Detail
No. 430S-4	Concrete Backfill Under Curb & Gutter

No. 430S-5

Reinforcing Bar Detail at Existing Curb and Gutter

<u>RELATED CROSS REFERENCE MATERIALS</u>

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 302S	Aggregates for Surface Treatments
Item No. 360	Concrete Pavement
Item No. 430S	P.C. Concrete Curb and Gutter
Item No. 433S	P.C. Concrete Driveways
Item No. 434S	P.C. Concrete Medians and Islands
Item No. 436S	P.C. Concrete Valley Gutters
Item No. 606S	Fertilizer

Item No. 432S
Portland Cement Concrete Sidewalks

432S.1 Description

This item shall govern the construction of Portland cement concrete sidewalks (Standard Detail No. 432S-1), 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.

432S.2 Submittals

The submittal requirements of this specification item include:

- A. Class A portland cement (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.
- D. Number, manufacturer, model, construction, finish and installation details of streetscape appurtenances of bicycle racks, benches, chairs, trash receptacles, streetlights, tree wells and above grade tree planters [for sidewalks, 12 feet (3.66 meters) or wider].

432S.3 Materials

- A. Portland Cement Concrete
Portland cement concrete shall be Class A conforming to Specification Item No. 403S, "Concrete for Structures" or Specification Item No. 407S, "Fibrous Concrete".
- B. Reinforcement
Reinforcement shall conform to Specification Item No. 406S, "Reinforcing Steel" or Specification Item No. 407S, "Fibrous Concrete".
- C. Expansion Joint Materials
Expansion joint materials shall conform to Specification Item No. 408S, "Expansion Joint Materials".
- D. Membrane Curing Compound
Membrane curing compound shall conform to Specification Item No. 409S, "Membrane Curing".

432S.4 Construction Methods

The subgrade shall be excavated in accordance with Specification Item No. 111S, "Excavation", prepared in accordance with Specification Item No. 201S, "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. 201S. 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. For sidewalks with widths exceeding 6 feet (1.83 meters) longitudinal weakened-plane tooled joints shall be provided as indicated on the Drawings or as directed by the Engineer or designated representative.

Reinforcement for sidewalks shall consist either of polypropylene fibrillated fibers or 6" x 6" x W1.4 x W1.4 (150mm x 150mm x MW9 x MW9) welded wire fabric or one layer #3 (10M) reinforcing bars, placed no more than 18 inches (450 mm) on center both directions. All reinforcement shall be accurately placed at slab mid-depth, equidistant from the top and bottom of the p.c. concrete and held firmly in place by means of bar supports of adequate strength and number that will prevent displacement and keep the steel at its proper position during the placement of the p.c. concrete. In no instance shall the steel be placed directly on the subgrade or sand cushion layer.

Prior to placement of the concrete, the reinforcement installation shall be inspected by the Engineer or designated representative to insure conformance with the drawings, specifications and this item. In addition care shall be exercised to keep all steel in its proper position during placement of the p.c. concrete. If during placement of the concrete, the reinforcement is observed to loose bar support, float upward or move in any direction, the placement shall be stopped until corrective action is taken.

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 covers the entire surface with 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 formed to produce a finished surface with detectable warnings (Standard Detail 432S-2A) 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 Austin Standard Details (Standard Details 432S-3, 432S-3A through 432S-3H, 432S-5, 432S-5A, 432S-5B, etc.).

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. 480S, "Concrete Paving Units"). The concrete paving units shall be constructed in accordance with Standard Specification Item No. 485S, "Concrete Paving Units for Sidewalk Ramps" and appropriate City of Austin Standard Details (Standard Details 432S-2A, 432S-3, 432S-3A through 432S-3H, 432S-5, 432S-5A and 432S-5B).

At the proper time after finishing, the surface shall be protected by a membrane, compound curing agent or by wetted cotton or burlap mats, conforming to Item No. 409S, "Membrane Curing". 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. 410S, "Concrete Structures". The top 4 inches (100 mm) of fill shall be clean topsoil conforming to Item No. 604S, "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.

432S.5 Streetscape Furniture Installation Requirements

A. General General

Bicycle racks, benches and chairs, trash receptacles, tree wells and above grade tree wells and planters shall only be installed in sidewalks that are 12 feet (3.66 meters) or wider. When installation is indicated on the Drawings or directed by the Engineer or designated representative, these items shall be permanently installed as indicated in Standard Details 710S-4 and 710S-5; 432S-9B; 432S-7C, and 432S-7F; and 432S-8B. Above grade tree wells shall be installed in conformance with Standard Detail 432S-7E, while above grade tree planters shall be installed in conformance with Standard Detail Nos. 432S-7D and 432S-7G.

B. Location Requirements

1. Benches.

Benches shall be placed either perpendicular to the curb with the center of the bench on line with trees and light poles and facing toward the building entry, or parallel to the building and within 6" (150 mm) of the building wall, facing out to the street.

Bench siting shall be in conformance with Standard Detail No. 432S-9C in 12' (3.6 M) or wider sidewalks and Standard Detail No. 432S-9D in sidewalks of width between 12' (3.6 M) and 18' (5.4 M).

2. Bike Racks.

Bike racks are to be placed perpendicular to the curb with the centerline of the rack on line with trees and light poles.

Bike rack siting shall be in conformance with Standard Detail No. 710S-6A in 12' (3.6 M) or wider sidewalks and Standard Detail No. 710S-6B in sidewalks of width between 12' (3.6 M) and 18' (5.4 M).

3. Trash Receptacles.

Trash receptacles shall either be placed along the curb, with the center line of the receptacle on line with the trees and light poles, or shall be located at the building entry in alignment with the structural bay system of the building. If located at the entry there shall be no more than 1 foot (300 mm) clearance between the receptacle and the building wall.

Trash receptacle siting adjacent to curb ramps within an intersection shall be in conformance with Standard Detail No. 432S-8C in 12' (3.6 M) or wider sidewalks.

P432S.6 Pedestrian Railing

When a pedestrian railing installation is required along sidewalks for pedestrian protection as indicated on the Drawings or directed by the Engineer or designated representative, this type of pedestrian railing shall be permanently installed in conformance with one of the following designated Standard Details: 707S-1, 707S-2, 707S-3 or 707S-4.

When a pedestrian railing installation is required along portions of sidewalks identified as 'ramps' for ADA accessibility purposes as indicated on the Drawings or directed by the Engineer or designated representative, this type of pedestrian railing shall be permanently installed in conformance with one of the following designated Standard Details: 707S-2, 707S-3 or 707S-4.

432S.7 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.

Accepted work performed as prescribed by "Streetscape Appurtenances" will be measured per each for the type of appurtenance indicated on the Drawings.

Accepted work performed as prescribed by "Pedestrian Railing" will be measured per lineal foot of the type of railing indicated on the Drawings.

432S.8 Payment

The work performed as prescribed by this item for concrete sidewalk will be paid for at the unit bid price per square foot for "Concrete Sidewalk" and/or "Sidewalks Reconstruction"; per each for "Concrete Sidewalk Ramps" and "Streetscape Appurtenances" or per lineal foot for "Pedestrian Railing".

The unit bid price for new sidewalk shall include full compensation for excavating and/or removal and/or relocating obstructions, vegetating adjacent areas disturbed by sidewalk construction, preparing the subgrade; for furnishing and placing all materials including cushion material, all reinforcement, bar supports, joints, expansion joint materials, and for any other materials, manipulations, labor, tools, equipment, finishing, curing and incidentals necessary to complete the work.

The unit bid price for sidewalk reconstruction 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, bar supports, joints, expansion joint materials, and for any other materials, manipulations, labor, tools, equipment, finishing, curing and incidentals necessary to complete the work.

The unit bid price for ramps shall include full compensation for preparing the subgrade when not included as a separate item; for furnishing and placing all materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work. All necessary excavation, filling and grading of the slopes adjacent to the completed concrete paver units will be included in the unit price bid for the item of construction in which this item is used, unless included as a separate pay item in the Contract bid form.

The unit bid price for streetscape appurtenances shall include full compensation for the individual item (i.e. bench, chair, bicycle rack, trash receptacle, street light or above grade tree planter), as well as the removal of existing sidewalk, preparation of footings, furnishing and placing all materials, manipulation and finishing, labor, tools, equipment and incidentals necessary to complete the work.

The unit bid price for pedestrian railing shall include full compensation for the complete installation of the specific pedestrian railing including but not limited to preparation of footings or curb, furnishing and placing all materials, manipulation and finishing, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

New Sidewalks

Pay Item 432S-4:	New P.C. Concrete Sidewalks, 4 Inch thickness	Per Square Foot.
Pay Item 432S-5:	New P.C. Concrete Sidewalks, 5 Inch thickness	Per Square Foot.
Pay Item 432S-6:	New P.C. Concrete Sidewalks, 6 Inch thickness	Per Square Foot.
Pay Item 432S-7:	New P.C. Concrete Sidewalks, 7 Inch thickness	Per Square Foot.

Sidewalks Reconstruction

Pay Item 432SR-4:	Reconstruct Concrete Sidewalks to 4 Inch thickness, including removal of existing sidewalk	Per Square Foot.
Pay Item 432SR-5:	Reconstruct Concrete Sidewalks to 5 Inch thickness, including removal of existing sidewalk	Per Square Foot.
Pay Item 432SR-6:	Reconstruct Concrete Sidewalks to 6 Inch thickness, including removal of existing sidewalk	Per Square Foot.
Pay Item 432SR-7:	Reconstruct Concrete Sidewalks to 7 Inch thickness, including removal of existing sidewalk	Per Square Foot.

Ramps

Pay Item 432S - RP-1:	P.C. Sidewalk Curb Ramp with Pavers (Type I)	Per Each.
Pay Item 432S-RP-1A:	P.C. Sidewalk Curb Ramp with Pavers (Type IA)	Per Each.
Pay Item 432S-RP-1B:	P.C. Sidewalk Curb Ramp with Pavers (Type IB)	Per Each.

Streetscape Appurtenances

Pay Item 432S-SAC-1	Streetscape Bench (_____ inches in length)	Per Each.
Pay Item 432S-SAC-2	Streetscape Chair	Per Each.
Pay Item 432S-SAC-3	Streetscape Bicycle Rack	Per Each.
Pay Item 432S-SAC-4	Streetscape Trash Receptacle	Per Each.
Pay Item 432S-SAC-5	Streetscape Street Light	Per Each.
Pay Item 432S-SAC-7C	Streetscape Tree Well for Concrete Sidewalks	Per Each.
Pay Item 432S-SAC-7D	Streetscape Above Grade Tree Planters with Bench	Per Each.
Pay Item 432S-SAC-7E	Streetscape Above Grade Tree Well with Seat	Per Each.
Pay Item 432S-SAC-7F	Streetscape Tree Well without Grate	Per Each.
Pay Item 432S-SAC-7G	Streetscape Above Grade Galvanized Steel Tree Planters	Per Each

Pedestrian Railing

Pay Item 432S-PRC-1	Pedestrian Railing (Standard 707S-1)	Per LF.
Pay Item 432S-PRC-2	Pedestrian ADA Railing – Option 1 (Standard 707S-2)	Per LF.
Pay Item 432S-PRC-3	Pedestrian ADA Railing – Option 2 (Standard 707S-3)	Per LF.
Pay Item 432S-PRC-4	Pedestrian ADA Railing – Option 3 (Standard 707S-4)	Per LF.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 432S, "P. C. Concrete Sidewalks"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 111S	Excavation
Item No. 201S	Subgrade Preparation
Item No. 403S	Concrete for Structures
Item No. 406S	Reinforcing Steel
Item No. 407S	Fibrous Concrete
Item No. 408S	Expansion Joint Materials
Item No. 409S	Membrane Curing
Item No. 410S	Concrete Structures
Item No. 480S	Concrete Paving Unit
Item No. 485S	Concrete Paving Units for Sidewalk Ramps
Item No. 604S	Seeding for Erosion Control

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
432S-1	Sidewalk
432S-2A	Detectable Warning-Paver
432S-3	Type I Curb Ramps-Full Intersection
432S-3A	Type I Curb Ramps-T Intersection
432S-3B	Type IA/IB Curb Ramps-Full Intersection
432S-3C	Type IA/IB Curb Ramps-T Intersection
432S-3D	Combined Curb Ramps-Full Intersection
432S-3E	Combined Curb Ramps-T Intersection
432S-3F	Combined Sidewalk Curb Ramp with Pavers
432S-3G	Combined Sidewalk Curb Ramp with Pavers within Limited ROW
432S-3H	Type I Curb Ramps within PC/PT of Curb and Gutter
432S-5	Type I Sidewalk Curb Ramp
432S-5A	Type IA Sidewalk Curb Ramp
432S-7C	Tree Well for New Trees Planted Within Concrete Sidewalk 3.6 M (12') or Greater
432S-7D	Above Grade Tree Planters
432S-7E	Above Grade Tree Well with Bench
432S-7F	Tree Well Without Grate
432S-7G	Above Grade Galvanized Steel Tree Planters
432S-8B	Trash Receptacle Installation in Concrete Sidewalk
432A-8C	Furnishing Location in 12' (3.6 M) or greater Trash Receptacle Siting
432S-9B	Bench/Chair Installation in Sidewalks
432S-9C	Furnishing Location in 12' (3.6 M) or greater Sidewalks-Bench Siting
432S-9D	Furnishing Location in Greater than 12' (3.6 M) or Less than 18' (5.4 M) Sidewalks-Bench Siting
707S-1	Pedestrian Railing
707S-2	Pedestrian ADA Railing – Option 1
707S-3	Pedestrian ADA Railing – Option 2
707S-4	Pedestrian ADA Railing – Option 3
710S-4	Bicycle Rack Installation in Concrete Sidewalks (Alternate 1)
710S-5	Bicycle Rack Installation in Concrete Sidewalks (Alternate 2)

710S-6A	Furnishing Location in 12' (3.6 M) or greater Sidewalks-Bicycle Rack Siting
710S-6B	Furnishing Location in Greater than 12' (3.6 M) or Less than 18' (5.4 M) Sidewalks-Bicycle Rack Siting

American Disabilities Act, Federal Register; Volume 56, No. 144; July 26, 1991

ADA Accessibility Guidelines For Building And Facilities

<u>Designation</u>	<u>Description</u>
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)

<u>Designation</u>	<u>Description</u>
Section 4.29	Detectable Warnings on Walking Surfaces
Section A4.29.2	Detectable Warnings on Walking Surfaces

<i>RELATED CROSS REFERENCE MATERIALS</i>

City of Austin Standard Contract Documents

<u>Designation</u>	<u>Description</u>
00700	General Conditions
01500	Temporary Facilities
01550	Public Safety and Convenience

City of Austin Utilities Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 5.2.3	Utility Adjustments For Roadway Construction Projects

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Portland Cement Concrete
Item No. 110S	Street Excavation
Item No. 132S	Embankment
Item No. 203S	Lime Treatment for Materials In Place
Item No. 204S	Portland Cement Treatment for Materials In Place
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 234S	Rolling (Tamping)
Item No. 236S	Rolling (Proof)
Item No. 360S	Concrete Pavement
Item No. 402S	Controlled Low Strength Material
Item No. 404S	Pneumatically Placed Concrete
Item No. 405S	Concrete Admixtures
Item No. 411S	Surface Finishes for Concrete

Item No. 433S
P. C. Concrete Driveways

433S.1 Description

This item shall govern construction of Portland Cement (p.c.) concrete driveways, as herein specified, on an approved subgrade, in conformity with the lines, grades and cross section indicated on the Drawings, identified in Standard Detail Series 433S, 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.

433S.2 Submittals

The submittal requirements of this specification item include:

- A. Class A and/or Item 360S p.c. concrete mix design,
- B. Type of Installation (i.e. Type I, Flared 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.

433S.3 Materials

A. Concrete

The Portland Cement Concrete for a Type I driveway (Standards 433S-1 and 433S-1A shall conform to Class A, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures." The Portland Cement Concrete for a Type II driveway (Standard 433S-2) shall conform to a normal concrete mix design for concrete pavement, Section 360S.4(2) of Standard Specification Item No. 360S, "Concrete Pavement".

B. Reinforcing Steel

Reinforcing steel and welded wire fabric shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification Item No. 408S, "Expansion Joint Materials".

D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing".

E. Cushion Layer

The Cushion layer shall consist of crusher screenings, gravel or coarse sand.

433S.4 Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410S, "Concrete Structures".

A. Subgrade Preparation

The subgrade shall be excavated, prepared and shaped to the lines, grades and cross sections indicated on the Drawings or as directed by the Engineer or designated representative. The subgrade shall be thoroughly compacted in accordance with Standard Specification Item No. 201S, "Subgrade Preparation". A 2-inch (50-mm) minimum compacted thickness cushion shall be spread, wetted thoroughly, tamped and leveled. The cushion shall be moist at the time the p.c. concrete is placed.

If the subgrade is undercut or natural ground is located below the top of subgrade, the necessary backfill material shall conform with Standard Specification Item 130S, "Borrow" and shall be compacted with a mechanical tamper. Hand tamping will not be permitted.

Where the subgrade material consists of gravel or includes 70 percent of rock, the 2-inch (50-mm) cushion layer may not be required. The Engineer or designated representative will determine if the subgrade meets the above requirements.

B. Forms

Forms shall be of metal, well-seasoned wood or other approved material of a section satisfactory to the Engineer or designated representative. Wood forms shall not be less than 2 inches (50 mm) nominal thickness for straight runs and 1-inch (25-mm) nominal thickness for curved runs. Forms shall be a section satisfactory to the Engineer or designated representative and clean, straight, free from warp and of 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 placement of p.c. concrete.

C. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, 3/4 inch (19 mm) thick, shall be provided where the new construction abuts the existing sidewalks or driveways or as directed by the Engineer or designated representative. The expansion joint material shall be placed vertically and shall extend the full depth of the p.c. concrete. Similar expansion material shall be placed around all obstructions protruding through the driveway. Weakened plane joints shall be located on 10-foot (3-meter) centers or as directed by the Engineer or designated representative. Normal dimensions of the weakened plane groove joints shall be 1/4-inch (6.25-mm) wide and 3/4 inch (19 mm) deep.

D. Reinforcement

Reinforcement for Type I driveways shall consist of 1 layer of 6 x 6 by W 1.4 x W 1.4 (150 x 150 by MW9 x MW9) wire fabric or No. 3 (10 M) bars placed not more than 18 inches (450 mm) on center, both directions. Reinforcement for Type II driveways shall consist of 1 layer of layer of No. 4 (13M) bars placed no more than 18 inches (450 mm) on center, both directions.

All reinforcements shall be accurately placed equidistant from the top and bottom of the p.c. concrete slab and held firmly in place by means of bar supports of adequate strength and number that will prevent displacement and keep the steel at its proper position. In no instance shall the steel be placed directly on the subgrade or sand cushion layer.

Prior to placement of the concrete, the reinforcement installation shall be inspected by the Engineer or designated representative to insure conformance with the drawings, specifications and this item. In addition, care shall be exercised to keep all steel in its proper position during the placement of p.c. concrete. If during placement of the concrete, the reinforcement is observed to loose bar support, float upward or move in any direction, the placement shall be stopped until corrective action is taken.

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 No. 3 (10 M) and No. 4 (13M) bars shall have a minimum lap of 12 inches (300 mm).

E. P.C. Concrete Placement and Finishing

The p.c. concrete shall be placed in the forms and spaced, tamped and thoroughly compacted 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 otherwise indicated on the Drawings. The outer edges and joints shall be rounded with approved tools to a 1/4-inch (6.3 mm) radius. Care shall be exercised to prevent loss of dummy joints or rounded edges when applying the broom finish.

F. Curing

At the proper time after finishing, the surface shall be protected by a membrane compound curing agent in conformance with Standard Specification Item No. 409S, "Membrane Curing" or by wetting cotton or burlap mats. Either method shall be subject to approval by the Engineer or designated representative.

Traffic shall be barricaded from using the driveway for a minimum of 4 days after initial placing and may be opened to traffic only with approval of the Engineer or designated representative.

G. Incidental Work

All necessary excavation, filling and grading of the slopes, adjacent to the completed pcc driveways, 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 with topsoil conforming to Standard Specification Item No. 130S, "Borrow". When turf is to be established, the preparation of the seedbed shall conform to Standard Specification Item No. 604S, "Seeding for Erosion Control", in a manner acceptable to the Engineer or designated representative.

433S.5 Measurement

Accepted work performed as prescribed by this item will be measured by the square foot (square meters: 1 square meter equals 10.764 square feet) of surface area of the specific type of p.c. concrete driveway.

433S.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "Concrete Driveways". The unit bid price shall include full compensation for preparation of the subgrade; furnishing and placing all materials, including cushion layer, all reinforcing steel, bar supports and expansion joint materials; and any other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 433S-A: Type I P.C. Concrete Driveway Per Square Foot.

Pay Item No. 433S-B: Flared Type I P.C. Concrete Driveway Per Square Foot.

Pay Item No. 433S-C: Type II P.C. Concrete Driveway Per Square Foot.

End

<i>SPECIFIC</i> CROSS REFERENCE MATERIALS
Specification Item No. 433S, "P.C. Concrete Driveways"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 130S	Borrow
Item No. 201S	Subgrade Preparation
Item No. 360S	Concrete Pavement
Item No. 403S	Concrete for Structures, Section 403S.7
Item No. 403S	Concrete for Structures, Table 4: Classes of Concrete
Item No. 406S	Reinforcing Steel
Item No. 408S	Expansion Joint Materials
Item No. 409S	Membrane Curing
Item No. 410S	Concrete Structures
Item No. 604S	Seeding for Erosion Control

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
No. 433S-1	Type I Driveway (1 & 2 Family Residential Use Only)
No. 433S-1A	Flared Type I Driveway (1 & 2 Family Residential Use Only)
No. 433S-2	Type II Driveway

<i>RELATED</i> CROSS REFERENCE MATERIALS
Specification Item No. 433S, "P.C. Concrete Driveways"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 430S	P.C. Concrete Curb and Gutter
Item No. 431S	Machine Laid PCC Curb and Gutter
Item No. 432S	Concrete Sidewalks
Item No. 434S	P.C. Concrete Medians and Islands
Item No. 436S	P.C. Concrete Valley Gutters
Item No. 470S	Curb Cuts for Sidewalk Ramps and Driveways
Item No. 606S	Fertilizer

Item No. 434S
P.C. Concrete Medians and Islands

434S.1 Description

This item shall govern construction of Portland cement concrete traffic islands and medians in accordance with these specifications and in conformity to the lines, grades, sections 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, the inch-pound units are given preference followed by SI units shown within parentheses.

434S.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p.c. concrete mix design,
- B. Type of Installation (i.e. Median or Island) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane),

434S.3 Materials

- A. Portland Cement (p.c.) Concrete

The p.c. concrete shall conform to Class A Concrete, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures".

- B. Reinforcing Steel

Reinforcing steel and welded wire fabric shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

- C. Expansion Joint Materials

Preformed expansion joint materials shall conform to Standard Specification Item No. 408S, Expansion Joint Materials".

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing".

- E. Admixtures

Admixtures shall conform to Standard Specification Item No. 405S, "Concrete Admixtures".

- F. Aggregate Cushion

Cushion layer shall consist of crusher screening, gravel, sand, crushed stone or "Flexible Base" materials (Standard Specification Item No. 210S) approved by the Engineer or designated representative.

434S.4 Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410S, "Concrete Structures".

A. PCC Mix Design

The p.c. concrete shall conform to an approved design mix for a Class A p.c. concrete on file with the City or proposed Class A mix designs with the necessary test data may be submitted for approval by the Engineer or designated representative.

High range water reducing admixtures conforming to Standard Specification Item No. 360, "Concrete Pavements" may be used when approved by the Engineer or designated representative.

B. Subgrade and Base Preparation

The subgrade shall be excavated, prepared and shaped to the lines, grades and cross section indicated on the Drawings or as directed by the Engineer or designated representative, and shall be thoroughly compacted conforming to Standard Specification Item No. 201S, "Subgrade Preparation". A cushion layer, 2 inches (50 mm) minimum thickness, shall be spread, wetted thoroughly, tamped and leveled. The cushion shall be moist at the time the p.c. concrete is placed.

C. Forms

Forms shall be of metal, well-seasoned wood or other approved material. The length of the forms shall be a minimum of 10 feet (3 meters). Flexible or curved forms shall be used for curves of 100-foot (30-meter) radius or less. Wood forms for straight sections shall be not less than 2 inches (50 mm) in thickness. Forms shall be a section, that is satisfactory to the Engineer or designated representative, and shall be clean, free from warp, and of a depth equal to the finished work. All forms shall be securely staked to line and grade and maintained in a true position during the placement of the p.c. concrete and, if required, forms shall be thoroughly oiled with a light form oil prior to p.c. concrete placement. If the adjacent existing asphalt pavement is damaged during construction, it shall be restored to its original condition.

D. Reinforcement

Reinforcement shall conform to the details indicated on the Drawings or the directions of the Engineer or designated representative. All reinforcement shall be accurately placed at slab mid-depth, equidistant from the top and bottom of the p.c. concrete, and held firmly in place by means of bar supports of adequate strength and number that will prevent displacement and keep the reinforcement in its proper position during the placement of the p.c. concrete. In no instance shall the steel be placed directly on the subgrade or sand cushion layer.

Prior to placement of the concrete, the reinforcement installation shall be inspected by the Engineer or designated representative to insure conformance with the drawings, specifications and this item. In addition care shall be exercised to keep all steel in its proper position during placement of the p.c. concrete. If during placement of the concrete, the reinforcement is observed to loose bar support, float upward or move in any direction, the placement shall be stopped until corrective action is taken.

E. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, 3/4 inch (19 mm) in thickness, shall be placed as indicated on the Drawings with a maximum spacing of 40 feet (12 meters) or as directed by the Engineer or designated representative. Expansion joints shall be placed on the same alignment when adjacent to a Portland Cement concrete pavement. Weakened plane joints shall be made 3/4 inch (19 mm) deep and equally spaced, normally at 5 foot (1.5 meters) on centers or as directed by the Engineer or designated representative. Expansion joints shall be required between the curb and median p.c. concrete.

F. P.C. Concrete Placement and Finishing

The p.c. concrete shall be placed in the forms to the depth indicated on the Drawings, and properly consolidated and until mortar entirely covers the surface and forms a monolithic finish. If a vibrator is used, care shall be taken not to leave it in one location long enough to induce segregation. The top surface shall be floated and troweled to a uniform smooth surface, then finished with a camel hairbrush or wood float to a gritty texture. The outer edges shall be rounded with approved tools to the radii indicated on the Drawings.

When the ambient air temperature is above 85°F (30°C), an approved retarding agent will be required in all p.c. concrete. The maximum temperature of all p.c. concrete placed shall not exceed 95°F (35°C), unless High Range Water Reducer Admixtures are used.

G. Curing

Immediately after finishing the p.c. concrete median or island, the pcc surface shall be protected by a membrane-compound curing agent conforming with Standard Specification Item No. 409S, "Membrane Curing". The curing procedures shall be acceptable to the Engineer or designated representative.

434S.5 Measurement

Accepted work as prescribed by this item will be measured by the square foot (square meter: 1 square meter equals 10.764 square feet) of surface area of p.c concrete medians and/or p.c. concrete island, complete in place.

434S.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "P.C. Concrete Medians and Islands". The unit bid price shall include full compensation for preparation of the subgrade; finishing and placing all materials, including all reinforcing steel, welded wire fabric; bar supports and any other materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 434S: ___ Inch P.C. Concrete Medians and Islands Per Square Foot.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>
Specification Item No. 434S, "P.C. Concrete Medians and Islands"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 201S	Subgrade Preparation
Item No. 210S	Flexible Base
Item No. 403S	Concrete for Structures
Section 403S.7: Item No. 403S	Table 4: Classes of Concrete
Item No. 405S	Concrete Admixtures
Item No. 406S	Reinforcing Steel
Item No. 408S	Expansion Joint Materials
Item No. 409S	Membrane Curing
Item No. 410S	Concrete Structures

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item No. 434S, "P.C. Concrete Medians and Islands"
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City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 360	Concrete Pavement
Item No. 430S	P.C. Concrete Curb and Gutter
Item No. 431S	Machine Laid PCC Curb and Gutter
Item No. 432S	P.C. Concrete Sidewalks
Item No. 433S	P. C. Concrete Driveways
Item No. 434S	P.C. Concrete Medians and Islands
Item No. 436S	P.C. Concrete Valley Gutters
Item No. 470S	Curb Cuts for Sidewalk Ramps and Driveways

Item No. 435S
P.C. Concrete Steps

435S.1 Description

This item shall govern construction of Portland Cement (p.c.) concrete steps (with or without reinforcing steel as required) on approved subgrade and in conformity with the lines, grades, sections 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, the inch-pound units are given preference followed by SI units shown within parentheses.

435S.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p. c. concrete mix design,
- B. Construction details (i.e., reinforcing steel, curing membrane, etc.),

435S.3 Materials

- A. Concrete

The p.c. concrete shall be Class A Concrete, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures".

- B. Reinforcing Steel

Reinforcing steel shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

- C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification Item No. 408S, "Expansion Joint Materials".

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing".

435S.4 Construction Methods

All excavation, including removal of existing steps or sidewalks and backfill, shall conform to Standard Specification Item No. 401S, "Structural Excavation and Backfill".

All forms and forming, placement of reinforcement when required, placement of concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410S, "Concrete Structures".

The height of the steps will be determined by the existing grade or as directed by the Engineer or designated representative. The tread width is normally 10 inches (250 mm) and the riser is normally 7 1/2 inches (190 mm), but these dimensions may be varied to

fit existing conditions as directed by the Engineer or designated representative. Step width will match the existing sidewalk, but not less than 3 feet (0.9 meter).

Reinforcement for the steps, when required, shall be as indicated on the Drawings.

Expansion joints shall be placed along the lower and upper tread and along each side when abutting p.c. concrete.

The steps shall be constructed monolithically. The p.c. concrete shall be placed in the forms and properly consolidated until it covers the area. The top surface shall be floated and troweled to a smooth surface, then finished with a camel hairbrush or wood float to a gritty texture and neat appearance. The outer edges and joints shall be rounded with approved tools with a 1/4-inch (6.3 mm) radius.

At the proper time after finishing, the surface shall be protected by a membrane compound curing agent conforming to Standard Specification Item No. 409S, "Membrane Curing" or by wetting cotton or burlap mats. Either method shall be subject to approval by the Engineer or designated representative.

435S.5 Measurement

Accepted work as prescribed by this item will be measured by the cumulative width in feet (meters: 1 meter equals 3.281 feet) of individual steps (treads) including the bottom step.

435S.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lineal foot for "P.C. Concrete Steps". The unit bid price shall include full compensation for all excavation, forms, concrete, reinforcement, curing, backfill, sloping; all labor, tools, materials, equipment; and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 435S: P.C. Concrete Steps Per Lineal Foot.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
Specification Item No. 435S, "P.C. Concrete Steps"	

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 201S	Subgrade Preparation
Item No. 210S	Flexible Base
Item No. 401S	Structural Excavation and Backfill
Item No. 403S	Concrete for Structures
Section 403S.7; Item No. 403S	Table 4: Classes of Concrete
Item No. 405S	Concrete Admixtures
Item No. 406S	Reinforcing Steel
Item No. 408S	Expansion Joint Materials
Item No. 409S	Membrane Curing
Item No. 410S	Concrete Structures

<i>RELATED CROSS REFERENCE MATERIALS</i>
Specification Item No. 435S, "P.C. Concrete Steps"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 360	Concrete Pavement
Item No. 430S	P.C. Concrete Curb and Gutter
Item No. 431S	Machine Laid PCC Curb and Gutter
Item No. 432S	P.C. Concrete Sidewalks
Item No. 433S	P.C. Concrete Driveways
Item No. 434S	P.C. Concrete Medians and Islands
Item No. 436S	P.C. Concrete Valley Gutters
Item No. 470S	Curb Cuts for Sidewalk Ramps and Driveways

Item No. 436S
P.C. Concrete Valley Gutters

436S.1 Description

This item shall govern the construction of Portland cement (p. c.) concrete valley gutters on an approved subgrade in conformity to the lines, grades, Standard Detail No. 436S-2 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, the inch-pound units are given preference followed by SI units shown within parentheses.

436S.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p. c. concrete mix design,
- B. Construction details (i.e., reinforcing steel, curing membrane, etc.),

436S.3 Materials

- A. Portland Cement Concrete

The Portland cement concrete shall be Class A Concrete, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures".

- B. Reinforcing Steel

Reinforcing steel and welded wire fabric shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

- C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification Item No. 408S, "Expansion Joint Materials".

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing".

436S.4 Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410S, "Concrete Structures".

- A. Subgrade Preparation

Where a stabilized subbase is not provided, the subgrade shall be excavated in accordance with Standard Specification Index No. 111S, "Excavation" to remove all unstable or otherwise objectionable material and all holes, ruts and depressions shall be filled with approved material.

Rolling shall be performed in accordance with Standard Specification Item No. 230S or 232S, to the extent indicated on the Drawings or directed by the Engineer or designated representative. The roadbed shall be completed to the plane of the typical sections indicated on the Drawings and the lines and/or grades established by the Engineer or designated representative. All work shall conform to Standard Specification Item No. 201S, "Subgrade Preparation".

If the subgrade is dry, the valley gutter area shall be sprinkled lightly immediately before the Portland cement concrete is placed.

Unless otherwise specified on the Drawings, all necessary excavation, filling and grading of the subgrade will be considered incidental work pertaining to this item, and will not be paid for directly.

B. Forms

Forms shall be of metal, well-seasoned wood or other approved material. Wood forms for straight sections shall be not less than 2 inches (50 mm) nominal thickness. Forms shall be a section satisfactory to the Engineer or designated representative and clean, straight, free from warp and of 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 placement of concrete and, if necessary, forms shall be oiled with a light form oil, prior to placement of p.c. concrete.

C. Reinforcing Steel

Reinforcement for Portland cement concrete valley gutters shall conform to Standard Detail No. 436S-2; details indicated on the Drawings or as directed by the Engineer or designated representative. Care shall be exercised to keep the reinforcement in its proper position during the placement of Portland cement concrete.

D. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material 3/4 inch (19 mm) thick shall be provided as indicated on the Drawings or as directed by the Engineer or designated representative. The expansion joint material shall be placed vertically and shall extend the full depth of the Portland cement concrete. Weakened plane joints shall be provided on 10 foot (3 meter) centers or as directed by the Engineer or designated representative. Normal dimensions of the weakened plane joints shall be 1/4 inch (6.3 mm) wide and 3/4 inch (19 mm) deep.

E. Placement and Finishing

The Portland cement concrete shall be placed in the forms and properly consolidated until it entirely covers the surface and has a monolithic finish. The top surface shall be screeded and floated to a uniform smooth surface, then finished with a wood float to a gritty texture. The outer edges shall be rounded with approved tools to a 1/4-inch (6.3 mm) radius.

F. Curing

At the proper time after finishing, the surface shall be protected by a membrane-curing compound conforming to Standard Specification Item No. 409S, "Membrane Curing" or by wetting cotton or burlap mats. Either method shall be subject to approval by the Engineer or designated representative. Traffic shall be securely barricaded from using the Portland cement concrete valley gutter for a minimum of 4 days after initial placement and may be opened to traffic only with the approval of the Engineer or designated representative.

436S.5 Measurement

Accepted work performed as prescribed by this item will be measured by the square foot (square meter: 1 square meter equals 10.764 square feet) of surface area of Portland cement concrete placed. The square foot measurement shall include the reinforced monolithic curb placed at the ends of the valley gutter.

436S.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "P. C. Concrete Valley Gutters". The unit bid price shall include full compensation for preparation the subgrade; furnishing and placing all materials, including reinforcing steel and expansion joint materials; any other materials, manipulations, labor, tools, equipment, barricading and all incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 436S: P. C. Concrete Valley Gutters Per Square Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS	
Specification Item No. 436S, "P.C. Concrete Valley Gutters"	

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 111S	Excavation
Item No. 201S	Subgrade Preparation
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic)
Item No. 403S	Concrete for Structures
Section 403S.7; Item No. 403S	Table 4: Classes of Concrete
Item No. 406S	Reinforcing Steel
Item No. 408S	Expansion Joint Materials
Item No. 409S	Membrane Curing
Item No. 410S	Concrete Structures

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
436S-2	P. C. Concrete Valley Gutter

<u>RELATED</u> CROSS REFERENCE MATERIALS	
Specification Item No. 436S, "P.C. Concrete Valley Gutters"	

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 110S	Street Excavation
Item No. 130S	Borrow
Item No. 236S	Proof Rolling
Item No. 360	Concrete Pavement
Item No. 405S	Concrete Admixtures
Item No. 430S	P.C. Concrete Curb and Gutter
Item No. 431S	Machine Laid PCC Curb and Gutter

Item No. 439S
Parking Lot Bumper Curbs

439S.1 Description

This item shall govern parking lot bumper curbs, composed of precast concrete and reinforcing steel for placement on gravel, asphalt and concrete surfaces as indicated on the Drawings.

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.

439S.2 Submittals

The submittal requirements of this specification item include:

- A. Type A Portland cement concrete design mix.
- B. Reinforcing steel details.

439S.3 Materials

- A. Concrete. All precast concrete shall be Class A Concrete conforming to Specification Item No. 403S, "Concrete for Structures".
- B. Reinforcing Steel. All reinforcing steel shall be #3 (10M) bar conforming to Specification Item No. 406S, "Reinforcing Steel".

439S.4 Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Specification Item No. 410S, "Concrete Structures".

Reinforcement shall conform to the details indicated on the Drawings. Care shall be exercised to keep reinforcement in its proper position during the depositing of concrete.

Concrete shall be placed in the forms to the depth indicated and vibrated until thoroughly compacted. Care shall be taken during vibration to insure that a vibrator is not held too long at one location that segregation is produced. The top surface of the concrete shall be floated and troweled to a uniform smooth surface, and then finished with a camel hair brush or wood float to a gritty texture. The outer edges shall be rounded with approved tools to the radii shown on the Drawings.

When the ambient air temperature is above 85°F (30°C), an approved retarding agent will be required in all concrete unless moist curing procedures are employed. The maximum temperature of all concrete placed shall not exceed 95°F (35°C).

439S.5 Measurement

Parking Lot Bumper Curbs shall be measured per each, complete and in place.

439S.6 Payment

The work performed as prescribed by this Specification Item will be paid for at the unit bid price per each. The unit bid price shall include full compensation for: all materials, including all reinforcing steel, placing and the concrete curb, and all labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 439S: Parking Lot Bumper Curbs - Per Each.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item 439S "Parking Lot Bumper Curbs"

City of Austin Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403S	Concrete for Structures
Item No. 406S	Reinforcing Steel
Item No. 410S	Concrete Structures

<u>RELATED</u> CROSS REFERENCE MATERIALS
Specification Item 439S "Parking Lot Bumper Curbs"

City of Austin Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 405S	Concrete Admixtures
Item No. 409S	Membrane Curing
Item No. 411S	Surface Finishes for Concrete

City of Austin Standards

<u>Designation</u>	<u>Description</u>
Item No. 406S-1	Reinforced Steel Tolerances

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

<u>Designation</u>	<u>Description</u>
Item 420	Concrete Structures
Item 421	Portland Cement Concrete
Item 427	Surface Finishes for Concrete
Item 437	Concrete Admixtures
Item 440	Reinforcing Steel

American Society for Testing and Materials

<u>Designation</u>	<u>Description</u>
A-496	Standard Specification for Steel Wire, Deformed for Concrete Reinforcement
A-615/615M	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

Item No. 470S

Curb Cuts for Sidewalk Ramps and Driveways

470S.1 Description

This item shall govern horizontal and vertical curb saw cuts, which are undertaken on existing or newly placed Portland cement concrete curb, in order to accommodate the construction of new concrete sidewalk ramps and/or driveways at the locations indicated on the Drawings or as directed by the Engineer or designated representative. The curb cutting operation shall be conducted from the street side of the existing or newly placed curb.

This specification is optional and 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.

470S.2 Submittals

The submittal requirements of this specification item include:

- A. Manufacturer and model number of saw to be used for curb cuts.
- B. Documentation that the saw that is to be used on the project is designated specifically to curb cuts.

470S.3 Materials

A diamond-blade-cutting saw shall be utilized for all required curb sawing/cutting. The saw shall be capable of cutting existing or newly placed curb material into the shape of a ramp and/or driveway; leaving a smooth, accurate top face. The saw shall be specifically designed for this purpose and shall be approved by the Engineer or designated representative prior to the start of any curb cut work.

A diamond-grinding wheel shall be used for rounding the sawed concrete edges.

470S.4 Construction Methods

The curb shall be sawn in accordance with City of Austin Standard Detail 470S-1 or as directed by the Engineer or designated representative. The sawing shall be made along neat lines and shall result in smooth edges and top faces. The length of curb face, which must be removed in order to conform to the proposed sidewalk ramp or driveway, shall be sawn full depth at the bottom of the curb face using a diamond saw blade.

The saw cutting of the curb face shall be initiated at an elevation $\frac{1}{2}$ inch (12.5 millimeters) above the existing gutter and extended at an angle of $\frac{3}{4}$ inch per foot (63 mm per meter) upwards and away from the gutter pan to conform with the new sidewalk ramp or driveway grade. End cuts shall be sawn full depth on an angle so that the saw cut face provides a dimension of 55 to 60 inches (1.4 to 1.5 meters) for ADA ramps and 30 inches (750mm) for driveways (Standard Detail No. 470S-1). The corners of the tops of the end cuts shall be ground using a diamond-grinding wheel to a radius of $\frac{1}{4}$ inch (6 mm).

Special care shall be taken to insure that there is no disturbance or damage to the existing roadway pavement, sidewalk pavement or curbs scheduled to remain. Any

damage to remaining pavements, sidewalks and/or curb due to the Contractor's operations shall be repaired at the Contractor's sole cost and expense.

The work under this specification item shall also include the disposal of all concrete curb materials removed during the curb cutting operation. Disposal shall conform to the requirements of City of Austin Standard Specification Item No. 401S, "Structural Excavation and Backfill".

470S.5 Measurement

Accepted work as prescribed by this item shall include the removal and disposal of all sawn material and shall be measured by the number of lineal feet (lineal meters: 1 meter is equal to 3.281 feet) of sawcutting from top of curb cut at beginning to top of curb cut at ending for each proposed sidewalk ramp location that are completed in accordance with the Drawings, Standard Detail or as directed by the Engineer or designated representative.

470S.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lineal foot of "Curb Cuts" for sidewalk ramps and driveways. The bid price shall include full compensation for the cost of all labor, materials and equipment necessary to complete the Work, the removal and disposal of the curb cut, and the cost of any repairs necessitated from damage produced during the Contractor's operations.

Pay Item No. 470S-D: Curb Cuts for Driveways ----- Per Lineal Foot.

Pay Item No. 470S-R: Curb Cuts for Sidewalk Ramps ----- Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS	
Specification 470S, "Curb Cuts For Sidewalk Ramps and Driveways"	

City of Austin Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 401S	Structural Excavation and Backfill

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
470S-1	Typical Curb Cuts for Sidewalk Ramps

<u>RELATED</u> CROSS REFERENCE MATERIALS	
Specification 470S, "Curb Cuts For Sidewalk Ramps and Driveways"	

City of Austin Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 104S	Removing Concrete
Item No. 110S	Street Excavation
Item No. 340S	Hot Mix Asphaltic Concrete Pavement
Item No. 360	Concrete Pavement
Item No. 370S	Concrete Pavers

Item No. 375S	Concrete Pavers for Sidewalk Ramps
Item No. 403S	Concrete for Structures
Item No. 410S	Concrete Structures
Item No. 430S	Concrete Curb and Gutter
Item No. 431S	Machine Laid Curb and Gutter
Item No. 432S	Concrete Sidewalks
Item No. 433S	Concrete Driveways

RELATED CROSS REFERENCE MATERIALS - Continued

Specification 470S, "Curb Cuts For Sidewalk Ramps and Driveways"

City of Austin Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 434S	Concrete Median and Islands
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 610S	Preservation of Trees and Other Vegetation

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
430S-1	Curb and Gutter Section
430S-3	Curb Expansion Joint Dowel Detail
430S-4	Concrete Backfill Under Curb & Gutter
432S-1	Sidewalk
432S-3	Intersection Curb Ramps
432S-3A	Curb Ramps at T-Type Intersections
432S-3B	Intersection Curb Ramps with Returned Curb
432S-3C	Curb Ramps with Returned Curb at T Intersections
432S-3D	Combined Curb Ramps
432S-3E	Combined Curb Ramp at T type Intersection
432S-3F	Combined Sidewalk Curb Ramp with Pavers
432S-5	Sidewalk Curb Ramp With Pavers (type I)
432S-5A	Sidewalk Curb Ramp With Pavers (type IA)
432S-5B	Sidewalk Curb Ramp With Pavers (type IB)
432S-6	Concrete Stamp
433S-1	Type I Driveway
433S-2	Type II Driveway
610S-1	Tree Protection Fence Locations

Texas Department of Transportation:

Standard Specifications for Construction and Maintenance
of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 104	Removing Concrete
Item No. 420	Concrete Structures

Item No. 485S
Concrete Paver Units for Sidewalk Ramps

485S.1 Description

This item shall govern furnishing and installing interlocking concrete paver units, manufactured for the construction of paved sidewalk ramps, constructed as herein specified on an approved base or subgrade in conformity to the lines, grades and details indicated on the Drawings, Standard Detail or as established by the Engineer or designated representative.

485S.2 Submittals

The submittal requirements of this specification item may include:

- A. Samples for initial selection from manufacturer color charts showing the full range of colors, textures and patterns for each type of paving unit indicated on the Drawings,
- B. Shop drawings indicating pattern orientation and cross section details,
- C. Manufacturer Certification that the Interlocking Paving Units meet or exceed all the requirements of ASTM C-936 and this specification item.

485S.3 Materials

- A. Base Course

Base Course shall be constructed of either a fibrous reinforced concrete (Standard Specification Item No. 407S, Class J Portland cement concrete (Standard Specification Item No. 403S, "Concrete For Structures") or cement treated material (Standard Specification Item No. 204S, "Portland Cement Treatment for Materials In Place").

- B. Concrete Paver Units

Paving units shall be modular concrete pavers conforming to ASTM Designation: C 936, Solid Concrete Interlocking Paving Units" and the requirements specified in this Item. The paver units shall be made using normal weight aggregates conforming to ASTM C-33.

- C. Pigments

Pigments used in concrete paver units shall be synthetic iron oxide and shall be alkali-resistant, light fast, water insoluble, chemically inert and weather resistant.

- D. Grout Mix

When required in conjunction with a bedding layer for the concrete paver units or with paver closure units, the grout mix shall be composed of one part Portland cement, one part masonry cement (or 1/4 part hydrated lime), parts of concrete sand equal to 2-1/2 to 3 times the sum of the volumes of the cement and lime used, and sufficient water to make the mixture plastic.

485S.4 Physical Requirements

The general shape of the concrete paver units shall be similar to that indicated on the Drawings. The concrete paver units shall be of the color and laid in the pattern as specified or as approved in writing by the Engineer or designated representative.

All units shall be sound and free of defects that would interfere with the appearance or proper placement of the unit or impair the strength or longevity of the final structure. Any units, that are structurally damaged during the work shall be immediately removed and replaced.

485S.5 Construction Method

A. Preparation of Subgrade, subbase and base layers

The subgrade, subbase or base course shall be shaped to the lines, grades and cross sections as indicated on the Drawings or as directed by the Engineer or designated representative and shall be thoroughly compacted. Any unsuitable material encountered in the subgrade shall be removed and replaced by a suitable material and compacted to a uniform grade. When subgrade stabilization has been specified, the subgrade shall be prepared accordingly.

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

B. Paver Unit Installation

Concrete paver units shall be bedded in a 1" (25 mm) thick mortar bed placed on top of a 3" (75-mm) minimum Class A Fibrous Concrete pad (see Standard Specification Item 407S, "Fibrous Concrete"; Standard Specification Item 403S, "Concrete for Structures") or on top of 4" (100-mm) thick layer of cement treated material (see Standard Specification Item No. 204S, "Portland Cement Treatment for Materials In Place"). The concrete paver units shall be placed in conformance with Standard Detail Series 432S to the laying pattern indicated on the Drawings. The Contractor shall exercise particular care to maintain the laying pattern throughout the job. Paving units shall be placed to achieve gaps nominally 1/8 inch (3.2 mm) wide between adjacent units to insure that all joints are correctly aligned.

The first row shall abut an edge restraint with a gap of 1/8 inch (3.2 mm) and shall be laid at a suitable angle to the edge restraint to achieve the required visual orientation of paving units in the completed sidewalk.

In each row, all full units shall be placed first. Closure units shall be cut and fitted subsequently. In no case shall a closure unit consist of less than 25 percent of a full unit. Areas with closure units less than 25 percent of a full unit shall be filled solid with mortar. Units may be cut using a mechanical or hydraulic cutter or by power sawing. A grout mix shall be used to fill larger edge spaces.

Any foot or wheelbarrow traffic during the construction shall use boards overlaying paver units to prevent disturbance of units prior to final set. No other traffic shall be allowed on the pavement at this stage of construction.

As soon as practical after placement of pavers in the mortar bed, and in any case prior to the termination of work on that day, and prior to the acceptance of construction traffic, bedding sand for joint-filling shall be spread over the sidewalk and allowed to dry. When dry, the filling sand shall be swept to fill the joints. After traffic has been allowed on the pavers, joints shall be refilled with dry sand periodically until no additional sand will be accepted in the joints.

485S.6 Measurement

Accepted work performed as prescribed by this item will be measured as indicated in Section 432S.5 of Standard Specification Item No. 432S, "P.C. Concrete Sidewalks" or Section 480S.6 of Standard Specification Item No. 480S, "Concrete Paver Units for Sidewalks".

485.7 Payment

The work performed as prescribed by this item is included in the unit price bid for either Standard Specification Item No. 432S, "P.C. Concrete Sidewalks" or Standard Specification Item No. 480S, "Concrete Paver Units for Sidewalks" and payment for the sidewalk ramps shall be made under the appropriate standard specification item.

End

<i>SPECIFIC</i> CROSS REFERENCE MATERIALS	
Specification Item 485S, "Concrete Paver Units For Sidewalk Ramps"	

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 204S	Portland Cement Treatment for Materials In Place
Item No. 403S	Concrete for Structures
Item No. 407S	Fibrous Concrete
Item No. 432S	P.C. Concrete Sidewalks
Item No. 480S	Concrete Paving Units

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
432S-2A	Detectable Warning-Paver
432S-3	Type 1 Curb Ramps-Full Intersection
432S-3A	Type 1 Curb Ramps-"T" Intersection

City of Austin Standard Details (Continued)

<u>Designation</u>	<u>Description</u>
432S-3B	Type 1A/1B Curb Ramps-Full Intersection
432S-3C	Type 1A/1B Curb Ramps-"T" Intersection
432S-3D	Combined Curb Ramps-Full Intersection

432S-3E	Combined Curb Ramps-"T" Intersection
432S-3F	Combined Sidewalk Curb Ramps with Pavers
432S-5	Type 1 Sidewalk Curb Ramp
432S-5A	Type 1A Sidewalk Curb Ramp
432S-5B	Type 1B Sidewalk Curb Ramp

American Society for Testing and Materials, ASTM

<u>Designation</u>	<u>Description</u>
ASTM C-33	Standard Specifications for Concrete Aggregates
ASTM C-936	Specifications for Solid Concrete Interlocking Paving Units

<i>RELATED</i> CROSS REFERENCE MATERIALS

Specification Item 485S, "Concrete Paver Units For Sidewalk Ramps"
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City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 201S	Subgrade Preparation

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
432S-1	Sidewalk

Item No. 503S
Frames, Grates, Rings and Covers

503S.1 Description

This item shall govern furnishing and installation of frames, grates, rings and covers for inlets, manholes and other structures indicated on the Drawings.

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.

503S.2 Submittals

The submittal requirements of this specification item include manufacturer, model number, description, painting requirements and characteristics of frames, grates, rings, covers, height adjustment insert and nuts and bolts required for completion of the work.

503S.3 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is the kind and quality that satisfies the specified functions and quality. The City of Austin Water and Wastewater Utility Standard Products Lists (SPLs) form a part of these Specifications. Contractors may, when appropriate, elect to use products from the SPLs; however, submittal to the Engineer or designated representative is still required. If the Contractor elects to use any materials from these lists, each product shall be completely and clearly identified by its corresponding SPL number when making the product submittal.

The purpose of the SPLs is to expedite the review by the Engineer or designated representative and, if necessary, the City of Austin Water and Wastewater Utility Standard Products Committee of Contractor product submittals. The SPL's should not be interpreted as being a pre-approved list of products necessarily meeting the requirements for a given construction Project. Items contained in the SPL cannot be substituted for items that are shown on the Drawings, called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the Engineer or designated representative in conjunction with the Water and Wastewater Utility Standard Products Committee. The Standard Product List current at the time of plan approval will govern.

A. Welded Steel

Welded steel grates and frames shall conform to the number; size, dimensions and details indicated on the Drawings and shall be welded into an assembly in accordance with those details. Steel shall conform to the requirements of ASTM A 36/A 36M, "Specification for Structural Steel".

B. Castings

Castings, whether Carbon-Steel, Gray Cast Iron or Ductile Iron shall conform to the shape and dimensions indicated on the Drawings and shall be clean substantial castings, free from sand or blowholes or other defects. Surfaces of the castings shall be free from burnt on sand and shall be reasonably smooth. Runners, risers, fins and other cast on pieces shall be removed from the castings and such areas ground smooth. Bearing surfaces between manhole rings and covers or grates and frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact. Pairs of machined castings shall be matchmarked to facilitate subsequent identification at installation with the exception of water and wastewater manhole and valve castings. These manhole and valve castings shall be fabricated with such draft, tolerances, bolt hole spacing, etc., that all rings and covers of a particular type or class are interchangeable and match-marking will not be required.

Steel castings shall conform to ASTM A 27/27M, "Specifications for Steel Castings, Carbon, for General Application". Grade 70-36 (480-250) shall be furnished unless otherwise specified on the Drawings.

Cast iron castings shall conform to ASTM A 48, "Specification for Gray Iron Castings", Class 30.

Ductile Iron castings shall conform to ASTM A 536, "Specification for Ductile Iron Castings". Grade 60-40-18 (415-275-125) shall be used unless otherwise indicated on the Drawings.

C. Manhole Cover Riser Rings

Height-adjustment inserts for wastewater manhole rings, which are used for raising standard manhole covers, shall be those models listed in Water and Wastewater Standard Products List item QPL WW-330.

D. Nuts and Bolts

Nuts and bolts shall be hex head 5/8" x 2.5" (16 mm x 63.5 mm) #11 National Coarse Thread, Type 316 stainless steel. For bolted manhole covers, a thin film of an approved "Anti-freeze" compound, approved by the Engineer or designated representative, shall be applied to all bolts.

E. Mortar

Unless otherwise specified or approved by the Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part Portland cement and three (3) parts sand and sufficient water to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements for Grade No. 1, Item No. 403, "Concrete for Structures".

503S.4 Construction Methods

Frames, grates, rings and covers shall be constructed of the specified materials in accordance with the details indicated on the Drawings or in the City of Austin Standard

Details. The Frames, grates, rings and covers shall be placed carefully to the lines or grades indicated on the Drawings or as directed by the Engineer or designated representative.

All welding shall conform to the requirements of the ANSI/AWS Structural Welding Code D1.1. Welded frames, grates, rings and covers shall be given 1 coat of a commercial grade red lead oil paint and 2 coats of commercial grade aluminum paint. All coats shall be a minimum of 1.5 mils (0.4 mm), dry.

Painting of gray iron castings will not be required, except when used in conjunction with structural steel shapes.

503S.5 Measurement and Payment

Frames, grates, rings and covers will not be measured and payment for furnishing all materials, tools, equipment, labor and incidentals to complete the Work will be included in the Bid Items which constitute the complete structures.

End

<u>SPECIFIED</u> Cross Reference Materials	
Standard Specification Item Number 503S, "Frames, Grates, Rings and Covers"	

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403S	Concrete for Structures

City of Austin Water and Wastewater Standard Products List

<u>Designation</u>	<u>Description</u>
QPL WW-330	Manhole Cover Riser Rings for raising City of Austin Standard Manhole Covers

American Society for Testing Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A36/A36M	Specification for Structural Steel
A27/A27M	Specification for Steel Castings, Carbon, for General Application
A48	Specification for Gray Iron Castings
A536	Specification for Ductile Iron Castings

ANSI/AWS

<u>Designation</u>	<u>Description</u>
Code D 1.1	Structural Welding Code

<i>RELATED</i> Cross Reference Materials
Standard Specification Item Number 503S, "Frames, Grates, Rings and Covers"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 504S	Adjusting Structures
Item No. 510	Pipe

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
No. 503S-1	457mm (18") Cover and Frame
No. 503S-2S	Storm Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-2W	Sanitary Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-3S	Bolted Storm Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-3W	Bolted Sanitary Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-4S	Storm Sewer Manhole Ring and 813 mm (32") Cover
No. 503S-4W	Sanitary Sewer Manhole Ring and 813 mm (32") Cover
No. 503S-5S	Bolted Storm Sewer Manhole Ring and 813 mm (32") Cover
No. 503S-5W	Watertight Manhole Ring and 813 mm (32") Cover
No. 506S-2	Major Manhole Adjustment
No. 506S-11	Storm Sewer Manhole Details

TxDOT Specifications

<u>Designation</u>	<u>Description</u>
Item 421	Portland Cement Concrete

Item No. 503S
Frames, Grates, Rings and Covers

503S.1 Description

This item shall govern furnishing and installation of frames, grates, rings and covers for inlets, manholes and other structures indicated on the Drawings.

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.

503S.2 Submittals

The submittal requirements of this specification item include manufacturer, model number, description, painting requirements and characteristics of frames, grates, rings, covers, height adjustment insert and nuts and bolts required for completion of the work.

503S.3 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is the kind and quality that satisfies the specified functions and quality. The City of Austin Water and Wastewater Utility Standard Products Lists (SPLs) form a part of these Specifications. Contractors may, when appropriate, elect to use products from the SPLs; however, submittal to the Engineer or designated representative is still required. If the Contractor elects to use any materials from these lists, each product shall be completely and clearly identified by its corresponding SPL number when making the product submittal.

The purpose of the SPLs is to expedite the review by the Engineer or designated representative and, if necessary, the City of Austin Water and Wastewater Utility Standard Products Committee of Contractor product submittals. The SPL's should not be interpreted as being a pre-approved list of products necessarily meeting the requirements for a given construction Project. Items contained in the SPL cannot be substituted for items that are shown on the Drawings, called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the Engineer or designated representative in conjunction with the Water and Wastewater Utility Standard Products Committee. The Standard Product List current at the time of plan approval will govern.

A. Welded Steel

Welded steel grates and frames shall conform to the number; size, dimensions and details indicated on the Drawings and shall be welded into an assembly in accordance with those details. Steel shall conform to the requirements of ASTM A 36/A 36M, "Specification for Structural Steel".

B. Castings

Castings, whether Carbon-Steel, Gray Cast Iron or Ductile Iron shall conform to the shape and dimensions indicated on the Drawings and shall be clean substantial castings, free from sand or blowholes or other defects. Surfaces of the castings shall be free from burnt on sand and shall be reasonably smooth. Runners, risers, fins and other cast on pieces shall be removed from the castings and such areas ground smooth. Bearing surfaces between manhole rings and covers or grates and frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact. Pairs of machined castings shall be matchmarked to facilitate subsequent identification at installation with the exception of water and wastewater manhole and valve castings. These manhole and valve castings shall be fabricated with such draft, tolerances, bolt hole spacing, etc., that all rings and covers of a particular type or class are interchangeable and match-marking will not be required.

Steel castings shall conform to ASTM A 27/27M, "Specifications for Steel Castings, Carbon, for General Application". Grade 70-36 (480-250) shall be furnished unless otherwise specified on the Drawings.

Cast iron castings shall conform to ASTM A 48, "Specification for Gray Iron Castings", Class 30.

Ductile Iron castings shall conform to ASTM A 536, "Specification for Ductile Iron Castings". Grade 60-40-18 (415-275-125) shall be used unless otherwise indicated on the Drawings.

C. Manhole Cover Riser Rings

Height-adjustment inserts for wastewater manhole rings, which are used for raising standard manhole covers, shall be those models listed in Water and Wastewater Standard Products List item QPL WW-330.

D. Nuts and Bolts

Nuts and bolts shall be hex head 5/8" x 2.5" (16 mm x 63.5 mm) #11 National Coarse Thread, Type 316 stainless steel. For bolted manhole covers, a thin film of an approved "Anti-freeze" compound, approved by the Engineer or designated representative, shall be applied to all bolts.

E. Mortar

Unless otherwise specified or approved by the Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part Portland cement and three (3) parts sand and sufficient water to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements for Grade No. 1, Item No. 403, "Concrete for Structures".

503S.4 Construction Methods

Frames, grates, rings and covers shall be constructed of the specified materials in accordance with the details indicated on the Drawings or in the City of Austin Standard

Details. The Frames, grates, rings and covers shall be placed carefully to the lines or grades indicated on the Drawings or as directed by the Engineer or designated representative.

All welding shall conform to the requirements of the ANSI/AWS Structural Welding Code D1.1. Welded frames, grates, rings and covers shall be given 1 coat of a commercial grade red lead oil paint and 2 coats of commercial grade aluminum paint. All coats shall be a minimum of 1.5 mils (0.4 mm), dry.

Painting of gray iron castings will not be required, except when used in conjunction with structural steel shapes.

503S.5 Measurement and Payment

Frames, grates, rings and covers will not be measured and payment for furnishing all materials, tools, equipment, labor and incidentals to complete the Work will be included in the Bid Items which constitute the complete structures.

End

<u>SPECIFIED</u> Cross Reference Materials	
Standard Specification Item Number 503S, "Frames, Grates, Rings and Covers"	

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403S	Concrete for Structures

City of Austin Water and Wastewater Standard Products List

<u>Designation</u>	<u>Description</u>
QPL WW-330	Manhole Cover Riser Rings for raising City of Austin Standard Manhole Covers

American Society for Testing Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A36/A36M	Specification for Structural Steel
A27/A27M	Specification for Steel Castings, Carbon, for General Application
A48	Specification for Gray Iron Castings
A536	Specification for Ductile Iron Castings

ANSI/AWS

<u>Designation</u>	<u>Description</u>
Code D 1.1	Structural Welding Code

<i>RELATED</i> Cross Reference Materials
Standard Specification Item Number 503S, "Frames, Grates, Rings and Covers"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 504S	Adjusting Structures
Item No. 510	Pipe

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
No. 503S-1	457mm (18") Cover and Frame
No. 503S-2S	Storm Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-2W	Sanitary Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-3S	Bolted Storm Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-3W	Bolted Sanitary Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-4S	Storm Sewer Manhole Ring and 813 mm (32") Cover
No. 503S-4W	Sanitary Sewer Manhole Ring and 813 mm (32") Cover
No. 503S-5S	Bolted Storm Sewer Manhole Ring and 813 mm (32") Cover
No. 503S-5W	Watertight Manhole Ring and 813 mm (32") Cover
No. 506S-2	Major Manhole Adjustment
No. 506S-11	Storm Sewer Manhole Details

TxDOT Specifications

<u>Designation</u>	<u>Description</u>
Item 421	Portland Cement Concrete

Item No. 505S
Concrete Encasement and Encasement Pipe

505S.1 Description

This item shall govern the furnishing of materials and the methods of constructing a Portland cement concrete encasement or encasement pipe in a trench.

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.

505S.2 Submittals

The submittal requirements of this specification item include:

- A. Type, of pipe, construction methods and sequence,
- B. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- C. Proposed proportioning of materials for the mortar mix.

505S.3 Materials

A. Portland Cement Concrete

The Portland cement concrete shall conform to Class D Concrete, Item No. 403S, "Concrete for Structures".

B. Pipe

Portland Cement concrete pipe shall conform to ASTM C-76, Class III or better.

Corrugated Metal Pipe (CMP) shall conform to Section 510.2 (8) (o) of the City of Austin Standard Specification Item No. 510, "Pipe".

Steel Pipe shall conform to ASTM A134 with a minimum thickness of 3/8 inch (9.5 mm) for pipe with a diameter of 16 inches (400 mm) and greater.

C. Grout

Grout shall consist of not less than 6 sacks Portland cement per cubic yard (335 kilograms Portland cement per cubic meter) and clean washed sand mixed with water. The grout shall have a consistency such that the grout will flow into and completely fill all voids. If allowed by the Engineer or designated representative, an air entraining admixture may be added to facilitate placement.

505S.4 Construction Methods

When indicated on the Drawings or acceptable to Engineer or designated representative, concrete encasement shall be placed to protect the pipe. Pipe or bedding shall not be placed where:

- (a) the top of the pipe would have less than 30 inches (750 mm) of cover from finish grade,
- (b) the ground water invades the trench, or
- (c) the trench bottom is of unstable material.

If either of these conditions is encountered, the Engineer or designated representative shall be notified and may direct the Contractor to:

- (a) encase the pipe with concrete,
- (b) change pipe material, or
- (c) use a higher strength class of pipe.

Concrete encasement shall extend from 6 inches (150 mm) below to 6 inches (150 mm) above the outer projections of the pipe over the entire width of the trench in accordance with the City of Austin Standard Detail 501S-1," Encasement Detail w/ Casing Spacers".

The ends of the encasement pipe shall be bulkheaded (Standard Specification Item No. 507S) with concrete blocks, bricks or stones, dry-stacked without mortar, sufficient to prevent the intrusion of trench backfill material into the encasement, but fitted loosely enough to facilitate the escape of water from the encasement should carrier pipe leakage or failure occur.

505S. 5 Measurement

Concrete encasement will be measured by the lineal foot (meter: 1 meter equals 3.281 feet), for size of pipe being encased, complete in place. The measurement will be made between ends of the encasement, along the central axis as installed.

Encasement pipe installed by open cut will be measured by size of encasement installed, complete in place. The measurement will be made between the ends of the pipe, along the central axis as installed.

505S.6 Payment

Work performed and materials furnished as prescribed by this item will be included in a unit price bid item from Standard Specification Item No. 510, "Pipe" unless included as a separate pay item in the contract.

When included for payment, it shall be measured as provided under "Measurement" and will be paid at the unit bid price per lineal foot for "Concrete Encasement" or "Encasement Pipe" of the size indicated on the Drawings. The unit bid price shall include full compensation for furnishing all materials, pipe for all preparation, hauling, installation and for all labor, tools, equipment and incidentals necessary to complete the work, including bench excavation and disposal of surplus material.

Payment, when included as a contract Pay Item, will be made under one of the following:

Pay Item No. 505S-A: Concrete Encasement for ___ Dia. Pipe - Per Lineal Foot.

Pay Item No. 505S-B: Encasement Pipe ___ Dia., Type ___, - Per Lineal Foot.

End

<u>SPECIFIC</u> Cross Reference Materials	
Standard Specification Item No. 505S, "Encasement and Encasement Pipe"	

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item 403S	Concrete For Structures
Item 507S	Bulkheads
Item 510	Pipe
Section 510.2(8)(o)	Corrugated Metal Pipe (CMP)

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Detail 501S-1	Encasement Detail w/ Casing Spacers

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-134	Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)
C-76/C-76M	Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

<u>RELATED</u> Cross Reference Materials	
Standard Specification Item No. 505S, "Encasement and Encasement Pipe"	

TxDOT Specifications

<u>Designation</u>	<u>Description</u>
Item 421	Portland Cement Concrete
Section 421.9	Quality of Concrete
Section 421.2(8)	Mortar and Grout

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 501S	Jacking or Boring Pipe
Item No. 506	Manholes
Section 510.2(8)(c)	Concrete pipe
Section 510.2(8)(m)	Steel Pipe
Item No. 593S	Concrete Retards

ITEM NO. 506 - MANHOLES 3-15-11

506.1 - Description

This item governs construction of pre-cast and cast-in-place wastewater manholes, storm water manholes, storm water junction boxes and cast-in-place wastewater junction boxes, complete in place, including excavation, installation, backfilling and surface restoration; required items including rings, covers, coatings, and appurtenances; and incidental work such as pumping and drainage necessary to complete the work. Contractor-performed acceptance testing is required for wastewater manholes.

506.2 - Qualifications

Applicators of coatings to the interior surfaces of wastewater manholes, as specified in 506S.4.R and 506S.5.J, shall be listed on Standard Products List WW-511.

506.3 - Project Submittals

A. Products and Materials

The Contractor shall submit descriptive information and evidence that the materials the Contractor proposes for incorporation in the Work are of the kind and quality that satisfy the requirements in the Contract Documents. The City of Austin Water Utility Standard Products Lists are considered a part of the Specifications for the Work. The Contractor shall use products from the SPLs for all water and wastewater construction unless alternative products are shown on the Drawings; called for in the specifications; or specified in the Bidding Requirements, Contract Forms and Conditions of the Contract.

The products included in the Standard Products Lists current at the time of plan approval shall govern; unless a specific product or products on the lists have subsequently been removed from those SPLs because of quality or performance issues. Products and materials that are not covered by SPLs shall meet the requirements in the contract documents.

Submittals for the products and materials covered by this specification shall include manufacturer catalog sheets, technical data sheets, shop drawings, product or material test results, requirements listed below, and any other information needed to adequately describe the product or material. For products covered by SPLs, the submittal shall include a copy of the applicable SPL with the proposed product identified. An SPL by itself is not considered an adequate submittal.

The submittal requirements of this specification item include:

1. For pre-cast manholes and junction boxes: shop drawings for each structure showing, at a minimum, the Project and Contractor's name; manufacturer's name and plant location; applicable specifications; list of materials (such as adjusting rings, boots, gaskets, and pre-cast sections) by type and quantity; elevation view showing diameter or size, ring and cover size and elevation, ring type (bolted or unbolted, flared top or flared bottom) wall thickness, elevations of transitions from large diameter sections to smaller diameter sections, base width and thickness, total depth, size of openings, reinforcement, and length of each pre-cast section; structure identification number and station location; pipe line identification; pipe material and size; pipe flowline elevations; plan view showing azimuthal orientation (based on 360 degrees clockwise) of the pipes relative to the outflow pipe; technical data sheets covering pipe-to-manhole or pipe-to-junction box connectors, and gaskets
2. For cast-in-place manholes and junction boxes: formwork drawings sealed by a registered Professional Engineer licensed in the State of Texas with documented experience in formwork design for wall pours that exceed 4 feet in height and slabs that are not ground supported
3. For hydraulic cement concrete; mix components and proportions, material sources, materials test results

4. For mortar: mix components and proportions, material sources, materials test results
5. For non-shrink grout: technical data sheet indicating ASTM type and containing instructions on surface preparation, mixing, placing, and curing procedures
6. For wastewater manhole coatings and linings: technical data sheets that include instructions on surface preparation, mixing, placing, and curing procedures

B. Acceptance Test Records

Submittal of acceptance test records is required for wastewater manholes and shall include as a minimum the following items:

Name of the manhole manufacturer

Interior surface coating type and application method

Model and manufacturer of vacuum tester

Date tested/date re-tested

Indication of whether test passed or failed and statement of corrective action taken if test failed

Test Method Used

Location/station of manhole

Type of base: Precast/cast-in-place

Type of repairs made to the joints

The test records shall also be included as part of the Project records turned in with the acceptance package.

506.4 - Materials

A. Concrete

All cast-in-place concrete shall conform to City of Austin Standard Specification Item No. 403S, "Concrete for Structures." Cast in place concrete shall be Class A or as specified on the Drawings. Concrete used in precast concrete manhole base sections, riser sections and appurtenances shall conform to the requirements of Texas Department of Transportation Item 421, Hydraulic Cement Concrete. Concrete for backfill of over-excavated areas shall be City of Austin Class A, or Class J (City of Austin Standard Specification Item 403S, Concrete For Structures) or Controlled Low Strength Material (City of Austin Standard Specification Item 402S) as indicated on the Drawings.

B. Mortar

Mortar shall be composed of one part Portland cement, one part masonry cement (or ¼ part hydrated lime), and sand equal to 2½ to 3 times the sum of the volumes of the cements and lime used. The sand shall meet the requirements for "Fine Aggregate" as given in Standard Specification Item No. 403S "Concrete For Structures." Mortar shall not be used for any purpose on the inside of wastewater manholes.

C. Grout

Grout shall be the non-shrink type conforming to ASTM C 1107, Packaged, Dry, Hydraulic Cement Grout (Nonshrink), Grade C. Grout shall be used as packaged, with the mixed ingredients requiring only the addition of water.

D. Reinforcement

The reinforcing steel shall conform to the requirements of Standard Specification Item No. 406S, "Reinforcing Steel." Secondary, non-structural steel in cast-in-place stormwater manholes may be replaced by collated fibrillated polypropylene fibers, if approved by the Engineer or designated representative.

E. Brick

The brick for ring adjustment courses and for stormwater manholes shall be of first quality, sound, hard burned, perfectly shaped brick conforming to the requirements of ASTM C 62, Grade SW, or concrete brick meeting the requirements of ASTM C 55, Grade N-1.

F. Rings and Covers

Rings and covers shall conform to the requirements of City of Austin Standard Specification Item No. 503S, "Frames, Grates, Rings and Covers."

1. Replacement Rings and Covers, 24 in Diameter Lids

This ring and cover shall be used for the replacement of broken rings and covers, minor manhole adjustment, or as otherwise directed by the Engineer or designated representative.

2. Rings and Covers, 32 in. Diameter Lids

This ring and cover shall be used for all new manhole construction, except as otherwise directed by the Engineer or designated representative.

G. Bulkheads

Bulkheads shall meet the requirements of City of Austin Standard Specification Item No. 507S "Bulkheads."

H. Precast Base Sections, Riser Sections, Flat-top Slabs and Cones

Precast concrete base sections, riser sections, flat-top slabs, and cones shall conform to the requirements of ASTM C 478. The width of the invert shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped channels. The channel depth at the point where a pipe connects to the manhole wall, for pipes 24 inches in diameter and smaller, shall be a minimum of three fourths of the diameter of the pipe, with the top of the channel being a smooth transition between the inlet and outlet pipe connection points. For manholes connecting to pipes larger than 24 inches in diameter, the channel depth at the point where a pipe connects to the manhole wall shall be at least equal to the full pipe diameter. Changes in flow direction in the inverts of manholes shall be made by constructing smooth, long-radius sweeps to minimize splashing, turbulence, and eddies. The manhole invert grade shall 1) be a continuation of the inlet and outlet pipe grades carried through to the centerline of the manhole, or 2) have a minimum slope of 2.5 percent between the inlet and outlet pipe inverts, or 3) have a minimum difference of 0.10 feet between the inlet and outlet pipe inverts, whichever provides the maximum difference in invert elevation between the inlet and outlet pipes. In all cases, the bottom(s) of the channel(s) shall provide a smooth transition between the inlet and outlet pipes. Where wastewater lines enter a manhole above the flowline of the outlet, the invert shall be filleted to prevent splashing and solids deposition.

Joints for wastewater base sections, riser sections, and cones shall conform to the requirements of ASTM C 443. Additionally, joint dimensions for 48-inch inside diameter wastewater manhole sections and cones shall comply with City of Austin Standard No. 506S-13, "Wedge Seal Joint Detail, Precast Manhole Section." Joint dimensions for wastewater manhole sections and cones larger than 48-inch inside diameter shall comply with City of Austin Standard No. 506S-12, "O-Ring Joint Detail Precast Manhole Section" or City of Austin Standard No. 506S-13, "Wedge Seal Joint Detail, Precast Manhole Section". Precast bases for 48 inch inside diameter manholes shall have preformed inverts. Inserts acceptable to the Engineer or designated representative shall be embedded in the concrete wall of the manhole sections to facilitate handling; however, through-wall holes for lifting will not be permitted.

I. Precast Junction Boxes

Precast junction boxes shall be allowed only where indicated on the Drawings or acceptable to the Engineer or designated representative.

J. Pipe-to-Manhole and Pipe-to-Junction-Box Connectors

Resilient connectors, ring waterstops, and seals at connections of wastewater pipes to pre-cast and cast-in-place manholes and junction boxes shall be watertight, flexible, resilient and non-corrosive, conforming to ASTM C 923. Metallic mechanical devices for securing the connectors, ring waterstops, and seals in place shall be Type 304 stainless steel.

K. Precast Flat-Slab Transition/Junction Box Lids

Precast slab transitions and lids shall be designed to safely resist pressures resulting from loads which might result from any combination of forces imposed by an HS-20 loading as defined by the American Association of State Highway and Transportation Officials (AASHTO). The joints of precast slab transitions and of lids for wastewater applications shall conform to the requirements of ASTM C443.

L. Precast-Prefabricated Tee Manholes

Tee manholes shall be allowed only where indicated on the Drawings or as directed by the Engineer or designated representative. The main pipe section shall conform to the requirements of City of Austin Standard Specification Item No. 510, "Pipe." The vertical manhole portion (tee) above the main pipe shall conform to the requirements of the precast components.

The manhole tee shall have a minimum inside diameter of 48 inches and shall rise vertically centered or tangent to the main pipe, as indicated on the Drawings or as directed by the Engineer or designated representative. An access hole less than 48-inches in diameter shall be cut into the main pipe to allow a ledge for support of access ladders. Unless otherwise specified on the Drawings, the main pipe portion of the tee manhole shall be included in the unit price bid for the unit tee manhole price.

M. Precast Grade Rings

Rings shall be reinforced Class A concrete

1. Precast Grade Rings, 24½ inches Inside Diameter

This adjustment ring shall be used only for adjusting existing manholes with 24 inch diameter lids and for Wastewater Access Device. Inside to outside diameter dimension of ring shall be 6 inches with a thickness of 3 inches to 6 inches.

2. Precast Grade Rings, 35 inches Inside Diameter

This adjustment ring shall be used for all new manhole construction with 32 inch diameter lids. Inside to outside diameter dimension of ring shall be 6 inches with a thickness of 2 inches to 6 inches.

N. High Density Polyethylene Grade Rings

Plastic grade (adjusting) rings shall be injection molded from high density polyethylene identified according to ASTM D4976. Reprocessable and recyclable ethylene plastic materials are allowed. Manufacturers of HDPE adjusting rings shall be listed on SPL WW-703.

O. Controlled Low Strength Material

Controlled low strength material (CLSM) shall meet Standard Specification Item 402S, Controlled Low Strength Material.

P. Cement Stabilized Sand

Cement stabilized sand for bedding or backfilling shall contain 2 bags of Portland cement per cubic yard. The sand shall meet the requirements for "Fine Aggregate" in Standard Specification Item 403S, Concrete for Structures.

Q. Waterproofing Joint Materials

O-rings and wedge seals for the joints of all wastewater manholes, and for stormwater manholes when indicated on the Drawings, shall conform to the requirements of ASTM C443. Cold applied preformed plastic gaskets for stormwater manholes shall be as specified in City of Austin Standard Specification Item No. 510, "Pipe." Plastic seals wrapped around manholes at joints, and hydrophillic waterstops installed in joints, shall be listed on SPL WW-146A. PVC waterstops installed in joints and waterproofing compounds applied to the exterior surfaces of manholes and junction boxes shall be as specified in the Contract Documents.

R. Interior Surface Coatings for Wastewater Manholes

Interior surface coatings for wastewater manholes shall be either: as specified on the Drawings, as designated in writing by the Engineer or designated representative, or as included on SPL WW-511, which lists acceptable products, uses and applicators.

S. Structural Lining Systems for Wastewater Manholes

Structural lining systems for wastewater manholes shall be either: as specified on the Drawings, as designated in writing by the Engineer or designated representative, or as included on SPL WW-511A.

506.5 - Construction

A. General

A minimum horizontal separation of 12 inches shall be maintained between adjacent pipes inside and outside a manhole or junction box. Pipe ends within the base section or junction box walls shall not be relied upon to support overlying manhole dead and live load weights. All wastewater branch connections to new or existing mains shall be made at manholes, with the branch pipe crown installed at an elevation no lower than the elevation of the effluent pipe crown. Changes in flow direction in the inverts shall be made by constructing smooth, long-radius sweeps to minimize splashing, turbulence, and eddies. Where wastewater lines enter the manhole up to 24 inches above the flowline of the outlet, the invert shall be sloped upward in a U-shaped channel three-fourths of the diameter of the incoming pipe to receive the flow, thus preventing splashing or solids deposition. A drop pipe shall be provided for a wastewater pipe entering a manhole whenever the invert cannot be constructed to prevent splashing and solids deposition. Construction of extensions to existing systems shall require placement of bulkheads at locations indicated or directed by the Engineer or designated representative.

Unless otherwise indicated on the Drawings, stormwater manholes shall have eccentric cones and wastewater manholes shall have concentric cones, except on manholes over large mains where an eccentric cone shall be situated to provide access to an invert ledge. Eccentric cones may be used where conflicts with other utilities dictate. Flat-slab tops may be used only where clearance problems are encountered or where specified on the Drawings. Cast-in-place wastewater junction boxes shall be allowed only where indicated on the Drawings or where accepted by the Engineer or designated representative.

B. Foundation Support

Manholes shall be founded at the established elevations on uniformly stable subgrade. Unstable subgrade shall be over-excavated a minimum of 12 inches and replaced with a material acceptable to the Engineer or designated representative. Precast base units shall be founded and leveled on a 6

inch thick layer of coarse aggregate bedding. A pipe section with a prefabricated tee manhole and half the length of the adjoining pipe sections on each side shall be founded on a minimum of 6 inch thick layer of unreinforced Class A concrete (City of Austin Standard Specification Item No. 403S, "Concrete For Structures"). The cast-in-place concrete cradle shall be placed against undisturbed trench walls up to the pipe's springline.

C. Cast-in-Place Concrete

Structural concrete work shall conform to Standard Specification Item No. 410S, Concrete for Structures. Forms shall be used for all slabs that are not ground supported and for all vertical surfaces above the foundation level. Formwork shall be designed according to American Concrete Institute ACI 347, Guide to Formwork for Concrete. Outside forms on vertical surfaces may be omitted where concrete can be cast against the surrounding earthen material that can be trimmed to a smooth vertical face.

D. Manhole Bases

Pre-cast bases shall conform to requirements in 506.4.H.

Cast-in-place bases shall have a minimum thickness of 12 inches at the invert flowline. The widths of all manhole inverts shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped channels. The channel depth at the point where a pipe connects to the manhole wall, for pipes 24 inches in diameter and smaller, shall be a minimum of three-fourths of the pipe diameter, with the top of the channel being a smooth transition between the inlet and outlet pipe connection points. For manholes connecting to pipes greater than 24 inches in diameter, the channel depth at the point where a pipe connects to the manhole wall shall be equal to the full pipe diameter. The manhole invert grade shall 1) be a continuation of the inlet and outlet pipe grades carried through to the centerline of the manhole, or 2) have a minimum slope of 2.5 percent between the inlet and outlet pipe inverts, or 3) have a minimum difference of 0.10 feet between the inlet and outlet pipe inverts, whichever provides the maximum difference in invert elevation between the inlet and outlet pipes. In all cases, the bottom(s) of the channel(s) shall provide a smooth transition between the inlet and outlet pipes. Changes in flow direction in the inverts of manholes shall be made by constructing smooth, large-radius sweeps to prevent splashing, turbulence, and eddies. The lowermost riser section may be set in the Portland cement concrete, while still plastic, after which the base shall be cured a minimum of 24 hours prior to proceeding with construction of the manhole up to 12 feet in depth. The base shall be cured an additional 24 hours prior to continuing construction above the 12-foot level.

Wastewater manholes having cast-in-place bases may be constructed over existing wastewater pipes and the top half of the pipe removed to facilitate invert construction, except where the existing pipe is PVC, in which case, the entire pipe shall be removed from inside the manhole. The manhole floor shall rise outwardly from the springline elevation of the pipe, approximately one inch for each 12 inch of run (8 percent slope). The floors of stormwater manholes, also, shall rise outwardly from the springline elevation of the pipe, approximately one inch for each 12 inches of run (8 percent slope).

Wastewater manholes with lines larger than 18 inches shall require pre-cast bases; manholes constructed over in-service mains however, may be built on cast-in-place bases if the flow cannot be interrupted.

E. Pipe Connections to Manholes and Junction Boxes

Wastewater pipe connections to manholes and junction boxes shall be made using flexible, resilient, and non-corrosive watertight boot connectors or ring waterstops acceptable to the Engineer and conforming to the requirements of ASTM C-923. Any voids in the annular space between the pipe and boot connector or ring waterstop and the inside of the manhole wall shall be filled with non-shrink grout to prevent solids collection.

F. Pipe Connections to Existing Manholes and Junction Boxes

Wastewater pipe connections to existing manholes and junction boxes shall be made by removing the wall section by coring or alternative method approved by the Engineer or designated representative; installing flexible, resilient, and non-corrosive boot connectors or ring waterstops acceptable to the Engineer or designated representative and conforming to the requirements of ASTM C-923; filling any voids in the annular space between the pipe and boot connector or ring waterstop and the inside of the manhole or junction box wall with non-shrink grout; rebuilding the invert to conform to Section 506S.5.D; rehabilitating the interior walls with structural lining material listed on SPL WW-511A, and coating the interior of the manhole with material listed on SPL WW-511.

G. Waterproofing

PVC waterstops, hydrophillic waterstops, joint wrapping, and waterproofing compounds shall be installed as specified. Material wrapped around manholes at joints shall be listed on SPL WW-146A regardless of whether installation of the material is required by the Contract for waterproofing or is volunteered by the Contractor for ensuring acceptance of the manhole joints.

H. Backfilling

Backfilling of manholes shall conform to the density requirements of City of Austin Standard Specification Item No. 510, Pipe. Manhole construction in roadways may be staged to facilitate pavement base construction. Manholes constructed to interim elevations to facilitate interim construction shall be covered with steel plates that conform to the requirements of City of Austin Standard 804S-4, sheets 5, 6 and 7, Steel Plating. Steel plates on wastewater manholes shall be set in mortar to minimize inflow of storm water runoff. Manholes shall be completed to finish elevation prior to placement of the roadway's finish surface except on pavement reconstruction projects, where castings may be adjusted after paving is completed. The excavation for completion of manhole construction shall be backfilled in accordance with City of Austin Standards for Trench Repair.

I. Height Adjustment of Manholes

1. General

All adjustments shall be completed prior to the placement of the final roadway surface except on pavement reconstruction projects, where castings may be adjusted after paving is completed.

Brick shall not be used in making height adjustments to wastewater manholes. Mortar shall not be used for any purpose on the inside of wastewater manholes.

Manhole components to be reused shall be carefully removed and the contact areas shall be cleaned of all mortar, concrete, grease and sealing compounds. Any items broken in the process of removal and cleaning shall be replaced in kind by the Contractor at its expense.

If the adjustment involves lowering the top of a manhole, a sufficient depth of pre-cast concrete rings or brick courses shall be removed to permit reconstruction. Existing mortar shall be cleaned from the top surface remaining in place and from all brick or concrete rings to be reused and the manhole rebuilt to the required elevation. The manhole ring and cover shall then be installed with the top surface conforming to the proposed grade.

If the adjustment involves raising the elevation of the top of the manhole in accordance with Minor Manhole Height Adjustment," the top of brick or concrete ring shall be cleaned and built up vertically to the new elevation, using new or salvaged concrete rings or bricks and the ring and cover installed with the top surface conforming to the proposed grade.

After rings and covers are set to grade, the inside and outside of the precast concrete grade rings shall be wiped with non-shrink grout to form a durable surface and water-tight joints. The grouted surface shall be smooth and even with the manhole cone section. Grout shall not be placed when the atmospheric temperature is at or below 40°F. If a sudden drop in temperature

below 40°F occurs or temperatures below 40°F are predicted, the grouted surfaces shall be protected against freezing for at least 24 hours.

2. Minor Manhole Height Adjustment (New and Existing Manholes)

Minor manhole height adjustments shall be performed as indicated on City of Austin Standard 506S-4, "Minor Manhole Height Adjustment", and shall consist of adding precast reinforced concrete rings to adjust new and existing manholes to final grade. Brick shall not be used in making height adjustments to wastewater manholes.

If the adjustment involves raising the elevation of the top of the manhole, the top of brick or concrete ring shall be cleaned and built up vertically to the new elevation, using new or salvaged concrete rings or bricks and the ring and cover installed with the top surface conforming to the proposed grade.

For new manhole construction, the maximum allowable throat or chimney height, including the depth of the ring casting, shall be limited to 21 inches of vertical face on the interior surface. For adjustments of existing manholes that fall within the limits of overlay and street reconstruction projects, the maximum vertical allowable height, including the depth of the ring casting, shall be limited to 27 inches of vertical face on the interior surface. All other existing manholes shall have a maximum allowable throat or chimney height adjustment, including the depth of the ring casting, of 12 inches of vertical face on the interior surface. Any adjustment that will exceed these requirements shall be accomplished as indicated on City of Austin Standard 506S-2, Major Manhole Height Adjustment and as described below. Manholes not located in paved areas shall have bolted covers. Manholes located within paved areas (street right of way only) shall be standard non-bolted unless otherwise noted on the drawings.

3. Major Manhole Height Adjustment (Existing Manholes Only)

Any adjustment that exceeds the requirements of Minor Manhole Adjustments, shall be accomplished as indicated on City of Austin Standard 506S-2, Major Manhole Height Adjustment, and shall consist of any combination of removing the concrete rings, and/or the manhole cone section, and/or the straight riser section of the manhole in order to bring the manhole to final grade. Major manhole adjustments shall apply only to existing manholes. Manholes not located in paved areas shall have bolted covers. Manholes located within paved areas (street right of way only) shall be standard non-bolted unless otherwise noted on the drawings.

J. Interior Coatings of Wastewater Manholes and Junction Boxes

The interior surfaces of all Portland cement concrete wastewater manholes and junction boxes shall be coated with products specified either on the Drawings, designated in writing by the Engineer or representative, or listed on SPL WW-511. Product selection shall conform to usage described in that SPL. Surface preparation shall follow the product manufacturer's recommended procedures contained in technical data sheets unless otherwise specified in the contract documents. The Contractor shall measure the coating thickness according to ASTM D 6132, Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Over Concrete Using an Ultrasonic Gage. Thickness measures shall be made at locations designated by the Engineer or designated representative. All thickness measurements shall be witnessed by the Engineer or designated representative.

K. Structural Linings of Existing Wastewater Manholes

The interior surfaces of existing wastewater manholes and junction boxes at locations shown in the Drawings or as designated by the Engineer shall be strengthened by application of structural lining systems either as specified on the Drawings, directed in writing by the Engineer or designated representative, or listed on SPL WW-511A. Selection of products for coating the interior of existing manholes shall be based on the condition of the manholes. Surface preparation shall follow the

product manufacturer's recommended procedures contained in technical data sheets unless otherwise specified in the contract documents.

L. Abandonment of Existing Manholes

Manholes designated on the Drawings for abandonment, shall be removed to a level not less than four feet below grade. Two-foot long sections of the inlet and outlet pipes shall be cut and removed on the outside of the manhole, the ends of the remaining pipe and the pipe sections penetrating the manhole wall shall be securely plugged, and the structure filled with material in accordance with Standard 506S-15 or as directed by the Engineer or designated representative.

506.6 - Acceptance Testing of Wastewater Manholes

Manholes shall be tested separately and independently of the wastewater lines.

A. Test by the Vacuum Method

A vacuum test shall be performed by the Contractor prior to backfilling those manholes that fall within the right-of-way that require detouring of vehicular traffic. A second vacuum test will not be required after backfilling and compaction is complete unless there is evidence that the manhole has been damaged or disturbed subsequent to the initial vacuum test.

For manhole installations which do not require detouring of vehicular traffic, the vacuum method is recommended and may be used by the Contractor prior to backfilling the manhole to insure proper installation so that defects may be located and repaired; however, a vacuum test shall be performed after backfilling, and compaction are complete. Testing after backfill and compaction are complete will be the basis for acceptance of the manhole.

1. Equipment

- a) The manhole vacuum tester shall be a device approved for use by the Engineer or designated representative.
- b) Pipe sealing plugs shall have a load resisting capacity equal to or greater than that required for the size of the connected pipe to be sealed.

2. Procedures - applicable to new 48-inch diameter manholes

- a) Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before installation or unless it is applied at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints. Tests shall be performed before grouting the invert or around pipe penetrations and before coating the interior surfaces of the manhole or junction box.
- b) After cleaning the interior surfaces of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer. Plugs and the ends of pipes connected by flexible boots shall be blocked to prevent their movement during the vacuum test.
- c) The vacuum test head shall be placed on the top of the cone section or, inside of the top of the manhole cone section, and the compression seal band inflated to the pressure recommended by its manufacturer. The vacuum pump shall be connected to the outlet port with the valve open. When a vacuum of 10 inches of mercury (-5 psig) has been attained, the valve shall be closed and the time noted. Tampering with the test equipment will not be allowed.

- d) The manhole shall have passed the test if the vacuum does not drop below 9 inches of mercury (-4.5 psig) within 3 minutes of the time the valve was closed. The actual vacuum shall be recorded at the end of the 3 minutes during which the valve was closed.
- e) When the standard vacuum test cannot be performed because of design or material constraints (examples: T-Type manholes, T-Lock Liners, or other reasons acceptable to the Engineer or designated representative), testing of individual joints shall be performed as directed by the Engineer or designated representative.

B. Test by the Exfiltration Method

At the discretion of the Engineer or designated representative, the Contractor may substitute the Exfiltration Method of testing for the Vacuum test described in Section 506.6. A. above. This method may only be used when ground water is not present. If ground water is present a Vacuum Test shall be used unless otherwise directed by the Engineer or designated representative. All backfilling and compaction shall be completed prior to the commencement of testing.

The procedures for the test shall include the following:

1. Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before field assembly, or at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints. Tests shall be performed before grouting the invert or around pipe penetrations and before coating the interior surfaces of the manhole or junction box.
2. After cleaning the interior surface of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer.
3. Concrete manholes shall be filled with water or otherwise thoroughly wetted for a period of 24 hours prior to testing.
4. At the start of the test, the manhole shall be filled to the top with water. The test time shall be 1 hour. The Construction Inspector must be present for observation during the entire time of the test. Permissible loss of water in the 1-hour test time is 0.025 gallons per diameter foot, per foot of manhole depth. For a 4-foot diameter manhole, this quantity converts to a maximum permissible drop in the water level (from the top of the manhole cone) of 0.1 inches per foot of manhole depth or 1.0 inches for a 10-foot deep manhole.

C. Failure to Pass the Test - Records of Tests

If the manhole fails to pass the initial test method as described in (A) Test by the Vacuum Method and, if allowed, (B) Test by the Exfiltration Method, or if visible groundwater leakage into the manhole is observed, the Contractor shall locate the leak, if necessary by disassembly of the manhole. The Contractor shall check the gaskets and replace them if necessary. The Contractor may re-lubricate the joints and re-assemble the manhole, or the Contractor may install an acceptable exterior joint sealing product (see City of Austin Standard Products List Item SPL WW-146A) on all joints and then retest the manhole. If any manhole fails the vacuum and/or exfiltration test twice, the Contractor shall consider replacing that manhole. If the Contractor chooses to attempt to repair that manhole, the manhole must be retested until it passes. In no case shall cold applied preformed plastic gaskets be used for repair. Records of all manhole testing shall be made available to the Engineer or designated representative at the close of each working day, or as otherwise directed by the Engineer or designated representative. Any damaged or visually defective products, or any products out of acceptable tolerance shall be removed from the site.

D. Inspection

The Engineer or designated representative shall make a visual inspection of each manhole after it has passed the testing requirements and is considered to be in its final condition. The inspection

shall determine the completeness of the manhole; any defects shall be corrected to the satisfaction of Engineer or designated representative.

506.7 - Measurement

A "Junction Box" and "Box Manholes" will be measured by each structure of the indicated size regardless of depth.

A "Standard Pre-cast Manhole with Pre-cast Base", "Standard Pre-cast Manhole with Cast-in-Place (CIP) Base", "Special Manhole", "Drop Manhole with Pre-cast Base", "Drop Manhole with Cast-in-Place (CIP) Base", "Centered Tee Manhole", or "Tangent Tee Manhole" will be measured by each structure of the indicated size for the first 8 feet of depth.

An "Extra Depth Manhole" will be measured by linear vertical foot of Standard Pre-cast Manhole with Pre-cast Base, Standard Pre-cast Manhole with CIP Base, Drop Manhole with Pre-cast Base, Drop Manhole with CIP Base, Special Manhole, Centered Tee Manhole, or Tangent Tee Manhole of the indicated size in excess of eight feet of depth. Manhole depth will be measured from the invert flow line to the finished surface elevation.

"Minor Manhole Height Adjustment" and "Major Manhole Height Adjustment" will be measured by each unit for the indicated size. Only existing manholes will be measured for minor or major manhole height adjustment.

"Connection to Existing Manhole or Junction Box" will be measured per each for the indicated type of structure and location.

"Structural Lining" will be measured by the linear vertical foot for the indicated structure.

New manholes constructed to interim elevations to facilitate stage construction shall be measured as one unit regardless of the number of interim elevations constructed. All labor, materials and other expenses necessary for the stage construction shall be included in the unit price bid for the completed unit. Cost of abandonment of existing manholes shall be included in the unit price bid for the completed unit, unless Pay Item No. 506 AB is indicated on the Drawings and identified in Standard Contract Bid Form 00300U.

506.8 - Payment

Payment for completed junction boxes and manholes of the type indicated on the Drawings shall be made at the appropriate unit bid price. The unit bid price shall include all labor, equipment, materials, (including but not limited to frames and grates, rings and covers, adjusting rings, cone sections, riser sections, gaskets, drop piping and fittings, bases, pipe-to-manhole connectors, concrete, reinforcing steel, non-shrink grout, mortar, joint wrap where specified, and, for wastewater manholes, interior coatings), time and incidentals necessary to complete the work.

Payment for a "Junction Box" and "Box Manhole" will be made at the unit price bid for the indicated size, complete in place.

Payment for the first 8 feet of a "Standard Pre-cast Manhole with Pre-cast Base", "Standard Pre-cast Manhole with Cast-in-Place (CIP) Base", "Special Manhole", "Drop Manhole with Pre-cast Base", "Drop Manhole with Cast-in-Place (CIP) Base", "Centered Tee Manhole", or "Tangent Tee Manhole" will be made at the unit price bid for the indicated type and size, complete in place.

Payment for that portion of a Standard Pre-cast Manhole with Pre-cast Base, Standard Pre-cast Manhole with CIP Base, Drop Manhole with Pre-cast Base, Drop Manhole with CIP Base, Special Manhole, Centered Tee Manhole, or Tangent Tee Manhole in excess of 8 feet in depth will be made at the unit price bid for "Extra Depth Manhole" of the indicated type and size, complete in place.

Payment for "Minor Manhole Height Adjustment" and "Major Manhole Height Adjustment" will be made at the unit bid price, complete in place.

Payment for "Structural Lining" will be made at the unit price per linear vertical foot, which will include surface preparation, environmental adjustments, lining application, and curing, as required.

Payment for "Connection to Existing Manhole or Junction Box" shall be made at the unit price per connection and will include removing the wall section by coring or alternative method approved by the Engineer or designated representative, rehabilitating the interior walls, rebuilding the invert, and preparing and coating the interior surfaces of the structure.

When indicated in the Drawings, abandonment of existing manholes shall be made at the unit price for abandonment.

The intended use of each item shall be designated by a two-letter code (Wastewater = WW; Stormwater = SW) in the spaces provided after the pay item number:

Pay Item No. 506S M _____:	Standard Pre-cast Manhole w/Pre-cast Base, _____ Dia.	Per Each.
Pay Item No. 506S M1 _____:	Standard Pre-Cast Manhole w/CIP Base, _____ Dia.	Per Each.
Pay Item No. 506S S _____:	Special Manhole, _____ Dia.	Per Each.
Pay Item No. 506S D _____:	Drop Manhole w/Pre-cast Base, _____ _____ Dia.	Per Each.
Pay Item No. 506S D1 _____:	Drop Manhole w/CIP Base, _____ Dia.	Per Each.
Pay Item No. 506S C _____:	Centered Tee Manhole, _____ Dia. × _____ Dia.	Per Each.
Pay Item No. 506S T _____:	Tangent Tee Manhole, _____ Dia. × _____ Dia.	Per Each.
Pay Item No. 506S J _____:	Junction Box, _____ Ft. × _____ _____ Ft.	Per Each.
Pay Item No. 506S B _____:	Box Manhole _____ Ft. × _____ _____ Ft.	Per Each.
Pay Item No. 506S	Major Manhole Height Adjustment, _____	Per Each.

2_____:	Dia.	
Pay Item No. 506S 4_____:	Minor Manhole Height Adjustment, _____ Dia.	Per Each.
Pay Item No. 506S AB_____:	Abandonment of existing Manholes:	Per Each.
Pay Item No. 506S EDM_____:	Extra Depth of Manhole, _____ Dia.	Per Linear Vert. Foot.
Pay Item No. 506S SL_____:	Structural Lining of _____:	Per Linear Vert. Foot.
Pay Item No. 506S CN_____:	Connection to Existing _____:	Per Each.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item No. 506, "Manholes"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item 403S	Concrete For Structures
Item 406S	Reinforcing Steel
Item 402S	Controlled Low Strength Material
Item 410S	Concrete Structures
Item 503S	Frames, Grates, Rings and Covers

Item 504S	Adjusting Structures
Item 507S	Bulkheads
Item 510	Pipe
<u>Texas Department of Transportation Standard Specifications For Construction and Maintenance of Highways, Streets and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 421	Hydraulic Cement Concrete
<u>City of Austin Utilities Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 2.8.0	Abandonment of Facilities
Subsection 2.8.2	Manholes
<u>City of Austin Water Utility Documents</u>	
<u>Designation</u>	<u>Description</u>
SPL WW-146A	Manhole Seals, Plastic, Watertight
SPL WW-511	Lining System for Wastewater Manholes
SPL WW-511A	Structural Lining System for Wastewater Manholes
SPL WW-703	Adjusting (grade) rings for manhole chimney sections

<u>City of Austin Standard</u>	
<u>Designation</u>	<u>Description</u>
506S-2	Major Manhole Height Adjustment
506S-4	Minor Manhole Height Adjustment
506S-15	Abandoned Manhole
506S-12	O-Ring Joint Detail, Precast Manhole Section
506S-13	Wedge Seal Joint Detail, Precast Manhole Section Adjustment
506S-15	Abandoned Manhole
804S-4, 5, 6 and 7 of 9	Steel Plating
<u>City of Austin Standard Contract</u>	
<u>Designation</u>	<u>Description</u>
00300U	Bid Form (Unit Prices)
<u>American Society for Testing and Materials (ASTM)</u>	
<u>Designation</u>	<u>Description</u>
ASTM C 55	Specification for Concrete Building Brick
ASTM C 62	Specification for Building Brick Solid Masonry Units Made from Clay or Shale
ASTM C478/C478M	Standard Specification for Precast Concrete Manhole

ASTM C443/C443M	Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C923/C923M	Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures Pipes
ASTM C1107	Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D6132	Specification for Polyethylene Plastics Molding and Extrusion Materials
D4976	Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coating Over Concrete Using an Ultrasonic Gage
<u>American Concrete Institute</u>	
<u>Designation</u>	<u>Description</u>
Item 347	Guide to Formwork for Concrete

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item No. 506, "Manholes"</u>	
<u>City of Austin Utilities Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 2	Water and Wastewater Design Criteria
<u>City of Austin Standards</u>	

<u>Designation</u>	<u>Description</u>
1100S-1	Casting Adjustments
503S-4S	Storm Sewer Manhole Ring and 32" Cover
503S-4W	Sanitary Sewer Manhole Ring and 32" Cover
503S-5S	Bolted Storm Sewer Manhole Ring and 32" Cover
503S-5W	Watertight Manhole Ring and 32" Cover (W&WW)
506S-1	Manhole Invert Plan
506S-5	Typical Box Manhole 30" and Larger Pipe
506S-7	Precast Manhole with Drop Inlet on Cast in Place Foundation
506S-8	Precast Manhole with Drop Inlet on Precast Base
506S-9	Precast Manhole On Cast-In-Place Foundation
506S-10	Wastewater Manhole on Precast Base
506S-11	Storm Sewer Manhole Details
<u>American Association of State Highway and Transportation Officials (AASHTO)</u>	
<u>Designation</u>	<u>Description</u>
M306	Standard Specifications for Drainage Structure Castings

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Item No. 508S

Miscellaneous Structures and Appurtenances

508S.1 Description

This item governs the construction of miscellaneous structures and appurtenances, complete in place or to the stage detailed and/or indicated in the Drawings, using the materials specified herein, including the excavation, installation, backfilling, placement of the concrete and when required, the furnishing and installation of frames, grates, rings, covers, safety end treatment and any concrete curb and gutter indicated on the Drawings.

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

508S.2 Submittals

The submittal requirements of this specification item include:

- A. Type of structure and appurtenances (inlets, headwalls, frames, grates, energy dissipators, etc.), construction methods and sequence (precast, cast in place), materials (bolts, nuts, plates, angles, etc.)
- B. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix.
- C. Proposed proportioning of materials for the mortar mix.
- D. Analysis and thickness calculations for temporary steel covers.

508S.3 Types

The various types of structures and appurtenances such as inlets, headwalls, energy dissipators, etc., are designated on the Drawings by letter or by number for the particular design of structure to be constructed in accordance with the details indicated on the Drawings. Unless otherwise indicated on the Drawings, the Contractor may have the option of furnishing cast in place or precast structures.

508S.4 Materials

A. Portland Cement Concrete

The Portland cement concrete shall conform to Item No. 403S, "Concrete For Structures", with the following classes:

Cast in Place Concrete	Class A
Precast Concrete	Class C

B. Mortar

Mortar shall be composed of 1 part Portland cement and 2 parts clean, sharp mortar sand suitably graded for the purpose by conforming in other respects to the provisions

of Standard Specification Item No. 403S, "Concrete for Structures" for fine aggregate. Hydrated lime or lime putty may be added to the mix, but in no case shall it exceed 10 percent by weight (mass) of the total dry mix.

C. Reinforcement and Steel

Reinforcing Steel shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

Structural Steel shall conform to Standard Specification Item No. 720S, "Metal for Structures".

D. Frames, Grates, Rings and Covers

Frames, grates, rings and covers shall conform to City of Austin Standard Specification Item No. 503S, "Frames, Grates, Rings and Covers".

E. Safety End Treatment for Structures

The safety end treatment for structures shall conform to TxDOT Specification Item No. 467, "Safety End Treatment".

1. Bolts and Nuts. All bolts, nuts and associated hardware shall meet the specifications of ASTM A 307.
2. Plates and Angles. All plates and similar angles and brackets shall meet the specifications of ASTM A 36.
3. Pipe Runners. Pipe Runners shall conform to the requirements of ASTM A53, Grade B.
4. Galvanizing. All hardware including nuts, bolts and plates listed above shall be galvanized conforming to ASTM A 123 or A 153.

F. Miscellaneous Items

Cast iron for supports, steps and inlet units shall conform to the shape and dimensions indicated on the Drawings. The casting shall be clean and perfect, free from sand or blowholes or other defects. Cast iron castings shall meet the requirements of ASTM A 48, Class 30. Steel for temporary covers when used with stage construction shall be adequate for the loads imposed.

508S.5 Construction Methods

All concrete work shall be performed in accordance with Standard Specification Item No. 410S, "Concrete Structures". Forms will be required for all cast-in-place concrete walls, except where the nature of the surrounding material is such that it can be trimmed to a smooth vertical face (the outside form for concrete bases). Where cast in place concrete is used in wall construction of storm sewers, the steps shall be cast into the wall when the concrete is placed.

The construction inlets shall be completed, as soon as is practicable after installation is complete of the sewer lines in the inlet. All sewer line shall be cut neatly at the inside face of the walls of the inlet and pointed up with mortar.

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Bases for cast in place inlets may be placed prior to or at the Contractor's option after the sewer is constructed.

Bases for box sewers shall be cast as an integral part of the sewer. The manholes may be constructed prior to backfilling or if the Contractor so elects, the manhole opening may be covered temporarily with a steel plate to facilitate the compaction of backfill for the sewer as a whole. Thereafter, required excavation for the inlet shall be made and the inlet constructed and backfilled.

The inverts passing out or through an inlet shall be shaped and grouted across the floor of the inlet as indicated on the Drawings. This shaping may be accomplished by adding shaping mortar or concrete after the base is cast or by placing the required additional material with the base.

All miscellaneous structures shall be completed in accordance with the details indicated on the Drawings. Backfilling to original ground elevation shall be in accordance with the provisions of the appropriate items and as directed by the Engineer or designated representative.

Energy dissipators and headwalls shall be constructed in accordance with City of Austin Standard Detail 508S-13.

508S.6 Measurement

All miscellaneous structures and safety end treatments satisfactorily completed as indicated on the Drawings will be measured as completed units per each.

Concrete removal, excavation and backfill, riprap, pipe, headwalls, wing walls, collars and apron slabs will not be measured under this item but will be included in the unit price bid for the item of construction in which this item is used.

Frames, grates, rings, covers, safety end treatment and any concrete curb and gutter indicated will not be measured and paid for but shall be included in the unit price bid of one of the pay items identified in the contract bid form.

508S.7 Payment

A . Inlets

Payment for Inlets of the type indicated in place in accordance with these specifications and measured as prescribed above will be made at the unit bid price for each Inlet, of the type specified.

B. Energy Dissipators and Headwalls

Payment for special complete structures will be made at the unit price bid per each.

C Safety End Treatment

Payment for Safety End Treatment, complete in place, will be made at the unit bid price for each unit of the type indicated on the Drawings.

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Payment will be made under one of the following:

Pay Item No. 508S-E:	Energy Dissipators, _____ In. Dia. -	Per Each.
Pay Item No. 508S-H:	Headwalls, Type _____, ____ In. Dia. Pipe -	Per Each.
Pay Item No. 508S-IG:	Inlet, Grated -	Per Each.
Pay Item No. 508S-SET	Safety End Treatment, Type ____ Size ____	Per Each
Pay Item No. 508S-I5R:	Inlet, Recessed -	Per Each.
Pay Item No. 508S-I10R:	Inlet, Recessed -	Per Each.
Pay Item No. 508S-I15R:	Inlet, Recessed -	Per Each.
Pay Item No. 508S-I20R:	Inlet, Recessed -	Per Each.
Pay Item No. 508S-I5S:	Inlet, Recessed -	Per Each.
Pay Item No. 508S-I10S:	Inlet, Standard -	Per Each.
Pay Item No. 508S-I15S:	Inlet, Standard -	Per Each.
Pay Item No. 508S-I20S:	Inlet, Standard -	Per Each.

End

<i>SPECIFIED</i> Cross Reference Materials	
Standard Specification Item No. 508S, "Miscellaneous Structures and Appurtenances"	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 403S	Concrete For Structures
Item No. 406	Reinforcing Steel
Item No. 410	Concrete Structures
Item No. 720	Structural Steel
Item No. 503S	Frames, Grates, Rings and Covers
<u>TxDOT Standard Specifications For Construction And Maintenance</u>	
<u>Of Highways, Streets, And Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 467	Safety End Treatment
<u>American Society for Testing and Materials (ASTM)</u>	
<u>Designation</u>	<u>Description</u>
ASTM A36/36M	Specification for Structural Steel
ASTM A48	Specification for Gray Iron Castings
ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Specifications for Carbon Steel Externally Threaded Standard Fasteners
ASTM C913	Specifications for Precast Concrete Water and Wastewater Structures

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RELATED Cross Reference Materials

City of Austin Drainage Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 6.6.0	Energy Dissipators

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 501S	Jacking or Boring Pipe
Item No. 504S	Adjusting Structures
Item No. 506	Manholes
Item No. 507S	Bulkheads
Item No. 510	Pipe

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
508S-13	Standard Headwall and Energy Dissipators
510S-1	Concrete Trench Cap

TxDOT Specifications

<u>Designation</u>	<u>Description</u>
Item 420	Concrete Structures
Item 421	Portland Cement Concrete
Section 421.2(5)	Fine Aggregate
Item 424	Precast Concrete Structures (Fabrication)
Item 440	Reinforcing Steel
Item 466	Headwalls and Wingwalls
Item 467	Safety End Treatment
Item 471	Frames, Grates, Rings and Covers
Item 529	Concrete Curb, Gutter and Combined Curb and Gutter

Item No. 509S
Excavation Safety Systems

509S.1 Description

This item shall govern the designing, furnishing, installing, maintaining and removing or abandoning of temporary Excavation Safety Systems consisting of trench shields, aluminum hydraulic shoring, timber shoring, trench jacks, tieback or braced sheeting, tieback slurry walls, soil nailing, rock bolting, tieback or braced soldier piles and lagging, and other systems for protecting workers in excavations. This item shall also govern the designing and constructing of sloping and benching systems for protecting workers in excavations.

At a minimum, the Excavation Safety Systems shall conform to United States Department of Labor Rules 29 CFR, Occupational Safety and Health Administration, Part 1926 Safety and Health Regulations for Construction, Subpart P, Excavation (hereinafter called OSHA).

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.

509S.2 Definitions

"Competent Person" shall mean one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. The competent person shall be capable of interpreting the manufacturer's data sheets and interpreting and implementing the Excavation Safety System Plan.

An "Excavation" shall mean any cut, cavity, trench, or depression in an earth surface, formed by earth removed by the Contractor. The Contractor shall provide an Excavation Safety System for all excavations except when 1) the excavation is in stable rock as determined by the Texas-licensed Professional Engineer who prepared the Contractor's Excavation Safety System Plan or 2) the excavation is less than 5 feet (1.52 m) in depth and examination of the ground by the Contractor's competent person provides no indication of a potential cave-in.

"Trench" (trench excavation) shall mean any narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth shall be greater than the width, but the width of a trench (measured at the bottom) shall not be greater than 15 feet (4.56 m). Excavation Safety Systems for such trenches shall be defined as "Trench Excavation Safety Protective Systems".

If the Contractor installs or constructs forms or other structures in an excavation such that the dimension measured from the forms or structures to the sides of the excavation is reduced to 15 feet (4.6 m) or less (measured at the bottom of the excavation), those excavations shall also be defined as a Trench if workers must enter it. Excavation Safety Systems for such trenches shall also be defined as "Trench Excavation Safety Protective Systems".

509S.3 Excavation Safety System Submittals

- A. The Notice to Proceed with construction may be issued by the Owner before the Contractor has submitted the necessary Excavation Safety Plan(s); however, excavation shall not proceed until the Owner has received the Contractor's Excavation Safety Plan(s) for the Project.

B. Prior to Starting Excavation

Prior to starting any Excavation, the Contractor shall submit to the Owner:

1. A certificate indicating that the Contractor's Competent Person(s) has completed training in an excavation safety program based on OSHA regulations within the past 5 years.
2. Manufacturer's tabulated data or other tabulated data for Excavation Safety Systems consisting of pre-engineered protective systems such as trench shields, aluminum hydraulic shoring, timber shoring, pneumatic shoring, or trench jacks, or benching or sloping or other protective systems that are not designed specifically for the Project.

Manufacturer's tabulated data shall meet the requirements in OSHA and shall describe the specific equipment to be used on the Project. Tabulated data must bear the seal of the licensed professional engineer who approved the data. Manufacturer's tabulated data shall be an attachment to the Contractor's Excavation Safety System Plan described below.

509S.4 Excavation Safety System Plan

The Contractor shall prepare an Excavation Safety System Plan (hereafter called the "Plan") specifically for the Project. The Contractor shall retain a Texas-licensed Professional Engineer to prepare the Plan. On City-funded projects, the Contractor must follow qualifications-based procedures to procure the required Professional Engineering services, according to Chapter 2254 of the Texas Government Code.

The Contractor shall be responsible for obtaining geotechnical information necessary for design of the Excavation Safety System. If geotechnical information for design of the Project has been acquired by the Owner or designated representative, it shall be provided to the Contractor for information purposes subject to the provisions of City of Austin Standard Contract Section 00220, "Geotechnical Data."

- A. The Plan for Excavation Safety Systems consisting of pre-engineered protective systems such as trench shields, aluminum hydraulic shoring, timber shoring, pneumatic shoring, or trench jacks, or benching or sloping or other protective systems that are not designed specifically for the Project shall include:
1. Detailed Drawings of the Excavation Safety System(s) that will provide worker protection conforming to OSHA. The Drawings shall note the required load carrying capacity, dimensions, materials, and other physical properties or characteristics in sufficient detail to describe thoroughly and completely the Excavation Safety System(s).
 2. Drawings, notes, or tables clearly detailing the specific areas of the Project in which each Excavation Safety System shall be used, the permissible size of the excavation, the length of time that the excavation shall remain open, the means of egress from the excavation, the location of material storage sites in relation to the excavation, the methods for placing/compacting bedding/backfill within the safety of the system, any excavation safety equipment restrictions and subsequent removal of the system.
 3. Recommendations and limitations for using the Excavation Safety Systems.
 4. A Certificate of Insurance of the Excavation Safety System Engineer's Professional Liability Insurance coverage. For City-funded projects, coverage meeting the requirements of Standard Contract Documents Section 00810 shall be provided. For privately funded projects the coverage shall be at least \$1,000,000.
- B. The Plan for Excavation Safety Systems consisting of tieback or braced sheeting, tieback or braced soldier piles and lagging, slurry walls, soil nailing, rock bolting or other protective systems that are designed specifically for the Project shall include:

1. Detailed Drawings of the Excavation Safety System(s) that will provide worker protection conforming to OSHA. The Drawings shall note the design assumptions, design criteria, factors of safety, applicable codes, dimensions, components, types of materials, and other physical properties or characteristics in sufficient detail to describe thoroughly and completely the Excavation Safety System(s).
2. Detailed technical specifications for the Excavation Safety System addressing the properties of the materials, construction means and methods, quality control and quality assurance testing, performance monitoring, and monitoring of adjacent features, as appropriate.
3. Drawings that clearly detail the specific areas of the Project in which each type of system shall be used and showing the plan and elevation (vertical profile) views.
4. Drawings, notes or tables clearly detailing the length of time that the excavation shall remain open, the means of egress from the excavation, the location of material storage sites in relation to the excavation, the methods for placing/compacting bedding/backfill within the safety of the system, any excavation safety equipment restrictions and subsequent removal or abandonment of the system or parts thereof.
5. Recommendations and limitations for using the Excavation Safety Systems.
6. A Certificate of Insurance of the Excavation Safety System Engineer's Professional Liability Insurance coverage. For City-funded projects, coverage meeting the requirements of Standard Contract Documents Section 00810 shall be provided. For privately funded projects the coverage shall be at least \$1,000,000.

509S.5 Excavation Safety System Submittal Review

Review of the Excavation Safety System submittal conducted by the Owner or designated representative shall only relate to conformance with the requirements herein. The Owner's failure to note exceptions to the submittal shall not relieve the Contractor of any or all responsibility or liability for the adequacy of the Excavation Safety System. The Contractor shall remain solely and completely responsible for all Excavation Safety Systems and for the associated means, methods, procedures, and materials.

509S.6 Contractor's Responsibility

The Contractor shall be responsible for implementing the Excavation Safety System Plan and for confirming that the Excavation Safety System(s) used on the Project meets the requirements of the Plan.

The Contractor's Competent Person(s) shall be on the Project whenever workers are in an excavation meeting the definitions of a Trench given in 509S.2.

509S.7 Construction Methods

The Contractor's Competent Person(s) shall maintain a copy of appropriate OSHA regulations onsite and shall implement OSHA excavation safety regulations at the work site. The Contractor shall perform all excavation in a safe manner and shall maintain the Excavation Safety Systems to prevent death or injury to personnel or damage to structures, utilities or property in or near excavation.

If evidence of possible cave-ins or earthen slides is apparent or an installed Excavation Safety System is damaged, the Contractor shall immediately cease work in the excavation, evacuate

personnel from any potentially hazardous areas and notify the Owner. 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 Excavation Safety System shall be at the Contractor's sole expense.

509S.8 Changed Conditions

When changed conditions require modifications to the Excavation Safety System, the Contractor shall provide to the Owner or designated representative a new design or an alternate Excavation Safety System Plan that is proposed by the Contractor's Excavation Safety System Engineer to address the changed conditions. Copies of the new design or alternate system shall be provided to the Owner or designated representative in accordance with the requirements of section 509S.3, "Excavation Safety System Plan Submittals". A copy of the most current Excavation Safety System Plan shall be maintained on site and made available to inspection and enforcement officials at all times.

Any changes to the Excavation 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 Excavation Safety System Plan are necessitated by severe and uncharacteristic natural conditions or other conditions not reasonably within the control of the Contractor, the Contractor may make a written request to the Owner for a Change Order to address the anticipated work. The Contractor shall notify the Owner 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 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.

509S.9 Measurement

Trench Excavation Safety Protective Systems will only be measured and paid for those trenches that workers would reasonably be expected to enter.

Trench Excavation Safety Protective Systems for Trenches excavated to a final width (measured at the bottom of the excavation) not exceeding 15 feet (4.56 m) shall be measured by the linear foot (meter: 1 meter equals 3.281 feet) through manholes, bore pits, receiving pits, and other appurtenances along the centerline of the trench. This method of measurement shall apply to any and all protective systems, including but not limited to tieback or braced sheeting, tieback or braced soldier piles and lagging, slurry walls, soil nails, rock bolts, shoring, trench boxes, and sloping or benching as used to provide a Trench Excavation Safety Protective System in accordance with the Excavation Safety System Plan.

Trench Excavation Safety Protective Systems for Trenches created by installation or construction of forms or other structures in an excavation whose width is greater than 15 feet (4.56 m) such that the dimension measured from the forms or structures to the sides of the excavation is reduced to 15 feet (4.56 m) or less (measured at the bottom of the excavation) shall be measured by the linear foot along the centerline of the Trench. Where forms or structures create multiple Trenches in one excavation, each Trench shall be measured separately. This method of measurement shall apply to any and all protective systems, including but not limited to tieback or braced sheeting, tieback or braced soldier piles and lagging, slurry walls, soil nails, rock bolts, shoring, trench boxes, and sloping or benching as used to provide a Trench Excavation Safety Protective System in accordance with the Excavation Safety System Plan.

509S.10 Payment

Payment for Trench Excavation Safety Protective Systems, measured as prescribed above, will be made at unit bid price per centerline linear foot of Trench. The unit bid price shall include full compensation for designing, furnishing, installing the system; for dewatering, and for maintaining, replacing, repairing and removing the Trench Excavation Safety Protective System and for sloping, special clearing, and excavation necessary to safely implement the Excavation Safety System Plan. No payment will be made for Trench Excavation Safety Protective Systems made necessary by the Contractor's selection of an optional design or sequence of work that creates the need for the Trench Excavation Safety Protective System.

Payment will be made under the following:

Pay Item No. 509S-1: Trench Excavation Safety Protective Systems,
(all depths) Per Linear Foot.

END

<u>SPECIFIC</u> Cross Reference Materials	
Standard Specification Item No. 509S, "Excavation Safety Systems"	

City of Austin Standard Contract Documents

<u>Designation</u>	<u>Description</u>
Section 00020	Invitation for Bids
Section 00220	Geotechnical Data
Section 00650	Certificate of Insurance
Section 00700, Article 6.11	Safety and Protection
Section 810	Supplemental General Conditions

29 CFR, Occupational Safety and Health Administration, Part 1926 Safety and Health
Regulations for Construction, Subpart P, Excavation
Texas Health and Safety Code Title 9 Chapter 756 Subchapter C
Texas Government Code Chapter 2254

<u>RELATED</u> Cross Reference Materials	
Standard Specification Item No. 509S, "Excavation Safety Systems"	

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

<u>Designation</u>	<u>Description</u>
Item 104	Removing Concrete
Item 110	Excavation
Item 402	Trench Excavation Protection

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 130S	Borrow

Item No. 132S	Embankment
Item No. 201S	Subgrade Preparation
Item No. 402S	Controlled Low Strength Material
Item No. 501S	Jacking or Boring Pipe
Item No. 503S	Frames, Grates, Rings and Covers
Item No. 504S	Adjusting Structures
Item No. 505S	Concrete Encasement and Encasement Pipe
Item No. 506	Manholes
Item No. 507S	Bulkheads
Item No. 510	Pipe
Item No. 511S	Water Valves
Item No. 593S	Concrete Retards
Item No. 594S	Gabions and Revet Mattresses

Item No. 510
Pipe

510.1 Description

This item governs the furnishing and installing of all pipe and/or materials for constructing pipe mains, sewers, laterals, stubs, inlet leads, service connections, culverts, temporary service lines and temporary diversion lines, including all applicable Work such as excavating, bedding, jointing, backfilling materials, tests, concrete trench cap, concrete cap and encasement, etc., prescribed under this item in accordance with the provisions of the Edwards Aquifer Protection Ordinance, when applicable, and City of Austin Utility Criteria Manual, Section 5, "Working in Public Rights-of-Way". The pipe shall be of the sizes, types, class and dimensions indicated or as designated by the E/A 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, and drainage 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 are of the kind and quality that satisfies the specified functions and quality. Austin Water Utility Standard Products Lists (SPL) form a part of the Specifications. Contractors may, when appropriate, elect to use products from the SPL; however, submittal to the E/A is still required. Should the Contractor elect to use any materials from these lists, each product shall be completely and clearly identified by its corresponding SPL number when making the product submittal. This will expedite the review process in which the E/A, and, if necessary, the Austin Water Utility Standard Products Committee, decides whether the products meet the Contract requirements and the specific use foreseen by the E/A in the design of this engineered Project. The purpose of the SPL's is to expedite review, by the E/A and, if necessary, the Austin Water Utility Standard Products Committee, of Contractor product submittals. The SPL's shall not be considered as being a pre-approved list of products necessarily meeting the requirements of the Project. Items contained in the SPL cannot be substituted for items shown on the Drawings, or called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the E/A in conjunction with the Austin Water Utility Standard Products Committee. The Standard Product List current at the time of plan approval will govern.

(1) Concrete

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

(2) Coarse Aggregate

Coarse aggregate shall conform to Item No. 403S, "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:

SIEVE SIZE	% RETAINED BY WEIGHT
1-1/2"	0
1"	0-10
1/2"	40-85
#4	90-100
#8	95-100

(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. 210S, "Flexible Base".

(3) Fine Aggregate

(a) Concrete and Mortar Sand

Fine aggregate shall conform to Item No. 403S, "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:

GRADATION TABLE	
SIEVE SIZE	% RETAINED BY WEIGHT
1/4"	0
#60	75-100
#100	95-100

(c) Stone Screenings

Stone screenings shall be free of mud, clay, vegetation or other debris, and shall conform to the following Table:

SIEVE SIZE	% PASSING
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

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 402S, "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:

SIEVE SIZE	% RETAINED BY WEIGHT
3/4"	0
1/2"	0-25
1/4"	90-100

(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 E/A.

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 E/A, all 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 E/A.

(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 be in accordance with Austin Water Utility's Standard Products List SPL WW-534 and shall have a corrosion resistant interior lining acceptable to the Owner.

All water pipe within utility easements on private property shall be Ductile Iron Pipe, Pressure Class 350 minimum for pipe 12-inch size and smaller and Pressure Class 250 minimum for pipe greater than 12-inch size wrapped as indicated. For sizes over 24 inches, Concrete Pressure Pipe, steel cylinder type, conforming to the requirements of AWWA C-301 will be acceptable.

There may be no service connections to Concrete Pressure Pipe installed in utility easements on private property. Approved service clamps or saddles shall be used when tapping ductile iron pipe 12 inch size and smaller. All service tubing (3/4 inch thru 2 inches) installed in utility easements on private property shall be 150 psi annealed seamless Type K copper tubing with no sweat or soldered joints.

All reclaimed water mains shall be constructed of ductile iron pipe, Pressure Class 350 minimum for pipe 12-inch size and smaller and Pressure Class 250 for pipe

Manufacturers of concrete pipe and pipe larger than 24-inch diameter shall have a quality control program consisting of one or more of the following:

- All such quality control programs shall be paid for by the manufacturer. It is the intent of this requirement that the manufacturer will document all appropriate tests and inspections with sampling and inspection criteria, frequency of testing and inspection, date of testing and inspection and date on which every piece was manufactured. Required testing and inspection, including that by an independent, third party, shall be performed full-time during production of pipe for the PROJECT. When requested by the OWNER, the manufacturer will provide copies of test data and results and inspection reports with the shipment of pipe for the PROJECT. Test data and results and inspection reports shall be traceable to specific pipe lots or pieces. Owner approval of the manufacturer's quality control program will expire after three years, at which time the manufacturer must present a current quality control program for approval in order to retain listing on the applicable SPL. Owner approval of the Concrete Pipe manufacturer's quality control program will expire after three years, at which time the manufacturer must present a current quality control program for approval.

Pipe

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. All water pipe and related products shall be registered by the National Sanitation Foundation as having been certified to meet NSF/ANSI Standard 61.

(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 Austin 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 Austin Water Utility 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 potable or reclaimed 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 indicated on Austin Water Utility's Standard Products List SPL WW-534. 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 E/A, 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 map).
- 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 of all iron potable/reclaimed 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 Owner. 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

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.

5 Warning Tape

Warning tape for identifying restrained joint pipe and fittings shall be yellow and shall have black lettering at least 2 inches high that reads "Restrained Joint / Junta de Restriccion" at intervals not exceeding 24 inches. The warning tape shall be polypropylene having a minimum thickness of 2 mils, a minimum width of 3 inches, and adhesive backing on the side opposite the lettering.

(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 O-ring joint design. Wastewater pipe shall be of the O-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 installing storm sewers (or storm drains), the Contractor shall have the option of using joints with preformed flexible joint sealants or with rubber gaskets. Preformed flexible joint sealants for storm drain joints shall comply with ASTM C990, and rubber gaskets for storm drain joints shall comply with ASTM C 1619. Mortar shall not be used to seal pre-fabricated joints. Pipe manufacturer shall be responsible for submitting to the Owner a detailed design of the joint upon request. The pipe manufacturer shall be responsible for submitting to the Owner a complete list of joint sizes showing the minimum size of material to be used with each size joint, along with complete instructions on recommended installation procedures. Quality control testing at the

manufacturing plant shall be in accordance with Texas Department of Transportation (TxDOT) Departmental Materials Specifications (DMS) 7310, "Reinforced Concrete Pipe And Machine-Made Precast Concrete Box Culvert Fabrication And Plant Qualification". The pipe manufacturer shall be verified as compliant with TxDOT DMS 7310 at time of pipe delivery to the jobsite.

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:

Composition (% by weight)	Test Method	Typical Analysis
Bitumen (petroleum plastic content)	ASTM D 4	50-70
Ash-inert Mineral Water	Tex-526-C	30-50
Volatile Matter (at 325 F)	Tex-506-C	2.0 Maximum

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:

Property	Test Method	Typical Analysis	
		Minimum	Maximum
Specific Gravity at 77 F	ASTM D 71	1.20	1.35
Ductility at 77F (cm) Minimum	Tex-503-C	5.0	
Softening point	Tex-505-C	275 F	
Penetration:			
32 F (300 g) 60 sec	Tex-502-C	75	
77 F (150 g) 5 sec	Tex-502-C	50	120
115 F (150 g) 5 sec	Tex-502-C		150
Flashpoint C.O.C. F	Tex-504-C	600 F	
Fire Point C.O.C. F	Tex-504-C	625 F	

When constructing wastewater lines, the Contractor shall use O-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 cutting on a bias one or both pipes as may be required for the alignment indicated. The pipe cut shall be sufficiently long to allow exposing the reinforcement, which shall be bent, welded and incorporated into the pipe bend and reinforced concrete collar to maintain the structural integrity. The collar shall be 6 inches minimum, reinforced with #4 bars on a 1 foot center both directions. Builder's hardware cloth may be used on the outside of the joint to aid in holding cementing materials in place. Plywood, fiberboard or other materials placed on the inside of the pipe as formwork shall be removed as soon as the joint materials have obtained initial set, after which the inside surface of the pipe joint shall be finished smooth and true to the line and grade established. The Contractor may

use prefabricated bends meeting the specification requirements in lieu of field fabricated bends. 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 E/A'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 E/A 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 and 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 150, 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) Reserved

(f) Polyethylene Tubing

1. General

All polyethylene (PE) tubing shall be high density, high molecular weight plastic tubing meeting ASTM D 2737; it shall be pressure rated at 200 psi working pressure and must bear the National Sanitation Foundation seal of approval for potable water service. Pipe manufacturers shall be listed on SPL WW-65.

2. Materials

Polyethylene plastics shall be Designation PE3408 (Grade P34 with hydrostatic design stress of 800 psi).

3. 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.

Dimension Ratio (DR) 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.

Polyethylene tubing for reclaimed service lines shall be purple.

4. Tube Size

PE tubing shall be standard copper tube size outside diameter, with Standard Dimension Ratio (SDR) of 9.

(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. Copper tubing for reclaimed water shall be wrapped in purple polyethylene film wrap. Pipe manufacturers shall be listed on SPL WW-613.

(h) Service Connection Fittings

All fittings used in customer service connection - tapping mains, connecting meters, etc. - must be currently listed on the applicable Water and Wastewater Standard Products List (SPL WW-68), or called for in the City of Austin Standard Details (520 - series).

(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 Austin Standards, Austin Water Utility Standard Products Lists, and AWWA C-800, except as herein modified or supplemented.

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 compression fittings. Compression connections 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 Potable/Reclaimed Water Pipe

1. General

All polyvinyl chloride (PVC) potable/reclaimed 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 E/A.

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.

All pipe 4 inches and larger must be approved 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 certified, 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

PVC for reclaimed piping shall be purple or wrapped in purple polyethylene film wrap.

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

Inductive Tracer Detection Tape shall be placed directly above the centerline of all non-metallic pipe a minimum of 12 inches below

subgrade or, in areas outside the limits of pavement, a minimum of 18 inches below finished grade. The tracer tape shall be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Except for minimum depth of cover, the tracer tape shall be placed according to manufacturer's recommendations. Manufacturers must be listed on SPL WW-597.

(I) Polyvinyl Chloride (PVC) Pipe (Nonpressure) and Fittings

1. General

PVC sewer and wastewater pipe and fittings 6 through 15 inch diameter shall conform to ASTM D 3034. Pipe shall have minimum cell classification of 12364 or 12454. Fittings shall have cell classification of 12454 or 13343. Pipe stiffness shall be at least 115 psi as determined by ASTM D 2412. Pipe manufacturers shall be on SPL WW-227, and fitting manufacturers shall be on SPL WW-227B.

PVC sewer and wastewater pipe and fittings 18 through 27 inch diameter shall conform to ASTM F 679. Pipe shall have minimum cell classification of 12364 or 12454. Pipe stiffness shall be at least 72 psi as determined by ASTM D 2412. Pipe manufacturers shall be on SPL WW-227A, and fitting manufacturers shall be on SPL WW-227B.

2. Joints

PVC pipe and fitting shall have elastomeric gasket joints conforming to ASTM D 3212. Gaskets shall conform to ASTM F 477.

3. Pipe Markings

Pipe meeting ASTM D 3034 shall have permanent marking on the pipe that includes the following at intervals of not more than 5 feet:

Manufacturer's name and/or trademark and code.

Nominal pipe size.

PVC cell classification per ASTM D 1784

The legend "SDR-__ PVC Sewer Pipe" (SDR 26, 23.5. or less is required)

The designation "ASTM D 3034"

Pipe meeting ASTM F 679 shall have permanent marking that includes the following at intervals of not more than 5 feet:

Manufacturer's name or trademark and code

Nominal pipe size

PVC cell classification per ASTM D 1784

Pipe stiffness designation "PS _ _ PVC Sewer Pipe" (PS of at least 72 is required)

The designation "ASTM F 679"

4. Fitting Markings

Fittings meeting ASTM D 3034 shall have permanent marking that includes the following:

Manufacturer's name or trademark,

Nominal size

The material designation "PVC"

The designation, "ASTM D 3034"

Fittings meeting ASTM F 679 shall have permanent marking that includes the following:

Manufacturer's name or trademark and code

Nominal size

The material designation "PVC"

The designation "ASTM F 679"

5. Tracer Tape

Inductive Tracer Detection Tape shall be placed directly above the centerline of all non-metallic pipe a minimum of 12 inches below subgrade or, in areas outside the limits of pavement, a minimum of 18 inches below finished grade. The tracer tape shall be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Except for minimum depth of cover, the tracer tape shall be placed according to manufacturer's recommendations. Manufacturers must be listed on SPL WW-597.

(m) Steel Pipe

1. Standard Weight

ASTM A 53, Schedule 40.

2. Extra Heavy Weight

Seamless ASTM A 53, Schedule 80.

3. Encasement Pipe

- a. For direct-bury installations, pipe shall conform to ASTM A134 with minimum thickness of 3/8 inch (9.5 mm).
- b. For jacked installations, pipe shall conform to requirements on drawings.

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

1. General Reference Standards Specification.

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

c. Product data to show compliance of all couplings, supports, fittings, coatings and related items.

a. The internal design pressure of all steel pipe and fittings shall be as indicated.

a. Description

(2) Diameter

b. Wall Thickness

a. Welded

- 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. Potable water only shall be used in the preparation of any cement, mortar, or grout lining.
- 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.

(o) 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 gauges 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

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 indications. 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 quality of work 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 E/A, 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.

(9) Geotextile Filter Fabric for Pipe Bedding Material

Geotextile filter fabric for pipe bedding material shall be Hanes Geo Components - TerraTex NO4.5 (AOS US Standard Sieve 70) geotextile fabric or approved equal.

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 as set forth in "General Conditions". Clearing the site shall conform to Item No. 102S, "Clearing and Grubbing". Maintenance of environmental quality protection shall comply with all requirements of "General Conditions" and Item No. 601S, "Salvaging and Placing Topsoil".

The Contractor shall 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's operations damage the utilities in place, 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 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 City 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 E/A 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 pipe line 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 E/A 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, and at the expense of, the Contractor and as approved by the E/A.

Where traffic must cross open trenches, the Contractor shall provide suitable bridges in conformance with Standard 804S-4. 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 E/A. When such conditions delay the Work, an extension of time for working day contracts will be allowed in accordance with "General Conditions".

(2) Water Line/New Wastewater Line Separation

Separation between water, reclaimed water, and wastewater lines shall be provided as shown in the Drawings.

Crossings of water, reclaimed water, and wastewater lines shall conform to details in the Drawings.

Wastewater manholes within 9 feet of water and reclaimed water lines shall be made watertight according to details in the Drawings.

(3) Utility and Storm Sewer Crossings

When the Contractor installs a pipe that crosses under a utility or storm sewer structure and the top of the pipe is within 18 inches of the bottom of the structure, the pipe shall be backfilled as shown in the Drawings. When the Contractor installs a pipe that crosses under a utility or storm sewer structure that is not shown in the Drawings, the pipe shall be backfilled as directed by the Engineer. Payment for backfilling pipe at utility or storm sewer structures not shown in the Drawings shall be by Change Order.

(4) Trench Excavation

Excavation in a paved street shall be preceded by saw cutting completely through any asphaltic cement concrete or portland cement concrete surface, base, or subbase to the underlying subgrade. This requirement shall not apply to excavations made with trenching machines that use a rotating continuous belt or chain for cutting and removing of material.

Underground piped utilities shall be constructed in an open cut in accordance with Federal regulations, applicable State Statutes conforming to Item No. 509S, "Excavation 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 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 included in the unit price bid for pipe.

(5) Trench Width

Trenches for water, reclaimed, 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 not to exceed 18 inches on each side beyond the outside surfaces of the pipe.

If the trench width within the pipe zone exceeds this maximum, 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 fill 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, subgrade for staged construction, street or other permanent surface to the top or uppermost projection of the pipe.

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

1. Potable/reclaimed water piping installed in undisturbed ground in easements of undeveloped areas, which are not within existing or planned streets, roads or other traffic areas shall be laid with at least 36 inches of cover.
2. Potable/reclaimed 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 E/A, installation of potable/reclaimed water piping in proposed new streets 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 36 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 natural ground in easements or other undeveloped areas, which are not within existing or planned streets, roads or other traffic areas shall be laid with at least 42 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 such proposed streets 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, so 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.

the Engineer for review. Prior to start of construction on the Project, the Engineer will send a reviewed final laying schedule marked for construction to the Contractor. 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 E/A. 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 E/A 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 at least 6 inches (150 mm) below the pipe and to a depth of the springline of storm water pipe and at least 12 inches (300 mm) above water, reclaimed, and wastewater pipe.

Standard Bedding Materials

USE / PIPE MATERIAL	Cement Stabilized Backfill	Natural or Mf'd Sand	Pea Gravel	PIPE BEDDING STONE			
				Uncrushed Gravel	Crushed Gravel	Crushed Stone	Stone Screenings
WATER and RECLAIMED WATER							
Welded Steel	X					X	
Service Tubing 3/4" to 2-1/2"		X	X				X
WATER and RECLAIMED WATER (Ductile Iron)							
Up to 15 Inch ID		X	X	X			X
Larger Than 15 Inch ID			X	X			
WATER and RECLAIMED WATER (PVC only) and WASTEWATER							
Up to 15 Inch ID		X	X	X	X	X	X
Larger Than 15 Inch ID			X	X	X	X	
STORMWATER							

Concrete		X	X	X	X	X	X
Metal		X	X	X			X

(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 E/A 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 E/A, 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. 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. each 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 E/A.
4. Sand, alone, shall not be used for installation of concrete storm water pipe unless the bedding envelope is wrapped with a geotextile membrane and the joints of the stormdrain conduit are wrapped to

prevent the migration of fines into the bedding envelope and into the stormdrain conduit

5. For concrete storm water pipe, if pea gravel, uncrushed gravel, crushed gravel, crushed stone, or combination thereof is used for pipe bedding material, a geotextile filter fabric shall be placed around the perimeter of the joint

(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 E/A. Joints, which have been placed, but not joined, backfilled, etc., shall be protected in a manner satisfactory to the E/A.

(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.

(e) Storm Drain Joints

Storm drain joints sealed with preformed flexible joint sealants shall be provided and installed in compliance with ASTM C990. Storm drain joints sealed with rubber gaskets shall comply with ASTM C443. Install joint sealants in accordance with the pipe and joint sealant manufacturers' recommendations. Place the joint sealer so that no dirt or other deleterious materials come in contact with the joint sealing material. Pull or push home the pipe with enough force to properly seal the joint with the final joint opening (gap) on the inside of the installed pipe being less than or equal to the pipe manufacturer's recommended dimensions. Protrusion of joint material greater than 1/8" into the interior of the pipe will not be accepted. Excess joint material will be removed to within 1/8" of pipe surface. Observe joint sealant manufacturer's recommendations for installation temperature of the joint sealant. Apply joint sealant to pipe joint immediately before placing pipe in trench, and then connect pipe to previously laid pipe.

If inspection (video or other means) reveal C-990 joints that show signs of backfill infiltration, or where joints or conduits exhibit excessive joint gap or are otherwise defective, then the contractor has the following options:

1. Conduits less than 36-inches in any dimension: pour a concrete collar around the joint or wrap joint with a wrap meeting requirements of ASTM C-877 or approved equal
2. Conduits greater than or equal to 36-inches in all dimensions: repair joints using joint repair techniques recommended by the manufacturer to achieve a completed system that meets all Contract requirements.

(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. Potable water shall be used in the preparation of any cement, mortar, or grout lining.

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 E/A. 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 E/A 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

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 Owner 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 exceeding 22-1/2 degrees; 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 E/A. 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

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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. Manufacturers of pipe with restrained joints integral to the pipe shall be listed on SPL WW-27F. All pipe and fitting systems with restrained joints shall be identified by applying an adhesive-backed warning tape to the top of the pipe and for the full length of the pipe, regardless of the type of pipe. For plastic pipes the warning tape shall be applied directly to the top of the pipe. For metal pipes and fittings the warning tape shall be applied to the top of the polyethylene film wrap. The warning tape shall conform to 510.2(8)(b)5.

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 E/A. E/A 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 within 6 inches of pipe joints. Concrete cap, cradle and encasement shall conform to City of Austin Standard No. 510S-1, "Concrete Trench Cap". 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 E/A, 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 wye, 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 E/A'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 E/A, 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 E/A. 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 E/A 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.

(c) Connecting Existing Services to New Mains

Where wastewater services currently exist and are being replaced from the main to the property line, those services shall be physically located at the property line prior to installing any new mains into which the services will be connected. Where wastewater services currently exist but are not being replaced to the property line, those services shall be physically located at the point of connection between the new and existing pipes prior to installing any new mains into which the services will be connected.

(24) Potable or Reclaimed Water System Connections

All necessary connections of new piping or accessories to the existing potable or reclaimed water system shall be made by, and at the expense of, the Contractor. To minimize any inconvenience from outages, the Contractor shall schedule all such connections in advance and such schedule must be approved by the E/A before beginning any Work.

(a) Shutoffs

The City will make all shutoffs on existing potable or reclaimed water mains. The Contractor shall be required to notify the E/A's field representative on the job at least 72 hours prior to the desired time for any shutoff. The E/A's field representative will notify any affected utility customers at least 48 hours prior to the shutoff. The Water Utility will make the shutoff after ensuring that all appropriate measures have been taken to protect the potable or reclaimed 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 potable or reclaimed system, 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 E/A's field 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 Potable or Reclaimed 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 potable or reclaimed 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 Potable or Reclaimed 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 potable or reclaimed 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 the Contractor's 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, an Austin Water Utility 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 E/A. Direct tapping of these pipes will not be permitted.

All potable or reclaimed 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 E/A, 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 E/A 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 E/A 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 E/A. 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 E/A 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 following 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 E/A.

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.

(h) Temporary Trench Repair/Surfacing

If details of temporary trench repair/surfacing are not provided in the contract documents, the Contractor shall submit for approval of the E/A (1) a plan for temporary trench repair for areas that will be open to traffic but will be excavated later for full depth repair, and (2) a proposed method for covering trenches to maintain access to properties. The temporary surfacing shall afford a smooth riding surface and shall be maintained by the Contractor the entire time the temporary surface is in place.

(i) Permanent Trench Repair

The Contractor shall install permanent trench repairs conforming to details in the drawings.

(26) Quality Testing for Installed Pipe

(a) Wastewater Pipe Acceptance Testing

After wastewater pipe has been backfilled, the Contractor shall perform infiltration tests, exfiltration tests, or low pressure air tests as determined by the E/A. In addition, the Contractor shall perform deflection tests and shall assist OWNER'S personnel, as directed, in performing pipeline settlement tests. The Contractor shall be responsible for making appropriate repairs to those element that do not pass any of these tests.

(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.

Exfiltration testing shall be performed by the Contractor when determined by the E/A to be the appropriate test method. Exfiltration testing shall conform to requirements of the Texas Commission on Environmental Quality given in the Texas Administrative Code Title 30 Part 1 Chapter 317 Rule §317.2.

(c) Infiltration Test

Infiltration testing shall be performed by the Contractor when determined by the E/A to be the appropriate test method. Infiltration testing shall conform to

requirements of the Texas Commission on Environmental Quality given in the Texas Administrative Code Title 30 Part 1 Chapter 317 Rule §317.2.

(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 Gravity Flow Wastewater Lines

1. General

Wastewater lines up to 24-inch diameter shall be air tested between manholes. Wastewater lines 30-inch in diameter shall be air tested between manholes or at pipe joints. Wastewater lines 36-inch diameter and larger shall be air tested at joints. 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 E/A 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 backpressure of any ground water 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 3.5 psig greater than the average backpressure 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.

For pipe less than 36-inch diameter, compare the time recorded with the time computed using the following equation:

$$T = (0.0850 \times D \times K) \div Q, \text{ where}$$

T = time for pressure to drop 1.0 pounds per square inch gauge in seconds;

$$K = 0.000419 \times D \times L, \text{ but not less than 1.0}$$

D = nominal inside diameter, in inches, as marked on the pipe;

L = length of line of same pipe size in feet; and

Q = rate of loss, 0.0015 cubic feet per minute per square foot of internal surface area (ft³/min/ft sq) shall be used.

Because a K value of less than 1.0 shall not be used, there are minimum test times for each pipe diameter as shown in the following table:

Table For Low Pressure Air Testing of Pipe

Pipe Diameter (inches)	Minimum Time (seconds)	Minimum Time applies to All Pipes Shorter than (feet)	Time for Longer Pipes (seconds)
8	454	298	1.520 × L
10 (See Note 1)	567	239	2.374 × L
12	680	199	3.419 × L
15	850	159	5.342 × L
18	1020	133	7.693 × L
21	1190	114	10.471 × L
24	1360	100	13.676 × L
30	1700	80	21.369 × L

Note 1. 10 inch diameter pipe to be used only by Austin Water Utility maintenance personnel.

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 equation or 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.

Lines that are 36 inches or larger inside diameter must be air tested at each joint. Lines that are 30-inch 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. A drop in pressure from 3.5 psig to 2.5 psig (adjusted for groundwater level) in less than twenty seconds shall be cause for rejection.

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. 506S, "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 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 sized at 95% of the inside diameter of the pipe, shall be conducted by the Contractor 30 days before the warranty expires on the Contractor's Work.

Contractor shall submit proposed pipe mandrels to the E/A or the E/A's designated representative for concurrence prior to testing the line.

Test(s) must be performed without mechanical pulling devices and must be witnessed by the E/A or the E/A's designated representative.

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

(g) Inspection of Installed Storm Drain Conduits

1. General

All storm drain conduits (pipe and box culvert) shall be inspected for conformance to the requirements of this specification. Smart Housing,

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low/moderate income housing, and projects that are 100-percent privately funded are exempt from the cost of the initial video inspection. All deficiencies revealed by inspection shall be corrected. Video re-inspection meeting the requirements of this specification shall be provided at the Contractor's expense to show that deficiencies have been corrected satisfactorily. Further, the contractor shall provide video in complete segments (manhole to manhole) versus specific deficiency locations.

Projects that are not exempt from the cost of the initial video inspection are also subject to the following constraints:

- All inspectors utilized by the Contractor for video inspection shall be NASSCO-PACP certified for a minimum of 3 years.
- The Contractor will be required to inspect, assess, and record the condition of the storm drain pipe using National Association of Sewer Service Companies (NASSCOs) Pipeline Assessment Certification Program (PACP) coding standards.

2. Video Inspection of Installed Storm Drain Conduits

Contractor shall provide all labor, equipment, material and supplies and perform all operations required to conduct internal closed-circuit television and video recording of all storm drain conduits. Video recording of each storm drain conduit section shall be conducted after the trench has been backfilled and prior to placement of permanent pavement repairs or permanent pavement reconstruction. The video recording shall be provided to the Owner for review. Contractor shall not place permanent pavement repairs or permanent pavement reconstruction over the storm drain conduit until Owner has reviewed the video and agrees that there are no defects in the storm drain conduit installation shown in the video submitted by the Contractor or shown in any video acquired by the Owner through other means. Placement of permanent pavement repair or permanent pavement reconstruction over the installed storm drain conduit before the Owner acknowledges no defects shall be at the Contractor's risk. Any defects revealed by the video inspection shall be corrected at the Contractor's expense and a new video submitted to the Owner for review prior to acceptance of the conduit.

All video work shall be conducted under the direct full-time supervision of a NASSCO-PACP certified operator.

The conduit inspection camera shall have the capability of panning plus/minus 275 degrees and rotating 360 degrees. The television camera shall be specifically designed and constructed for such use. The camera shall be operative in 100% humidity conditions. Camera shall have an accurate footage counter that displays on the monitor the exact distance of the camera (to the nearest tenth of a foot) from the centerline of the starting manhole or access point. Camera shall have height adjustment so that the camera lens is always centered within plus/minus 10% of the center axis of the conduit being videoed. Camera shall provide a minimum of 460 lines of horizontal

resolution and 400 lines of vertical resolution. Camera shall be equipped with a remote iris to control the illumination range for an acceptable picture. Geometrical distortion of the image shall not exceed one percent (1%). The video image produced by each camera shall be calibrated using a Marconi Resolution Chart No. 1 or equivalent.

Lighting for the camera shall be sufficient to allow a clear picture of the entire periphery of the conduit without loss of contrast, flare out of picture or shadowing. A reflector in front of the camera may be required to enhance lighting in dark or large sized conduit. The video camera shall be capable of showing on the digital display the Owner's name, Project name, Contractor name, date, line size and material, conduit identification, and ongoing footage counter. The camera, television monitor, and other components of the video system shall be capable of producing a picture quality satisfactory to the satisfaction of the Owner. The recording of the internal condition of the storm drain conduit shall be clear, accurate, focused and in color. If the recording fails to meet these requirements, the equipment shall be removed and replaced with equipment that is suitable. No payment will be made for an unsatisfactory recording.

If during video inspection, water is encountered inside the conduit, the conduit shall be dewatered by the Contractor. The storm drain section must be dry. Video recording conducted while the camera is floating is not acceptable unless approved by the Owner.

If during video inspection, debris is encountered that prohibits a proper inspection of the conduit, the Contractor shall remove the debris before proceeding.

All video shall be documented using a data logger and reporting system that are PACP compliant and which use codes as established by the National Association of Sewer Service Companies (NASSCO)s - Pipeline Assessment and Certification Program (PACP).

Computer printed location records shall be kept by the Contractor and shall clearly show the location and orientation of all points of significance such as joints, conduit connections, connections at manholes and inlets, and defects. Copy of all records shall be supplied to the Owner. Noted defects shall be documented as color digital files and color hard copy print-outs. Photo logs shall accompany each photo submitted.

The video recording shall supply a visual and audio record of the storm drain conduits that may be replayed. Video recordings shall include an audio track recorded by the video technician during the actual video work describing the parameters of the storm drain conduit being videoed (i.e. location, depth, diameter, pipe material), as well as describing connections, defects and unusual conditions observed during the video work. Video recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. Once

- A. National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) certification of operators who will be performing video work.
- B. Compact Disc (CD) or Digital Video Disc (DVD) of recording of storm drain conduits (concrete storm water pipe or box culvert).
 - a. The color CD or DVD shall include a digital color key map in a format acceptable to the Owner with each segment of storm

drain conduit labeled with the appropriate inspection ID on the map.

- b. The file folder for each segment of the storm drain conduit shall have a unique name based on the Owner's approved inspection naming convention and shall contain the following:
 - i. Video files
 - ii. Video inspection logs with information coded in accordance with the PACP
 - iii. Photo logs
 - iv. A report summarizing the results of the video inspection
 - v. A proposed method of repair for any defects discovered.

3. Time commitments from City for projects that are exempt from the cost of the initial video inspection

Projects that are exempt from the cost of the initial video inspection are afforded the following time commitments from the City.

- A. Initial inspection – contractor must inform the City of Austin construction inspector assigned to the project in writing that all stormdrain infrastructure for the project has been completed according to the permit and is ready for inspection. The inspector will then notify the Watershed Protection Department (WPD) in writing that the all of the stormdrain infrastructure for the project has been completed and is ready for inspection. The WPD is allowed 15-days to complete inspection from written notification by the inspector. The outcome of this item does not impact the one-year warranty requirements.
- B. Video re-inspection by the contractor for deficient installed stormdrain infrastructure. The contractor must submit the video inspection data as defined in this specification to the City of Austin construction inspector assigned to the project along with a written letter of transmittal certified by a professional engineer stating that all identified stormdrain infrastructure installation deficiencies for the project have been corrected. The inspector will then notify the Watershed Protection Department (WPD) in writing and convey the video inspection data to the WPD. The WPD is allowed 15-days to complete review of the data from the date of delivery by the inspector.

(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 and the hydrant valve seats closed and nozzle caps removed, shall be included in the test.

(a) Pressure Test

The entire project or each valved section shall be tested, at a constant pressure of 200 psi for a sufficient period (approximately 10 minutes) to discover defective materials or substandard work. The Contractor assumes all risks associated with testing against valves. Repairs shall be made by the Contractor to correct any defective materials or substandard work. The Contractor shall pre-test new lines before requesting pressure tests by City Forces. The Contractor shall have new lines pressurized to a minimum of 100 psi, on the date of testing, prior to arrival of City Forces.

(b) Leakage Test

A leakage test will follow the pressure test and will be conducted on the entire project or each valved section. The Contractor assumes all risks associated with testing against valves. The leakage test shall be conducted at 150 psi for at least 2 hours. The test pressure shall not vary by more than ± 5 psi for the duration of the test.

(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 after the air in the pipeline has been expelled and the pipe has been filled with water.

No pipe installation will be accepted if leakage exceeds the amount given by the following formula:

$$\text{Allowable leakage (gal / hr)} = [L \times D] \div 10,875$$

Where L = length of pipe tested, in feet

D = nominal pipe diameter, in inches, as marked on the pipe

(2) Location and Correction of Leakage

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

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All visible leakage in pipe shall also be corrected by Contractor at the Contractor's 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 Austin. 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 staffed 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 Austin Water Utility. 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 Austin Water 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 gooseneck assembly. After samples have been collected, the gooseneck 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 Austin Water Quality Laboratory will notify the assigned City of Austin 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 E/A 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 shall become the property of the Contractor for disposal at the Contractor's 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. The backfill placed at that time shall meet all compaction test requirements. The Contractor 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.

Placement of the final lift of permanent pavement, if a pavement is required, 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, reclaimed, and wastewater lines will be measured along pipe horizontal centerline stationing through fittings, valves, manholes, and other appurtenances.

Ductile iron fittings, whether standard mechanical joint or integral factory restrained joint type, will be measured by the ton and paid for in accordance with the schedule in Standard Products List WW-27C. Bolts, glands and gaskets will not be measured for

payment. Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be measured separately and are included in the unit price for the respective pipe bid items.

Factory restrained joint pipe meeting the requirements of Standard Products List WW-27F will be measured by the linear foot. The estimated quantity on the bid form is only for restrained joint pipe having integral mechanically restrained joints.

Connecting a new water, wastewater, or reclaimed water service to an existing, comparable type of private service will be measured by each connection. Service pipe from the main to the service connection will be measured by the linear foot.

The Contractor shall be responsible for removing and treating ground water flowing into a trench up to a baseline flow rate of 350 gpm of sustained flow for each mainline open trench (no more than 300 linear feet open trench per work zone segment is allowed at one time). This baseline flow rate is not a prediction of ground water conditions to be expected on the Project. Rather, it establishes contract terms regarding the quantity of ground water for which the contractor is responsible without extra or separate compensation. The flow rate must exceed 350 gpm continuously for at least 4 consecutive hours to be considered sustained flow. It is expected that trench dewatering for this baseline rate may be accomplished with a single 3-inch trash-type pump per open trench; however, measured flow rate, not pump size, type or characteristics shall be used to determine if the baseline rate has been exceeded. Flow rate shall be determined by measurements made at the discharge point of the water treatment facilities. Surface storm water flowing into a trench shall be the Contractor's responsibility to remove and treat without compensation, regardless of inflow rate or volume.

Adjustment of elevations during construction resulting in changes in flow line elevations of plus or minus two feet or less will not be considered for credit or additional compensation and no measurement for payment will be made.

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.

Video inspection of newly installed box culverts and storm drain pipe will be measured per linear foot of pipe videoed.

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.

No separate payment will be made for dewatering a trench with ground water inflow of less than the baseline rate of 350 gpm of sustained flow as described above. Dewatering of those trenches shall be included in the contract unit price of the Pipe pay item. Payment for dewatering a trench with ground water inflow exceeding 350 gpm of sustained flow shall be agreed by change order. Dewatering of bore pits shall be included in the contract unit price for Bore Entry Pit or Exit Pit regardless of inflow rate or volume unless specified otherwise in the bid item for Bore Entry Pit or Exit Pit.

(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. Restrained joint pipe meeting the requirements of Standard Products List WW-27F will be paid for separately at the unit price bid per linear foot. Unless otherwise provided herein, as separate pay item(s), 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

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 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.

pipe joint restraint devices, where specified or allowed, meeting Standard Products Lists WW-27A or WW-27G .

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 including in the unit price bid for 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. 593S, "Concrete Retards".

(4) Boring or Jacking

When called for in the Bid, boring or jacking will be paid under Item 501S, "Jacking or Boring Pipe".

(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

Ductile iron fittings, furnished in accordance with these specifications, will be paid for at the unit price bid per ton, complete in place, according to the schedule of weights in Standard Products List WW-27C. Bolts, glands, and gaskets will not be paid for separately and shall be included in the contract unit price for fittings.

(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. 505S, "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) Excavation Safety Systems

When called for in Bid, Trench Safety Systems shall conform to Item No. 509S, "Excavation Safety Systems".

(12) Connecting a New Water, Wastewater, or Reclaimed Water Service to an existing, comparable type of private service will be paid for at the unit price bid, complete in place, according to the size of new service and size of existing private service, and shall be full payment for furnishing and installing all necessary materials, such as cleanouts, pipe, couplings, and fittings, and including excavation and backfill.

(13) Video Inspection

Video Inspection of Newly Installed Box Culverts and Storm Drain Pipe will be paid for at the unit price bid per linear foot and shall be full payment for all labor, equipment, and materials required for video inspection per this specification, including all submittals of CD/DVD as required.

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

Pay Item No. 510-AR ___Dia.	Pipe, ___Dia. _____Type (all depths), including Excavation and Backfill	Per Linear Foot.
Pay Item No. 510-ARRJ- ___Dia.:	Factory Restrained Joint Pipe, ___Dia. Class____ Ductile Iron, (all depths) including Excavation and Backfill	Per Linear Foot.
Pay Item No. 510-BR ___x___Dia.:	Connecting New____Service to Existing Private Service (____Dia. New Service to ___Dia. Private Service)	Per Each.
Pay Item No. 510 - CR:	Pipe Excavation, ___Ft. Width	Per Linear Foot.
Pay Item No. 510 - DR:	Pipe Trench Backfill, ___Ft. Width	Per Linear Foot.
Pay Item No. 510 - ER:	Concrete Seal or Cradle, ___Dia. Pipe	Per Linear Foot.
Pay Item No. 510 - FR:	Concrete Trench Cap, ___Ft. Width	Per Linear Foot.
Pay Item No. 510 - GR:	Concrete Cap and Encasement, ___Dia. Pipe	Per Linear Foot.
Pay Item No. 510 - HR:	Cement Stabilized Backfill, ___Dia. Pipe	Per Linear Foot.
Pay Item No. 510 - IR ___x___Dia.:	Pressure Taps, ___ Dia. X ___ Dia.	Per Each.
Pay Item No. 510 - JR ___x___Dia.:	Wet Connections, ___ Dia. x ___ Dia.	Per Each.
Pay Item No. 510 - KR:	Ductile Iron Fittings	Per Ton.
Pay Item No. 510-ASD ___Dia.:	Pipe, ___Dia. Type (all depths), including Excavation and Backfill	Per Linear Foot.
Pay Item No. 510-CSD:	Pipe Excavation, ___Ft. Width	Per Linear Foot.
Pay Item No. 510-DSD:	Pipe Trench Backfill, ___Ft. Width	Per Linear Foot.
Pay Item No. 510-ESD:	Concrete Seal or Cradle, ___Dia. Pipe	Per Linear Foot.
Pay Item No. 510-FSD:	Concrete Trench Cap, ___Ft. Width	Per Linear Foot.

Pay Item No. 510-GSD	Concrete Cap and Encasement, __Dia. Pipe	Per Linear Foot.
Pay Item No. 510-HSD:	Cement Stabilized Backfill, ____Dia. Pipe	Per Linear Foot.
Pay Item No. 510-AW__Dia.:	Pipe, __Dia. Type (all depths), including Excavation and Backfill	Per Linear Foot.
Pay Item No. 510-AWRJ__Dia.:	Factory Restrained Joint Pipe, __Dia., Class____ Ductile Iron, (all depths) including Excavation and Backfill	Per Linear Foot.
Pay Item No. 510-BW__x__Dia.:	Connecting New____ Service to Existing Private Service (____Dia. New Service to ____Dia. Private Service)	Per Each.
Pay Item No. 510-CW:	Pipe Excavation, ____Ft. Width	Per Linear Foot.
Pay Item No. 510-DW:	Pipe Trench Backfill, ____Ft. Width	Per Linear Foot.
Pay Item No. 510-EW:	Concrete Seal or Cradle, ____Dia. Pipe	Per Linear Foot.
Pay Item No. 510-FW:	Concrete Trench Cap, ____Ft. Width	Per Linear Foot.
Pay Item No. 510-GW:	Concrete Cap and Encasement, __Dia. Pipe	Per Linear Foot.
Pay Item No. 510-HW:	Cement Stabilized Backfill, __Dia. Pipe	Per Linear Foot.
Pay Item No. 510-IW__x__Dia.	Pressure Taps, ____ Dia. X ____ Dia.	Per Each.
Pay Item No. 510-JW__x__Dia.:	Wet Connections, ____ Dia. x ____ Dia.	Per Each.
Pay Item No. 510-KW:	Ductile Iron Fittings	Per Ton.
Pay Item No. 510-AWW__Dia.:	Pipe, __Dia. ____Type (all depths), including Excavation and Backfill	Per Linear Foot.
Pay Item No. 510-AWRJ__Dia.	Factory Restrained Joint Pipe, __Dia., Class Ductile Iron, (all depths) including Excavation and Backfill	Per Linear Foot.
Pay Item No. 510-BWW__x__Dia.:	Connecting New____ Service to Existing Private Service (____Dia. New Service to ____Dia. Private Service)	Per Each.
Pay Item No. 510-CWW:	Pipe Excavation, ____Ft. Width	Per Linear Foot.
Pay Item No. 510-	Pipe Trench Backfill, ____Ft. Width	Per Linear Foot.

DWW:

Pay Item No. 510-EWW: Concrete Seal or Cradle, ____Dia. Pipe Per Linear Foot.

Pay Item No. 510-FWW: Concrete Trench Cap, ____Ft. Width Per Linear Foot.

Pay Item No. 510-GWW: Concrete Cap and Encasement, _Dia. Pipe Per Linear Foot.

Pay Item No. 510-HWW: Cement Stabilized Backfill, ____Dia. Pipe Per Linear Foot.

Pay Item No. 510-KWW: Ductile Iron Fittings Per Ton.

Pay Item No. 510-VIDEO Video Inspection of Newly Installed Box Culverts and Storm Drain Pipe Per Linear Foot.

An "R" after the pay item indicates the use for reclaimed water.

An "SD" after the pay item indicates the use for storm drain.

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:

Standard Specifications Manual: Item Nos. Ref: 102S, 210S, 402S, 403S, 501S, 505S, 506, 507S, 509S, 593S, 601S, 604S

Standards Manual: Standard Detail Nos. 510S-1, (520 - series).

Design Criteria Manuals: Utilities Criteria Manual, Section 5.

Item No. 511S
Water Valves

511S.1 Description

This item shall govern the valves furnished and installed as indicated on the Drawings. Unless otherwise indicated on the Drawings, all valves 4 inches (102 mm) and larger shall be AWWA-type valves of suitable design and fully equipped for service buried in the earth, without need for further modification and shall be wrapped with 8-mil (0.2 mm) polyethylene film with all edges and laps securely taped to provide a continuous wrap. For reclaimed water piping, the polyethylene film shall be purple. Where not indicated, the Contractor may use valves with any type end-joint allowed for fittings of the pipe class being used. Unless otherwise indicated on the Drawings, all valve stems shall be adjusted to situate the operating nut not more than 24 inches (0.6 meters) below the proposed ground or paving surface of the finished project. Laydown valves shall not be used unless indicated otherwise on the Drawings by call out. Standard details shall not be an indicator of options.

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

511S.2 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is of the kind and quality that satisfies the specified functions and quality. The City of Austin Water and Wastewater Utility Standard Products Lists (SPL) are considered to form a part of these Specifications. Contractors may, when appropriate, elect to use products from the SPL; however, submittal to the Engineer/Architect (E/A) is still required. If the Contractor elects to use any materials from these lists, each product shall be completely and clearly identified by its corresponding SPL number when making the product submittal. This will expedite the review process in which the E/A, and, if necessary, the Water and Wastewater Utility Standard Products Committee, decide whether the products meet the Contract requirements and the specific use foreseen by the E/A in the design of this engineered Project.

The SPL's should not be interpreted as being a pre-approved list of products necessarily meeting the requirements for a given construction Project. Items contained in the SPL cannot be substituted for items shown on the Drawings, or called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the E/A in conjunction with the Water and Wastewater Utility Standard Products Committee. The Standard Product List current at the time of plan approval will govern.

A) Samples, Inspection and Testing Requirements:

All tests and inspections called for by the applicable standards shall be performed by the manufacturer. Upon request, results of these tests shall be made available to the purchaser.

B) Other Requirements:

Each submittal shall be accompanied by:

1) Complete data covering:

- a). the operator, including type and size, model number, etc.,
- b). the name and address of the manufacturer's nearest service facility,

- c). the number of turns to fully open or close the valve.
- 2) Detailed instructions for calibrating the limit stops for open and closed positions, and
- 3) Any other information that may be necessary to operate and maintain the operator.
- 4) Complete dimensional data and installation instructions for the valve assembly as it is to be installed, including the operator.
- 5) Complete replacement parts lists and drawings, identifying every part for both the valve and operator.

511S.3 Valves

A) Iron-Body Gate Valves

Resilient-seated gate valves for potable or reclaimed service, including tapping valves, shall conform to AWWA C-509 and Standard Products List item WW-282.

Reduced-wall, resilient-seated gate valves for potable or reclaimed service, including tapping valves, shall conform to AWWA C-515 and Standard Products List item WW-700,

Metal-seated gate valves for potable or reclaimed service, including tapping valves, shall conform to AWWA C-500 and Standard Products List item WW-132.

- 1) Stem Seals: All valves shall have approved O-ring type stem seals. At least two O-rings shall be in contact with the valve stem where it penetrates the valve body.
- 2) Operation: All valves shall have non-rising stems with a 2" (50 mm) square operating nut, or with a spoke type handwheel when so ordered, turning clockwise to close.
- 3) Gearing: Gate valves in 24 inch (610 mm) and larger sizes shall be geared and, when necessary for proper bury depth and cover, shall be the horizontal bevel-geared type enclosed in a lubricated gear case.
- 4) Bypass: Unless otherwise indicated on the Drawings, 16 inch (406 mm) and larger metal-seated gate valves shall be equipped with a bypass of the non-rising stem type which meets the same AWWA standard required for the main valve.
- 5) Valve Ends: Valve ends shall be push-on, flanged or mechanical joint, as indicated or approved.

Tapping valves shall have inlet flanges conforming to MSS SP-60, with boltholes drilled per ANSI B16.1 Class 125. Seat rings and body casting shall be over-sized as required to accommodate full size cutters; the outlet end shall be constructed and drilled to allow the drilling machine adapter to be attached directly to the valve.

- 6) Gear Case: All geared valves shall have enclosed gear cases of the extended type, attached to the valve bonnet in a manner that makes it possible to replace the stem seal without disassembly and without disturbing the gears, bearing or gear lubricant. Gear cases shall be designed and fabricated with an opening to atmosphere so that leakage past the stem seal does not enter the gear case.
- 7) Valve Body: Double disc gate valves in 16 inch (406 mm) and larger sizes installed in the horizontal position shall have bronze rollers, tracks, scrapers, etc. For reclaimed water valves, the body shall be manufactured in purple, factory painted purple, or field painted purple.

B) Butterfly Valves:

Unless otherwise indicated, all valves shall conform to the current "AWWA" Standard C-504, "Rubber-Seated Butterfly Valves", Class 150B, except as modified or supplemented herein.

1) Functional Requirements

- a). Valves shall be the short body design and shall have flanged connections on both ends unless otherwise called for.
- b). Valves shall be of such design that the valve discs will not vibrate or flutter when operated in a throttled position. Valve discs shall be secured to the shafts by means of keys or pins so arranged that the valve discs can be readily removed without damage thereto. All keys and pins used in securing valve discs to shafts shall be stainless steel or monel. Valve discs shall be stainless steel or ductile iron, ASTM A 536, Grade 65-45-12 (448-310-12); seating edge shall be stainless steel or other corrosion resistant material.
- c). Valve shafts shall be constructed of wrought stainless steel or monel. The ends of the shaft shall be permanently marked to indicate the position of the disc on the shaft.
- d). All buried valves shall have approved manufacturer's O-ring type or split V type "Chevron" shaft seals. When O-ring seals are used, there shall be at least two O-rings in contact with the valve shaft where it penetrates the valve body.

On 24 inch (635 mm) and larger valves, the seat shall be completely replaceable and/or adjustable with common hand tools without disassembling the valve from the pipeline.

Rubber seats located on the valve disc shall be mechanically secured with stainless steel retainer rings and fasteners.

- e). Unless otherwise indicated, valves shall be provided with manual operators with vertical stems and 2 inches (50 mm) square operating nut turning clockwise to close and equipped with a valve disc position indicator. All keys or pins shall be stainless steel or monel. Buried valves shall have the valve stems extended or adjusted to locate the top of the operating nut no more than 24 inches (0.6 meter) below finish grade.
- f). Unless otherwise indicated, motorized butterfly valves shall be equipped with 230/460 volt, 3-phase reversing motor operators, extended as required to locate the center line of the operator shaft approximately 4 feet to 4 feet, 6 inches (1.2 to 1.4 meters) above finish grade. Operators shall be equipped with cast iron or malleable iron manual override hand wheel with a valve position indicator, local push button controls, lighted status/position indicator, torque and travel limit switches and all switches, relays and controls (except external power and signal wiring) necessary for both local and remote operation.

2) Performance Requirements

- a). Unless otherwise indicated, valve operators shall be sized to seat, unseat, open and close the valve with 150 psi (1 megapascal) shutoff pressure differential across the disk and allow a flow velocity of 16 feet (4.9 meters) per second past the disc in either direction.
- b). Motorized valve motors shall be capable of producing at least 140 percent of the torque required to operate the valves under conditions of maximum non-shock shutoff pressure without exceeding a permissible temperature rise of 131°F over

104°F ambient (55 degrees Celsius over 40 degrees Celsius ambient); they shall have a duty rating of not less than 15 minutes and shall be capable of operating the valve through 4 1/2 cycles against full unbalanced pressure without exceeding the permissible temperature rise. Motors shall be suitable for operating the valve under maximum differential pressure when voltage to motor terminals is 80 percent of nominal voltage. Motor bearings shall be permanently lubricated and sealed.

C) Ball Valves:

Ball valves shall be brass, bronze, stainless steel or PVC as indicated on the Drawings or Details or as approved by the Engineer or designated representative.

D) Air-Vacuum Release Valves

- 1) Valves shall be combination air-release, air-vacuum units having small and large orifice units contained and operating within a single body or assembled unit.

The small orifice system shall automatically release small volumes of air while the pipe is operating under normal conditions. The large air-vacuum orifice system shall automatically exhaust large volumes of air while the pipe is being filled and shall permit immediate re-entry of air while being drained.

Valves shall be rated for at least 150 psi (1 megapascal) {maximum} normal service pressure.

- 2) Material Requirements

Valve exterior bodies and covers shall be cast iron or reinforced nylon.

Internal bushings, hinge pins, float guide and retaining screws, pins, etc., shall be stainless steel, bronze, nylon or Buna-N rubber.

Orifice seats shall be Buna-N rubber.

Floats shall be stainless steel, nylon or Buna-N rubber, rated at 1000 psi (6.9 megapascals).

Unless otherwise indicated, these valves shall be as included in the Standard Products List (SPL WW-367 for water, WW-462 for wastewater force mains).

E) Fire Hydrants

All fire hydrants shall be Dry Barrel, Traffic Model (break-away), Post Type having Compression Type Main Valves with 5 1/4" (133 mm) opening, closing with line pressure. Approved models are listed on SPL WW-3 of the Water and Wastewater Utility Standard Products List.

- 1) Applicable Specifications

AWWA C-502 current: "AWWA Standard for Dry-Barrel Fire Hydrants".

NFPA 1963: "National (American) Standard Fire Hose Coupling Screw Thread" and City of Austin 4 inch (102 mm) Fire Hose Connection Standard (Available upon request from the Austin Water Utility's Standards Committee Chairperson at 972-0204).

ANSI A-21.11 current: "American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings".

- 2) Functional Requirements

Design Working Pressure shall be 200 psi (1.38 megapascals) and a test pressure of 400 psi (2.76 megapascals).

Inlet shall be side connection hub end for mechanical joint (ANSI A-21.11-current). Shoe shall be rigidly designed to prevent breakage.

Lower Barrel shall be rigid to assure above ground break at traffic feature. Bury length of hydrant shall be four (4) feet (1.2 meters) minimum, five (5) feet (1.5 meters) maximum (hydrant lead pipe may be elbowed up from main using restrained joints; flanged joints in lead pipes are not allowed). Flange type connections between hydrant shoe, barrel sections and bonnet shall have minimum of 6 corrosion resistant bolts.

Hydrant Main Valve shall be 5 1/4 inch (133 mm) I.D. Valve stem design shall meet requirements of AWWA C502, with Operating Nut turning clockwise to close. Operating Nut shall be pentagonal, 1 1/2 inch (38 mm) point to flat at base, and 1 7/16 inches (36.5 mm) at top and 1 inch (25 mm) minimum height. Seat ring shall be bronze (bronze to bronze threading), and shall be removable with lightweight stem wrench. Valve mechanisms shall be flushed with each operation of valve; there shall be a minimum of two (2) drain ports.

Traffic Feature shall have replaceable breakaway ferrous metal stem coupling held to stem by readily removable type 302 or 304 stainless steel fastenings. Breakaway flange or frangible lugs shall be designed to assure aboveground break. Breakaway or frangible bolts will not be acceptable.

Outlet Nozzles shall be located approximately 18 inches (450 mm) above ground. Each hydrant shall have two (2) 2 1/2 inch (63.5 mm) nozzles 180 degrees apart with National (American) Standard Fire Hose Coupling Screw Thread NFPA 1963 and one (1) 4 inch (102 mm) pumper nozzle with City of Austin standard thread—six (6) threads per inch (25 mm) "Higbee" cut, 4.8590 inch (123.4 mm) O.D., 4.6425 inch (117.9 mm) root diameter. Nozzles shall be threaded or cam-locked, O-ring sealed, and shall have type 302 or 304 stainless steel locking devices. Nozzle caps (without chains) and cap gaskets shall be furnished on the hydrant. The cap nut shall have the same configuration as the operating nut.

Hydrants shall be Dry-Top Construction, factory lubricated oil or grease with the lubricant plug readily accessible. The system shall be described for City approval.

A blue Type II-B-B reflectorized pavement marker, conforming to Standard Specification Item No. 863S, shall be placed 2 to 3 feet (0.6 to 0.9 meters) offset from the centerline of paved streets, on the side of and in line with, all newly installed fire hydrants.

Hydrant shall have double O-ring seals in a bronze stem sheath housing to assure separation of lubricant from water and shall have a weather cap or seal, or both, as approved by the Owner, to provide complete weather protection.

3) Material Requirements

All below ground bolts shall be corrosion resistant. The hydrant valve shall be Neoprene, 90-durometer minimum. The seat ring, drain ring, operating nut and nozzles shall be bronze, AWWA C-502 current, containing not over 16 percent zinc. Break-away stem coupling shall be of ferrous material; its retaining pins, bolts, nuts, etc. of type 302 or 304 stainless steel.

Coatings shall be durable and applied to clean surfaces. Exterior surfaces above ground shall receive a coating of the type and color specified in the applicable version of City of Austin SPL WW-3. The coating shall be applied according to coating manufacturer's

specifications. Other exposed ferrous metal shall receive asphalt-based varnish, or approved equal, applied according to the coating manufacturer's specifications.

F) Pressure/Flow Control Valves:

All control valves to regulate pressure, flow, etc., in City lines shall be models listed in the City of Austin Water and Wastewater Standard Products List (SPL).

G) Drain Valves:

Drain valve materials and installation shall conform to City of Austin Standard Detail No. 511S-9A.

H) Valve Stem Extensions:

Valve stem extensions shall consist of a single piece of the required length with a socket on one end and a nut on the other.

511S.4 Construction Methods

A) Setting Valves, Drains and Air Releases

Unless otherwise indicated, main line valves, drain valves and piping, air and vacuum release assemblies and other miscellaneous accessories shall be set and jointed in the manner described for cleaning, laying, and jointing pipe.

Unless otherwise indicated, valves shall be set at the locations shown on the Drawings and such that their location does not conflict with other appurtenances such as curb ramps. Valves shall be installed so that the tops of operating stems will be at the proper elevation required for the piping at the location indicated above. Valve boxes and valve stem casings shall be firmly supported and maintained, centered and aligned plumb over the valve or operating stem, with the top of the box or casing installed flush with the finished ground or pavement in existing streets, and installed with the top of the box or casing approximately 6 inches (150 mm) below the standard street subgrade in streets which are excavated for paving construction or where such excavation is scheduled or elsewhere as directed by the Engineer or designated representative.

Drainage branches or air blowoffs shall not be connected to any sanitary sewer or submerged in any stream or be installed in any other manner that will permit back siphonage into the distribution system (see City of Austin "Standard Detail Drawings- Series 500/500S"). Every drain line and every air release line shall have a full sized independent gate valve flanged directly to the main. Flap-valves, shear gates, etc., will not be accepted.

B) Setting Fire Hydrants:

Fire hydrants shall be located in a manner to provide accessibility and in such a manner that the possibility of damage from vehicles or conflict with pedestrian travel will be minimized. Unless otherwise directed, the setting of any hydrant shall conform to the following:

Hydrants between curb and sidewalk on public streets shall be installed as shown on Standard 511S-17, with outermost point of large nozzle cap 6" to 18" (150 mm to 450 mm) behind back of curb. Where walk abuts curb, and in other public areas or in commercial areas, dimension from gutter face of curb to outermost part of any nozzle cap shall be not less than 3 feet (0.9 meters), nor more than 6 feet (1.8 meters), except that no part of a hydrant or its nozzle caps shall be within 6 inches (150 mm) of any sidewalk or pedestrian ramp. Any fire hydrant placed near a street corner shall be no less than 20 feet (6 meters) from the curb line

All hydrants shall stand plumb; those near curbs shall have the 4-inch (102 mm) nozzle facing the curb and perpendicular to it. The hydrant bury mark shall be located at ground or other finish grade; nozzles of all new hydrants shall be approximately 18 inches (450 mm) above grade. Lower barrel length shall not exceed 5 feet (1.5 meters). Barrel extensions are not permitted unless approved by the Engineer or designated representative. Each hydrant shall be connected to the main by 6-inch (152 mm) ductile iron pipe; a 6-inch (152 mm) gate valve shall be installed in the line for individual shutoff of each new hydrant.

Below each hydrant, a drainage pit 2 feet (0.6 meter) in diameter and 2 feet (0.6 meter) deep shall be excavated and filled with compacted coarse gravel or broken stone mixed with coarse sand under and around the bowl of the hydrant, except where thrust blocking is located (City of Austin Specification Item 510 and Standard Detail 510-6 and to a level 6 inches (150 mm) above the hydrant drain opening.

The hydrant drainage pit shall not be connected to a sanitary sewer. The drain gravel shall be covered with filter fabric to prevent blockage of voids in the gravel by migration of backfill material. The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete thrust blocking (taking care not to obstruct the hydrant drain holes), or the hydrant shall be tied to the pipe with approved metal harness rods and clamps. The fire line shall be provided with joint restraint from the main line to the fire hydrant. Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting.

Fire hydrants on mains under construction shall be securely wrapped with a poly wrap bag or envelope taped into place. When the mains are accepted and placed in service the bag shall be removed.

- C) Pressure Taps: Refer to Section 510.3 (24) of Standard Specification Item Number 510, "Pipe".

- ### D) Plugging Dead Ends

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees or crosses and spigot ends shall be capped. All end plugs or caps shall be secured to the pipe conforming to Section 510.3 (22) of Standard Specification Item Number 510, "Pipe".

- E) Protective Covering:

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other steel component shall be coal tar coated and shall be wrapped with standard minimum 8-mil (0.2 mm) low density polyethylene film or a minimum 4-mil (0.1 mm) cross laminated high-density polyethylene meeting ANSI/AWWA Specification C-105-current, with all edges and laps taped securely to provide a continuous and watertight wrap. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling. For reclaimed water piping, the polyethylene shall be purple.

- F) Valve Box, Casing and Cover:

Stems of all buried valves shall be protected by valve box assemblies. Valve box castings shall conform to ASTM A 48, Class 30B. Testing shall be verified by the manufacturer at the time of shipment. Each casting shall have cast upon it a distinct mark identifying the manufacturer and the country of origin. Valve boxes and covers for potable water shall be round. Valve boxes and covers for reclaimed water piping shall be square and shall have "Reclaimed Water" indicated on the lid.

G) Drain Valve Installations:

Refer to City of Austin Standards 511S-9A.

H) Air Release Assemblies:

Refer to City of Austin Standards 511S-1A, 511S-1B, 511S-2A, 511S-2B, 511S-3A and 511S-3B.

I) Pressure/Flow Control Valves:

Assemblies shall be installed as indicated.

J) Connections to Existing System:

Refer to Item No. 510, "Pipe" for connections to the existing system.

K) Shutoffs:

Refer to Item No. 510, "Pipe" for shutoffs.

511S.5 Measurement

All types of valves will be measured per each. Fire hydrants and drain valve assemblies will be measured per each. Fire Hydrant barrel extensions will be measured per vertical foot (meter: 1 meter equals 3.28 feet). Pressure/Flow control valve assemblies and both manual and automatic air release assemblies will be measured per each. Reflectorized pavement markers for identifying the location of newly installed fire hydrants shall be measured per each, as per Standard Specification Item No. 863S.7.

Bury depths exceeding 5.5 feet (1.68 meters) are defined as Additional Bury Depths. Additional bury depths will only be measured if indicated on the Drawings and identified in the Standard Contract Bid Form 00300U; otherwise, the unit bid price for each completed unit includes all depths.

511S.6 Payment

Payment shall include full compensation, in accordance with the pay item established in the bid, for excavation, furnishing, hauling and placing valves, drain valve assemblies, fire hydrants and barrel extensions including anchorage and all incidental materials and work; preparing, shaping, dewatering, bedding, placing and compacting backfill materials and for all other incidentals necessary to complete the installation, as indicated in the Drawings, complete in place.

Payment for iron fittings and for wet connections is covered in Section 510.6 of Standard Specification Item 510, "Pipe".

Payment for excavation safety systems is covered in Section 509S.10 of Standard Specification Item 509S, Excavation Safety Systems.

A) Valves: Valves will be paid for at the unit bid price for the size and type valve installed, including valve stem casing and cover, excavation and backfill, setting, adjusting to grade, anchoring in place, and other appurtenances necessary for proper operation.

B) Fire Hydrants: Fire Hydrants installation shall be paid for at the unit bid price, which includes all necessary labor and materials to set, adjust to grade and anchor the hydrant body, barrel extensions, concrete block, gravel drain, and other appurtenances necessary for proper operation; but shall not include pipe and valve between the main line and fire hydrant base.

C) Pressure or Flow Control Valve Assemblies: Pressure control and flow control valve assemblies will be paid for at the unit bid price, including box or vault, setting, adjusting to grade, anchoring in place,

adjusting the control device to the required conditions, providing other appurtenances necessary for proper operation, and placing in operation.

- D) Drain Valve Assemblies: Drain valve installation shall be paid for at the unit bid price , which includes all necessary labor and materials to set, adjust to grade and anchor the bends, vertical piping, blind flange, joint restraint devices, concrete blocking, concrete pad, and other appurtenances necessary for proper operation; but shall not include pipe and valve between the main line and drain valve buried bend.
- E) Manual Air Release Assemblies: Manual air release installations will be paid for at the unit bid price and shall include valves, fittings, pipe, tapping the main, box and cover, and other appurtenances necessary for proper operation.
- F) Automatic Combination Air/Vacuum Release Valve Assembly: Automatic air-vacuum release assemblies will be paid for at the unit bid price and will include the main line tap or outlet, all pipe, valves, fittings, box or vault and cover, and other appurtenances necessary for proper operation.
- G) Additional Bury Depth: Additional bury depth will be paid for at the unit bid price, which will include all work necessary to install units with bury depths exceeding 5.5 feet (1.68 meters).
- H) Fire Hydrant Barrel Extensions: Hydrant barrel extensions will be paid for at the unit bid price which will include necessary hardware and rod extensions.
- I) Reflectorized Pavement Markers: Pavement markers will be paid for at the unit bid price, which will include necessary surface preparation and adhesive, as per Standard Specification Item No. 863S.8.

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

Pay Item No. 511S-A:	Valves, _____ Type, _____ Diameter	Per Each.
Pay Item No. 511S-B:	Fire Hydrants (See Standard No. 511S-17)	Per Each.
Pay Item No. 511S- C:	Pressure or Flow Control Valve Assemblies	Per Each.
Pay Item No. 511S- D:	Drain Valve Assemblies (See Standard No. 511S-9A)	Per Each.
Pay Item No. 511S- E:	Manual Air Release Assemblies, _____ Diameter	Per Each.
Pay Item No. 511S- F:	Automatic Combination Air/Vacuum Release Valve Assembly, _____ Diameter.	Per Each.
Pay Item No. 511S- G:	Additional Bury Depth	Per Vertical Foot.
Pay Item No. 511S-H:	Fire Hydrant Barrel Extensions	Per Vertical Foot

END

SPECIFIC CROSS REFERENCE MATERIALS

Specification 511S, "Water Valves"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 510	Pipe
Section-510.3 (22)	Pipe Anchorage, Support and Protection
Section-510.3(24)	Water System Connections

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
511S-1A	25 mm (1") – 76 mm (2") Vented Air Release Valve Installation (Type I)
511S-1B	25 mm (1") – 76 mm (2") Non-Vented Air Release Valve Installation (Type I)
511S-2A	Type II - 76 mm (3") or Larger Vented Air/Vacuum Valve Installation

511S-2B	Type II - 76 mm (3") or Larger Non-Vented Air/Vacuum Valve Installation
511S-3A	Type III - 76mm (3") or Larger Vented Air/Vacuum Valve Installation
511S-3B	Type III-76mm (3") or Larger Non-Vented Air/Vacuum Valve Installation
511S-9A	Drain Valve Assembly
511S-17	Standard Fire Hydrant Installation

SPECIFIC CROSS REFERENCE MATERIALS (Continued)
Specification 511S, "Water Valves"

City of Austin W/WW Standard Products

<u>Designation</u>	<u>Description</u>
WW-3	Standard Products List for Fire Hydrants
WW-132	Standard Products List for Metal-Seated Gate Valves, AWWA C-500
WW-282	Standard Products List for Resilient-Seated Gate Valves, AWWA C-509
WW-367	Standard Products List for Air Release Valves for Water
WW-462	Standard Products List for Air Release/Vacuum Relief Valves for Wastewater
WW-700	Standard Products List for Resilient-Seated Gate Valves, AWWA C-515

ANSI/AWWA Standards

<u>Designation</u>	<u>Description</u>
A-21.11	American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings
C-105	American National Standard for Polyethylene Encasement for Ductile-Iron Pipe
C-500	Metal-Seated Gate Valves for Water Supply Service
C-502	Dry-Barrel Fire Hydrants
C-504	Rubber-Seated Butterfly Valves
C-509	Resilient Seated Gate Valves for Water and Sewerage Systems
C-515	Reduced-Wall, Resilient-Seated Gate Valves For Water Supply Service

ASTM Standards

<u>Designation</u>	<u>Description</u>
ASTM A48/A48M	Specification for Gray Iron Castings
ASTM A 536	Specification for Ductile Iron Castings

National Fire Protection Association (NFPA)

1963	National (American) Standard Fire Hose Coupling Screw Thread
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RELATED CROSS REFERENCE MATERIALS
Specification 511S, "Water Valves"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 501S	Jacking or Boring Pipe
Item No. 503S	Frames, Grates, Rings and Covers
Item No. 505S	Concrete Encasement and Encasement Pipe
Item No. 506S	Manholes
Item No. 507S	Bulkheads
Item No. 508S	Miscellaneous Structures and Appurtenances
Item No. 509S	Excavation Safety Systems

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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. 509S, "Excavation 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 non-reinforced 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:

Solubility, % by wt. in	
Trichloroethylene	99.5 minimum
Brittleness Test	Pass
Flow, inches	0.25 maximum

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 I

Nominal Size, Inches	Inside Diameter Inches, Minimum	Thickness of Barrel Inches, Minimum
4	3.82	0.19
6	5.70	0.28

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 II

Nominal Size, Inch	Minimum Strength, lb. Inch
4	179
6	604

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:

$$\text{Percent Deflection} = \frac{\text{Reduction Vert. I.D.}}{\text{Nominal I.D.}} \times 100$$

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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 (1/2 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 (+1/4, -0 in.) on the spacing, and the rows shall be parallel to the axis of the pipe and $120 \pm 5^\circ$ 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. 620S, "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 1/2 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. 403S, "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 paper 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. 403S, "Concrete for Structures", Item No. 410, "Concrete Structures", Item No. 509S, "Excavation Safety Systems" and Item No. 591S, "Riprap for Slope Protection".

Payment will be made under:

Pay Item No. 551:	Pipe Underdrains, ____In. -	Per Linear Foot.
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End

Ref: 403S, 410, 509S, 591S, 620S

Item No. 591S
Riprap for Slope Protection

591S.1 Description

This item shall govern the excavation of all materials encountered for placing riprap, disposal of excess material and backfilling around the completed riprap to the grade indicated on the Drawings. The work shall include all pumping and bailing, furnishing and placing riprap of rock or concrete in accordance with the details and to the dimensions indicated on the Drawings.

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. The work conducted under this item pertains to riprap for protection of slopes, cuts, fills, drainage facilities and other features susceptible to erosion.

591S.2 Submittals

The submittal requirements for this specification item shall include:

- A. The type, size, gradation, physical properties and source of rock riprap material; test data for specific gravity, absorption, soundness and field verification of the rock riprap gradation including a size distribution plot and a list of the measured D15, D50, D85 and D100 (refer to Item No. 591S.3.A).
- B. The type, size, and source of broken concrete riprap material.
- C. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- D. Proposed proportioning of materials for the mortar mix,
- E. Type, details and installation requirements for reinforcement, joint material, tie backs and anchors,
- F. Description of filter fabric including characteristics, test data and manufacturer's recommendations for installation.
- G. The type, size, gradation and source of granular filter material.

Where vegetated soil-riprap is used, and proposed materials differ from the materials already approved for use elsewhere on the project, the submittal requirements also include:

- H. Identification of the seed species, source, mixture, pure live seed (PLS) as listed on the analysis tags, certification tags from all seed bags, and seed calculation worksheet per item No. 604S, Table 9.
- I. Soil retention blanket material type, evidence that the material is listed on the TxDOT Approved Product List, one (1) full set of manufacturer's literature and installation recommendations and any special details necessary for the proposed application.
- J. Identification of fill soil class, source, and characteristics of proposed borrow material as described in Item No. 130S Borrow.
- K. Identification of topsoil source and characteristics including textural (clay/silt/sand) percentage.

591S.3 Materials

A. Rock

The rock shall be suitable in all respects for the purpose intended. Rock sources shall be selected well in advance of the time the rock will be required and shall be pre-approved by the Engineer. Rock used for riprap shall be hard, durable, and angular in shape and consist of clean field rock or rough unhewn quarry rock as nearly uniform in section as practicable. Neither the width nor the thickness of a single rock shall be less than one third of its length. The rocks shall be dense, resistant to weathering and water action, and free of overburden, spoils, shale, and organic material. Shale, chalk, and limestone with shale or chalk seams shall not be acceptable. Rounded rock (river rock) shall not be acceptable.

The rock durability shall be evaluated by visual inspection and laboratory tests for specific gravity, absorption, and soundness. The minimum specific gravity shall be 2.4 (150 pounds per cubic foot) and the maximum absorption 4.2% using ASTM D 6473 or Tex-403-A. Soundness shall be tested in accordance with ASTM D 5240 or Tex-411-A and weight loss shall not exceed 18% after 5 cycles of magnesium sulfate solution, nor 14% after 5 cycles of sodium sulfate solution.

The rock riprap material shall be provided as a gradation of larger and smaller rock sizes associated with a rock class or median diameter (D50) as specified in the drawings. Rock diameter for angular material represents the length of the intermediate axis of an individual rock. The material gradation shall conform to table below for the class sizes corresponding to the D50. The D15, D50, D85, and D100 are the rock sizes for which 15%, 50%, 85%, and 100% of the total sample are of equal size or smaller, respectively.

Rock Riprap Gradation Table								
Rock Riprap Class by Median Particle Diameter (D50)		D15 (in)		D50 (in)		D85 (in)		D100 (in)
Class	Diameter (in)	Min	Max	Min	Max	Min	Max	Max
I	6	3.7	5.2	5.7	6.9	7.8	9.2	12.0
II	9	5.5	7.8	8.5	10.5	11.5	14.0	18.0
III	12	7.3	10.5	11.5	14.0	15.5	18.5	24.0
IV	15	9.2	13.0	14.5	17.5	19.5	23.0	30.0
V	18	11.0	15.5	17.0	20.5	23.5	27.5	36.0
VI	21	13.0	18.5	20.0	24.0	27.5	32.5	42.0
VII	24	14.5	21.0	23.0	27.5	31.0	37.0	48.0
VIII	30	18.5	26.0	28.5	34.5	39.0	46.0	60.0
IX	36	22.0	31.5	34.0	41.5	47.0	55.5	72.0
X	42	25.5	36.5	40.0	48.5	54.5	64.5	84.0

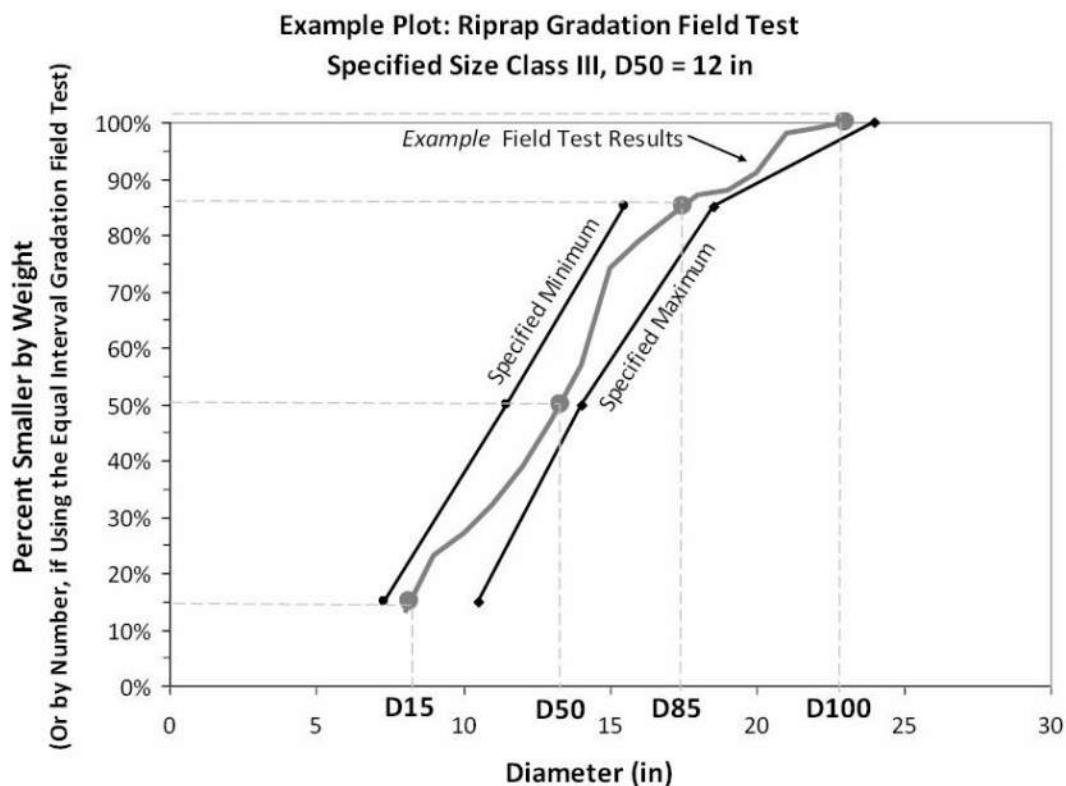
1. Reference: NCHRP Report 568
2. Conversion to weight-based gradation: $W = 0.0275D^3S_g$ where W is rock size in lbs, D is diameter in inches and S_g is the specific gravity of the rock.

Conformance of rock riprap to the gradation requirements shall be accomplished by field tests for rock sizes that cannot be analyzed via sieve or mechanical sorting machines. In order to perform a field test, the contractor shall provide a sample of the proposed rock riprap material meeting the gradation for the specified size class. Gradation field tests shall follow the equal interval test

procedure in NCHRP Report 568, Section 3.2.3, ASTM D 5519, or the modified equal interval method. The general steps of the modified equal interval method are:

1. Spread a representative, well mixed sample of riprap to form a flat, rectangular pile. The thickness of the pile should be approximately equal to D100. The length and width of the footprint should be determined based on the rock size and the minimum sample size that is requested by the Engineer.
2. With a large tape measure, create a linear transect across the sample pile. Mark each rock that falls directly under the tape measure at an equal interval. The interval should be two feet or greater, depending on the D50, such that no rock is marked more than once.
3. Lay additional transects parallel to the first transect, at a spacing equal to the interval between marked rocks. Repeat step B for each transect such that the marked rocks form an equally spaced grid across the pile.
4. Measure the diameter of each marked rock across the intermediate (middle or B axis). The number of rocks measured shall be equal or greater than the minimum sample size.
5. Analyze the data by sorting and plotting a curve of percent smaller by number vs. diameter. Identify the diameters.

Gradation tests shall result in: (1) a size distribution plot comparing the measured sample data with the specified diameter ranges for the rock size class (example below) and (2) the calculated D100, D85, D50, and D15 of the rock sample. The sample gradation is acceptable if the calculated diameters fall within the specified ranges of the applicable gradation. The acceptability of rock that falls outside the specified gradation ranges shall be at the discretion of the Engineer.



Approved rock rip-rap samples shall be stored onsite as a reference for ongoing visual inspection of additional materials supplied. Supplementary tests may be required for supply materials where visual inspection determines there may be a deviation from the required gradation. Labor, equipment and site location needed to assist in checking gradation shall be provided by the contractor at no additional cost to the owner.

B. Broken Concrete

The rock used for mortar riprap may consist of broken concrete removed under the contract or obtained from other approved sources. Broken concrete shall be as nearly uniform in section as practicable and of the sizes indicated in Section 591S.5, "Dry Riprap".

C. Concrete

Cast in place concrete shall be Class A Concrete and shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

D. Grout and Mortar

Grout and mortar shall consist of 1 part Portland Cement and 3 parts sand, thoroughly mixed with water. Mortar shall have a consistency such that it can be easily handled and spread by trowel. Grout shall have a consistency such that it will flow into and completely fill all joints.

E. Reinforcement

Reinforcement shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

F. Joints

Premolded expansion joint material shall conform to Standard Specification Item No. 408, "Concrete Joint Material".

G. Tie Backs and Anchors

Galvanized tie backs and anchors shall be as indicated on the Drawings.

H. Filter Fabric

Filter Fabric shall conform to Standard Specification Item No. 620S, "Filter Fabric".

I. Granular Filter

Aggregate used for granular filters shall conform to Standard Specification Item No. 403S "Concrete for Structures".

J. Soils

For vegetated soil-rock rip-rap, soil shall be integrated with the rock rip-rap at 30% soil to 70% rock by volume with minimal voids. Unless specified otherwise in the drawings, soil that is placed below six inches (6") below the rip-rap top surface shall be Class A Select Borrow material, as described in Item No. 130S Borrow, and referred to herein as "fill soil." Soil that is placed within the top six inches (6") of the rip-rap top surface shall be topsoil material as described in Item No, 601S Salvaging and Placing Topsoil, Section 3.

K. For vegetated soil-rock rip-rap, the type of seed mix and application rates shall be as

specified on the Drawings and within the referenced Standard Specification. If no seed mix is specified, apply according to Item No. 604S Seeding for Erosion Control, Section 6.

L. Soil retention blanket

For vegetated soil-rock rip-rap, soil retention blanket shall be a TxDOT approved Class I Type C or D, shall be made of 100% biodegradable fibers, unless specified otherwise in the Drawings. Blanket shall comply with the requirements of Item No. 605S Soil Retention Blanket, Section 3.

591S.4 Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures (Standard Specification Item 610S, "Preservation of Trees and Other Vegetation") shall be in place and utilities located and protected as set forth in the "General Conditions". Construction equipment shall not be operated within the drip line of trees unless indicated on the Drawings. Construction materials shall not be placed under the canopies of trees. No excavation or embankment shall be placed within the drip line of trees until tree wells (Standard Detail Number 610S-6, "Tree Protection, Tree Wells") are constructed. Spalls and small stones used to fill open joints and voids in rock riprap shall be rocked and wedged to provide a tight fit.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the Contractor's property and sole responsibility to dispose of this material in an environmentally sound manner off the limits of the right of way at a permitted disposal site.

All blasting shall conform to 01550, "Public Safety and Convenience." The Contractor shall comply with all laws, ordinances, applicable safety code requirements, International Fire Code Chapter 27 "Hazardous Materials General Provisions" and Chapter 33 "Explosives and Fireworks" and any other regulations relative to handling, storage and use of explosives. In all cases, a Blasting Permit must be obtained in advance from the appropriate City agency.

Areas to be protected by rock riprap shall be free of brush, trees, stumps and other objectionable materials and be graded to a smooth compacted surface. All soft or spongy material shall be removed and replaced with appropriate material to the depths shown on the plans or as directed by the engineer. Fill Areas, unless otherwise specified will be compacted in accordance with 132S - Embankment. Unacceptable subgrade conditions shall be reworked according to the Engineer's recommendations. Excavation areas shall be maintained until the riprap is placed.

A. Dry Rock Riprap

The mass of rock riprap shall be placed as to be in conformance with the required gradation mixtures, to the lines, grades and layers thickness that is shown on the drawings.

When the riprap will be placed on an erodible soil, as determined by the Engineer or designated representative, a layer of geotextile filter fabric or a granular filter layer shall be placed, prior to placement of the riprap material. In some cases multiple layers of granular filter material of varying gradations may be required. The median rock riprap size (D50), rock riprap layer thickness, filter type, when applicable the number of granular filter layers, granular filter aggregate gradations (grade/size classification), granular layer thicknesses shall be specified on the plans. The minimum granular filter layer thickness shall be 4 inches (102 mm). Geotextile filter fabric shall conform to Standard Specification No. 620 and be installed

with sufficient anchoring and overlap between seams according to the manufacturer's recommendations to ensure full filter barrier protection of the subgrade after riprap installation. When specified on the plans a four (4) inch minimum thickness granular cushion layer of gravel or sand may be placed over the filter fabric to prevent damage the fabric during placement of rock riprap.

Rock riprap shall be machine placed and distributed such that there will be no large accumulations of either larger or smaller sizes. Placing rock riprap by dumping into chutes or similar methods shall not be permitted. The rocks shall be placed in a single layer with close joints. The rock riprap layer thickness shall be no less than the maximum stone size (D100) or 1.5 times the D50, whichever produces the greater thickness. In areas exposed to flowing water the rock riprap layer thickness should be no less than 2.0 times the D50. The upright axis of the rocks shall make an angle of approximately 90 degrees with the embankment slope. The courses shall be placed from the bottom of the embankment upward, with the larger rocks being placed on the lower courses. Open joints shall be filled with spalls. Rocks shall be arranged to present a uniform finished top surface such that the variation between tops of adjacent rocks shall not exceed 3 inches (75 mm). Rocks that project more than the allowable amount in the finished work shall be replaced, embedded deeper or chipped.

B. Mortared Rock Riprap

Rock for this purpose, as far as practicable, shall be selected as to size and shape in order to secure fairly large, flat-surfaced rock which may be laid with a true and even surface and a minimum of voids. Fifty percent of the mass rock shall be broad flat rocks, weighing between 100 and 150 pounds (45 and 69 kilograms) each, placed with the flat surface uppermost and parallel to the slope. The largest rock shall be placed near the base of the slope. The spaces between the larger rocks shall be filled with rocks of suitable size, leaving the surface smooth, reasonably tight and conforming to the contour required on the Drawings. In general, the rocks shall be placed with a degree of care that will insure plane surfaces with variation from the true plane of no more than 3 inches in 4 feet (no more than 60 mm per meter). Warped and curved surfaces shall have the same general degree of accuracy as indicated for plane surfaces.

Before placing mortar, the rocks shall be wetted thoroughly and as each of the larger rocks is placed, it shall be surrounded by fresh mortar and adjacent rocks shall be shoved into contact. After the larger rocks are in place, all of the spaces or opening(s) between them shall be filled with mortar and the smaller rocks then placed by shoving them into position, forcing excess mortar to the surface and insuring that each rock is carefully and firmly embedded laterally. After the work described above has been completed, all excess mortar forced up shall be spread uniformly to completely fill all surface voids. All surface joints then shall be pointed up roughly, either with flush joints or with shallow, smooth raked joints.

B. Vegetated Soil-Rock Riprap

Adjacent stockpiles of rock riprap, fill soil, and topsoil shall be treated and there shall be no premixing of fill soil, top soil and rock prior to placement. Sufficient soil volume shall be provided to result in a final, complete-in-place ratio of 30% soil to 70% rock riprap by volume.

Place underlying filter material and first layer of rock riprap in accordance with 591S.4.A to a thickness equivalent to the D50 rock size of half the design rock layer thickness, whichever is greater. Place a layer of soil over and within the rock voids such that the top of the soil layer is approximately 75% of the rock layer thickness. Work the soil into the rock layer voids by wetting, prodding with a rock bar, and/or vibratory compaction until the soil height is

approximately 50% of the rock height. If the soil height becomes less than 50% of the rock height then repeat the previous steps.

Place the second layer of rock riprap per 591S.4.A up to the final design grade. Place soil over and within the rock riprap, working it into the voids as in the previous step and repeating application as needed until the top of the soil layer approximately matches the top surface of the rock riprap. Excess soil shall not be placed in the voids to the extent that the rock riprap is displaced. The resulting soil-riprap surface shall be smooth, with no lumps or depressions greater than two inches ($\pm 2''$) from the final design grade.

Once the soil-rock matrix is placed, the surface of the soil-rock riprap shall be seeded per the Drawings and covered with biodegradable erosion control fabric.

C. Concrete Riprap

Concrete for riprap shall be placed as indicated on the Drawings or as directed by the Engineer or designated representative. Unless otherwise indicated on the Drawings, concrete riprap shall be reinforced using wire or bar reinforcement.

Concrete shall be Class A or as indicated otherwise on the Drawings and shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

When welded wire reinforcement is indicated, it shall be a minimum of 6 x 6 W1.4 x W1.4 (150 x 150 MW9 x MW9) with a minimum lap of 6 inches (150 mm) at all splices. At the edge of the riprap, the wire fabric shall not be less than 1 inch (25 mm) nor more than 3 inches (75 mm) from the edge of the concrete and shall have no wires projecting beyond the last member parallel to the edge of the concrete.

When bar reinforcement is used, the sectional area of steel in each direction shall not be less than the sectional area of the wire fabric described above. The spacing of bar reinforcement shall not exceed 18 inches (450 mm) in each direction and the distance from the edge of concrete to the first parallel bar shall not exceed 6 inches (150 mm).

Reinforcement shall be supported properly throughout the placement to maintain its position approximately equidistant from the top and bottom surface of the slab.

Unless otherwise noted, expansion joints of the size and type indicated on the Drawings shall be provided at intervals not to exceed 40 feet (12.2 meters) and shall extend the full width and depth of the concrete. Marked joints shall be made 3/8 inch (9.5 mm) deep at 10 foot (3 meter) intervals. All joints shall be perpendicular and at right angles to the forms unless otherwise indicated on the Drawings.

Slopes and bottom of the trench for toe walls shall be compacted and the entire area sprinkled before the concrete is placed.

After the concrete has been placed, consolidated and shaped to conform to the dimensions indicated on the Drawings and has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to secure a reasonably smooth surface.

Immediately following the finishing operation, the riprap shall be cured conforming to Standard Specification Item No. 410S, "Concrete Structures".

D. Pneumatically Placed Concrete Riprap, Type I and Type II

Pneumatically placed concrete for riprap shall be placed as indicated on the Drawings or as established by the Engineer or designated representative. Pneumatically placed concrete shall conform to Standard Specification Item No. 404S, "Pneumatically Placed Concrete". Reinforcement shall conform to the details indicated on the Drawings and Standard Specification Item No. 406S, "Reinforcing Steel". Reinforcement shall be supported properly throughout placement of concrete. All subgrade surfaces shall be moist when concrete is placed.

The surface shall be given a wood float finish or a gun finish as indicated on the Drawings.

The strength and design of Pneumatically Placed Concrete Riprap shall be either Type I or if indicated, Type II conforming to Standard Specification Item No. 404S, "Pneumatically Placed Concrete".

Immediately following the finishing operation, the riprap shall be cured conforming to Standard Specification Item No. 410S, "Concrete Structures".

591S.5 Measurement

Measurement of acceptable riprap will be made on the basis of the (a) area in square yards (square meters: 1 square meter equals 1.196 square yards) indicated on the Drawings, complete in place or (b) the volume of concrete placed in cubic yards (cubic meters: 1 cubic meters equals 1.308 cubic yards), complete in place as indicated on the Drawings for the thickness specified.

Concrete toe walls will not be measured separately but shall be included in the unit price bid for riprap of the type with which it is placed.

591S.6 Payment

The riprap quantities, measured as provided above, will be paid for at the unit bid prices per square foot or per cubic yard as indicated for riprap of the various classifications. The Unit Bid Price shall include full compensation for furnishing, hauling and placing all materials, including toe walls, geotextile filter fabric, granular filter material, fill soil and top soil, seed, erosion control fabric, granular cushion, reinforcement and premolded expansion joint material and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment for excavation of toe wall trenches and for all necessary excavation below natural ground or the bottom of excavated drainage channels will be included in the unit bid price for riprap. Excavation, grading and fill materials required to shape drainage channels shall not be included in the unit bid price for riprap.

Payment for excavation required for shaping of slopes for riprap shall be included in the unit bid price for riprap, except for the situation when the header banks upon which the riprap is to be placed are built by prior contract. In this specific case the excavation for shaping of slopes, will be paid for conforming to Standard Specification Item No. 401, "Structural Excavation and Backfill".

Payment will be made under one of the following:

Pay Item No. 591S-A: Dry Rock Riprap
Pay Item No. 591S-B: Dry Rock Riprap

Per Square Yard.
Per Cubic Yard.

Pay Item No. 591S-D:	Mortared Rock Riprap	Per Square Yard.
Pay Item No. 591S-F:	Concrete Riprap, ____ In.	Per Square Yard.
Pay Item No. 591S-G:	Concrete Riprap	Per Cubic Yard.
Pay Item No. 591S-I	Vegetated Soil-Rock Riprap	Per Square Yard
Pay Item No. 591S-J	Vegetated Soil-Rock Riprap	Per Cubic Yard
Pay Item No. 591S-P	Pneumatically Placed Concrete Riprap, ____In.	Per Square Yard.

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End

SPECIFIC CROSS REFERENCE MATERIALS

Specification 591S, "Riprap for Slope Protection"

International Fire Code

Designation	Description
Chapter 27	Hazardous Materials
Chapter 33	Explosives and Fireworks

City of Austin Standard Contract Documents

Designation	Description
01550	Public Safety and Convenience

City of Austin Standard Specifications

Designation	Description
Item No. 130S	Borrow
Item No. 403S	Concrete for Structures
Item No. 404S	Pneumatically Placed Concrete
Item No. 406	Reinforcing Steel
Item No. 408	Concrete Joint Material
Item No. 410	Concrete Structures
Item No. 601S	Salvaging and Placing Topsoil
Item No. 604S	Seeding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 620S	Filter Fabric

American Society for Testing and Materials, ASTM

Designation	Description
ASTM D 5240	Standard Test Method for Evaluation of Durability of Rock for Erosion Control Using Sodium Sulfate or Magnesium Sulfate
ASTM D 5519	Standard Method Methods for Particle Size Analysis of Natural and Man-made Riprap Materials
ASTM D 6473	Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex-403-A	Test Procedure for Saturated Surface-Dry Specific Gravity and Absorption of Aggregates
Tex-411-A	Soundness of Aggregate Using Sodium Sulfate or Magnesium Sulfate

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

Designation	Description
Item No. 432	Riprap

RELATED CROSS REFERENCE MATERIALS
Specification 591S, "Riprap for Slope Protection"

City of Austin Standard Specifications

Designation	Description
Item No. 623S	Dry Stack Rock Wall

Engineering Design Manuals

Federal Highway Administration, 1989, Design of Riprap Revetment, Hydraulic Engineering Circular HEC-11, FHWA-1P-89-016.

National Cooperative Highway Research Program, 2006, Riprap Design Criteria, Recommended Specifications, and Design Criteria, NCHRP Report 568.

United States Bureau of Reclamation, 1983, Hydraulic Design of Stilling Basins and Energy Dissipators, Engineering Monograph No. 25.

U.S Department of Agriculture, 1983, Soil Conservation Service, Riprap for Slope Protection Against Wave Action, Technical Release No. 69, February.

US Army Corps of Engineers, 1994. Hydraulic Design of Flood Control Channels, US Army Corps of Engineers Engineer Manual EM 1110-2-1601.

Federal Highway Administration, 1998. "Geosynthetic Design and Construction Guidelines," FHWA-HI-95-038.

**Specification Item No. 594S
Gabions and Revet Mattresses**

594S.1 Description

The work to be performed under this specification shall include furnishing, assembling, filling, and tying rock-filled wire mesh compartmented gabions and revet mattresses in accordance with the lines, grades, and dimensions shown on the Drawings or otherwise established in the field by the Engineer or designated representative. The type of construction (i.e. twisted woven mesh, welded mesh or both) and wire sizes [i.e. 13.5 gage (2.2 mm), 12 gage (2.7 mm) or 10 gage (3.4 mm)] shall be as defined in the Drawings or otherwise 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 and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

594S.2 Materials

Gabions and revet mattresses shall be constructed of galvanized steel wire with polyvinyl-chloride (PVC) flexible coating. The gabions and revet mattresses shall be of the construction and sizes specified in the Drawings and shall meet the specifications presented herein. Unless otherwise specified in the Drawings or approved by the Engineer or designated representative, the gabions and revet mattresses may be constructed of either double twist woven mesh or welded wire mesh.

Gabions shall be furnished in the specified dimensions within a tolerance of ± 5 percent. Revet mattresses shall be furnished in the specified dimensions within a tolerance of ± 5 percent for the length and width and ± 10 percent for the height. For each individual gabion or revet mattress, the same mesh style shall be used for the base, front, ends, back, diaphragms and lid panels. Each gabion or revet mattress shall be manufactured and divided into cells of equal length, no greater than 3 feet (0.9 meter), by diaphragm panels.

(1) Gabion and Revet Mattress Wire

Gabion wire shall be galvanized steel, Class 3 or A coating, soft temper conforming to ASTM A 641, and shall specifically meet the requirements given below for gabions (12 gage wire) and/or revet mattresses (13.5 wire gage) as called for in the Drawings. PVC coating of the wire may be fuse-bonded or extruded onto the wire. Galvanization of welded wire shall be performed either before or after welding.

Table 1: Requirements – Mesh Wire for Gabions and Revet Mattress Units

Characteristic	Gabions	Revet Mattresses
Wire Gage	12 gage	13.5 gage
Maximum Tensile Strength (ASTM 641)	70,000 psi (483 mPa)	75,000 psi (517 mPa)
Nominal Wire Diameter (ASTM A 641)	0.106 inch (2.7 mm)	0.0866 inch (2.2 mm)
Minimum Diameter (ASTM A 641, Table 3)	0.102 inch (2.6 mm)	0.0826 inch (2.9 mm)
Galvanizing, Zinc (ASTM A 641, Table 1)	0.80 oz/ft ² (245 gr/m ²)	0.70 oz/ft ² (215 gr/m ²)

(2) Gabion Mesh

(A) Woven Mesh

Woven mesh shall be of a uniform non-raveling, double twist hexagonal pattern nominally of dimensions 3.25 inches by 4.5 inches (83 mm by 114 mm). Selvedge wire shall be 10 gage (nominal diameter of 3.4 mm).

(B) Welded Mesh

Mesh opening shall be nominally 3 inches by 3 inches (75 mm by 75 mm). Strength of welds shall meet the following requirements when tested in accordance with section 13.4 of ASTM A-974:

Table 2: Minimum Weld Strength Requirements

Type of Structure	Wire Size (Diameter)	Minimum Average Weld Shear Strength
	Gage (mm)	English Units (SI Units)
Gabions	12 (2.7)	472 lbf (2.10 kN)
Revet Mattress	13.5 (2.2)	292 lbf (1.30 kN)

(C) Manufacturing

Twisted wire mesh gabions shall be manufactured in conformance with ASTM A-975, while welded wire mesh gabions shall be manufactured in conformance with ASTM A-974.

(3) Revet Mattresses

(A) Woven Mesh

Woven mesh shall be of a uniform non-raveling, double twist hexagonal pattern, nominally of dimensions 2.5" x 3.25" (64 mm by 83 mm). Selvedge wire shall be 12 gage (nominal diameter of 2.7 mm).

(B) Welded Mesh

Mesh opening shall be nominally 1.5" x 3.0" (38 mm by 76 mm). Strength of welds shall meet the requirements listed in Table 2 for 13.5 gage (2.2 mm) wire, when tested in accordance with section 13.4 of ASTM A-974:

(C) Manufacturing

Twisted wire mesh revet mattresses shall be manufactured in conformance with ASTM A-975, while welded wire mesh revet mattresses shall be manufactured in conformance with ASTM A-974.

(4) PVC Coating

All wire used in fabrication of the gabions, revet mattresses and wiring operations during construction shall, after zinc coating, have a fuse-bonded or extruded coating of PVC. The coating shall be gray in color. The thickness shall be nominally 0.020 inch (0.5 mm), and shall not be less than 0.015 inch (0.38 mm) in thickness. It shall be capable of resisting deleterious effects of natural weather exposure, and immersion in salt water.

For PVC-coated welded wire fabric panel, cutting of the panels shall not be allowed closer than 1/4 inch \pm 1/8 inch (6 mm \pm 3.18 mm) after fabrication in order to prevent exposure near the welds.

(A) Initial Properties:

1) Woven Mesh:

The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-975:

a) Specific Gravity:

The specific gravity as determined in accordance with ASTM D-792 shall be between 1.3 to 1.35.

b) Durometer Hardness:

The hardness as determined in accordance with ASTM D-2240 shall be between 50 to 60, Shore D.

c) Tensile Strength:

The tensile strength when tested in accordance with ASTM D-412 shall not be less than 2985 psi (20.6 mPa).

d) Modulus of Elasticity at 100% Elongation:

The Modulus of Elasticity when determined in accordance with ASTM D-412 shall not be less than 2700 psi (18.6 mPa).

e) Resistance to Abrasion:

The percentage loss in weight (mass) during abrasion testing in accordance with ASTM D-1242 shall be less than 12%.

f) Brittleness Temperature:

The brittleness temperature shall not be higher than 15°F (−9.0°C) or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The maximum brittleness temperature should be at least 15°F (8°C) below the minimum temperature at which the gabion will be handled or filled.

2) Welded Mesh:

The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-974:

a) Specific Gravity:

The specific gravity as determined in accordance with ASTM D-792 shall be between 1.20 and 1.40.

b) Durometer Hardness:

The hardness as determined in accordance with ASTM D-2240 shall not be less than 75, Shore A.

c) Tensile Strength:

The tensile strength when tested in accordance with ASTM D-638 shall not be less than 2275 psi (15.7 mPa).

d) Modulus of Elasticity:

The Modulus of Elasticity when determined in accordance with ASTM D-638 shall not be less than 1980 psi (13.7 mPa).

e) Resistance to Abrasion:

The percentage loss in weight (mass) shall be less than 12 % during abrasion testing in accordance with ASTM D-1242, Method B, at 200 cycles, CSI-A abrader tape, 80 grit.

f) Brittleness Temperature:

The brittleness temperature shall not be higher than 15°F (-9.0°C) or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The maximum brittleness temperature should be at least 15°F (8°C) below the minimum temperature at which the gabion will be handled or filled.

g) Adhesion:

The PVC coating on the wire shall adhere to the wire such that the coating breaks rather than separates from the wire, when tested in accordance with the PVC Adhesion Test described in Section 13.3 of ASTM A-974.

h) Mandrel Bend:

The PVC-coated wire, when subjected to a single 360° bend at 0°F (-18°C) around a mandrel ten times the diameter of the wire, shall not exhibit breaks or cracks in the PVC coating.

(B) Performance Tests:

The PVC coating shall have the demonstrated ability to withstand the specified exposure testing.

- 1) Exposure to Salt Spray: The PVC shall show no effect after 3000 hours of salt spray exposure in accordance with ASTM Test Method B-117.
- 2) Exposure to Ultraviolet Rays: The PVC shall show no effect of exposure to ultraviolet light with test exposure of 3000 hours, using apparatus Type E and 145°F (63°C), when tested in accordance with ASTM Practice D-1499 and G-23.

(C) Properties After Exposure Tests:

After conclusion of the salt spray and exposure to ultraviolet light tests, the PVC shall not show cracks, blisters or splits, nor any noticeable change in color. In addition the PVC coating shall not show cracks or breaks after the wires are twisted in the fabrication of the mesh, nor shall there be any moisture intrusion under the PVC coating as a result of the test.

After completion of the exposure tests the following criteria shall also be met:

1) Woven Mesh:

- a) The Specific Gravity shall not change more than 6% of its initial value.
- b) The Durometer Hardness shall not change more than 10% of its initial value.

- c) The Tensile Strength shall not change more than 25% of its initial value.
- d) The Resistance to Abrasion shall not change more than 10% of its initial value.

2) Welded Mesh:

- a) The Specific Gravity shall not change more than 6% of its initial value.
- b) The Modulus of Elasticity shall not change more than 25% of its initial value.
- c) The Tensile Strength shall not change more than 25% of its initial value.
- d) The Resistance to Abrasion shall not change more than 10% of its initial value.

(D) Salt Spray Resistance for Fastener:

The fasteners for twisted mesh wire gabions and revet mattresses shall be subjected to Salt Spray Test of Test Method B-117 for a period of not less than 48 ± 1 hour cycle length. After testing the fasteners, the selvedge, or mesh wire confined by the fasteners shall show no rusty spots on any part of the surface excluding the cut ends.

(5) Stone

(A) Gabion Basket Stones

Stone fill shall be durable and of suitable quality to ensure permanence in the structure. The stone used to fill the gabion baskets shall be a clean, sound, and durable rock meeting the following requirements. It shall have a wearing loss less than 35 percent when the stone is tested with the Los Angeles Abrasion Machine in accordance with ASTM Test Method C535 (TxDOT Test Method Tex-410-A). The loss of material experienced during five cycles of magnesium sulfate exposure conducted in accordance with TxDOT Test Method Tex-411-A for Rock RipRap shall not exceed 18 percent. The stone shall be well graded to produce a dense fill, angular in texture, while meeting the following gradation requirements:

Table 3: Gabion Stone Gradation Requirements

Sieve Size US (SI)	Percent by Weight (Mass) % Passing Each Individual Sieve
8 Inch (200 mm)	100
4 Inch (100 mm)	0 - 5
3 Inch (75 mm)	0

The minimum unit weight (unit mass) of a rock-filled gabion shall be 120 pcf [1.92 megagrams (mg) per cubic meter]. Verification of unit weight (mass) shall be performed when ordered by the Engineer, by constructing a test gabion with materials supplied for construction with the same effort and method intended for production gabions.

(B) Revet Mattress Stone:

The stone used to fill the revet mattresses shall be as specified for gabions except that it shall have a maximum dimension of 5 inches (125mm) and a minimum dimension of 3 inches (75 mm). The majority of the stone shall be in the 3 to 4 inch (75 to 100 mm) range; cubical or rounded in shape. A tolerance of 5% shall be allowed on the upper and lower dimensions of the rock.

(6) Connections

(A) Wire

Lacing wire and connecting wire shall be 13.5 gage [0.087 inch (2.20 mm)] PVC coated galvanized steel, Class 3, soft temper, conforming to ASTM A-641. During testing, any separation of 2 inches (50 mm) or more between connecting wires shall be considered as a failure.

(B) Spiral Binder for Welded Wire Mesh

Spiral binders shall consist of 0.106 inch (2.7 mm) PVC coated wire for the gabion and 0.087 inch (2.2 mm) PVC coated wire for the revet mattresses. Spiral binders shall have a 3.0 inch (75 mm) maximum separation between continuous successive loops (3 inch or 75mm pitch).

The binder shall be made of galvanized steel, Class 3, soft temper, conforming to ASTM A-641.

(C) Alternate Fasteners for Twisted Woven Mesh

Alternate fasteners, acceptable for use by the intended gabion basket manufacturer, may be submitted to the Engineer for consideration and approval prior to construction. The fasteners may consist of split ring or interlocking fasteners. Alternate fasteners systems shall produce a joint that meets the requirements of ASTM A-975, Section 7, Table 2.

(7) Fastener System

The Contractor shall provide a complete description of the fastener system, including the number of fasteners required for all vertical and horizontal connections for single- and multiple-basket joinings, as well as the number and size wires the fastener is capable of properly joining. The Contractor shall provide a description of a properly installed fastener, including test reports, drawings and/or photographs. Properly formed fasteners shall meet the requirements of ASTM A-974 for welded wire mesh or ASTM A-975 for twisted woven mesh.

(A) Each interlocking fastener shall be locked and closed.

(B) Each overlapping ring fastener shall be closed and the free ends shall overlap an average of 1 inch (25 mm).

(C) Spiral binders shall be screwed into position such that they pass through each mesh opening along the joint. In order to prevent unraveling, both ends of the spiral shall be crimped back around itself.

(D) Wire fasteners shall not be used to join more wires, or larger wires, than tested and approved for the application.

(8) Panel to Panel Joint Strength

The minimum strength of the joined panels shall be as specified in Section 7.3 of ASTM A-974 for Welded wire panels or Section 7.3 of ASTM A-975 for twisted woven mesh.

(9) Miscellaneous

Aggregate bedding, geotextiles or other materials shall conform to the requirements established on the Drawings.

(10) Certificate of Compliance

The Contractor shall submit Certificates of Compliance for all materials proposed for use to the Engineer for review and approval one week prior to construction.

594S.3 Construction

Twisted wire mesh Gabon's and revote mattresses shall be supplied in the forms allowed in ASTM A-975, while welded wire mesh Gabon's and revote mattresses shall be supplied in a form allowed in ASTM A-974.

The Gabon/revote mattress manufacturer/supplier will be required to have a qualified representative on site at the start of gabion/revet mattress construction. The Contractor shall submit work experience documentation of the representative for review/approval by the Engineer or designated representative. The representative shall be available for consultation as needed throughout the gabion construction.

Gabions and revet mattresses shall be constructed to the lines and grades shown on the Drawings. Individual or groups of gabions or revet mattresses, which deviate from line and grade, shall, at the direction of the Engineer or designated representative, be removed and replaced at no cost to the owner. Gabions or revet mattresses, which are constructed with bulges, and/or underfilled, loosely filled, or otherwise lacking a neat and compact appearance shall, at the direction of the Engineer or designated representative, be repaired/replaced at no cost to the owner. Underfilling of gabion/revet mattress corners to facilitate insertion of spirals shall not be permitted.

(1) Foundation Preparation

The foundation shall be excavated to the extent shown on the Drawings or as directed by the Engineer or designated representative. All loose or otherwise unsuitable materials shall be removed. All depressions shall be carefully backfilled to grade. The depressions shall be backfilled with suitable materials from adjacent required excavation, or other approved source, and compacted to a density at least equal to that of the adjacent foundation. If pervious materials are encountered in the foundation depressions, the areas shall be backfilled with free draining materials.

Any buried debris protruding from the foundation that will impede the proper installation and detrimentally impact the final appearance of the gabion, shall also be removed, and the voids carefully backfilled and compacted as specified above. Immediately prior to gabion or revet mattress placement, the prepared foundation surface shall be inspected and approved by the Engineer and no material shall be placed thereon until that area has been approved.

Placement of filter material and/or filter fabric shall be as shown on the Drawings or directed by the Engineer.

(2) Gabion/Revet Mattress Basket Assembly

No work shall take place using PVC coated materials unless both the ambient air temperature and the temperature of the PVC materials are at least 15°F (8°C) above the brittleness temperature of the PVC materials.

Assembly of gabions and revet mattresses shall consist of shaping and tying each individual basket. Baskets shall be assembled by connecting all untied edges including

diaphragms with lacing wire, spirals or approved fasteners. The connections for the completed assemblies shall conform to the requirements of Section 7 of ASTM specifications A-974 (welded wire) and Section 7.3 and Table 2 of A-975 (double twisted).

Assembly of baskets, connection of baskets together and lid closures shall be accomplished in accordance with one of the following approved procedures:

(A) Lacing Wire:

Using lacing wire of appropriate length, secure one end of the wire onto the basket corner by looping and twisting the lacing wire together. Proceed along the joint by tying with double loops every other mesh opening at intervals not more than 6 inches (150 mm) apart, while pulling the basket elements tightly together. Secure the other end of the lacing wire again by looping and twisting the wire around itself.

(B) Spiral Binders for Welded Wire Mesh:

Spiral binders, meeting the minimum acceptance criteria of article 594S.2 (6) c) shall be screwed into position such that they pass through each mesh opening along the joint. To prevent unraveling, each end of the spiral binder shall be crimped back against itself.

C) Alternate Fasteners for Twisted Woven Mesh:

Interlocking fasteners meeting the minimum acceptance criteria of article 594S.2 (6) c), shall be installed with, as a minimum, one interlocking fastener in every other opening.

Ring fasteners meeting the minimum acceptance criteria of 594S.2 (6)c), shall be installed with, as a minimum, one split ring fastener in every opening, having a minimum 1 inch (25 mm) total overlap and securing only the number and diameter of wires for which tested.

Placing of gabions and revet mattresses shall consist of installing baskets to the lines and grades shown on the Drawings. Gabions and revet mattresses shall be securely fastened to each adjoining unit along the vertical and top reinforced edges of all contact surfaces. Overlying rows of baskets shall be staggered appropriately. Empty sections stacked on a filled line of gabions and revet mattresses shall be securely fastened to the bottom unit along the front, back and ends.

Prior to the placement of rock, the baskets used in the front vertical exposed faces of retaining walls shall be aligned. To facilitate alignment, tension may be applied to empty units at the direction of the Engineer or designated representative.

(3) Filling of Gabions and Revet Mattresses

The gabions and revet mattresses may be filled by machine, in maximum lifts of 12 inches (300 mm). The machine work shall be supplemented with handwork to avoid bulges and provide a compact mass with a minimum of voids. Care will be exercised so as not to damage the gabion/revet mattress elements or wire coating by limiting height of drop during filling to 3.0 feet (0.9 meter) for Gabions and 1.5 feet (0.5 meter) for revet mattresses. Undue deformation or bulging of the mesh shall be corrected prior to further stone filling. Where specified on the Drawings, select large stone shall be hand placed on vertical outside faces to achieve a desired neat appearance.

During placement, the depth of stone in any cell shall not exceed the depth in an adjoining cell by more than one foot (300 mm). Stone smaller than the mesh opening found against vertical faces shall be removed.

Two connecting wires in each direction for end units and two parallel connecting wires perpendicular to the exposed face for exposed face units shall be installed at every 12 inch (300 mm) lift. The connecting wires shall loop around two mesh openings, and the ends of wires shall be securely twisted with a minimum of three twists after looping. Prefabricated connecting wire may be used in lieu of connecting wire.

Connecting wires associated with 18-inch (450 mm) gabions shall be installed when and as specified on the Drawings or as recommended by the gabion/revet mattress manufacturer.

The gabion or revet mattress unit shall be overfilled by 1 1/2 to 2 inches (37.5 to 50 mm) and the lid shall be bent and stretched until it meets the perimeter edges of the front and end panels. The stretching shall be accomplished using an approved lid closing tool in order to prevent damage to the PVC coating. Crow bars or similar single point leverage devices will not be allowed. The lid shall then be securely tied with lacing wire, spirals or approved fasteners to the fronts, ends and diaphragms. Excessive deformation of the lid panel to facilitate closing of a bulging gabion or revet mattress will not be permitted.

All backfill shall be placed and compacted in sequence with the filling of the baskets; however, care shall be exercised in compacting the fill behind a single row of baskets since excessive compaction effort can displace the gabions/revet mattresses from the desired alignment.

Gabion or revet mattress units may be cut or shaped to fit odd length or odd shaped areas. They shall be cut at least 6" to 8" (150 mm to 200 mm) larger than the opening to allow sufficient material for overlap and lacing. All edges or faces formed in this manner shall be adjusted to present a finished and pleasing appearance.

At all times, care shall be taken to turn all loose and projecting ends of wire into the gabion units to prevent injury.

594S.4 Quality of Work

Wire of proper grade and quality, when fabricated and installed in the manner herein required, shall result in a strong, serviceable mesh-type product having substantially uniform openings. It shall be fabricated and finished properly, as determined by visual inspection, and shall conform to this specification.

594S.5 Measurement

Measurement of acceptable "Gabions and Revet Mattresses", complete in place, will be made on the basis of volume determined by the actual length, width and height.

594S.6 Payment

The Gabion and revet mattress quantities, measured as described above, will be paid for at the unit bid prices per cubic yard (cubic meter: 1 cubic meter equals 1.308 cubic yards) of the various types indicated. The price shall include full compensation for furnishing, hauling and placing all materials, including filter fabric, wire containers, connectors, reinforcement stones and backfill; for all labor, tools, equipment and incidentals needed to complete the work.

Excavation and all subgrade preparation required for shaping the foundation for the wire containers shall be included in the unit bid price for "Gabions and Revet Mattresses".

Payment will be made under one of the following:

Pay Item No. 594S-A: Gabions, Twisted Woven Wire -----Per Cubic Yard.
Pay Item No. 594S-B: Gabions, Welded Wire ----- Per Cubic Yard.
Pay Item No. 594S-C: Revet Mattresses, Twisted Woven Wire --- Per Cubic Yard.
Pay Item No. 594S-D: Revet Mattresses, Welded Wire----- Per Cubic Yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item 594S, "GABIONS and REVET MATTRESSES"

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 1.4.3.E	Permanent Structural Practices-Gabions
Figure 1.23	Gabions

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
594S-1	Gabions
594S-2	Gabion Details

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-974	Standard Specifications for Welded Wire Fabric Gabions and Gabion Mattresses (Metallic-Coated or Polyvinyl Chloride (PVC) Coated)
A-975	Standard Specifications for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel with Poly (Vinyl Chloride)(PVC) Coating)

<u>RELATED</u> CROSS REFERENCE MATERIALS

City of Austin Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 130S	Borrow
Item No. 132S	Embankment
Item No. 220S	Sprinkling for Dust Control
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 234S	Rolling (Tamping)
Item No. 236S	Proof Rolling
Item No. 510	Pipe
Item No. 601S	Salvaging and Placing Topsoil
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 605S	Soil Retention Blanket

Item No. 606S	Fertilizer
Item No. 607S	Slope Stabilization
Item No. 608S	Planting

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
642S-1	Silt Fence

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
410-A	Abrasion of Coarse Aggregate Using The Los Angeles Machine
411-A	Soundness of Aggregate By Use of Sodium Sulfate or Magnesium Sulfate

<u>RELATED</u> CROSS REFERENCE MATERIALS - Contibued
Specification Item 594S, "GABIONS and REVET MATTRESSES"

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-313	Standard Specification for Stainless Steel Spring Wire
A-370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
A-641	Specification for Zinc Coated (Galvanized) Carbon Steel Wire
A-853	Standard Specification for Steel Wire, Carbon, for General Use
B-117	Test Method of Salt Spray (Fog) Testing
C-535	Standard Test Method for Resistance of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
D-412	Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
D-638	Test Method for Tensile Properties of Plastics
D-746	Test Methods for Brittleness Temperature of Plastic and Elastomers by Impact
D-792	Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement
D-1203	Standard Test Methods for Volative Loss from Plastics Using Activated Carbon Methods
D-1242	Test Methods for Resistance of Plastics Materials to Abrasion
D-1499	Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics
D-2240	Test Method for Rubber Property-Durometer Hardness
D-2287	Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
G-23	Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Non-metallic Materials

Item No. 601S
Salvaging and Placing Topsoil

601S.1 Description

This item shall govern the removal, storage and placement of approved on-site naturally occurring topsoil and topsoil mix (see 601S.3.A) to the depths and area shown on the Drawings or as directed by the Engineer or Landscape Architect.

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.

601S.2 Submittals

A. Submittal required before construction.

1. Soil test results and soil classification necessary for approval of material as suitable topsoil. Soil test results should include, at minimum, texture, percentage organic matter (OM), salinity (soil salt) level; pH; and amounts of Phosphorous (P), potassium (K), calcium (Ca), magnesium (Mg), nitrate-nitrogen ($\text{NO}_3\text{-N}$) and sulfate-sulfur ($\text{SO}_4\text{-S}$).
2. For topsoil mixes containing compost, the soil test for shall also include moisture content, C:N ratio and Solvita compost maturity index.
3. A sample (21 gallon) of proposed topsoil or topsoil mix shall be submitted to the Owner or their representative 30 calendar days before installation and be approved before installation. Sample shall be labeled including type of material, specification number; name, address, and telephone number of manufacturer or supplier; and address of the location of the source or material stockpile.

B. Submittals /Inspection required during construction:

1. Delivery Tickets indicating type/product name, source and quantities of imported topsoil mix or compost) for mixing with salvaged soil).
2. Deliveries of soil to a job site shall be inspected by the project Engineer or Landscape Architect or Owner's construction inspector before placement to verify product compliance with specification.

601S.3 Materials

A. Topsoil Mix

1. Topsoil mix shall be composed of 4 parts of soil mixed with 1 part compost, by volume. The soil shall be locally available native soil that meets the following specifications:
 - a. Shall be free of trash, weeds, deleterious materials, rocks and debris.

- b. 100% shall pass through a 3/8-inch (9.5-mm) screen.
- c. Soil to be a black or dark brown loamy material that meets the requirements of the table below in accordance with the USDA textural triangle. Soil known locally as "red death" is not an allowable soil. Textural composition shall meet the following criteria:

Textural Class	Minimum	Maximum
Clay	5%	50%
Silt	10%	50%
Sand	15%	67%

- d. Organic matter percentage shall be at least 5.0% after the addition of compost.
 - e. Salinity shall be below 6.00 mmhos/cm.
 - f. An owner/project designer(s) may propose use of onsite salvaged topsoil which does not meet the soil texture class required above by providing a soil analysis and a written statement from a qualified professional in soils, landscape architecture, or agronomy indicating the onsite topsoil will provide an equivalent growth media and specifying what, if any, soil amendments are required.
3. The compost shall be locally available and shall meet the following specifications:
- a) Shall be well decomposed, stable to very stable, weed-free plant-based material source derived from yard trimmings or City approved alternate source. The Carbon/Nitrogen (C/N) ratio shall be less than 25:1 and trace metals test results should "pass".
 - b) Shall be blended and ground leaf, wood and other plant-based material, composted for a minimum of nine (9) months and at temperatures sufficient to break down all woody fibers, seeds and leaf structures, free of toxic material at levels that are harmful to plants or humans. Source material shall be yard waste trimmings blended with other plants or other materials designed to produce compost high in fungal material. Non-vegetal source materials may be acceptable upon approval by the Owner. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived.
 - c) Compost shall be commercially prepared compost and meet US Compost Council STA/TMECC criteria or as modified in this section for "Compost as a Landscape Backfill Mix Component".

http://compostingcouncil.org/admin/wp-content/plugins/wp-pdfupload/pdf/191/LandscapeArch_Specs.pdf

d) Compost shall comply with the following parameters:

PARAMETERS ¹	REPORTED AS (UNITS OF MEASURE)	GENERAL RANGE
pH	pH units	6.0 - 8.5
Salinity (electric conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, net weight basis	30 - 60%
Organic Matter Content	%, dry weight basis	30 - 65%
Particle Size	% passing a selected mesh size, dry weight basis	98% pass through ¾ inch screen
Stability Carbon Dioxide Evolution Rate	mg CO ₂ -C per g OM per day	<8
Solvita Compost Maturity Test	Solvita units	>6
Physical Contaminants (inerts)	%, dry weight basis	<1%
Chemical Contaminants ²	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants Select pathogens Fecal coliform bacteria or Salmonella ³	MPN per gram per dry weight MPN per 4 grams per dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

¹ Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The US Composting Council).

² US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41 ppm, Cadmium 39 ppm, Copper 1,500 ppm, Lead 300 ppm, Mercury 17ppm, Molybdenum 75 ppm, Nickel 420 ppm, Selenium 100 ppm, Zinc 2,800 ppm.

³ US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1,000 MPN/gram of total solids.

e) Compost and other soil amendments shall be worked into the existing onsite topsoil with a disc or tiller to create a well-blended material.

- All disturbed areas to be revegetated are required to provide a minimum of six (6) inches of topsoil. The topsoil shall be able to support the growth of planting (Standard Specification Item No. 608S), Seeding for Erosion Control (Standard Specification Item No. 604S), sodding (Standard Specification Item No. 602S) and Native Seeding and Planting for Restoration (Standard Specification Item No. 609S).

B. Water

Water shall be furnished by the Contractor and shall be clean and free from seed source, pesticide, fertilizer, industrial wastes and other objectionable matter.

601S.4 Sources

The salvaged topsoil may be obtained from the right-of-way at sites of proposed excavation or embankment when shown on the Drawings or identified by the Engineer or Landscape Architect. The approximate quantity of acceptable topsoil to be salvaged from the project will be shown on the Drawings. The topsoil or topsoil mix may also be obtained from approved sources, which are located outside the right-of-way and have been secured by the Contractor.

601S.5 Construction Methods

Tree protection fencing will be maintained at all times to protect all trees in the limits of construction. Where removal of trees is indicated on the Drawings, they shall be marked as directed by the Engineer or Landscape Architect, or certified Arborist.

Construction equipment shall not be operated nor construction materials stockpiled within the critical root zone of trees. Tree protection fencing shall remain in place per tree protection plan. Topsoil materials shall not be placed within the critical root zone until tree wells are constructed that conform to Item No. 610S, "Preservation of Trees and Other Vegetation" and Standard Details 591S-1 and 610S-6. The source and stockpile areas shall be kept drained, insofar as practicable, during the period of topsoil removal.

The existing topsoil shall be removed from the area indicated on the Drawings, stockpiled in designated area on the site plan, windrow along the right of way or other designated area outside the 100-year floodplain (as defined in the Drainage Criteria Manual and Land Development Code), or spread over an area that is ready for topsoil application in accordance with the Drawings or as directed by the Engineer or Landscape Architect.

Trash, wood, brush, stumps, rocks over 1 1/2 inches (37.5 mm) in size and other objectionable material encountered shall be removed and disposed of as directed by the Engineer or Landscape Architect prior to beginning of work required by this item. Grass and other herbaceous plant materials may remain. Large clumps shall be broken up.

Where the proposed planting area is compacted more than 85% proctor or 225 p.s.i., the existing soil should be tilled to a minimum depth of six inches before installation of the salvaged topsoil or topsoil mix. In the critical root zone of trees reference 661S.

The topsoil should not be placed if the ground is muddy, saturated, or frozen.

The topsoil should not be placed if the ground is extremely dry. Wet soil enough to prevent dust from leaving the site.

After the grading has been completed to the required alignment, grades and cross-sections and prior to the spreading of the salvaged topsoil, any clay or tight soil surfaces shall be scarified by plowing furrows approximately 4 inches (100 mm) deep along horizontal slope lines at 2 foot (600 mm) vertical intervals. The spreading of the salvaged topsoil or topsoil mix shall be undertaken as soon as the grading has been completed. The topsoil shall be spread so as to form a cover of uniform thickness indicated. After the topsoil has been placed and shaped, it shall be sprinkled with water and rolled to provide a suitable seed bed.

601S.6 Measurement and Payment

Salvaging, removal and/or placing topsoil materials will not be measured for payment, but shall be included in the unit price bid for the item of construction in which these activities are used.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 601S, "Salvaging and Placing Topsoil"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 608S	Planting
Item No. 609S	Native Grassland Seeding and Planting For Erosion Control
Item No. 610S	Preservation of Trees and Other Vegetation

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
591S-1	Dry Stack Rock Wall
610S-6	Typical Tree Well Applications

<u>RELATED</u> CROSS REFERENCE MATERIALS
Specification 601S, "Salvaging and Placing Topsoil"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Concrete
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 606S	Fertilizer

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
610S-1	Tree Protection Fence Locations
610S-2	Tree Protection Fence, Type B Chainlink
610S-3	Tree Protection Fence, Type B Wood
610S-4	Tree Protection Fence, Modified Type A
610S-5	Tree Protection Fence, Modified Type B

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 164	Seeding for Erosion Control
Item No. 204	Sprinkling

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic Limit of Soils
Tex-106-E	Method of Calculating the Plasticity Index of Soils

Item No. 602S
Sodding for Erosion Control

602S.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.

602S.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.

602S.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. 606S, "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.

602S.4 Planting Season

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

602S.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

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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).

Availability of water from the Austin Water Utility will be limited as stated under the Water Conservation Standard, City of Austin Land Development Code Chapter 6-2, Article II, "Water Use Management Plan Established".

The use of potable water will be restricted as stated in City of Austin Land Development Code Sections 6-4-73, 6-4-54, 6-4-63, 6-4-64, 6-4-65, 6-4-81, 6-4-92, 15-9-37(D) and 15-9-101(B).

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.

602S.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. 606S, "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.

602S.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) vertical 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. 606S, "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 602S.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.

602S.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.

602S.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:

Pay Item No. 602S-A:	Bermuda Block Sodding -	Per Square Yard.
Pay Item No. 602S-B:	St. Augustine Block Sodding -	Per Square Yard.
Pay Item No. 602S-C:	Bermuda Mulch Sodding -	Per Square Yard.
Pay Item No. 602S-D:	Grass Sodding -	Per Square Yard.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
Specification 602S, "Sodding for Erosion Control"	

City of Austin Land Development Code

Designation

Description

Chapter 4-2, Article II Emergency and Peak Day Water Use Management

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 606S	Fertilizer

City of Austin Land Development Code

<u>Designation</u>	<u>Description</u>
Section 6-4-52	Water Use Management Plan Established
Section 6-4-53	Applicability
Section 6-4-54	Compliance Required
Section 6-4-63	Permanent Water Use Restrictions
Section 6-4-64	Water Conservation Stage One Regulations
Section 6-4-65	Water Conservation Stage Two Regulations
Section 6-4-81	Variance
Section 6-4-92	Penalty
Section 15-9-37(D)	Customer's Responsibilities
Section 15-9-101(B)	Basis for Termination of Service

RELATED CROSS REFERENCE MATERIALS

Specification 602S, "Sodding for Erosion Control"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 601S	Salvaging and Placing Topsoil
Item No. 604S	Seeding for Erosion Control
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 204	Sprinkling

Item No. 604S
Seeding for Erosion Control

604S.1 Description

This item shall govern the preparation of a seed bed for temporary or permanent erosion control; sowing of seeds; fertilizing; mulching with straw, cellulose fiber wood chips, and recycled paper mulch; and other management practices along and across such areas as indicated in the Drawings or as directed by the Landscape Architect, 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 with SI units shown within parentheses.

604S.2 Submittals

The following submittal items are required in writing during construction:

- A. Identification of the seed species, source, mixture, and PLS of the seed as listed on the analysis tags and certification tags from all seed bags. Seed calculation worksheet per Table 7. PLS is the percentage of seed purity multiplied by the percentage of germination plus dormant seed. The analysis tag, required on all seed sold in Texas, includes information on quality: kind and variety of seed, lot number, percent pure live seed, percent other crop seed, percent inert matter, percent weed seeds, germination percentage, and date of test. The certification tag also verifies seed quality, an assurance of seed variety and attesting to standards for germination and purity. Information provided includes class of certification, kind of crop, variety, lot number, and name and address of the owner
- B. If fertilizer is proposed, results of a recent soil test (6 months old or less) of the area to be seeded, before fertilization. Soil samples shall be collected after final grading, when topsoil has been placed. The test results must include soil lab recommended additions of Nitrogen (N), Phosphorus (P), and Potassium (K) for the type of vegetation proposed, as well as soil organic matter percentage and textural class.
- C. Fertilizer formulation and release rate based on a soil test (see B above).
- D. For hydromulch applications, proposed application rate of seed, type of mulch and tacking agent, and other relevant information. An example of the required documentation is in Table 1.
- E. Type of hydraulic seeding equipment and nozzles proposed for use.
- F. If pesticide use is proposed, an IPM plan for pest removal including pesticide label, proposed application rate and timing, and MSDS sheets.
- G. One gallon sample of proposed vegetative mulch.

The following submittal items are required before Substantial Completion:

- A. For hydromulch applications, the complete hydromulch application log, including date, time and quantity of product units placed in the slurry tank. An example of an

application log is provided in Table 2. This log may be requested at any time during construction by the Landscape Architect, Engineer, or authorized inspector.

- B. Pesticide application tracking log. As of January 1, 2012, documentation of all outdoor pesticide use on city-owned properties is required to demonstrate compliance with the EPA/TCEQ mandated Municipal Stormwater Permit, the TPDES General Pesticide Permit, City Code, and the IPM program.

Table 1: Example of proposed hydromulch application rates

Hydro Mix	Sheet No.	Seed Mix	Acres	Hydro Slurry Unit (per acre rates)				
				Seed (Bags/ac)	Tackifier (Buckets/ac)	Mulch (Bales/ac)	Fertilizer (Bags/ac)	Addl. Amendments (Bags/ac)
1	L2	A	1.0	1	100	1000	50	5
F2	L3	A	0.5	2	200	1500	50	5
3	L5	B	3.0	3	300	3000	50	5

Table 2: Example of hydromulch application log

Date	Start Time	Finish Time	AC/ Tank	Water (gal)	Seed Mix	Hydro Slurry Unit (per acre rates)				
						Seed (Bags/ac)	Tackifier (Buckets /ac)	Mulch (Bales /ac)	Fertilizer (Bags/ac)	Addl. Amendments (Bags/ac)
4/13	10:30	11:15	1.0	330	A	1	100	1000	50	5
4/17	2:00	2:30	0.5	330	A	2	200	1500	50	5
5/20	8:30	10:00	1.2	330	B	3	300	3000	50	5
Totals						6	600	5500	127	15

604S.3. Materials

- A. Seed. All seed must meet the requirements of the Texas Seed Law including the labeling requirements for showing pure live seed (PLS), name and type of seed and all other required elements of the Analysis and Certification Tags.

The seed furnished shall be of the previous season's crop and the date of analysis, shown on each bag, shall be within twelve (12) months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers, unless a specific mix is proposed for use. A sample of each variety of seed shall be furnished for analysis and testing when directed by the Landscape Architect, Engineer or designated representative.

The amount of seed planted square yard (0.84 square meters) or per acre (hectare) shall be of the type specified in sections 604S.5 and 604S.6.

- B. Water. Water shall be clean and free of industrial wastes and other substances harmful to the growth of plant material or the area irrigated.
- C. Top soil. Top soil shall conform to Item No. 601S.3(A).
- D. Fertilizer. The fertilizer shall conform to Item No. 606S, "Fertilizer". The type and rate of fertilizer should be based on chemical tests of recent (no older than 6 months before application) representative site soil samples. Fertilizer should be applied only when plants can take them up for growth, during: 1) seed germination and plant establishment and 2) after plant establishment. Fertilizer shall not be applied within 48 hours of a potential rain event.
- E. Straw Mulch or Hay Mulch. Straw Mulch shall be oat, wheat or rice straw. Hay mulch shall be prairie grass, or other hay approved by the Landscape Architect, Engineer or designated representative. The straw or hay 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 moldy or rotted.
- F. Tackifier. The tackifier shall be a biodegradable tacking agent, approved by the Landscape Architect, Engineer or designated representative.
- G. Cellulose Fiber Mulch (Natural Wood). Cellulose Fiber Mulch shall be natural cellulose fiber mulch produced from grinding clean whole wood chips. The mulch shall be designed for use in conventional mechanical planting, hydraulic planting of seed or hydraulic mulching of grass seed, either alone or with fertilizers and other additives. The mulch shall be such, that when applied, the material shall form a strong, moisture-retaining mat without the need of an asphalt binder.
- H. Recycled Paper Mulch. Recycled paper mulch shall be specifically manufactured from post-consumer paper and shall contain a minimum of 85% recycled paper content by weight, shall contain no more than 15% moisture and 1.6% ash, and shall contain no growth inhibiting material or weed seeds. The recycled paper mulch shall be mixed with grass seed and fertilizer (see "fertilizer" above) for hydro-seeding/mulching, erosion control, and a binder over straw mulch. The mulch, when applied, shall form a strong, moisture-retaining mat of a green color without the need of an asphalt binder.
- I. Mulch. Mulches, acting as seed coverings, can enhance seed germination and seedling establishment. Characteristics of ideal mulches for seeding are those that protect seeds from wind (drying), excessive solar radiation, high evapotranspiration rates, and erosion, while allowing germination and growth. Relatively coarsely shredded, weed-free vegetative mulch should be used on seed installations, especially in open, sunny areas. These materials shall be clean, free of foreign matter, and dry enough to spread evenly.
- J. Pesticide. A least toxic, integrated pest management (IPM) approach shall be used to control weeds. A written request for approval of weed control products and materials shall be submitted to the City of Austin Watershed Protection Department (ERM) IPM program coordinator for approval. Additional information can be found at <http://www.austintexas.gov/ipm>.

604S.4 Construction Methods

- A. General. The Contractor shall limit preparation of the seedbed to areas that will be seeded immediately. When seeding for permanent erosion control, weed species listed in Table 3

shall be managed by application of an appropriate herbicide and/or by physical removal by the roots before the seeding operation. The goal of weed management is to facilitate establishment of the permanent vegetative cover. Additionally, the Owner may require removal of any plant species that appears to be out-competing seeded or planted species during the construction period.

Table 3: Weed List

Weed Type	Botanical Name	Common Name
Annual Grass	Cenchrus spp.	Sandbur
Herb	Cnidioscolus texanus	Bull Nettle
Herb	Urtica spp.	Stinging Nettle
Vine	Toxicodendron radicans	Poison Ivy
Perennial Grass	Sorghum halapense	Johnson Grass
Perennial Grass	Arundo donax	Giant Cane
Perennial Grass	Phyllostachys aurea	Golden Bamboo
Summer Annual Herb	Ambrosia trifida	Ragweed
Winter Annual Herb	Rapistrum rugosum	Bastard Cabbage
Winter Annual Herb	Bromus arvensis	Japanese Brome
Winter Annual Herb	Lolium multiflorum	Annual Ryegrass

- B. Preparing Seed Bed. After the designated areas have been rough graded to the lines, grades and typical sections indicated in the Drawings or as provided for in other items of this contract and for any other soil area disturbed by the construction, a suitable seedbed shall be prepared. The seedbed shall consist of a minimum of either 6 inches (150 millimeters) of approved topsoil or 6 inches (150 millimeters) of approved salvaged topsoil.

The topsoil or growing medium must be prepared so that compaction is appropriate for plant growth, and to achieve acceptable bulk density or hydrologic function. Rippers and subsoilers may be used to loosen compacted soil and roughen the surface. Disks, plows and excavator attachments are good for compaction reduction, roughening and incorporating amendments. If tracked machinery is used in seedbed preparation, cleat marks should run with the contour to prevent rills. The optimum depth for seeding shall be 1/8 to 1/4 inch (3 to 6 millimeters).

Water shall be gently applied as required to prepare the seedbed prior to the planting operation either by broadcast seeding or hydraulic planting. Seeding shall be performed in accordance with the requirements described below.

- C. Watering. All watering shall comply with City Code Chapter 6-4 (Water Conservation). All seeded areas regardless of seed type and method of seeding (e.g., broadcast, hydroseed) shall be watered immediately after installation. For seed germination and establishment it is important to keep the seedbed in a moist condition favorable for the growth of plant materials.

Watering applications shall constantly maintain the seedbed in a moist condition favorable for the growth of plant materials. Watering shall continue until the plant material is at least

1-1/2 inches (40 mm) in height and accepted by the Engineer or designated representative. Supplemental watering can be postponed immediately after a half- inch (12.5 mm) or greater rainfall on the site but shall be resumed before the soil dries out.

- D. Cool Season Cover Crop. From September 15 to March 1, non-native and native seeding shall include a cool season cover crop at the rate specified in Table 6. Cool season cover crops are not permanent erosion control. If installed separately from the permanently erosion control seed mix, the cool season cover crops shall be mowed to a height of less than one (1) inch after March 1, and the area shall be re-seeded at the specified seeding rate for non-native or native warm-season species (March 1 to September 15).

604S.5 Non-Native Seeding

- A. Method A - Broadcast Seeding. The seed or seed mixture in the quantity specified shall be uniformly distributed over the prepared seed bed areas indicated on the Drawings or where directed by the Engineer or designated representative. If the sowing of seed is by hand, rather than by mechanical methods, the seed shall be sown in two directions at right angles to each other. If mechanical equipment is used, all varieties of seed, as well as fertilizer (if required), may be distributed at the same time, provided that each component is uniformly applied at the specified rate. After planting, the planted area shall be rolled with a corrugated roller of the "Cultipacker" type. All rolling of the slope areas shall be on the contour.

Seed Mixture and Rate of Application for Broadcast Seeding:

From March 1 to September 15, seeding shall be with hulled Bermuda Grass at a rate of 45 lbs/ac (5.0 kilograms per hectare) with a minimum PLS = 0.83. Fertilizer shall be applied if warranted by a soil test, and shall conform to Item No. 606S, "Fertilizer". Bermuda grass is a warm-season grass and is therefore considered permanent erosion control once established.

Method B - Hydraulic Planting. The seedbed shall be prepared as specified above and hydraulic planting equipment, which is capable of placing all materials in a single operation, shall be used. Information about hydromulching for temporary and permanent vegetation stabilization is in the Environmental Criteria Manual (ECM) Section 1.4.7.

Hydroseeding equipment shall be clean and free of all previous seeds, fertilizer, mulch, or any hydroseeding products used on prior jobs.

March 1 to September 15

Hydraulic planting mixture and minimum rate of application pounds per acre or square yard (kilograms per ha):

Hulled Bermuda Seed (min. PLS=0.83)	Fiber Mulch		Soil Tackifier
	Cellulose	Wood	
45 Lbs/ac (50.44 kg/ha)	2000 Lbs/ac (2242 kg/ha)		60.98 Lbs/ac (68.36 kg/ha)
		2500 Lbs/ac (2803 kg/ha)	65.34 Lbs/ac (73.25 kg/ha)

604S.6 Native Grass and Forb Seeding

The seed mixture shall include both grasses and forbs. The dry and moist sites grass mix shall be seeded at rates of at least 23.5 and 17.0 lb/ac (26.32 and 19.04 kg/ha), respectively and the dry and wet site forb mix shall be seeded at a rate of at least 11.5 and 9.0 lb/ac (12.88 and 10.08 kg/ha), for total application rates of 35.00 lb/ac (39.20 and 29.12 kg/ha) [dry site] and 26 lb/ac (29.12 kg/ha) [wet site]. Minimum diversity for dry sites (Table 4) is eight species of grasses and 10 species of forbs. Minimum diversity for wet sites (Table 5) is six species of grasses and seven species of forbs. The species indicated with an asterisk shall be included in all proposed mixes. Application rates may be modified, but no species shall constitute more than 20% of a seed mix. Any species proposed for installation and not included in Tables 4 or 5 shall be by City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative, and shall be native to Central Texas as referenced by the LBJ Wildflower Center plant database (www.wildflower.org) or USDA plant database.

Table 4: Native Grasses and Forbs: Dry Sites

Type	Common Name	Botanical Name	Exposure	Recommended Application Rates	
				lbs/ac	kg/ha
Grass Seed Mix	Sideoats grama*	Bouteloua curtipendula	Full-part sun	7.0	7.8
	Green sprangletop*	Leptochloa dubia	Full sun	6.0	6.7
	Buffalograss	Buchloe dactyloides	Full sun	24.0	27.0
	Blue Grama Grass	Bouteloua gracilis	Full-part sun	10.0	11.2
	Canada Wild Rye	Elymus canadensis	Full-part sun	10.0	11.2
	Purple Three-Awn	Aristida purpurea	Full sun	4.0	4.5
	Cane Bluestem	Bothriochloa barbinodis	Full sun	3.0	3.3
	Galleta	Pleuraphis jamesii	Full sun	10.0	11.2
	Black Grama*	Bouteloua eripoda	Full sun	10.0	11.2
	Sand Dropseed*	Sporobolus cryptandrus	Full sun	1.0	1.1
	Alkali Sacaton	Sporobolus airoides	Full sun	0.5	1.7
	Curly Mesquite	Hilaria belangeri	Full sun	2.0	2.2
	Sand Lovegrass	Eragrostis trichodes	Full sun	2.0	2.2
	Black-Eyed Susan	Rudbeckia hirta	Full-part sun	2.0	2.2

	Illinois Bundleflower*	Desmanthus illinoensis (legume)	Full-part sun shade	15.0	16.8
	Scarlet Sage	Salvia coccinea	Full-part sun shade	8.0	9.0
	Pink Evening Primrose	Oenothera speciosa	Full-part sun shade	1.0	1.1
	Drummond Phlox	Phlox drummondii	Full-part sun	8.0	9.0
	Plains Coreopsis	Coreopsis tinctoria	Full-part sun	2.0	2.2
	Greenthread	Thelesperma filifolium	Full sun	6.0	6.7
	Purple Prairie Clover*	Dalea purpurea	Full sun	4.0	4.5
	Cutleaf Daisy	Engelmannia pinnatifida	Full-part sun	18.0	20.1
Forb Seed Mix	Partridge Pea*	Chamaecrista fasciculata	Full-part sun	20.0	22.4
	Indian Blanket	Gaillardia pulchella	Full-part sun	10.0	11.2
	Bluebonnet*	Lupinus texensis (legume)	Full sun	20.0	22.4
	Mexican Hat	Ratibida columnaris	Full-part sun	2.0	2.2
	Maximilian Sunflower	Helianthus maximiliana	Full-part sun	5.0	5.6
	Prairie Coneflower	Ratibida columnifera	Full-part sun	2.0	2.2
	Clasping Coneflower	Dracopis amplexicaulis	Full-part sun	3.0	3.4
	Purple Coneflower	Echinacea purpurea	Full-part sun shade	10.0	11.2
	Lemon Mint	Monarda citriodora	Full-part sun	3.0	3.4
	Huisache Daisy	Amblyolepis setigera	Full-part sun	8.0	9.0
	Texas Yellow Star	Lindheimera texana	Full-part sun	12.0	13.5
	Lanceleaf Coreopsis	Coreopsis lanceolata	Full-part sun shade	10.0	11.2
	Bush Sunflower	Simsia calva	Full-part sun	3.0	3.4
	Winecup	Callirhoe involucrata	Full-part sun shade	5.0	5.6
	Antelope horns	Asclepias asperula	Full sun	0.1	0.04
	Green milkweed	Asclepias viridis	Full sun	0.1	0.04
TOTAL					
Total seed mix application rate is 35.0 lb/ac (23.5 lb/ac grasses and 11.5 lb/ac forbs), to be composed of at least 8 species from the grass list and 10 species from the forb list to include the required species.					

*Required species that must be included in the mix

Table 5: Native Grasses and Forbs: Wet Sites

Type	Common Name	Botanical Name	Exposure	Recommended Application Rates	
				lbs/ac	kg/ha
Grass Seed Mix	White Tridens	Tridens albescens	Full-part sun	0.5	0.56
	Plains Bristlegrass	Setaria leucopila	Full-part sun	6.0	6.7
	Switchgrass	Panicum virgatum	Full-part sun	4.0	4.5
	Inland Sea Oats	Chasmanthium latifolium	Shade	12.0	13.5
	Canada Wild Rye	Elymus canadensis	Full sun - shade	10.0	11.2
	Big Bluestem	Andropogon gerardii	Full sun	4.0	4.5
	Bushy Bluestem	Andropogon glomeratus	Full sun	3.0	3.4
	Green Sprangletop*	Leptochloa dubia	Full sun	2.0	2.2
	Eastern Gamagrass	Tripsacum dactyloides	Full sun - shade	3.0	3.4
Forb Seed Mix	American Basketflower	Centaurea americana	Full sun	10.0	11.2
	Common milkweed	Asclepias syriaca	Full sun	0.1	0.04
	Butterfly weed	Asclepias tuberosa	Full sun	0.1	0.04
	Blue Mistflower	Conoclinium coelestinum	Full-part sun	0.5	0.6
	Clasping Coneflower	Dracopsis amplexicaulis	Full-part sun	3.0	3.4
	Maximilian Sunflower	Helianthus maximiliani	Full-part sun	4.0	4.5
	Prairie Blazing Star	Liatris pycnostachya	Full sun	2.0	2.2
	Pink Evening Primrose	Oenothera speciosa	Full sun-dappled shade	1.0	1.1
	Mexican Hat	Ratibida columnifera	Full-part sun	2.0	2.2
	Black-eyed Susan	Rudbeckia hirta	Full sun-dappled shade	2.0	2.2
	Illinois Bundleflower	Desmanthus illinoensis	Full sun-dappled shade	15.0	16.8
	Obedient Plant	Physostegia virginiana	Full sun-dappled shade	4.0	4.5
	Partridge Pea*	Camaecrista fasciculata	Full-part sun	20.0	22.4

Type	Common Name	Botanical Name	Exposure	Recommended Application Rates	
				lbs/ac	kg/ha
	Purple Prairie Clover	<i>Dalea purpurea</i> var <i>purpurea</i>	Full sun	4.0	4.5
	Pitcher Sage	<i>Salvia azurea</i>	Full-part sun	3.0	3.4
	Showy Tick Trefoil	<i>Desmodium canadense</i>	Full sun	0.5	0.6
	Winecup*	<i>Callirhoe involucrata</i>	Full-part sun	5.0	5.6
TOTAL					
Total seed mix application rate is 26.0 lb/ac (17.0 lb/ac grasses and 9.0 lb/ac forbs), to be composed of at least 8 species from the grass list and 10 species from the forb list to include the required species.					

Table 6: Cool Season Cover Crop				
Common Name	Botanical Name	Exposure	Application rates	
			lbs/ac	kg/ha
Western Wheatgrass	<i>Pascopyrum smithii</i>	Full-pt sun; dappled shade	5.6	6.28
Oats	<i>Avena sativa</i>	Full sun	4.0	4.48
Cereal Rye Grain	<i>Secale cereale</i>	Full sun	34.0	38.11

One cover crop species of the listed species is required to be planted between September 15 to March 1. Contractor must ensure that any seed application requiring a cool season cover crop does not utilize annual ryegrass (*Lolium multiflorum*) or perennial ryegrass (*Lolium perenne*). Only cereal rye grain (*Secale cereale*), oats (*Avena sativa*) and western wheatgrass (*Pascopyrum smithii*) are approved as cool season cover crop.

Species substitution as necessary due to availability shall be approved by the Landscape Architect, Engineer or designated representative. Watering and fertilizer application shall follow procedures outlined above or as otherwise specified on the Drawings.

Seed shall be applied by broadcast, hydromulch, blown compost, or drill method and shall be distributed evenly over the topsoil areas. Mulching shall immediately follow seed application for broadcast and hydromulch applications.

Seed Rate Calculations

The amount of seed needed to be planted on a project shall be calculated before installation to ensure adequate seed is placed, and provided as a submittal. Table 7 is an example worksheet, followed by an example calculation. Information for calculation can be obtained from seed tags or the supplier.

Table 7. Seed Calculation Worksheet

Plant Group	Desired Seeding Rate (lbs/ac)	PLS (pure live seed)	Bulk Rate (lbs/ac)	Seeding Area (ac)	Amt. of Seed to be Installed (lbs)
Grasses					
Forbs					
TOTAL					

FORMULAE:

PLS (pure live seed) = (Purity x Germination) x 100. Can also use average PLS from seed tags.

Bulk Rate (lbs/AC) = Desired Seed Rate (lbs/AC)/PLS

Amt. of Seed to be Installed (lbs) = Bulk Rate (lbs/AC) x Seeding Area (AC)

Example:

Plant Group	Desired Seeding Rate (lbs/ac)	PLS (pure live seed)	Bulk Rate (lbs/ac)	Seeding Area (ac)	Amt. of Seed to be Installed (lbs)
Grasses	131.00	0.81	161.73	1.50*	242.60
Forbs	65.34	0.87	75.10	1.50*	112.70
TOTAL	196.34	0.84 (ave.)	236.83	1.50	355.30

604S.7 Mulch

Mulches may be used to help prevent soil erosion until final stabilization is achieved. Mulch shall be used to cover broadcasted seeds, especially in sunny, open areas, to protect them from drying out during germination.

A. Straw Mulch.

Straw mulch shall be spread uniformly over the area indicated or as designated by the Engineer or designated representative at the rate of 2 to 2 1/2 tons of straw per acre (4.5 to 5.6 megagrams of straw per hectare). The actual rate of application will be designated by the Landscape Architect, Engineer or designated representative. Straw may be hand or machine placed and adequately secured.

B. Hydromulch

Refer to ECM Section 1.4.7 for hydromulching applications.

C. Shredded Brush Mulch.

Small brush or tree limbs, which have been shredded, may be used for mulching Native for mulching Native Grass seeding.

604S.8 Management Practices

Management Practices include (1) weed management (pesticide application or mechanical removal) to so that 90 percent of the revegetation area is free of weeds listed in Table 3, and (2) reseeding areas of poor germination to achieve coverage and height per 604S.9, with no bare areas greater than 10 s.f..

Ninety (90) percent of a permanent revegetation area must be free of weeds listed in Table 3. Weeds shall be controlled in the most efficient manner possible. Management of weed species should begin early in the project, before seeding for permanent control, and extend into plant establishment, especially for perennial weeds. Manual removal or application of an appropriate herbicide may be required after the initial seeding if emergence of an annual weed species threatens establishment of sufficient preferred plant cover. Disturbance due to weed management after the initial seeding may necessitate re-seeding of the area to establish sufficient preferred plant coverage. Care should be taken to temporarily stabilize areas where physical removal of weeds has been performed to prevent erosion and sediment runoff.

The entire root system of perennial weeds shall be removed to prevent re-sprouting. Weeds may be controlled with an approved contact, systemic herbicide, provided the product is used with appropriate care and is applied in accordance with label instructions and the following guidelines:

1. Herbicide shall not be applied when the wind is greater than 8 mph (12.9 kph),
2. Herbicide shall not be applied when rainfall is expected within 24 hours,
3. Herbicide shall not contact surface water, i.e. creeks, rivers, and lakes,
4. Herbicide shall not contact desirable vegetation (a wicking method shall be used, if necessary, to accurately contact target weed only during application).

The Landscape Architect, Engineer or designated representative shall be consulted to determine appropriate weed control management when weeds are located in an environmentally sensitive location (e.g. near water or adjacent to a critical environmental feature).

At locations that fail to show an acceptable stand of planting for any reason during the initial seeding, repair and/or reseed locations as determined by the Landscape Architect, Engineer or designated representative. A successful stand of grasses and forbs for erosion control should exhibit the following:

- Seedlings with vigorous green foliage;
- Green leaves remaining throughout the summer, at least at the plant bases;
- Uniform density, with grasses and/or forbs well intermixed;
- Minimum of 95% cover; and
- No exposed soil greater than 10 s.f. in aerial extent.

The Contractor shall meet the requirements of the initial seeding, including seeding method, seed mix, and application rates, unless otherwise agreed to in writing by the Owner. Corrected deficiencies will be re-inspected and approved by the Owner, and final acceptance will be granted upon satisfactory completion.

604S.9 Measurement

Work and acceptable material for "Seeding for Erosion Control" will be measured by the square yard (meter: 1 meter equals 1.196 square yards) or by the acre (hectare: 1 hectare equals 2.471 acres), complete in place, so that all areas of the site that rely on vegetation for stability must be uniformly vegetated with a minimum of 95 percent total coverage for the non-native or native mixes, and 95 percent coverage for the native mix. Bare areas shall not exceed 16 square feet (1.5 square meters), and the average height of vegetation shall stand at a minimum of 1 1/2 inch (40 millimeters). Ninety (90) percent of the revegetated area, whether native or non-native re-vegetation, must be free of weeds listed in Table 3. Bare areas greater than 10 s.f. shall be re-prepared and reseeded as required to develop an acceptable stand of plant material.

604S.10 Payment

The work performed and materials furnished and measured will be paid for at the unit bid price for "Seeding for Erosion Control" of the method specified on the Drawings and type of mulch. The unit bid price shall include full compensation for furnishing all materials, including all topsoil, water, seed, tackifier, fertilizer or mulch and for performing all operations necessary to complete the work.

All fertilizer will be measured and paid for conforming to Item No. 606S, "Fertilizer".

Payment will be made under one of the following:

Pay Item No. 604S-A:	Non-Native Seeding for Erosion Control Method, Hydraulic Planting	Per Square Yard
Pay Item No. 604S-B:	Non-Native Seeding for Erosion Control, Broadcast Seeding	Per Square Yard
Pay Item No. 604S-C:	Non-Native Seeding for Erosion Control Method, Hydraulic Planting	Per Acre
Pay Item No. 604S-D:	Native Seeding for Erosion Control Method, Hydraulic Planting	Per Square Yard
Pay Item No. 604S-E:	Native Seeding for Erosion Control, Broadcast Seeding,	Per Square Yard
Pay Item No. 604S-F:	Native Seeding for Erosion Control Method, Hydraulic Planting	Per Acre
Pay Item No. 604S-G:	Mulch,	Per Square Yard
Pay Item No. 604S-H:	Mulch,	Per Acre
Pay Item No. 604S-I:	Topsoil and Seedbed Preparation,	Per Square Yard
Pay Item No. 604S-J:	Topsoil and Seedbed Preparation,	Per Acre
Pay Item No. 604S-K:	Watering,	Per 1000 gal (Kgal)
Pay Item No. 604S-L:	Management Practices,	Per Square Yard
Pay Item No. 604S-M:	Management Practices,	Per Acre

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
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Specification Item 604S "Seeding for Erosion Control"

City of Austin Technical Specifications

Designation	Description
Item No. 130S	Borrow
Item No. 601S	Salvaging and Placing Topsoil
Item No. 606S	Fertilizer

City of Austin Land Development Code

Designation	Description
Section 6-4	Water Conservation

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item 604S "Seeding for Erosion Control"

City of Austin Technical Specifications

Designation	Description
Item No. 601S	Salvaging and Placing Topsoil
Item No. 602S	Sodding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 607S	Slope Stabilization
Item No. 608S	Planting

City of Austin Standards (Details)

Designation	Description
627S-1	Grass Lined Swale
633S-1	Landgrading

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

Designation	Description
Item No. 160	Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 180	Wildflower Seeding
Item No. 192	Landscape Planting

Item No. 605S
Soil Retention Blanket

605S.1 Description

This item shall govern the provision and placement of wood, straw or coconut fiber mat, synthetic mat, paper mat, jute mesh or other material as a soil retention blanket for erosion control on slopes or ditches or short-term or long-term protection of seeded or sodded areas indicated on the Drawings or as specified 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 with SI units shown within parentheses.

605S.2 Submittals

The submittal requirements for this specification item shall include the soil retention blanket material type and sample, evidence that the material is listed on TxDOT/TTI Approved Products List, one (1) full set of Manufacturer's literature and installation recommendations, and any special details necessary for the proposed application.

605S.3 Materials

A. Soil Retention Blankets

All soil retention blankets must be listed on TxDOT Approved Products List or approved by the Engineer or designated representative.

The soil retention blanket shall be one (1) of the following classes and types as shown on the Drawings:

1. Class 1. "Slope Protection"

- (a) Type A. Slopes 1:3 or flatter - Clay soils
- (b) Type B. Slopes 1:3 or flatter - Sandy soils
- (c) Type C Slopes steeper than 1:3 - Clay soils
- (d) Type D Slopes steeper than 1:3 - Sandy soils

2. Class 2. "Flexible Channel Liner"

- (a) Type E Short-term duration (Up to 2 years)
Shear Stress (t_d) < 1 pound per square foot [psf] (48 Pa)
- (b) Type F Short-term duration (Up to 2 years)
Shear Stress (t_d) 1 to 2 psf (48 to 96 Pa)
- (c) Type G Long-term duration (Longer than 2 years)
Shear Stress (t_d) >2 to <5 psf (>96 to <239 Pa)
- (d) Type H Long-term duration (Longer than 2 years)
Shear Stress (t_d) \geq 5 psf (\geq 239 Pa)

B. Fasteners

The fasteners shall conform to the recommendations of the manufacturer for the selected soil retention blanket.

605S.4 Construction Methods

A. General

The soil retention blanket shall conform to the class and type shown on the Drawings. The Contractor has the option of selecting an approved soil retention blanket conforming to the class and type shown on the Drawings which is included on the Approved Products List published by TxDOT/TTI Hydraulics and Erosion Control Laboratory.

B. Site Preparation:

Prior to placement of the soil retention blanket, the seedbed area to be covered shall be relatively free of all clods and rocks over 1 1/2 inches (37.5 mm) in maximum dimension and all sticks or other foreign matter that will prevent close contact of the preparation mat with the soil surface. The area shall be smooth and free of ruts and other depressions. If the prepared seedbed becomes crusted or eroded as a result of rain or if any eroded places, ruts or depressions exist for any reason, the Contractor shall be required to rework the soil until it is smooth and to reseed or resod the area at the Contractor's own expense. After the area has been properly prepared, the blanket shall be laid out flat, even and smooth, without stretching or crimping the material.

C. Installation

The Soil Retention Blanket, whether installed as slope protection or as flexible channel liner in accordance with the TxDOT/TTI Approved Products List, shall be placed within 24 hours after seeding (Standard Specification Item No. 604S), sodding (Standard Specification Item No. 602S) or native grassland seeding and planting (Standard Specification Item No. 609S) erosion control operations have been completed, or as approved by the Engineer or designated representative. The soil retention blanket shall be installed and anchored in accordance with the Manufacturer's recommendations. The Contractor shall contact the Engineer or designated representative three (3) days prior to the installation of the soil retention blanket to allow for inspection of the installation by City of Austin personnel.

605S.5 Measurement

This work and acceptable material for "Soil Retention Blanket" will be measured by the square yard (square meter: 1 square meter is equal to 1.196 square yards) of surface area covered, complete in place.

605S.6 Payment

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit bid price for "Soil Retention Blanket" of the class shown on the Drawings or approved by the Engineer or designated representative. The unit price shall include full compensation for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work. Anchors, checks, terminal and wire staples will not be paid for directly, but will be included in the unit price bid for this specification item.

Payment will be made under the following:

Pay Item No. 605S-A: Soil Retention Blanket Class___; Type ___ - Per Square Yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 605S, "Soil Retention Blanket"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 609S	Native Grassland Seeding and Planting for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 606S
Fertilizer

606S.1 Description

This item shall govern the provision and distribution of fertilizer over the areas indicated on the Drawings and in accordance with these specifications.

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

606S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Type of soil(s) at the site.
- B. Type(s) of re-vegetation (seeding, sodding, etc).
- C. Type(s) of fertilizer.
- D. Rate(s) of application of fertilizer.
- E. Chemical analysis of the fertilizer(s).

606S.3 Materials

All fertilizer used on site shall be delivered in bags or containers, which are clearly labeled and show the analysis. The figures in the analysis shall represent the percent of nitrogen, phosphoric acid and potash nutrients, respectively, as determined by the methods of the Association of Official Agricultural Chemists. The fertilizer may be subject to testing by the State Chemist in accordance with the Texas Fertilizer Law. A pelleted or granulated fertilizer shall be used.. Fifty percent or greater of the Nitrogen required shall be in the form of Nitrate Nitrogen (NO_3). The remaining Nitrogen required may be in the form of Urea Nitrogen [$\text{CO}(\text{NH}_2)_2$].

The total amount of nutrients furnished and applied per acre (hectare: 1 hectare equals 2.471 acres) shall equal or exceed that specified for each nutrient.

606S.4 Construction Methods

General requirements and criterion for vegetative activities, including fertilizing, for the City of Austin are presented in Section 1.4.4, "Vegetative Practice", and Section 1.5.4, "Revegetation Criteria" of the City of Austin Environmental Criteria Manual.

The fertilizer type and rate of application should be based on chemical tests of representative soil samples taken after completion of construction and ground work. Appropriate initial fertilizer application rates for the Austin area (in lieu of recommendations from soil testing) are provided in the sections of the City of Austin Environmental Criteria Manual identified below:

- A. Permanent seeding. - [Section 1.4.4.B.4].
- B. Restoring Climax Grasses - [Section 1.5.5.E].
- C. Sod. - [Section 1.4.4.E.5].
- D. Maintenance of Mulch Sod. - [Section 1.4.4.C.4].

Pelleted or granulated fertilizer shall be applied uniformly into the soil to a depth of 4 inches (100 mm) over the area specified on the Drawings to be fertilized and in the manner directed for the particular item of work. The fertilizer shall be dry and in good physical condition. Fertilizer that is powdered or caked will be rejected. Distribution of the fertilizer for the particular item of work shall meet the approval of the Engineer or Designated Representative.

Maintenance fertilizing shall be applied every 6 months after the new sod or grass is placed or until the work is accepted by the City.

The fertilizer may also be applied with the hydromulch

606S.5 Measurement

Work and acceptable material for "Fertilizer" will be measured by the normal ton of 2,000 pounds (megagrams: 1 megagram equals 1.1023 tons) or by the 100 pounds (50 kilograms: 1 kilogram equals 2.205 pounds) as determined by approved scales or guaranteed weight of sacks shown by the manufacturer.

606S.6 Payment

The work performed and materials furnished and measured as provided under "Measurement" shall be included in the unit price bid for the item of construction in which fertilizer is used, unless specified in the Drawings as a Pay Item.

When fertilizer is specified on the Drawings as a pay item or included in the contract bid form, the work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price for "Fertilizer" of the analysis specified on the Drawings. The unit bid price shall include full compensation for furnishing all materials and performing all operations necessary to complete the work.

Payment, when specified, will be made under one of the following:

Pay Item No. 606S-A:	Fertilizer	Per Ton.
Pay Item No. 606S-B:	Fertilizer	Per 100 Pounds.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
Specification Item 606S "Fertilizer"	

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 1.4.4.B.4	Design Criteria of Section B. Critical Area Stabilization (with Permanent Seeding)
Section 1.4.4.C.4	Design Criteria of Section C. Critical Area Stabilization (with Mulch Sod)
Section 1.4.4.E.5	Site Preparation of Section E. Critical Area Stabilization (with Sod)
Section 1.5.5.E	Fertilizer, Section E of 1.5.5, "Restoring Climax Grasses"

RELATED CROSS REFERENCE MATERIALS
Specification Item 606S "Fertilizer"

City of Austin Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 601S	Salvaging and Placing Topsoil
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 607S	Slope Stabilization
Item No. 608S	Planting
Item No. 609S	Native Grassland Seeding and Planting for Erosion Control
Item No. 610S	Preservation of Trees and Other Vegetation

Item No. **607S**
Slope Stabilization Applications
For Erosion Control

607S.1 Description

This item shall govern the construction of slope stabilization devices, where plant growth cannot be readily established or sustained without slope stabilization measures, in conformance with this Specification Item and in accordance with locations, lines and grades indicated on the Drawings or as directed by the Engineer or designated representative.

This Standard Specification Item shall apply to erosion control measures only and shall not apply to structural stabilization of slopes.

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

607S.2 Submittals

The submittal requirements for this specification item shall include the soil retention blanket material type and sample, evidence that the material is listed on the current version of TxDOT/TTI's Approved Products List, one (1) full set of manufacturer's literature and installation recommendations, and any necessary special details.

607S.3 Materials

A. Precast Concrete Units.

Concrete units shall be precast concrete blocks with a 12 to 16 inch (300 to 400 mm) module and shall be 4 or 6 inches (100 or 150 mm) thick, as indicated on the Drawings. The concrete shall attain a minimum 28-day compressive strength of 4000 psi (27.5 megaPascals) in conformance to Class S of Standard Specification Item No. 403, "Concrete for Structures". Each precast concrete unit will weigh at least 30 pounds per cubic foot (480 kilograms per cubic meter) and the open void area will range from 20 to 25 percent.

The Filter/carrier fabric shall conform to Item No. 620S, "Filter Fabric". The fabric shall be of sufficient strength to support not less than 1 1/2 times the weight (mass) of the mat when slung by lifting at both ends.

B. GeoGrid

GeoGrid shall consist of polypropylene base and shall be: 1) resistant to all natural occurring alkaline and acidic soil conditions, 2) resistant to attack by bacteria and fungi, and 3) ultraviolet stable. The plastic grid shall have a thermal stability range from -60° F to 175° F (-50°C to 80°C) and a Melt Index of 0.2 grams/10 minutes.

Geogrid shall have a density between 75 to 106 pounds per cubic feet (1.2 to 1.7 megagrams per cubic meter) and thickness shall be 0.15 to 0.25 inch (4 to 6 mm).

Tensile strength shall be 860 to 1230 pounds per square foot (41 to 59 mPa) across the roll.

C. Earth Reinforcement System

A patented earth reinforcement system shall consist of interlocking precast reinforced concrete units of the size, shape and texture indicated on the Drawings, placed on a concrete foundation. All precast concrete shall be Class S, with a minimum 28 day compressive strength of 4000 psi (27.5 mPa), cast-in-place concrete shall be Class A, conforming to Item No. 403, "Concrete for Structures". All joints shall be caulked and protected with a filter fabric as indicated on the Drawings. All reinforcing steel shall conform to Item No. 406, "Reinforcing Steel". All tie back and reinforcing mesh shall be in accordance with manufacturer's recommendations.

Filter fabric to conform to Item No. 620S, "Filter Fabric.

D. Gabions and Revet Mattresses.

Gabions shall be assembled and placed as directed on the Drawings in accordance with Standard Specification Item No. 594S, " Gabions and Revet Mattresses".

E. Additional Materials and Methods

In addition to those systems described above, the following items may be used in combinations or separately, as indicated on the Drawings:

Standard Specification Subject	Item No
Concrete for Structures	403S
Concrete Structures	410
Riprap for Slope Protection	591S
Concrete Retards	593S
Sodding for Slope Stabilization	602S
Seeding for Slope Stabilization	604S
Salvaging and Placing Topsoil	601S
Soil Retention Blanket	605S
Filter Fabric	620S
Dry Stack Wall (DS)	623S
Rock Berm (RB)	639S
Mortared Rock Wall (RW)	640S

Additional Products not mentioned herein may be indicated on the Drawings.

607S.4 Construction Methods

A. Precast Concrete Units

1. Subgrade Preparation.

The slope on which the units are to be placed shall be constructed according to lines and grades indicated on the Drawings. Fill materials shall be placed in lifts, which do not exceed 8 inch (200 mm) loose measure, and compacted to a minimum of 95 percent of maximum dry density as determined in accordance with

TxDOT Test Method Tex-114-E or as approved by the Engineer or designated representative.

2. Placing the Units.

The precast concrete units shall be placed on a concrete foundation in accordance with the manufacturer's recommendations. Filter fabric will be required.

3. Backfill.

Backfill shall consist of fine granular material or topsoil as indicated on the Drawings or as approved by the Engineer or designated representative. Seeding or sodding, when required, shall be placed directly over topsoil and shall conform to Item No. 604S, "Seeding for Erosion Control" and Item No. 602S, "Sodding for Erosion Control".

B. GeoGrid

1. Subgrade Preparation.

The compacted slope on which the plastic grids are to be placed shall be constructed according to the lines and grades indicated on the Drawings. Prior to placement the grid, pieces of wood, rock, concrete, brick or other objects that might damage the plastic grid shall be removed.

2. Placement of the Geo Grid.

The grid shall be placed directly on the ground surface. Adjacent and adjoining rolls shall be overlapped and tied in accordance with manufacturer's recommendations by a minimum of 1 and 6 feet (0.3 to 1.8 meters) respectively. The grid shall be installed and anchored in accordance with manufacturer's recommendations and details indicated on the Drawings.

Any damage to the fabric as a result of Contractor's vehicles, equipment or operations shall be repaired at Contractor's own expense.

The amount of grid placed shall be limited to that which can be covered with backfill within the succeeding 72 hours.

3. Backfill.

A minimum thickness of 4 inches (100 mm) of fine granular material shall be placed directly over the plastic grid and compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with TxDOT Test Method Tex-114-E. Seeding or sodding shall be placed on areas backfilled as indicated on the Drawings and shall conform to Item No. 604S, "Seeding for Erosion Control" or Item No. 602S, "Sodding for Erosion Control".

C. Earth Reinforcement System

1. Excavation.

Excavation shall conform to applicable requirements of Standard Specification Item No. 111S, "Excavation" and Standard Specification Item No. 401, "Structural Excavation and Backfill" in accordance with limits and construction stages indicated on the Drawings. Any foundation soils found to be unsuitable shall be removed and replaced with acceptable backfill material.

2. Foundation.

The foundation subbase for the structure, approved by the Engineer or designated representative, shall be graded and then compacted to 95 percent of the maximum dry density as determined in accordance with TxDOT Test Method Tex-114-E. The leveling pad shall be constructed of Class A concrete conforming to Standard Specification Item No. 403S, "Concrete for Structures", along the lines and grades indicated on the Drawings.

3. Wall Erection.

The wall modules, joint filler and leveling pads shall be placed as indicated on the Drawings in accordance with the manufacturer's recommendations. Special care shall be taken in setting the bottom course of units to true line and grade.

All modular units above the first course level shall interlock with lower courses. Vertical joints shall be staggered with each successive course. The vertical joints on the front face of the wall shall not exceed 3/4 inch (19 mm) tolerance. Joint filler shall be installed in all joints and filter fabric shall be installed behind the wall as indicated on the Drawings. The overall vertical tolerance of wall plumbness (from top to bottom) shall not exceed 1/2 inch per 10 feet (4 mm per meter) from the dimensions indicated on the Drawings.

4. Drainage. Drainage shall conform to Standard Specification Item No. 551, "Pipe Underdrains" and to the details indicated on the Drawings.

5. Backfill.

The placement of the backfill shall follow closely behind the erection of each lift of panels. The maximum lift thickness shall not exceed 8 inches (200 mm), loose measure. At each reinforcing mesh level, the backfill shall be roughly leveled before placing and attaching mesh. Reinforcing mesh or straps shall be placed normal to the face of the wall.

Backfill compaction shall be accomplished without disturbance or distortion of reinforcing mesh, filter fabric and face panels. All backfill shall be compacted to 95 percent maximum dry density as determined in accordance with TxDOT Test Method Tex-114-E. The Contractor shall decrease the lift thickness, if necessary, to obtain the specified density. During backfill compaction the moisture content may not exceed a value 2 percent greater than maximum dry density (i.e. optimum as determined by TxDOT Test Method Tex-114-E).

Compaction of the backfill shall not be accomplished by sheep foot, grid rollers or any other type of equipment employing a foot, which in the opinion of the Engineer or designated representative could damage the reinforcing mesh. At the end of each day's operation, the Contractor shall shape the backfill to drain away from the face of the wall.

All backfill material used adjacent to the structure shall be crushed stone, that is free from organic or otherwise deleterious materials, and the grading of the backfill material established in accordance with TxDOT Test Method Tex-110-E shall conform to the following gradation limits.

Sieve Size		Percent Passing
US	SI	

6 inches	150 mm	100
3 inches	75 mm	75 -100
No. 200	75µm	0-15

607S.5 Measurement

Work and accepted material for "Slope Stabilization" will be measured by the square yard (square meter: 1 square meter is equal to 1.196 square yards), complete in place from the top of the foundation to the top of the slope stabilization erosion control. Foundations will not be measured for payment.

607S.6 Payment

Work performed and materials furnished as prescribed by this Specification Item and measured under "Measurement" will be paid for at unit bid price per square yard for "Slope Stabilization for Erosion Control". The unit bid price shall include full compensation for: a) all excavation, foundation installation, subgrade preparation, placement of filter fabric, underdrains, precast blocks and tie backs, and b) all labor, tools, equipment and incidentals necessary to complete the backfilling operations.

Payment will be made under:

Pay Item No. 607S-A:	Precast Concrete Unit	Per Square Yard.
Pay Item No. 607S-B:	GeoGrid, _____	Per Square Yard.
Pay Item No. 607S-C:	Earth Reinforcement System	Per Square Yard.

End

<i>SPECIFIC</i> CROSS REFERENCE MATERIALS
Specification 607S, "Slope Stabilization Applications For Erosion Control"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 111S	Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 403S	Concrete for Structures
Item No. 406	Reinforcing Steel
Item No. 410	Concrete Structures
Item No. 551	Pipe Underdrains
Item No. 591S	Riprap for Slope Protection
Item No. 593S	Concrete Retards
Item No. 594S	Gabions and Revet Mattresses
Item No. 601S	Salvaging and Placing Topsoil
Item No. 602S	Sodding for Erosion Control

<i>SPECIFIC</i> CROSS REFERENCE MATERIALS - Continued
Specification 607S, "Slope Stabilization Applications For Erosion Control"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 604S	Seeding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 620S	Filter Fabric
Item No. 623S	Dry Stack Wall (DS)
Item No. 639S	Rock Berm (RB)
Item No. 640S	Mortared Rock Wall (RW)

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Item No. 110-E	Surveying and Sampling Soils for Highways
Item No. 114-E	Laboratory Compaction Characteristics & Moisture-Density Relationship of Subgrade & Embankment Soil

TxDOT/TTI Hydraulics and Erosion Control Laboratory

<u>Designation</u>	<u>Description</u>
Annual Report	Approved Products List

<i>RELATED CROSS REFERENCE MATERIALS</i>
Specification 607S, "Slope Stabilization Applications For Erosion Control"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 609S

Native Grassland Seeding and Planting for Erosion Control

609S.1 Description

This item shall govern the preparation of a seeding and planting area to the lines and grades indicated on the Drawings. This may include seedbed preparation, sowing of seeds, planting of rooted plants, watering, hydromulch, compost and other management practices, as indicated in the Drawings or as directed 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 with SI units shown within parentheses.

609S.2 Submittals

The submittal requirements for this specification item shall include:

- A. For seed, provide Identification of the species, source, mixture and pure live seed (PLS) of the seed as listed on each seed bag to be used. Copies of the analysis tags and certification tags from all seed bags shall be submitted.
- B. Type of mulch or compost.
- C. Watering frequency and amount as shown on an irrigation watering schedule.
- D. Type of management practices (e.g., hand weeding, pesticide application, etc.) proposed, with a proposed schedule for observation and treatment.
- E. For hydromulch applications, the proposed application rate of seed, type of mulch and tacking agent, and other relevant information. An example of the required documentation is in Table 1.
- F. Type of hydraulic seeding equipment and nozzles proposed for use.
- G. If pesticide use is proposed, an IPM plan for pest control including pesticide label, proposed application rate and timing, and MSDS sheets.
- H. One gallon sample of proposed mulch or compost.
- I. The following submittal items are required before Substantial Completion.
 - A. For hydromulch applications, submit the complete hydromulch application log, including date, time and quantity of product units placed in the slurry tank. An example of an application log is in Table 2.
 - B. Pesticide and fertilizer application tracking log. As of January 1, 2012, documentation of all outdoor pesticide and fertilized use on city-owned properties is required to demonstrate compliance with the EPA/TCEQ mandated Municipal Stormwater Permit, the TPDES General Pesticide Permit, City Code, and the IPM program.

Table 1: Example of proposed hydromulch application rates

Hydro Mix	Sheet No.	S E C	Acres	Hydro Slurry Unit (per acre rates)				
				Seed (Bags/ac)	Tackifier (Buckets/ac)	Mulch (Bales/ac)	Fertilizer (Bags/ac)	Addl. Amendment (Bags/ac)
1	L2	A	1.0	1	100	1000	50	5
2	L3	A	0.5	2	200	1500	50	5
3	L5	B	3.0	3	300	3000	50	5

Table 2: Example of hydromulch application log

Date	Start time	Finish time	ac/ Tank	Water (gal)	Seed Mix	Hydro Slurry Unit (per acre rates)				
						Seed (Bags /ac)	Tackifier (Buckets /ac)	Mulch (Bales /ac)	Fertilizer (Bags /ac)	Addl. Amendment (Bags/ac)
4/13	10:30	11:15	1.0	3300	A	1	100	1000	50	5
4/17	2:00	2:30	0.5	3300	A	2	200	1500	50	5
5/20	8:30	10:00	1.2	3300	B	3	300	3000	50	5

609S.3. Materials

A. Seed

All seed must meet the requirements of the Texas Seed Law including the labeling requirements for showing PLS, name and type of seed, and all other required elements of the Analysis and Certification Tags. The seed furnished shall be of the previous season's crop and the date of analysis shown on each bag shall be within 12 months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers, unless a specific mix is proposed for use. A sample of each variety of seed shall be furnished for analysis and testing when directed by the Landscape Architect, Engineer or designated representative.

The amount of seed planted per square yard (.84 square meters) or acre (hectare) shall be of the type specified in section 609S.5.

- B. Water. Water shall be clean and free of industrial wastes and other substances harmful to the growth of plant materials in the area irrigated.
- C. Topsoil. Topsoil shall conform to Standard Specification Item No. 601S.3(A)
- D. Pesticide. A least toxic, integrated pest management (IPM) approach shall be used to control weeds. A written request for approval of weed control product(s) and/or materials shall be submitted to the City of Austin Watershed Protection

Department (ERM), IPM program coordinator for approval. Additional information can be found at <http://www.austintexas.gov/ipm>.

- E. Fertilizer. If fertilizer use is deemed necessary, the fertilizer shall conform to Standard Specification Item No. 606S, "Fertilizer." The type and rate of fertilizer should be based on chemical tests of recent (no older than 6 months before application) representative site soil samples. Fertilizer should be applied only when plants can take them up for growth, during:
 - 1) seed germination and plant establishment and
 - 2) after plant establishment.

Fertilizer shall not be applied within 48 hours of a potential rain event.

- F. Tackifier. The tacking agent shall be a biodegradable material approved by the Landscape Architect, Engineer, or designated representative.
- G. Mulch. Mulch may be used to help prevent soil erosion until preferred plant establishment, whether the mulch be hydraulically applied or shredded vegetative matter. Hydromulching for temporary and permanent vegetation stabilization shall conform to Environmental Criteria Section 1.4.7.
- H. Hydroseeding Equipment. Hydroseeding equipment shall be clean and free of all previous seeds, fertilizer, mulch, or any hydroseeding products used on prior jobs.
- I. Rooted Plants. Where proposed, rooted plants shall conform to the requirements of Standard Specification 608S, Planting.

609S.4 Construction Methods

- A. General.

The Contractor shall limit preparation to areas that will be seeded/planted immediately. All weedy species (Table 3) shall be controlled by application of a herbicide and/or by physical removal (by the roots) prior to, during the planting operation, and through establishment. The specified weedy species shall be maintained at ten (10) percent or less of total cover after seeding. Additionally, the Landscape Architect, Engineer, or qualified landscape professional may require removal of any plant species that appears to be out-competing seeded or planted species during construction or the establishment period.

Seeds and fruits of non-native woody invasive species should be separated from the rest of the removed plants before mulching or hauling off the material. It must be bagged and disposed of in a landfill to prevent unintentional reintroduction to the site or elsewhere.

Table 3: Weed List

Weed Type	Botanical Name	Common Name
Summer Annual Herb	Ambrosia spp.	Ragweed
Perennial Grass	Bothriochloa ischaemum	K.R. Bluestem
Annual Grass	Cenchrus spp.	Sandbur
Herb	Cnidoscolus texanus	Bull Nettle
Perennial Grass	Sorghum halapense	Johnson Grass
Perennial Grass	Arundo donax	Giant Cane
Perennial Grass	Phyllostachys aurea	Golden Bamboo
Vine	Toxicodendron radicans	Poison Ivy
Herb	Urtica spp.	Stinging Nettle
Winter Annual Herb	Rapistrum rugosum	Bastard Cabbage
Winter Annual Grass	Bromus arvensis	Japanese Brome
Winter Annual Grass	Lolium multiflorum	Annual Ryegrass
Tree	Triadica sebifera	Chinese Tallow
Tree	Ligustrum sp.	Privet
Tree	Melia azedarach	Chinaberry
Tree	Lonicera japonica	Japanese Honeysuckle
Shrub	Nandina domestica	Heavenly Bamboo
Shrub	Photinia sp.	Photinia

B. Seed Bed Preparation.

After the designated seeding/planting areas have been rough graded, a suitable planting area shall be prepared. In areas where cut or fill is required, a minimum of 6 inches (150 mm) of topsoil (see Section 609S.3.C) shall be placed or use approved existing soil (that is not infested with invasive or noxious plant rootstock [e.g., *Arundo donax* rhizomes]) stockpiled over the entire planting area.

The topsoil or growing medium must be prepared so that compaction is appropriate for plant growth, and to achieve acceptable bulk density or hydrologic function. Ripper and subsoilers may be used to loosen compacted soil and roughen the surface. Disks, plows and excavator attachments are good for compaction reduction, roughening, and for incorporating amendments. If tracked machinery is used in seedbed preparation, cleat marks should run with the contour to prevent rills.

In areas with no soil disturbance, the weeds shall be eliminated and a minimum of 6 inches (150 mm) of topsoil, if none currently exists, shall be placed. The seedbed shall be prepared with limited irregularities, lumps or soil clods and the surface shall be raked or rolled to facilitate seed to soil contact.

Water shall be gently applied as required to prepare the seedbed before the planting operation either by broadcast seeding or hydraulic planting. Seeding shall be performed in accordance with the requirements hereinafter described.

C. Watering

All watering shall comply with City Code Chapter 6-4 (Water Conservation). Water the seeded/planted areas immediately after installation to achieve germination and a healthy stand of native plants that can ultimately survive without supplemental water.

Apply the water uniformly to the planted areas without causing displacement or erosion of the materials or soil.

Watering applications shall insure that the plantbed is maintained in a moist condition favorable for the growth of plant materials. Watering shall continue until minimum coverage is achieved and accepted by the Landscape Architect, Engineer or designated representative.

Watering may be postponed immediately after a half inch (12.5 mm) or greater rainfall on the site but shall be resumed before the soil dries out.

D. Cool Season Cover Crop.

From September 15 to March 1, non-native and native seeding shall include a cool season cover crop at the rate specified in Tables 4, 5, or 6. Cool season cover crops are not permanent erosion control. If installed separately from the proposed seed mix, the cool season cover crops shall be mowed to a height of less than one (1) inch after March 1, and the area shall be re-seeded at the specified seeding rate for native warm-season species (March 1 to September 15).

609S.5 Native Grassland Seeding and Planting

Seeding and planting shall be performed in accordance with the requirements described below. The optimum depth for seeding shall be 1/4 inch (6 millimeters). Seed shall be applied by a method that achieves consistent distribution across a site and proper seed to soil contact (i.e. hand broadcasting, hydromulch, or drill method).

Rooted plants should be strategically and thoughtfully placed on a site. They need not be installed at a consistent, regular pattern across the plantable area(s) of a site but can be clustered or placed irregularly. The goal is to place the rooted plants where they will have the greatest or best effect or impact, and where there is sufficient space (e.g., root space, space off of utilities) and proper conditions (e.g., soil depth, moisture, light) for their long-term success. Installation of rooted plants shall comply with Standard Specification 608S, but rooted plants must not be spaced closer than three-feet (3') on center. Mulching around seed and rooted plants is not required, but it is a good technique for protecting plants

during germination and establishment. Figure 609S.5-1 is an example of rooted plant layout on a hypothetical site.

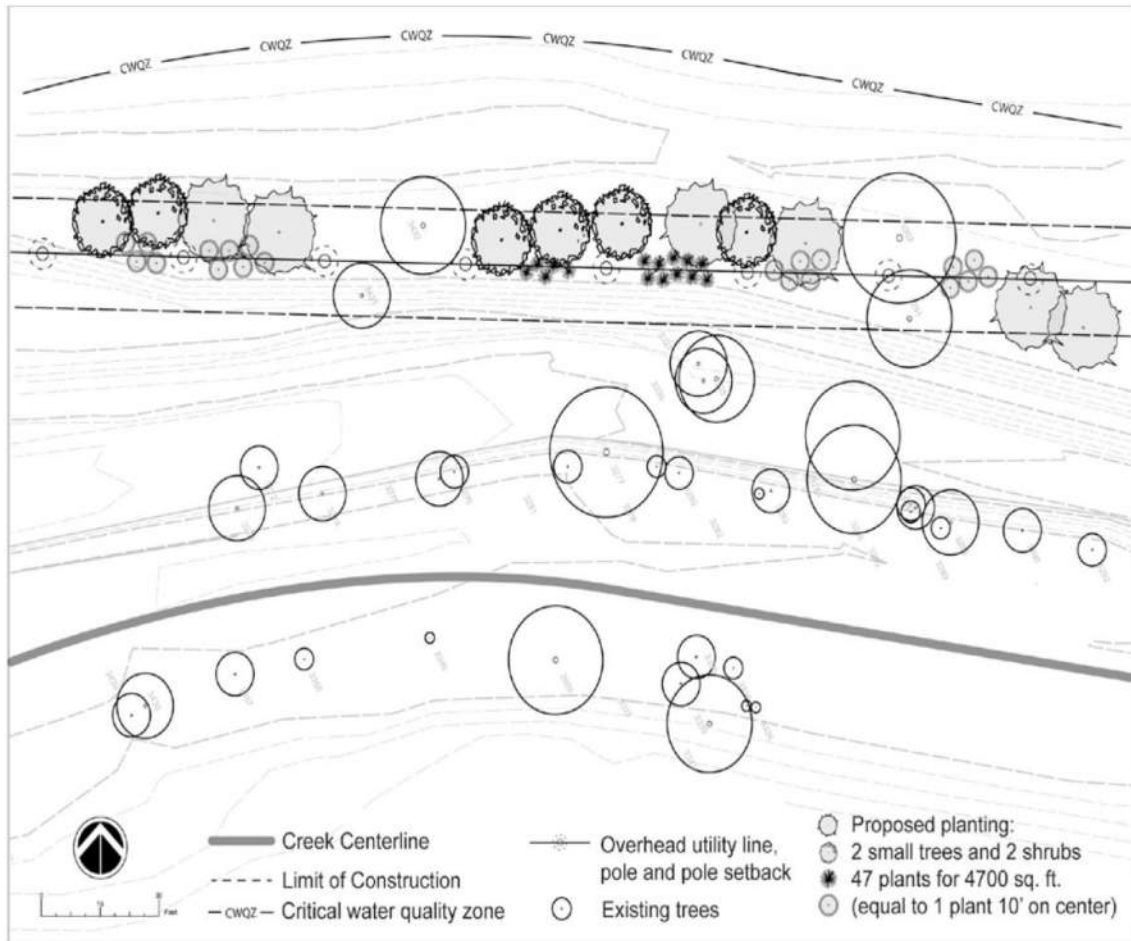


Figure 609S.5-1: Example of Rooted Plant Layout and Calculation

Rooted Plants such as trees, ornamentals, and shrubs are prohibited from being installed within fifteen (15) feet of any Austin Water Utility (AWU) infrastructure and/or within any easement dedicated for AWU infrastructure. Rooted plants such as grasses, succulents and/or ground cover are permitted within fifteen (15) of any AWU infrastructure and/or within any easement dedicated for AWU infrastructure.

Species substitution, when necessary due to availability, shall be approved by City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative. Only native or adapted species suitable for the designated environmental conditions shall be allowed as substitutes. Shorter growing natives such as Buffalograss should be sodded around manholes or other structures requiring higher visibility for access.

If the plant materials are being installed during the cool season (September 15 to March 1), a cool season cover crop species (as listed below) shall be included in the seed mix or installed separately.

The seed and rooted plant mixtures shall be applied in accordance with appropriate growing environments (Upland Full Sun-Table 4, Upland Shade-Dappled-Table 5 and Facultative Moderate to High Moisture-Table 6). Grasses shall constitute 67 percent of the seed mix, with forbs comprising 33 percent. No species shall constitute more than 20% of a seed mix.

Table 4. Upland Species, Full Sun Areas

Type	Common Name	Botanical Name	Recommended Application rate lbs/ac (kg/ha)	Rooted Plants Species, Diversity, Quantity & Size
Grass Seed Mix**	Buffalograss	Buchloe dactyloides	24.0 (27.0)	A minimum of two (2) native species of small or large trees, and two (2) native species of shrubs with Very Low or Low (VL or L) water needs and Sun or Sun/Part Shade light needs as listed in the current Grow Green Native and Adapted Landscape Plants guidance document***. Plants must be a minimum size of 1-gallon (see Table 8, equivalency chart) and minimum of 1 plant per 100 square feet.
	Blue Grama	Bouteloua gracilis	10.0 (11.2)	
	Green Sprangletop	Leptochloa dubia	2.0 (2.2)	
	Sand Dropseed	Sporobolus cryptandrus	1.0 (1.1)	
	Galleta	Pleuraphis jamesii	10.0 (11.2)	
	Canada Wild Rye	Elymus canadensis	10.0 (11.2)	
	Purple Threeawn	Aristida purpurea	4.0 (4.5)	
	Sideoats Grama	Bouteloua curtipendula	7.0 (7.8)	
Forb Seed Mix**	Bluebonnet	Lupinus texensis	20.0 (22.4)	
	Purple Prairie Clover	Dalea purpurea	4.0 (4.5)	
	Plains Coreopsis	Coreopsis tinctoria	2.0 (2.2)	
	Partridge Pea	Chamaecrista fasciculata	20.0 (22.4)	
	Greenthread	Thelesperma filifolium	6.0 (6.7)	
	Indian Blanket	Gaillardia pulchella	10.0 (11.2)	
	Lemon Mint	Monarda citriodora	3.0 (3.4)	

	Mexican Hat	Ratibida columnaris	2.0 (2.2)	
	Pink Evening Primrose	Oenothera speciosa	1.0 (1.1)	
	Sunflower (Common)	Helianthus annuus	5.0 (5.6)	
	Milkweed (Antelope Horn or Green milkweed)	Asclepias asperula or Asclepias viridis	0.1 (0.04)	
<p style="text-align: center;">Total Total recommended seed mix application rate is 35 lbs/ac (23.5 lbs/ac grass, 11.5 lbs/ac forbs).</p>				
Cool Season Cover Grasses	Cereal rye grain*	Secale cereale	34.0 (38.1)	Add at least one of the cool season grasses to the warm-season mix between September 15 and March 1.
	Oats*	Avena sativa	4.0 (4.5)	
	Western Wheatgrass*	Pascopyrum smithii	5.6 (6.3)	

* Plant only between. September 15 to March 1. Non-persistent winter cover crop for erosion control. Only one cool season species is required per installation.

** Any unavailable species can be substituted with the same quantity of another species from this list or another species approved by an authorized City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative. The total pounds/acre (lbs/ac) of the proposed seed mix can be calculated based on the desired percentage of each seed in a mix.

*** www.austintexas.gov/department/grow-green/plant-guide

Table 5. Upland Species, Shade-Dappled Light Areas

Type	Common Name	Botanical Name	Recommended Application rate lbs/ac (kg/ha)	Rooted Plants Species, Diversity, Quantity & Size
Grass Seed Mix***	Inland Sea oats**	Chasmanthium latifolium	12.0 (13.5)	A minimum of two (2) native species of small or large trees, and two (2) native species of shrubs with very low (VL), low (L), or low- medium (L-M) water
	Canada Wildrye	Elymus canadensis	10.0 (11.2)	
	Sideoats Grama	Bouteloua curtipendula	7.0 (7.8)	

Forb Seed Mix***	Purple Coneflower	Echinacea purpurea	10.0 (11.2)	needs and Sun /Part Shade light needs as listed in the current Grow Green Native and Adapted Landscape Plants guidance document****. Plants must be a minimum size of 1-gallon (see Table 8, equivalency chart) and minimum of 1 plant per 100 square feet.
	Lanceleaf Coreopsis	Coreopsis lanceolata	10.0 (11.2)	
	Scarlet Sage	Salvia coccinea	8.0 (9.0)	
	Drummond Phlox	Phlox drummondii	8.0 (9.0)	
	Black-Eyed Susan	Rudbeckia hirta	2.0 (2.2)	
	Cutleaf Daisy	Engelmannia pinnatifida	18.0 (20.2)	
	Tall Aster	Aster praealtus	1.0 (1.1)	
	Illinois bundleflower	Desmanthus illinoensis	15.0 (16.8)	
	Standing cypress	Ipomopsis rubra	6.0 (6.7)	
	Winecup	Callirhoe involucrata	5 (5.6)	
	Milkweed (Butterfly Weed or Showy Milkweed)	Asclepias tuberosa or Asclepias speciosa	0.1 (0.04)	
Total				
Total recommended seed mix application rate is 35 lbs/ac (23.5 lbs/ac grass, 11.5 lbs/ac forbs).				
Cool Season Cover Grasses	Cereal rye grain***	Secale cereale	34.0 (38.1)	Add at least one of the cool season grasses to the warm-season mix between September 15 and March 1.
	Oats***	Avena sativa	4.0 (4.5)	
	Western Wheatgrass***	Pascopyrum smithii	5.6 (6.3)	

** If unavailable replace with Prairie Wild Rye.

*** Plant only between September 15 to March 1. Non-persistent winter cover crop for erosion control. Only one cool-season species is required per installation.

**** Any unavailable species can be substituted with the same quantity of another species from this list or another species approved by an authorized City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative. The total pounds/acre (lbs/ac) of the proposed seed mix shall be calculated based on the desired percentage of each seed in a mix.

**** www.austintexas.gov/departments/grow-green/plant-guide

Table 6. Facultative Species, Moderate - High Moisture Areas

Type	Common Name	Botanical Name	Recommended Application rate lbs/ac (kg/ha)	Rooted Plants Species, Diversity, Quantity & Size
Grass Seed Mix**	Big Bluestem	<i>Andropogon gerardii</i>	8.0 (9.0)	A minimum of two (2) native species of small or large trees, and two (2) native species of shrubs with low (L), low-medium (L-M), or medium (M) water needs and Sun/Part Shade or Shade light needs as listed in the current Grow Green Native and Adapted Landscape Plants guidance document***. Plants must be a minimum size of 1-gallon (see Table 8, equivalency chart) and minimum of 1 plant per 100 square feet.
	Big Muhuly (Lindhiemers)	<i>Muhlenbergia lindheimeri</i>	6.0 (6.7)	
	Bushy Bluestem	<i>Andropogon glomeratus</i>	6.0 (6.7)	
	Eastern Gamagrass	<i>Tripsacum dactyloides</i>	12.0 (13.5)	
	Indiangrass	<i>Sorghastrum nutans</i>	6.0 (6.7)	
	Inland Seaoats	<i>Chasmanthium latifolium</i>	12.0 (13.5)	
	Canada Wildrye	<i>Elymus canadensis</i>	10.0 (11.2)	
	Sand Lovegrass	<i>Eragrostis trichodes</i>	2.0 (2.2)	
	Switchgrass	<i>Panicum virgatum</i>	4.0 (4.5)	
Forb Seed Mix**	Black-Eyed Susan	<i>Rudbeckia hirta</i>	2.0 (2.2)	
	Illinois Bundleflower	<i>Desmanthus illinoensis</i>	15.0 (16.8)	
	Purple Prairie Clover	<i>Dalea purpurea</i>	4.0 (4.5)	
	Clasping Coneflower	<i>Dracopis amplexicaulis</i>	3.0 (3.4)	
	Plains Coreopsis	<i>Coreopsis tinctoria</i>	2.0 (2.2)	
	Goldenrod	<i>Solidago altissima</i>	1.0 (1.1)	
	Lazy Daisy	<i>Aphanostephus</i> sp.	1.0 (1.1)	
	Lemon Mint	<i>Monarda citriodora</i>	3.0 (3.4)	
	Sunflower (Common)	<i>Helianthus annuus</i>	5.0 (5.6)	
	Sunflower (Maximilian)	<i>Helianthus maximiliana</i>	4.0 (4.5)	

	Milkweed (common or Butterfly Milkweed)	Asclepias syriaca or Asclepia tuberosa	0.1 (0.04)	
Total Total recommended seed mix application rate is 26.0 lbs/ac (17.0 lbs/ac grass, 9.0 lbs/ac forbs).				
Cool Season Cover Grasses	Cereal rye grain*	Secale cereale	34.0 (38.1)	Add at least one of the cool season grasses to the warm-season mix between September 15 and March 1.
	Oats*	Avena sativa	4.0 (4.5)	
	Western Wheatgrass*	Pascopyrum smithii	5.6 (6.3)	

* Plant only between September 15 to March 1. Non-persistent winter cover crop for erosion control.

** Any unavailable species can be substituted with the same quantity of another species from this list or another species approved by an authorized City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative. The total pounds/acre (lbs/ac) of the proposed seed mix can be calculated based on the desired percentage of each seed in a mix.

*** www.austintexas.gov/department/grow-green/plant-guide

Table 7. Rooted Plant Size Equivalents

Potential Substitute		Equivalent To	
Quantity	Plant Size	Quantity	Plant Size
1	5-gallon	4	One-gallon
1	Two- or Three-gallon	2	One-gallon
4	4" pots or quarts	1	One-gallon
8	Plugs, live roots, saplings	1	One-gallon

Table 8. Seed Rate Calculation

Multiple species native seed mixes require careful calculations to ensure proper planting rates. The example below is for illustrative purposes only.

Species	Seeding Rate (lbs/ac)	Desired proportion of a species in the total mix (%)	Total quantity of seed in mix (lbs/ac)
Grass 1	7	.20	1.40
Grass 2	2	.20	0.40

Species	Seeding Rate (lbs/ac)	Desired proportion of a species in the total mix (%)	Total quantity of seed in mix (lbs/ac)
Grass 3	24	.20	4.80
Forb 1	10	.20	2.00
Forb 2	8	.20	1.60
TOTALS	- -	1.0 (100%)	10.2

Table 9. Seed Calculation Worksheet

The amount of seed needed to be planted on a project shall be calculated before installation to ensure adequate seed is placed, and provided as a submittal. Table 9 is an example worksheet, followed by an example calculation. Information for calculation can be obtained from seed tags or the supplier.

Plant Group	Desired Seeding Rate (lbs/ac)	PLS (pure live seed)	Bulk Rate (lbs/ac)	Seeding Area (ac)	Amt. of Seed to be Installed (lbs)
Grasses					
Forbs					
TOTAL					

FORMULAS:

PLS (pure live seed) = (Purity × Germination) × 100. Can also use average PLS from seed tags.

Bulk Rate (lbs/ac) = Desired Seed Rate (lbs/ac)/PLS

Amt. of Seed to be Installed (lbs) = Bulk Rate (lbs/ac) × Seeding Area (ac)

Example:

Plant Group	Desired Seeding Rate (lbs/ac)	PLS [pure live seed] (% decimal)	Bulk Rate (lbs/ac)	Seeding Area (ac)	Amt. of Seed to be Installed (lbs)
Grasses	131.00	0.81	161.73	1.50*	242.60
Forbs	65.34	0.87	75.10	1.50*	112.70
TOTAL	196.34	0.84 (ave.)	236.83	1.50	355.30

*Applied over the same 1.5 ac area.

609S.6 Management Practices

Management Practices include (1) weed management (pesticide application or mechanical removal) to so that 90 percent of the revegetation area is free of weeds listed in Table 3, (2) reseeding areas of poor germination to achieve coverage and height per 609S.8, with no bare areas greater than 10 s.f., and (3) replacement and replanting of rooted plants per 608S.5(O) [Plant Material Removal and Replacement] and 608S.7 (Acceptability of Plants).

Weeds, as defined in the Weed List (Table 3), shall be controlled in the most efficient manner possible. The timing of weed control may occur prior to soil disturbance, just before the installation of seed, and/or during the period of plant establishment. Weed control shall be introduced at one or all of these times, so that the greatest control is achieved. The preferred method of control is to remove weeds, either by physical or mechanical means, when the site is conducive (e.g. when the ground is moist) to this approach.

The entire root system of perennial weeds shall be removed to prevent re-sprouting. Table 9 provides management practices for woody invasive vegetation. Weeds may be controlled with an approved contact, systemic herbicide, provided the product is used with appropriate care and is applied in accordance with label instructions and the following guidelines:

1. Herbicide shall not be applied when the wind is greater than 8 mph (12.9 kph),
2. Herbicide shall not be applied when rainfall is expected within 24 hours,
3. Herbicide shall not contact surface water, i.e. creeks, rivers, and lakes,
4. Herbicide shall not contact desirable vegetation (a wicking method shall be used, if necessary, to accurately contact target weed only during application).

Table 10. Management Practices for Woody Invasive Vegetation

Before Seeding	
Stems ≤1 inch	Pull with weed wrench
Stems >1 inch	Cut at base and spray stump with appropriate herbicide within five minutes. Bag and dispose of seeds and fruit in landfill.
After Seeding	
Seedlings	Hand pull
Sprouts	Foliar application of appropriate herbicide

The Landscape Architect, Engineer or designated representative shall be consulted to determine appropriate weed control management when weeds are located in an environmentally sensitive location (e.g. near water or adjacent to a critical environmental feature).

609S.7 - Reseeding/Replanting

At locations that fail to show an acceptable stand of planting for any reason during the initial seeding, repair and/or reseed, replant locations as determined by the Landscape Architect, Engineer or designated representative. A successful stand of grasses and forbs should exhibit the following:

- Seedlings with vigorous green foliage;
- Green leaves remaining throughout the summer, at least at the plant bases;
- Uniform density, with grasses and/or forbs well intermixed;
- Minimum of 95% cover; and
- No patches of exposed soil greater than 10 s.f. in aerial extent.

The Owner or designated representative will inspect the seeding/planting during April of the calendar year following the year of initial seeding/planting and determine the necessity and extent of over seeding reseeding, or replanting required. Contractor shall ideally complete any required reseeding/replanting before May 15 of that year. This date may be extended if, in the opinion of the Owner and qualified landscape professional, the weather conditions before May 15 are not suitable for reseeding work. If the timing is bad, an annual cover crop can be over-seeded in a deficient area to temporarily provide coverage until a suitable time for seeding or planting perennial seed or rooted plants. If vegetation fails to grow and thrive, the soil must be tested to determine whether nutrient imbalances are responsible and, if so, an appropriate course of nutrient remediation (e.g., fertilizers, composts, topsoils, or other organic amendments) as recommended by a landscape professional must be implemented by the Contractor.

The Contractor shall meet the requirements for initial seeding and planting, including seeding method, seed mix, application rates, and slope texturing as applicable, unless otherwise agreed to in writing by the Owner and/or City staff. Corrected deficiencies will be re-inspected and approved by the Owner and designated representative, and final acceptance will be granted only upon satisfactory completion.

609S.8 Measurement

Work and acceptable material for Native Seed and Planting for Restoration will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) or by the acre (hectare: 1 hectare equals 2.471 acres), complete in place, so that all areas of a site that rely on vegetation for stability must be uniformly vegetated with a minimum of 95 percent total coverage with no bare areas exceeding 10 square feet (1.5 square meters) and a 1½ inch tall (40 millimeters) successful stand of plant materials. Ninety (90) percent of the overall planted area must be free of weeds listed in Table 3. Bare areas shall be re-prepared and reseeded as required by the Landscape Architect, Engineer or designated representative to develop an acceptable stand of vegetation.

609S.9 Payment

The work performed and materials furnished and measured will be paid for at the unit bid price for Native Grasslands and Planting For Restoration of the method specified on the Drawings.

The unit bid price shall include full compensation for furnishing all materials, including all topsoil, water, seed, or fertilizer or mulch and for performing all operations necessary to complete the work.

Payment will be made under one or more of the following pay items:

Pay Item No. 609S-A:	Topsoil and Seedbed Preparation	Per Square Yard.
Pay Item No. 609S-B:	Topsoil and Seedbed Preparation	Per Acre.
Pay Item No. 609S-C:	Native Seeding	Per Square Yard.
Pay Item No. 609S-D:	Native Seeding	Per Acre.
Pay Item No. 609S-E:	Rooted Plants	Per each.
Pay Item No. 609S-F:	Watering	Per 1,000 Gallons (Kgal).
Pay Item No. 609S-G:	Management Practices	Per Square Yard.
Pay Item No. 609S-H:	Management Practices	Per Acre.

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item 609S "Native Grassland Seeding and Planting for Erosion Control"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 130S	Borrow
Item No. 601S	Salvaging and Placing Topsoil
Item No. 606S	Fertilizer

City of Austin Land Development Code

<u>Designation</u>	<u>Description</u>
Section 6-4	Water Conversation

RELATED CROSS REFERENCE MATERIALS

Specification Item 609S "Native Grassland Seeding and Planting for Erosion Control"

<u>Designation</u>	<u>Description</u>
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding (Non-Native) for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 607S	Slope Stabilization
Item No. 608S	Planting

City of Austin Standards (Details)

<u>Standard No.</u>	<u>Description</u>
627S-1	Grass Lined Swale
62S7-2	Grass Lined Swale W/ Stone Center
633S-1	Landgrading

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

<u>Designation</u>	<u>Description</u>
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer

Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 180	Wildflower Seeding
Item No. 192	Roadside Planting and Establishment

Item No. 610S
Preservation of Trees and Other Vegetation

610S.1 Description and Definitions

This item shall govern the proper care, protection and treatment of trees and other vegetation in the vicinity of the permitted development activity (as defined in Land Development Code 25-1-21(27)). All work shall be performed in accordance with the City approved drawings and specifications (e.g. Standard Series 600) or as approved by the City Arborist (as defined below). Tree pruning and/or treatments shall be performed under the direct supervision of a qualified arborist (as defined below) or as allowed by the City Arborist.

Definitions

City Arborist – City official designated by the Director of the Planning and Development Review Department (Land Development Code 25-8-603) or as designated by the City Arborist.

Oak wilt - a tree disease caused by a fungus “*Ceratocystis fagacearum*” that infects the vascular system of Oak “genus *Quercus*” trees and prevents water transport through the trunk and canopy of the tree. This usually fatal tree disease can be spread by certain insects that come into contact with tree wounds or by interconnected tree roots. February through June is a high risk period due to the stage of the fungus and insect activity. See section 610S.4(H) for additional requirements for preventing Oak wilt infection.

Qualified Arborist – an individual engaged in the profession of arboriculture or closely related field who, through experience, education, and related training, possesses the competence to provide for, or supervise, the management of trees and other woody plants (as defined in the most current version of ANSI A300 (Part 1)-2001, section 4.1).

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.

610S.2 Submittals

The following is a list of the minimum 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. Qualified Arborist credentials (i.e. proof of certification from the International Society of Arboriculture, licenses, resume and/or references);
- C. Type, location and construction details for proposed tree wells;

- D. Location, type, materials of construction and installation details for permeable paving;
- E. Proposed nutrient mix specifications and when required by the City Arborist, soil and/or foliar analysis for fertilizer applications.

610S.3 Materials

A. Protective Fencing and Signage

Protective fencing is designated as the materials used to protect the root zones of trees as illustrated in City of Austin Standard Detail 610S-1. Three basic types of protective fencing materials are allowed by the City of Austin. 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 Arborist. Type C fencing shall be replaced by Type A or Type B fencing as directed by the City Arborist 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 City of Austin Standard Details 610S-2 and 610S-4 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 City of Austin Standard Details 610S-3 and 610S-5 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 Arborist):

(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 -60oF to 200oF (-16oC to 93oC) 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) Other approved equivalent restraining material.

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 post by bands or wire ties.

4. Signage

A laminated sign, no smaller than 8.5 X 11 inches, shall be posted on each tree protective device, and at least every 100 linear feet on protective fencing, identifying the following information: Tree & Root Protection Zone, Per City of Austin code (Chapter 25-8, Subchapter B, Article 1) this protective device is to remain in place for the entirety of the development project and illegal removal is subject to fines and work suspensions. Additional information can be obtained at the City Arborist (512-974-1876) web site (<http://www.ci.austin.tx.us/trees>). Zona de Protección del Árbol y las Raíces: el dispositivo protector debe quedarse en el lugar para la totalidad del proyecto de la construcción. Para información adicional, contacta la Arborista Municipal (512) 974-1876 o http://www.ci.austin.tx.us/trees/trees_spanish.htm.

B. Trunk Protection (Limited Application)

When indicated on the drawings or directed by the City Arborist tree trunk protection shall be provided in accordance with City of Austin Standard Details 610S-4 and 610S-5. 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 and shall be attached in a manner that does not damage the tree.

C. Tree Dressing

Wound treatments should not be used to cover wounds or pruning cuts, except when recommended for disease (see section 610S.4 (H)), insect, mistletoe, or sprout control (from ANSI A300 (Part 1)-2001, section 5.4.1).

D. Tree Wells for Raised Grades

When existing grades are raised by more than 4 inches (10.16 cm), the tree root system shall be protected by the installation of tree wells in accordance with City of Austin Standard Detail 610S-6. Native stone or non-toxic 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 (Environmental Criteria Manual Section 3.5.A.1)

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 or directed by the City Arborist.

F. Fertilizer

Humate/nutrient solutions with mycorrhizae components or soil injection at recommended rates are to be used when appropriate. Construction which will be completed in less than 90 days may use materials at half the recommended rates. Alternative organic fertilizer materials are acceptable when approved by the City Arborist.

610S.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 the permitted development activity.

All individual or groups of trees, shrubs, and natural areas shown to be protected on the drawings or identified to be protected by the City Arborist, shall be protected during construction with temporary fencing as indicated on the drawings or as directed by the City Arborist.

Protective fences (section 610S.4.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 (Section 1.3.1.C.6) and desirable sight triangle (Figure 1-6 criteria found in the City of Austin Transportation Criteria Manual).

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 (Environment Criteria Manual, Appendix P-2, Note 6):
 - (a) Soil compaction in the root zone area resulting from vehicular traffic or storage of equipment or materials.
 - (b) Critical root zone disturbances due to grade changes [greater than 4" (10.16 cm) cut or fill] or trenching not reviewed and authorized by the City Arborist.
 - (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 no more than 2 feet (0.6 meters) beyond the area of disturbance unless approved by the City Arborist;
 - (b) When permeable paving is to be installed within a tree's critical root zone, 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 (Environment Criteria Manual, Appendix P-2, Note 6.c), the fence shall be erected up to 10 feet (3 meters) to allow work space between the fence and the structure. Apply organic mulch to a depth of 8 inches [30.48 cm] 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 Arborist 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 fencing requirement (City of Austin Standard Details 610S-4 and 610S-5).

B. Pruning and Repair of Damage

Tree pruning, to provide clearance for the work and/or to remove hazards, shall be performed under the direct supervision of a qualified arborist and shall follow standards identified in ANSI A300 (Part 1), "Pruning". A minimum clearance height of eight (8) feet (2.4 meters) above the street level must be provided and maintained for all existing trees if adjacent to a sidewalk. However, if the limbs of trees overhang the curb line or edge of travel lane of any street, a minimum clearance height of fourteen (14) feet (4.2 meters) is required (Transportation Criteria manual section 6.2.3,A, 4, "Clearance Height"). Pruning shall provide the minimum clearance needed to perform the work or remove a hazard unless otherwise directed by the City Arborist to comply with transportation criteria or to mitigate for damage.

If tree damage compromises a tree's structural integrity then the area shall be adequately secured until a qualified arborist makes an assessment of the tree and corrective actions are completed with approval from the City Arborist. Damage to oak trees shall be treated immediately, with consideration for site safety, to reduce the risk of Oak Wilt infection (See 610S.4.H, "Oak Wilt Prevention"). Tree root wounds shall be treated to remove loose, damaged tissue from in and around the wound or if necessary the root shall be cut cleanly and covered with topsoil, or other material approved by the City Arborist, to prevent drying of root tissue and to create a favorable environment for root sprouting. Trunk wounds shall also be treated to remove loose, damaged tissue around the wound. Tree canopy repairs shall be performed in accordance with the most current version of ANSI A300 (Part 1), "Pruning", to prevent further damage to the tree and to promote recovery of the tree to sound condition. The ANSI standard describes proper pruning methods for limb removal and for making finish pruning cuts.

Trees damaged or removed without prior approval or where minimum design criteria is exceeded due to failure to maintain approved tree protection shall be mitigated (Environmental Criteria Manual section 3.5.4, "Mitigation Measures") in accordance with Land Development Code Chapter 25-8, Subchapter B, Article 1.

All trees damaged during construction shall receive an application of fertilizer within the drip line conforming to Standard Specification Item No. 606S, "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 4 inches (10.16 cm) within the critical root zone of any tree with a trunk diameter greater than 8 inches (200 mm), the City Arborist may require a tree well to be constructed per the City of Austin approved specifications and details (Section 610S.3.D and City of Austin Standard Detail 610S-6).

D. Paving Around Trees

Where new paving within the $\frac{1}{2}$ critical root zone of any tree greater than a 8 inches (10.16 cm) diameter is approved, a permeable pavement and aeration system may be required by the City Arborist per the City of Austin Standard Detail (Section 610S.3.E, Environmental Criteria Manual Section 3.5.3.A.1 and Figure 3-8) must be installed as indicated on the Drawings, except for street construction.

E. Tree Removal

Tree removal shall comply with Land Development Code Chapter 25-8, Subchapter B, Article 1. An approved permit, or an approved site plan is required for removal of trees 8" and larger (see Environmental Criteria manual section 3.3.2.A.2 and figure 3-1 for measurement standards) with additional requirements for City Parkland properties and for Hill Country Roadway Corridor sites. Trees 19 inches in diameter and greater are defined as protected trees and require specific review from the City Arborist to approve a permit or site plan for removal. In addition heritage trees require a more extensive evaluation by the City Arborist and may require rulings from boards and commissions.

All trees to be removed shall be performed in a manner that does not damage the canopies, trunks or root systems of remaining trees and that protects all existing facilities, improvements and vegetation. Removal of oak trees shall follow the Oak Wilt Prevention procedures per the City of Austin Standards (Section 610S.4.(H)). All tree material shall be removed from the site unless authorized by the City Arborist or if it will be used as wood chips or mulch.

When a tree or shrub is scheduled for removal, it shall be cut to a maximum depth of 12 inches (30.5 cm) below the surrounding grade (the tree(s) should be removed at grade, and with hand saws, in situations where other tree root systems are present which are to be preserved). When applicable, after tree removal, soil shall be placed in the hole to a depth matching the existing grade.

All damage resulting from tree removal or pruning shall be repaired at the Contractor's own expense and shall follow guidelines in this specification.

F. Final Cleanup

All temporary tree and shrub preservation and protection measures shall be removed when the construction has been completed and any mulch applications shall be removed or reduced to no more than 3 inches (7.62 cm) depth.

G. Root Zone Aeration and Fertilization

As a component of an effective remedial tree care program per Environmental Criteria Manual section 3.5.4, preserved trees within the limits of construction may require soil aeration and supplemental nutrients. Soil and/or foliar analysis should be used to determine the need for supplemental nutrients. The City Arborist may require these analyses as part of a comprehensive tree care plan. Soil pH shall be considered when determining the fertilization composition as soil pH influences the tree's ability to uptake nutrients from the soil. If analyses indicate the need for supplemental nutrients, then humate/nutrient solutions with mycorrhizae components are highly recommended. In addition, soil analysis may be needed to determine if organic material or beneficial microorganisms are needed to improve soil health. Materials and methods are to be approved by the City Arborist (512-974-1876) prior to application. The owner or general contractor shall select a fertilization contractor and ensure coordination with the City Arborist.

Pre-construction treatment should be applied in the appropriate season; ideally the season preceding the proposed construction. Minimally, areas to be treated include the entire critical root zone of trees as depicted on the City approved plans. Treatment should include, but not limited to, fertilization, soil treatment, mulching, and proper pruning.

Post-construction treatment should occur during final revegetation or as determined by a qualified arborist after construction. Construction activities often result in a reduction in soil macro and micro pores and an increase in soil bulk density. To ameliorate the degraded soil conditions, aeration via water and/or air injected into the soil is needed or by other methods as approved by the City Arborist. The proposed nutrient mix specifications and soil and/or foliar analysis results need to be provided to and approved by the City Arborist prior to application (Fax # 512-974-3010). Construction which will be completed in less than 90 days may use materials at ½ recommended rates. Alternative organic fertilizer materials are acceptable when approved by the City Arborist. Within 7 days after fertilization is performed, the contractor shall provide documentation of the work performed to the City Arborist, Planning and Development Review Department. P.O. Box 1088, Austin, TX 78767. This note should be referenced as item #1 in the Sequence of Construction.

H. Oak Wilt Prevention Policy

1. Purpose and Scope

The purpose of this Oak Wilt Prevention Policy is to identify measures that city staff and city-hired contractors and their sub-contractors, who perform the services of removing or trimming trees, will take to prevent the spread of oak wilt.

2. Definitions

Oak Wilt Disease: A tree disease caused by the fungus, *Ceratocystis fagacearum*. The fungus infects the vascular system of a tree. The vascular system contains vessels which transport moisture throughout the tree. The vessels of an infected tree effectively become blocked by the infection of the fungus, and cannot transport adequate moisture to sustain a healthy or living tree. In most cases, the end result is tree mortality.

3 Prevention Policy

- (a) Prior to beginning field work, all city staff associated with projects involving potential contact with oak trees shall be made aware of the city's official Oak Wilt Policy by receiving and reading a written copy of this policy. Staff receiving a written copy of the policy shall include, but not limited to, project managers, equipment operators responsible for removing or trimming trees, or operators using heavy equipment which could cause wounding of susceptible oaks in the use of the equipment. In addition, individual city departments will provide a written copy of the Oak Wilt Policy to contractors participating in city projects in areas where oak trees are present before initiating field work.
- (b) When possible, city staff and contractors should avoid trimming, pruning, or wounding Live Oaks and Red Oaks (Spanish, Shumard, Texas Red, and Blackjack oaks) from February through June.
- (c) At all times and irrespective of limb size, all cuts and wounds to oak trees shall be dressed immediately using a non-phytotoxic tree wound dressing. Stump cuts and damaged roots (both above and below ground) shall also be dressed.
- (d) Disinfection of pruning tools, saws, and related equipment is mandatory during the trimming or pruning of oak trees. Disinfection of tree removal and trimming equipment shall occur before work begins in a project area, between work in individual oak trees, and again prior to leaving a project area. Acceptable disinfectants include either aerosol disinfectant or a 10 percent bleach-water solution.

*NOTE: Although this policy would require the disinfection of pruning equipment before and between oak trees as a precaution, research does not substantiate disinfection as a means of preventing the transmission of the oak wilt disease.

4. Disposal Policy

- (a) Chipping or shredding the wood from infected trees to use as mulch is an acceptable means of recycling the wood. Chipping or shredding allows the wood to dry out quickly, thereby killing the fungus.
- (b) Burning diseased wood is an acceptable means of disposal. Burning diseased logs will kill the fungus, and the fungus will not spread with the smoke.
- (c) Logs from diseased Red Oaks, that are not chipped, shredded, or burned shall be disposed of at a landfill.
- (d) Firewood from diseased Red Oak trees shall not be stored near healthy trees where fungal spores or insects that carry the spores have the potential to spread the fungus to healthy trees. It is recommended to store oak firewood under a sheet of clear plastic, tightly sealing the edges of plastic with soil or bricks. Doing so will prevent any spore carrying beetles from escaping and will solarize and heat the stored firewood to speed the drying process. It is also recommended to use

clear plastic, as black plastic will reveal any escape holes to the beetles.

- (e) In situations where diseased Red Oak trees are identified and are not accessible for chipping, shredding, or removal, the trunk of the diseased tree should be girdled, and the stem treated with an appropriate herbicide to deaden the tree and hasten the desiccation and drying of the wood below the minimum moisture content that could support the development of fungal spores.

610S.5 Measurement

Tree and shrub pruning, 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 and City of Austin Standard Detail 610S-6, "Tree Protection, Tree Wells".

Removal of existing trees will be measured per each tree.

610S.6 Payment

The work and materials prescribed herein with the exception of the Protective Fencing and Tree Well (Tree Protection) will not be paid for directly but shall be included in the unit price bid for the item of construction in which this activity is used, unless a payment item is included as a contract pay item.

Payment will be made under:

Pay Item 610S-A:	Protective Fencing Type A Chain Link fence (Typical Application-high damage potential)	Per Lineal Foot
Pay Item 610S-B:	Protective Fencing Type B Wood Fence (Typical Application-high damage potential)	Per Lineal Foot
Pay Item 610S-C:	Protective Fencing Type C Other Materials (Limited Application-minimal damage potential)	Per Lineal Foot
Pay Item 610S-D:	Tree Well (Tree Protection)	Per Each
Pay Item 610S-E:	Tree Trunk Protection, Wood Planking	Per Each
Pay Item 610S-R:	Removal of Existing Trees	Per Each

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification Item 610S, "Preservation of Trees and Other Vegetation"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 606S	Fertilizer

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Item No. 610S-1	Tree Protection Fence Locations
Item No. 610S-2	Tree Protection Fence, Type A, Chainlink
Item No. 610S-3	Tree Protection Fence, Type B, Wood
Item No. 610S-4	Tree Protection Fence, Modified Type A, Chainlink
Item No. 610S-5	Tree Protection Fence, Modified Type B, Wood
Item No. 610S-6	Tree Protection, Tree Wells

City of Austin Transportation Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 1.3.1.C.6	Sight Distance
Section 6.2.3.A.4	Clearance Height
Figure 1-6	Desirable Sight Triangle

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Appendix P-2, Note 6	Exceptions to Installing Fences
Appendix P-2, Note 6c	Trees close to proposed buildings-----
Appendix P-6	Remedial Tree Care Notes
Section 3.3.2.A.2	Diameter of trees-----
Section 3.5.0	Design Criteria
Section 3.5.3.A.1	Permeable Paving
Figure 3-8	Example of Minimum Design Criteria Applied to Permeable Parking

City of Austin Land Development Code

<u>Designation</u>	<u>Description</u>
Section 25-8-603	Tree Protection Administration
Section 25-8-623	Inspection by City Arborist

ASTM, American Society for Testing and Materials

<u>Designation</u>	<u>Description</u>
D-2729	Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

<u>RELATED CROSS REFERENCE MATERIALS</u>
Specification 610S, "Preservation of Trees and Other Vegetation"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 608S	Planting

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering

Item No. 620S
Filter Fabric

620S.1 Description

This item shall govern the furnishing of materials and for placement of filter fabric as indicated on the Drawings or directed by the Engineer or designated representative. Filter Fabric shall have the capability for allowing the passage of ground water through it without transporting the soil placed around the filter fabric.

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.

620S.2 Submittals

The submittal requirements of this specification item include:

- A. catalog cuts,
- B. samples of material selected,
- C. testing results,
- D. manufacturer's recommended installation procedures, and
- E. manufacturer certification of compliance with this specification.

620S.3 Materials

A. General

The fabric shall be constructed exclusively of synthetic thermoplastic fibers and may be either woven or non-woven to form a mat of uniform quality. Fabric fibers may be either continuous or discontinuous and oriented in either a random or an aligned pattern throughout the fabric. The fabric shall be mildew resistant, rot proof and shall be satisfactory for use in a wet soil and aggregate environment. The fabric shall contain ultraviolet stabilizers and shall have non-raveling edges.

B. Physical Requirements

The fabric shall meet the requirements of table 1, when sampled and tested in accordance with the methods indicated in the table below.

For applications such as water quality facility underdrain wrappings that require a high flow-through rate or when specified by the Engineer, the fabric shall be woven mono-filament and meet the requirements of Table 2.

All material shall be shipped with suitable wrapping to protect the fabric during shipping and storage at the job site.

620S.4 Construction Methods

The submittal requirements shall be completed before any materials are ordered.

The "Filter Fabric" shall be installed in accordance with the manufacturer's recommendations, as indicated on the Drawings or as directed by the Engineer or

designated representative. When lapping is required, it shall be in accordance with the manufacturer's recommendations. Backfilling around the Filter Fabric shall be done in such a manner that the Filter Fabric material will not be damaged during the placement.

TABLE 1: FILTER FABRIC REQUIREMENTS		
Original Physical Properties	Test Method	Requirements
Fabric weight (mass), on an ambient temperature air-dried tension free sample, expressed in oz/ sq. yd (grams/ square meter)	TxDoT Tex-616-J*	Underdrains/Slope Stabilization 4.0 (135) minimum
		Gabions and Revet Mattresses 6.0 (200) minimum
Water flow rate by falling head method, 7.9 inches (20 cm) to 3.9 inches (10 cm) on 2 inch (50 mm) ID cylinder with 1 inch (25 mm) diameter orifice, with flow rate expressed in gal/sq.ft/minute (liters/square meter/minute).	TxDoT Tex-616-J*	80 (3,260) minimum
Breaking load in either machine or cross-machine direction, expressed in pounds (newtons)	ASTM D-1682 grab method G**	100 (445) minimum
Equivalent opening size for US Standard (SI) sieves.	CW-02215	70 to 100 (212 to 150µm)
"Apparent elongation" at breaking load in either machine or cross-machine direction, expressed as percent	ASTM D-1682 grab method G**	100 maximum

* TxDoT Tex-616-J, "Testing of Construction Fibers"

** ASTM D 1682 grab method G, "Test Methods for Breaking Load and Elongation of Textile Fabrics" as modified by TxDoT Test Method Tex-616-J

*** CW-02215, US Army Corps of Engineers, Civil Works Construction Guide Specification "Plastic Filter Fabric".

TABLE 2: HIGH FLOW FILTER FABRIC REQUIREMENTS		
Property	Test Method	Requirements
Fabric weight	D 3776	3.0 ounces/square yard, minimum
Ultraviolet (UV) Radiation Stability	D 4355	70% strength retained minimum, After 500 hours in xenon arc device
Mullen burst strength	D- 3786	120 pound per square inch minimum
Water Flow Rate	D-4491	275 gallons/minute/square feet, minimum

620S.5 Measurement

Work and acceptable material for "Filter Fabric" and "High Flow Filter Fabric" will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards), complete in place.

620S.6 Payment

The work performed and the materials furnished and measured as provided under "Measurement" will be paid at the unit bid price for "Filter Fabric". The unit bid price, when included in the contract as a pay item, shall include full compensation for all materials, excavation and backfilling and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 620S-A:	Filter Fabric	Per Square Yard.
Pay Item No. 620S-B:	High Flow Filter Fabric	Per Square Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification 620S, "Filter Fabric"

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
D 1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
D 3776	Standard Test Method for Mass Per Unit Area (Weight) of Fabric
D 4355	Test Methods for Deterioration of Geotextiles By Exposure to Ultraviolet Light, Moisture and Heat in a Xenon Arc Type Apparatus
D 3786	Standard Test Method for Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method
D 4491	Standard Test Method for Water Permeability of Geotextiles by Permittivity

Texas Department of Transportation Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-616-J	Testing of Construction Fabrics

RELATED CROSS REFERENCE MATERIALS

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 1.4.2.E	Rock Berm
Section 1.6.5.A.4	Sand Filtration Bed Details

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 639S-1	Rock Berm
Number 661-1	Sand Bed Filtration Configurations Using Geomembrane Liner
Number 661-2	Sand Bed Filtration Configurations Using Clay Liner/No Liner Required
Number 661-3	Biofiltration Bed Configurations Using Geomembrane/Clay Liner Required

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 623S
Dry Stack Rock Wall

623S.1 Description

This item shall govern furnishing and placing dry stack gravity rock walls (Environmental Criteria Manual Section 1.8.2.B.6) in conformance with Standard Detail 623S.1 and as herein specified on a prepared subgrade, including the excavation and backfilling for the wall, to the height, lines, grades, details and locations 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.

623S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- B. Proposed proportioning of materials for the mortar mix,
- C. Test results for the weathered field limestone,
- D. Aggregate type and gradation scheduled for granular blanket,
- E. Description of filter fabric including characteristics, test data and manufacturer's recommendations for installation

623S.3 Materials

A. Rock

Native Rock shall be durable weathered field limestone of suitable quality to ensure permanence in the structure. The stone shall have a wearing loss less than 35 percent when the stone is tested with the Los Angeles Abrasion Machine in accordance with ASTM Test Method C535 (TxDOT Test Method Tex-410A). The loss of material experienced during five cycles of magnesium sulfate exposure conducted in accordance with TxDOT Test Method Tex-411A for Rock RipRap shall not exceed 18 percent.

B. Concrete

Concrete for footings shall be Class A Concrete and conform to Standard Specification Item No. 403S, "Concrete for Structures".

C. Granular Blanket

Flexible Base aggregate conforming to Standard Specification Item No. 210S, "Flexible Base", shall be used for the granular blanket.

D. Mortar

Mortar shall consist of 1 part masonry cement to 3 parts sand by volume, based on dry materials. Mortar which has been mixed longer than 30 minutes or which has developed its initial set shall not be used.

E. Filter Fabric

Filter Fabric conforming to Standard Specification Item No. 620S, "Filter Fabric", shall be used for dry stack rock walls constructed in erodible soils.

623S.4 Construction Methods

Dry Stack Rock Wall shall be constructed in horizontal courses, on the prepared and compacted subgrade, granular blanket or concrete foundation as indicated on the Drawings and Standard Detail 623S.1. The horizontal and vertical joints of the two lower and upper stone layers shall be mortared. The remaining horizontal and vertical joints shall be dry or mortared as indicated on the Drawings.

623S.5 Measurement

Acceptable 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 finished sloping face. Separate measurement will not be made for backfill, footing or the removal of existing mortared rock walls, and these items shall be included in the unit price bid for the item bids.

623S.6 Payment

Work performed and materials furnished or prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid price per square foot for "Dry Stack Rock Wall". The unit bid price shall include full compensation for: furnishing all materials, completing all excavation including existing mortared rock walls, constructing the footings, backfilling behind the wall and providing all equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 623S: Dry Stack Rock Wall - Per Square Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS	
Specification 623S, "Dry Stack Rock Wall"	

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 1.8.2.B.6	Construction on Slopes

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403S	Concrete for Structures
Item No. 210S	Flexible Base
Item No. 620S	Filter Fabric

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
410-A	Abrasion of Coarse Aggregate Using The Los Angeles Machine
411-A	Soundness of Aggregate By Use of Sodium Sulfate or Magnesium Sulfate

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
C-535	Standard Test Method for Resistance of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

<u>RELATED</u> CROSS REFERENCE MATERIALS	
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City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 624S
Earth Outlet Sediment Trap

624S.1 Description

This item shall govern the trap formed by either an excavation and/or embankment. The trap shall have a discharge point over or cut into natural ground. The outlet shall be free of any restriction to flow. The removal of the entire structure, re-grading and re-vegetation of the area shall be included in this Standard Specification Item.

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.

624S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding;
- B. Type of mulch;
- C. Type of tacking agent;
- D. Type and rate of application of fertilizer.

624S.3 Materials

Seeding shall conform to Item No. 604S, "Seeding for Erosion Control".

624S.4 Construction Methods

All excavation operations shall be carried out in such a manner that erosion and water pollution shall be minimal. Any excavated portion of the sediment trap shall have 2:1 or flatter slopes.

Area under the embankment and the pool area shall be cleared, grubbed or stripped of all vegetation and root mat in conformance with Standard Specification Item No. 120S, "Clearing and Grubbing".

The fill material for the embankment shall be free of roots or other woody vegetation, as well as oversized stones, rocks, organic material or other objectionable material. The embankment shall conform to Standard Specification Item No. 132S, "Embankment".

Outlet crest elevation shall be at least 1 foot (300 mm) below the top of the embankment.

Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to 1/2 the design depth of the trap or 1 foot (300 mm), whichever is less. The sediment that is removed from the trap shall be deposited in an approved spoils area and in such a manner that it will not cause additional siltation.

The structure shall be inspected after each rain and repairs made as needed by the Contractor throughout the duration of this contract or until the Engineer or designated representative gives permission in writing to remove the structure.

The structure shall be removed and the area graded and re-seeded in conformance with Standard Specification Item No. 604S, "Seeding for Erosion Control", when the drainage area has been properly stabilized.

624S.5 Measurement

Acceptable work, that is performed as prescribed by this Standard Specification item, will be measured by the square yards (square meters: 1 square meter is equal to 1.196 square yards) of sediment trap constructed, removed and re-vegetated.

624S.6 Payment

Work performed and materials furnished for this item will be paid at the unit bid price per square yard of sediment trap.

Payment will be made under:

Pay Item No. 624S: Earth Outlet Sediment Trap Per Square Yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS	
Specification 624S, "Earth Outlet Sediment Trap"	

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 120S	Clearing and Grubbing
Item No. 132S	Embankment
Item No. 604S	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS	
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City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610 S	Preservation of Trees and Other Vegetation

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 627S
Grass-Lined Swale

627S.1 Description

This item governs natural or constructed drainage ways of parabolic or trapezoidal cross section that are located below adjacent ground level and is stabilized by suitable vegetation (Environmental Criteria Manual Section 1.4.3.B). The flow is normally wide and shallow and conveys the runoff down the slope.

A grass-lined swale shall be used when it is necessary to convey runoff only without causing erosion. In cases where there is base flow involved, it shall be handled by the addition of a subsurface drain or a stone or gabion mattress lined low flow channel to the grass-lined swale.

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.

627S.2 Submittals

The submittal requirements for this specification item shall include:

- A. The submittal requirements (if necessary) for Standard Specification Item Numbers 594S, Gabions and Revet Mattresses", 602S, "Sodding for Erosion Control", 604S, "Seeding for Erosion Control" and 605S, "Soil retention Blanket".
- B. Aggregate types, gradations, and physical characteristics for the Portland Cement Concrete mix,

627S.3 Materials

A. Grass-lined Swale

1 Seed and Mulch

Seed and mulch shall conform to Item No. 604S, "Seeding for Erosion Control".

2 Sod

Sodding shall conform to Item No. 602S, "Sodding for Erosion Control".

3 Soil Retention Blanket

The soil retention blanket shall conform to Standard Specification Item No. 605S, "Soil Retention Blanket".

627S.4 Construction Methods

Except as indicated on the Drawings or directed by the Engineer or designated representative, all trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the waterway.

The waterway shall be excavated or shaped to line, grade, typical sections, and cross-section indicated on the Drawings and shall be free of bank projections or other irregularities, which could impede normal flow.

Fill shall conform to Standard Specification Item No. 132S, "Embankment".

All soil and materials not needed to complete the swale shall be removed.

627S.5 Measurement

Acceptable work performed as prescribed by this item shall be measured by lineal feet (lineal meters: 1 lineal meter equals 3.281 lineal feet) along the centerline of the stone center "pilot" channel.

627S.6 Payment

Work performed and materials furnished for this item shall be paid at the unit bid price per lineal foot.

Payment will be made under:

Pay Item No. 627S-GSS: Grass-Lined Swale	Per
Lineal Foot	

End

<i>SPECIFIC</i> CROSS REFERENCE MATERIALS	
Specification 627S, "Grass-Lined Swale and Grass-Lined Swale with Stone Center"	

City of Austin Environmental Criteria Manual

Designation	Description
Section 1.4.4.B.4	Permanent Erosion and Sedimentation Control
Section 1.4.6.B	Standards for Grass-Lined Swales

City of Austin Standard Specifications

Designation	Description
Item No. 132S	Embankment
Item No. 403S	Concrete for Structures
Item No. 594S	Gabions and Revet Mattresses
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 605S	Soil Retention Blanket

City of Austin Standard Details

Designation	Description
No. 627S-1	Grass-Lined Swale

<u>RELATED</u> CROSS REFERENCE MATERIALS
Specification 627S, "Grass-Lined Swale "

City of Austin Standard Specifications

Designation	Description
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation

Item No. 120S Channel Excavation

Item No. 401	Structural Excavation and Backfill
Item No. 404S	Pneumatically Placed Concrete
Item No. 406	Reinforcing Steel
Item No. 408	Concrete Joint Material
Item No. 410	Concrete Structures
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 620S	Filter Fabric

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 631S
Interceptor Swale

631S.1 Description

This Standard Specification Item governs a temporary excavated drainage way that is located across disturbed areas or rights of way. The purpose of an interceptor swale (Environmental Criteria Manual Section 1.4.2.B) is to shorten the length of exposed slopes, thereby reducing the potential for erosion, by intercepting storm runoff and diverting it to a stabilized outlet or sediment-trapping device. This item shall also include removal of the "Interceptor Swale" and re-vegetation of the area.

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.

631S.2 Submittals

The submittal requirements for this specification item shall include:

A. The dry riprap submittal shall include:

1. Type, size and source of rock,
2. Filter fabric, and
3. Construction details.

B. The seeding submittal shall include:

1. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding,
2. Type of mulch,
3. Type of tacking agent, and
4. Type and rate of application of fertilizer.

631S.3 Materials

A. Stabilization

Dry riprap shall conform to the requirements for Dry Riprap (Section 591S.5) of Standard Specification Item No. 591S, "Riprap for Slope Protection".

B. Seeding

Seeding shall conform to Item No. 604S, "Seeding for Erosion Control".

631S.4 Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the swale, as indicated on the Drawings.

The swale shall be excavated or shaped to line, grade and cross section as required to meet the criteria specified herein and Standard Detail 631S-1, "Interceptor Swale" and shall be free of bank projections or other irregularities which could impede normal flow.

All earth, that is removed and not needed in construction, shall be disposed of at an approved spoils site so that it will not interfere with the function of the swale.

"Interceptor Swale" shall have a level bottom and shall have an outlet that functions with a minimum of erosion.

Runoff shall be conveyed to a sediment-trapping device, as indicated on the Drawings.

Stabilization, when required, shall conform to Standard Specification Item No. 591S, "Riprap for Slope Protection" and/or Standard Specification Item No. 627S, "Grass-Lined Swale and Grass-Lined Swale with Stone Center".

The structure shall be inspected monthly and after each rainfall. Repairs shall be made by the Contractor, as needed throughout the duration of this Contract or until the Engineer or designated representative issues written permission to remove the structure.

631S.5 Measurement

Acceptable work performed as prescribed by this Standard Specification item will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) along the 2-foot (0.6 meter) minimum top width, complete in place.

631S.6 Payment

Work performed and materials furnished for this item as provided under "Measurement" will be paid for at the unit bid price per lineal foot. The Unit Bid Price shall include full compensation for: (a) furnishing, hauling and placing all materials including all labor, tools, equipment and the incidentals needed to complete the work, (b) maintaining the dike, (c) removing any silt accumulations; (d) removing, regrading and disposing of all materials when the dike is no longer required and (e) re-vegetating the area upon removal of the dike.

Payment will be made under:

Pay Item No. 631S: Interceptor Swale - Per Lineal Foot.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
Specification 631S, "Interceptor Swale"	

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 631S-1	Interceptor Swale

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 591S	Riprap for Slope Protection
Item No. 604S	Seeding for Erosion Control

<i>RELATED</i> CROSS REFERENCE MATERIALS
Specification 631S, "Interceptor Swale"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602S	Sodding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610 S	Preservation of Trees and Other Vegetation
Item No. 620S	Filter Fabric
Item No. 621S	Diversion
Item No. 627S	Grass-Lined Swale and Grass-Lined Swale With Stone Center
Item No. 636S	Perimeter Swale

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 632S
Storm Inlet Sediment Trap

632S.1 Description

This item governs the construction of a temporary silt basin around a drainage structure, the maintenance of the trap, the removal of silt accumulations until the trap is no longer required, the restoration of the area to the final grade and the re-vegetation of the disturbed area.

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.

632S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Locations and Types of inlet traps (yard or curb drain).
- B. Seeding
 - 1. Identification of the type, source, mixture, pure Live Seed (PLS) and rate of application,
 - 2. Type of mulch,
 - 3. Type of tacking agent, and
 - 4. Type and rate of application of fertilizer.

632S.3 Materials

A. Seeding

Seeding for re-vegetation shall conform to Standard Specification Item No. 604S, "Seeding for Erosion Control".

B. Embankment

Embankment shall conform to Standard Specification Item No. 132S, "Embankment".

632S.4 Construction Methods

The area under the embankment shall be cleared, grubbed and stripped of any vegetation and root material in conformance with Standard Specification Item 102S, "Clearing and Grubbing".

Construction operations shall be carried out in such a manner that erosion and water pollution shall be minimized.

Sediment shall be removed and the trap shall be restored to its original dimensions when the sediment has accumulated to 1/2 the design depth of the trap. The sediment, that is removed, shall be deposited in an approved area and in such a manner that it will not erode.

The structure shall be inspected monthly and after each rain and repairs made as needed by the Contractor throughout the duration of this contract or until the Engineer or designated representative provides written permission to remove the structure.

When the trap is no longer required, the Contractor shall remove the silt accumulation and backfill the trap in accordance with Standard Specification Item No. 130S, "Borrow" or Standard Specification Item No. 132S, "Embankment". Any material placed shall be compacted in 8-inch (200 mm) lifts, loose measure and compacted to the required density by mechanical means.

The temporary Storm Inlet Sediment Trap shall be removed, when directed by the Engineer or designated representative, and the area leveled off and protected by erosion control measures appropriate for the terrain as indicated on the Drawings and/or Standard Detail Number 632S-1, "Storm Inlet Sediment Trap". Permanent Storm Inlet Sediment Traps shall be seeded and comply with all the requirements for Item No. 604S, "Seeding for Erosion Control".

632S.5 Measurement

Acceptable work performed as prescribed by this item will be measured by the cubic foot (cubic meter: 1 cubic meter equals 35.31 cubic feet) of sediment trap complete in place.

632S.6 Payment

The Work performed and the materials furnished for this item as provided under "Measurement" will be paid for at the unit bid price per cubic foot of sediment trap constructed. The Unit Bid Price shall include full compensation for: (a) furnishing, hauling and placing all materials including all labor, tools, equipment and the incidentals needed to complete the work, (b) maintaining the trap, (c) removing any silt accumulations, (d) removing, regrading and disposing of all silt and debris, (e) regrading and placing embankment and (f) re-vegetation of area upon removal of the trap.

Payment will be made under:

Pay Item No. 632S: Storm Inlet Sediment Trap Per Cubic Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS	
Specification 632S, "Storm Inlet Sediment Trap"	

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 632S-1	Storm Inlet Sediment Trap

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 102S	Clearing and Grubbing
Item No. 130S	Borrow
Item No. 132S	Embankment
Item No. 604S	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS
Specification 632S, "Storm Inlet Sediment Trap"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602S	Sodding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 633S
Landgrading

633S.1 Description

This item shall govern reshaping the existing topography in accordance with the Drawings and Standard Detail 633S-1, "Landgrading". The purpose of landgrading is to provide for erosion control and vegetation establishment on those areas where the existing topography is to be reshaped by grading.

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.

633S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Sediment control plan
- B. Seeding plan including:
 - 1. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding,
 - 2. Type of mulch,
 - 3. Type of tacking agent, and
 - 4. Type and rate of application of fertilizer.

633S.3 Materials

- A. Seeding

Seeding shall conform to Item No. 604S, "Seeding for Erosion Control".
- B. Pipe Underdrains

Pipe underdrains shall conform to Item No. 551, "Pipe Underdrains".

633S.4 Construction Methods

All sediment control practices and measures shall be constructed and in place before proceeding with the construction of "Landgrading". The sediment control practices and measures shall be maintained in accordance with the sediment control plan. Topsoil and fill materials, which are stripped for the establishment of vegetation, shall be stockpiled in amounts necessary to complete finished grading of all exposed areas. Temporary stockpiles, borrow areas and permitted spoil areas shall be shown on the Drawings and no other areas shall be used for these purposes. Cleared areas, that are to receive fill materials, shall be grubbed to remove trees, vegetation, roots and other objectionable material as required by Standard Specification Item No. 102S, "Clearing and Grubbing". Seeps or springs encountered during construction shall be intercepted and diverted to a

pipe underdrain conforming to Standard Specification Item No. 551, "Pipe Underdrains" and Standard Detail No. 551-1.

Except for approved landfills, fill material shall be free of brush, rubbish, rocks, logs, stumps, building debris and other objectionable materials that would interfere with or prevent construction of satisfactory fills. All fills shall be compacted as required by the Drawings and Standard Detail 633S-1 to reduce erosion, slippage, settlement, subsidence or other related problems. Fill intended to support buildings, structures and conduits, etc., shall be compacted in accordance with Standard Specification Item No. 132S, "Embankment". All graded areas shall be permanently stabilized and seeded immediately following finished grading.

633S.5 Measurement

Acceptable work performed as prescribed by this item will be measured by either square feet (square meters: 1 square meter equals 1.196 square feet) or acres (hectares; 1 hectare equals 2.471 acres) of the area to be graded, which will include stabilization and groundcover re-establishment.

633S.6 Payment

Work performed and material furnished for this item will be paid for at the unit bid price per square foot or acre of the area graded. Pipe Underdrains, when required, will be paid for in accordance with Item No. 551, "Pipe Underdrains".

Payment will be made under:

Pay Item No. 633S-A:	Landgrading	Per Square Foot.
Pay Item No. 633S-B:	Landgrading	Per Acre.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS	
Specification 633S, "Landgrading (LG) "	

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 633S-1	Landgrading

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 102S	Clearing and Grubbing
Item No. 132S	Embankment
Item No. 551	Pipe Underdrains
Item No. 604S	Seeding for Erosion Control

<u>RELATED CROSS REFERENCE MATERIALS</u>
Specification 633S, "Landgrading (LG) "

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 602S	Sodding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 620S	Filter Fabric

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

**Item No. 634S
Level Spreader**

634S.1 Description

This item governs furnishing and installing an entrance channel conversion to sheet flow without causing erosion to the existing vegetation. This item shall include the re-vegetation of the area.

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.

634S.2 Submittals

The submittal requirements for this specification item shall include:

- A. The source, material type and classification, density and moisture requirements of the embankment materials
- B. The soil retention blanket material type and sample, evidence that the material is listed on TxDoT/TTI's Approved Products List, one (1) full set of Manufacturer's literature and installation recommendations, and any special details necessary for the proposed application.
- C. Re-vegetation program, including:
 - 1. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.
 - 2. Type of mulch.
 - 3. Type of tacking agent.
 - 4. Type and rate of application of fertilizer.

634S.3 Materials

A. Filter Fabric

Filter Fabric shall conform to Item No. 620S, "Filter Fabric".

B. Backfill

Fill shall conform to Item No. 132S, "Embankment".

634S.4 Construction Methods

Level Spreader shall be constructed level to insure uniform spreading of sediment-free runoff. The Level Spreader shall be constructed on undisturbed soil. A filter fabric erosion stop shall be placed vertically at least 6 inches (150 mm) deep in a silt trench 1 foot (300 mm) back from the level lip and parallel to the lip. The entire level lip area shall be protected by 2 strips of "Soil Retention Blanket" (Standard Specification Item 605S). The entrance channel shall not exceed a 1 percent grade before extending the spreader. All groundcover shall be re-established and construction areas stabilized.

The structure shall be inspected monthly and after each rainfall. Repairs shall be made by the Contractor, as needed, throughout the duration of the contract or until the Engineer or designated representative provides written permission to remove the structure.

634S.5 Measurement

Measurement of the Level Spreader as prescribed by this item will be by the square foot (square meters: 1 square meter equals 10.764 square feet) of the bottom channel.

634S.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 "Level Spreader". 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 of existing fencing, 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:

Pay Item No. 634S: Level Spreader Per Square Foot of Bottom Channel.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS	
Specification 634S, "Level Spreader"	

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 634S-1	Level Spreader

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 132S	Embankment
Item No. 605S	Soil Retention Blanket
Item No. 620S	Filter Fabric

<u>RELATED</u> CROSS REFERENCE MATERIALS	
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City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 635S
Perimeter Dike

635S.1 Description

This item shall govern construction of a temporary ridge of compacted soil located along the perimeter of the site or disturbed area. The removal of the entire structure and re-vegetation of the area are also included in this item. The purpose of a perimeter dike is to prevent offsite storm runoff from entering the disturbed area and to prevent sediment-laden storm runoff from leaving the construction site or disturbed area.

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.

635S.2 Submittals

The submittal requirements for this specification item shall include:

- A. The Dry Riprap submittal shall include:
 - 1. Type, size and source of rock,
 - 2. Filter fabric, and
 - 3. Construction details.
- B. Re-vegetation program, including:
 - 1. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding,
 - 2. Type of mulch,
 - 3. Type of tacking agent, and
 - 4. Type and rate of application of fertilizer.

635S.3 Materials

- A. Riprap

Riprap for stabilization shall conform to Dry Riprap, Item No. 591S, "Riprap for Slope Protection".
- B. Seeding

Seeding shall conform to Item No. 604S, "Seeding for Erosion Control".

635S.4 Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of in a manner that will not interfere with the excavation and construction of the dike as indicated on the Drawings and Standard Detail No. 635S-1, "Perimeter Dike". The dike shall not drain onto the public right of way.

All perimeter dikes shall be machine compacted to the extent necessary to provide not less than 95 percent density conforming to TxDOT Test Method Tex-114-E and shall have

positive drainage to an outlet. Diverted runoff from a protected or stabilized upland area shall flow directly onto an undisturbed stabilized area or into a level spreader (Standard Specification Item No. 634S) or grade stabilization structure (Standard Specification Item No. 625S).

Diverted runoff from a disturbed or exposed upland area shall be conveyed to a sediment-trapping device such as sediment trap, a sediment basin or to an area protected by any of these practices (Environmental Criteria Manual Section 1.4.0). Unless otherwise indicated on the Drawings, stabilization shall conform to Item No. 591S, "Riprap for Slope Protection" and/or Item No. 627S, "Grass-Lined Swale and Grass-Lined Swale with Stone Center". Riprap, when used, shall be placed in a uniform layer embedded in the soil.

The structure shall be inspected monthly and after each rainfall. Repairs shall be made by the Contractor, as needed, throughout the duration of this contract or until the Engineer or designated representative provides written permission to remove the structure.

635S.5 Measurement

Acceptable work performed as prescribed by this item will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) along the centerline of the 2-foot (0.6 meter) minimum top width.

635S.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 "Perimeter Dike". 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 any existing fencing, removal of silt and removal and disposal of all materials at the completion of construction in and re-vegetation of disturbed areas.

Payment will be made under:

Pay Item No. 635S: Perimeter Dike -

Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 635S, "Perimeter Dike"

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 635S-1	Perimeter Dike

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 591S	Riprap for Slope Protection
Item No. 604S	Seeding for Erosion Control
Item No. 625S	Grade Stabilization Structure
Item No. 627S	Grass-Lined Swale and Grass-Lined Swale with Stone Center
Item No. 634S	Level Spreader

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 1.4.0	Erosion and Sedimentation Control

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Test Method Tex-114-E	Laboratory Compaction Characteristics And Moisture-Density Relationship of Subgrade and Embankment Soils

<u>RELATED CROSS REFERENCE MATERIALS - Continued</u>
Specification 635S, "Perimeter Dike"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 602S	Sodding for Erosion Control
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 622S	Diversion Dike (DD)
Item No. 630S	Interceptor Dike (ID)
Item No. 636S	Perimeter Swale (PS)

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 637S
Pipe Slope Drain

637S.1 Description

This item governs the installation of a flexible tubing and/or rigid pipe with a prefabricated entrance section that is temporarily placed to extend from the top to the bottom of a slope. The removal of the pipe slope drain structure is also included in this item. The purpose of the pipe slope drain is to convey surface runoff safely down slopes without causing erosion.

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.

637S.2 Submittals

The submittal requirements for this specification item shall include:

- A. The Dry Riprap submittal shall include:
 - 1. Type, size and source of rock,
 - 2. Filter fabric, and
 - 3. Construction details.
- B. The pipe and inlet pipe submittal shall include:
 - 1. Size, properties, banding, etc for the Corrugated Metal Pipe.
 - 2. Size, properties, and installation details and instructions.

637S.3 Materials

A. Pipe and Inlet Pipe

The pipe and inlet pipe shall be corrugated metal pipe (Standard Specification Item 510, "Pipe") with watertight connecting bands of the size indicated on the Drawings.

B. Flexible Tubing

The flexible tubing shall be the same diameter as the inlet pipe and shall be constructed of a durable material with hold-down grommets spaced 10 feet (3 meters) on centers.

C. Riprap

Riprap area shall consist of 6 inch (150 mm) stone and shall meet the requirements for Dry Riprap (Section 591S.5) of Standard Specification Item No. 591S, "Riprap for Slope Protection" .

637S.4 Construction Methods - Flexible

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed in a manner that will not interfere with the excavation and construction of the drain as indicated on the Drawings. The drain shall not drain onto the public right of way.

The top of the earth dike over the inlet pipe and those dikes carrying water to the pipe shall be at least 1 foot higher at all points than the top of the inlet pipe.

The pipe slope drain shall be of the type indicated on the Drawings and constructed to the details indicated on the Drawings and/or Standard Detail Numbers 637S-1, "Pipe Slope Drain (FLEXIBLE)" and 637S-2, "Pipe Slope Drain (RIGID)".

The flexible tubing shall be securely fastened to the corrugated metal pipe with metal strapping or watertight connecting collars. The flexible tubing shall be securely anchored to the slope by staking at the grommets provided.

A riprap apron shall be provided at the outlet, as indicated on the Drawings and/or Standard Details.

The structure shall be inspected monthly and after each rainfall. Sediment buildup shall be removed and repairs shall be made by the Contractor, as needed, throughout the duration of this contract or until the Engineer or designated representative provides written permission to remove the structure.

637S.5 Measurement

Acceptable work performed as prescribed by this item will be measured per each.

637S.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 "Pipe Slope Drain". 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 existing fencing, removal of silt and removal and disposal of all materials at the completion of construction.

Payment will be made under:

Pay Item No. 637S:	Pipe Slope Drain	Per Each.
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End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 637S, "Pipe Slope Drain"

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 637S-1	Pipe Slope Drain (Flexible)
Number 637S-2	Pipe Slope Drain (Rigid)

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 591S,	Riprap for Slope Protection
Item No. 510	Pipe
Item No. 604S	Seeding for Erosion Control

<u>Related</u> CROSS REFERENCE MATERIALS

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602S	Sodding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 620S	Filter Fabric

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 638S
PIPE OUTLET SEDIMENT TRAP

638S.1 Description

This item shall govern construction of a basin formed by an embankment or excavation along with an embankment at the point of discharge of the pipe. The removal of the pipe outlet sediment trap structure shall also be included in this item. The outlet for the trap shall be through a perforated riser and a pipe through the embankment.

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.

638S.2 Submittals

The submittal requirements for this specification item shall include the Size, properties, banding, installation details and instructions for the corrugated metal pipe for the pipe and pipe riser.

638S.3 Materials

Corrugated metal pipe shall be used with diameter selected from the following table:

Minimum Pipe Diameter		Maximum Drainage Area	
Inches	Millimeters	Acres	Hectares
12	300	1	0.4
18	450	2	0.8
21	525	3	1.2
24	600	4	1.6
30	750	5	2.0

638S.4 Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of in a manner that will not interfere with the excavation and construction of the trap as indicated on the Drawings and/or Standard Detail Number 638S-1, "Pipe Outlet Sediment Trap." The trap shall not drain onto the public right of way.

All excavation operations shall be carried out in such a manner that erosion and water pollution shall be minimal. Any excavated portion of sediment trap shall have 2:1 or flatter slopes.

All pipe connections shall be watertight.

At least the top 2/3 of the riser shall be perforated with 1/2 inch (12.5 mm) diameter holes spaced 8 inches (200 mm) vertically and 10 to 12 inches (250 to 300 mm) horizontally.

Fill material around the pipe spillway shall be compacted in 4 inch (100 mm) layers. A minimum of 2 feet (0.6 meter) of compacted backfill shall be placed over the pipe spillway before crossing it with construction equipment.

The fill material for the embankment shall be free of roots or other woody vegetation, as well as oversized stones, rocks, organic material or other objectionable material. The embankment shall be compacted by traversing with mechanical equipment while it is being constructed.

The structure shall be inspected monthly and after each rainfall. Repairs shall be made by the Contractor, as needed, throughout the duration of the contract or until the Engineer or designated representative provides written permission to remove the structure.

Sediment shall be removed and trap restored to its original dimensions when the sediment has accumulated to 1/2 the design depth of the trap or 1 foot (300 mm), whichever is less. The sediment that is removed shall be deposited in an approved area and in such a manner that it will not erode.

The structure shall be removed and area restored and vegetated when the drainage area has been properly stabilized.

638S.5 Measurement

Acceptable work performed as prescribed by this item will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) of sediment trap constructed.

638S.6 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per square yard of "Pipe Outlet Sediment Trap". 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 existing fencing, removal of silt and removal and disposal of all materials at the completion of construction.

Payment will be made under:

Pay Item No. 638S: Pipe Outlet Sediment Trap Per Square Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification 638S, "Pipe Outlet sediment Trap"

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 638S-1	Pipe Outlet Sediment Trap

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 510	Pipe

RELATED CROSS REFERENCE MATERIALS
Specification 638S, "Pipe Outlet sediment Trap"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401S	Structural Excavation and Backfill
Item No. 602S	Sodding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 620S	Filter Fabric

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right-of-Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering

Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

**ITEM NO. 639S
ROCK BERM**

639S.1 Description

This item shall govern the construction of a temporary berm of open graded rock that is installed at the toe of a slope on the perimeter of a developing area. Rock berms are appropriate for use as flow diverters, energy dissipators, grade control, and level spreaders to release the water in sheet flow (Environmental Criteria Manual Section 1.4.5.E). This item shall also govern the removal of the "Rock Berm" and re-vegetation of the area.

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.

639S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Function (flow diversion, grade control, energy dissipator, level spreader, or other) and dimensions of the rock berm
- B. Source, type and gradation of rock
- C. Re-vegetation program, including:
 - 1. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.
 - 2. Type of mulch.
 - 3. Type of tacking agent.
 - 4. Type and rate of application of fertilizer.

639S.3 Design Criteria

A detailed design is not required for the installation of a rock berm; however, the following criteria shall be observed:

Drainage area	less than 5 acres (2 hectares).
Height	18 inches (450 mm) minimum height, measured vertically from the top of the existing ground at the upslope toe to the top of the berm.
Top width	2 feet (0.6 meter) minimum.
Side slopes	2:1 or flatter.
Grade	Berms will be built along a contour as near possible to a 0 percent grade.

639S.4 Materials

Surplus rock excavated from utility trenches or from other excavations may be used in construction of these berms. In general, the rocks shall be sound with a minimum of 3 inches (75 mm) in smallest dimension and shall weigh between 10 and 30 pounds (4.5 to 13.6 kilograms) each. Seeding for re-vegetation shall conform to Item No. 604S, "Seeding for Erosion Control".

Use only open-graded rock of the size indicated on Standard Detail No. 639S-1, with most of the fines removed.

639S.5 Construction Methods

All trees, brush, stumps and objectionable material shall be removed and disposed in a manner that will not interfere with the construction of the berm.

A trench shall be excavated to a minimum depth of 4 inches (100 mm) below existing grade for placement of the rock as indicated on Standard Detail No. 639S-1 and the Drawings. The rocks shall be placed in interlocking layers with close joints starting at the base. Open joints shall be filled with rock-spalled materials as required to stabilize the berm.

The area upstream from the rock berm shall be maintained in a condition, which will allow sediment to be removed following the runoff from a rainfall event. After each rainfall event with an accumulation of 1 inch (25 mm) or more, an inspection of the rock berm will be made by the Contractor and the stone shall be replaced, when the structure ceases to function as intended because of sediment accumulation among the rocks, washout, construction traffic damage, etc.

If the sediment reaches a depth equal to 1/3 the height of the berm or 6 inches (150 mm), whichever is less, the Contractor will remove the accumulated sediment and dispose of it at an approved disposal site in a manner that will not contribute to additional sedimentation. The berm will be reshaped as needed during construction.

When the site is completely stabilized, the berm will be removed and disposed of in a manner approved by the Engineer or designated representative.

The area will be re-vegetated as required by Item No. 604S, "Seeding for Erosion Control".

639S.6 Measurement

Acceptable work performed and prescribed in this item will be measured by the linear foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) along the centerline of top of berm.

639S.7 Payment

The work performed and material furnished and measured as provided under "Measurement" to construct this item will be paid for at the unit bid price per linear foot of rock berm barrier as indicated on the Drawings. The Unit Bid Price shall include full compensation for:

- (a) furnishing, hauling and placing all materials including all labor, tools, equipment and incidentals needed to complete the work,
- (b) maintaining the berm,
- (c) removing sediment accumulations,
- (d) rock replacement,
- (e) removing and disposing of all materials when the berm is no longer required and
- (f) re-vegetating the site upon removal of the berm.

Payment will be made under:

Pay Item No. 639S:	Rock Berm	Per Lineal Foot.
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End

<i>SPECIFIC CROSS REFERENCE MATERIALS</i>
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Specification 639S, "Rock Berm"

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 1.4.2.E	Rock Berm

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 639S-1	Rock Berm

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 604S	Seeding for Erosion Control

<i>RELATED CROSS REFERENCE MATERIALS</i>

Specification 639S, "Rock Berm"

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Table 1-1.3	Recommended Design Values For Functional Controls
Table 1-2	Maximum Water Depth At The Barrier

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401S	Structural Excavation and Backfill
Item No. 602S	Sodding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 606S	Fertilizer

Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 620S	Filter Fabric

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 641S
Stabilized Construction Entrance

641S.1 Description

This item governs the construction of a stabilized pad of crushed stone located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk or parking area. The removal of the stabilized pad of crushed stone shall also be included in the item. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking or deposition of sediment onto public right of way (Environmental Criteria Manual Section 1.4.2.N.4).

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.

641S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Source, type and gradation of rock
- B. Drainage technique (i.e. drainage swale or entrance grading) proposed to prevent runoff from exiting the construction site.

641S.3 Materials

Aggregate for construction shall conform to the following gradation:

Table 1: Aggregate Gradation Chart (TEX 401-A, % Retained per sieve)	
US 5 inch (SI 125 mm)	US 3 inch (SI 75 mm)
0	100

641S.4 Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of in a manner that will not interfere with the excavation and construction of the entrance as indicated on the Drawings or as presented in Standard Details No. 641S-1. The entrance shall not drain onto the public right of way or shall not allow surface water runoff to exit the construction site.

When necessary, vehicle wheels shall be cleaned to remove sediment prior to entrance onto public right of way. When vehicle washing is required, it shall be done on an area stabilized with crushed stone, which drains into an approved sediment trap or sediment basin. All sediment shall be prevented from entering any storm drain, ditch or watercourse through use of sand bags, gravel, boards, silt fence (Standard Specification Item No 642S) or other methods approved by the Engineer or designated representative.

The entrance shall be maintained in a condition that will prevent tracking or disposition of sediment onto public right of way. This restriction may require periodic top dressing with additional stone as conditions demand, as well as the repair and/or cleanout of any measures used to trap sediment. All sediment that is spilled, dropped, washed or tracked onto public right of way must be removed immediately.

641S.5 Measurement

Acceptable work performed as prescribed in this item will be measured by unit of each stabilized construction entrance installed.

641S.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 "Stabilized Construction Entrance". 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 existing fencing, removal of silt and removal and disposal of all materials at the completion of construction.

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

Pay Item No. 641S: Stabilized Construction Entrance Per Each.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS	
Specification 641S, "Stabilized Construction Entrance (SCE)"	

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 1.4.2.N.4	Stabilized Construction Entrance "Design Criteria"

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 641S-1	Stabilized Construction Entrance

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 642S	Silt Fence (SF)

<u>RELATED</u> CROSS REFERENCE MATERIALS	
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City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 1.4.2.J	Sandbag Berm
Figure 1-11	Sand Bag Berm
Section 1.4.2.G	Silt Fence

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401S	Structural Excavation and Backfill
Item No. 610S	Preservation of Trees and Other Vegetation

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

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way

Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 168	Vegetative Watering

**ITEM NO. 642S
SILT FENCE**

642S.1 Description

This item shall govern the provision and placement of a silt fence fabric fence (Environmental Criteria Manual Section 1.4.5.G) including maintenance of the fence, removal of accumulated silt, removal of the silt fence and re-vegetation of disturbed areas 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.

642S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Source, manufacturer, characteristics and test data for the silt fence fabric,
- B. Manufacturer, characteristics and test data for the posts and wire fence.
- C. Re-vegetation program, including:
 - 1. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.
 - 2. Type of mulch.
 - 3. Type of tacking agent.
 - 4. Type and rate of application of fertilizer.

642S.3 Materials

- A. Fabric
 - 1. General:

The silt fence fabric shall be of nonwoven polypropylene, polyethylene or polyamide thermoplastic fibers with non-raveling edges. The silt fence 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 silt fence 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, on Standard Detail No. 642S-1 and/or on the Drawings.

B. Posts:

Posts shall be steel Tee or Y-posts, not less than 4 feet (1.22 meters) in length with a minimum weight of 1.25 pounds per foot (1.86 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. Caps are required (*not specifying discretionary criteria).

C. Wire Fence:

Wire fence shall be welded wire fabric 2 in. x 4 in. 12.5 SWG, wire diameter 0.099 in (± 0.005 in.), and shall conform to Standard Specification Item No. 406, "Reinforcing Steel".

TABLE 1. Silt Fence Fabric Requirements		
Physical Properties	Method	Requirements
Fabric Weight in ounces per square yard (grams/square meter)	TEX-616-J ¹	5.0 minimum (150 minimum)
Equivalent Sieve Opening Size: US Standard (SI Standard sieve size)	CW-02215 ²	40 to 100 (425 to 150 μ m)
Mullen Burst Strength: lbs. per sq. inch (psi) megaPascal (mPa)	ASTM D-3786 ³	280 minimum (1.9 minimum)
Ultraviolet Resistance; % Strength Retention	ASTM D-1682 ⁴	70 minimum

¹ TxDoT Test Method Tex-616-J, "Testing of Construction Fabrics".

² US Army Corps of Engineers Civil Works Construction Guide Specification CW-02215, "Plastic Filter Fabric".

³ ASTM D-3786, " Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method".

⁴ ASTM D-1682, " Test Methods for Breaking Load and Elongation of Textile Fabrics ".

642S.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 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 silt fence 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.

* Per OSHA §1926.701, 'all protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement'. Caps must be large enough to dissipate the forces of impact to prevent impalement from a reasonably foreseeable fall distance. It should be noted that the use of impalement protection caps is but one method of protection; covers or wooden troughs can be another means of meeting the guarding requirement. For City of Austin purposes, this also applies to t-posts and wooden stakes.

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).

642S. 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.

642S.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 in and re-vegetation of disturbed areas.

Payment will be made under:

Pay Item No. 642S:	Silt Fence for Erosion Control	Per Lineal Foot.
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END

SPECIFIC CROSS REFERENCE MATERIALS

Specification 642S, "Silt Fence"

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 1.4.5.G	Silt Fence

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 642S-1	Silt Fence

City of Austin Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 406	Reinforcing Steel

American Society For Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-702	Specification for Steel Fence Posts and Assemblies, Hot Wrought
D-1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
D-3786	Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method

Texas Department of Transportation Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-616-J	Testing of Construction Fabrics

U.S. Army Corps of Engineers

<u>Designation</u>	<u>Description</u>
CW-02215	Civil Works Construction Guide Specification "Plastic Filter Fabric"

RELATED CROSS REFERENCE MATERIALS
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Specification 642S, "Silt Fence"

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Table 1-1.3	Recommended Design Values For Functional Controls
Table 1-2	Maximum Water Depth At The Barrier

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401S	Structural Excavation and Backfill
Item No. 610S	Preservation of Trees and Other Vegetation

Item No. 643S
Stone Outlet Structure

643S.1 Description

This item shall consist of a temporary crushed stone dike installed in conjunction with and as part of a diversion dike, interceptor dike or perimeter swale. The purpose of this stone outlet structure is to provide a protected outlet for a diversion dike, interceptor dike or perimeter dike, to provide for diffusion of concentrated flow and to allow the area behind the dike to de-water (Environmental Criteria Manual Section 1.4.2.D). This item shall include removal of the "Stone Outlet Structure" and re-vegetation of the area.

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.

643S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Source, manufacturer, characteristics and test data for the filter fabric,
- B. Source, type and gradation of stone,
- C. Re-vegetation program, including:
 - 1. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.
 - 2. Type of mulch.
 - 3. Type of tacking agent.
 - 4. Type and rate of application of fertilizer.

643S.3 Materials

A. Stone

The stone used in construction of this stone outlet dike shall be crushed stone at least 3 inches (75 mm) in diameter but not over 6 inches (150 mm) in diameter or 1/2 cubic foot (.014 cubic meter) in volume.

B. Seeding

Seeding for re-vegetation shall conform to Standard Specification Item No. 604S, "Seeding for Erosion Control".

C. Fabric Core

1. General:

The filter fabric shall be of non-woven polypropylene, polyethylene or polyamide geotextile 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, on Standard Detail No. 643S-1 and/or on the Drawings.

TABLE 1. Filter Fabric Requirements		
Physical Properties	Method	Requirements
Fabric Weight in ounces per square yard (grams/square meter)	TEX-616-J ¹	4.5 minimum (150 minimum)
Water Flow Rate in gallons/sq. foot/ minute (liters/square meter/minute)	TEX-616-J ¹	40 maximum (1630 maximum)
Equivalent Sieve Opening Size: US Standard (SI Standard sieve size)	CW-02215 ²	40 minimum (425 µm minimum)
Mullen Burst Strength: lbs. per sq. inch (psi) megaPascal (mPa)	ASTM D-3786 ³	250 minimum (1.7 minimum)
Ultraviolet Resistance; % Strength Retention	ASTM D-1682 ⁴	70 minimum

¹ TxDOT Test Method Tex-616-J, "Testing of Construction Fabrics".

² US Army Corps of Engineers Civil Works Construction Guide Specification CW-02215, "Plastic Filter Fabric".

³ ASTM D-3786, "Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method".

⁴ ASTM D-1682, "Test Methods for Breaking Load and Elongation of Textile Fabrics".

643S.4 Construction Methods

On the area over which the Stone Outlet Structure is to be placed, all clearing, grubbing and excavation operations shall be completed before placing the Stone Outlet Structure. The Stone Outlet Structure foundation soil shall be compacted to the extent necessary to provide an in place density (TxDOT Test Method Tex-115E) not less than 90 percent of the laboratory density as determined in accordance with TxDOT Test Method Tex-114-E. The stone shall be placed, spread and shaped to the grades indicated on the Drawings and/or Standard Detail No. 643S-1. All disturbed areas shall be graded and compacted to an in place density (TxDOT Test Method Tex-115E) not less than 85 percent of the maximum laboratory density (TxDOT Test Method Tex-114-E) and then seeded in accordance with Standard Specification Item 604S.

The stone outlet structure shall be inspected by the Contractor monthly and after each rainfall event with an accumulation of 1 inch (25 mm) or more. Stone shall be replaced when the structure ceases to function as intended due to silt accumulation among the stone, washout, construction traffic damage, etc. When the silt reaches a depth equal to 1/3 the height of the structure or six inches (150 mm), whichever is less, the Contractor will remove the accumulated silt and dispose of it at a disposal site, that is approved by the Engineer or designated representative, in a manner that will insure that additional siltation will not occur.

When indicated on the Drawings, the Stone Outlet Structure shall be removed when directed by the Engineer or designated representative and the area leveled off and protected by erosion control measures appropriate for the terrain. Stabilization shall consist of complete vegetation cover, sufficiently established to be erosion resistant.

643S.5 Measurement

Acceptable work performed as prescribed by this item shall be measured by the cubic foot (cubic meter: 1 cubic meter equals 35.315 cubic feet) of the outlet.

643S.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 "Stone Outlet Structure". 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 existing fencing, 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:

Pay Item No. 643S: Stone Outlet Structure Per Cubic Foot.

End

SPECIFIC CROSS REFERENCE MATERIALS

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 1.4.2.D	Stone Outlet Structures

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 643S-1	Stone Outlet Structure

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 604S	Seeding for Erosion Control

American Society For Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
D-1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
D-3786	Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method

Texas Department of Transportation Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade & Embankment Soils
Tex-115-E	Field Method For Determination of In-Place Density of Soils and Base Materials
Tex-616-J	Testing of Construction Fabrics

U.S. Army Corps of Engineers

<u>Designation</u>	<u>Description</u>
CW-02215	Civil Works Construction Guide Specification, "Plastic Filter Fabric".

RELATED CROSS REFERENCE MATERIALS

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
Table 1-1.3	Recommended Design Values For Functional Controls
Table 1-2	Maximum Water Depth At The Barrier

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401S	Structural Excavation and Backfill
Item No. 610S	Preservation of Trees and Other Vegetation

Item No. **646S**
Tied Precast Concrete Revetment

646S.1 Description

This item shall govern the materials and construction of an Erosion Control System in accordance with these specifications and with the lines, grades, design and dimension indicated on the Drawings or as directed 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.

646S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Source, manufacturer, characteristics and test data for the revetment rope,
- B. PC Concrete mix design information, including mix composition, source, type and gradation of aggregates, sand etc. and proposed admixtures,
- C. Source, manufacturer, characteristics and test data for the filter fabric

646S.3 Materials

A. Portland Cement (p.c.) Concrete

The Portland cement concrete shall be Class B and shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

Air entrainment admixtures shall be used in the p.c. concrete mix and shall conform to Standard Specification Item No. 405, "Concrete Admixtures". With prior approval of the Engineer or designated representative, retarding admixtures may be used. Concrete sand and crushed stone or gravel passing 3/8 inch US Standard (SI sieve designation of 9.5 mm) sieve shall be used for the concrete mix design.

B. Revetment Rope

Revetment Rope shall be constructed of high tenacity, low elongation, continuous filament polyester fibers, consisting of parallel core fibers, which are contained within an outer braid jacket or cover.

The outer cover shall consist of an 8, 10, 12 or 16 strand braid covering the core fibers.

The weight (mass) of the core shall be between 65 percent and 75 percent of the total weight (mass) of the rope.

Construction of the rope shall be such that the cover braid is non-load bearing and the rope is torque free.

Minimum average breaking strengths for new, dry rope and the minimum and maximum weights (mass) for the rope are as follows:

Rope Diameter			Circumference		Minimum		Minimum	
Nominal	Actual				Weight, lbs.	Mass, kgs.	Breaking Strength	
inches	Ins.	mm	Ins.	mm	Per 100 ft.	per 100 m	lbs.	kNs.
3/16			.589	15	1.3	1.9	1,600	7.1
1/4	.240	6.1	.754	19	2.1	4.1	2,750	12.2
1/4	.255	6.5	.801	20	2.6	5.0	3,300	14.7
1/4	.280	7.1	.880	22	2.9	5.6	4,000	17.8
1/4	.295	7.5	.927	24	3.1	6.0	4,500	20.0
5/16	.32	8.1	1.005	27	4.2	8.1	6,000	26.7
3/8	.380	9.6	1.194	30	5.0	9.7	8,800	39.1
1/2	.5	12.7	1.571	40	9.4	18.2	14,000	62.3

Elongation requirements specified below are based upon stabilized new, dry rope. Stabilization refers to a process in which the rope is cycled 50 times between a load corresponding to 200D square and a load equal to 10 percent, 20 percent or 30 percent of the rope's approximate average breaking strength. Relevant elongation values are as shown in the table below. The tolerance on these values is plus or minus 5 percent.

	Percent Breaking Strength		
	10%	20%	30%
Permanent Elongation While Working	0.7%	1.8%	2.6%
Elastic Elongation	0.6%	1.4%	2.2%
Total Stretch	1.3%	3.2%	4.8%

The critical temperature, defined as the point at which degradation of the rope occurs due to temperature alone, shall be a minimum of 350°F (177°C). The melting point of the rope materials shall be a minimum of 480°F (249°C).

C. Anchors and Miscellaneous Hardware

Anchors shall be screw type helix anchors and shall conform to ASTM A-36. Anchor size, length and spacing shall produce a direct pull equivalent to the dead weight (mass) of the mats. The anchors shall be galvanized in accordance with ASTM A-123. Clips, sleeves and other miscellaneous hardware shall be aluminum.

Filter fabric shall be placed below the revetment conforming to Item No. 620S, "Filter Fabric".

D. Blocks and Mats

Cellular concrete blocks shall be cast to the dimensions of 4 inches (100 mm) by 11 7/8 (300 mm) inches by 23 7/8 inches (600 mm) nominal, with a minimum weight of 35 to 40 pounds per square foot (170 to 195 kilograms per square meter). (OPTIONAL: Each mattress shall contain a nonabrasive plastic tubing incorporated into the system continuously longitudinally and laterally.) The blocks shall have cells and outer recesses in the vertical direction. (OPTIONAL: Vertical cells may be eliminated in certain specified projects.)

The blocks shall be assembled into mats of length and width to fit the proposed work. The blocks shall be bound into mats by the use of the revetment rope. Two strands

of rope shall extend through each block in a longitudinal direction and 1 strand of rope shall extend through each block in a lateral direction.

Each longitudinal rope will be looped at one end of each row of blocks and the ends bound together at the opposite end of each row. The binding of the rope ends shall be by sleeves. Lateral rope shall extend approximately 6 inches (150 mm) past the outer recesses of the mat and shall be held in place by buttons or similar devices.

Longitudinal ropes shall be a minimum 1/4 inch (6.3 mm) diameter for mats up to 50 feet (15 meters) in length and 5/16 inch (7.8 mm) for mat lengths in excess of 50 feet (15 meters). Rope used in the transverse direction shall be 1/4 inch (6.3 mm) in diameter.

646S.4 Construction Methods

The slope on which the mats are to be placed shall be constructed according to the lines and grades indicated on the Drawings. Fills shall be placed by pushing embankment material into place with a bulldozer or similar equipment. When the material is high enough above water level to support compaction equipment, the fill shall be compacted by this equipment to an in-place density (TxDoT Test Method Tex-115-E) not less than 95 percent of the maximum density conforming to TxDoT Test Method Tex-114-E.

Additional height of fill will be obtained by adding thin layers of embankment material and walking it down with compaction equipment. The depth of layers and amount of compaction shall be varied to obtain a density equal to or greater than the adjoining natural soil.

An anchor trench shall be constructed at the top of the mat system according to the lines, grades and dimensions indicated on the Drawings. Toe trenches and side trenches, if indicated on the Drawings, will also be constructed.

Woven and/or non-woven filter fabric shall be placed on the slope and in the anchor and trench as indicated on the Drawings.

Prior to placement of the fabric, pieces of wood, rock, concrete, brick or other objects that might puncture the fabric shall be removed.

Fabric shall be placed directly on the ground surface. Longitudinal and transverse joints shall be overlapped at least 3 feet (0.9 meter). Workers placing the fabric may walk on the fabric. However, equipment shall be prohibited from operating on it.

The fabric shall be kept in its protective wrapping until ready for use. Any fabric that has been out of its protective cover for over 72 hours without being covered shall be considered unsatisfactory and shall be removed and replaced with satisfactory fabric.

Torn, punctured or separated sections of fabric shall be repaired by placing a fabric patch over the hole prior to placing the mats. The patch shall be large enough to overlap a minimum of 3 feet (0.9 meter) in all directions.

The mats shall then be attached to a spreader bar or other type device and placed in their proper positions by the use of a crane or other equipment approved by the Engineer or designated representative.

Mats shall be anchored at the top by fastening the rope loop to anchors driven into the anchor trench as indicated on the Drawings. Enough anchors shall be used to support the entire weight (mass) of the mat.

As adjacent mats are placed, they shall be secured to each other from the top down to the water line by fastening the protruding transverse ropes together along each side of the mats. The fastening shall be done with sleeves or clips.

Anchor trenches and side trenches shall be backfilled and compacted flush with the top of the mats from the water line up.

Mats shall be custom fabricated at the plant or cut on the job site to fit irregular configurations.

The entire surface specified for erosion control shall be covered by mats without any vacancies, gaps or holes.

646S.5 Measurement

Work and accepted material as prescribed for this item will be measured by the square foot (square meter: 1 square meter equals 10.764 square feet) of surface area and toe trenches covered by mats.

646S.6 Payment

Work performed and materials furnished as prescribed by this specification item and measured under "Measurement" will be paid for at the unit bid price per square foot for "Tied Precast Concrete Revetment". This unit bid price shall include full compensation for all surface preparation, furnishing and placing all filter fabric, for furnishing and placing all blocks, rope, anchors, sleeves, clips and buttons and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 646S: Tied Precast Concrete Revetment Per Square Foot.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
Specification 646S, "Tied Precast Concrete Revetment"	

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403S	Concrete for Structures
Item No. 406	Concrete Admixtures
Item No. 620S	Filter Fabric

American Society For Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-36	Specifications for Structural Steel
A-123	Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS - Continued
Specification 646S, "Tied Precast Concrete Revetment"

Texas Department of Transportation Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade & Embankment Soils
Tex-115-E	Field Method For Determination of In-Place Density of Soils and Base Materials
Tex-616-J	Testing of Construction Fabrics

<u>RELATED</u> CROSS REFERENCE MATERIALS
Specification 646S, "Tied Precast Concrete Revetment"

Texas Department of Transportation Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-616-J	Testing of Construction Fabrics

American Society For Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
D-1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
D-3786	Test Method for Hydraulic Bursting Strength of Knitting Goods and Non-woven Fabrics: Diaphragm Bursting Strength Tester Method

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 610S	Preservation of Trees and Other Vegetation

**ITEM NO. 647S
MULCH BERM**

647S.1 Description

A Mulch Berm consists of wood mulch, wood chips, or other organic material. It is used to intercept, settle, and filter sheet flow and pond runoff. Mulch berms provide an environmentally sensitive and cost-effective alternative to sediment fences.

647S.2 Submittals

The submittal requirements for this specification item shall include the following:

A. Mulch Material

1. A small sample of mulch material proposed to be used on the site will be provided to the engineer.
2. Provide a designated project stockpile of mulch for sampling and testing at the producer's site.
3. A copy of the lab analysis, performed by an STA-certified lab, verifying that the mulch material meets the requirements of Table 1.

Table 1		
Item	Requirement	Reference Specification
Particle Size	less than or equal to 5 inches in length with 95% passing a 2-inch screen and less than 30% passing a 1-inch screen	TXDOT Special Specification 1011, Mulch Filter Berm.
pH	5.5 – 8.5	TMECC 04. 11-A, "1.5 Slurry pH"
Organic Matter Content	25%, dry weight basis	TMECC 05.07-A, "Loss-On-Ignition Organic Matter Method"

647S.3 Materials

- A. Mulching material can be manufactured on or off the project site and may consist of:
1. Shredded bark
 2. Stump grindings
 3. Composted bark

- B. The mulch shall have the following composition:
1. Untreated wood chips shall be less than or equal to 5 inches in length with 95% passing a 2-inch screen and less than 30% passing a 1-inch screen (TXDOT Special Specification 1011, Mulch Filter Berm).
 2. Large portions of silts, clays, or fine sands are not acceptable.
 3. The pH of the mulch shall be between 5.5 and 8.5.
 4. The organic matter content shall be greater than or equal to 25% on a dry weight basis.
- C. Mulch material must be free of refuse, physical contaminants, and material toxic to plant growth. It is not acceptable for the mulch material to contain ground construction debris, biosolids, manure, or recyclable material.
- D. Prior to placement, a representative sample of the mulching material must be tested and certified by the project engineer or his/her designee and accepted by the city inspector.

647S.4 Installation

- A. Mulch Berms should be a minimum 24 inches high and 36 inches wide.
- B. Install mulch berms per Figure 1.4.5.J in the City of Austin Environmental Criteria Manual.
- C. Mulch berms should be used at the base of slopes no steeper than 2:1 and should not exceed the maximum spacing criteria provided in the following table.

Slope	Spacing Interval (ft)	Max. Drainage Area (sf) per 100ft of Berm
100:1 to 50:1 (1-2%)	100	10,000
50:1 to 30:1 (2-3.3%)	75	7,500
30:1 to 25:1 (3.3-4%)	65	6,500
25:1 to 20:1 (4-5%)	50	4,800
20:1 to 10:1 (5-10%)	25	2,600
10:1 to 5:1 (10-20%)	15	1,300
5:1 to 2:1 (20-50%)	10	1,000

- D. Place mulch berms at a 5 ft or greater distance away from the toe of the slopes to maximize space available for sediment deposition.
- E. When placed on level contours, sheet flow of water should be perpendicular to the mulch berm at impact and unconcentrated.
- F. In order to prevent water flowing around the ends of the mulch berms, point the ends of the berms up slope.

- G. In order to prevent water from flowing between the gaps at adjacent ends of mulch berms, overlap the ends of adjacent mulch berms a minimum of 12 inches.
- H. 4.5 G (Silt Fence)
- I. For steeper slopes, an additional mulch berm can be constructed on the top of the slope and within the slope area as determined by specific field conditions. Multiple mulch berms are recommended on steeper slopes.
- J. Do not use mulch berms in areas of concentrated flow as they are intended to control sheet flow only.

647S.5 Inspection and Maintenance

- A. Inspect mulch berms after installation for gaps under the mulch berms and for gaps between the joints of adjacent ends of mulch berms. Contractor shall repair gaps such that no water flows under or around berm.
- B. Inspect every seven days and within 24 hours of a rainfall event of 0.5 inches or greater. Replace and repair mulch berms as necessary.
- C. Sediment retained by the mulch berms shall be removed when it has reached one third of the exposed height of the mulch berms.
- D. Mulch berms can be vegetated or un-vegetated. Vegetated mulch berms can be left in place. The vegetation will grow in the slope, further anchoring the berm.

647S.6 Payment

The work performed and the materials furnished as prescribed by this item shall be paid for by the linear foot of mulch berm installed.

Payment will be made under:

Pay Item No. 647S:	Mulch Berm	Per Lineal Foot.
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END

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item No. 647S, "Mulch Berm"

City of Austin Environmental Criteria Manual

Designation	Description
1.4.5.J	Mulch Berm
1.4.5.G	Silt Fence

City of Austin Standard Details

Designation	Description
647S-1	Mulch Berm

**ITEM NO. 648S
MULCH SOCK**

648S.1 Description

A Mulch sock consists of material encased in a tube of mesh. It is used to intercept, settle, and filter sheet flow and pond runoff. Mulch socks provide an environmentally sensitive and cost-effective alternative to sediment fences.

648S.2 Submittals

The submittal requirements for this specification item shall include the following:

A. Mulch Material

1. A small sample of mulch material proposed to be used on the site will be provided to the engineer.
2. Provide a designated project stockpile of mulch for sampling and testing at the producer's site.
3. A copy of the lab analysis, performed by an STA-certified lab, verifying that the mulch material meets the requirements of Table 1.

Table 1		
Item	Requirement	Reference Specification
Particle Size	3" minus screening process	Equivalent to TXDOT item 161, Compost, Section 1.6.2.B, Wood Chip requirements
pH	5.5 – 8.5	TMECC 04. 11-A, "1.5 Slurry pH"
Organic Matter Content	25%, dry weight basis	TMECC 05.07-A, "Loss-On-Ignition Organic Matter Method"

B. Tube Material

The CONTRACTOR shall submit a sample of the material that the CONTRACTOR proposes to use on the project. A sample of the material should be accompanied by material data sheet identifying composition, ability of the material to biodegrade, and size of openings in tube at a minimum.

648S.3 Materials

- A. Mulching material can be manufactured on or off the project site and may consist of:
 - 1. Shredded bark
 - 2. Stump grindings
 - 3. Composted bark
- B. The mulch shall have the following composition:
 - 1. Wood chips shall be produced from a 3-inch minus screening process (equivalent to TxDOT item 161, Compost, Section 1.6.2.B Wood Chip Requirements).
 - 2. Large portions of silts, clays, or fine sands are not acceptable.
 - 3. The pH of the mulch shall be between 5.5 and 8.5.
 - 4. The organic matter content shall be greater than or equal to 25% on a dry weight basis.
- C. Mulch material must be free of refuse, physical contaminants, and material toxic to plant growth. It is not acceptable for the mulch material to contain ground construction debris, biosolids, manure, or recyclable material.
- D. Prior to placement, a representative sample of the mulching material must be tested and certified by the project engineer or his/her designee and accepted by the city inspector.
- E. "Sock" material will be 100% biodegradable, photodegradable, or recyclable such as burlap, twine, UV photodegradable plastic, polyester, or any other acceptable material. The material mesh opening should be equal to or less than 3/8 inch (10 mm) and the material tensile strength should be equal to or greater than 44 psi (3.09 kg/cm²).

648S.4 Installation

- A. Use 12 or 18 inch diameter mulch socks for all sediment control applications. This diameter of mulch sock material has proven to be the most consistent for all sediment control applications (TxDOT, April 2006).
- B. Install mulch socks per Figure 1.4.5.F in the City of Austin Environmental Criteria Manual.

- C. Mulch socks should be used at the base of slopes no steeper than 2:1 and should not exceed the maximum spacing criteria provided in the following table.

Slope	Max. Slope Length Between <u>18 in. Dia. Sock</u> (ft)	Max. Drainage Area (sf) per 100ft of Sock
100:1 - 50:1	100	10,000
50:1 - 30:1	75	7,500
30:1 - 25:1	65	6,500
25:1 - 20:1	50	4,800
20:1 - 10:1	25	2,600
10:1 - 5:1	15	1,300
5:1 - 2:1	10	1,000

Slope	Max. Slope Length Between <u>12 in. Dia. Sock</u> (ft)	Max. Drainage Area (sf) per 100ft of Sock
100:1 - 50:1	100	6,000
50:1 - 30:1	40	4,000
30:1 - 25:1	30	3,000
25:1 - 20:1	25	2,600
20:1 - 10:1	15	1,300
10:1 - 5:1	10	1,000
5:1 - 2:1	5	500

- D. Place mulch socks at a 5 ft or greater distance away from the toe of the slopes to maximize space available for sediment deposition.
- E. When placed on level contours, sheet flow of water should be perpendicular to the mulch sock at impact and unconcentrated.
- F. Install mulch socks using rebar (#5 minimum with safety caps) a minimum of 48 inches in length placed on 2-ft centers. In order to prevent the movement or floating of the mulch sock during rain events or construction operations, install steel posts on alternating sides of the sock. Drive the posts into the ground to a minimum depth of 24 inches, leaving less than 12 inches of post above the exposed mulch sock.
- G. In order to prevent water flowing around the ends of the mulch socks, point the ends of the socks up slope.
- H. In order to prevent water from flowing between the gaps at adjacent ends of mulch socks, overlap the ends of adjacent mulch socks a minimum of 12 inches. Never stack mulch socks on top of one another.
- I. Mulch Socks should be placed using 'smiles' and 'j-hooks'. See ECM Section 1.4.5 G (Silt Fence)
- J. For steeper slopes, an additional mulch sock can be constructed on the top of the slope and within the slope area as determined by specific field conditions. Multiple mulch socks are recommended on steeper slopes.

- K. Do not use mulch socks in areas of concentrated flow as they are intended to control sheet flow only.

648S.5 Inspection and Maintenance

- A. Inspect mulch socks after installation for gaps under the mulch socks and for gaps between the joints of adjacent ends of mulch socks. Contractor shall repair gaps such that no water flows under or around sock.
- B. Inspect every seven days and within 24 hours of a rainfall event of 0.5 inches or greater. Replace and repair mulch socks as necessary.
- C. Sediment retained by the mulch socks shall be removed when it has reached one third of the exposed height of the mulch socks.
- D. Mulch socks can be vegetated or un-vegetated. Vegetated mulch socks can be left in place. The vegetation will grow in the slope, further anchoring the sock.

648S.6 Payment

The work performed and the materials furnished as prescribed by this item shall be paid for by the linear foot of mulch sock installed.

Payment will be made under:

Pay Item No. 648S:	Mulch Sock	Per Lineal Foot.
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END

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>
Specification Item No. 648S, "Mulch Sock"

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
1.4.5.F	Mulch Sock
1.4.5.G	Silt Fence

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
648S-1	Mulch Sock

Item No. 658S
Void and Water Flow Mitigation

658S.1 Description

This item governs notification requirements, as well as the furnishing and installing mitigation measures, specified by the Engineer or the designated Representative, for voids and water flow features discovered in bedrock during excavation activities of a project. This item does not apply to excavations that occur below the water table or in unconsolidated earth material. It is intended to address features observed upon initial excavation or discrete discharge points that are discovered when trench backfill material is removed. The purpose of the mitigation is to preserve voids and water flow features while maintaining utility integrity and preventing pollution.

The necessary investigation, selection methods for determining mitigation measures, and site plan correction submittal requirements are presented in Section 1.12.0 of the City of Austin Environmental Criteria Manual.

Standard Details 658S-1 through S-7 shall be used in site plan correction submittals related to the implementation of this item.

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.

658S.2 Submittals

A. Submittals requirements of this specification include:

1. 3 x 5 hard rock: Source, type and gradation of rock.
2. Controlled Low Strength Material (CLSM): Mix design for CLSM and other submittals shall be as required by Standard Specification Item 402S.
3. Low Slump Concrete: The mix design for Class I, Curb & Gutter, Hand-vibrated Concrete (3500 psi) and other submittals shall be as required by Standard Specification Item 403S.7, Table 5. The concrete shall have a maximum 3 inch (75 mm) slump.
4. Filter Fabric: Submittals as required by Standard Specification Item 620S. The material to be used for this application shall be noted.
5. Permanent Turf Reinforcement Mat (PTRM): Non-degradable turf reinforcement mat that meets the specification requirements of the U.S. Department of Transportation, Federal Highway Administration (FHWA) FP-03, Section 713.18. The mat shall be made of nylon or other inert plastic and not be coated with chemical, substance or film. Maximum mesh opening shall be no greater than 2.5 mm (0.1 inch).

658S.3 Materials

- A. 3 x 5 hard rock: Rocks shall be sound with a minimum of 3 inches (75 mm) in smallest dimension and 5 inches (125 mm) in largest dimension. Open-graded rock of the size indicated on Details and fines removed, shall be used.
- B. Controlled Low Strength Material (CLSM): This material shall meet the requirements for CLSM as specified in Standard Specification Item 402S.
- C. Filter Fabric: This material shall meet the requirements for filter fabric as specified in Standard Specification Item 620S.
- D. Low Slump Concrete: This concrete shall meet the requirements for Class I, Curb & Gutter, Hand-vibrated Concrete as specified in Standard Specification Item 403S.7, Table 5. The concrete shall have a maximum 3-inch slump.
- E. Polypropylene Bags filled with pea gravel. Pea gravel shall meet requirements of Standard Specification Item 510.2 (5).
- F. Gravel Backfill: Gravel backfill shall meet requirements of Standard Specification Item 510.2 (2) (a) for pipe bedding stone.
- G. Permanent Turf Reinforcement Mat (PTRM): Non-degradable turf reinforcement mat shall meet the specification requirements of the U.S. Department of Transportation, Federal Highway Administration (FHWA) FP-03, Section 713.18. The mat shall be made of nylon or other inert plastic and not be coated with chemical, substance or film. Maximum mesh opening shall be no greater than 2.5 mm (0.1 inch).

658S.4 Procedures

- A. The Engineer or designated representative shall select a Geologist or designate a Geologist representative to observe trench walls greater than 5 feet (1.5 meters) deep of projects located within the Edwards Aquifer Recharge Zone (as defined by the City of Austin) or within 500 feet (152.5 meters) of a spring or seep identified during the permit review. The Geologist is defined as a geoscientist licensed under the Geology discipline by the Texas Board of Professional Geoscientists (Title 22, Part 39, Chapter 850.1). The Geologist representative is defined as a person who has been trained to identify and describe the geological origin of voids in karst terrain geology by the Geologist. A Professional Engineer with geological experience in karst terrain who qualifies to practice geoscience per the Texas Board of Professional Geoscientists rules (Title 22, Part 39, Chapters 850 and 851), may serve as the Geologist. Inspections must occur at least once daily during excavation operations and prior to backfilling the trench. Contractor shall be responsible to provide 24-hour prior notice of excavation activity to the designated Geologist or Geologist representative. The Contractor shall be responsible for ensuring that the Geologist or Geologist representative has the opportunity to observe the vertical face of all excavation activities (including pre-trenching operations) prior to any initial temporary back fill operations and following backfill removal for bedding, final back fill, pipe or manhole installation.

- B. Each underground void or water flow feature shall be mitigated in accordance with one or more of the following procedures and methods:
1. The Geologist or designated Geologist representative will observe the trench wall for any voids larger than 1 cubic foot (0.023 cubic meters) or any water flow feature. The Geologist or the Owner shall call the City of Austin Environmental Inspector, the Construction Inspector or Site/Subdivision Inspector, the City of Austin geologist, as necessary, for additional observation of the anomaly. For General Permit projects, the General Permit office shall be notified. For City of Austin-constructed projects, the location of the anomaly shall be recorded in the Construction Inspector's daily progress report. The owner must also notify the Texas Commission on Environmental Quality (TCEQ) for projects located within the jurisdictional boundaries of the Edwards Aquifer Recharge Zone, as defined in Chapter 213 of Title 30 of the Texas Administrative Code.
 2. Initial observation of the anomaly shall be made from the top of the trench. The Contractor shall submit an Excavation Safety System Plan (City of Austin Standard Technical Specification Item 509S) for approval and shall install all necessary safety equipment to allow direct observation of the anomaly.
 3. The Contractor must stop all excavation or trenching activities within 25 feet (7.62 meters) of the outer edge of the void's interior extent.
 4. In certain cases, the Geologist or designated Geologist representative may determine that the void requires protection prior to any further backfill operations. Protection preventing the backfill from entering the void may consist of plywood planking or other barricade necessary to block the backfill. Areas of flowing water may require temporary mitigation measures, as well. The Contractor shall implement all appropriate mitigation measures established by the Geologist or designated Geologist representative.
 5. If a void is located at the bottom of a trench, temporary void protection per Class I, Standard Detail 658S-1, shall be provided at all times that trench excavation is halted and until Owner's geologic and biologic inspection has occurred and Contractor has been given instructions on how to proceed.
 6. A second void or water flow feature inspection may be required following final excavation operations. The Contractor shall stabilize the trench to allow for observation of the anomaly from within the trench. The Contractor shall provide an Excavation Safety System Plan (City of Austin Standard Technical Specification Item 509S) and shall install all necessary safety equipment to allow direct observation of the void or water flow feature. The Contractor shall assist in the investigation by providing access to the anomaly (e.g., ladders, harness and rigging, scaffolding, etc.) and confined space safety equipment. Contractor shall install all necessary shoring and trench protection.
 7. The Contractor shall provide the safety plan for allowing trench entry for anomaly inspection. The Contractor's designated safety supervisor shall ensure that all OSHA requirements are met during anomaly observation. The Contractor shall not place pipe, pipe bedding, and backfill within 25 feet (7.62 meters) of the anomaly prior to final inspection.

8. The Engineer or designated representative shall submit a site plan correction to the City of Austin for all voids and/or anomalies that require mitigation measures; except for voids that are less than 18 cubic feet (.504 cubic meters), are dry, have no airflow and are located above the top of a utility pipe. The site plan correction shall show the surveyed location of the void (s) and/or anomaly (ies) and shall reference mitigation measures from this specification. The corresponding detail (s) are to be included in the correction. The Contractor shall not proceed with construction of the mitigation measures, excavating, pipe placement or installing pipe bedding or backfill within 25 feet (7.62 meters) of the anomaly (ies) until an approved site plan correction is acquired.
9. Mitigation of voids that are less than 18 cubic feet (.504 cubic meters), are dry, have no airflow and are located above the top of a utility pipe may proceed following a site meeting of the Engineer, the Geologist, the City of Austin Environmental Inspector, a City of Austin geologist and concurrence of a mitigation method. The Environmental Inspector will issue a punch list that will require a site plan correction approval prior to issuing a Certificate of Occupancy on any private project or prior to a final walk-through on a subdivision project and prior to the issuance of the engineer's concurrence letter. For City of Austin General Permits office projects, a member of that office must be present at the site meeting and agree with the proposed mitigation method.
10. The Contractor shall construct the void and/or water flow mitigation measure (s) in accordance with the approved site plan correction. Anticipated measures shall be documented within the Contract Documents and pay items. The Contractor and Construction Inspector shall record material quantities of all completed mitigation measures in accordance with the pay items in the Construction Inspector's daily progress report for each day that a specific mitigation event is undertaken.
11. Upon completion of each void and/or water flow mitigation measure, a Geologist or designated Geologist representative shall inspect the work before the Contractor resumes construction activities within 25 feet (7.62 meters) of the anomaly.

658S.5 Execution

A. GENERAL

The Engineer or designated representative shall establish the appropriate permanent void and water flow mitigation measures. Void and/or water flow mitigation measures shall be constructed as herein depicted and specified for most anomalies encountered. If the Geologist or designated Geologist representative observes unusually large voids or unforeseen circumstances, other measures may be prescribed by the Engineer or designated representative once the anomaly is observed.

B. VOID AND WATER FLOW MITIGATION MEASURES

1. Class I temporary void mitigation measures for a void at the bottom of a trench or along a sidewall of a trench, as indicated in Standard Detail 658S-1, generally consist of:
 - a. Temporary protection of the void shall be provided by covering the void opening with filter fabric with minimum of 3 foot (915 mm) distance from edge of void to edge of filter fabric. This action will be taken prior to covering the trench or temporary backfilling operations.
 - b. The void opening shall be covered with plywood planking with a minimum of 1 foot (305 mm) distance from edge of the void to the edge of the planking. Planking is to be placed to prevent backfill from entering void. Rock (minimum weight of 5 pounds (2.3. kg)) or concrete block shall be placed over planking.
2. Class II permanent void mitigation measures, as indicated in Standard Detail 658S-2, generally consist of:
 - a. Permanent protection of the void by hand packing with 3 to 5-inch (75 to 125 mm) rock to provide stable bearing support and covering the rock at the opening with filter fabric. Low slump concrete (3500 psi) shall be placed to cover the opening area and to seal the void at the limits of excavation. Concrete shall be a minimum of 18 inches (457 mm) thick within the void opening and shall extend a minimum of 6 inches (152 mm) beyond the edge of the void. Void openings that are less than 30 inches deep shall be sealed entirely with concrete. A form shall be used to ensure proper placement of a low slump concrete-seal over the void opening. After the void is covered, the controlled low-strength bedding and backfill material shall be placed. The controlled low-strength fill material shall extend a minimum of 5 feet (1.5 meters) beyond the edge of all voids in all directions.
 - b. For Grade 2 voids, additional measures may be specified by the Engineer or designated representative (e.g., increase thickness of concrete and placement of rebar reinforcement in the concrete, placement of a steel plate over void opening, etc.).
3. Class III void mitigation measures, as indicated in Standard Detail 658S-3, generally consist of:
 - a. Permanent protection of the void by hand packing large areas with pea gravel-filled polypropylene bags to provide stable bearing support in order to protect a void from infiltration of backfill material. If a void is greater than 100 cubic feet (2.8 cubic meters) or is located within a rock strata that is structurally unstable, then 3 to 5-inch (75 to 125 mm) rock may be utilized behind the gravel-filled polypropylene bags to prevent ground collapse. A connector pipe may be required to maintain air or water flow within a void bisected by the trench. After a void is filled, low slump concrete (Class I, 3500 psi) shall be placed to seal the void opening. If needed, place a form to ensure a minimum thickness of concrete that extends at least 18 inches (457 mm) into the void.
 - b. Secondary containment of wastewater and stormsewer lines by outer carrier pipe or low slump concrete (Class I, 3500 psi) or CLSM

encasement is required. If CLSM encasement is proposed, then the engineer must submit pipe deflection and wall crushing calculations. Low slump concrete or CLSM encasement shall be a minimum of 6 inches (152 mm) thickness on all sides of the pipe and shall extend a minimum of 5 feet (1.5 m) beyond the edge of any voids. Design of carrier pipe must be reviewed by the City of Austin for all City of Austin wastewater and stormsewer lines prior to submittal of the site plan correction. Stabilizing collars and other supports, as needed, must be provided. The engineer must modify Standard Detail 658S-3 or provide a specific detail showing the proposed carrier pipe installation and void mitigation.

4. Class IV void mitigation measures, as indicated in Standard Detail 658S-4, are-RESERVED FOR FUTURE RULE REVISION.
5. Class V void mitigation measures, as indicated in Standard Detail 658S-5, generally consist of:
 - a. Placement of CLSM bedding material along the length of pipe as directed by the Engineer or designated representative.
 - b. Placement of gravel backfill material wrapped in PTRM one foot (.305 meters) beyond limits of void in all directions. PTRM shall be placed along areas between the gravel material and trench walls/earth backfill and shall overlap at top.
 - c. A minimum of 3 feet (.915 meters) of CLSM backfill shall be placed along the length of pipe on either side of the gravel backfill material and shall extend a minimum of 1 foot (.305 meters) above the gravel backfill material. Forms shall be used to control the placement of CLSM material.
6. For very large voids, the Engineer shall define specific mitigation measures. The Contractor will implement specific mitigation measures per the direction of the Engineer or designated representative after the site plan correction is approved by the City of Austin.

C. REPORTING

1. The Contractor shall provide written documentation to the Engineer or designated representative describing the void and water flow mitigation measures taken on the Project. The information shall be included in the Construction Inspector's daily progress report. The report shall include, as a minimum, the following information:
 - a. Location (line stationing, distance from permanent structure, depth in trench from adjacent surface grade, geologic strata, etc.).
 - b. Physical dimensions of void and/or description of water flow recorded on the Contractor Void Description and Documentation Log Sheet (provided as Attachment A).
 - c. Photographs, field notes, maps, sketches, and measurements.

- d. Mitigation action taken and status. Include a copy of the plan sheet showing the location of the void and details for mitigation measures.

For City of Austin-constructed projects, also include the following:

- e. Actual agreed-upon quantities of materials used by Contractor in execution of mitigation shall be included in the Construction Inspector's daily progress report.
- f. Signature from the Contractor and Construction Inspector indicating agreement with the documented quantities and any delays associated with downtime for observation of the void.

658S.6 Measurement

- A. Measurement for void and water flow mitigation measures shall be made as follows:
 - 1. Measurement of temporary void protection (filter fabric, plywood planking, etc.) shall be per each occurrence.
 - 2. Measurement of controlled low strength material shall be by the cubic yard of material in place.
 - 3. Measurement of pea gravel-filled polypropylene bags shall be by each. Minimum size is 1 cubic foot (0.028 cubic meters).
 - 4. Measurement of 3 to 5-inch (75 to 125 mm) rock shall be by the cubic yard (cubic meter) of rock placed.
 - 5. Measurement of filter fabric shall be by the square yard of filter fabric as needed to maintain specified clearance from edge of void.
 - 6. Measurement of permanent turf reinforcement mat shall be by the cubic foot (cubic meter) of material in place.
 - 7. Measurement of low slump concrete material shall be by the cubic foot (cubic meter) of material in place.
 - 8. Measurement for provision of Special Trench Safety shall be per Linear Foot.
 - 9. Measurement for Downtime Associated with Observation of Voids and/or Flowing Water shall be per Day. This pay item shall only apply in circumstances where the Contractor's operations have been halted and Contractor cannot continue work in another area of the project. Delay time will not be allocated for time that work on a void mitigation measure is in progress, only for time associated with observation and determination of mitigation measures to be taken. Contractor must notify the City's Inspector within one hour of the beginning of the delay and document the time and cause of delay. Documentation shall also include explanation of why work could not continue. Work stoppage for one hour or less shall not be cause for delay and will not be measured, but shall be included in the unit price bid in the pipe pay items. Partial day delays shall be measured as fractions of a day

calculated by half days. Delays over one hour and up to 4 hours will be counted at 0.5 DAY.

658S.7 Payment

This section does not obligate the City of Austin to pay for void and water flow mitigation measures on private projects.

The work performed for "Temporary Void Protection (Plywood Planking)" and "Pea Gravel-Filled Polypropylene Bags for Void Mitigation" will be paid for at the unit price bid per each occurrence. The unit price bid items shall include full compensation for all materials and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

The work performed for "Controlled Low Strength Material," "Low Slump Concrete," and "3 To 5 Inch Rock for Void Mitigation" will be paid for at the unit price bid per cubic yard. These unit bid price items shall include full compensation for all concrete, rock, curing, finishing, and for all labor, tools, materials, equipment and incidentals necessary to complete the work.

The work performed for "Filter Fabric for Void Mitigation" and for "Permanent Turf Reinforcement Mat" will be paid for at the unit price bid per square yard. These unit bid price items shall include full compensation for all materials and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

The work performed for "Special Trench Safety Associated with Observation of Voids and/or Flowing Water" will be paid for at the unit price bid per linear foot. These unit bid price items shall include full compensation for all materials, supervision, mobilization, de-mobilization, and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

The work performed for "Downtime Associated with Observation of Voids and/or Flowing Water" will be paid for at the unit price bid per day. This unit bid price item shall include full compensation for all materials, supervision, mobilization, de-mobilization, and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment for will be made using the following bid items:

Pay Item 658S-1:	Temporary Void Protection (Plywood Planking)	Per Each
Pay Item 658S-2:	Controlled Low Strength Material for Mitigation	Per Cubic Yard
Pay Item 658S-3:	Pea Gravel-Filled Polypropylene Bags for Void Mitigation	Per Each

Pay Item 658S-4:	3 To 5 Inch Rock for Void Mitigation	Per Cubic Foot
Pay Item 658S-5:	Filter Fabric for Void Mitigation	Per Square Yard
Pay Item 658S-6:	Permanent Turf Reinforcement Mat for Void Mitigation	Per Square Yard
Pay Item 658S-7:	Low Slump Concrete	Per Cubic Foot
Pay Item 658S-8:	Special Trench Safety Associated with Observation of Voids and/or Flowing Water	Per Linear Foot
Pay Item 658S-9:	Downtime Associated with Observation of Voids and/or Flowing Water	Per Day

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 658S, "Void and Water Flow Mitigation"

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
ECM 1.12.0	Void and Water Flow Mitigation

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
658S-1 Trench	Class I – Temporary Protection of Void at Bottom of
658S-2	Class II – Permanent Void Mitigation Measures
658S-3	Class III – Void Mitigation Measures
658S-4	Class IV – Water Flow Mitigation Measures Groundwater Within Bedding Material Depth
658S-5	Class V – Water Flow Mitigation Measures Groundwater Above Bedding Material Depth
658S-6	Class V – Combination Void and Potential Water Flow Mitigation Measures
658S-7	Modified Concrete Retard

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item 402S	Controlled Low Strength Material
Item 403S	Concrete for Structures
Item 509S	Excavation Safety Systems
Item 510.2 (2)(a)	Pipe Materials, Pipe Bedding Stone
Item 510.2 (5)	Pipe Materials, Pea Gravel
Item 620S	Filter Fabric

<u>RELATED</u> CROSS REFERENCE MATERIALS

U.S.Department of Transportation, federal Highway Administration

<u>Designation</u>	<u>Description</u>
FP-03, Section 713.18 specifications	Permanent Turf Reinforcement Mat

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
ECM, Appendix P-1, Note 8	Erosion and sedimentation control note

requiring notification and work stoppage for voids
discovered on a project.

ATTACHMENT A.

Contractor Void Description and Documentation Log Sheet

CONTRACTOR VOID DESCRIPTION AND DOCUMENTATION LOG SHEET

Name: _____ Project Name: _____
Date: _____ Time: _____ COA Site Plan No.: _____
Construction Supervisor's Name: _____ Phone Number: _____
Project Engineer: _____

How was void intercepted? (trenching, excavating, etc.)

Depth of void from ground surface:

Location of void, as distance measured from two closest surveyed stations:

GPS Coordinates of void:
(report as UTM State Plane Coordinate system, NAD 83 or state reference system for a handheld GPS unit)

Size of void: width length height

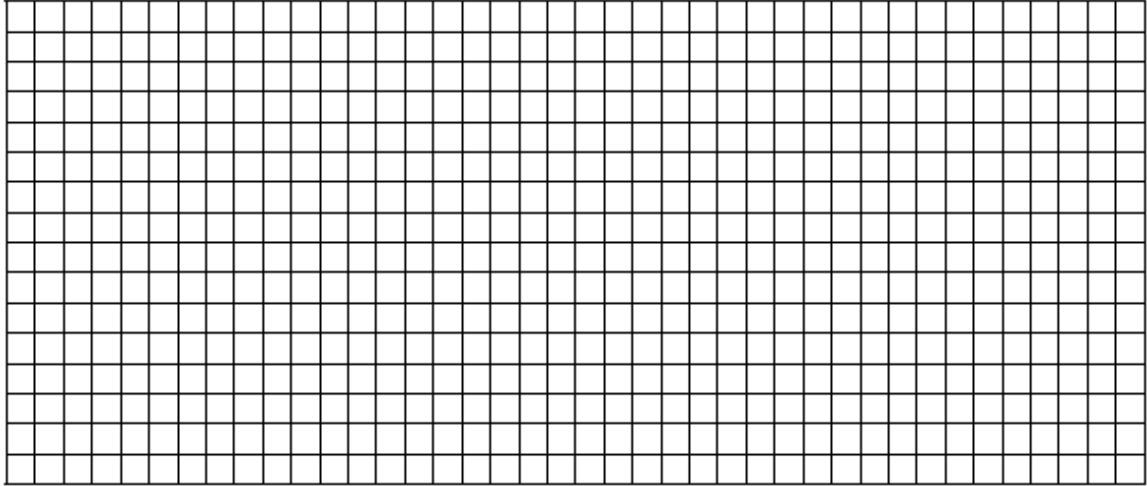
Depth extending into rock

Shape of void: circular Keyhole irregular, curved shape
 vertical fracture
 fracture trend: (azimuthal degrees)
 horizontal fracture

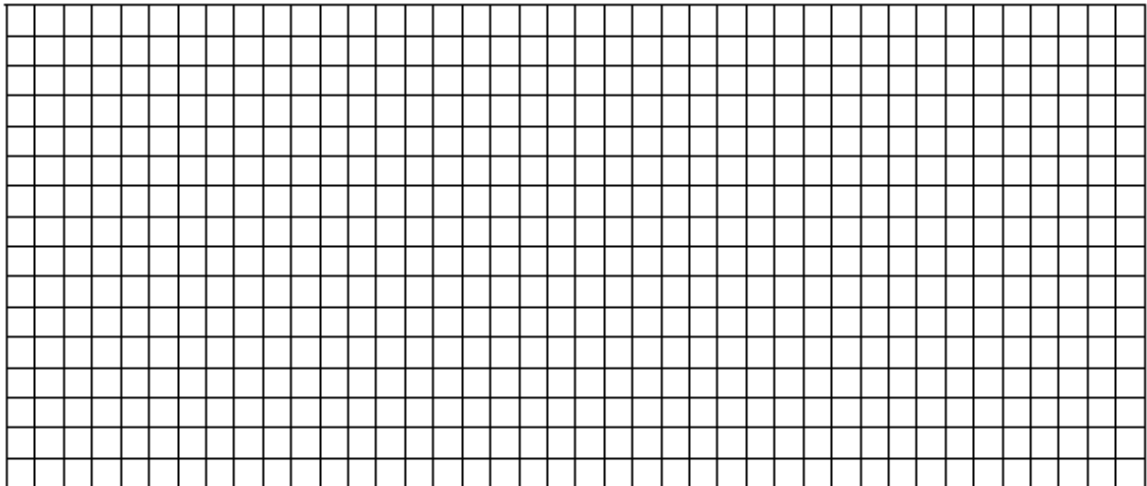
Characteristics: water flowing out? Rate or volume?
air flow out?

Sketch a profiles of the void showing both sidewalls and the floor of the trench. Include measurements such as depth of trench, size of void (width, length, height), etc.
TAKE PHOTOGRAPHS OF THE TRENCH WALLS AND THE INTERIOR OF THE VOID.

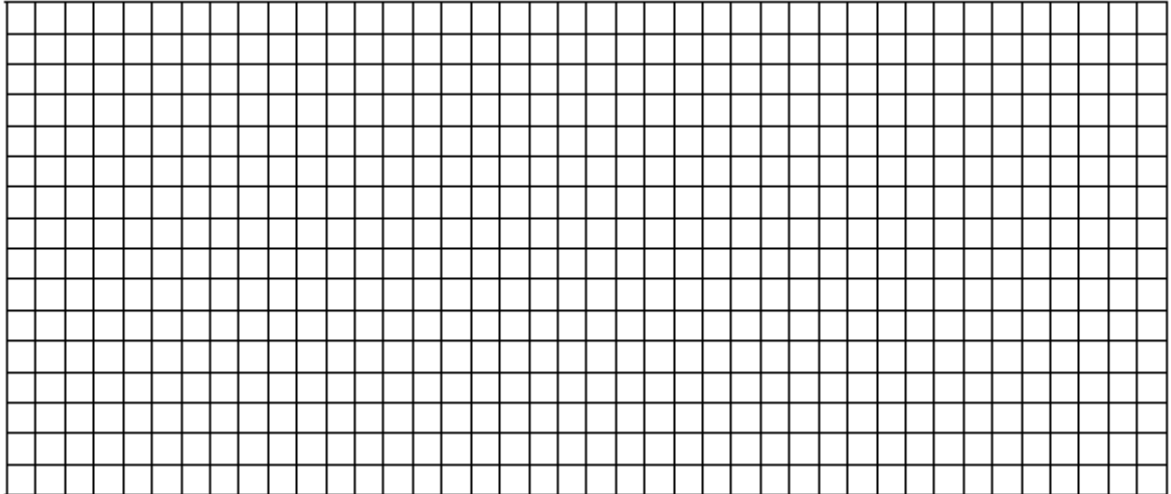
LEFT WALL



RIGHT WALL



TOP VIEW



**Item No. 660S
Biofiltration Medium**

660S.1 – Description

This item shall govern mixing and placing medium for a biofiltration basin intended to treat storm runoff. 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.

(1) Submittals

The submittal requirements of this specification item include:

- A. A signed statement provided by the Contractor that:
 1. A laboratory analysis has been conducted by of the actual mixture being proposed, and has been verified as meeting the specifications below. The date of the laboratory analysis must be no more than six months prior to the date of installation of the biofiltration medium. A copy of the laboratory results must be provided.
 2. No "sandy loam" fill material (aka "red death") is included in the mixture.
 3. Report the source of organic matter.
- B. Laboratory reports of analyses results documenting that the mixture meets the following specifications:
 1. Particle size distribution performed per ASTM D-422:
 - Coarse fragments + sand content of 70 - 90% by weight
 - Clay content of 3 - 10% by weight
 - Silt + clay content \leq 27% by weight
 2. Percent organic matter of 0.5 - 5% by weight per ASTM D2974 Method C
- C. Contractor's statement that the biofiltration medium has been tested by a laboratory using approved procedures (copy of lab results provided below) and meets the criteria as noted in Table 1 below:

Table 1 - Biofiltration Medium Characteristics

Parameter	Results*	Criteria	Criteria Met?*
Percent Sand + Coarse Fragments (ASTMD-422)		70 - 90%	
Percent Clay (< 0.002 mm)		3 - 10%	
Percent Silt + Clay (< 0.05 mm)		\leq 27%	

Percent Organic Matter (ASTM D-2974)		0.5 - 5%	
Is any "Red Death" included in medium?		None allowed	
Is the mixture free of trash, stones, weeds, or other undesirable material?		None allowed	
Is the medium well-mixed and homogenous?		Must be homogenous	

* Laboratory Must Fill In These Cells

Table 2 - Biofiltration Medium Testing and Installation Dates

Date of Laboratory Analysis (earliest)*	
Date of Medium Installation*	
Time between Dates (months)*	
Criteria for Time Between Dates (months)	6
Is Criteria Met?*	

* Contractor Must Fill In These Cells

660S.2 – Materials

- (1) The following mixture (% by volume) should create an appropriate biofiltration medium, subject to specific characteristics of the topsoil, which may exhibit considerable variability:

70-80% concrete sand per ASTM C33 and/or screened decomposed granite sand
20-30% screened bulk topsoil (chocolate loam is also acceptable)

The source materials must be free of stones, roots, or other similar objects larger than two inches. Additionally, it should be free of trash, other undesirable material, and should not contain weeds or weed seeds.

The ingredients shall be well-mixed to create a homogenous medium.

- (2) Unacceptable Materials

A commercially available fill material that should not be used is typically marketed as "sandy loam." This product is often referred to by landscapers as "red death", which refers to the color of the material, and is an infertile fill material that has poor drainage characteristics. All materials shall be free of Bermuda grass, Quackgrass, Johnson grass, or other noxious weeds, their roots or seeds.

660S.3 - Construction Methods

- (1) Erosion Control

Prior to commencing this work, all required erosion control and environmental measures shall be in place as indicated on the approved site plan and/or modified.

- (2) Scheduling, Delivery, Storage and Signage

The biofiltration medium must be delivered to, or mixed at, the site prior to the mid-construction conference. The medium must be certified as meeting the required specifications by the project Engineer, and approved by the City Inspector. The medium must be stored on-site separate from other materials, and covered to prevent erosion of the mixture by rainfall and runoff. The medium must have a prominent tag affixed that reads "BIOFILTRATION MEDIUM FOR WATER QUALITY POND."

(3) Placement

Complete construction and stabilize all areas draining to the biofiltration basin. Permanent controls will be cleaned out and filter medium will be installed after stabilization of the site. Install geotextile fabric per the Biofiltration Bed detail provided in Standard Detail 661-3. Biofiltration medium shall be placed in lifts of 12 to 18 inches without using heavy operating equipment or compaction. Lifts should be lightly watered to encourage soil settling. The final surface must be raked flat. The project Engineer must be notified 24 hours prior to installation of the biofiltration medium and approve and certify the installation.

(4) Shrinkage

Some shrinkage of the medium is to be expected after installation, in the range of 5-15%. As a general recommendation about 20 inches of medium should be installed to achieve a depth of 18 inches.

660S.4 – Measurement

Biofiltration medium 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 biofiltration medium will be used as the measurement for payment of this item.

660S.5 – 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 the following:

Pay Item No. 660S:	Biofiltration Medium.	Per Cubic Yard.
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END OF SECTION

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification Biofiltration Medium</u>	
City of Austin Environmental Criteria Manual	
<u>Designation</u>	<u>Description</u>
Section 1.6.7.C	Biofiltration

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Biofiltration Medium</u>	
City of Austin Environmental Criteria Manual	
<u>Designation</u>	<u>Description</u>
Section 1.6.5.A.4	Sand Filtration Basin Details
City of Austin Standards Details	
<u>Designation</u>	<u>Description</u>
Item No. 661-3	Biofiltration Bed Configurations Using Geomembrane/Clay Liner
City of Austin Standard Specifications	
<u>Designation</u>	<u>Description</u>
Item No. 620S	Filter Fabric

**Item No. 710S
Bicycle Racks**

710S.1 Description

This item shall govern Class II and Class III bicycle racks and associated support medium as indicated on the Drawings.

A Class II bicycle rack shall be a rack where both wheels and the frame of a bicycle can be secured with one (1) user-supplied lock without the requirement for wheel removal. The design, type and capacity of a Class II bicycle rack shall be approved by the Engineer or designated representative

A Class III bicycle rack shall be a rack where both one wheel and the frame can be secured with a user supplied lock (see Standard Detail 710S-1, "Class III Style Bicycle Parking"). The Class III rack shall consist of either a single U/Hoop (Rack 1), multiple inverted U/Hoop (Rack 2), single post (Rack 3), or other Rack approved 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.

710S.2 Submittals

The submittal requirements of this specification item include:

- A. Class (i.e. II or III) Type and capacity of bicycle rack (i.e. number of bicycles served).
- B. Fabrication and installation details, color and finish of the rack(s).
- C. Support medium (i.e. existing slab, new pad, concrete filled excavation, etc.) and details of installation.
- D. Complete manufacturer's warranty against defects for a period not less than one year from date of installation.

710S.3 Materials

- A. Steel elements.

All steel shall be ASTM A-36 1010-1018 low carbon prime steel and the screws, nuts and bolts shall be tamper proof and plated with commercial zinc. The bicycle racks shall be hot dipped galvanized (ASTM A 123) unless the Drawings indicate that the rack assembly shall be provided in a specific color with a polyester-vinyl coated finish, a powder coated finish, or a polyvinyl thermoplastic finish.

- B. Portland Cement Concrete

Portland cement concrete shall be Class A conforming to Specification Item No. 403S, "Concrete for Structures" or Specification Item No. 407S, "Fibrous Concrete".

- C. Reinforcement

Reinforcement shall conform to Specification Item No. 406S, "Reinforcing Steel" or Specification Item No. 407, "Fibrous Concrete".

D. Expansion Joint Materials

Expansion joint materials shall conform to Specification Item No. 408, "Expansion Joint Materials".

E. Membrane Curing Compound

Membrane curing compound shall conform to Specification Item No. 409, "Membrane Curing".

710S.4 Construction of Racks

A. Class II Bicycle Rack.

The Class II Rack shall consist of a locking system, which will secure both bicycle wheels and the frame with one (1) lock without the removal of either wheel.

B. Class III Bicycle Rack.

1. The Class III Rack Type 1 (Standard Detail 710S-1, sheet 1 of 3) shall consist of a one piece welded inverted U/Hoop assembly of Schedule 40 steel pipe with an minimum outside diameter (OD) of 1.5 inches (38 mm) on a minimum .25" (6.35 mm) thick base plate.

2. The Class III Rack Type 2 (Standard Detail 710S-1, sheet 2 of 3) shall consist of a single Schedule 40 steel pipe with an minimum outside diameter (OD) of 2 3/8 (60 mm) set in Portland cement concrete below the ground surface as indicated on the Drawings. The steel pipe shall be topped with a 7 1/2 inch (190 mm) polymer molded sphere that is secured with a hardened steel pin.

3. The Class III Rack Type 3 (Standard Detail 710S-1, sheet 3 of 3) shall consist of a one piece welded inverted U/Hoop assembly of Schedule 40 steel pipe with an minimum outside diameter (OD) of 2 3/8 inches (60 mm) supported with a minimum .25" (6.35 mm) thick circular base plate at one end of the rack and an in ground anchor mount on the other end.

4. The base plates can be round, square, or rectangular. If round, the diameter of the base plate must be at least 6" (150 mm) with a 4.5" (114 mm) bolt circle. If square, the base plate must be at least 4" by 4" (100 mm by 100 mm). If rectangular, the base plate must be 6" by 2" (150 mm by 50 mm). All base plates must be pre-drilled with two 3/8" (9.5 mm) diameter holes per plate for mounting. Each entire unit shall be hot dip galvanized after fabrication.

C. The bicycle racks shall be supported as indicated on the Drawings. The Class II racks and the Class III Rack Type 1 shall be supported on either existing or newly placed Portland cement concrete slabs. The Class III, Rack Types 2 and 3, can be placed on either existing or new slabs; however, these racks require additional underslab support of the steel pipe with p.c. concrete encasement as indicated in Standard Detail 710S-1 (sheets 2 and 3).

The construction of the new slabs shall be completed in accordance with Standard Specification Item Number 432S, "Concrete Sidewalks". Unless noted otherwise on the Drawings, the slab shall be 4 inches (100 mm) in thickness.

710S.5 Installation of Bicycle Racks

Bicycle parking racks shall be installed in existing paver sidewalks, new paver sidewalks and concrete sidewalks in accordance with Standard Details 710S-3, 710S-4 and 710S-5, respectively.

710S.6 Measurement

Bicycle Parking Racks shall be measured per each, complete and in place and any new p.c. concrete slab will be measured by the square foot (square meter: 1 square meter is equal to 10.764 square feet) of surface area of "Bicycle Parking Concrete Pad".

710S.7 Payment

The installation of Bicycle Parking Racks, as described by this Specification Item, will be paid for at the unit bid price per each. The construction of a p.c. concrete bicycle-parking pad will be paid for at the unit bid price per square foot for "Concrete Bicycle Parking Pad".

The unit bid prices shall include full compensation for the specified equipment items; the excavation, removal and disposal of existing sidewalk, location, placement and installation of parking racks; all materials, including all steel pipe and plate, screws, nuts and bolts, reinforcing steel and concrete; placing and finishing the concrete pad, and all labor, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 710S-A:	Class II Bicycle Rack	Per Each.
Pay Item No. 710S-B:	Class III, Type 1 Bicycle Rack	Per Each.
Pay Item No. 710S-C:	Class III, Type 2 Bicycle Rack	Per Each.
Pay Item No. 710S-D:	Class III, Type 3 Bicycle Rack	Per Each.
Pay Item No. 710S-E:	Class III, Other Type Bicycle Rack	Per Each.
Pay Item No. 710S-F:	4 inch Concrete Bicycle Parking Pad	Per Square Foot.

End

<i>SPECIFIC</i> CROSS REFERENCE MATERIALS	
Standard Specification Item Number 710S, "Bicycle Racks"	

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403S	Concrete for Structures
Item No. 406S	Reinforcing Steel
Item No. 407S	Fibrous Concrete
Item No. 408	Expansion Joint Materials
Item No. 409	Membrane Curing

Item No. 410 Concrete Structures
Item No. 432S Concrete Sidewalks

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS - Continued
Standard Specification Item Number 710S, "Bicycle Racks"

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
710S-1	Class III Style Bicycle Parking
710S-2	Class II Style Bicycle Parking
710S-3	Bicycle Rack Installation in Concrete Paver Sidewalk – Alternate 1
710S-4	Bicycle Rack Installation in Concrete Sidewalk – Alternate 1
710S-5	Bicycle Rack Installation in Sidewalk – Alternate 2

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
ASTM A 36	Specification for Structural Steel
ASTM A 123	Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products

<u>RELATED</u> CROSS REFERENCE MATERIALS

City of Austin Standard Contract Documents

<u>Designation</u>	<u>Description</u>
00700	General Conditions
01500	Temporary Facilities
01550	Public Safety and Convenience

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Concrete
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 132S	Embankment
Item No. 201S	Subgrade Preparation
Item No. 405	Concrete Admixtures
Item No. 406	Reinforced Steel Tolerances
Item No. 411	Surface Finishes for Concrete
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 642S	Silt Fence

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

<u>Designation</u>	<u>Description</u>
Item 420	Concrete Structures
Item 421	Hydraulic Cement Concrete
Item 427	Surface Finishes for Concrete
Item 437	Concrete Admixtures
Item 440	Reinforcing Steel

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-496	Standard Specification for Steel Wire, Deformed for Concrete Reinforcement
A-615/615M	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

Item No. 824S
Traffic Signs

824S.1 Description

This item shall govern furnishing and placement of Traffic Signs including excavation, posts, hardware and signs.

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.

824S.2 Submittals

The submittal requirements of this specification item include:

- A. Identification of the types of materials proposed for traffic sign, i.e. faces, posts, clamps, etc.,
- B. Results of any State or Federal tests (reflectance, diffuse day color, specific intensity brightness, Weather-O-meter, etc.) performed on their products,

824S.3 Materials

The following ASTM Standards and documents, of the issue in effect on the date of Invitation for Bid, form a part of this specification to the extent herein.

- A. ASTM B 209 Specification for Aluminum and Aluminum Alloy Sheet and Plate
- B. ASTM D 523 Standard Method for Test for Specular Gloss
- C. ASTM D 4956 Standard Specification for Retroreflective Sheeting for Traffic Control
- D. ASTM E 284 Standard Definition of Terms Relating to Appearance of Materials
- E. ASTM E 308 Computing the Colors of Objects by Using the CIE System
- F. ASTM E 810 Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting
- G. ASTM E 1164 Standard Practice for Obtaining Spectrophotometric Data for Object-Color Evaluation
- H. CIE Publication Number 39-2, Recommendation for Surface Colors for Visual Signaling
- I. FP-92 Standard Specifications for Construction of Roads and Bridges on Federal Highway Project
- J. Substrate. This shall be aluminum alloy 5052-H38 or 6061-T-6 and otherwise in conformance with ASTM B-209.
- 1. Metal working. The aluminum shall be free of burrs and pits on both sides, including edges and holes, and shall be made ready for applications of the sheeting.

The aluminum shall be new and corrosion-free with holes drilled or punched, corners rounded to the radii shown in the standard detail sheet, and all edges smoothed prior to application of sheeting.

2. Size. The dimensions of substrate applications for regulatory, warning, and guide signs shall be as specified by the Engineer and as shown on the plans.
- K. Background, Legends, Symbols, and Colors. These shall be in accordance with the Standard Highway Sign Designs (SHSD) for Texas and with the Texas Manual of Uniform Traffic Control Devices (TMUTCD).
1. Retroreflective Materials. Retroreflective materials shall comply with Texas Department of Transportation Departmental Materials Specification 8300, Sign Face Materials. The materials requirements for Reflective Sheeting must meet all the requirements of ASTM D 4956.
 - a. Retroreflective Sheeting. Type III (High Intensity Prismatic): The materials as listed in these specifications shall comply with Texas Department of Transportation Departmental Materials Specification 8300, Sign Face Materials. The materials requirements for Reflective Sheeting must meet all the requirements of ASTM D 4956. Colors shall be as specified in specifications for Standard Highway Sign Colors (FHWA, HTO-21).
 - b. Retroreflective Sheeting. Type IX (Fluorescent yellow green): The materials shall comply with ASTM 4956. Designed to provide higher nighttime sign brightness in the legibility distance and brightness at high entrance angles. The minimum fluorescence luminance factor (YF) for new sheeting shall be 35%.
 2. Electronically Cuttable Film. Electronically cuttable film shall consist of flexible, transparent, durable acrylic colored films coated with a transparent pressure sensitive adhesive protected by a clear removable liner. These films are designed to be applied to retroreflective materials for the creation of traffic control signs and devices by either cutting by knife over roll (sprocket fed or friction fed) and flat bed electronic cutting machines. The films shall be available in standard traffic colors, be dimensionally stable, and be designed to optimally cut, weed, lift, and transfer. Use of electronic cuttable films will not require the release of any volatile organic compounds.

When electronic cuttable film is applied to retroreflective sheeting, the resulting color of the composite sheeting will conform to Texas Department of Transportation Departmental Materials Specification 8300, Sign Face Materials. The materials requirements for Reflective Sheeting must meet all the requirements of ASTM D 4956.

Only signage utilizing electronically cuttable film will be allowed. Silk screened sign faces will not be accepted.

- a. Color Test. Conformance to color requirements shall be determined by instrumental method in accordance with ASTM E 1164 on sheeting applied to aluminum test panels. The values shall be determined on a HunterLab Labscan 6000 0/45 Spectrocolorimeter with option CMR 559 [or approved equal 0/45 (45/0) instrument

with circumferential viewing (illumination)].

Computations shall be done in accordance with ASTM E 308 for the 2° observer.

- b.** Coefficient of Retroreflection R^A . When electronic cuttable film is applied to retroreflective sheeting, the composite will conform to the percentage retained of the minimum coefficient of retroreflection specified by the using agency and the manufacturer for the retroreflective sheeting when the retroreflective sheeting is screen processed. The coefficient of retroreflection shall be determined in accordance with ASTM E 810. Coefficients of retroreflection R^A shall be specified in units of candelas as per foot candle per square foot (candelas per lux per square meter). The observation angles shall be 0.2 and 0.5 degrees unless otherwise specified. The entrance angles shall be -4 and 30 degrees unless otherwise specified. The electronic cuttable film shall have and 85° specular gloss of not less than 50 when tested in accordance with ASTM D 523.
- c.** Processing and Cuttability. The electronic cuttable film shall permit cutting, weeding, masking with transfer tape, lifting, and application to retroreflective sheeting when used in accordance with manufacturer's recommendations at temperatures between 65° and 95° F and relative humidifies between 30% and 70%. The film shall lay flat with minimal edge curl and be dimensionally stable.
- d.** Adhesive Liner. The protective liner attached to the adhesive shall be removable by peeling without soaking in water or other solutions, without breaking, tearing, or removing any adhesive from the electronic cuttable film. The liner shall have a controlled release from the adhesive coated film sufficient to allow cutting without the film popping off from the liner while still allowing the liner to easily be peeled from the film.
- e.** Film. Film with punched edges for use on sprocket fed knife over roll cutters shall be edge scored and weeded to remove film in the punched area as a means of eliminating adhesive build up on the sprockets.
- f.** Resistance to Accelerated Outdoor Weathering. When electronic cuttable film is applied to retroreflective sheeting, the surface of the film shall be weather resistant and show no appreciable cracking, blistering, crazing, or dimensional change after 2 years unprotected outdoor exposure, facing the equator and inclined 45° from the vertical. Following weather exposure, panels shall be washed in a 5% HCl solution for 45 seconds, rinsed thoroughly with clean water, blotted dry with a soft cloth and brought to equilibrium at standard conditions.

After cleaning, the coefficient of retroreflection shall not be less than the value specified by the using agency for the retroreflective sheeting when the retroreflective sheeting is screen processed. Show no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting or curling or more than 1/32 inch shrinkage or expansion. Show good color fastness or better when tested. The electronic cuttable film shall not be removable from the retroreflective sheeting without damage.

- 3.** Application Methods. The method of application of sheeting, letters, numbers, and symbols shall be precisely as prescribed in writing by the manufacturer.

 - a.** Legend Spacing and Layout. Spacing and layout for all traffic control signs shall

conform to the Texas SHSD.

- L.** Sign Posts. Steel post shall conform to the standard specification for hot rolled carbon sheet steel, structural quality, ASTM designation A570, Grade 50. Average minimum yield strength after cold forming is 60,000 psi. The cross section of the post shall be square tube formed steel, carefully rolled to size and shall be welded directly in the corner by high frequency resistance welding or equivalent process and externally scarified to agree with corner radii. Sign posts shall be hot dipped galvanized conforming to ASTM A653, G90.

1. Sizes. Perforated sign posts, anchors and sleeves shall be of the following size:

Size	USS Gauge	Weight
1 3/4" X 1 3/4 "	14	1.71
2" X 2"	12	2.42

On square tubing, holes shall be on centerline of each side in true alignment and opposite each other directly and diagonally. The length of each post shall have a permissible length tolerance of $\pm 1/4$ ".

The finished posts shall be straight and have a smooth, uniform finish. It shall be possible to telescope all consecutive sizes of square tubes freely and for not less than ten feet of their length without the necessity of matching any particular face to any other face. All holes and ends shall be free from burrs and ends shall be cut square.

- a. Tolerance on Outside Sizes

Nominal Outside Dimension	Outside Tolerances at Corners
1 3/4" X 1 3/4 "	± 0.008 "
2" X 2"	± 0.008 "

Note: Measurement from outside dimensions shall be made at least 2 inches from the end of the tube.

Permissible variation in wall thickness is $+0.011$ ", -0.005 ".

Convexity and concavity shall be measured in the center of the flat sides, tolerance in ± 0.010 ", determined at the corner.

- b. Squareness of Sides and Twist Permissible in 3" Length.

Nominal Outside Dimension	Squareness Tolerance	Twist
1 3/4" X 1 3/4 "	± 0.010 "	0.062"
2" X 2"	± 0.012 "	0.062"

Permissible variation in straightness is 1/16 of an inch in 3 feet. The standard outside corner radius shall be 5/32 of an inch $\pm 1/64$ inch.

2. Installation. The square end of the post shall not be modified or pointed.
 - a. Mount Base. When sign post installation is required over building basements, bridges and cavities, a galvanized cast iron surface mount coupler shall be used. The square post surface mount base must be a NCHRP 350-Compliant breakaway system for use with 1 ¾ - inch square post.
 - b. Hardware. All ground mounted signs shall be attached to posts using 3/8" aluminum drive rivets. Stainless steel banding material, brackets and clips will be used for signs installed on light standards or mast arms.
 - c. Construction.
 1. Concrete specifications: Insert a 2" square x 30" 12 gauge into concrete with 1-2 inches exposed above ground. Make sure the anchor assembly is level. Attach the sign to the 1 ¾" square 14 gauge post (length varies with installation) at a minimum height of seven feet using drive rivets and nylon washers. Insert the post 6-8 inches into the anchor assembly. Bolt the signpost to the anchor assembly using a corner bolt and flange nut.
 2. Soil specifications: Drive a 2" square x 30" 12 gauge omni-directional anchor sleeve into soil with 1-2 inches exposed above ground. Make sure the anchor assembly is level. Attach the sign to the 1 ¾" square x 14 gauge post (length varies with installation) at a minimum height of seven feet using drive rivets and nylon washers. Insert the post 6-8 inches into the anchor assembly. Bolt the signpost to the anchor assembly using a corner bolt and flange nut.
- M. Maker's Mark Decals. Each sign shall be permanently marked on the lower right corner of the back side with the month and year of installation, and name of manufacturer.

Table 1
Minimum Coefficient of Retroreflectivity
[0.2° observation angle and -4° entrance angle]

Type III Sheeting: 10 Year Life Span	
Sheeting Color	Candelas per Foot-Candle per Sq. Ft.
White	250
Yellow	170
Green	45
Red	45
Blue	20
Brown	12

Table 2
Minimum Coefficient of Retroreflectivity
[0.2° observation angle and -4° entrance angle]

Type IX Sheeting: 7 Year Life Span	
Sheeting Color	Candelas per Foot- Candle per Sq. Ft.
Fluorescent Yellow Green	300

824S.4 Equipment

Provide machinery, tools, and equipment necessary for proper execution of the work.

824S.5 Construction:

Construction shall be high quality with no visible defects in the finished product. Fabrication shall be in accordance with these specifications. Street name signs shall always be supplied and installed at each project intersection whether signs previously existed at the location or not.

- A. Unsignalized Intersection. At unsignalized intersections, ground-mounted street name signs of 9 inch height with 6 inch letters and 3 inch suffix and block numbers are required. Lettering on street name signs must be in upper/lower case letters.
- B. Signalized Intersection.
 1. Ground Mounted Street Signs
If a signalized intersection has either mast arms or span- wire on which overhead street name signs can be attached, no ground mounted streets name signs are required at that intersection.
 2. Overhead Street Signs
Signs shall be strapped to the mast arm or span wire. Attachments to mast arms shall be by means of a 3/4 inch stainless steel strap and a stainless steel flared strap bracket.
 - a. Letter Heights
Overhead street name signs shall be 18 inches high. Street name signs must be 8 inch (or larger) upper/lower case letters. The suffix and block numbers shall be at least 4 ½ inches high.
- C. Existing Signs.
The removal of existing signs shall be coordinated with the Austin Transportation Department to assure required signage is in place during all construction phases. When existing signs are to be removed, they will be removed from their post by hand and delivered to the Traffic Sign Shop (974 - 4055).
- D. No Parking Signs
No Parking signs with horizontal dimensions wider than 15" shall not be used unless specifically authorized in advance by the City. For 24 hour parking restriction see the attached detail for the typical No Parking sign.

824S.6 Measurement

Traffic signs shall be measured as each complete sign constructed and placed as indicated on the Drawings.

824S.7 Payment

The work performed and materials furnished as prescribed by this item will be paid for at the unit bid price for "Traffic Signs" per each complete in place. The unit bid price shall include full compensation for furnishing all materials, completing the excavation, placing p.c. concrete and reinforcing steel, setting posts in p.c. concrete and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 824S: Traffic Signs Per Each.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>
Specification Item No. 824S, "Traffic Signs"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 401S	Structural Excavation and Backfill
Item No. 403S	Concrete for Structures
Item No. 406S	Reinforcing Steel
Item No. 410S	Concrete Structures
Item No. 411	Surface Finishes for Concrete
Item No. 722	Paint and Painting

Texas Department of Transportation Manual of Testing Procedures:

<u>Designation</u>	<u>Description</u>
Tex-839-B	Determining Color in Reflective Materials
Tex-842-B	Method for Measuring Retroreflectivity

Texas Department of Transportation; Departmental Materials Specifications

<u>Designation</u>	<u>Description</u>
DMS-8300	Flat Surface Reflective Sheeting

American Society for Testing and Materials (ASTM):

<u>Designation</u>	<u>Description</u>
A-36/A-36M	Specification for Structural Steel
A-307	Specification for Carbon Steel Externally Threaded Standard Fasteners
A-320	Specification for Alloys-Steel Bolting Materials For Low-Temperature Service
A-513	Specification for Electric Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
B-26	Specification for Aluminum-Alloy Sand Castings
B-108/B-108M	Specification for Aluminum-Alloy Permanent Mold Castings
B-221/B-221M	Specification for Aluminum-Alloy Extended Bars, Rods, Wire, Shapes, and Tubes
D-523	Test Method for Specular Gloss

<u>SPECIFIC CROSS REFERENCE MATERIALS- Continued</u>
Specification Item No. 824S, "Traffic Signs"

American Society for Testing and Materials (ASTM):

<u>Designation</u>	<u>Description</u>
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D 822	Recommended Practice for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products
D 828	Test Method for Tensile Breaking Strength of Paper and Paperboard
E 97	45-degree, 0-degree Directional Reflectance Factor of Opaque Specimens by Broad-Band Filter Reflectometry
G 23	Recommended Practice for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Nonmetallic Materials

Other Specifications

Federal Specification A-G-90
Federal Test Method 8801
Federal Specification O-G-93 (stick only)
Federal Specification TT-P-64lb.

<u>RELATED CROSS REFERENCE MATERIALS</u>
Specification Item No. 824S, "Traffic Signs

Texas Department of Transportation Technical Documents:

<u>Designation</u>	<u>Description</u>
(TMUTCD)	Texas Manual on Uniform Traffic Control Devices

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
824S-1	Standard Street-End Markers

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

<u>Designation</u>	<u>Description</u>
Item No. 445	Galvanizing
Item No. 636	Aluminum Signs (Type A)
Item No. 637	Aluminum Signs (Type G)
Item No. 642	Aluminum Signs (Type O)
Item No. 646	Small Roadside Sign Supports
Item No. 647	Large Roadside Sign Supports
Item No. 656	Foundations for Signs, Traffic Signals and Roadway Illumination Assemblies

Texas Department of Transportation: Departmental Materials Specifications

<u>Designation</u>	<u>Description</u>
DMS-7110	Aluminum Sign Blanks
DMS-7120	Sign Hardware
DMS-8310	Flexible Roll-up Reflective Signs
DMS-8320	Vinyl, Non-reflective Decal Sheeting

Item No. 860S
Pavement Marking Paint**860S.1 Description**

This item shall govern the installation of reflectorized paint pavement marking. The width of the line shall be 4 inches (100 millimeters) and the color as indicated on the Drawings.

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.

860S.2 Submittals

The submittal requirements of this specification item include:

- A. Proposed paint color(s), brand names, raw materials and products for traffic paint.
- B. Sampling and testing procedures and specific test results for pigment, calcium carbonate, acrylic resins and other materials used in the traffic paints.
- C. Proposed shipping requirements including container type(s) (drums and/or buckets), and labeling.
- D. Manufacturer's recommendations for mixing, storage and application of the traffic glass beads and traffic paint.
- E. All applicable Materials Safety data Sheets for the traffic paint.

860S.3 Materials**A. Traffic Stripe Reflective Glass Traffic Beads**

1. The glass spheres shall not contain more than 30 percent (by weight {mass}) irregular shaped particles when tested in accordance with TxDOT Test Method-832-B. The no. 20 (850 μ m) sieve shall have a maximum of 35% by weight (mass) allowed irregular particles, based on a visual inspection.

Unless noted otherwise on the Drawings or designated in writing by the Engineer or designated representative, the application rate of the glass traffic beads shall not be less than 6 pounds per gallon (0.7 kilograms per liter). Glass traffic beads shall be essentially free of sharp angular particles and particles showing milky or surface scarring or scratching. Glass traffic beads shall be water white in color.

2. The glass traffic beads shall meet the following graduation requirements when tested in accordance with TxDOT Test Method Tex-831-B:

US Sieve	SI Sieve	% weight (mass) retained
# 20	(850 μ m)	3 to 10
# 30	(600 μ m)	20 to 40
# 40	(425 μ m)	30 to 50
# 50	(300 μ m)	15 to 35
# 80	(180 μ m)	0 to 10

3. Index of Refraction: The glass traffic beads, when tested by the liquid immersion method at 77°F (25°C), shall show an index of refraction within the range of 1.50 to 1.53.

4. Wetting: The glass traffic beads shall be capable of being readily wet with water, when tested according to TxDOT Test Method Tex-826-B.
5. Stability: The glass traffic beads shall show no tendency toward decomposition, surface etching, change in retroreflective characteristics or change in color after
 - (a) One-hour exposure to concentrated hydrochloric acid at 77°F (25°C),
 - (b) 24 hours exposure to weak acids, weak alkali, and
 - (c) 100 hours of weather-o-meter (Atlas, Sunshine Type) exposure, ASTM G-23, Method 1, Type EH.
6. Contaminants: Glass traffic beads shall:
 - (a) contain less than 1/4 of 1 percent moisture by weight (mass).
 - (b) free of trash, dirt, etc.
 - (c) show no evidence of objectionable static electricity when flowing through a regular traffic bead dispenser.
7. Sampling and Testing (TxDOT Test Method Tex-801-B) shall be in accordance with the latest applicable procedures included in the TxDOT Manual on Testing. Applicable test methods include but are not limited to the following:
 - Tex 806-B, "Method for Determining Grind and Oversize Pigment Particles"
 - Tex-810-B, "Test Method for Color and Color Stability of Opaque Colored Pigments"
 - Tex-811-B, "Skinning Characteristics of Coatings"
 - Tex-822-B, "Method for Determining Refractive Index of Glass Beads"
 - Tex-826-B, "Water Absorption Test of Beads"
 - Tex-828-B, "Determining Functional Characteristics of Pavement Markings"
 - Tex-830-B, "Method for Sampling Traffic Stripe Beads"
 - Tex-831-B, "Method for Determining The Gradation of Glass Traffic-Stripe Beads"
 - Tex-832-B, "Methods for Determining the Roundness of Glass Spheres"

B. Pavement Marking Paint

1. Functional Requirements

- (a) All paint-type materials that are applied at ambient or slightly elevated temperatures shall conform to TxDOT Departmental Materials Specifications DMS-8200, YPT 10 and/or WPT-10 and DMS-8290.
- (b) The paint shall be homogenous, well ground to a uniform and smooth consistency and shall not skin nor settle badly nor cake, liver, thicken, curdle or gel in the container.
- (c) The paint, when applied to a bituminous pavement surface under normal field conditions at the required rate of .015 inch (0.4 mm) wet film thickness, shall have a maximum "no pickup" drying time of 15 minutes to prevent displacement or discoloration under traffic.
- (d) In preparation of the paint, the pigments shall be dispersed in the vehicle by appropriate methods so that a fineness reading of not less than 4 is obtained with a Hegman grind gauge.

- (e) Consistency viscosity, measured with a Krebs-Modified-Stormer viscometer at 77°F (25°C), shall be from 80-90 K.U (with water deleted).
- (f) A thin film of paint spread on a glass plate and allowed to dry thoroughly shall not darken or show any discoloration when subjected to ultraviolet rays for a period of 5 minutes.

2. Material Requirements

(a) Raw Materials

- (1) The exact brands and types of raw materials used in the wet standards are listed for the purpose of facilitating the selection of parallel materials that are equal, not only in quality and composition but also in physical and chemical behavior after aging in the finished product.
- (2) After proposed brand names and types of raw materials by the City of Austin, no substitution will be allowed during the manufacture without prior agreement with the City.
- (3) It shall be the responsibility of the Contractor to utilize materials that not only meet the individual raw material specification, but that also produce a coating that meets the specific formula requirements.
- (4) All materials required to meet TxDOT, Federal and ASTM specifications must meet the latest specification as indicated on the Drawings in effect on the date of the proposal or invitation to bid.

(b) Pigments

(1) Titanium Dioxide:

Titanium Dioxide shall meet ASTM D-476, Type II requirements.

(2) Yellow Pigment:

Yellow Pigment CI 65 (Reddish Yellow)	
Characteristic	Values
Specific Gravity	1.74 to 1.76
Oil Absorption	20 to 30 %
Moisture	0.5 % maximum
Pigment retained on #325 (45 µm) sieve	0.1 % maximum
C.I. Number	11740
Heat Stability	266°F (130°C)

In addition to the requirements identified above, evidence shall be provided that the infrared spectrum matches the standard spectrum on file with TxDOT's Construction Division, Materials Section (CSTM)

- (3) Calcium Carbonate: Calcium Carbonate shall conform to ASTM D-1199, Type GC, Grade I, with a minimum of 95% CaCO₃ and Type PC, with a minimum of 98% CaCO₃.
- (c) Acrylic Traffic Resins: The acrylic traffic resin shall be similar and equal to the standard sample submitted by the manufacturer. The resin shall be approved prior to the contract award for the proposed use of the pavement paint.

Acrylic Traffic Emulsion

Characteristic	Values
Solids Content	49.5 to 50.5
Viscosity, #2 Spindle, 60 rpm, 77°F (25°C), cps	250 maximum
pH	10.0 to 10.6
Film appearance, 3 mil (75 µm) dry	Smooth, clear, continuous

In addition to the requirements identified above, evidence shall be provided that the infrared spectrum matches the standard spectrum on file with TxDot's Construction Division, Materials Section (CSTM)

- (d) Miscellaneous Materials: These materials shall be similar and equal to the standard sample submitted by the vendor. The specific materials shall be approved prior to the contract award for the proposed use of the pavement paint.

- 1) Dispersant
Byk 156
Tamol 850
Colloids 226/35
- 2) Surfactant
Triton X-405
Colloids CA-407
- 3) Defoamer
Foamaster 111
Drew 493
Colloids 654
- 4) Hydroxy Ethyl Cellulose
Natrosol 250 HBR
Bermocoll E431FQ
Cellosize QP - 30,000
- 5) Coalescent
Texanol
Exxate 1200
- 6) Preservative
Troysan
Dowicil 75
Nuosept 101
- 7) Methyl Alcohol
ASTM D-1152, 1.3320 maximum

- (e) Standard Formulae:

The following tables represent the Standard Formulae to be followed by the manufacturer when manufacturing paint to be used by the Contractor on City of Austin paint striping contracts.

Formula: White Traffic Paint

WPT-11 - LEAD FREE WHITE TRAFFIC PAINT		
Component	Pounds	Kilograms
Acrylic Emulsion, 50% Solids, Fastrack 2706	540.	245.
Coalescent, Texanol	20.	9.1
Titanium Dioxide, Rutile, Type II, Tiona RCL-9	100.	45.4
Calcium Carbonate, Type PC, Mississippi M-60	150.	68.
Calcium Carbonate, Type GC, Hubercarb M-4	440.	199.6
Hydroxy Ethyl Cellulose, Natrosol 250 HBR (*)	0.5	0.2
Defoamer, Foamaster 111	5.	2.3
Dispersant, Colloids 226/35	9.	4.1
Surfactant, Triton X-405	2.	0.9
Methyl Alcohol	30.	13.6
Preservative, Troysan 192	2.	0.9
Water, Potable (**)	18.**	8.1**
TOTALS	1316.5	597.2

(*) The Hydroxy Ethyl Cellulose amount may be varied up to two (2) pounds [0.9 kilograms].

(**) Only 10 pounds (4.5 kilograms) shall be used in the actual manufacture of the pavement paint. The remaining 8 pounds (3.6 kilograms) shall be used as a drum float.

Formula: Yellow Traffic Paint

YPT-11 - LEAD FREE YELLOW TRAFFIC PAINT		
Component	Pounds	Kilograms
Acrylic Emulsion, 50% Solids, Fastrack 2706	540	245.
Coalescent, Texanol	20	9.1
C.I. Pigment Yellow 65, Sunglow Yellow 1244	30.	13.6
Titanium Dioxide, Rutile, Type II, Tiona RCL-9(***)	20.	9.1
Calcium Carbonate, Type PC, Mississippi M-60	150	68.
Calcium Carbonate, Type GC, Hubercarb M-4	450	204.1
Hydroxy Ethyl Cellulose, Natrosol 250 HBR (*)	0.5	0.2
Defoamer, Foamaster 111	5.	2.3
Dispersant, Colloids 226/35	9.	4.1
Surfactant, Triton X-405	2.	0.9
Methyl Alcohol	30.	13.6
Preservative, Troysan 192	2.	0.9
Water, Potable (**)	18.**	8.1**
TOTALS	1276.5	579.0

Additional Criteria for Pavement Paint

Item	Requirements
Grind Particles:	4 minimum, 8 maximum (TxDoT Test Method Tex-806-B)
Gallon Weight:	± 0.10 lbs. of theoretical gallon weight

(Liter mass:)	(± 0.012 kilograms or theoretical liter mass)
Consistency:	80 to 90 K.U.
PH:	a minimum of 9.6
Skinning:	No skinning within 48 hours (TxDoT Test Method Tex-811-B)

- (*) The Hydroxy Ethyl Cellulose amount may be varied up to two (2) pounds [0.9 kilograms]
- (**) Only 10 pounds (4.5 kilograms) shall be used in the actual manufacture of the pavement paint. The remaining 8 pounds (3.6 kilograms) shall be used as a drum float.
- (***) Titanium Dioxide, Rutile, Special, Hiox will be allowed as a substitute in the YPT-11 formula only.

(f) Container and Marking

- 1) Shipment: Shipment shall be made in suitable, strong, well-sealed containers that meet this specification, State of Texas, and federal requirements and are sufficiently sturdy to withstand normal shipping and handling.
- 2) Drum Package Requirements. The paint shall be provided in a new, serviceable, non-leaking, 55 gallon (209 liter) lined, steel drum meeting all applicable federal regulations. Drums are to be non-returnable with full removable heads, three (3) rolling hoops and 12 gauge locking rings with 5/8 inch (15.9 millimeter) locking nut bolt. The nominal metal thickness is to be 0.044 inch (1.1 mm). Each drum is to be equipped with a natural sponge-rubber cord, high-density gasket. The rubber shall be approximately 0.4375 inch (10.9 mm) thick. The gasket, when compressed, shall produce an airtight closure when the drum is sealed.

When a locking nut is used on drum rings, the locking nut shall be in a non-locking position while tightening the ring. After the ring is tight, the locking nut shall be secured in the locking position.

A seal shall be affixed to each drum in a manner that the contents of the drum cannot be adulterated without destroying the seal.

- 3) Bucket Packaging Requirements: Paint is to be furnished in new 5 gallon (19 liter) lined, 24 gauge steel, non-leaking buckets.
- 4) Filling Instructions: The paint drums will be filled at 54.5 gallons (206.4 liters) by weight (mass) with a water float of 0.53 gallons (2.0 liters).

The paint buckets will be filled at 4.95 gallons (18.75 liters) by weight (mass) with a water float of 0.05 gallons (0.18 liters).

- 5) Labeling: Finished paint product containers and cases shall be plainly and securely labeled with:
 - a) City of Austin
 - b) Name and designation of the product,
 - c) Requisition number,
 - d) Batch number,
 - e) Manufacturing date,
 - f) Gross weight, and
 - g) Manufacturer's name.

Labeling shall be prominently displayed on the sides of containers and cases and must be moisture resistant to withstand outdoor storage for a minimum of one year. When the finished product is palletized for

shipment, the labels shall be displayed on the outside for easy identification. Once the finished product has been labeled properly, the label shall not be modified or changed in any manner without specific approval from the City of Austin. (Note: The material manufacturer shall supply a Materials Safety Data Sheet to comply with OSHA's "Hazard Communication Standard 29 CFR § 1910.1200").

860S.4 Construction Methods

The Contractor shall use a crew, that is experienced in the work of installing pavement markings and in the necessary traffic control for such operations on the roadway surface, and shall supply all the equipment, personnel, traffic control and materials necessary for the placement of the pavement markings as indicated on the Drawings or directed by the Engineer or designated representative. All work shall conform to the current edition of the Texas Manual of Uniform Traffic Control Devices (TMUTCD), The City of Austin Transportation Criteria Manual, Standard Details 804S-3C and 804S-3D, and this standard specification item.

The pavement surface to receive the pavement markings shall be thoroughly cleaned of all dirt, organic growth or other material that will prevent adhesion of the paint to the roadway surface.

The pavement markings shall be placed in the proper alignment with guides established on the roadway. Deviation from the alignment established shall not exceed 2 inches (50 millimeters) and in addition, the deviation in alignment of the markings being placed shall not exceed 1 inch per 200 feet (25 millimeters per 30 meters) of roadway nor shall any deviation be abrupt.

When deemed necessary by the Engineer or designated representative, the Contractor, at the Contractor's expense, shall place any additional pilot markings required to facilitate the placement of the permanent markings in the alignment specified. Any and all additional markings placed on the roadway for alignment purposes shall be temporary in nature and shall not establish a permanent marking on the roadway.

Materials used for pilot markings and equipment used to place such markings shall be approved by the Engineer or designated representative.

Paint markings on the roadway that are not in alignment or sequence as indicated shall be totally and completely removed by any effective method approved by the Engineer or designated representative, except that grinding will not be permitted.

Paint shall be applied at a rate of not less than 15 gallons nor more than 20 gallons per mile of solid 4 inch stripe (not less than 35 liters nor more than 45 liters per kilometer of solid 100-mm stripe). Application rate for solid 8-inch (200-mm) stripe shall be between 30 and 40 gallons per mile (between 70 and 90 liters per kilometer). (These rates yield wet film thickness from 15 to 20 mils [0.4 to 0.5 mm].)

Beads shall be applied to the paint markings at a uniform rate sufficient to achieve the retroreflective characteristics specified when observed conforming to TxDOT Test Method Tex-828-B. All markings placed shall have uniform and distinctive retroreflective characteristics.

Applied markings shall be protected from traffic until they have dried sufficiently so as not to be damaged or tracked by normal traffic movements.

860S.5 Equipment

Paint striping equipment used to place 4 inch (100 mm) solid or broken lines shall have the capability of placing a minimum of 60,000 linear feet (18 300 lineal meters) of marking per working day. Equipment used for placing markings in widths other than 4 inches (100 mm) shall have capabilities similar to 4 inch (100 mm) marking equipment and shall be capable of placing linear markings up to 8 inches (200 mm) in width in 1 pass.

The equipment shall be maintained in satisfactory operating condition. The equipment shall be equipped so that one 4-inch (100-mm) broken line and either 1 or 2 solid lines can be placed at the same time in alignment and spacing as indicated on the drawings. Four inch (100 mm) marking equipment will be considered as unsatisfactorily maintained if it fails to attain an average hourly placement rate of 7000 linear feet (2 100 linear meters) in any 5 consecutive working days of 7 hours or more.

The equipment shall be equipped with an automatic cutoff device (with manual operating capabilities) to provide clean, square marking ends and to provide a method of applying broken line in a stripe to gap ratio of 15 to 25. The length of the stripe shall not be less than 15 feet nor longer than 15.5 feet (less than 4.5 meters nor longer than 4.7 meters). The total length of the stripe-gap cycle shall not be less than 39.5 feet nor longer than 40.5 feet (less than 12 meters nor longer than 12.3 meters) in variance from one cycle to the next nor shall the average total length of a cycle for a road mile (1.6 kilometer) of broken line exceed 40.5 feet or be less than 39.5 feet (exceed 12.3 meters or be less than 12 meters).

The equipment shall be capable of placing lines of all widths with clean edges and of uniform cross section. Four-inch (100-mm) lines shall be 4 inches (100 mm) plus or minus 1/8 inch (3 mm). Eight inch (200 mm) lines shall be 8 inches (200 mm) minimum and 8 1/4 inches (210 mm) maximum in width.

The equipment shall be equipped with an outrigger or outriggers as required to place edge-lines as called for in the plans.

The equipment shall be equipped with traffic glass bead dispensers, 1 for each paint spray gun, placed on the equipment so that beads are applied to the paint almost instantly as the marking is being placed on the roadway surface. The traffic glass bead dispensers shall be designed and aligned so that the beads are applied uniformly to the entire surface of the marking. The traffic glass bead dispensers shall be equipped with automatic cutoff controls, synchronized with the cutoff of the marking equipment. Paint pots or tanks shall be equipped with an agitator that will keep the paint thoroughly mixed and may be either a pressurized or non-pressurized type.

860S.6 Measurement

Work for Pavement Marking Paint lines will be measured by the lineal foot (lineal meter: 1 meter equals 3.28 feet) of the various widths. Work for pavement marking, paint letter or figures will be measured by the square foot (square meter: 1 square meter equals 10.76 square feet).

860S.7 Payment

Work performed as prescribed by this item, measured as provided under "Measurement", shall be paid for at the unit bid price for "Pavement Marking Paint" per lineal foot or square foot of the various widths specified. This price shall include full compensation for furnishing

all labor, tools, equipment, materials and incidentals necessary to complete the work specified.

Payment will be made under one of the following:

Pay Item No. 860S-A:	Pavement Marking Paint, ____ In.	Per Lineal Foot.
Pay Item No. 860S-B:	Pavement Marking Paint	Per Square Foot.
Pay Item No. 860S-C:	Pavement Marking Paint (Reflectorized), __In.	Per Lineal Foot.
Pay Item No. 860S-D:	Pavement Marking Paint (Reflectorized)	Per Square Foot.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>
Specification Item 860S "Pavement Marking Paint (Reflectorized)"

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex 801-B	Testing Coatings and Related Materials
Tex 806-B	Method for Determining Grind and Oversize Pigment Particles
Tex-810-B	Test Method for Color and Color Stability of Opaque Colored Pigments
Tex-811-B	Skinning Characteristics of Coatings
Tex-822-B	Method for Determining Refractive Index of Glass Beads
Tex-826-B	Water Absorption Test of Beads
Tex-828-B	Determining Functional Characteristics of Pavement Markings
Tex-830-B	Method for Sampling Traffic Stripe Beads
Tex-831-B	Method for Determining The Gradation of Glass Traffic-Stripe Beads
Tex-832-B	Methods for Determining the Roundness of Glass Spheres

Texas Department of Transportation: Departmental Materials Specifications

<u>Designation</u>	<u>Description</u>
DMS-8200	Pavement Paint
YPT-11 and/or WPT-11	Pavement Paint

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
D 476	Specification for Titanium Dioxide Pigments
D 1152	Specification for Methanol (Methyl Alcohol) with Refractive Index
D 1199	Specification for Calcium Carbonate Pigments
G-23	Recommended Practice for Operating Light-and- Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Nonmetallic Materials

Federal Specifications - OSHA 29 CFR

<u>Designation</u>	<u>Description</u>
§ 1910.1200	Hazard Communication Standard."

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
804S-3C	Parking Stalls, Crosswalk, and Stop Bars
804S-3D	General Notes

City of Austin Transportation Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 8	Traffic Control

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>
Specification Item 860S "Pavement Marking Paint (Reflectorized)"

State of Texas Manual on Uniform Traffic Control Devices for Streets and Highways

<u>Designation</u>	<u>Description</u>
Part III	Markings
Part VI	Traffic Controls for Street and Highway Construction, Maintenance,

Part VI, Article D Utility and Incident Management Operations
Markings
Part VI, Article F Control of Traffic Through Work Areas

<u>RELATED CROSS REFERENCE MATERIALS</u>	
Specification Item 860S "Pavement Marking Paint (Reflectorized)"	

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 863S	Reflectorized Pavement Markers
Item No. 864S	Abbreviated Pavement Markings
Item No. 865S	Non-Reflectorized Traffic Buttons
Item No. 866S	Jiggle Bar Tile
Item No. 867S	Epoxy Adhesive
Item No. 870S	Work Zone Pavement Markings
Item No. 871S	Reflectorized Pavement Markings
Item No. 872S	Prefabricated Pavement Markings
Item No. 873S	Raised Pavement Markers
Item No. 874S	Eliminating Existing Pavement Markings and Markers
Item No. 875S	Pavement Surface Preparation For Markings

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

<u>Designation</u>	<u>Description</u>
Item No. 662	Work Zone Pavement Markings
Item No. 666	Reflectorized Pavement Markings
Item No. 667	Prefabricated Pavement Markings
Item No. 672	Raised Pavement Markers
Item No. 677	Eliminating Existing Pavement Markings and Markers
Item No. 678	Pavement Surface Preparation For Markings

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-829-B	Method For Measuring Pavement Temperature

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
D-235	Specification for Mineral Spirits
D-362	Specification for Industrial Grade Toluene
D-600	Specification for Liquid Paint Driers
D-605	Specification for Magnesium Silicate Pigment (Talc)
D-740	Specification for Methyl Ethyl Ketone
D-1210	Test Method For Fineness Of Dispersion Of Pigment-Vehicle Systems

Item No. 874S
Eliminating Existing Pavement
Markings and Markers

874S.1 Description

This item shall govern the elimination of existing pavement markings of various types and sizes, and pavement markers as shown on the Drawings or as directed, in writing, by the Engineer or designated representative.

874S.2 Materials

All surface treatment material application rates shall be as directed by the Engineer or designated representative. Unless otherwise shown on the Drawings, surface treatment materials shall conform to the requirements of Specification Item 301S, "Asphalts, Oils and Emulsions", and Specification Item 302S, "Aggregates for Surface Treatment". Testing of surface treatment materials may be waived by the Engineer or designated representative. Asphalt and aggregate types and grades shall be as shown on the Drawings or as approved by the Engineer or designated representative.

874S.3 Construction Methods

Elimination of existing pavement markings and markers shall be accomplished by one or more of the following methods as approved by the Engineer or designated representative.

A. Markings on Asphaltic Surfaces.

1. Placement of a surface treatment a minimum of two (2) feet {600 mm} wide to cover the existing marking.
2. Placement of a surface treatment, thin overlay or microsurfacing a minimum of one (1) lane in width in areas where directional changes of traffic are involved or other areas as directed by the Engineer or designated representative. Construction methods for surface treatments shall conform to Specification Item 320S, "Two Course Surface Treatment".

B. Markings on Concrete Surfaces.

Removal by an approved burning method.

C. Markings on Asphaltic or Concrete Surfaces.

Removal by water, water-sand blasting techniques or any other method(s) proven satisfactory to the Engineer.

D. Markers on Asphaltic or Concrete Surfaces.

Removal by any mechanical method to remove marker and adhesive.

Existing pavement markings and markers on both concrete and asphaltic surfaces shall be removed in such a manner that color and/or texture contrast of the pavement surface will be held to a minimum.

Removal of pavement markings on concrete surfaces by blast cleaning shall be accomplished in accordance with Specification Item 875S, "Pavement Surface Preparation for Markings", except for measurement and payment. Blast cleaning shall be performed in such a manner that damage to the Portland cement concrete surface is held to a minimum.

When thermoplastic pavement markings or prefabricated pavement markings are encountered, the application of heat may be used to remove the bulk of the marking material prior to blast cleaning. When heat is used, care shall be taken to prevent spalling of Portland cement concrete surfaces.

A burner may be used for complete removal of pavement markings. Broom removal or light blast cleaning may be used for removal of minor residue.

Damage to asphaltic surfaces, such as spalling, shelling, etc., that is greater than ¼ inch (6 mm) in depth and is caused by the removal of pavement markers shall be repaired by the application of a two (2) foot (600 mm) wide surface treatment for longitudinal markers with no directional change or a minimum of one (1) lane width surface treatment in areas where directional changes of traffic are involved.

Grinding is not an acceptable method of marker or marking removal. However, equipment utilizing special milling flails is considered acceptable in the removal of markings and markers on asphalt and Portland cement concrete surfaces.

874S.4 Measurement

This Specification Item will be measured by the square yard (square meter: 1 square meter is equal to 1.196 square yards) of surface treatment, thin overlay or microsurfacing (full lane width) placed; by each word, symbol or shape eliminated; by the lineal foot (lineal meter: 1 lineal meter is equal to 3.281 lineal feet) of markings eliminated; or by any other unit as shown on the Drawings.

Payment for revised quantities will be paid for at the unit price bid for that bid item.

The elimination of pavement markers required in conjunction with the elimination of longitudinal markings will not be measured for payment.

874S.5 Payment

The work performed and materials furnished in accordance with this Specification Item and measured as provided under "Measurement" will be paid for at the unit bid price for "Eliminating Existing Pavement Markings and Markers" of the various types specified. This price shall include full compensation for blast cleaning, mechanical cleaning and/or other cleaning methods; for all materials, tools, equipment and incidentals necessary to complete the Work, except as specified below.

Elimination of pavement markers when pavement markers are to be removed in conjunction with the elimination of longitudinal markings shall be included in the unit price bid for the item of construction indicated on the drawings.

Payment will be made under one or more of the following:

- Pay Item 874S-A:** Eliminating Existing Pavement Markings:
_____inches in width, _____ per lineal foot
- Pay Item 874S-B:** Eliminating Existing Work Zone Pavement Markings:
_____inches in width, _____ per lineal foot
- Pay Item 874S- C:** Eliminating Existing Reflectorized Thermoplastic Pavement Markings: **Words** _____inches in width per each
- Pay Item 874S- D:** Eliminating Existing Reflectorized Thermoplastic Pavement Markings: **Shapes** _____inches in width per each
- Pay Item 874S- E:** Eliminating Existing Reflectorized Thermoplastic Pavement Markings: **Symbols** _____inches in width per each
- Pay Item 874S- F:** Eliminating Existing Raised Pavement Markings, _____ Type' . _____ per each

END

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item No. 874S, "Eliminating Existing Pavement Markings And Markers"

City of Austin Contract Documents

<u>Designation</u>	<u>Description</u>
Section 00300U	Bid Form (Unit Prices)

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 302S	Aggregates for Surface Treatments
Item No. 320S	Two Course Surface Treatment
Item No. 875S	Pavement Surface Preparation For Markings

<u>RELATED</u> CROSS REFERENCE MATERIALS
Specification Item No. 874S, "Eliminating Existing Pavement Markings And Markers"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 310S	Emulsified Asphalt Treatment
Item No. 311S	Emulsified Asphalt Repaving
Item No. 312S	Seal Coat
Item No. 313S	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)
Item No. 315S	Milling Asphaltic Concrete Paving
Item No. 340S	Hot Mix Asphaltic Concrete Pavement
Item No. 341S	Paving Fabric
Item No. 350S	Heating, Scarifying and Repaving
Item No. 360	Concrete Pavement

Item No. 413S	Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)
Item No. 801S	Construction Detours
Item No. 803S	Barricades, Signs and Traffic Handling
Item No. 860S	Pavement Marking Paint (Reflectorized)
Item No. 863S	Reflectorized Pavement Markers
Item No. 864S	Abbreviated Pavement Markings
Item No. 865S	Non-Reflectorized Traffic Buttons
Item No. 866S	Jiggle Bar Tile
Item No. 867S	Epoxy Adhesive
Item No. 870S	Work Zone Pavement Markings
Item No. 871S	Reflectorized Pavement Markers
Item No. 872S	Prefabricated Pavement Markings
Item No. 873S	Raised Pavement Markings

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
863S-1	Pavement Buttons (Reflectorized-Type I & Type II)
865S-1	Traffic Buttons (Non-Reflectorized)

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

<u>Designation</u>	<u>Description</u>
Item No. 302	Aggregates for Surface Treatments
Item No. 314	Emulsified Asphalt Treatment
Item No. 315	Emulsified Asphalt Seal
Item No. 316	Surface Treatments
Item No. 334	Hot Mix-Cold Laid Asphaltic Concrete Pavement
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 342	Plant Mix Seal
Item No. 351	Repairing Existing Flexible Pavement Structure
Item No. 354	Planing and/or Texturing Pavement
Item No. 358	Asphaltic Concrete Surface Rehabilitation
Item No. 360	Concrete Pavement
Item No. 421	Hydraulic Cement Concrete
Item No. 427	Surface Finishes for Concrete
Item No. 428	Concrete Surface Treatment
Item No. 662	Work Zone Pavement Markings
Item No. 666	Reflectorized Pavement Markings
Item No. 667	Prefabricated Pavement Markings
Item No. 672	Raised Pavement Markers
Item No. 677	Eliminating Existing Pavement Markings and Markers
Item No. 678	Pavement Surface Preparation For Markings

RELATED CROSS REFERENCE MATERIALS - Continued

Specification Item No. 874S, "Eliminating Existing Pavement Markings And Markers"

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex 729-I	Sampling of Traffic Markers
Tex-828-B	Determining Functional Characteristics of Pavement Markings
Tex-829-B	Method For Measuring Pavement Temperature
Tex-854-B	Evaluation Of Thermoplastic Striping For Uniformity And Thickness

Texas Department of Transportation: Departmental Materials Specification

<u>Designation</u>	<u>Description</u>
DMS-4100	Jiggle Bar Tile
DMS-4200	Pavement Markers (Reflectorized)
DMS-4300	Traffic Buttons
DMS-4210	Pavement Markers
DMS-6130	Bituminous Adhesive
DMS-8200	Pavement Paint
DMS-8220	Thermoplastic marking material
DMS-8240	Prefabricated Marking Materials
DMS-8241	Removable Tape
DMS-8290	Pavement Paint
YPT-10 and/or WPT-10	Pavement Paint

Item No. 875S

Pavement Surface Preparation For Markings

875S.1 Description

This item shall govern the surface preparation of pavement surface areas prior to placement of pavement markings or raised pavement markers.

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.

875S.2 Materials

Abrasive blasting medium, when used, shall be a quality commercial product capable of producing the specified surface cleanliness without the deposition of deleterious materials on the cleaned surface. Water used in blasting operations shall be potable.

875S.3 Equipment

Equipment shall be maintained in good condition. Air compression equipment shall utilize moisture and oil traps, in working order, of sufficient capacity to remove contaminants from blasting air and prevent the deposition of moisture, oil or other contaminants on the street surface.

875S.4 Construction Methods

Widths, lengths and shapes of the prepared surfaces shall be of sufficient size to include the full area of pavement markings or raised pavement markers shown on the Drawings.

Surface preparation of Portland cement concrete surfaces shall be sufficient to remove contaminants. Damage to the street due to over-blasting shall be held to a minimum. Asphaltic surfaces shall be cleaned by brushing, washing, compressed air, high pressure water or any combination thereof to remove all forms of contamination and loose materials. All other surfaces to be cleaned by blast cleaning shall be cleaned sufficiently to remove loose and flaking materials from the street surface.

When existing markings are encountered, they shall be cleaned sufficiently to remove all loose and flaking materials. Small spots of old markings or contaminants of up to 0.5 square inch (320 mm²) in area may remain if the contaminant is not removed by the following test:

Firmly press a 10 inch (250 mm) long, two-inch (50 mm) wide strip of monofilament tape onto the surface to be tested, leaving approximately 2 inches {50 mm} free. Grasp the free end and remove the tape with a sharp pull.

Blasting pressure and technique shall be controlled to prevent damage to the pavement surface. Portland cement concrete surfaces shall not be cleaned by grinding.

875S.5 Measurement

This Specification Item will be measured by the lineal foot (lineal meter: 1 lineal meter is equal to 3.281 lineal feet) of the various widths, by each of the various words, symbols or shapes, or by any other unit as shown on the Drawings.

Payment for revised quantities will be paid for at the unit price bid for that bid item.

875S.6 Payment

The work performed and materials furnished in accordance with this Specification Item and measured as provided under "Measurement" will be paid for at the unit bid price for "Pavement Surface Preparation for Markings" of the various types specified. This price shall include full compensation for all materials, tools, equipment, labor and incidentals necessary to complete the Work.

Payment shall be made by one or more of the following:

- Pay Item 875S-A:** Pavement Surface Preparation for existing pavement surface
____ inches in width, for ____ Surface Type per lineal foot
- Pay Item 875S-B:** Pavement Surface Preparation for existing Words
____ inches in width, for ____ Surface Type per each
- Pay Item 875S-C:** Pavement Surface Preparation for existing Shapes
____ inches in width, for ____ Surface Type per each
- Pay Item 875S-D:** Pavement Surface Preparation for existing Symbols
____ inches in width, for ____ Surface Type per each

END

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS	
Specification Item No. 874S, "Eliminating Existing Pavement Markings And Markers"	

City of Austin Contract Documents

<u>Designation</u>	<u>Description</u>
Section 00300U	Bid Form (Unit Prices)

<u>RELATED</u> CROSS REFERENCE MATERIALS	
Specification Item No. 875S, "Pavement Surface Preparation For Markings"	

City of Austin Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 302S	Aggregates for Surface Treatments
Item No. 310S	Emulsified Asphalt Treatment
Item No. 311S	Emulsified Asphalt Repaving
Item No. 312S	Seal Coat
Item No. 313S	Rubber Asphalt Joint and Crack Sealant
Item No. 315S	Milling Asphaltic Concrete Paving
Item No. 320S	Two Course Surface Treatment
Item No. 340S	Hot Mix Asphaltic Concrete Pavement

Item No. 341S	Paving Fabric
Item No. 350S	Heating, Scarifying and Repaving
Item No. 360	Concrete Pavement
Item No. 801S	Construction Detours
Item No. 803S	Barricades, Signs and Traffic Handling
Item No. 860S	Pavement Marking Paint (Reflectorized)
Item No. 863S	Reflectorized Pavement Markers
Item No. 864S	Abbreviated Pavement Markings
Item No. 865S	Non-Reflectorized Traffic Buttons
Item No. 866S	Jiggle Bar Tile
Item No. 867S	Epoxy Adhesive
Item No. 870S	Work Zone Pavement Markings
Item No. 871S	Reflectorized Pavement Markers
Item No. 872S	Prefabricated Pavement Markings
Item No. 873S	Raised Pavement Markings
Item No. 874S	Eliminating Existing Pavement Markings and Markers

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
863S-1	Pavement Buttons (Reflectorized-Type I & Type II)
865S-1	Traffic Buttons (Non-Reflectorized)

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

<u>Designation</u>	<u>Description</u>
Item No. 302	Aggregates for Surface Treatments
Item No. 314	Emulsified Asphalt Treatment
Item No. 315	Emulsified Asphalt Seal
Item No. 316	Surface Treatments

RELATED CROSS REFERENCE MATERIALS (Continued)

Specification Item No. 875S, "Pavement Surface Preparation For Markings"

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

<u>Designation</u>	<u>Description</u>
Item No. 334	Hot Mix-Cold Laid Asphaltic Concrete Pavement
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 342	Plant Mix Seal
Item No. 351	Repairing Existing Flexible Pavement Structure
Item No. 354	Planing and/or Texturing Pavement
Item No. 358	Asphaltic Concrete Surface Rehabilitation
Item No. 360	Concrete Pavement
Item No. 421	Hydraulic Cement Concrete
Item No. 427	Surface Finishes for Concrete
Item No. 428	Concrete Surface Treatment
Item No. 662	Work Zone Pavement Markings
Item No. 666	Reflectorized Pavement Markings
Item No. 667	Prefabricated Pavement Markings
Item No. 672	Raised Pavement Markers

Item No. 677 Eliminating Existing Pavement Markings and Markers

Item No. 678 Pavement Surface Preparation For Markings

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex 729-I	Sampling of Traffic Markers
Tex-828-B	Determining Functional Characteristics of Pavement Markings
Tex-829-B	Method For Measuring Pavement Temperature
Tex-854-B	Evaluation Of Thermoplastic Striping For Uniformity And Thickness

Texas Department of Transportation: Departmental Materials Specification

<u>Designation</u>	<u>Description</u>
DMS-4100	Jiggle Bar Tile
DMS-4200	Pavement Markers (Reflectorized)
DMS-4300	Traffic Buttons
DMS-4210	Pavement Markers
DMS-6130	Bituminous Adhesive
DMS-8200	Pavement Paint
DMS-8220	Thermoplastic marking material
DMS-8240	Prefabricated Marking Materials
DMS-8241	Removable Tape
DMS-8290	Pavement Paint
YPT-10 and/or WPT-10	Pavement Paint