

**Item No. 110S
Street Excavation****110S.1 Description**

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

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

110S.2 Submittals

The submittal requirements of this specification item may include:

- A. A permit when utility adjustments are made in the right-of-way,
- B. A plan for removal and deposition of all 'Waste' materials, and
- C. A Blasting Permit if blasting is required and allowed on the project.

110S.3 Classification

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

110S.4 Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures shall be in place. The existing utilities shall be located and protected as specified in the Standard Contract Documents, Section 00700, "General Conditions" and/or indicated on the Drawings. A permit shall be required when utility adjustments are to be made in preparation for construction in the right-of-way, as specified in Section 5.2.0 of the City of Austin Utilities Criteria Manual.

Construction equipment shall not be operated nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed, that conform to Item No. 610S, " Preservation of Trees and Other Vegetation ".

All street excavation shall be performed as specified herein and shall conform to the established alignment, grades and cross sections. The Contractor will be required to set blue-tops for the subgrade along centerlines, at quarter points and curb lines or edge of

pavement at intervals not exceeding 50 feet (15 meters). Suitable excavated materials shall be utilized, insofar as practicable, in constructing any required embankments. The construction of all embankments shall conform to Item No. 132S, "Embankment".

All earth cuts for base and/or pavement structure construction shall be scarified to a uniform depth of at least 6 inches (150 millimeters) below the required finished subgrade elevation for the entire roadbed width. The material shall be mixed, reshaped by blading, sprinkled and then rolled in accordance with Section 2 of the City of Austin Specification Item 132S, "Embankment".

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

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

All blasting shall conform to the General Notes on the Drawings and to the Standard Contract Document Section 01550, "Public Safety and Convenience". In all cases where blasting is permitted, a Blasting Permit must be obtained in advance from the City of Austin Department of Public Works and Transportation.

110S.5 Measurement

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

A. Method A

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

B. Method B

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

110S.6 Payment

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

Payment will be made under one of the following:

- Pay Item No. 110S-A:** Street Excavation Per Cubic yard.
- Pay Item No. 110S-B:** Street Excavation, Plan Quantity Per Cubic yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item 110S, "STREET EXCAVATION"

City of Austin Standard Contract Documents

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

City of Austin Utilities Criteria Manual

<u>Designation</u>	<u>Description</u>
Section 5.2.0	Permit for Excavation in the Public Right-of-Way

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. 104S	Removing Portland Cement Concrete
Item No. 132S	Embankment
Item No. 201S	Subgrade Preparation
Item No. 236S	Proof Rolling
Item No. 610S	Preservation of Trees and Other Vegetation

<u>RELATED</u> CROSS REFERENCE MATERIALS

City of Austin Standard Contract Documents

<u>Designation</u>	<u>Description</u>
01500	Temporary Facilities

The Code of the City of Austin, Code of Ordinances, Volume 1

<u>Designation</u>	<u>Description</u>
Article 14-11-181	Permit Required
Article 14-11-189	Conditions for Permit Issuance
Article 14-11-190	Excavation Sequence and Permit Term

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
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. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 622S	Diversion Dike
Item No. 628S	Sediment Containment Dikes
Item No. 642S	Silt Fence

RELATED CROSS REFERENCE MATERIALS - Continued
Specification Item 110S, "STREET EXCAVATION"

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
610S-6	Tree Protection, Tree Wells
621S-1	Diversion
622S-1	Diversion Dike
624S-1	Earth Outlet Sediment Trap
625S-1	Grade Stabilization Structure
627S-1	Grass Lined Swale
627S-2	Grass Lined Swale With Stone Center
628S	Triangular Sediment Filter Dike
628S-1	Hay Bale Dike
629S-1	Brush Berm
630S-1	Interceptor Dike
631S-1	Interceptor Swale
632S-1	Storm Inlet Sediment Trap
633S-1	Landgrading
634S-1	Level Spreader
635S-1	Perimeter Dike
636S-1	Perimeter Swale
637S-1	Pipe Slope Drain (Flexible)
637S-2	Pipe Slope Drain (Rigid)
638S-1	Pipe Outlet Sediment Trap
639S-1	Rock Berm
641S-1	Stabilized Construction Entrance
642S-1	Silt Fence
643S-1	Stone Outlet Structure
644S-1	Stone Outlet Sediment Trap

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. 112	Subgrade Widening
Item No. 132	Embankment
Item No. 150	Blading
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 164	Seeding for Erosion Control
Item No. 204	Sprinkling
Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 213	Rolling (Pneumatic Tire)
Item No. 260	Lime Treatment for Materials Used as Subgrade (Road Mixed)
Item No. 265	Lime-Fly Ash (LFA) Treatment for Materials Used as Subgrade

<i>RELATED</i> CROSS REFERENCE MATERIALS - Continued
Specification Item 110S, "STREET EXCAVATION"

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
Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials

ITEM NO. 210S FLEXIBLE BASE 2-24-10

210S.1 Description

This item governs furnishing and placing a crushed stone base course for surfacing, pavement, or other base courses. "Flexible Base" shall be constructed on an approved, prepared surface in one or more courses conforming to the typical sections and to the lines and grades, indicated on the Drawings or 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.

210S.2 Submittals

The submittal requirements of this specification item may include:

- A. Source, gradation and test results for the crushed limestone material,
- B. Notification that the crushed limestone stockpile is completed and ready for testing, and
- C. Field density test results for in-place compacted flexible base,

210S.3 Material

- A. Mineral Aggregate

The material shall be crushed argillaceous limestone meeting the requirements specified herein. The material shall be from sources approved by the City and shall consist of durable crushed stone that has been screened to the required gradation.

Flexible base materials shall be tested according to the following TxDOT standard test methods:

a) Preparation for Soil Constants and Sieve Analysis	Tex-101-E
b) Liquid Limit	Tex-104-E
c) Plastic Limit	Tex-105-E
d) Plasticity Index	Tex-106-E
e) Sieve Analysis	Tex-110-E
f) Wet Ball Mill	Tex-116-E
g) Triaxial Test	Tex-117-E, Part II

- 1. Plasticity Index shall be determined in accordance with Tex-107-E (Linear Shrinkage) when liquid limit is unattainable as defined in Tex-104-E.
- 2. When a soundness value is required on the drawings, the material shall be tested in accordance with Tex-411-A.

Base material shall be stockpiled after crushing, then tested by the City's designated laboratory and approved by the Engineer or designated representative prior to being hauled to the Project.

The material shall be well graded and shall meet the following requirements:

Sieve Designation		Other Requirements	% Retained	
US	SI			
1 3/4"	45 mm		0	

7/8"	22.4 mm		10—35	
3/4"	9.5 mm		30—50	
#4	4.75 mm		45—65	
#40	425 µm		70—85	
		Maximum Plasticity Index		10
		Maximum Wet Ball Mill		42
Maximum Increase in passing #40 (425 µm) sieve from Wet Ball Mill Test			20	

Minimum compressive strength when subjected to the triaxial test shall be 35 psi at 0 psi lateral pressure [240 kiloPascal (kPa) at 0 kPa lateral pressure] and 175 psi at 15 psi lateral pressure [1200 kiloPascal (kPa) at 100 kPa lateral pressure].

B. Asphaltic Material

Prime Coat. Prime Coat shall conform to the requirements of Standard Specification Item 306S, "Prime Coat", except for measurement and payment.

210S.4 Stockpiling, Storage and Management

A. Managing Material:

The stockpile shall be constructed on a relatively smooth area that has been cleared of debris, weeds, brush, trees and grass. Stockpiles shall contain between 25,000 and 50,000 cubic yards (19,100 to 38,200 cubic meters). The stockpile shall be constructed using scrapers, bottom dumps or other similar equipment that allows dumping and spreading without rehandling. The stockpile shall be constructed to allow dumping and spreading in one direction only. The height of the stockpile shall not exceed the capabilities of available equipment to make a full cut (bottom to top) on any of the four sides.

A stockpile shall be completed before being tested by the City. The Contractor's supplier shall notify the City when a stockpile has been completed and is ready to be tested. The stockpile shall not be added to after it has been tested.

The Contractor shall provide material only from stockpiles that have been inspected, tested and accepted by the City. A ticket showing the date, source, stockpile number, and net weight (mass) shall be provided to the Inspector with each load of material delivered to the Project.

Material shall be loaded from the stockpile by making successive vertical cuts through its entire depth.

B. Test Sampling:

The Contractor's supplier may choose the method of sample gathering for testing by the City's laboratory as follows:

1. The supplier shall make a full-height cut a sufficient distance into each side of the stockpile to obtain a uniform sample. The four samples (one from each side of the stockpile) shall then be combined and mixed into a single "test" specimen from which the City's laboratory can obtain a sample.
2. As the stockpile is constructed, a perpendicular cut will be made across the spreading direction at every two feet to four feet (0.6 to 1.2 meters) of height and the sample used to start a "mini" stockpile. The process shall be repeated in two feet to four feet (0.6 to 1.2 meter) increments of height, until the stockpile and the "mini" stockpile are completed. Samples shall be obtained from the "mini" stockpile in the same manner described in (1) above.

C. Testing and Acceptance:

When initial tests indicate that the material is unacceptable, the City may, if requested by the Contractor's supplier, sample and test the material one more time. The additional sampling and testing shall be paid for by the supplier.

210S.5 Construction Methods

A. Preparation of Subgrade:

Flexible base shall not be placed until the Contractor has verified by proof rolling that the subgrade has been prepared and compacted in conformity with Standard Specification Item 201S, "Subgrade Preparation," to the typical sections, lines and grades indicated on the Drawings. Any deviation shall be corrected and proof rolled prior to placement of the flexible base material.

The Contractor shall not place flexible base until the subgrade has cured to the satisfaction of the Engineer or designated representative, regardless of whether or not the subgrade has been successfully proof rolled. As a minimum, this will be after the surface displays no damp spots and there is no evidence of "sponginess" in the subgrade.

B. First Lift:

Immediately before placing the flexible base material, the subgrade shall be checked for conformity with grade and section. The thickness of each lift of flexible base shall be equal increments of the total base depth. No single lift shall be more than six inches (150 mm) or less than three inches (75 mm) compacted thickness.

The material shall be delivered in approved vehicles. It shall be the responsibility of the Contractor to deliver the required amount of material. If it becomes evident that insufficient material was placed, additional material as necessary shall be delivered and the entire course scarified, mixed and compacted.

Material deposited upon the subgrade shall be spread and shaped the same day unless otherwise approved by the Engineer or designated representative. In the event inclement weather or other unforeseen circumstances render spreading of the material impractical, the material shall be spread as soon as conditions allow.

Additionally, if the material cannot be spread and worked the same day it is deposited, the Contractor shall "close up" the dump piles before leaving the job site. "Closed up" shall be defined as the use of a motor grader to blade all dump piles together, leaving no open space between piles.

The material shall be spread, sprinkled, if required, then thoroughly mixed; bladed, dragged and shaped to conform to the typical sections indicated on the Drawings.

All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well-graded material.

Each lift shall be sprinkled as required to bring the material to optimum moisture content, then compacted to the extent necessary to provide not less than the percent density specified in Section 210S.5.D, "Density." In addition to the requirements specified for density, the full depth of flexible base material shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of flexible base material is completed, tests, as necessary, will be made by the Engineer or designated representative. As a minimum, three in-place density tests per section per day will be taken. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. All initial testing will be paid for by the City. All retesting shall be paid for by the Contractor.

Throughout the entire operation, the surface of the material shall be maintained by blading and, upon completion, shall be smooth and shall conform to the typical section indicated on the Drawings and to the established lines and grades.

In that area on which pavement is to be placed, any deviation in excess of 1/4 inch (6.5 mm) in cross section or 1/4 inch in a length of 16 feet (6.5 mm in a length of 5 meters) measured longitudinally shall be corrected by loosening, adding or removing material, and by reshaping and recompacting. All irregularities, depressions or weak spots shall be corrected immediately by scarifying the areas affected, adding suitable material as required, and by reshaping and recompacting. Should the lift, due to any reason or cause, lose the required stability, density and/or finish before the surfacing is complete, it shall be recompacted and refinished at the Contractor's expense.

C. Succeeding Lifts:

Construction methods for succeeding lifts shall be the same as prescribed for the first lift. For that lift of the flexible base upon which the curb and gutter will be constructed, as well as the last flexible base lift (i.e. top of the flexible base), the Contractor shall check the surface of the lift for conformity to the lines and grades by setting "blue tops" at intervals not exceeding 50 feet (15 meters) on the centerline, at quarterpoints, at curb lines or edge of pavement, and at other points that may be indicated on the Drawings.

When the thickness of a particular lift of the flexible base is in question, the Contractor shall check the surface of the lift for conformity to the lines and grades by setting "blue tops" at intervals not exceeding 50 feet (15 meters) on the centerline, at quarter points, at curb lines or edge of pavement, and at other points that may be indicated on the Drawings

D. Density:

The flexible base shall be compacted to not less than 100 percent density as determined by TxDOT Test Method Tex-113-E.

Field density determination shall be made in accordance with TxDOT Test Method Tex-115-E unless otherwise approved by the Engineer or designated representative. Each lift of the flexible base shall also be tested by proof rolling in conformity with Standard Specification Item 236S "Proof Rolling."

E. Priming:

After the flexible base material has been compacted to not less than 100 percent density, and tested by proof rolling, a prime coat will be applied in accordance with Standard Specification Item 306S, "Prime Coat."

F. Curing:

Pavement materials, such as a tack coat or surface course, shall not be placed on the primed surface until the prime coat has been absorbed into the base course. At least 24 hours, or longer if designated by the Engineer or designated representative, shall be allowed when cutback asphalt is used as the prime coat.

210S.6 Measurement

"Flexible Base" will be measured by the cubic yard (cubic meter: 1 cubic meter equals 1.196 cubic yards), complete in place, as indicated in the Contract Documents.

210S.7 Payment

This item will be paid for at the contract unit bid price for "Flexible Base". The unit bid price shall include full compensation for all work specified herein, including the furnishing, hauling, placing and compacting of all materials; for rolling, proof rolling, recompacting and refinishing; for all water required; for retesting as necessary; for priming; and for all equipment, tools, labor and incidentals necessary to complete the Work.

Prime coat will not be measured nor paid for directly but shall be included in the unit price bid for Standard Specification Item 210S, "Flexible Base."

Payment will be made under one of the following:

Pay Item No. 210S-A:	Flexible Base	Per Cubic Yard.
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End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification 210S, "Flexible Base"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 201S	Subgrade Preparation
Item No. 236S	Proof Rolling
Item No. 306S	Prime Coat
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Tex-101-E	Preparation of Soil and Flexible Base Materials for Testing
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
Tex-107-A	Determination of Bar Linear Shrinkage of Soils
Tex-110-E	Determination of Particle Size Analysis of Soils
Tex-113-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Base Materials and Cohesionless Sands
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials
Tex-116-E	Ball Mill Method for Determination of the Disintegration of Flexible Base Material
Tex-117-E	Triaxial Compression Tests for Disturbed Soils and Base Materials
Tex-411-A	Soundness of Aggregate By Use of Sodium Sulfate or Magnesium Sulfate

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 210S, "Flexible Base"</u>	
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
No. 1000S-2	Flexible Base with Asphalt Surface Trench Repair-Existing Pavement
No. 510S-3	Typical Trench with Paved Surface
No. 1000S	Bus Stop Paving
No. 1000S-10	Local Street Sections
No. 1000S-11(1)	Residential and City of Austin Neighborhood Collector Street Sections
No. 1000S-11(2)	Industrial and Commercial Collector Street Sections
No. 1000S-12(1)	Primary Collector Street Sections
No. 1000S-12(2)	Primary Arterial Street Sections
No. 1000S-13(1)	Minor Arterial Street Sections (4 Lanes)
No. 1000S-13(2)	Minor Arterial Street Sections-(4 Lanes divided)
No. 1000S-14	Major Arterial Street Sections
<u>City of Austin Utility Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 5.8.2	Flexible Base
Section 5.7.3	Flexible Base with Asphalt Surface
Section 5.9.1	Excavation in Alley

<u>City of Austin Transportation Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 3.2.0	General Criteria
Section 3.4.3.D	Layer Data-Minimum Thickness
Table 3-1	Minimum Layer Thickness
Section 3.4.3.F	Layer Data- Minimum Thickness
Table 3-2	Layer Thickness Increment
Section 3.4.3.J	Layer Data-Stiffness Coefficient
Table 3-3	Stiffness Coefficient
Table 3-9	Recommended Salvage values
Table 3-10	AASHTO Layer Coefficients

ITEM NO. 301S ASPHALTS, OILS, AND EMULSIONS 8-20-07

301S.1 Description

This item includes the requirements for cutback asphalts, emulsified asphalts, polymer modified asphalt cements, performance graded asphalt binders and other miscellaneous asphaltic materials and latex additives.

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.

301S.2 Submittals

Submittals shall include test results for each the materials described herein when specifically identified on the drawings and/or referenced in associated standard specification items and standard details.

Submittals may include samples of the base asphalt cement and polymer additives.

301S.3 Materials

When tested in accordance with designated TxDOT, AASHTO and/or ASTM test methods, the various materials shall meet the applicable requirements of this specification.

A. Acronyms

The acronyms used in this specification are defined in the following table.

Table 1: Acronyms

Acronym	Definition	Acronym	Definition
Test Method Prefix		Polymer Modifier	
Tex	TxDOT	SBR or L	Styrene-Butadiene Rubber (Latex)
T	AASHTO	SBS	Styrene-Butadiene-Styrene Block Copolymer
D	ASTM	TR	Tire Rubber, from ambient temperature grinding of truck and passenger tires
		P	Polymer Modified
AC	Asphalt Cement	SS	Slow Setting
RC	Rapid Curing	H-suffix	Harder Residue (Lower Penetration)
MC	Medium Curing	AE	Asphalt Emulsion
SCM	Special Cutback Material	S-suffix	Stockpile Usage
HF	High Float	AE-P	Asphalt Emulsion Prime
C	Cationic	EAP&T	Emulsified Asphalt Prime and Tack
RS	Rapid Setting	PCE	Prime, Cure, and Erosion Control
MS	Medium Setting	PG	Performance Grade

B. Asphalt Cement

The material shall be homogeneous, free from water, shall not foam when heated to 350°F (177°C) and shall meet the requirements in Table 2.

Table 2: Asphalt Cement Requirements

Viscosity Grade	Test Method	AC-10		AC-20		AC-30	
		Min	Max	Min	Max	Min	Max
Property							
Viscosity: 140°F, poises (60°C, pascals)	T 202	800 (80)	1200 (120)	1600 (160)	2400 (240)	2400 (240)	3600 (360)
Viscosity: 275°F, stokes (135°C, pascals)	T 202	1.9 (.19)	-	2.5 (.25)	-	3.0 (.30)	-
Penetration: 77°F (25°C), 100g, 5s	T 49	85	-	55	-	45	-
Flash Point, C.O.C. °F (°C)	T 48	450 (232)	-	450 (232)	-	450 (232)	-
% Solubility trichloroethylene	T44	99.0	-	99.0	-	99.0	-
Spot test	Tex 509-C						
Viscosity: 140°F stokes (60°C pascals)	T 202	-	3000 (300)	-	6000 (600)	-	9000 (900)

Ductility 77°F (25°C), 5 cm/min, cm	T 202	100	-	70	-	50	-
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C. Polymer Modified Asphalt Cement

Polymer modified asphalt cement must be smooth, homogeneous, and shall comply with the requirements listed in Table 3.

Table 3: Polymer Modified Asphalt Cement Requirements

Polymer Modified Viscosity Grade		AC-5		AC-10		AC-15P		AC-45P*	
Polymer Type		SBR		SBR		SBS		SBS	
Property	Test Method	Min	Max	Min	Max	Min	Max	Min	Max
Polymer in % (solids basis)	Tex-533-C	2.0	-	2.0	-	3.0	-	3.0	-
Viscosity									
140°F, poise (60°C, pascals)	T 202	700 (70)	-	1300 (130)	-	1500 (150)	-	4500 (450)	-
275°F, poise (135°C, pascals)	T 202	-	7.0 (0.7)	-	8.0 (0.8)	-	8.0 (0.8)	14.0 (1.4)	
Penetration, 77°F (25°C), 100 g, 5 s.	T 49	120	-	80	-	100	150	50	74
Ductility, 5cm/min., 39.2°F, cm	T 51	70	-	60	-	-	-	15	-
Elastic Recovery, 50°F (10°C), %	Tex-539-C	-	-	-	-	55	-		-
Polymer Separation, 48 hrs**.	Tex-540-C	None		None		None		None	
Flash Point, C.O.C., °F (°C),	T 48	425 (218)	-	425 (218)	-	425 (218)	-	425 (218)	-
Tests on Residue from Thin Film Oven Test: (T179)									
Retained Penetration Ratio, 77°F (25°C), % original	T 49	-	-	-	-	0.60	1.00	0.60	0.90

* The SBS block copolymer may be pre-blended with a polymer processing oil (up to a 1:1 ratio of polymer to oil) to aid the solution of the polymer in the asphalt.

** A 350-gram (0.77 pound) sample of the asphalt-SBS blend is stored for 48 hours at 325°F (163°C). Upon completion of the storage time, the sample is visually examined for separation of the SBS from the asphalt (smoothness and homogeneity). If a question still exists about the separation of the SBS, samples shall be taken from the top and bottom of the sample for Infrared Spectroscopy analysis. A difference of 0.4% or more in the concentration of the SBS between the top and bottom samples shall constitute separation.

D. Cutback Asphalt

Cutback asphalt shall meet the requirements presented in Tables 4 and 5 for the specified type and grade.

Table 4: Rapid Curing Type Cutback Asphalt Requirements

Type-Grade		RC-250		RC-800		RC-3000	
Properties	Test Method	Min	Max	Min	Max	Min	Max
Water, percent	T55	-	0.2	-	0.2	-	0.2
Flash Point, T.O.C., °F (°C)	T79	80 (27)	-	80 (27)	-	80 (27)	-

Kinematic viscosity @ 140°F, cst (60°C, mm ² /s)	T201	250	400	800	1600	3000	6000
Distillation Test:	T78						
Distillate, % by volume of total distillate to 680°F (360°C):							
to 437°F (225°C):		40	75	35	70	20	55
to 500°F (260°C):		65	90	55	85	45	75
to 600°F (316°C):		85	-	80	-	70	-
Residue from Distillation, Volume %		70	-	75	-	82	-
Tests of Distillation Residue:							
Penetration, 100g, 5 sec., 77°F (25°C), cm	T49	80	120	80	120	80	120
Ductility, 5 cm/min., 77°F, 5 cm/min., cm	T51	100	-	100	-	100	-
(25°C, 50 mm/min., mm)		1000	-	1000	-	1000	-
Solubility in trichloroethylene, %	T44	99.0	-	99.0	-	99.0	-
Spot Test	Tex 509-C	ALL NEGATIVE					

Table 5: Medium Curing Type Cutback Asphalt Requirements

Type		MC-30		MC-70		MC-250		MC-800		MC-3000	
Properties	Test Method	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Water, %	T55	-	0.2	-	0.2	-	0.2	-	0.2	-	0.2
Flash Point, T.O.C., °F (°C)	T79	100 (38)	-	100 (38)	-	150 (65)	-	150 (65)	-	150 (65)	-
Kinematic viscosity. @ 140°F. cst (60°C, mm ² /s)	T201	30	60	70	140	250	500	800	1600	3000	6000
Distillation Test:	T78										
Distillate, as % by volume to total distillate to 680°F(360°C):, shall be as follows:											
to 437°F (225°C):		-	25	-	20	-	10	-	-	-	-
to 500°F (260°C):		40	70	20	60	15	55	-	35	-	15
to 600°F (316°C):		75	93	65	90	60	87	45	80	15	≥75
Residue from 80°F (225°C) distillation											
Volume Percent		50	-	55	-	67	-	75	-	80	-
Tests on Distillation Residue:											
Penetration	T49	120	250	120	250	120	250	120	250	120	250
@77°F (25°C), 100g, s, 01 mm:											
Ductility	T51										
@ 77°F, 5 cm/min, cms		100*	-	100*	-	100*	-	100*	-	100*	-
(25°C, 50 mm/min., mm)		1000*	-	1000*	-	1000*	-	1000*	-	1000*	-
% Solubility in trichloroethylene	T44	99.0	-	99.0	-	99.0	-	99.0	-	99.0	-

Spot Test	Tex 509-C	ALL NEGATIVE
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* If penetration of residue is more than 200 and the ductility at 77°F (25°C) is less than 100 cm (1000 mm), the material will be acceptable if its ductility at 60°F (16°C) is more than 100cm (1000 mm).

E. Emulsified Asphalt

The material shall be homogenous. It shall show no separation of asphalt after thorough mixing and shall meet the requirements for the specified type and grade presented in Tables 6, 7 and 8.

Table 6: Anionic Emulsion Requirements

	Type	Medium Setting		Slow Setting			
		MS-2		SS-1		SS-1h	
Property	Test Method	Min	Max	Min	Max	Min	Max
Furol Viscosity @ 77°F (25°C), sec.	T72	-	-	20	100	30	100
@ 122°F(50°C), sec		100	300	-	-	-	-
Sieve Test, %.	T59	-	0.1	-	0.1	-	0.1
Miscibility (Standard Test)	T59	-	-	Passing		Passing	
Cement Mixing, %	T59	-	-	-	2.0	-	2.0
% Demulsibility: 35 cc 0.02N CaCl ₂	T59	-	30	-	-	-	-
Storage Stability 1 day, %	T59	-	1	-	1	-	1
Freezing Test, 3 Cycles*	T59	Passing		Passing	Passing		
Distillation Test	T59						
Distillation Residue, %		65	-	60			
Distillate Oil Portion, %		-	½	-	½	-	½
Tests of Residue from Distillation:							
Penetration @ 77°F (25°C), 100g, 5s	T49	120	160	120	160	70	100
Solubility in Trichloroethylene, %	T44	97.5	-	97.5	-	97.5	-
Ductility @ 77F, 5 cm/min., cm	T51	100	-	100	-	80	-
(@ 25°C, 50 mm/min., mm)		1000	-	1000	-	800	-

* Applies only when Engineer or designated representative specifies the material for winter use.

Table 7: High Float anionic Emulsion Requirements

	Type	Rapid Setting		Medium Setting	
		HFRS-2		AES-300	
Property	Test Method	Min	Max	Min	Max
Viscosity, Saybolt Furol	T72				
@ 77°F (25°C), sec.		-	-	75	400
@ 122°F (50°C), sec.		150	400	-	-
Oil Portion of Distillate, %	T59	-	2	-	7
Sieve Test, %	T59	-	0.1	-	0.1
Particle Charge	T59	positive		positive	

Coating Ability and Water Resistance:	T59				
Coating, dry aggregate		-	-	good	
Coating, after spraying		-	-	fair	
Coating, wet aggregate				fair	
Coating, after spraying				fair	
% Demulsibility: 35 ml 0.02 N CaCl ₂	T59	50	-	-	-
Storage Stability Test, 1 day, %	T59	-	1	-	1
Distillation Test	T59				
Residue by Distillation, % by weight		65	-	65	-
Oil Distillate, by volume of emulsion, %		-	1/2	-	5
Tests on Residue from Distillation:					
Penetration at 77°F (25°C), 100g, 5s	T49	100	140	300	-
Solubility in Trichloroethylene, %	T44	97.5	-	97.5	-
Ductility @ 77°F., 5 cm/min, cms (25°C., 50 mm/min, mm)	T51	100	-	-	-
Float Test at 140°F (60°C), sec.	Tex 509-C	1200	-	1200	-

Table 8: Cationic Emulsion Requirements

	Type	Rapid Setting				Medium Setting				Slow Setting			
		CRS-2		CRS-2h		CMS-2		CMS-2s		CSS-1		CSS-1h	
Property	Test Method	Min	Max	Min	Max	Min.	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T72												
@ 77°F (25°C), sec.		-	-	-	-	-	-	-	-	20	100	20	100
@ 122°F (50°C), sec.		150	400	150	400	100	300	100	300	-	-	-	-
Storage stability test, 1 day %	T59	-	1	-	1	-	1	-	1	-	1	-	1
% Demulsibility: *, **	T59	40	-	40	-	-	-	-	-	-	-	-	-
Coating, ability & water resistance	T59												
Coating, dry aggregate		-	-	-	-	good	good	-	-	-	-	-	-
Coating, after spraying		-	-	-	-	fair	fair	-	-	-	-	-	-
Coating, wet aggregate		-	-	-	-	fair	fair	-	-	-	-	-	-
Coating, after spraying		-	-	-	-	fair	fair	-	-	-	-	-	-
Particle charge test	T59	Positive		Positive		Positive		Positive		Positive		Positive	
Sieve test, %	T59	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10
Cement Mixing test, %	T59	-	-	-	-	-	-	-	-	-	2.0	-	2.0
Distillation Test:	T59												
% Oil distillate, vol. of emulsion		-	1/2	-	1/2	-	7	-	5	-	1/2	-	1/2
Residue by Distillation, % by wt.		65	-	65	-	65	-	65	-	60	-	60	-

Tests on Residue from Distillation:													
Penetration, 77°F	T49	120	160	80	110	120	200	300	-	120	160	80	110
(25°C), 100g, 5s.													
Ductility, 77°F, 5 cm/min, cm	T51	100	-	80	-	100	-	-	-	100	-	80	-
(25°C, 50 mm/min, mm)		1000	-	800	-	1000	-	-	-	1000	-	800	-
% Solubility in trichloroethylene	T44	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-

* At a level of 35 ml 0.8% sodium dioctyl sulfosuccinate.

** The demulsibility test shall be made within 30 days from date of shipment.

F. Polymer Modified Emulsions

The material shall be homogenous. It shall show no separation of asphalt after thorough mixing and shall meet the requirements for the specified type and grade presented in Tables 9 and 10.

G. Specialty Emulsions

Specialty emulsions may be either asphaltic-based or resin-based and must meet the requirements included in Table 11.

H. Recycling Agent

Recycling agent and emulsified recycling agent must meet the requirements of Table 12. Additionally, recycling agent and residue from emulsified recycling agent, when added in the specified proportions to the recycled asphalt, must meet the properties specified on the drawings.

Table 9: Polymer Modified Emulsified Asphalt Requirements

Type-Grade	Test Method	Rapid Setting				Medium Setting						Slow Setting	
		RS-1P		HFRS-2P		AES-150P		AES-300P		AES-300S		SS-1P	
Property	Test Method	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72												
77°F, sec.		-	-	-	-	75	400	75	400	75	400	30	100
122°F, sec.		50	200	150	400	-	-	-	-	-	-	-	-
Sieve Test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Miscibility	T 59	-	-	-	-	-	-	-	-	-	-	pass	
Coating Ability and Water Resistance:	T 59												
dry aggregate/after spray		-	-	-	-	good/fair		good/fair		good/fair		-	
wet aggregate/after spray		-	-	-	-	fair/fair		fair/fair		fair/fair		-	
Demulsibility, 35 ml of 0.02 N CaCl ₂ , %	T 59	60	-	50	-	-	-	-	-	-	-	-	-

Storage Stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1	-	1
Breaking Index, g	Tex-542-C	-	80	-	-	-	-	-	-	-	-	-	-
Distillation Test: ¹	T 59												
Residue by Distillation, % by wt.		65	-	65	-	65	-	65	-	65	-	60	-
Oil Distillate, % by vol of emulsion		-	3	-	0.5	-	3	-	5	-	7	-	0.5
Tests: Residue from Distillation:													
Polymer Content, wt. % (solids basis)	Tex-533-C	-	-	3.0	-	-	-	-	-	-	-	3.0	-
Penetration, 77°F, (25°C) 100 g, 5 sec.	T 49	225	300	90	140	150	300	300	-	300	-	100	140
Solubility in Trichloroethylene, %	T 44	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-
Viscosity, 140°F, poise 60°C, Pa-s	T 202	-	-	1500	-	-	-	-	-	-	-	1300	-
Float Test, 140°F, sec.	T 50	-	-	1200	-	1200	-	1200	-	1200	-	-	-
Ductility ² ,													
39.2°F, 5 cm/min., cm	T 51	-	-	50	-	-	-	-	-	-	-	50	-
(4°C, 5 cm/min., mm)		-	-	500	-	-	-	-	-	-	-	500	-
Elastic Recovery ² , 50°F,(10°C), %	Tex-539-C	55	-	55	-	-	-	-	-	-	-	-	-
Tests on RTFO Curing of Distillation Residue:	Tex-541-C												
Elastic Recovery, 50°F,(10°C) %	Tex-539-C	-	-	-	-	50	-	50	-	30	-	-	-

¹ Exception to AASHTO T 59: Bring the temperature on the lower thermometer slowly to 350°F +/- 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 +/- 5 min. from the first application of heat.

² HFRS-2P must meet one of either the Ductility or Elastic Recovery.

Table 10: Polymer Modified Cationic Emulsified Asphalt Requirements

Type-Grade		Rapid Setting	Slow Setting
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Property	Test Method	CRS-1P		CRS-2P		CSS-1P	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72	-	-	-	-	20	100
77°F (25°C), sec.		50	150	150	400	-	-
122°F (50°C), sec.		-	0.1	-	0.1	-	0.1
Sieve Test, %	T 59	60	-	70	-	-	-
Demulsibility, 35 ml of 0.8% sodium dioctyl sulfosuccinate, %	T 59	-	1				
Storage Stability, 1 day, %	T 59	-	1	-	1	-	1
Breaking Index, g	Tex-542-C		80	-	-	-	-
Particle Charge	T 59	positive		positive		positive	
Distillation Test: ¹	T 59	65	-	65	-	62	-
Residue by Distillation, % by wt.							
Oil Distillate, % by volume of emulsion		-	3	-	0.5	-	0.5
Tests on Residue from Distillation:							
Polymer Content, wt. % (solids basis)	Tex-533-C	-	-	3.0	-	3.0	-
Penetration, 77°F (25°C), 100 g, 5 sec.	T 49	225	300	90	150	55	90
Viscosity, 140°F, poise (60°C, Pa-s)	T 202	-	-	1300	-	-	-
Solubility in Trichloroethylene, %	T 44	97.0	-	97.0	-	97.0	-
Softening Point, °F	T 53	-	-	-	-	135	-
Ductility, 77°F, 5 cm/min., cm (25°C, 5 cm/min., mm)	T 51	-	-	-	-	70 700	-
Ductility ² , 39.2°F, 5 cm/min., cm (4°C, 5 cm/min., mm)	T 51	-	-	50	-	-	-
Elastic Recovery ² , 50°F (10°C), %	Tex-539-C	45	-	55	-	-	-

¹ Exception to AASHTO T 59: Bring the temperature on the lower thermometer slowly to 350°F +/- 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 +/- 5 min. from the first application of heat.

² CRS-2P must meet one of either the Ductility or Elastic Recovery.

Table 11: Specialty Emulsion Requirements

Type-Grade	Test Method	Medium Setting				Slow Setting		
		AE-P		EAP&T		PCE ¹		
Property	Test Method	Min	Max	Min	Max	Min	Max	
Viscosity, Saybolt Furol	T 72							
77°F (25°C), sec.		-	-	-	-	10	100	
122°F (50°C), sec.		15	150	-	-	-	-	
Sieve Test, %	T 59	-	0.1	-	0.1	-	0.1	
Miscibility ²	T 59	-			pass		pass	
Demulsibility, 35 ml of 0.10 N CaCl ₂ , %	T 59	-	70	-	-	-	-	
Storage Stability, 1 day, %	T 59	-	1	-	1	-	-	
Particle Size ³ , % by volume ≤ 2.5 m	Tex-238-F	-	-	90	-	-	-	

Asphalt Emulsion Distillation to 500°F (260°C) followed by Cutback Asphalt Distillation of Residue to 680°F (360°C):	T 59 & T 78						
Residue after both Distillations, % by wt.		40	-	-	-	-	-
Total Oil Distillate from both distillations, % by volume of emulsion		25	40	-	-	-	-
Distillation:	T 59						
Residue by Distillation, % by wt.		-	-	60	-	-	-
Evaporation:4	T 59						
Residue by Evaporation, % by wt.		-	-	-	-	60	-
Tests on Residue after all Distillation(s):							
Viscosity, 140°F, poise (60°C, Pa-s)	T 202	-	-	800	-	-	-
Kinematic Viscosity, 140°F, cSt (60°C, mm ² /s)	T 201	-	-	-	-	100	350
Flash Point, C.O.C., °F (°C)	T 48	-	-	-	-	400 204	-
Solubility in Trichloroethylene, %	T 44	97.5	-	-	-	-	-
Float Test, 122°F (50°C), sec	T 50	50	200	-	-	-	-

¹ Supply with each shipment of PCE:

- a) a copy of a lab report from an approved analytical lab, signed by a lab official, indicating the PCE formulation does not meet any characteristics of a Resource Conservation Recovery Act (RCRA) hazardous waste;
- b) a certification from the producer that the formulation supplied does not differ from the one tested and that no listed RCRA hazardous wastes or PCB's have been mixed with the product; and
- c) a Materials Safety Data Sheet.

² Exception to AASHTO T 59: In dilution, use 350 ml of distilled or deionized water and a 1000-ml beaker.

³ Tex-238-F, beginning at "Particle Size Analysis by Laser Diffraction," "Procedure" (using - medium: distilled or deionized water and dispersant: none), or other approved method.

⁴ Exception to AASHTO T 59: Leave sample in the oven until foaming ceases, then cool and weigh.

Table 12: Recycling Agent and Emulsified Recycling Agent Requirements

Property	Test Method	Recycling Agent		Emulsified Recycling Agent	
		Min	Max	Min	Max
Viscosity, Saybolt Furol, 77°F, sec.	T 72	-	-	15	100
Sieve Test, %	T 59	-	-	-	0.1
Miscibility ¹	T 59	-		No Coagulation	
Evaporation Test: ²	T 59				
Residue by Evaporation, % by wt.		-	-	60	-
Tests on Recycling Agent or Residue from Evaporation:					

Flash Point, C.O.C., °F	T 48	400	-	400	-
Kinematic Viscosity,	T 201				
140°F, cSt		75	200	75	200
275°F, cSt		-	10.0	-	10.0

¹ Exception to AASHTO T 59: Use 0.02 N CaCl₂ solution in place of water.

² Exception to AASHTO T 59: Maintain sample at 300°F until foaming ceases, then cool and weigh.

I. Crack Sealer

This section sets forth the requirements for a polymer modified emulsion suitable for sealing fine cracks, and a rubber asphalt compound suitable for sealing cracks of 1/8 inch (3 mm) or greater width.

1. Polymer Modified Asphalt Emulsion Crack Sealer

For cracks on the order of 1/8 inch (3 mm) width, HFRS-2P polymer modified emulsion as described in the table included in Section F, Polymer Modified Emulsions of this item may be used. Requirements for the polymer modified emulsion and rubber-asphalt crack-sealing compound are presented in Table 13.

Table 13: Polymer Modified Asphalt Emulsion Crack Sealer Requirements

Property	Test Methods	Min	Max
Rotational Viscosity, 77°F, cP	ASTM D 2196, Method A	10,000	25,000
Sieve Test, %	T 59	-	0.1
Storage Stability, 1 day, %	T 59	-	1
Evaporation	Tex-543-C		
Residue by Evaporation, % by wt.		65	-
Tests on Residue from Evaporation:			
Penetration, 77°F, 100 g, 5 sec.	T 49	35	75
Softening Point, °F	T 53	140	-
Ductility, 39.2°F, 5 cm/min., cm	T 51	100	-

2. Rubber-Asphalt Crack Sealing Compound

This specification item may be a proprietary product. The compound shall be capable of being melted and applied at a temperature of 400°F (200°C) or less by a suitable oil jacketed kettle equipped with a pressure pump, a hose and a nozzle. It shall contain no water or highly-volatile matter. It shall not be tracked by vehicular traffic once it cools to road pavement temperature.

The rubber-asphalt crack sealing compound shall meet requirements in Table 14.

Table 14: Rubber-Asphalt Crack Sealer Requirements

Property	Test Methods	Class A		Class B	
		Min	Max	Min	Max
CRM Content, Grade A or B, % by wt.	Tex-544-C	22	26	-	-
CRM Content, Grade B, % by wt.	Tex-544-C	-	-	13	17
Virgin Rubber Content ¹ , % by wt.		-	-	2	-
Flash Point ² , COC, °F	T 48	400	-	400	-
Penetration ³ , 77°F, 150g, 5 sec.	T 49	30	50	30	50
Penetration ³ , 32°F, 200g, 60 sec.	T 49	12	-	12	-

Softening Point, °F	T 53	-	-	170	-
Bond ⁴ , 3 cycles, 20°F	Tex-525-C	-	Pass		

- ¹ Provide certification that the min. % virgin-rubber was added.
- ² Before passing the test flame over the cup, agitate the sealing compound with a $\frac{3}{8}$ to $\frac{1}{2}$ in. (9.5 to 12.7 mm) wide, square-end metal spatula in a manner so as to bring the material on the bottom of the cup to the surface, i.e., turn the material over. Start at one side of the thermometer, move around to the other, and then return to the starting point using 8 to 10 rapid circular strokes. Accomplish agitation in 3 to 4 sec. Pass the test flame over the cup immediately after stirring is completed.
- ³ Exception to AASHTO T 49: Substitute the cone specified in ASTM D 217 for the penetration needle.
- ⁴ No crack in the crack sealing materials or break in the bond between the sealer and the mortar blocks over $\frac{1}{4}$ in. deep for any specimen after completion of the test.
 - a. Properties of Rubber Used in Sealer. The rubber shall be one of the following types;
 - 1) Type I - Ground tire rubber.
 - 2) Type II - A mixture of ground tire rubber and high natural reclaimed scrap rubber. The natural rubber content, determined by ASTM D 297, shall be a minimum of 25 percent.
 - b. Ground Rubber. The ground rubber shall comply with the following gradation requirements when tested by TxDOT Test Method Tex-200-F, Part I.

Table 15: Ground Rubber Gradation Requirements

Sieve Size		Percent Retained	
U.S.	SI	Type I	Type II
No. 8	2.36 mm	0	-
No. 10	2.00 mm	0-5	0
No. 30	600mm	90-100	50-70
No. 50	300mm	95-100	70-95
No. 100	150mm	-	95-100

The ground rubber shall be free from fabric, wire, cord or other contaminating materials.

- c. Packaging. The rubber-asphalt crack sealing compound shall be packaged in boxes, which contain two 30-35 pound (14-16 kilogram) blocks that are individually packaged in a liner made of polyethylene, or other packaging approved by the Engineer or designated representative.

J. Performance Graded Binders

Performance graded binders must be smooth, homogeneous, show no separation when tested in accordance with Test Method Tex-540-C, and must meet the requirements in the following table.

Separation testing is not required if:

- a modifier is introduced separately at the mix plant either by injection in the asphalt line or mixer, or
- the binder is blended on site in continuously agitated tanks, or
- binder acceptance is based on field samples taken from an in-line sampling port at the hot mix plant after the addition of modifiers.

Table 16: Performance Graded Binder Requirements (Printer-friendly version in PDF)

Performance Grade	PG 58			PG 64				PG 70				PG 76				PG 82		
	- 22	- 28	- 34	- 16	- 22	- 28	- 34	- 16	- 22	- 28	- 34	- 16	- 22	- 28	- 34	- 16	- 22	- 28
Average 7-day Max Pavement Design Temperature, °C ¹	58			64				70				76				82		
Min Pavement Design Temperature, °C ¹	≥- 22	≥- 28	≥- 34	≥- 16	≥- 22	≥- 28	≥- 34	≥- 16	≥- 22	≥- 28	≥- 34	≥- 16	≥- 22	≥- 28	≥- 34	≥- 16	≥- 22	≥- 28
ORIGINAL BINDER																		
Flash Point, AASHTO T 48: Min,	230°C																	
Viscosity, AASHTO TP 48: ^{2,3} Max, 3.0 Pas, Test Temperature,	135°C																	
Dynamic Shear, AASHTO TP 5: ⁴ G*/sin (δ), Min, 1.00 kPa Test Temperature @ 10 rad/sec.,	58°C			64°C				70°C				76°C				82°C		
Elastic Recovery, ASTM D 6084, 50°F, % Min	-	-	30	-	-	30	50	-	30	50	60	30	50	60	70	50	60	70
ROLLING THIN FILM OVEN (Tex-541-C)																		
Mass Loss, Max, %	1.0																	
Dynamic Shear, AASHTO TP 5: G*/sin (δ) in, 2.20 kPa Test Temperature @10 rad/sec.,	58°C			64°C				70°C				76°C				82°C		
PRESSURE AGING VESSEL (PAV) RESIDUE (AASHTO PP 1)																		
PAV Aging Temperature	100°C																	
Dynamic Shear, AASHTO TP 5: G*/sin (δ) Max, 5000 kPa Test Temperature 10 rad/sec., °C	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22
Creep Stiffness, AASHTO TP 1: ^{5,6} S, Max, 300 mPa, M - value, Min, 0.300 Test Temperature @ 60 sec., °C	- 12	- 18	- 24	-6	- 12	- 18	- 24	-6	- 12	- 18	- 24	-6	- 12	- 18	- 24	-6	- 12	- 18
Direct Tension, AASHTO TP 3: ⁶ Failure Strain, Min,	- 12	- 18	- 24	-6	- 12	- 18	- 24	-6	- 12	- 18	- 24	-6	- 12	- 18	- 24	-6	- 12	- 18

1.0% Test Temperature @1.0 mm/min., °C																			
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- ¹ Pavement temperatures are estimated from air temperatures using an algorithm contained in the PGEXCEL3.xls software program, may be provided by the Department or by following the procedures as outlined in AASHTO MP 2 and PP 28.
- ² This requirement may be waived at the Department's discretion if the supplier warrants that the asphalt binder can be adequately pumped, mixed and compacted at temperatures that meet all applicable safety, environmental, and constructability requirements. At test temperatures where the binder is a Newtonian fluid, any suitable standard means of viscosity measurement may be used, including capillary (AASHTO T 201 or T 202) or rotational viscometry (AASHTO TP 48).
- ³ Viscosity at 135°C is an indicator of mixing and compaction temperatures that can be expected in the lab and field. High values may indicate high mixing and compaction temperatures. Additionally, significant variation can occur from batch to batch. Contractors should be aware that variation could significantly impact their mixing and compaction operations. Contractors are therefore responsible for addressing any constructability issues that may arise.
- ⁴ For quality control of unmodified asphalt binder production, measurement of the viscosity of the original asphalt binder may be substituted for dynamic shear measurements of $G^*/\sin(\delta)$ at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary (AASHTO T 201 or T 202) or rotational viscometry (AASHTO TP 48).
- ⁵ Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.
- ⁶ If creep stiffness is below 300 mPa, direct tension test is not required. If creep stiffness is between 300 and 600 mPa, the direct tension failure strain requirement can be used instead of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.

301S.4 Equipment.

All equipment necessary to transport, store, sample, heat, apply, and incorporate asphalts, oils and emulsions shall be provided.

301S.5 Construction

Typical materials used for specific applications are identified in Table 17. These are typical uses only and circumstances may require use of other material.

Table 17: Typical Material Use

Material Application	Typically Used Materials
Hot-Mixed, Hot-Laid Asphalt Mixtures	PG Binders, Modified PG Binders
Surface Treatment	AC-5, AC-10, AC-5 w/2% SBR, AC-10 w/2% SBR, AC-15P, AC-15-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, Surface Treatment
(Cool Weather)	RS-1P, CRS-1P, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, MC-2400L
Precoating	AC-5, AC-10, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack Coat	RC-250, SS-1, SS-1H, CSS-1, CSS-1H, EAP&T
Fog Seal	SS-1, SS-1H, CSS-1, CSS-1H

Hot-Mixed, Cold-Laid Asphalt Mixtures	AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, CMS-2S
Patching Mix	MC-800, SCM I, SCM II, AES-300S
Recycling	AC-3, AES-150P, AES-300P, Recycling Agent, Emulsified Recycling Agent
Crack Sealing	SS-1P, Polymer Mod AE Crack Sealant, Rubber Asphalt Crack Sealers (Class A, Class B)
Prime	MC-30, AE-P, EAP&T, PCE
Curing Membrane	SS-1, SS-1H, CSS-1, CSS-1H, PCE
Erosion Control	SS-1, SS-1H, CSS-1, CSS-1H, PCE

301S.6 Storage, Heating and Application Temperatures

Asphaltic materials should be applied at the temperature, which provides proper and uniform distribution. Within practical limits higher temperatures than necessary to produce the desired results shall be avoided. Satisfactory application usually should be obtained within the recommended ranges shown below.

No material shall be heated above the following maximum temperatures:

Table:18 Recommended Temperature Ranges

Type-Grade	Recommended Range; °F (°C)	Maximum Temperature; °F (°C) for	
	Application/Mixing	Allowable Application	Storage
AC-5, 10,20,30	275—350 (135—177)	375 (191)	400 (204)
AC-5 or AC-10 + 2% SBR	300—375 (142—191)	390* (199)	375 (191)
AC-10 + 3% SBR, AC-45P	300—350 (142—191)	350 (177)	360 (182)
RC-250	125—180 (52—82)	200 (93)	200 (93)
RC-800	170—230 (77—110)	260 (127)	260 (127)
RC-3000	215—275 (102—135)	285 (141)	285 (141)
MC-30, AEP	70—150 (21—66)	175 (79)	175 (79)
MC-70	125—175 (52—79)	200 (93)	200 (93)
MC-250	125—210 (52—99)	240 (116)	240 (116)
MC-800, SCM I, SCM II	175—260 (79—127)	275 (135)	275 (135)
MC-3000 & MC-2400 Latex	225—275 (107—135)	290 (143)	290 (143)
HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CMS-2, CMS-2S, AES-300, AES-300S, AES-150P, AES-300P	120—160	180	180
SS-1, SS-1h, SS-1P, CSS-1, CSS-1h, PCE, EAP & T, SS-1P, RS-1P, CRS-1P, CSS-1P, recycling agent, emulsified recycling agent, polymer modified AE crack sealant.	50—130 (10—54)	140 (60)	140 (60)
RS-2, RS-2h, MS-2, CRS-2, CRS-2h, CRS-2p, CMS-2,	110—160 (43—71)	170 (77)	170 (77)

CMS-2S, HFRS-2, HFRS-2p, AES-300			
Special Precoat Material	125—250 (52—121)	275 (135)	275 (135)
PG Binders, Modified PG Binders	275—350	350	350
Rubber Asphalt Crack Sealers (Class A, Class B)	350—375	400	-
Rubber-Asphalt Crack Sealer	350—375 (177—191)	400 (204)	-

* AC-5 + 2% SBR and AC-10 + 2% SBR, which is designated for surface treatment work, may be heated to a maximum temperature of 390°F (200°C) by the supplier loading through an in-line heater, or with the permission of the Engineer or designated representative, these materials may be heated to maximum of 390°F (200°C) by the Contractor just prior to application. When any of the SBR-modified asphalt cements are used in asphaltic concrete, the storage temperature at the mix plant should not exceed 350°F (177°C).

Attention is called to the fact that asphaltic materials (except emulsions) are very flammable and constitute fire hazards. Proper precautions should be used in all cases, especially with RC cutbacks.

Utmost care shall be taken to prevent open flames from coming in contact with the asphaltic material or the gases of it. The Contractor shall be responsible for any fires or accidents, which may result from heating the asphaltic materials.

301S.7 Measurement and Payment

All asphaltic materials included in this specification will not be paid for directly but shall be included in the unit price bid for the item of construction in which this item is used.

End

SPECIFIC CROSS REFERENCE MATERIALS	
Specification Item 301S "Asphalts, Oils and Emulsions"	
American Association of State Highway and Transportation Officials (AASHTO)	
Designation	Description
AASHTO T-44	Solubility of Bituminous Materials in Organic Solvents
AASHTO T-48	Flash and Fire Points by Cleveland Open Cup
AASHTO T-49	Penetration of Bituminous Materials
AASHTO T-50	Float Test for Bituminous Materials
AASHTO T-51	Ductility of Bituminous Materials
AASHTO T-53	Distillation of Road Tar
AASHTO T-55	Water in Petroleum Products and Bituminous Materials by Distillation
AASHTO T-59	Testing Emulsified Asphalt
AASHTO T-72	Saybolt Viscosity
AASHTO T-78	Distillation of Cut-Back Asphaltic (Bituminous) Products
AASHTO T-79	Flash Point with Tag Open-Cup Apparatus
AASHTO T-201	Kinematic Viscosity of Asphalts
AASHTO T-202	Viscosity of Asphalts by Vacuum Capillary Viscometer
AASHTO TP-1	Creep Stiffness
AASHTO TP-3	Direct Tension
AASHTO TP-5	Dynamic Shear
AASHTO TP-48	Rotational Viscometry

<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregates
Tex-238-F	Laser Diffraction Particle Size Distribution Analyzer
Tex-509-C	Spot Test of Asphaltic Materials
Tex-525-C	Tests for Asphalt and Concrete Joint Sealers
Tex-533-C	Determination of Polymer Additive Percentages in Polymer Modified Asphalt Cements
Tex-539-C	
Tex-540-C	
Tex-541-C	
Tex-542-C	
Tex-543-C	
Tex-544-C	
<u>American Society for Testing and Materials (ASTM)</u>	
<u>Designation</u>	<u>Description</u>
D 217	Test Methods for Cone Penetration of Lubricating Grease
D 297	Test Methods for Rubber Products-Chemical Analysis
D 2186 Method A	Test Methods for Deposit-Forming Impurities in Steam
D 6084	Test Method for Elastic Recovery of Bituminous Materials by Ductilometer

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 301S "Asphalts, Oils and Emulsions"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 206S	Asphalt Stabilized Base
Item No. 210S	Flexible Base
Item No. 302S	Aggregates for Surface Treatments
Item No. 306S	Prime Coat
Item No. 307S	Tack Coat
Item No. 310S	Emulsified Asphalt Treatment
Item No. 311S	Emulsified Asphalt Repaving
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
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. 351S	Recycling Agent
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>

1000S-10	Local Street Sections
1000S-11(1)	Residential and Neighborhood collector Street Sections
1000S-11(2)	Industrial and Collector Street Sections
1000S-12(1)	Primary Collector Street Sections
1000S-12(2)	Primary Arterial Street Sections
1000S-13(1)	Minor Arterial Street Sections (4 Lanes)
1000S-13(2)	Minor Arterial Street Sections (4 Lanes divided)
1000S-14	Major Arterial Street

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

<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 316	Surface Treatments
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 354	Planing and/or Texturing Pavement
Item 520	Weighing and Measuring Equipment

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-126-E	Molding, Testing and Evaluation of Bituminous Black Base Materials
Tex-207-F	Determination of Density of Compacted Bituminous Mixtures
Tex-211-F	Recovery of Asphalt from Bituminous Mixtures by Absorption
Tex-215-	Determination of Asphalt Content of Rock Asphalt Process by Hot Solvent Method
Tex-217-F	Determination of Deleterious Material and Decantation Test for Coarse Aggregates
Tex-224-F	Determination of Flakiness
Tex-400-A	Method of Sampling Stone, Gravel, Sand and Mineral Aggregates
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
Tex-411-A	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
Tex-438-A	Accelerated Polish Test for Aggregate
Tex-460-A	Determination of Crushed Face Particle
Tex-501-C	Test for Water in Petroleum Products and Other Bituminous Materials
Tex-502-C	Test for Penetration of Bituminous Material
Tex-503-C	Test for Ductility of Bituminous Materials
Tex-504-C	Test for Flash and Fire Points of Petroleum Materials by Cleveland Open Cup

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-505-C	Test for Softening Point of Bituminous Materials by Ring-and-Ball Method
Tex-506-C	Test for Loss on Heating of Oils and Asphaltic Compounds
Tex-507-C	Proportion of Bitumen Soluble in Trichloroethylene
Tex-510-C	Determining the Effect of Heat and Air on Asphaltic Materials when Exposed in Thin Films
Tex-512-C	Test for Flash Points of Volatile Flammable Materials by Tag Open-Cup Apparatus
Tex-513-C	Test for Saybolt Viscosity

Tex-515-C	Distillation of Cut-Back Asphalt Products
Tex-519-C	Float Test for Bituminous Materials
Tex-520-C	Test for Residue of Specified Penetration
Tex-521-C	Testing Emulsified Asphalts
Tex-528-C	Test for Absolute Viscosity of Asphalt Cements
Tex-529-C	Test for Kinematic Viscosity of Asphalts

ITEM NO. 340S HOT MIX ASPHALTIC CONCRETE PAVEMENT 9-26-12

340S.1 Description

This item shall govern base, level up, and pavement surface courses composed of a compacted mixture of aggregate and asphaltic cement mixed hot in a mixing plant. The hot mix asphaltic (HMA) concrete pavement shall be constructed on a previously completed and approved subgrade, subbase material, base material, concrete slab or existing pavement.

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.

340S.2 Submittals

The submittal requirements of this specification item may include:

- A. A mix design submittal including the plant corrected Job Mix Formula (JMF) for the hot mix asphaltic concrete.
- B. Certification that the aggregate materials meet appropriate quality requirements.
- C. Particle-size gradation and specific gravity tests on all aggregate materials.
- D. Certification that the asphalt cement for paving materials meet appropriate quality requirements.

340S.3 Materials

The Contractor shall furnish materials to meet the requirements specified herein and shall be solely responsible for the quality and consistency of the product delivered to the Project.

- A. Aggregate: The aggregate shall be composed of coarse aggregate, a fine aggregate and, if required or allowed, mineral filler and reclaimed asphalt pavement (RAP). RAP use will be allowed in all base course mixtures except as specifically excluded herein, in the Contract Documents or on the Drawings, provided no more than 20% RAP is used.

RAP use will not be permitted in pavement surface courses.

Aggregates shall meet the quality requirements of Table 1 and other requirements as specified herein. The aggregate contained in RAP will not be required to meet Table 1 requirements unless indicated otherwise on the Drawings.

1. Coarse Aggregate: Coarse aggregate is defined as that part of the aggregate retained on the No. 10 (2.00 mm) sieve and shall consist of clean, tough, durable fragments of crushed stone or crushed gravel of uniform quality throughout.

Gravel from each source shall be crushed to the extent that it has a minimum of 85% of the particles retained on the No. 4 (4.75 mm) sieve with two or more mechanically induced crushed faces as determined by TxDOT Test Method TEX-460-A (Part I). The material passing the No. 4 (4.75 mm) sieve and retained on the No. 10 (2.00 mm) sieve must be the produced from crushing aggregate that was originally retained on the No. 4 (4.75 mm) sieve.

2. Reclaimed Asphalt Pavement (RAP): RAP is defined as a salvaged, milled, pulverized, broken or crushed asphaltic pavement. The RAP to be used in the mix shall be crushed or broken to the extent that 100 percent will pass the 2-inch (50 mm) sieve.

The RAP shall be stockpiled in such a manner that assures that it will not become contaminated by dirt or other objectionable materials. Unless indicated otherwise on the Drawings, stockpiled, crushed RAP must not exhibit a decantation more than 5 percent or a plasticity index more than 8, when tested in accordance with TxDOT Test Method Tex-406-A, Part I, or Test Method Tex-106-E, respectively.

3. Fine Aggregate: Fine aggregate is defined as that part of the aggregate passing the No. 10 (2.00 mm) sieve and shall be of uniform quality throughout. A maximum of 15 percent of the total aggregate may be field sand or other uncrushed fine aggregate.

Screenings shall be supplied from sources whose coarse aggregate meets the abrasion and magnesium sulfate soundness loss requirements shown in Table 1.

- a. Unless indicated otherwise on the Drawings, stone screenings, which are the product of a rock crushing operation, are required and shall meet the following gradation requirements when tested in accordance with TxDOT Test Method Tex-200-F, Part I.

Material	Percent by Weight (Mass)
Passing 3/8inch (9.50 mm) sieve	100
Passing No. 10 (2.00 mm) sieve	70—100
Passing No. 200 (75 µm) sieve	0—15

- b. Crushed gravel screenings may be used with, or in lieu of, stone screenings only when indicated on the Drawings. Crushed gravel screenings must be the product of crushing aggregate that was originally retained on the No. 4 (4.75 mm) sieve and must meet the gradation for stone screenings shown above.

4. Mineral Filler: Mineral filler shall consist of thoroughly dried stone dust, Portland cement, fly ash, lime or other mineral dust approved by the Engineer or designated representative. The mineral filler shall be free from foreign matter.

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

Fly ash obtained from a source using a process fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Natural Resource Conservation Commission (TNRCC) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TNRCC and EPA authorizations to operate the facility.

The addition of baghouse fines or other collected fines will be permitted if the mixture quality is not adversely affected in the opinion of the Engineer or designated representative. In no case shall the amount of material passing the No. 200 (75 µm) sieve exceed the tolerances of the job-mix formula or the master gradation limits.

When tested by TEX-200-F (Part I or Part III, as applicable), the mineral filler shall meet the following gradation requirements. Baghouse fines are not required to meet the gradation requirements.

Material	Percent by Weight (mass)
Passing No. 30 (600 µm) Sieve	95—100
Passing No. 80 (187.5 µm) Sieve, not less than	75
Passing No. 200 (75 µm) Sieve, not less than	55

TABLE 1: AGGREGATE QUALITY REQUIREMENTS *

Requirement	Test Method	Amount
COARSE AGGREGATE		
Deleterious Material, percent, maximum	Tex-217-F, I	1.5
Decantation, percent, maximum	Tex-217-F, II	1.5
Los Angeles Abrasion, percent, maximum	Tex-410-A	40
Magnesium Sulfate Soundness Loss 5 cycle, percent, maximum	Tex-410-A	30
FINE AGGREGATE		
Linear Shrinkage, maximum	Tex-107-E, II	3
COMBINED AGGREGATES		
Sand Equivalent Value, minimum	Tex-203-F	45

* - Aggregates, without added mineral filler or additives, combined as used in the job-mix formula (Plant Corrected).

B. Asphaltic Material:

1. Paving Mixture: Asphalt cement for the paving mixture shall conform to the requirements of Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions", for AC-20 or PG64-22, Styrene (SBS) Modified Asphalt Cement, AC-SBS Blend AC-45P or PG76-22S, unless otherwise indicated in the Project Documents.
2. Tack Coat: Tack Coat shall conform to Standard Specification Item No. 307S, "Tack Coat".

C. Additives: Additives to facilitate mixing and/or improve the quality of the asphaltic mixture or tack coat may be used with the authorization of the Engineer or designated representative. The Contractor may choose to use either lime or a liquid anti-stripping agent to reduce moisture susceptibility of the aggregate.

340S.4 Paving Mixtures

An asphalt mixture design is developed by a laboratory process, which includes the determination of the quality and quantity of the asphalt cement and the individual aggregates, and the testing of the combined mixture (Laboratory Design). The Laboratory Design is subsequently revised to produce an appropriate job mix formula.

The job mix formula (JMF) lists the quantity of each component to be used in the mix after the laboratory design has been adjusted by running it through a particular plant (i.e. the mix design is Plant Corrected). The JMF will be the standard to which the Acceptance Plan will be applied. The JMF of one drum or batching unit shall not be used for another unit.

The Contractor shall submit to the Engineer on forms provided by the Engineer or designated representative, an asphalt mixture design reviewed, signed and sealed by a Registered Professional Engineer licensed in the State of Texas or certified by a TxDOT Level II Certified Asphalt Technician. An asphalt mixture design shall be submitted for a comprehensive review every two (2) years. Mix designs older than one year will not be accepted without a review of current test data of the proposed materials and current mix design to ensure that the materials meet specification requirements.

The JMF (Plant Corrected) shall be submitted to the Engineer or designated representative on a form provided by the Engineer through the Construction Inspector or Project Manager of the Project for review, for each individual Project, a minimum of three (3) working days before the mixture is to be placed. Under no circumstances will a mixture be placed before its use is reviewed and approved by the Engineer or designated representative.

Performance of the mix design shall remain the responsibility of the Contractor.

- A. Mixture Design: The mix shall be designed in accordance with TxDOT Construction Bulletin C-14 and Test Method Tex-204-F to conform with the requirements herein. The master grading limits of the appropriate type and the JMF will be plotted on a graduated chart with sieve sizes raised to the 0.45 power and will be submitted to the Engineer or designated representative with the asphalt mixture design.

The Bulk Specific Gravity of aggregates in RAP will be determined on extracted aggregates.

- B. Types: The blend of coarse aggregate, fine aggregate, and mineral filler, if allowed, that is established by TxDOT Test Method Tex-200-F, Dry Sieve Analysis, shall conform to the master gradation shown in Table 2 for the type of specified mixture. The voids in the mineral aggregate (VMA) will be determined as a mixture design requirement only, in accordance with TxDOT Test Method Tex-207-F, and shall not be less than the value indicated in Table 2.

TABLE 2: Master Grading - Percent Passing by Weight (Mass) or Volume

Sieve Size US (SI)	Type A Coarse Base	Type B Fine Base	Type C Coarse Surface	Type D Fine Surface	Type F Fine Mixture
1½" (37.5 mm)	100				
1¼" (31 mm)	95—100				
1" (25 mm)		100			
¾" (22 mm)	70—90	95—100	100		
⅝" (15.5 mm)		75—95	95—100		
½" (12.5 mm)	50—70			100	
⅜" (9.5 mm)		60—80	70—85	85—100	100
¼" (6.25 mm)					95—100
No. 4 (4.75 mm)	30—50	40—60	43—63	50—70	
No. 10 (2.00 mm)	20—34	27—40	30—40	32—42	32—42
No. 40 (425 µm)	5—20	10—25	10—25	11—26	9—24
No. 80 (187.5 µm)	2—12	3—13	3—13	4—14	3—13
No. 200 (75 µm)	1—6*	1—6*	1—6*	1—6*	1—6*
VMA % minimum	11	12	13	14	15
Rec. Min. Lift	3" (75 mm)	2" (50 mm)	1¾" (70 mm)	1" (50 mm)	¾" (20 mm)

- C. Tolerances: Fluctuations in the aggregate gradation and asphalt content of the Job Mix Formula (JMF) shall not vary by more than the following criteria but the aggregate gradation shall be limited to the range of the master gradation as established by TEX-210-F.

SIEVES	Percent By Weight (Mass)
2" (50 mm) Sieve through No. 10" (2.00 mm) Sieve	±5.0
No. 40 (425 µm) through No. 200 (75 µm) Sieve	±3.0
Asphalt Content	±0.5

- D. Stability and Density: The mixture shall be designed at or near optimum density, as indicated on the Drawings, to conform to the following percent of Maximum Theoretical Density as measured by TxDOT Test Method TEX-227-F and Stability conforming to TxDOT Test Method TEX-208-F. The laboratory mixture shall be molded in accordance with TxDOT Test Method TEX-206-F and the Bulk Specific Gravity determined in accordance with TxDOT Test Method TEX-207-F.

	Optimum Laboratory Density (%)	Laboratory Density (%)

			Min.	Max.
Local Streets Surface Courses	96	94.5	97.5	35 Min.
Collectors & Arterials Surface Courses	96	94.5	97.5	40—60
All Base Courses	96	94.5	97.5	35 Min.

- E. Job Mix Formula Field Adjustments: The Contractor shall produce a mixture of uniform composition closely conforming to the reviewed JMF, that falls within the limits of the tolerances given above and the Acceptance Plan.

If it is determined by the City of Austin that adjustments to the JMF are necessary to achieve the specified requirements, the Engineer or designated representative may allow adjustments of the JMF within the following limits without a laboratory redesign of the mixture. The adjusted JMF shall not exceed the master grading criteria for the type of mixture specified. The proposed JMF adjustments shall not exceed 5 percent on any one sieve, ½-inch (12.5 mm) size and larger, or 3 percent on the sieve size below the ½-inch (12.5 mm) sieve of the JMF (Plant Corrected) reviewed for the Project.

When the proposed adjustments exceed either the 5 or 3 percent limits, and the Engineer or designated representative determines that the impact of these changes may adversely affect pavement performance, a new laboratory mixture design will be required.

The asphalt content may be adjusted with the concurrence of the Engineer or designated representative to maintain desirable laboratory density near the optimum value while achieving other mix requirements. However, increasing the asphalt content of the mixture in order to reduce pavement air voids will not be allowed. Also, if the percent air voids is determined to be less than 4 percent, adjustments shall be made to the plant production by the Contractor, within the tolerances as outlined above, so that an adequate air void level is attained.

340S.5 Equipment

The trucks that deliver the hot mix asphalt concrete material to the project shall be of sufficient number to insure a continuous paving operation. All equipment used for the production, placement and compaction of the mixture shall be maintained in good repair and operating conditions to the satisfaction of the Engineer or designated representative. All equipment shall be made available for inspection. If the Engineer or designated representative expresses concern about the condition of any equipment, it shall not be used until it is repaired to the satisfaction of the Engineer or designated representative.

- A. Mixing Plants: Plants may be of the weigh-batch type, the modified weigh-batch type or drum-mix type equipped with suitable material conveyers, power units, mixing equipment, aggregate proportioning devices, dryers, bins, dust collectors and sensing and recording devices as appropriate for the mixing plant type. The mixing plants shall meet the requirements specified in Section 340.4, 'Equipment' of TxDOT Specification Item No. 340, "Hot Mix Asphaltic Concrete Pavement".
- B. Spreading and Finishing Paving Machine: The paving machine shall be self-propelled and equipped with a heated compacting screed capable of producing a finish surface meeting the requirements of the street cross-section indicated on the Drawings and all surface criteria. Extensions to the screed shall have the same heating and compacting capabilities as the primary unit, except for use on variable depth tapered areas and/or as approved by the Engineer or designated representative.

The paving machine shall be equipped with an approved automatic dual longitudinal screed control system and an automatic transverse screed control system. The longitudinal controls shall be capable of operating from any longitudinal grade reference including a string line, ski, mobile string line or matching shoe. Unless indicated otherwise on the Drawings, the Contractor may use any one of these grade references. The

selected grade reference equipment shall be maintained in good operating condition by personnel trained in the use of the specific type of equipment.

The Contractor shall furnish all labor and equipment required for establishing and maintaining appropriate grade reference.

- C. Rollers: The Contractor shall select rollers conforming to Item 230S, "Rolling (Flat Wheel)" and Item 232S, "Rolling (Pneumatic Tire)". Rollers that do not conform to these requirements shall be immediately removed from the Project.
- D. Motor Grader: A self-propelled power motor grader may only be used when its use is approved by the Engineer or designated representative. It shall have a blade of not less than 12 feet (3.66 meters) and a wheelbase of not less than 16 feet (4.88 meters). Smaller graders may be used for small irregular areas when approved by the Engineer or designated representative.
- E. Material Transfer Equipment: Equipment for transferring the HMA mixture from the hauling units or the roadbed to the spreading and finishing machine will be allowed unless indicated otherwise on the Drawings.

Windrow pick-up equipment, if permitted by the Engineer or designated representative, shall be constructed in such a manner that substantially all of the HMA mixture deposited on the roadbed is picked up and loaded into the spreading and finishing machine. The HMA mixture shall not be contaminated with foreign material. The loading equipment shall be designed so that it does not interfere with the spreading and finishing machine in obtaining the required line, grade and surface without resorting to hand finishing.
- F. Straightedges and Templates: The Contractor shall provide a ten-foot (3.05 meter) straightedge acceptable to the Engineer or designated representative for surface testing. Satisfactory templates shall be provided as required by the Engineer or designated representative.

340S.6 Stockpiling Aggregates

Aggregates shall be stockpiled to facilitate blending. When the aggregate is not stockpiled on a hard, non-contaminant base, the bottom six-inch (150 mm) depth of the stockpiles shall not be used in asphaltic mixtures. Where space is limited at the plant site, the aggregate stockpiles shall be separated by walls or other appropriate barriers.

Aggregates shall be stockpiled and handled in a manner that will insure minimization of segregation and contamination. Aggregate and RAP stockpiles shall only contain material from a single source.

340S.7 Mixture Temperature

The Contractor shall select a target temperature for discharge of the HMA mixture from the mixer between 250°F (120°C) and 350°F (176°C) that is suitable to weather and Project conditions. The target temperature shall be reported to the Engineer or designated representative daily and recorded in the Daily Progress Report. The HMA mixture temperature shall not vary by more than 25°F (14°C) from the target temperature for discharge from the mixer. HMA mixtures that are discharged from the mixer at a temperature exceeding 360°F (182°C) or a temperature more than 50°F (28°C) below the target temperature shall not be accepted and shall not be placed on the Project.

340S.8 Mixture Storage

A surge-storage system may be used to minimize production interruptions during a normal day of operation. When approved by the Engineer or designated representative, overnight storage of HMA mixture in insulated storage bins may be used provided that material temperature and physical properties of the HMA mixture are not

adversely affected. HMA mixtures that include hardened lumps shall not be used. Stored HMA mixtures shall not be exempt from any requirements provided in this specification.

When a surge-storage system is used, it shall be equipped with a device such as a gob hopper or other device approved by the Engineer or designated representative to prevent segregation in the surge-storage bin.

340S.9 Mixture Moisture Content

Hot mix asphalt (HMA) mixtures produced from any plant shall not have a moisture content in excess of 1 percent by weight (mass) when discharged from the mixer. The moisture content shall be determined in accordance with TxDOT Test Method Tex-212-F, Part II, except that the sample shall be left in the oven a total of not less than four (4) hours.

340S.10 Construction Methods

- A. General: The Contractor shall be responsible for the production, transportation, placement and compaction of the specified HMA paving mixture to the requirements of this specification. The Contractor shall also be responsible for providing a safe environment for inspection personnel to inspect the equipment and to acquire samples.

All hot mix asphalt concrete pavement surface courses shall be placed with a spreading and finishing (lay-down) machine only. All hot mix asphalt concrete pavement base layers with the possible exception of the first lift of the base layer shall also be placed with a spreading and finishing (lay-down) machine. Longitudinal pavement joints shall be located under the proposed lane lines. Density tests shall be taken prior to opening to traffic.

The first lift of a base layer may be placed with a motor grader if approved in advance by the Engineer or designated representative. The loose measure thickness of this first lift shall not exceed 6 inches (150 mm). If placed with a motor grader, the first lift shall achieve a minimum in-place relative density of 89% as determined by TxDOT test procedures TEX-207-F and TEX-227-F. All subsequent lifts should be placed with a spreading and finishing (lay-down) machine and shall be subject to the requirements of Section 340S.12, "Acceptance Plan". Density tests will be taken randomly to confirm compliance with the specification requirements.

For hot mix asphalt overlays, an automatic screed shall be used with outriggers.

Any material delivered to the Project that by visual inspection can reasonably be expected not to meet specification requirements (i.e. segregated or burned material, deficient or excess asphalt, low mixing temperature, visible contaminants, etc.), as determined by the Engineer or designated representative, shall not be used or left in place.

Equipment shall be inspected prior to use and, if found to be defective or in an operating condition that could potentially affect the quality of the finished pavement, as determined by the Engineer or designated representative, its use shall not be allowed. Leakage of fuels, oils, grease, hydraulic or brake fluids or other contaminants onto the prepared surface or newly-laid HMA layer will not be allowed and may require replacement of the affected pavement area.

The HMA paving mixture, when placed with a spreading and finishing machine, shall not be placed when the air temperature is below 50°F (10°C) and is falling, but it may be placed when the air temperature is above 40°F (4°C) and is rising.

The paving mixture, when used as a level-up course or when spread with a motor grader, shall not be placed when the air temperature is below 60°F (15°C) and is falling, but it may be placed when the air temperature is 50°F (10°C) and is rising. An HMA layer with a thickness of 1½ inches (37.5 mm) and less shall not be placed

when the temperature of the surface on which the layer is to be placed is below 50°F (10°C). The temperature shall be taken in a shaded area away from artificial heat.

Additional surface temperature requirements may be included in the Contract Documents or indicated on the Drawings.

Surfaces to be paved shall be finished, primed, cured, broomed and tacked, as appropriate, to the satisfaction of the Engineer or designated representative. If the surface on which the first course of the paving mixture is to be placed is a flexible base course, and a cut-back asphalt is to be used as a prime coat, the flexible base shall have been primed and cured a minimum of 24 hours before the paving mixture may be placed. The 24-hour restriction will not apply to a flexible base that has been primed with material other than a cutback. However, the surface on which the tack coat and/or paving mixture are to be placed shall be in a dry condition.

Pavement shall be opened to traffic as soon as possible after temporary pavement markings or permanent markings are in place as indicated on the Drawings) or as directed by the Engineer or designated representative. Construction traffic allowed on pavements open to the public will be subject to all laws governing traffic on streets and highways.

- B. Tack Coat: The surface upon which the tack is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer or designated representative. The surface shall be given a uniform application of tack coat as governed by Standard Specification Item No. 307S, "Tack Coat". The tack coat shall be applied, as directed by the Engineer or designated representative, with an approved sprayer at a rate not to exceed 0.05 gallons per square yard. (0.225 liters per square meter) of surface area. Where the paving mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated when approved by the Engineer or designated representative. All contact surfaces of curbs, castings and all structures and all joints shall be painted with a thin uniform application of tack coat.

During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutter and structures. Before the Work can be accepted, all splatter shall be removed by the Contractor at the Contractor's expense.

- C. Transporting Hot Mix Asphaltic (HMA) Concrete: The HMA mixture shall be hauled to the Work site in tight vehicles that were previously cleaned of all foreign material. Dispatching of the vehicles shall normally be arranged so that all material delivered is placed and all rolling completed during daylight hours. Nighttime paving may be allowed, when approved in advance by the Engineer or designated representative.

In cool weather or for long hauls, truck bodies containing the HMA mixture shall be covered.

If necessary, to prevent the HMA mixture from adhering to the truck body, the inside of the truck may be given a light coating of a release agent satisfactory to the Engineer or designated representative.

- D. HMA Placement: The HMA mixture shall be dumped and spread on the approved prepared surface with the spreading and finishing machine. When properly compacted, the finished pavement shall be smooth, of uniform texture and density and shall meet the requirements of the typical cross sections and the surface tests. In addition the placement of the HMA mixture shall be done without tearing, shoving, gouging or segregating the mixture and without producing streaks in the HMA layer.

Discharge of the HMA mixture into the finishing machine shall be controlled so that the spreading and finishing machine is not bounced or jarred and the required lines and grades shall be obtained without resorting to hand finishing except as permitted below in this Section.

Unless indicated otherwise on the Drawings, dumping of the HMA material in a windrow and then placing the HMA mixture in the finishing machine with windrow pick-up equipment will be permitted provided the temperature of the HMA mixture does not drop more than 50°F (28°C) below the target temperature before being placed by the finishing machine.

Under no circumstances will the HMA material be permitted to be dumped on or near the job site and then reloaded for hauling to the site of placement. Exceptions may be allowed if approved by the Engineer or designated representative.

The windrow pick-up equipment shall be operated in such a manner that substantially all the mixture deposited on the roadbed or prepared surface is picked up and loaded into the finishing machine without contamination by foreign material. The windrow pick-up equipment will also be so operated that the finishing machine will obtain the required line, grade and surface without resorting to hand finishing. Any operation of the windrow pick-up equipment resulting in accumulation and subsequent shedding of accumulated material into the HMA mixture will not be permitted.

When approved by the Engineer or designated representative, level-up courses may be spread with a motor grader that meets the requirements of this specification item.

The spreading and finishing machine shall be operated at a uniform forward speed consistent with the plant production rate, hauling capability and roller train capacity to result in a continuous operation. Stopping of the spreading and finishing machine between trucks is to be held to a minimum. If, in the opinion of the Engineer or designated representative, delivery of material is adversely affecting the condition of the HMA layer (excessive stopping of the spreading and finishing machine, loss of mixture temperature, etc.), the Engineer or designated representative may require paving operations to cease until acceptable methods are provided to minimize starting and stopping of the spreading and finishing machine.

The hopper gates of the spreading and finishing machine shall be adjusted to provide an adequate and consistent flow of material. This shall result in enough material being delivered to the augers so that they are operating approximately 85 percent of the time or more. The augers shall provide means to supply adequate flow of material to the center of the paver. Augers shall supply an adequate flow of material for the full width of the mat being placed, as approved by the Engineer or designated representative. Augers should be kept approximately one-half to three-quarters full of HMA mixture at all times during the paving operation.

When the HMA mixture is placed in a narrow strip along the edge of an existing pavement, or is used to level up small areas of an existing pavement or is placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated when permitted by the Engineer or designated representative.

The paving material adjacent to castings and flush curb and gutter and structures shall be finished uniformly high so that when compacted, it will be slightly above but not more than 1/8 inch (3 mm) above the edge of the casting or gutter lip.

Construction joints of successive courses of HMA material shall be offset at least 6 inches (150 mm). Longitudinal joints in the layer shall be placed to coincide with lane lines as directed the Engineer or designated representative. Transverse joints shall be offset a minimum of 5 feet (1.5 meters).

- E. Compaction: The pavement layers/lifts shall be compacted thoroughly and uniformly to obtain the compaction and cross section meeting the requirements indicated on the Drawings and this specification item.

Regardless of the method used for compaction, all rolling to achieve specified density shall cease before the temperature of the HMA mixture drops below 175°F (80°C).

Rolling with a pneumatic tire roller shall be used to seal the surface. Rolling with a tandem or other steel-wheel roller shall be provided if required to iron out any roller marks. Surface sealing and removal of roller marks may be accomplished at HMA temperatures below 175°F (80°C).

Vibratory rollers shall not be allowed in the vibrating mode on layers with a plan thickness less than 1½ inches (37.5 mm).

The motion of the rollers shall be slow enough to avoid other than usual initial displacement. If any displacement occurs, it shall be corrected to the satisfaction of the Engineer or designated representative.

The roller shall not be allowed to stand on pavement, which has not been compacted to minimum density requirements. In order to prevent adhesion of the surface mixture to the steel-wheel rollers, the wheels shall be thoroughly moistened with water; however an excess of water will not be allowed. Necessary precautions shall be taken to prevent the dropping of diesel, gasoline, oil, grease or other foreign matter on the pavement, either when the rollers are in operation or when standing.

The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller, or in such positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

Rolling with a trench roller will be required on widened areas, in trenches and other limited areas where satisfactory density cannot be obtained with the approved rollers.

340S.11 Sampling and Testing

The HMA mixture shall be tested daily at the Project site for conformance to specification requirements. The Engineer or designated representative shall utilize a random selection method to determine sample locations based on the Contractor's anticipated production. Each day's anticipated production shall be divided into three (3) essentially equal single-pass, sub-area lots. Each day's sample locations shall be equally distributed over the three (3) sub-areas. If, due to the weather or plant malfunctions, the Contractor's daily-anticipated production is not attained, the random locations will not be recalculated. Also, no more than one location of the three (3) sub-areas shall be located in an irregular shaped area such as a cul-de-sac.

Unless directed otherwise by the Engineer or designated representative, a minimum of three bag samples and three correlating 6-inch (150-mm) cores will be obtained from each day's production.

Bag samples shall be taken during lay-down operations. The primary sampling point for the bag samples shall be from the windrow if a windrow elevator is used. If a windrow elevator is not used, the sample shall be taken from the middle of the paving machine hopper. This sampling location will require a stoppage in the paving operation in order for the Inspector to safely secure a sample from the hopper. One core shall be taken for every 2,000 single-pass square yards (1,675 single-pass square meters) with a minimum of three (3) cores for all projects. One core shall be taken at the same station and pass sampled for each of the bag samples. Cores shall be taken by the City's laboratory within 48 hours of pavement laydown unless otherwise directed by the Engineer or designated representative.

For total areas of less than 500 square yards (420 square meters), a total of only two bag samples and two correlating cores will be obtained. If the Contractor desires additional testing, it shall be at its own entire expense.

The Engineer or designated representative may alter, increase or waive the testing schedule to ensure that the Work performed and the material used meet specification requirements. Acceptability of the completed pavement shall be based on the average of test results for the Project as defined in Section 340S.12, "Acceptance Plan" of this item.

Gradation, asphalt content and stability value of the HMA mixture shall be reported for each of the bag samples. The stability value reported for each of the bag samples shall be the average of three (3) tests per bag.

Pavement thickness and density shall be determined from 6-inch (150 mm) field cores. For each day's placement, density of cores for which no corresponding bag samples were taken shall be determined by using the average Maximum Theoretical Density of the day's three (3) bag samples or as may otherwise be determined by the Engineer or designated representative.

When, in the opinion of the Engineer or designated representative, test results appear unrepresentative, additional testing may be authorized. The retesting will be at the expense of the Contractor and the results of the

retesting shall be averaged with the results of the original testing. If the results of retesting indicate that the original test results were erroneous, the original test results will be discarded. In the instance of erroneous original test results the subsequent first set of retests will be at the expense of the City of Austin.

Pavements with low-density results may be recored; but the pavement shall not receive any additional compactive effort.

Pavements that will not or cannot be cored within 48 hours shall be closed to both public and construction traffic.

340S.12 Acceptance Plan

For the purpose of the Acceptance Plan only, the "Paving Project" of each of the specified mixture types shall be defined by the Engineer or designated representative before the paving operation begins

Considerations for defining the Paving Project shall include paving operations staged due to traffic considerations, pavement structural section (i.e. with varying layer thicknesses), time required for paving, changes to the Job Mix Formula, phasing of large projects, or other factors affecting the consistency in the production, lay-down/compaction, use of completed portions, and/or aging of in-place material.

Acceptability of the completed pavement structure for a Paving Project shall be based on all daily averages of three test results and when approved by the Engineer or designated representative the overall average of all test results for each of the mixture/layer types specified on the Drawings.

Pay adjustments for two or more acceptance factors shall be accumulative. Pay adjustments of 100% unit price reduction shall require removal and replacement of the Work. Replacement materials shall be subject to all requirements of this specification. Alternatively, the Engineer or designated representative may allow the Work to remain in place without payment provided that the Work is warranted for an extended period under conditions as determined by the Engineer or designated representative. The decision of the Engineer or designated representative related to the removal and replacement of the Work shall be the final authority.

A. Non-Pay-Adjustment Acceptance Factors:

1. **Surface Characteristics:** Unless otherwise directed by the Engineer or designated representative, all pavements shall be tested for smoothness. Surfaces shall be tested with a 10-foot (3.05 meter) straightedge parallel to the roadway centerline and perpendicular to the centerline on flat, cross-slope sections. Maximum allowable deviation in 10 feet shall be 1/8 inch (1-mm per meter) parallel to the centerline and 1/4 inch (2-mm per meter) perpendicular to the centerline. Sections exceeding these maximums shall be corrected to the satisfaction of the Engineer or designated representative. The completed surface must meet the approval of the Engineer or designated representative for surface smoothness, finish and appearance.

If the surface ravel, ruts or deteriorates in any manner prior to the end of the warranty period, it will be the Contractor's responsibility to correct this condition at its own entire expense to the satisfaction of the Engineer or designated representative in conformance with the requirements of this specification.

For HMAC rehabilitation and overlay projects, if cracks develop in the pavement surface within the one-year warranty period, the Contractor shall seal the cracks in accordance with Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)".

For new HMAC roadways constructed in accordance with the Drawings and specifications, if cracks less than 1/4 inch (6 mm) in width develop in the pavement surface within the one year warranty period the Contractor shall seal the cracks in accordance with Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)".

If cracks equal to or greater than 1/4 inch (6 mm) in width develop in the pavement surface within the one-year warranty period, the cracking shall be reviewed and evaluated by the Engineer or designated representative before corrective action is taken.

2. **Stability:** Stability test results shall be used as indicators of potential problems. Where stability test results fall below the range specified in this specification, additional tests shall be taken as directed by the Engineer or designated representative for further evaluation and monitoring of the paving mixture. This additional stability testing will be at the expense of the Contractor. When, in the opinion of the Engineer or designated representative, the stability is deemed unacceptable for the intended use of the pavement, the paving mixture shall be removed and replaced to the limits indicated by test results or may be left in place on conditions acceptable to the Engineer or designated representative. When the paving mixture is removed and replaced, it shall be at the sole expense of the Contractor.
3. **Laboratory Density:** Laboratory density results as determined by TxDOT Test Method Tex-207-F shall be used as indicators of potential problems. Where laboratory density test results are less than 94.5% or more than 97.5% of mix design maximum density, additional tests shall be taken as directed by the Engineer or designated representative for further evaluation and monitoring of the paving mixture. This additional laboratory density testing will be at the expense of the Contractor. When, in the opinion of the Engineer or designated representative, the laboratory density is deemed unacceptable for the intended use of the pavement, the paving mixture shall be removed and replaced to the limits indicated by test results.

The removal and replacement of the paving mixture shall be at the sole expense of the Contractor.
4. **Limited Areas:** Irrespective of an acceptable overall Paving Project average for any or all of the Pay-Adjustment Acceptance Factors, limited substandard portions of the Work, as determined by the Engineer or designated representative, shall be remedied or removed and replaced to the satisfaction of the Engineer or designated representative at the sole expense of the Contractor.

- B. **Pay-Adjustment Acceptance Factors:** Contract unit prices shall be adjusted for paving mixtures that fail to meet acceptance criteria for gradation, asphalt content, density and mat thickness in accordance with the following:

Gradation Acceptance Schedule (TEX-210-F)

Sieve	Deviation From Job Mix Formula		Percent Contract Unit Price Reduction
	Daily Average	Overall Average	
Total retained on No. 10 (2.00 mm)	±6.5 6.6±	±5.0 5.1±	0 10
Passing No. 200 (75 µm)	±3.9 4.0±	±3.0 3.1±	0 5

Asphalt Content Acceptance Schedule (TEX-210-F, Part II)

Deviation from the Job Mix Formula		Percent Contract Unit Price Reduction	
Daily Average	Overall Average	Local Streets*	All Others
±0.5	±0.4	0	0
±0.51 to ±0.60	±0.41 to ±0.50	15	25
+0.61 to +0.70	+0.51 to +0.60	25**	100; Remove and Replace
-0.61 to -0.70	-0.51 to -0.60	100; Remove and Replace	100; Remove and Replace
Over ±0.70	Over ±0.60	100; Remove and Replace	100; Remove and Replace

*A local or residential street that serves as access to residence or other abutting property.

**If the street has an ADT of 500, or less, with 1%, or less, of truck traffic, plus a 2 year warranty; otherwise, Remove and Replace

Density Acceptance Schedule (TEX-207-F/TEX-227-F)

*Percent Density		Percent Contract Unit Price Reduction	
Daily Average	Overall Average	1½" (38 mm) Thickness or Greater	Less than 1½" (38 mm) Thickness
Above 96.5	Above 96	100; Remove and Replace	100; Remove and Replace
90.5 to 96.5	91 to 96	0	0
90.5 to 87.6	90.9 to 88.1	0.625 per 0.10% deficiency in density	0.50 per 0.10% deficiency in density
Less than 87.6	Less than 88.1	100; Remove and Replace	100; Remove and Replace

*Core bulk density divided by max. theoretical density

Thickness Acceptance Schedule

Variance Percent of Thickness		Percent Contract Unit Price Reduction
Daily Average	Overall Average	
0—15.0	0—10	0
15.1—20.0	10.1—16	20
20.1—30.0	16.1—25	50
Over 30.0	Over 25	100; Remove and Replace or mill/overlay 1" (25 mm) minimum

The Density Acceptance Schedule For Irregularly Shaped Areas; Hike And Bike Trails And Utility Trenches (see following table) will apply to utility trenches of widths less than 4 feet (1.2 meter) and to irregular shaped areas and hike and bike trails in which an appropriate rolling pattern cannot be established making it difficult to achieve compaction.

Density Acceptance Schedule For Irregularly Shaped Areas; Hike And Bike Trails and Utility Trenches (TEX-207-F/TEX-227-F)

*Percent Density	Percent Contract Unit Price Reduction	
Daily Average	1½" (38 mm) Thickness or Greater	Less than 1½" (38 mm) Thickness
Above 96.5	100; Remove and Replace	100; Remove and Replace
96.5 to 89.0	0	0
89.0 to 86.1	0.625 per 0.10% deficiency in density	0.50 per 0.10% deficiency in density
Less than 86.1	100; Remove and Replace	100; Remove and Replace

*Core bulk density divided by maximum theoretical density

The Density Acceptance Schedule will apply to utility trenches 4 feet (1.2 meter) or wider.

Core thicknesses greater than Drawing requirements shall be factored into the average thickness calculation as the Drawing required thickness. If total thickness of lift(s) proves to be less than required, the Contractor may remove and replace the overlay deficient areas as agreed to by the Engineer or designated representative. Overlays to correct thickness deficiencies shall be not less than one (1) inch (25-mm) thick. Overlays shall require milling of the asphalt in order to prevent a "featheredge" of the overlaying pavement.

The extent of the area to be overlaid or removed and replaced shall be determined by additional cores with thicknesses greater than or equal to the required thickness. All additional coring that is necessary to determine the area shall be paid for by the Contractor.

340S.13 Measurement

Work performed and material placed shall be measured under one of the following methods. When Drawing quantity measurement is specified, adjustment of quantity may be made as follows. If the quantity measured as outlined vary from those shown on the Drawings by more than 5%, either party to the Contract may request in writing and adjustment of the quantity by each separate bid item. The party to the Contract which requests the adjustment shall present to the other party one copy of measurements and calculations showing the revised quantity in question. This revised quantity, when approved by the Engineer or designated representative, shall constitute the final quantity for which payment will be made. However, no adjustment will be made for any quantity, which exceeds the Drawing required thickness.

- A. Method A: Asphaltic concrete pavement shall be measured by the ton (2,000 pounds) of the type actually used in completed and accepted Work in accordance with the Drawings and specifications.

The measurement shall be made on approved truck scales that meet the requirements of the National Institute of Standards and Technology Handbooks 44 and 112 except that the required accuracy shall be 0.4 percent of the load being weighed. The Contractor shall furnish a report of calibration from a scale mechanic licensed by the Texas Department of Agriculture certifying that the scales meet this requirement.

- B. Method B: Asphaltic concrete pavement shall be measured by the square yard of specified total thickness of the type of paving mixture actually used in completed and accepted Work in accordance with Drawings and specifications. Multiple lifts of the same type shall be considered as one for square yard measurement purposes.
- C. Method C: Asphaltic concrete pavement shall be measured by the lineal foot of specified total thickness of the type of paving mixture actually used in completed and accepted Work in accordance with Drawings and specifications. Multiple lifts of the same type shall be considered as one for linear foot measurement purposes.

340S.14 Payment

Work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid prices or pay adjusted unit price for Hot Mix Asphaltic Concrete Pavement, of the types and thicknesses specified. The unit bid prices shall include full compensation for furnishing all labor, equipment, time, materials and incidentals necessary to complete the Work.

Removal of existing hot mix asphalt concrete transition areas prior to overlay, tack coat, saw cutting and temporary pavement markings will not be measured or paid for directly but shall be included in the unit price bid for Standard Specification Item No. 340S, "Hot Mix Asphaltic Concrete Pavement."

Payment for Work meeting these specifications will be made under one of the following:

Pay Item No. 340S-A:	Hot Mix Asphaltic Concrete Pavement, Type ____,	Per Ton
Pay Item No. 340S-B:	Hot Mix Asphaltic Concrete Pavement, ___ inches, Type ____.	Per Square Yard.
Pay Item No. 340S-C:	Hot Mix Asphaltic Concrete Pavement, ___ Inches, Type ____.	Per Lineal Foot.
Pay Item No. 340S-PQ:	Hot Mix Asphaltic Concrete Pavement, ___ Inches, Type ____, Plan Quantity	Per Ton.

Pay Item No. 340S-L:	Hot Mix Asphaltic Concrete Pavement, ___ in., Type ___, Level-up Course.	Lump Sum
Pay Item No. 340S-M:	Crack Sealing Mobilization,	Lump Sum
Pay Item No. 340S-S:	Crack Sealing,	per Lineal Foot

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Special Specification Item 340S, "Hot Mix Asphaltic Concrete Pavement"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 307S	Tack Coat
Item No. 313S	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-106E	Method of Calculating the Plasticity Index of Soils
Tex-107E	Determination of Bar Linear Shrinkage of Soils
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregates
Tex-203-F	Sand Equivalent Test
Tex-204-F	Design of Bituminous Mixtures
Tex-207-F	Determination of Density of Compacted Bituminous Mixtures
Tex-208-F	Test for Stabilometer Value of Bituminous Mixtures
Tex-210-F	Determination of Asphalt Content of Bituminous Mixtures by Extraction
Tex-212-F, Part II	Determination of Moisture Content of Bituminous Mixtures (by oven drying)
Tex-217-F	Determination of Deleterious Material and Decantation Test For Coarse Aggregates
Tex-227-F	Theoretical Maximum Specific Gravity of Bituminous Mixtures
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
Tex-460-A	Determination of Crushed Face Particle
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 340	Hot Mix Asphalt Concrete Pavement

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Special Specification Item 340S, "Hot Mix Asphaltic Concrete Pavement"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 206S	Asphalt Stabilized Base
Item No. 210S	Flexible Base
Item No. 306S	Prime Coat
Item No. 310S	Emulsified Asphalt Treatment

Item No. 311S	Emulsified Asphalt Repaving
Item No. 320S	Two Course Surface Treatment
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-215-F	Determination of Asphalt Content of Rock Asphalt By Hot Solvent Method
Tex-224-F	Determination of Flakiness
Tex-400-A	Method of Sampling Stone, Gravel, Sand and Mineral Aggregates
Tex-411-A	Soundness of Aggregate by Use of Sodium Sulfate or magnesium Sulfate
Tex-438-A	Accelerated Polish Test for Aggregate

ITEM NO. 402S CONTROLLED LOW STRENGTH MATERIAL 11-13-07

402S.1 Description

This item governs Controlled Low Strength Material (CLSM) used for trench backfill and for filling abandoned culverts, pipes, other enclosures, and for other uses as indicated on the drawings, Standard Details or as approved by the Engineer or designated representative. CLSM is a low strength, self-compacting, flowable, cementitious material used in lieu of soil backfill. It is intentionally prepared at low strength to allow for future removal using conventional excavation equipment.

The CLSM shall be composed of Portland cement or fly ash, or both, filler aggregate and water. The CLSM, specified for use in filling abandoned culverts, pipes, or other enclosures, shall contain a settlement compensator, in addition to the other ingredients, to minimize settlement of the CLSM within the enclosure.

Normal Set CLSM shall be specified whenever the material will remain uncovered or will not be subjected to traffic or other loads within 24 hours after placement. Fast Set CLSM shall be specified whenever the material will be covered, subjected to traffic or other loads within 24 hours, or needed to expedite construction.

CLSM can be used for permanent subgrade repairs below the base layer, but shall not be used for permanent pavement repairs. For temporary traffic applications, a minimum 2 inch (50 mm) cap composed of Hot Mix-Cold Laid Asphaltic Concrete (TxDOT Standard Specification Item 334) shall be placed on the CLSM.

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.

402S.2 Submittals

The submittal requirements of this specification item include:

- A. A mix design submittal including the results of unconfined compressive strength tests, air entrainment (if applicable), flow consistency, hardened unit weight, and timed Ball Drop and corresponding Penetrometer tests.
- B. Certifications and test results for the cement fly ash, and admixtures.
- C. Particle-size gradation and specific gravity tests on the filler aggregate.

402S.3 Materials

- A. Cement.

Portland cement shall conform to ASTM C 150, Type I (General Purpose).

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

- B. Fly Ash

Fly ash shall conform to the requirements of Standard Specification Item No. 405, "Concrete Admixtures" and TxDOT Specification Item 437.

- C. Filler Aggregate.

Filler aggregate shall consist of sand, stone screenings, pavement milling cuttings or other granular material that is compatible with the other mixture components. The filler aggregate shall be fine enough to stay in suspension to the extent required for proper flow without segregation, and, in the case of filling of enclosures, for minimal settlement. Filler aggregate shall have a Plasticity Index (TxDOT Test Method Tex-106-E) less than 15 and shall conform to the following gradation:

Sieve Designation	US	(SI)	Percent Passing
	No. 200	(75µm)	0—10

D. Mixing Water.

Mixing water shall conform to the requirements of Standard Specification Item No. 403, "Concrete for Structures".

E. Settlement Compensator

An air entraining admixture with a higher than usual dosage, which meets the requirements of Standard Specification Item No. 405, "Concrete Admixtures", shall be used as a settlement compensator. The settlement compensator may be introduced to the CLSM at the job site by placement of prepackaged admixture in capsules or bags in the mixing drum in accordance with the admixture manufacturer's recommendations.

402S.4 Mix Design

The proportioning of CLSM shall be the responsibility of the Contractor. The Contractor shall furnish a mix design conforming to the requirements herein, for review and approval by the Engineer or designated representative. The mix design shall be prepared by a qualified commercial laboratory and then reviewed and signed by a registered Professional Engineer licensed in the State of Texas.

The Mix Design submittal must include:

- A. Test results for unconfined compressive strength, air entrainment (if applicable), flow consistency, hardened unit weight, and timed Ball Drop (ASTM C-360) and corresponding Penetrometer tests (with a concrete pocket penetrometer),
- B. Certifications and test results for the cement, fly ash, and admixtures, and
- C. Results of particle-size gradation and specific gravity tests on the filler aggregate. The submittal shall include Penetrometer tests performed every thirty minutes until the Ball Drop test shows a 2-inch (50 mm) indentation, as well as the predicted Penetrometer reading that corresponds to a 3-inch (75 mm) Ball Drop indentation. Particle-size gradation shall be determined using a series of sieves that gives no fewer than five uniformly spaced points for graphing the entire range of particle sizes larger than a No. 200 sieve (75-µm).

The Contractor shall perform the work required to substantiate the design at no cost to the City, including all testing. Approved mix designs shall be valid for one year, provided there are no changes in the type, source, or characteristics of the materials during that year.

At the end of one year, the mix design may be submitted for renewal, provided that:

- A. field tests of the CLSM during the year have been satisfactory,
- B. there have been no changes in type or source of the materials of the mix, and
- C. the characteristics of the materials have not changed significantly since the original submittal.

The Contractor shall also submit certifications and test results for the cement, fly ash and admixtures, and particle-size gradation and specific gravity test results for the filler aggregate. The Contractor shall compare results of tests made on the filler aggregate at the end of the year to the results of tests reported in the original submittal.

Gradation changes less than ten percent in percent passing any sieve and specific gravity changes less than five percent shall not be considered significant.

402S.5 Strength

The CLSM mix designs shall meet the unconfined compressive strength requirements outlined in the table below. The compression tests shall be conducted in accordance with TxDOT Method Tex-418-A, using approved unbonded caps on specimens with four-inch (100 mm) diameter and eight-inch (200 mm) height [or three-inch (75 mm) diameter by six-inch (150 mm) high specimens if a smaller capacity loading device gives more accurate results].

Unconfined Compressive Strength, psi (mPa)		
Age	Normal Set CLSM	Fast Set CLSM
3 hours	—	35 (0.24) minimum
24 hours	35 (0.24) minimum	—
28 days	300 (2.1) maximum	300 (2.1) maximum

402S.6 Flow Consistency

Flow consistency shall be established in tests involving the use of a six-inch (150 mm) length by three-inch (75 mm) diameter open-ended straight tubing made of steel, plastic or other non-absorbent material that is non-reactive with cement or fly ash. The tube shall be placed with one end on a horizontal flat surface and held in a vertical position. The tube shall then be filled to the top with CLSM. The top surface shall be struck off with a suitable straight edge and any spillage shall be removed from the base of the tube. Within five seconds thereafter the tube shall be raised carefully, using a steady upward lift with no lateral or torsional motion. The entire test, from the start of filling until removal of the tube, shall be completed within 1½ minutes without interruption.

After removal of the tube, the spread of the CLSM shall be measured immediately along two diameters that are perpendicular to one another. The average of those two measurements is defined as the flow consistency of the mix. The flow consistency of the CLSM shall be considered satisfactory if a circular-type spread of the mix occurs without segregation and a flow consistency (average diameter of spread) of 8 inches (200 mm) or more is achieved.

402S.7 Air Entrainment

Air entraining admixture shall be added as a settlement compensator, whenever the CLSM will be used to fill an enclosure (Section 402S-1). The dosage shall be sufficient to result in an air content of 15 to 25 percent (as determined by TxDOT Method Tex-416-A) at the time of placement of the CLSM.

402S.8 Field Strength Tests

Ball Drop or Penetrometer tests shall be used to determine, when the CLSM has developed sufficient strength to be covered or subjected to traffic or other loads as approved by the Engineer or designated representative.

The Ball Drop test shall be performed according to the latest version of ASTM C-360. An indentation diameter of three inches (75 mm) or less, and the absence of a sheen or any visible surface water in the indentation area shall indicate that the CLSM has achieved the desired strength. Because trench width and depth may affect the test results, the Contractor may perform this test on a control sample of CLSM in a two-foot (600 mm) square by six-inch (150 mm) deep container.

Penetrometer tests using a hand-held, spring reaction-type device commonly called a concrete pocket penetrometer, shall be performed on the surface of the CLAMS. A Penetrometer reading, equal to or greater than

the value established in the mix design (Section 402S.4) for a Ball Drop test indentation of 3-inches (75 mm), shall indicate that the CLSM has achieved the desired strength.

402S.9 Construction Methods

A. General

The height of free fall placement of the CLSM shall not exceed four feet (1.2 meters). Since CLSM is considered to be self-compacting, a vibrator shall not be allowed. The CLSM shall not be covered with any overlying materials or subjected to traffic or other loads until the Ball Drop test or the Penetrometer test shows acceptable results (Section 402S.8) or until the CLSM has been in place a minimum of 24 hours for Normal Set CLSM and a minimum of 3 hours for Fast Set CLSM. Curing of the CLSM will not be required.

B. Utility Line Backfill

After the utility pipe has been placed and the proper bedding material placed in accordance with the details on the drawings, the trench may be immediately backfilled with the CLSM to the subgrade level shown on the drawings, Standard Details 1100S-6A, B, C & D, 430S-4, 511S-13A and 511S-13B or as directed by the Engineer or designated representative.

C. Culvert Backfill

Care shall be taken to prevent movement of the structure. If the pipe or structure moves either horizontally or vertically, the CLSM and the structure shall be immediately removed and the pipe or structure re-laid to proper line and grade.

D. Other Backfill

CLSM may be used for backfill material in lieu of soil as shown on the drawings, Standard Details or as approved by the Engineer or designated representative.

E. Filling Abandoned Culverts, Pipe, or other Enclosures

The CLSM shall be placed in a manner that allows all air or water, or both, to be displaced readily as the CLSM fills the enclosure.

402S.10 Acceptance Testing During Construction

The Engineer or designated representative may perform flow consistency, air entrainment, and unconfined compressive strength tests to determine if the CLSM meets the specification requirements. The number and frequency of acceptance tests will be determined by the Engineer or designated representative.

402S.11 Measurement and Payment

The work and materials presented herein will generally not be paid for directly, but shall be included in the unit price bid for the item of construction in which this item is used.

When specified in the contract bid form as a separate pay item, the item will be paid for at the contract unit bid price(s) for "Controlled Low Strength Material". The bid prices shall include full compensation for all Work herein specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the Work.

Payment will be made under the following:

Pay Item No. 402S-A:	Controlled Low Strength Material	Per Cubic Yard
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End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Standard Specification Item 402S, "Controlled Low Strength Material"</u>	
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
430S-4	Concrete Backfill Under Curb & Gutter
506S-14	Control or Mini Manhole
511S-13A	Water Valve Box Adjustment to Grade W/Full Depth Concrete
511S-13B	Water Valve Box Adjustment to Grade W/Concrete and H.M.A.C.
1100S-6A	Narrow Excavation Next to C&G - Trench Width 0.3 M (12") & Less
1100S-6B	Narrow Excavations - Trench Width 0.3 M (12") & Less
1100S-6C	Excavation Next to C&G - Trench Width Greater than 0.3 M (12")
1100S-6D	Excavations - Trench Width Greater than 0.3 M (12")
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No 403S	Concrete for Structures
Item No 405S	Concrete Admixtures
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 334	Hot Mix-Cold Laid Asphaltic Concrete Pavement
Item No. 420	Concrete Structures
Item No. 421	Portland Cement Concrete
Item No. 437	Concrete Admixtures

RELATED CROSS REFERENCE MATERIALS	
<u>Standard Specification Item 402S, "Controlled Low Strength Material"</u>	
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-106-E	Method Of Calculating the Plasticity Index of Soils
Tex-416-A	Air Content of Freshly Mixed Concrete By The Pressure Method
Tex-418-A	Compressive Strength of Cylindrical Concrete
<u>American Society for Testing and Materials (ASTM)</u>	
<u>Designation</u>	<u>Description</u>
ASTM C 150	Portland Cement
ASTM C 360	Ball Penetration in Fresh Portland Cement Concrete
ASTM C 403	Time of Setting of Concrete Mixtures by Penetration Resistance
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 504S	Adjusting Structures
Item No. 506S	Manholes
Item No. 508S	Miscellaneous Structures and Appurtenances
Item No. 510	Pipe

Item No. 430S
P.C. Concrete Curb and Gutter

430S.1 Description

This item shall govern Portland Cement (p.c.) concrete curb, p.c. concrete curb and gutter with reinforcing steel or p.c. concrete laydown curb as required, that is constructed in accordance with this specification on an approved subgrade and base in conformity with Standard Detail Series 430S and the lines, grades, section 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.

430S.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p.c. concrete mix design,
- B. Type of Installation (i.e. P.C. Concrete Curb and Gutter or P.C. Concrete Curb or P.C. Concrete Laydown 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.

430S.3 Materials

A. Concrete

The Portland cement (p.c.) concrete shall conform to Class A Concrete, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures" or Sections 360S.4 and 360S.6 of Standard Specification Item No. 360S, "Concrete Pavement" when curb and gutter is to be constructed integral with the pavement.

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".

E. Flexible Base

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

430S.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, grades, cross section and dimensions indicated on the Drawings. A minimum of 4 inches (100 mm) of flexible base shall be spread, wetted and thoroughly compacted under curb and gutter as specified in Standard Specification Item No. 210S, "Flexible Base". If dry, the base shall be sprinkled lightly with water before p.c. concrete is deposited thereon.

B. C & G 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, of the depth required and clean, straight, free from warp and, if required, oiled with a light form oil. All forms shall be securely staked to line and grade and maintained in a true position during the placement of p.c. concrete.

C. Reinforcing Steel

The reinforcing steel, if required, 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.

D. 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.

E. P.C. Concrete Placement and Form Removal

Concrete shall be placed in the forms and properly consolidated. Within 1 hour after p.c. concrete placement, a thin coating, that is no more than 1/2 inch (12.5 mm) nor less than 1/4 inch (6.25 mm) thick of finish mortar, composed of 1 part Portland Cement to 2 parts fine aggregate, shall be worked into the exposed faces of the curb and gutter by means of a "mule". After the p.c. concrete has become sufficiently set, the exposed edges shall be rounded by the use of an edging tool to the radii indicated on Standard Detail 430S-1. The entire exposed surface of the curb and gutter shall be floated to a uniform smooth surface, and then finished with

a camel hairbrush to a gritty texture. The forms shall remain in place a minimum of 24 hours unless approved otherwise by the Engineer or designated representative.

After removal of the forms, any minor honeycombed surfaces shall be plastered with a mortar mix as described above. Excessively honeycombed curb and gutter, as determined by the Engineer or designated representative, shall be completely removed and replaced when directed.

F. Curing

Immediately after finishing the curb, concrete shall be protected by a membrane curing conforming to Standard Specification Item No. 409S, "Membrane Curing".

After a minimum of 3 days curing and before placement of the final lift of the base course, the curb shall be backfilled to the full height of the p.c. concrete, tamped and sloped as directed by the Engineer or designated representative. The upper 4 inches (100-mm) of backfill shall be of clean topsoil that conforms to Standard Specification Item No. 130S, "Borrow" and is free of stones and debris.

G. Seeding in Turf Areas

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

430S.5 Measurement

Accepted work as prescribed by this item will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) of p.c. concrete curb and gutter, p.c. concrete curb and/or p.c. concrete laydown curb, complete in place.

430S.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 Curb and Gutter" or P.C. Concrete Curb. The price shall include full compensation for all work as set forth and described under payment Method A and/or B.

A. Method A (Pay Item No. 430S-A)

This payment method shall include all the work performed for "P.C. Concrete 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 concrete and base material, 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.

B. Method B (Pay Item No. 430S-B)

This payment method includes all the work performed for "P.C. Concrete Curb and Gutter", complete, at the unit bid price. The unit bid price shall include full compensation for fine grading, furnishing and placing concrete and 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.

Item No 130S	Borrow
Item No 210S	Flexible Base
Item No. 360S	Concrete Pavement
Section 360S.4 of Item 360S	Proportioning of Concrete
Section 360S.6 of Item 360S	Concrete Mixing and Placing
Item No. 403S	Concrete for Structures
Section 403S.7 of Item No. 403S	(Table 4)
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>
430S-1	Curb and Gutter Section
430S-3	Curb Expansion Joint Dowel Detail
430S-4	Concrete Backfill Under Curb & Gutter
430S-5	Reinforcing Bar Detail at Existing Curb and Gutter

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item No. 430S, "P.C. Concrete Curb and Gutter"
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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. 340S	Hot Mix Asphaltic Concrete Pavement
Item No. 431S	Machine Laid PCC Curb and Gutters
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

<i>SPECIFIC</i> 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. 501S JACKING OR BORING PIPE 9-26-12

501S.1 Description

This item shall govern furnishing and installing of encasement pipe by methods of jacking or boring as indicated on the Drawings and in conformity with this specification. This item shall also include, but not be limited to other constructions activities such as traffic control measures, excavation, removal of all materials encountered in jacking or boring pipe operations, disposal of all material not required in the work, grouting, end seal installation, backfilling and re-vegetation.

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.

501S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Shop drawings identifying proposed jacking or boring method complete in assembled position
- B. Trench Safety Plan including pits, trenches and sheeting or bracing if necessary,
- C. Design for jacking or boring head,
- D. Installation of jacking or boring supports or back stop,
- E. Arrangement and position of jacks and pipe guides, and
- F. Grouting plan,

501S.3 Materials

- A. Pipe

Carrier pipe and encasement pipe shall conform to Standard Specification Item Nos. 505S, "Concrete Encasement and Encasement Pipe" and 510, "Pipe" and shall be size, type materials, thickness and class indicated on the Drawings, unless otherwise specified.

- B. Grout

Grout for void areas shall consist of 1 part Portland cement and 4 parts fine, clean sand mixed with water.

501S.4 Construction Methods

- A. General

The Contractor is responsible for:

1. Adequacy of jacking and boring operations,
2. Installation of support systems as indicated on the Drawings,
3. Provision of encasement and carrier pipe, and
4. Execution of work involving the jacking operation, the wet or dry method of boring and the installation of encasement pipe simultaneously.

The Contractor shall have sole responsibility for the safety of the jacking and boring operations and for persons engaged in the work. The Contractor's attention is directed to the Construction Industry

Occupational Safety and Health Administration (OSHA) Standards (29 FR 1926/1920) as published in U.S. Department of Labor publication OSHA 2207, latest revision, with particular attention to Subpart S. The Contractor shall conform to the requirements in accordance with Standard Specification Item 509S, "Trench Safety System" and shall provide an appropriate Trench Safety Plan.

When the grade of the pipe at the jacking or boring end is below the ground surface, suitable pits or trenches shall be excavated to provide sufficient room to conduct the jacking or boring operations and for placement of end joints of the pipe. In order to provide a safe and stable work area, the excavated area shall be securely sheeted and braced to prevent earth caving in accordance with the Trench Safety Plan.

The location of the work pit and associated traffic control measures required for the jacking or boring operations shall conform to the requirements of the City of Austin Transportation Criteria Manual and TxDoT Manual on Uniform Traffic Control Devices.

Where installation of pipe is required under railroad embankments, highways, streets, or other facilities by jacking or boring methods, construction shall be undertaken in such a manner that it will not interfere with operation of any railroad, street, highway, utility or other facility and shall not weaken or damage any embankment or structure. All appropriate permits shall be acquired prior to the initiation of the work.

During construction operations, and until the work pits are backfilled and fill material compacted, traffic barricades and warning lights to safeguard traffic and pedestrians shall be furnished and maintained by the Contractor. The Contractor shall submit the proposed pit location and traffic control plan for review by the Engineer or designated representative. The Review by the Engineer or designated representative, however, will not relieve the Contractor of the responsibility to obtain specified results in a safe, professional manner.

When grade of pipe at jacking or boring end is below ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking or boring operations and for joining pipe. Work shall be securely sheeted and braced as indicated on the Trench Safety Plan to prevent earth caving and to provide a safe and stable work area.

The pipe shall be jacked or bored from the low or downstream end, if possible. Minor lateral or vertical variation in the final position of pipe from line and grade established by Engineer or designated representative will be permitted at the discretion of Engineer or designated representative provided that such variation is regular and occurs only in one direction and that the final grade of the flow line conforms to the specified direction.

When conforming to details indicated on the drawings, but the bottom of the work pit is unstable or excessively wet or the installation of water and wastewater pipe will result in less than 30 inches (750 mm) of cover, the Contractor shall notify the Engineer or designated representative. The Engineer or designated representative may require the Contractor to install a concrete seal, cradle, cap or encasement or other appropriate action.

Immediately after jacking or boring is complete and the encasement pipe is accurately positioned and approved for line and grade, the clear space between the pipe and the surrounding excavated material shall be completely filled by pressure grouting for entire length of installation if the encasement pipe is 36 inches or larger in diameter.

After placement of the carrier pipe is complete, the ends of the encasement pipe shall be sealed with end seals meeting SPL WW-575A.

As soon as possible after the carrier pipe(s) and end seals are completed, the work pits or trenches, which are excavated to facilitate these operations, shall be backfilled. The backfill in the street ROW shall be compacted to not less than 95 percent of the maximum density conforming to TxDOT Test Method Tex-114-E, "Laboratory Compaction Characteristics & Moisture-Density Relationship of Subgrade & Embankment Soil". Field density measurements will be made in accordance with TxDOT Test Method Tex-115-E, "Field Method for Determination of In-Place Density of Soils and Base Materials".

Where the characteristics of soil, size or size of proposed pipe dictate that tunneling is more satisfactory than jacking or boring, a tunneling method may be submitted for acceptance by Engineer or designated representative.

B. Jacking

Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating the jacks, an even pressure shall be applied to all jacks used so that the pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The complete jacking assembly shall be placed in order to line up with the direction and grade of the pipe. In general, the embankment material shall be excavated just ahead of the pipe, the material removed through the pipe and the pipe forced through embankment by jacking, into the space thus provided.

The excavation for the underside of the pipe, for at least 1/3 of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of no more than 2 inches (50 mm) may be provided for the upper half of the pipe. This clearance shall be tapered to zero at the point where excavation conforms to contour of pipe.

The distance that excavation shall extend beyond the end of the pipe depends on the character of material encountered, but it shall not exceed 2 feet (0.6 meter) in any case. This distance shall be decreased, when directed by the Engineer or designated representative, if the character of the material being excavated makes it desirable to keep the advance closer to the end of the pipe.

The Contractor may use a cutting edge of steel plate around head end of the pipe extending a short distance beyond the end of pipe with inside angles or lugs to keep cutting edge from slipping back onto the pipe.

When jacking of the pipe is begun, all operations shall be carried on without interruption, insofar as practical, to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at its entire expense.

C. Boring

The boring shall proceed from a work pit provided for the boring equipment and workers. Excavation for the work pits and the installation of shoring shall be as outlined in the Trench Safety Plan. The location of the pit shall be approved by the Engineer or designated representative. The boring shall be done mechanically using either a pilot hole or the augur method.

In the pilot hole method an approximate 2 inch (50 mm) pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored.

When the augur method is used, a steel encasement pipe of the appropriate diameter equipped with a cutter head to mechanically perform the excavation shall be used. Augurs shall be of sufficient diameter to convey the excavated material to the work pit.

Excavated material will be removed from the working pit and disposed of properly. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Water jetting will not be permitted.

In unstable soil formations, a gel-forming colloidal drilling fluid, that consists of at least 10 percent of high grade carefully processed bentonite, may be used to consolidate the drill cuttings, seal the walls of the hole and furnish lubrication to facilitate removal of the cuttings from the bore.

D. Tunneling

Where the characteristics of the soil, the size of the proposed pipe, or the use of monolithic sewer would make the use of tunneling more satisfactory than jacking or boring; or when indicated on the drawings, a tunneling method may be used, with the approval of the Engineer or designated representative.

E. Joints

If reinforced concrete pipe is used, the joints shall be in accordance with TxDOT Specification Item 464, "Reinforced Concrete Pipe".

501S.5 Measurement

Jacking or boring pipe will be measured by the linear foot (meter: 1 meter equals 3.281 feet) of pipe complete in place. Such measurement will be made between the ends of the pipe along the central axis as installed.

501S.6 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid price per linear foot for "Jacking or Boring Pipe" as the case may be, of type, size and class of encasement pipe indicated on the Drawings. The price shall include full compensation for furnishing, preparing, hauling and installing required materials, encasement pipe, end seals, for grouting and for labor, tools, equipment and incidentals necessary to complete work, including excavation, backfilling and disposal of surplus material.

The Carrier pipe shall be paid at the unit price bid for Standard Specification Item 510, "Pipe".

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

Pay Item No. 501S:	Jacking or Boring ____ In. Pipe, Class ____	Per Linear Foot.
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End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Specification Item 501S, "Jacking or Boring Pipe"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 505S	Concrete Encasement and Encasement Pipe
Item No. 509S	Trench Safety Systems
Item No. 510	Pipe
<u>TxDOT Standard Specifications For Construction And Maintenance Of Highways, Streets, And Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 464	Reinforced Concrete Pipe
<u>TxDOT Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-114-E	Laboratory Compaction Characteristics & Moisture Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials
<u>TxDOT Manual on Uniform Traffic Control Devices (MUTCD)</u>	
<u>Designation</u>	<u>Description</u>

MUTCD Part VI	Traffic Controls for Street and Highway Construction, Maintenance, Utility and Incident Management Operations
MUTCD Section 6C	Channelizing Devices
MUTCD Section 6C-8	Barricade Design
MUTCD Section 6C-9	Barricade Application
MUTCD Section 6E	Lighting Devices
MUTCD Section 6F	Control of Traffic Through Work Areas
<u>City of Austin Transportation Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 8	Traffic Control
Section 8.5.5.E	Typical Applications/Bore Pits

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 501S, "Jacking or Boring Pipe"</u>	
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
Detail 501S-1	Encasement Detail w/ Casing Spacers
<u>TxDOT Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item 476	Jacking, Boring or Tunneling Pipe
Item 502	Barricades, Signs and Traffic Handling

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

<i>SPECIFIED</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. 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 2-24-10

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. 403, "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 an Engineer or designated representative, a 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

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Standard Specification Item No. 505S, "Encasement and Encasement Pipe"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item 403	Concrete For Structures
Item 507S	Bulkheads
Item 510	Pipe
Section 510.2(8)(o)	Corrugated Metal Pipe (CMP)
<u>City of Austin Standard Details</u>	
<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

RELATED CROSS REFERENCE MATERIALS	
Standard Specification Item No. 505S, "Encasement and Encasement Pipe"	
<u>TxDOT Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item 421	Portland Cement Concrete
Section 421.9	Quality of Concrete
Section 421.2(8)	Mortar and Grout
<u>City of Austin Standard Specification Items</u>	
<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 2-22-21

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.

Source: Rule No. R161-21.08 , 2-22-2021.

506.2 Qualifications

Applicators of coatings to the interior surfaces of wastewater manholes, as specified in 506.4.R and 506.5.J, shall be listed on Austin Water (AW) Standard Products List (SPL) WW-511. Individual(s) setting up and operating equipment to core through the walls of existing manholes or junction boxes shall have experience in coring similar size holes through the walls of similar size and type structures on at least ten projects (or 15 manholes) in AW's jurisdiction.

Source: Rule No. R161-21.08 , 2-22-2021.

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. AW shall be included in all submittal review. The AW SPLs 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 SPLs 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; technical data sheets for coating thickness measuring equipment and for holiday detection test equipment.
7. For connections to existing manholes or junction boxes: details showing the size, location, and method of removal of the wall section, including any temporary supports attached to the manhole or junction box wall; details showing the location of existing joints, other connecting pipes, and other features that penetrate or attach to the wall; and technical data sheets covering the pipe-to-manhole or pipe-to-junction box connectors.

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.

C. Installation

The Contractor shall submit evidence that the individual(s) setting up the equipment and coring through the walls of manholes and junction boxes are experienced with the equipment and procedures and have successfully cored through the same types of materials using the same types of equipment.

Source: Rule No. R161-21.08 , 2-22-2021.

506.4 Materials

A. Concrete

All cast-in-place concrete shall conform to City of Austin (COA) 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 COA Class A, or Class J (COA Standard Specification Item 403S, Concrete For Structures) or Controlled Low Strength Material (COA 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. Use of brick to construct any part of wastewater manholes is prohibited.

F. Rings and Covers

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

1. Replacement Rings and Covers, 24-inch 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-inch 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 COA Standard Specification Item No. 507 "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, 4) have a straight section of invert that is 4 to 6 inches in length to transition between the curved portion of the invert channel and the connecting pipes in order to accommodate the mandrel apparatus for up to 15-inch diameter 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 the "Wedge Seal Offset Joint Detail, Precast Manhole Section", located in SPL WW-146. Joint dimensions for wastewater manhole sections and cones larger than 48-inch inside diameter shall comply with COA Standard No. 506S-12, "O-Ring Joint Detail Precast Manhole Section" or "Wedge Seal Offset Joint Detail, Precast Manhole Section", located in SPL WW-146. 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 conform to the requirements of ASTM C913 and 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 COA 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 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 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-146G.

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.

Source: Rule No. R161-21.08 , 2-22-2021.

506.5 Construction

A. General

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 6-inch thick layer of unreinforced Class A concrete (COA 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 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, 4) have a straight section of invert that is 4 to 6 inches in length to transition between the curved portion of the invert channel and the connecting pipes in order to accommodate the mandrel apparatus for up to 15-inch diameter 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 inches 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 New Manholes and Junction Boxes

Wastewater pipe connections to new 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. New precast manholes and manholes with cast-in-place bases shall have holes for pipe penetrations in the manhole wall separated by a minimum of 7 inches, designed by the manhole manufacturer and as measured from the inside diameter of the cored or formed holes on the inside wall of the manhole to ensure the structural integrity of the manhole wall.

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; installing flexible, resilient, and non-corrosive boot connectors or ring waterstops acceptable to the Engineer 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 506.5.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. Connections to existing manholes and junction boxes shall be made at locations that allow the removal limits of the wall section to be no closer than 12 inches to the inside diameter of the nearest existing connecting pipe. Equipment used to remove the wall section shall be operated in a manner that does not damage the adjacent interior coating, substrate, or wall. This includes installation of anchors or other supports that are attached to the manhole or junction box wall for temporary support of the removal equipment.

G. Waterproofing

PVC waterstops, hydrophilic 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 COA 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 COA 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 COA 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 COA 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 COA 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 COA Standard 506S-2, "Major Manhole Height Adjustment," and shall consist of any combination of removing and replacing 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.

The contractor shall test for discontinuities (holidays) in each new layer of interior organic coating applied to wastewater manholes and junction boxes. The test methods and equipment shall conform to ASTM D4787, Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrate. Each new layer of applied coating shall be tested to detect pinholes, voids, cracks, thin spots, and foreign inclusions. All discontinuity testing shall be performed using high-voltage, pulse-type equipment and witnessed by the Engineer or designated representative. The test voltage shall depend on the coating thickness according to the tabulated values in ASTM D4787. Test voltages for common coating thicknesses are as follow:

Coating or Lining Thickness, Mils	Test Voltage
20	2700
40	5500
80	11500
120	16500

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 COA Standard 506S-15 or as directed by the Engineer or designated representative.

Source: Rule No. R161-21.08 , 2-22-2021.

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.
- c) Gauges shall be calibrated and read in inches of mercury (inches Hg or in Hg) or pounds per square inch gauge (psig) or both.

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 (-10" Hg) (-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 (-9" Hg) (-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 inch 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 AW 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.

Source: Rule No. R161-21.08 , 2-22-2021.

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.

Source: Rule No. R161-21.08 , 2-22-2021.

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. 506 M __:	Standard Pre-cast Manhole w/Pre-cast Base, __ Dia.	Per Each.
Pay Item No. 506 M1 __:	Standard Pre-Cast Manhole w/CIP Base, __ Dia.	Per Each.
Pay Item No. 506 S __:	Special Manhole, __ Dia.	Per Each.
Pay Item No. 506 D __:	Drop Manhole w/Pre-cast Base, __ Dia.	Per Each.

Pay Item No. 506 D1 __:	Drop Manhole w/CIP Base, ___ Dia.	Per Each.
Pay Item No. 506 C __:	Centered Tee Manhole, ___ Dia. × ___ Dia.	Per Each.
Pay Item No. 506 T __:	Tangent Tee Manhole, ___ Dia. × ___ Dia.	Per Each.
Pay Item No. 506 J __:	Junction Box, ___ Ft. × ___ Ft.	Per Each.
Pay Item No. 506 B __:	Box Manhole ___ Ft. × ___ Ft.	Per Each.
Pay Item No. 506 2 __:	Major Manhole Height Adjustment, ___ Dia.	Per Each.
Pay Item No. 506 4 __:	Minor Manhole Height Adjustment, ___ Dia.	Per Each.
Pay Item No. 506 AB __:	Abandonment of existing Manholes:	Per Each.
Pay Item No. 506 EDM __:	Extra Depth of Manhole, ___ Dia.	Per Linear Vert. Foot.
Pay Item No. 506 SL __:	Structural Lining of ___:	Per Linear Vert. Foot.
Pay Item No. 506 CN __:	Connection to Existing ___:	Per Each.

End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Standard Specification Item No. 506, "Manholes"</u>	
<u>COA Standard Specifications Items</u>	
<u>Designation</u>	<u>Description</u>
Item 402S	Controlled Low Strength Material
Item 403S	Concrete For Structures
Item 406S	Reinforcing Steel
Item 410S	Concrete Structures
Item 503	Frames, Grates, Rings and Covers
Item 504	Adjusting Structures
Item 507	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>COA Utilities Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 2.8.0	Abandonment of Facilities
Subsection 2.9.4.D	Manholes
<u>AW Standard Products Lists</u>	
<u>Designation</u>	<u>Description</u>
SPL WW-146	Concrete Manhole Sections
SPL WW-146A	Manhole Seals
SPL WW-146G	Manhole Grade Rings, Plastic
SPL WW-511	Organic Lining for Wastewater Manholes
SPL WW-511A	Structural Lining for Wastewater Manholes
<u>COA Standard Details</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-15	Abandoned Manhole
804S-4, 5, 6 and 7 of 9	Steel Plating
<u>COA 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
<u>Designation</u>	<u>Description</u>

ASTM C 62	Specification for Building Brick Solid Masonry Units Made from Clay of 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 D4787	Continuity Verification of Liquid or Sheet Lining Applied to Concrete Substrate
ASTM D4976	Specification for Polyethylene Plastics Molding and Extrusion Materials
ASTM D6132	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

RELATED CROSS REFERENCE MATERIALS	
<u>Standard Specification Item No. 506, "Manholes"</u>	
AW Standard Products Lists	
SPL WW-219	32 Inch Manhole Cover Casting Sets
COA Utilities Criteria Manual	
<u>Designation</u>	<u>Description</u>
Section 2	Water, Reclaimed Water and Wastewater Criteria
COA Standards	
<u>Designation</u>	<u>Description</u>
1100S-1	Casting Adjustments
503S-4S	Storm Sewer Manhole Ring and 32" Cover
503S-5S	Bolted Storm Sewer Manhole Ring and 32" Cover
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

Source: Rule No. R161-21.08 , 2-22-2021.

ITEM NO. 509S EXCAVATION SAFETY SYSTEMS 9-26-12

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, tied-back or braced sheeting, tied-back slurry walls, soil nailing, rock bolting, tied-back 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 trench (measured at the bottom) shall not be wider 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 Plan Submittal

- 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.

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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 Review

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 tied-back or braced sheeting, tied-back 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.

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3. Drawings that clearly detail the specific areas of the Project in which each type of system shall be used and showing the Special Shoring in 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 on-site 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.
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END

SPECIFIC CROSS REFERENCE MATERIALS
Standard Specification Item No. 509S, "Excavation Safety Systems"

<u>City of Austin Standard Contract Documents</u>	
<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 CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item No. 509S, "Excavation Safety Systems"</u>	
<u>Texas Department of Transportation: Standard Specifications For Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 104	Removing Concrete
Item 110	Excavation
Item 402	Trench Excavation Protection
<u>City of Austin Standard Specification Items</u>	
<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 12-8-18

510.1 Description

This item governs the furnishing and installing 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
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1½"	0
1"	0—10
½'	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
¼"	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
⅜"	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
¾"	0
½"	0—25
¼"	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 (¾ 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 greater than 12-inch size. For mains 12-

inch size and smaller, PVC pipe, conforming to the requirements of AWWA C-900, DR 14 shall be acceptable. Reclaimed water pipe shall be manufactured purple, painted purple, or wrapped in purple polyethylene film wrap.

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: 1) a quality management system certified by the American National Standards Institute (ANSI) or National Sanitation Foundation (NSF) to comply with ISO 9001:2000, 2) a quality management system certified by the QCast Program following the requirements of the ACPA Plant Certification Manual, 3) a quality management system certified by the National Precast Concrete Association 4) a quality control program approved by the OWNER prior to submittal of bids for the PROJECT, or 5) an independent, third party quality control testing and inspection firm for testing and inspecting pipe produced for the PROJECT and approved by the OWNER prior to submittal of bids for the PROJECT. 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.

The quality of materials, the process of manufacture and the finished pipe shall be subject to inspection and approval by the E/A at the pipe manufacturing plant and at the project site prior to and during installation. Plant inspections shall be conducted at the discretion of the City Representative. Only manufacturers having a quality control program of the type described above will be considered as approved providers of concrete pipe and pipe products as listed in the Standard Products List (SPL).

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 mPa).
- Minimum yield strength: 50,000 psi (345 mPa).
- Minimum elongation: 5 percent.

1. Ductile Iron Fittings:

Fittings shall be push-on, flanged or mechanical joint as indicated or approved and shall meet all requirements of standards as follows:

- Sizes 4 inch through 24 inch: AWWA C-110 or AWWA C-153
- Sizes larger than 24 inch: AWWA C-110.

-Lining and Coating:

Interior surfaces 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 A21.11/C-111 for gaskets. They shall be manufactured by, or satisfy all recommendations of, the manufacturer of the pipe/fittings being used and be fabricated for use with Class 125 ANSI B16.1 flanges.

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

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

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

All threaded fasteners shall be marked with a readily visible symbol cast, forged or stamped on each nut and bolt, which will identify the fastener material and grade. The producer and the supplier shall provide adequate literature to facilitate such identification; painted markings are not acceptable.

3. Polyethylene Film Wrap

All iron pipe, fittings and accessories shall be wrapped with standard 8 mil (minimum) low density polyethylene film or 4-mil (minimum) cross laminated high-density polyethylene conforming to AWWA C-105, with all edges overlapped and taped securely with duct tape to provide a continuous wrap to prevent contact between the piping and the surrounding backfill. 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. Polyethylene film wrap for reclaimed water pipe shall be purple.

4. Marking

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

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 ½ inch for 16-inch pipe and ¾ 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 D2737; it shall be pressure rated at 200 psi working pressure and must bear the National Sanitation Foundation seal of approval for potable water service. 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 (SDR) and pressure rating in psi for water at 73.4 F (e.g., SDR-9, 200 psi).

ASTM D 2737 designation.

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

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 ¾" 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, or 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 18, 150 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 F 679"

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 thickness of the pipe and fittings, type and location of fittings and the type and limits of the lining and coating systems of the pipe and fittings.
 - c. Product data to show compliance of all couplings, supports, fittings, coatings and related items.
3. Job Conditions

-
- a. The internal design pressure of all steel pipe and fittings shall be as indicated.
 - b. The interior of all steel pipe for potable water, 4 inches and larger, shall be cement-mortar lined.
4. Manufacturing
- a. Description
Pipe shall comply with AWWA C-200.
 - (1) Circumferential deflection of all pipe in-place shall not exceed 2.0 percent of pipe diameter.
 - (2) Diameter
Nominal pipe diameter shall be the inside diameter of lining or pipe barrel, unless otherwise designated in Job Conditions.
 - b. Wall Thickness
 - (1) Steel pipe wall thickness shall be designed for the internal and external loads specified in this section. The cylinder thickness needed to resist internal pressure shall be based on an allowable stress in the steel equal to $\frac{1}{2}$ the minimum yield stress of the material used.
5. Fittings
- a. Welded
Fabricated steel fittings shall be of the same material as pipe and shall comply with AWWA C-208.
6. Flanges
- a. Flanges shall comply with the requirements of AWWA C-207, Class D or Class E. The class shall be based on operating conditions and mating flanges of valves and equipment.
 - b. Gaskets shall be cloth-inserted rubber, $\frac{1}{8}$ 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 $1\frac{1}{2}$ 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

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- (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:

10½ inches wide for 2 ¾inches × ½-inch corrugations.

12 inches wide for 3 inches × 1 inch or 5 inches × 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.

16¼ 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 ½-inch diameter. Bands 12 inches wide or less shall have a minimum of 2 bolts and bands greater than 12 inches wide shall have a minimum of 3 bolts.

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

5. Additional Coatings or Linings

a. Bituminous Coated

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

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

b. Paved Invert

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

c. Cement Lined

(1) General

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

Composition

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

Cement

Portland Cement shall conform to AASHTO M 85.

Aggregate

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

Mixture

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

Thickness

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

Lining Procedures

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

Surface Finish

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

Certification

Furnish manufacturer's standard certification of compliance upon request of the purchaser.

Joints

Pipe shall be joined together with coupling bands made from steel sheets to an indicated thickness of 0.064 inch (12 ga.). Coupling bands shall be formed with two corrugations that are spaced to provide seating in the third corrugation of each pipe end without creating more than ½ inch ± annular space between pipe ends when joined together.

Bands shall be drawn together by two ½ 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 $\frac{1}{4}$ 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.

Forms, sheathing and bracing, pumping, additional excavation and backfill required in unstable trench conditions shall be included in the unit price bid for pipe.

(10) Blasting

All blasting shall conform to the provisions of the "General Conditions" and/or "Public Safety and Convenience".

(11) Removing Old Structures

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

(12) Lines and Grades

Grades, lines and levels shall conform to the General Conditions and/or "Grades, Lines and Levels". Any damage to the above by the Contractor shall be re-established at the Contractor's expense. The Contractor shall furnish copies of all field notes and "cut sheets" to the City.

The location of the lines and grades indicated may be changed only by direction of the E/A. It is understood that the Contractor will be paid for Work actually performed on the basis of the unit Contract prices and that the Contractor shall make no claim for damages or loss of anticipated profits due to the change of location or grade.

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

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

Should the Contractor's procedures not produce a finished pipe placed to grade and alignment, the pipe shall be removed and relayed and the Contractor's 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.

(a) 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 ¾" to 2½"		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) Sand, alone, shall not be used in watercourses, in trenches where groundwater is present, or in trenches with grades greater than 5 percent.
- (2) Pea gravel or bedding stone, alone, shall not be used in the street right-of-way within 5 feet of subgrade elevation in trenches that are 3 feet or wider.
- (3) 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 $\frac{1}{8}$ " into the interior of the pipe will not be accepted. Excess joint material will be removed to within $\frac{1}{8}$ " 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 22½ 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 ¼ 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 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 4½ 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 Owner's Representative in writing a least twenty five (25) Calendar Days prior to the anticipated date for a wet-connection. The Owner's Representative is defined as the City Inspector. The Owner's Representative will notify any affected utility customers at least 48 hours prior to the shutoff. Austin Water (AW) 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 AW. The operation of the valve is to be conducted under the immediate supervision of the Owner's 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 Potable or Reclaimed Water System

The Contractor shall make all wet connections called for by the Contract or required to complete the Work. Two connections to an existing line performed during the same shutout, at the same time and at a distance less than 50 linear feet apart, will be considered one wet connection. Two connections to an existing line performed during the same shutout, at the same time and at a distance equal to, or greater than 50 linear feet will be considered two wet connections. A wet connection shall include draining and cutting into existing piping and connecting a new pipeline or other extension into the existing pressure piping, forming an addition to the 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 AW Inspector must be present. "Size on size" taps will not be permitted, unless made by use of an approved full bodied mechanical joint 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 $\frac{3}{4}$ point of the structure, the fill shall be placed uniformly on each side of the pipe in layers not to exceed 12 inches, loose measure.

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

(c) Backfill Materials

The Engineer or designated representative may approve any of the following well graded materials as backfill:

1. Select trench material
2. Sand
3. Crushed rock cuttings
4. Rock cuttings
5. Foundation Rock
6. Blasted material with fines and rock
7. Cement stabilized material
8. Borrow

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

(d) Backfill in Street Right-of-Way

Placement of backfill under existing or future pavement structures and within 2 feet of any structures shall be compacted to the specified density using any method, type and size of equipment, which will produce the specified compaction without damaging the pipe or bedding. Placement of backfill greater than 2 feet beyond structures in right-of-way shall conform to (g) below.

The thickness of lifts, 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 lift shall be brought to the moisture content necessary to obtain the specified density and shall be placed in a uniform thickness to ensure uniform compaction over the entire lift. Testing for density shall be in accordance with Test Method Tex-114-E and Test Method Tex-115-E.

It is highly desirable that the backfill lifts be placed in a flat (or level) configuration; however when approved by the Engineer or designated representative, the backfill lifts may be placed at gradients (percent of vertical rise or fall to horizontal run) that do not exceed 30%.

The proposed gradient for each lift or series of lifts shall be established based on the capabilities of the equipment proposed to attain the required compaction.

Each lift of backfill must provide the density as specified herein. Swelling soils (soils with a minimum Liquid Limit of 50, more than 50% passing a #200 sieve and a plasticity index greater than 22) 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 shall be sprinkled as specified 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 lift of backfill is complete, tests may be made by the Engineer or designated representative. If the material fails to meet the density indicated, the course shall be reworked as necessary to obtain the indicated compaction and the compaction method shall be altered on subsequent Work to obtain indicated density.

At any time, the Engineer or designated representative may order proof rolling to test the uniformity of compaction of the backfill lifts. All irregularities, depressions, weak or soft spots that develop shall be corrected immediately by the Contractor.

If the backfill, due to any reason, loses the specified 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 specified. The remainder of the street backfill shall either be Flexible Base, Concrete or Hot Mix Asphalt Concrete as specified on the drawings or replacement "in kind" to the surface of the materials originally removed for placement of 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 elements 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 33-inch diameter shall be air tested between manholes.

Wastewater lines 36-inch in diameter and larger shall be either air tested between manholes or at pipe 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 back pressure of any groundwater shall be determined (0.433 psi) for each foot of average water depth (if any) above the sewer.

Add air slowly to the section of sewer being tested until the internal air pressure is raised to 3.5 psig greater than the average back pressure of any ground water that may submerge the pipe. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure. After the temperature stabilization period, disconnect the air supply. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average backpressure of any ground water that may submerge the pipe.

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 = $0.000419 \times D \times L$, 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	$1.520 \times L$
10 (See Note 1)	567	239	$2.374 \times L$
12	680	199	$3.419 \times L$
15	850	159	$5.342 \times L$
18	1020	133	$7.693 \times L$
21	1190	114	$10.471 \times L$

24	1360	100	$13.676 \times L$
30	1700	80	$21.369 \times L$

Note 1. 10-inch diameter pipe to be used only by AW maintenance personnel.

Note 2. The test parameter for pipes larger than 30-inch diameter shall be shown on the construction plans.

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.

When joint testing, 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, 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 videoed, the CDs/DVDs shall be labeled and become the property of the Owner. The Contractor shall have all video and necessary playback equipment readily accessible for review by the Owner while the project is under construction.

Post-installation video shall not be completed until all work is completed on a section of storm drain conduit. Post-installation video work shall be completed by the Contractor in the presence of the Owner. The post-installation video work shall be completed to confirm that the storm drain conduits are free of defects. Provide a color video showing the completed work. Prepare and submit video logs providing location of storm drain conduit along with location of any defects. Manhole and inlet work shall be complete prior to post-installation video work.

For post-installation video, exercise the full capabilities of the camera equipment to document the completion and conformance of the storm drain installation work with the Contract Documents. Provide a full 360-degree view of conduit, all joints, and all connections. The camera shall be moved through the storm drain conduit in either direction at a moderate rate, stopping and slowly panning when necessary to permit proper documentation of the conduit condition at each pipe connection, joint, and defect. In no case shall the camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the storm drain conditions shall be used to move the camera through the storm drain conduit. When manually operated winches are used to pull the camera through the conduit, telephones or other suitable means of communication shall be set up between the two access points of the conduit being videoed to insure good communication between members of the video crew.

Distance measurements shall be provided to an accuracy of one tenth of a foot.

Video shall be continuous for each storm drain conduit segment. Do not show a single segment on more than one CD/DVD, unless specifically allowed by the Owner.

Contractor shall submit to Owner the following:

- A. National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) certification of operators who will be performing video work.

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- 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, the hydrant valve seats closed and no 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.

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 a base fee plus an hourly rate published in the current AW Fee Schedule. 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

Prior to performing any disinfection of potable water lines, the Contractor shall submit a Disinfection Plan (Plan) and obtain approval in accordance with COA specification 01300, Submittals. The Plan shall comply with AWWA C651 (Disinfecting Water Mains) and AWWA C655 (Field Dechlorination), latest editions, and shall be developed using one of the following templates, unless otherwise approved by the Engineer and/or AW: Disinfection Plan for Tablet/Granule Method, or Disinfection Plan for Continuous-Feed Method. Templates for these two methods are located at <http://www.austintexas.gov/departments/construction-standards>. The Contractor shall decide which disinfection method to use for a given project. The Slug Method and Spray Method are also acceptable if better suited for disinfection. The initial plan shall be submitted for review a minimum of 60 calendar

days prior to when the water main is scheduled to be placed into service, or at the preconstruction conference if the project requires that the waterline be placed in service in less than 60 days, as indicated in the Contractor's Construction Schedule. If any appurtenances are required for injection, sampling, or flushing purposes that are not shown in the original plan/profile sheets, then the Contractor shall include the appurtenances in the project Record Drawings. The Contractor shall disinfect potable water lines only in accordance with an approved Plan.

(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

For pipelines 16" or smaller in diameter, the Contractor may use either the AWWA C-651 "Tablet/Granular Method" or the "Continuous Feed Method" for disinfecting the pipeline. 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. As an option, backflow prevention in the form of a reduced pressure backflow assembly may 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 25 mg/liter available chlorine.

The disinfecting solution shall be retained in the piping for at least 16 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 10 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 by a dechlorination process until the chlorine concentration is no higher than the residual generally prevailing in the existing distribution system. This 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. The Contractor will supply the Dechlorination chemical conforming to ANSI/AWWA C655. 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 AW. 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 AW Dispatch office.

(e) Bacteriological Testing

After disinfection and final flushing, samples shall be collected per one of the two options.

Option A: Before approving a main for release, take an initial set of samples and then resample again after a minimum of 16 hours. Both sets of samples must pass for the main to be approved for release. Option B: Before approving a main for release, let it sit for a minimum of 16 hours without any water use. Then collect two sets of samples a minimum of 15 minutes apart while the sampling taps are left running. Both sets of samples must pass for the main to be approved for release. The two (2) sets of water samples from the line 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, at least one from each branch greater than one pipe length, and additional samples that are collected at intervals of not more than 1,200 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.

(31) Valve Turn Walk-through

As part of the acceptance of Water or Reclaimed Water pressure pipe, an AW Valve Walk-through will be performed after an initial inspection by the Owner's Representative to identify any deficient items. If deficient items are present during the AW Valve Walk-Through and the project fails acceptance, a re-inspection fee will apply and must be paid before a re-inspection is scheduled to confirm correction of deficient items. See AW Fee Schedule for the current Distribution Walk-Through Re-inspection Fee.

(32) 2-inch Jumper Hose

During connections to the water distribution system, the Contractor may be required to install a temporary jumper hose between the unpressurized water segment and an adjacent pressurized water segment for the purpose of maintaining water service to customers who can't operate without water service during the connection. The jumper shall include an approved backflow preventer and be of

adequate size and pressure rating to maintain service to the customer. It shall be polyethylene tubing meeting the requirements of COA SPL WW-65. The jumper hose and other components in the temporary service shall be disinfected, and bacteriological samples will be taken and pass before the temporary service is provided to the customer. Contractor shall provide adequate protection for the jumper hose in vehicular traffic areas at all times during use.

Source: Rule No. R161-17.05 , 5-31-2017; Rule No. R161-17.19 , 11-28-2017; Rule No. R161-18.23 , 12-8-2018.

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.

Jumper hose will be measured per linear foot of hose installed, including all depths, excavation and backfill, complete, and in place.

Source: Rule No. R161-17.05 , 5-31-2017.

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:

- a. clearing
- b. constructing any necessary embankment
- c. excavation
- d. disposal of surplus or unusable excavated material
- e. furnishing, hauling and placing pipe
- f. field constructed joints, collars, temporary plugs, caps or bulkheads
- g. all necessary lugs, rods or braces
- h. pipe coatings and protection
- i. connections to existing systems or structures, concrete blocking and thrust blocks and restrained joints
- j. preparing, shaping, pumping for dewatering, and shoring of trenches
- k. bedding materials
- l. backfill materials
- m. hauling, placing and preparing bedding materials

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- n. particle migration measures
 - o. hauling, moving, placing and compacting backfill materials
 - p. temporary and permanent pavement repairs and maintenance
 - q. temporary removal and replacement of pavement, curb, drainage structures, driveways, sidewalks and any other improvements damaged or removed during construction
 - r. cleanup
 - s. vertical stack on deep wastewater services
 - t. all other incidentals necessary to complete the pipe installation as indicated.
 - u. pipe joint restraint devices, where specified or allowed, meeting Standard Products List 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 included 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 Potable or Reclaimed 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.

(14) Jumper Hose

Jumper Hose will be paid at the unit bid price, complete and in place, including installation and removal of all materials necessary to provide a fully functional jumper hose. This item shall also include adequate protection for the jumper hose within vehicular traffic areas.

Source: Rule No. R161-17.05 , 5-31-2017.

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. (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-AWWRJ ___ 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-DWW:	Pipe Trench Backfill, ___ Ft. Width	Per Linear Foot.
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.
Pay Item No. 510-JH	2-inch Jumper Hose	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.

Source: Rule No. R161-17.05 , 5-31-2017.

End

Applicable References:

Standard Specifications Manual: Item Nos. Ref: 102S, 210S, 402S, 403, 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. 610S PRESERVATION OF TREES AND OTHER VEGETATION 12-7-18

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 -60°F to 200°F (-16°C to 93°C) and shall be inert to most chemicals and acid. The fabric pattern may vary from diamond to circular with a minimum unit weight of 0.4 lbs./Ft. (0.6 kilograms per meter).

The fabric shall have a 4 foot (1.2 meters) width minimum tensile yield strength (Horizontal) of 2000 psi [13.9 megaPascals], ultimate tensile strength of 2680 psi [18.5 megaPascals] (Horizontal) and a maximum opening no greater than 2 inches (50 mm).

(b) 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 5½ 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 ½ 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

Source: Rule No. R161-18.24 , 12-7-2018.

End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Specification Item 610S, "Preservation of Trees and Other Vegetation"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 606S	Fertilizer
<u>City of Austin Standard Details</u>	
<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
<u>City of Austin Transportation Criteria Manual</u>	
<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
<u>City of Austin Environmental Criteria Manual</u>	
<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
<u>City of Austin Land Development Code</u>	
<u>Designation</u>	<u>Description</u>
Section 25-8-603	Tree Protection Administration
Section 25-8-623	Inspection by City Arborist
<u>ASTM, American Society for Testing and Materials</u>	
<u>Designation</u>	<u>Description</u>
D-2729	Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 610S, "Preservation of Trees and Other Vegetation"</u>	
<u>City of Austin Standard Specification Items</u>	
<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
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<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. 628S
Sediment Containment Dikes**628S.1 Description**

This item shall govern the provision and placement of temporary filtration dikes along or across such areas as indicated on the Drawings. This method shall be used during construction only and its purpose shall be to temporarily control erosion by intercepting and retaining sediment.

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.

628S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Locations and Types of containment dikes (Hay Bales or Triangular Sediment Filter Dike).
- B. Seeding
 - 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.

628S.3 Materials**A. Hay Bales**

"Hay Bales" shall be free of Johnson Grass or other noxious weeds. The bales shall consist of either hay or straw in good condition and be securely tied with wire. Stakes for anchoring bales shall be #4 (10M) reinforcing bars, 1/2 inch (12.5 mm) steel pickets, or 2 x 2 inch (50 x 50 mm) wooden stakes. Hay bales shall be limited to drainage areas less than 2,500 square feet (0.02 hectares).

B. Filter Dike

"Filter Dike" shall be prefabricated from 6x6-D2.9xD2.9 (150x150-MW19xMW19) WWF and 4.5 oz. (127 grams) non-woven polyester filter fabric securely fastened to WWF with galvanized shoat rings or j-clips. A 12-inch (300-mm) skirt shall be a continuous extension of the filter fabric on the upstream face.

The filter fabric shall extend beyond the dike joints to provide a 3-inch (75-mm) overlap. Ends of dike not lapped with filter fabric shall be plugged with filter fabric.

628S.4 Construction Methods

The Contractor may select the material for the dikes, unless otherwise indicated, conforming to the details on the Drawings and Standard Detail Numbers 628S and 628S-1.

Bales shall be placed with ends tightly abutting the adjacent bales. Each bale shall be embedded in the soil a minimum of 4 inches (100 mm) and a maximum of 6 inches (150 mm). Bales shall be securely anchored in place by a minimum of 2 stakes per bale. The first stake in each bale shall be angled toward the previously placed bale to force the bales together. Stakes shall be embedded in the soil a minimum of 1 1/2 feet (0.45 meters). Bales that are not able to be imbedded and are place on impervious cover should be placed level with the concrete and have all bales butted end to end with no voids or gaps between them. Bales shall be bound by either wire or nylon string. Bales shall be replaced every 2 months or more often during wet periods.

For filter dikes, the filters shall be placed with ends tightly abutting the adjacent filter. Each filter and skirt shall be securely anchored in place using 6 inch (150 mm) staples at a maximum spacing of 12 inches (300 mm) on center. Anchoring on impervious areas shall be accomplished with gravel bags placed at 18 inches (450 mm) on center or with a nominal 1 inch by 4 inch (25 mm by 100 mm) board nailed at 18 inches (450 mm) on center.

Silt accumulation behind hay bales and triangular sediment filter dikes shall be removed at a maximum depth of 6 inches (150 mm) or when, in the opinion of the Engineer or designated representative, the structure ceases to function as intended.

All dikes shall be inspected by the Contractor at least monthly and after each rainfall. Dikes shall be repaired or replaced when necessary or as directed by the Engineer or designated representative.

After completion of construction or when directed by the Engineer or designated representative the dike shall be removed and the site re-graded to the final grades. Any depression shall be filled and any accumulations of silt shall be spread or removed to a permitted disposal area. After removal of the dike the area shall be graded and seeded conforming to Item No. 604S, "Seeding for Erosion Control".

628S.5 Measurement

The work performed and the materials furnished as prescribed by this item will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) of "Sediment Containment Dikes", complete in place.

628S.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 "Sediment Containment Dikes" 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) the repair and/or replacement of materials, (c) the removal and disposal of all silt and debris and (d) the removal of all dikes, silt and debris after completion of construction or when directed by the Engineer or designated representative.

When indicated on the Drawings, payment for sediment containment will be made under:

Pay Item No. 628S-A: Sediment Containment Dikes with hay bales Per Lineal Foot.

Pay Item No. 628S-B: Sediment Containment Dikes with filter fabric Per Lineal Foot.

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification 628S, "Sediment Containment Dike"

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Number 628S	Triangular Sediment Filter Dike
Number 628S-1	Hay Bale Dike

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 604S	Seeding for Erosion Control

City of Austin Standard Contract

<u>Section</u>	<u>Description</u>
00300U	Bid Form (Unit Prices)

RELATED CROSS REFERENCE MATERIALS
Specification 628S, "Sediment Containment 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. 401S	Structural Excavation and Backfill
Item No. 406S	Reinforcing Steel
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

RELATED CROSS REFERENCE MATERIALS (Continued)
Specification 628S, "Sediment Containment Dike"

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. 803S BARRICADES, SIGNS AND TRAFFIC HANDLING 11-15-11

803S.1 Description

This item shall govern for providing, installing, moving, replacing, maintaining, cleaning and removing upon completion of the work, all temporary or permanent street closure barricades, signs, cones, lights or other devices required to handle the traffic in conformance with the current edition of the Texas Manual of Uniform Traffic Control Devices for Street and Highways and as indicated on the Drawings or directed by the Engineer or designated representative.

Constructing a detour, if required, shall conform to Standard Specification Item No. 801S, "Constructing a Detour." Capital Improvement Project Signs shall conform to Standard Specification Item No. 802S, "Project Signs."

This item shall also include the installation of all required safety fencing as described in the latest adopted version of Standard Detail 804S-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.

803S.2 Submittals

The submittal requirements of this specification item include:

- A. Type of Barricade and proposed materials and Construction of the barricade,
- B. Test results for Retro-Reflective sheeting.

803S.3 Materials

All barricades, signs, cones, lights and other types of devices to handle traffic, as indicated on the Drawings or directed by the Engineer or designated representative, shall conform to details shown on the Drawings or those indicated in the Texas Manual on Uniform Traffic Control Devices (TMUTCD).

803S.4 Construction Methods

Prior to commencement of construction, suitable "Barricades, Signs and Traffic Handling" devices shall be installed to protect the workers and the public.

The Contractor shall be responsible for the installation of all markers, signs and barricades in accordance with the Drawings and in conformance with the Texas Manual on Uniform Traffic Control Devices (TMUTCD) and/or as indicated on the Drawings or directed by the Engineer or designated representative. If, in the opinion of the Engineer or designated representative, additional markers, signs or barricades are needed in the interest of safety, the Contractor will install such as are required or as directed by the Engineer or designated representative. All changes and/or revisions to the detour/traffic control plan shall be approved by the Engineer or designated representative.

Lumber shall be painted with two coats of paint as indicated on the Drawings.

803S.5 Maintenance

It shall be the Contractor's responsibility to maintain, clean, move and replace if necessary, barricades, signs and traffic handling devices during the time required for construction of the project. Permanent barricades shall be

constructed as required after the completion of the street by drilling holes to place the posts and concrete foundations. Foundation concrete shall be cured before the rails are attached. When no longer needed, all temporary Barricades, Signs and Traffic Handling Devices shall be removed and the area restored to its original condition or as directed by the Engineer or designated representative.

803S.6 Measurement

The work performed and material furnished as prescribed by this item, City of Austin Standard Details, details included on the Drawings or indicated in the TMUTCD shall be measured as follows:

A. Pavement Markings.

All pavement marking required for proper installation of the designated Traffic Control Plans and Details, as well as required removal of existing pavement marking, shall be measured and paid for under Standard Specification Item No. 870S, "Work Zone Pavement Markings" and Standard Specification Item No. 874S, "Eliminating Existing Pavement Markings".

B. Barricades, Signs and Traffic Handling.

All work performed and material furnished as prescribed by this item, City of Austin Standard Details, details shown on the Drawings or indicated in the TMUTCD, that are not included in the above paragraph, shall be measured by the number of calendar days, working days or months of actual service.

Traffic control for the project will be measured and paid for once per contract defined time period, i.e. either per Calendar Day, Working day or Month at the contract rate, regardless of the number of set-ups, locations or streets under construction.

C. Safety Fencing

Safety fencing will be measured by the lineal foot.

803S.7 Payment

The work performed and materials furnished as prescribed by this item, measured as provided under section "803S.6 Measurement" shall be paid for at the contract unit price for barricades, signs and traffic handling. This unit price shall include full compensation for furnishing, placement and removal of all materials and for all labor, tools, equipment, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 803S-CD:	Barricades, Signs, and Traffic Handling	Per Calendar Day.
Pay Item No. 803S-WD:	Barricades, Signs, and Traffic Handling	Per Working Day.
Pay Item No. 803S-MO:	Barricades, Signs, and Traffic Handling	Per Month.
Pay Item No. 803S-SF:	Safety Fence	Per Lineal Foot.

End

SPECIFIC CROSS REFERENCE MATERIALS	
Specification Item No. 803S, "Barricades, Signs and Traffic Handling"	
City of Austin Standard Specifications	
<u>Designation</u>	<u>Description</u>
Item No. 801S	Constructing a Detour
Item No. 802S	Project Signs
Item No. 870S	Work Zone Pavement Markings

Item No. 874S	Eliminating Existing Pavement Markings and Markers
<u>Texas Technical Documents:</u>	
<u>Designation</u>	<u>Description</u>
(TMUTCD)	Texas Manual on Uniform Traffic Control Devices

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Item No. 803S, "Barricades, Signs and Traffic Handling"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 403S	Concrete for Structures
Item No. 860S	Pavement Marking Paint (Reflectorized)
Item No. 863S	Reflectorized Pavement Markers
Item No. 864S	Abbreviated Pavement Markings
Item No. 867S	Epoxy Adhesive
Item No. 871S	Reflectorized Pavement Markings
Item No. 875S	Pavement Surface Preparation For Markings
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
803S-1	Street-End Barricades
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 502	Barricades, Signs and Traffic Handling
Item No. 508	Constructing Detours
Item No. 510	One-Way Traffic Control
Item No. 512	Portable Concrete Traffic Barrier
Item No. 514	Permanent Concrete Traffic Barrier
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
<u>Texas Department of Transportation: Departmental Materials Specifications</u>	
<u>Designation</u>	<u>Description</u>
DMS 7110	Aluminum Sign Blanks
DMS 8310	Flexible Roll-up Reflective Signs
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-839-B	Determining Color in Reflective Materials

Tex-842-B	Method for Measuring Retroreflectivity
<u>American Society for Testing and Materials (ASTM)</u>	
<u>Designation</u>	<u>Description</u>
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-108/B108M	Specification for Aluminum-Alloy Permanent Mold Castings
B-183	Practice for Preparation of Low-Carbon Steel for Electroplating
B-221/B-221M	Specification for Aluminum-Alloy Extended Bars, Rods, Wire, Shapes, and Tubes
D-523	Test Method for Specular Gloss
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
G-23	Recommended Practice for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Nonmetallic Materials