CITY OF AUSTIN
Public Works Department

PROJECT MANUAL
Contract Documents and Technical Specifications

VOLUME 2 of 4

Tennis Facilities - Pharr Tennis Center Renovations

C.I.P. PROJECT NUMBER: 9864.003
SOLICITATION NUMBER: CLMC851

CITY OF AUSTIN
Public Works Department
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Table of Contents

Document Number	Date	Title
VOLUME 1 of 4		
	01/05/21	Table of Contents
BIDDING REQUIREMENTS, CONTRACT FORMS, & CONDITIONS OF THE CONTRACT		
00020	04/03/20	Invitation for Bids
00100	04/03/20	Instructions to Bidders
00220	03/30/18	Geotechnical Data
00300L	04/03/20	Bid Form-Lump Sum
	04/03/20	Total Bid Form
00400	04/30/19	Statement of Bidder's Experience
00405	03/30/18	Certificate of Non-Suspension or Debarment
00410	09/17/18	Statement of Bidder's Safety Experience
00440	10/22/19	Prohibited Activities
00475	08/12/19	Nonresident Bidder Provisions
00500	02/04/20	Agreement (SAMPLE)
00610	02/04/20	Performance Bond
00620	02/04/20	Payment Bond
00630	10/22/19	Non-Discrimination and Non-Retaliation Certificate
00631	03/30/18	Title VI Assurances Appendix A
00632	03/30/18	Title VI Assurances Appendix E
00650	06/08/18	Certificate of Insurance
00670	01/11/19	Sales Tax Exemption Certificate
00680	03/30/18	Non-Use of Asbestos Affidavit (Prior to Construction)
00681	03/30/18	Non-Use of Asbestos Affidavit (After Construction)
00700	12/04/20	General Conditions
00810	12/04/20	Supplemental General Conditions
00820	03/30/18	Modifications to Bidding Requirements and Contract Forms
00830	02/04/20	Wage Rates and Payroll Reporting
00830BC	01/11/21	Wage Rates Building Construction Trades
00840	12/04/20	Construction Training Program Requirements
00900	01/11/19	Addendum (SAMPLE)
SPECIFICATIONS		
Division 1 - General Requirements		
01010	08/28/20	Summary of Work
01020	03/30/18	Allowances
01025	09/17/18	Measurement and Payment Lump Sum Contracts
01030	03/30/18	Alternates
01050	10/19/15	Grades Lines & Levels
01095	07/21/03	Reference Standards and Definitions
01096	05/06/11	Stormwater Pollution Prevention Plan (SWPPP)
01200	08/09/12	Project Meetings
01300	01/11/19	Submittals
01353	04/29/20	Construction Equipment Emissions Reduction Plan
01380	08/09/12	Construction Photography & Videos
01500	08/28/20	Temporary Facilities
01550	08/09/12	Public Safety and Convenience
01900	03/12/12	Prohibition of Asbestos Containing Materials

01900a	06/05/06	Statement of Non-Inclusion of Asbestos Containing Material
01900b	06/05/06	Statement of Non-Inclusion of Asbestos Containing Material

VOL. 2 of 4

City Standard Technical Specifications

The following sections (Series 100-800) are the City of Austin Standard Technical Specifications. These specifications are applicable to site work only and may be viewed, downloaded, or printed via the internet at:
https://library.municode.com/tx/austin

Series 100 – Earthwork

104S	9/26/12	REMOVING PORTLAND CEMENT CONCRETE
111S	9/26/12	EXCAVATION

Series 200 – Subgrade and Base Construction

201S	8/20/07	SUBGRADE PREPARATION
210S	2/24/10	FLEXIBLE BASE
236S	8/20/07	PROOF ROLLING

Series 300 – Street Surface Courses

340S	9/26/12	HOT MIX ASPHALTIC CONCRETE
360S	9/26/12	CONCRETE PAVEMENT

Series 400 – Concrete Structures and Miscellaneous Concrete

403S	09/26/12	CONCRETE FOR STRUCTURES
405S	11/13/07	CONCRETE ADMIXTURES
406S	09/26/12	REINFORCING STEEL
408S	11/13/07	CONCRETE JOINT MATERIALS
409S	11/13/07	MEMBRANE CURING
413S	11/13/07	CLEANING AND-OR SEALING JOINTS AND CRACKS
430S	11/15/11	PC CONCRETE CURB AND GUTTER
432S	01/04/10	PORTLAND CEMENT CONCRETE SIDEWALKS
433S	12/09/08	PC CONCRETE DRIVEWAYS
439S	11/13/07	PARKING LOT BUMPER CURBS

Series 600 – Environmental Enhancement

602S	06/16/08	SODDING FOR EROSION CONTROL
604S	01/04/16	SEEDING FOR EROSION CONTROL
608S	09/26/12	PLANTING
610S	12/07/18	PRESERVATION OF TREES AND OTHER VEGITATION
620S	01/04/16	FILTER FABRIC
641S	06/21/07	STABILIZED CONSTRUCTION ENTRANCE
642S	09/01/11	SILT FENCE
648S	08/18/10	MULCH SOCK
660S	01/04/16	BIOFILTRATION MEDIUM

Series 700 – Incidental Construction

701S	09/26/12	FENCING
710S	09/26/12	BICYCLE RACKS

Series 800 – Urban Transportation

860S	09/26/12	PAVEMENT MARKING PAINT
874S	04/03/09	ELIMINATING EXISTING PAVEMENT MARKINGS & MARKERS
875S	11/21/05	PAVEMENT SURFACE PREPARATION FOR MARKINGS

Series 1300 – PARD

1301S	08/16/04	GRANITE GRAVEL HIKE & BIKE TRAIL

Special Provisions to City Standard Technical Specifications

VOL. 3 of 4

Special Specifications

DIVISION 01 — GENERAL REQUIREMENTS

000107.1	02/16/21	ARCHITECT SEALS PAGE (A)
000107.1B	02/16/21	INTERIOR ARCHITECT SEALS PAGE (IA)
000107.2	02/16/21	CIVIL SEALS PAGE (C)
000107.3	02/16/21	LANDSCAPE SEALS PAGE (L)
000107.4	02/16/21	STRUCTURAL SEALS PAGE (S)
000107.5	02/16/21	MEP SEALS PAGE
012500	02/16/21	SUBSTITUTION PROCEDURES (A)
012500.13	02/16/21	SUBSTITUTION REQUEST FORM (A)
013200	02/16/21	CONSTRUCTION PROGRESS DOCUMENTATION (A)
015720	02/16/21	INDOOR AIR QUALITY PLAN DURING CONSTRUCTION (A)
017300	02/16/21	EXECUTION (A)
017419	02/16/21	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL (A)
017700	02/16/21	CLOSEOUT PROCEDURES (A)
018113.01	02/16/21	SUSTAINABLE DESIGN REQUIREMENTS (A)
019113	02/16/21	GENERAL COMMISSIONING REQUIREMENTS (CX)

DIVISION 02 — EXISTING CONDITIONS

024119.13	02/16/21	SELECTIVE DEMOLITION – SITE (L)
024119.16	02/16/21	SELECTIVE DEMOLITION – BUILDING (IA)

DIVISION 03 — CONCRETE

033000	02/16/21	CAST-IN-PLACE CONCRETE (S)
033816	02/16/21	UNBONDED POST-TENSIONED CONCRETE (S)

DIVISION 06 — WOOD, PLASTICS, AND COMPOSITES

060312	02/16/21	WOOD REPAIR (IA)
061053	02/16/21	MISCELLANEOUS ROUGH CARPENTRY (IA)
062023	02/16/21	INTERIOR FINISH CARPENTRY (IA)
062530	02/16/21	SLAT WALL PANEL SYSTEM (IA)
064116	02/16/21	PLASTIC-LAMINATE-CLAD-ARCHITECTURAL CABINETS (IA)
066400	02/16/21	PLASTIC PANELING (IA)

DIVISION 07 — THERMAL AND MOISTURE PROTECTION

072100	02/16/21	THERMAL INSULATION (IA)
072500	02/16/21	WEATHER BARRIERS (IA)
079200	02/16/21	JOINT SEALANTS (IA)

DIVISION 08 — OPENINGS

081113	02/16/21	HOLLOW METAL DOORS AND FRAMES (IA)
081416	02/16/21	FLUSH WOOD DOORS (IA)
084113	02/16/21	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS (IA)
087100	02/16/21	FINISH HARDWARE (A)
088000	02/16/21	GLAZING (IA)

DIVISION 09 — FINISHES

092900	02/16/21	GYPSUM BOARD (IA)
093013	02/16/21	CERAMIC TILING (IA)
095123	02/16/21	ACOUSTICAL TILE CEILINGS (IA)
096513	02/16/21	RESILIENT BASE AND ACCESSORIES (IA)
099113	02/16/21	EXTERIOR PAINTING (IA)
099123	02/16/21	INTERIOR PAINTING (IA)
099300	02/16/21	STAINING AND TRANSPARENT FINISHING (IA)

DIVISION 10 — SPECIALTIES

101100	02/16/21	VISUAL DISPLAY UNITS (IA)
101400	02/16/21	SIGNAGE (A)
102113	02/16/21	PHENOLIC-CORE TOILET COMPARTMENTS (IA)
102800	02/16/21	TOILET AND BATH ACCESSORIES (IA)
102814	02/16/21	ELECTRICA HAND DRYERS (IA)
104413	02/16/21	FIRE PROTECTION CABINETS (IA)
104416	02/16/21	FIRE EXTINGUISHERS (IA)

DIVISION 12 — FURNISHINGS

123661	02/16/21	SOLID SURFACING COUNTERTOPS (IA)
124813	02/16/21	ENTRANCE FLOOR MATS AND FRAMES (IA)
129300	02/16/21	SITE FURNISHINGS (L)

DIVISION 17 - MISC.

172039.8	09/21/20	E.410-ASBESTOS (O)
172039.8	09/21/20	E.411- LEAD (O)

DIVISION 22 — PLUMBING

220517	02/16/21	SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING (MEP)
220518	02/16/21	ESCUTCHEONS FOR PLUMBING PIPING (MEP)
220523.12	02/16/21	BALL VALVES FOR PLUMBING PIPING (MEP)
220523.14	02/16/21	CHECK VALVES FOR PLUMBING PIPING (MEP)
220529	02/16/21	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT (MEP)
220553	02/16/21	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT (MEP)
220719	02/16/21	PLUMBING PIPING INSULATION (MEP)
220800	02/16/21	PLUMBING COMMISSIONING (MEP)
221116	02/16/21	DOMESTIC WATER PIPING (MEP)
221119	02/16/21	DOMESTIC WATER PIPING SPECIALITIES (MEP)
221316	02/16/21	SANITARY WASTE AND VENT PIPING (MEP)
221319	02/16/21	SANITARY WASTE PIPING SPECIALITIES (MEP)
221319.13	02/16/21	SANITARY DRAINS (MEP)
224200	02/16/21	COMMERCIAL PLUMBING FIXTURES (MEP)

DIVISION 23 — HEATING VENTILATING AND AIR CONDITIONING

230000	02/16/21	HEATING VENTILATION AND AIR CONDITIONING (MEP)
230500	02/16/21	COMMON HVAC WORK RESULTS (MEP)
230513	02/16/21	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT (MEP)
230517	02/16/21	SLEEVES AND SLEEVE SEALS FOR HVAC PIPING (MEP)
230518	02/16/21	ESCUTCHEONS FOR HVAC PIPING (MEP)
230519	02/16/21	METERS AND GAGES FOR HVAC PIPING (MEP)

230529	02/16/21	HANGERS & SUPPORTS FOR HVAC PIPING & EQUIPMENT (MEP)
230548.13	02/16/21	VIBRATION CONTROLS FOR HVAC (MEP)
230553	02/16/21	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT (MEP)
230593	02/16/21	TESTING, ADJUSTING, AND BALANCING FOR HVAC (MEP)
230713	02/16/21	DUCT INSULATION (MEP)
230719	02/16/21	HVAC PIPING INSULATION (MEP)
230800	02/16/21	HVAC COMMISSIONING (MEP)
232113	02/16/21	CONDENSATE PIPING (MEP)
232123	02/16/21	HYDRONIC PUMPS (MEP)
232300	02/16/21	REFRIGERANT PIPING (MEP)
233113	02/16/21	METAL DUCTS (MEP)
233300	02/16/21	AIR DUCT ACCESSORIES (MEP)
233346	02/16/21	FLEXIBLE DUCTS (MEP)
233423	02/16/21	HVAC POWER VENTILATORS (MEP)
233713.13	02/16/21	AIR DIFFUSERS (MEP)
233713.23	02/16/21	REGISTERS AND GRILLES (MEP)
233719.43	02/16/21	SECURITY REGISTERS AND GRILLES

DIVISION 26 — ELECTRICAL

260519	02/16/21	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES (MEP)
260526	02/16/21	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS (MEP)
260529	02/16/21	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS (MEP)
260533	02/16/21	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS (MEP)
260543	02/16/21	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS (MEP)
260544	02/16/21	SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING (MEP)
260553	02/16/21	IDENTIFICATION FOR ELECTRICAL SYSTEMS (MEP)
260800	02/16/21	COMMISSIONING OF ELECTRICAL SYSTEMS (MEP)
262726	02/16/21	WIRING DEVICES (MEP)
262813	02/16/21	FUSES (MEP)
262816	02/16/21	ENCLOSED SWITCHES AND CIRCUIT BREAKERS (MEP)
265119	02/16/21	LED INTERIOR LIGHTING (MEP)
265219	02/16/21	EMERGENCY EXIT AND EXIT LIGHTING (MEP)
265613	02/16/21	LIGHTING POLES AND STANDARDS (MEP)
265619	02/16/21	LED EXTERIOR LIGHTING (MEP)
265668	02/16/21	EXTERIOR ATHLETIC LIGHTING (MEP)

DIVISION 32 — EXTERIOR IMPROVEMENTS

321823.53	02/16/21	TENNIS COURT SURFACING (L)
323116	02/16/21	WELDED WIRE FENCES AND GATES (L)
329113	02/16/21	SOIL PREPARATION (L)
329200	02/16/21	TURF AND GRASSES (L)

VOL. 4 of 4 08/2019 **MBE/WBE Procurement Program Package**

END

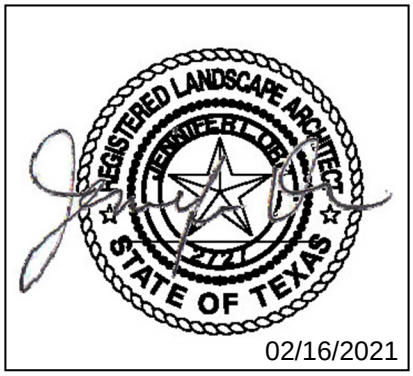
DOCUMENT 000107.2 – CIVIL SEAL PAGE

All sections identified on the Table of Contents with a suffix of (C) have been furnished by **JOSE GUERRA** (Civil Engineer) for this Project:

CIVIL SEAL

DOCUMENT 000107.3 – LANDSCAPE SEAL PAGE

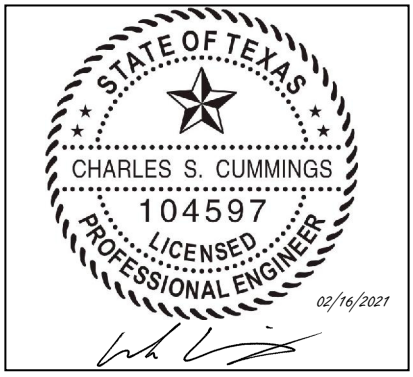
All sections identified on the Table of Contents with a suffix of (L) have been furnished by **STUDIO BALCONES** (Landscape Architect) for this Project:



LANDSCAPE SEAL

DOCUMENT 000107.4 – STRUCTURAL SEAL PAGE

All sections identified on the Table of Contents with a suffix of (S) have been furnished by **STRUCTURES** (Structural Engineer) for this Project:



STRUCTURAL SEAL

Item No. 104S
Removing Portland Cement Concrete

104S.1 Description

This item shall govern the demolition, removal and satisfactory disposal of existing Portland cement concrete, as classified, at locations indicated on the Drawings or as directed by the Engineer or designated representative.

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

104S.2 Submittals

The submittal requirements of this specification item may include:

A. A permit when utility adjustments are made in the right-of-way, and

B. A plan for removal and deposition of all 'broken up' existing Portland cement (p.c.) concrete materials and debris.

104S.3 Classification

Existing Portland cement concrete, when removed under this section, will be classified as follows:

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

104S.4 Materials

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

104S.5 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". A permit shall be required when utility adjustments are to be made in preparation for

highway construction, as specified in Section 5.2.0 of the City of Austin Utilities Criteria Manual.

The existing Portland cement concrete shall be broken up, removed in accordance with Item No. 101S, "Preparing Right of Way" and disposed of by the Contractor and deposited at a permitted disposal site.

When it is specified that only a portion of the existing Portland cement (p.c.) concrete is to be removed and that the remaining p.c. concrete will continue to serve its purpose, special care shall be exercised to avoid damage to that portion which will remain in place. Unless otherwise established by the Engineer or designated representative, existing p.c. concrete shall be cut to the neat lines, that are indicated on the Drawings, by sawing with an appropriate type circular type circular concrete saw to a minimum depth of 1/2 inch (12.5 mm). Any reinforcing steel encountered shall be cut off 1 inch (25 mm) inside of p.c. concrete sawed line. Any existing p.c. concrete, which is damaged or destroyed beyond the neat lines so established, shall be replaced at the Contractor's expense. Remaining p.c. concrete shall be mortared to protect the reinforcing steel and provide a neat clean appearance.

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

104S.6 Measurement

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

104S.7 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 "Remove P.C. Concrete Curb", "Remove P.C. Concrete Slab", "Remove P.C. Concrete Sidewalks and Driveways", "Remove P.C. Concrete Walls", "Remove P.C. Concrete Steps", "Remove P.C. Concrete Foundations" and "Remove Miscellaneous P.C. Concrete". The bid prices shall include full compensation for all Work herein specified, including the disposal of all material not required in the

Work, the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the Work.

Payment will be made under one of the following:

Pay Item No.	**104S-A:**	Remove P.C. Concrete Curb	Per Lineal foot.
Pay Item No.	**104S-B:**	Remove P.C. Concrete Slab	Per Square foot.
Pay Item No.	**104S-C:**	Remove P.C. Concrete Sidewalks and Driveways	Per Square foot
Pay Item No.	**104S-D:**	Remove P.C. Concrete Wall	Per Lineal foot.
Pay Item No.	**104S-E:**	Remove P.C. Concrete Steps	Per Lineal foot.
Pay Item No.	**104S-F:**	Remove P.C. Concrete Foundations	Per Each.
Pay Item No.	**104S-G:**	Remove Miscellaneous P.C. Concrete	Per Lump Sum.

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification Item 104S, "REMOVING CONCRETE"

City of Austin Standard Contract Documents

Designation	Description
00700	General Conditions

City of Austin Utilities Criteria Manual

Designation	Description
Section 5.2.0	Permit for Excavation in the Public Right-of-Way

City of Austin Standard Specifications

Designation	Description
Item No. 101S	Preparing Right of Way
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 403S	Concrete for Structures
Item No. 610S	Preservation of Trees and Other Vegetation

RELATED CROSS REFERENCE MATERIALS

City of Austin Standard Contract Documents

Designation	Description
01500	Temporary Facilities
01550	Public Safety and Convenience

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

Designation	Description
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

Designation	Description
Item No. 201S	Subgrade Preparation
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control

Item No. 622S	Diversion Dike
Item No. 628S	Sediment Containment Dikes
Item No. 642S	Silt Fence

RELATED CROSS REFERENCE MATERIALS - Continued
Specification Item 104S, "REMOVING CONCRETE"

City of Austin Standard Details

Designation	Description
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
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 (Flexible)
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

Designation	Description
Item No. 100	Preparing Right of Way
Item No. 104	Removing Concrete
Item No. 110	Excavation
Item No. 112	Subgrade Widening
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 420	Concrete Structures

Item No. 111S
Excavation

111S.1 Description

This item shall govern: (1) the excavation and proper utilization or satisfactory disposal of all excavated materials, of whatever character, within the limits of the Work and (2) construction, compaction, shaping and finishing of all designated earthwork areas in accordance with the specification requirements outlined herein and 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", No. 102S, "Clearing and Grubbing", No. 104S, "Removing Portland Cement Concrete", No. 132S "Embankment" and No. 201S, "Subgrade Preparation".

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.

111S.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.

111S.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.

111S.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 shall be protected as specified in the Standard Contracts Document 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 Specification Item No. 610S, “Preservation of Trees and Other Vegetation”.

All excavation shall be performed as specified herein and shall conform to the established alignment, grades and cross sections indicated on the Drawings. Suitable excavated

materials shall be utilized, insofar as practical, in constructing required embankments. The construction of all embankments shall conform to Specification Item No. 132S, "Embankment". No material shall be stockpiled within the banks of a waterway.

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 or designated representative, shall be replaced with material from the roadway excavation or with other suitable material as approved by the Engineer. 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 Provisions of the Standard Contract Document Section 01550, "Public Safety and Convenience". In all cases, a Blasting Permit must be obtained in advance from the City of Austin, Department of Public Works and Transportation.

Adequate dewatering and drainage of excavation shall be maintained throughout the time required to complete the excavation work.

111S.5 Measurement

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

(1) Method A

Measurement of the volume of excavation in cubic yards (cubic meters: 1 square meter is equal to 1.306 square yards) by the average end area methods. Cross-sectional areas shall be computed from the existing ground surface to the established line of the subgrade, as shown on typical sections in the Drawings, over the limits of the right of way or other work limits, including parkway slopes and sidewalk areas.

(2) Method B

Measurement of the volume of excavation in cubic yards (cubic meters: 1 square meter is equal to 1.306 square yards), based upon the average end area method taken from pre-construction cross sections and planned grades. The planned quantities for excavation will be used as the measurement for payment for this item.

111S.6 Payment

This item will be paid for at the contract unit bid price for "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 dewatering, drainage, subgrade preparation, unless otherwise indicated, 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. 111S-A:	Excavation	Per Cubic Yard.
Pay Item No. 111S-B:	Excavation, Plan Quantity	Per Cubic Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification Item 111S, "EXCAVATION"

City of Austin Standard Contract Documents

Designation	Description
00700	General Conditions
01550	Public Safety and Convenience

City of Austin Utilities Criteria Manual

Designation	Description
Section 5.2.0	Permit for Excavation in the Public Right-of-Way

City of Austin Technical Specifications

Designation	Description
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

RELATED CROSS REFERENCE MATERIALS
Specification Item 111S, "EXCAVATION"

City of Austin Standard Contract Documents

Designation	Description
01500	Temporary Facilities

City of Austin Standard Specifications

Designation	Description
Item No. 120S	Channel Excavation
Item No. 203	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. 622S	Diversion Dike
Item No. 628S	Sediment Containment Dikes
Item No. 642S	Silt Fence

City of Austin Standard Details

Designation	Description
No. 610S-1	Tree Protection Fence Locations
No. 610S-2	Tree Protection Fence, Type B Chainlink
No. 610S-3	Tree Protection Fence, Type B Wood
No. 610S-4	Tree Protection Fence, Modified Type A

No. 610S-5	Tree Protection Fence, Modified Type B
No. 621S-1	Diversion
No. 622S-1	Diversion Dike
No. 624S-1	Earth Outlet Sediment Trap
No. 625S-1	Grade Stabilization Structure
No. 627S-1	Grass Lined Swale
No. 627S-2	Grass Lined Swale With Stone Center
No. 628S	Triangular Sediment Filter Dike

City of Austin Standard Details

Designation	Description
No. 628S-1	Hay Bale Dike
No. 629S-1	Brush Berm
No. 630S-1	Interceptor Dike
No. 631S-1	Interceptor Swale
No. 632S-1	Storm Inlet Sediment Trap
No. 633S-1	Landgrading
No. 634S-1	Level Spreader
No. 635S-1	Perimeter Dike
No. 636S-1	Perimeter Swale
No. 637S-1	Pipe Slope Drain (Flexible)
No. 637S-2	Pipe Slope Drain (Flexible)
No. 638S-1	Pipe Outlet Sediment Trap
No. 639S-1	Rock Berm
No. 641S-1	Stabilized Construction Entrance
No. 642S-1	Silt Fence
No. 643S-1	Stone Outlet Structure
No. 644S-1	Stone Outlet Sediment Trap

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

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

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

Designation	Description
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

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
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. 201S
Subgrade Preparation

201S.1 Description

This item shall govern scarifying; blading and rolling the subgrade to obtain a uniform texture and provide as nearly as practicable a uniform density for the top 6 inches (150 mm) of the subgrade.

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.

201S.2 Submittals

The submittal requirements of this specification item may include:

A. A plan identifying classification and characteristics (P.I., optimum moisture-density, etc.) of insitu subgrade soils, as well as the source, classification and characteristics of any proposed borrow material,
B. Type and size of equipment proposed to produce the required compaction, and
C. Compaction (moisture-density, etc) test results for in-situ subgrade soils and/or borrow materials.

201S.3 Construction Methods

Prior to initiation of subgrade preparation activities, all operations involving Standard Specification Item No. 101S," Preparing Right of Way" and/or Standard Specification Item No. 102S, "Clearing and Grubbing" shall be completed. The surface of the subgrade shall be scarified and shaped in conformity with the typical sections and the lines and grades indicated on the Drawings; by the removal of existing material or addition of approved material as established by the Engineer or designated representative. Any deviation in the subgrade cross section which exceeds 1/2 inch in a length of 10 feet (12 mm in a length of 3 meters), measured longitudinally, shall be corrected by loosening, adding or removing material, and then reshaping and compacting by sprinkling and rolling.

All unsuitable material shall be removed and replaced with approved material. All foundations, walls or other objectionable material shall be removed in accordance with Standard Specification Item No. 104S, "Removing Portland Cement Concrete" to a minimum depth of 18 inches (450 mm) under all structures and 12 inches (300 mm) under areas to be vegetated. All holes, ruts and depressions shall be filled with approved material and compacted by approved methods.

The subgrade shall be prepared sufficiently in advance to insure satisfactory prosecution of the Work. The Contractor will be required to set blue tops for the subgrade on the centerline, at the quarter points and along the curb lines or edge of pavement at maximum intervals of 50 feet (15 meters). The subgrade shall be tested by proof rolling

in conformity with Standard Specification Item No. 236S, "Proof Rolling" prior to placement of the first course of base material. Any unstable or spongy subgrade areas identified by proof rolling shall be corrected either by additional re-working, drying and compaction, or by removal and replacement of unsuitable materials. When specifically directed by the Engineer or designated representative, the Contractor shall re-work the subgrade* as follows:

A. Remove the unstable subgrade to the full depth of the unstable insitu material or to a minimum depth of 6 inches (150 mm), whichever is greater;
B. Spread the material over a sufficient area to allow reworking of the excavated material;
C. Disc, scarify or otherwise breakup the excavated material and allow to dry (Note: If approved by the Engineer or designated representative, the addition of lime or other additive may be used to aid in the drying process or to stabilize the unstable material);
D. Fill the excavated area with the re-worked material and compact to specified densities; and
E. Proof roll the re-worked area.

* The Rework process will not be allowed for unstable organic subgrade soils. These type soils will be permanently removed and replaced with materials approved by the Engineer or designated representative.

All suitable material removed in accordance with Standard Specification Item No, 111S, "Excavation", may be utilized in the subgrade with the approval of the Engineer or designated representative. All other material required for completion of the Subgrade, including those defined in accordance with Specification Item No. 130S, "Borrow", shall also be subject to approval by the Engineer or designated representative.

It is the intent of this specification to provide the required density and moisture control for the subgrade based on the plasticity characteristics of the approved materials. The subgrade materials shall be sprinkled as required and compacted to the extent necessary to provide the density specified below, unless otherwise indicated on the Drawings. The Plasticity Index (P.I.) will be established in accordance with TxDOT Test Methods Tex-104-E, Tex-105-E and Tex-106-E. The density determination will be made in accordance with TxDOT Test Method Tex-114-E and field density measurements will be made in accordance with TxDOT Test Method Tex-115-E.

Description	Density, Percent	Moisture
Non-swelling Soils (P.I. less than 20)	Not less than 95	
Swelling Soils (P.I. between 20 and 35)	Not less than 95 nor more than 102	Not less than optimum
Swelling Soils (P.I. greater than 35)	Not less than 95 nor more than 100	Not less than optimum

Subgrade materials on which planting or turf will be established shall be compacted to a minimum of 85 percent of the density as determined in accordance with TxDOT Test

Method Tex-114-E. Field tests for density in accordance with TxDOT Test Method Tex-115-E will be made as soon as possible after compaction operations are completed. If the material fails to meet the density specified, it shall be reworked as necessary to obtain the density required.

Prior to placement of any base materials, the in-place density and moisture content of the top 6 inches (150 mm) of compacted subgrade shall be checked. If the tests indicate that the relative density and moisture do not meet the limits specified in the table above, the subgrade shall be reworked as necessary to obtain the specified compaction and moisture content. All initial testing will be paid for by the City of Austin. All retesting shall be paid for by the Contractor.

201S.4 Measurement

All acceptable subgrade preparation when included in the contract as a separate pay item, will be measured by the square yard (square meter: 1 square meter equals 1.196 Square yards). The measured area includes the entire width of the roadway for the entire length as indicated on the Drawings.

201S.5 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 as a separate pay item in the contract bid form, subgrade preparation shall be measured as specified above and paid for at the contract unit bid price for "Subgrade Preparation". The bid price shall include full compensation for all work herein specified, including the furnishing of all materials, equipment, tools and labor and incidentals necessary to complete the work.

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

Pay Item No. 201S: Subgrade Preparation Per Square Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification Item 201S, "SUBGRADE PREPARATION"

City of Austin Standard Specification Items

Designation	Description
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Portland Cement Concrete
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 130S	Borrow
Item No. 236S	Proof Rolling

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
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 & Moisture Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils & Base Materials

RELATED CROSS REFERENCE MATERIALS

City of Austin Standard Specifications

Designation	Description
Item No.132S	Embankment

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

Designation	Description
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. 204	Sprinkling
Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 213	Rolling (Pneumatic Tire)

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex-103-E	Determination of Moisture Content of Soil Materials

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[1]	Tex-105-E
d) Plasticity Index	Tex-106-E
e) Sieve Analysis	Tex-110-E
f) Wet Ball Mill[2]	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	
3/8"	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 and 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.

End

SPECIFIC CROSS REFERENCE MATERIALS

City of Austin Standard Specifications

Designation	Description
Item No. 201S	Subgrade Preparation
Item No. 236S	Proof Rolling
Item No. 306S	Prime Coat

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

Designation	Description
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

RELATED CROSS REFERENCE MATERIALS

City of Austin Standard Details

Designation	Description
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

City of Austin Utility Criteria Manual

Designation	Description
Section 5.8.2	Flexible Base
Section 5.7.3	Flexible Base with Asphalt Surface
Section 5.9.1	Excavation in Alley

City of Austin Transportation Criteria Manual

Designation	Description
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. 236S
Proof Rolling

236S.1 Description

This item shall govern furnishing and operating heavy pneumatic tired compaction equipment for locating unstable areas of embankment, subgrade and flexible base courses.

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.

236S.2 Submittals

The submittal requirements of this specification item may include:

A. A plan describing the condition of each roller proposed for the work, as well as the type of traction (self propelled or drawn), Type of roller, size, weight, tire pressure (if appropriate) and configuration of each individual roller, and

B. The operating speed proposed for each individual roller.

236S.3 Equipment

A. Standard Proof Roller:

The proof rolling equipment shall have a loading platform or body suitable for ballast loading that is supported on a minimum of two (2) axles with not more than two (2) pneumatic tired wheels per axle. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces. Pneumatic proof rolling equipment with multiple pivotal axles and more than two tires along the front or rear axle axis shall have articulating axle supports to equally distribute the load to all tires over uneven surfaces.

The proof roller unit, under working conditions, shall have a minimum contact width of 7-1/2 feet (2.3 meters) and shall be so designed that the gross roller weight may be varied uniformly from 25 tons to 50 tons (23 megagrams to 45 megagrams) by ballast loading. The tires shall be capable of operating under various loads with variable air pressures up to 145 psi (up to 1000 kiloPascals). The tires shall be smooth tread and shall impart a minimum ground contact pressure of 75 pounds per square inch (520 kiloPascals). Tires shall be practically full of liquid (i.e. when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position). The operating load and tire pressure shall be within the range of the manufacturer's chart as directed by the Engineer or designated representative.

The proof roller shall be drawn by a power train of adequate tractive effort or may be of a self-propelled type. The proof rolling equipment shall be equipped with a reverse mode transmission or be capable of turning 180 degrees in the street width. When a separate power train is used to draw the proof roller, the power train weight shall not be considered in the weight of the proof roller. The power train shall be rubber-tired when rolling subgrade and base materials. A cleated or track-type power train may be used on earth and rock embankments.

B. Alternate Equipment:

With the written approval of the Engineer or designated representative, the Contractor may utilize alternate equipment on embankment courses, subgrade and base courses subject to the requirements of the standard proof roller except with respect to minimum contact width, axle/tire arrangement and tire tread.

Alternate equipment for stability testing of embankments shall be restricted to equipment that can be shown to impart a stress distribution on the embankment structure equivalent to or greater than the stress induced by the concentrated weight of a standard proof roller.

C. Equipment Submittals:

All standard proof rollers and proposed alternate equipment must be approved by the Engineer or designated representative prior to their use. The Contractor shall furnish the Engineer or designated representative with charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished.

Alternate equipment submittals for proof rolling of embankments shall be signed and sealed by a registered Professional Engineer licensed in the State of Texas.

236S.4 Construction Methods

A. General:

Within the ranges set forth in Section 236S.3, the load and tire inflation pressures shall be adjusted as directed by the Engineer or designated representative. It is proposed to use a contact pressure corresponding as nearly as practical to the maximum supporting value of the earthwork or base. The entirety of prepared surfaces to be tested by this method shall be proof rolled by a minimum of two passes of the proof roller tires. Each succeeding trip of the proof roller shall be offset by not greater than one tire width.

When alternate equipment is proposed and only one axle meets minimum requirements, only the qualifying axle shall be used to proof roll. If the operation of the proof roller shows an area to be unstable, the substandard area shall be brought to satisfactory stability and uniformity by additional curing, compaction, or by removal and replacement of unsuitable materials. The re-worked area shall then be proof rolled.

Proof rollers shall be operated at speeds between 2 and 6 miles per hour (3 and 10 kilometers per hour) or as directed by the Engineer or designated representative.

Acceptable limits of elastic and plastic deformation of prepared subgrade courses shall be established by proof rolling Test Sections of representative soil conditions, previously tested and approved for density and moisture requirements of the governing subgrade and earth embankment items. Proof rolling of first course base over a plastic subgrade may be waived by the Engineer or designated representative if it is determined that the prepared first course base will be damaged by the proof roller.

B. Roadway Construction:

The subgrade and all lifts of base material shall be proof rolled in new roadway construction and in the reconstruction of existing streets. Proof rolling of the curb course base shall be substituted for proof rolling of final course base at the direction of the Engineer or designated representative. Proof rolling may be waived by the Engineer or designated representative where construction is limited to turn lanes, street widening less than 7-1/2 feet (2.3 meters) in width, or where the site is otherwise congested.

C. Trenches:

Trenches shall be proof rolled where no limitations to the operation of the proof roller exist as may be determined by the Engineer subject to the provisions hereunder.

All trenches shall be proof rolled in new roadways or in existing roadways under reconstruction. Trenches shall be proof rolled at the street subgrade elevation by longitudinal and perpendicular passes of the roller as may be dictated by the width of the trench.

Proof rolling of trenches in existing paved streets shall be limited to pavement cross-sections capable of sustaining the weight of the proof rolling equipment without imparting damage to the remaining pavement structure as determined by the Engineer. Trenches less than 4 feet (1.2 meters) in width shall be exempted of all proof rolling requirements. Only the final course base shall be proof rolled in trenches 4 feet (1.2 meters) or wider but narrower than the proof roller contact width. The subgrade, the first course and the final course base shall be proof rolled in trenches 7-1/2 feet (2.3 meters) or wider.

D. Embankment Construction:

All embankment courses shall be proof rolled, unless otherwise directed by the Engineer or designated representative.

If required by the Engineer or designated representative, stability testing of embankments constructed to the finished cross-section and elevation or to interim elevations shall either be conducted with a standard proof roller or alternate equipment, which can be proven to impart a horizontal and vertical pressure distributions equivalent to or greater than those induced by a standard proof roller.

236S.5 Measurement and Payment

No direct payment will be made for the materials, equipment or labor required by this item, but shall be included in the unit price bid for the item of construction in which this item is used.

End

RELATED CROSS REFERENCE MATERIALS
Specification Item 236S, “Proof Rolling”

City of Austin Contract Documents

Designation	Description
Section 00700	General Conditions

City of Austin Standard Specifications

Designation	Description
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

RELATED CROSS REFERENCE MATERIALS-Continued
Specification 236S, “Proof Rolling”

City of Austin Standard Specifications

Designation	Description
Item No. 201S	Subgrade Preparation
Item No. 202S	Hydrated Lime and Lime Slurry
Item No. 203S	Lime Treatment for Materials in Place
Item No. 204S	Portland Cement Treatment For Materials in Place
Item No. 206S	Asphalt Stabilized Base (Plant Mix)
Item No. 210S	Flexible Base
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 234S	Rolling (Tamping)
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 306S	Prime Coat
Item No. 307S	Tack Coat
Item No. 310S	Emulsified Asphalt Treatment
Item No. 320S	Two Course Surface Treatment
Item No. 340S	Hot Mix Asphaltic Concrete Pavement
Item No. 402S	Controlled Low Strength Material
Item No. 403S	Concrete for Structures

City of Austin Standard Details

Designation	Description
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

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

Designation	Description
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. 204	Sprinkling
Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 213	Rolling (Pneumatic Tire)
Item No. 264	Lime and Lime Slurry
Item No. 300	Asphalts, Oils and Emulsions
Item No. 301	Asphalt Anti-stripping Agents
Item No. 310	Prime Coat (Cutback Asphaltic Materials)
Item No. 314	Emulsified Asphalt Treatment
Item No. 316	Surface Treatments
Item No. 345	Asphalt Stabilized Base (Plant Mixed)

RELATED CROSS REFERENCE MATERIALS-Continued
Specification 236S, “Proof Rolling”

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex-101-E	Surveying and Sampling Soils for Highways
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 & Moisture Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils & Base Materials
Tex-117-E	Triaxial Compression Tests for Disturbed Soil and Base Materials
Tex-120-E	Soil Cement Testing
Tex-121-E	Soil Lime Testing
Tex-126-E	Molding, Testing and Evaluation of Bituminous Black Base Materials
Tex-207-F	Determination of Density of Compacted Bituminous Mixtures
Tex-210-F	Determination of Asphalt Content of Bituminous Mixtures
Tex-600-J	Sampling and Testing of Hydrated Lime, Quicklime & Commercial Lime Slurry

Item No. 340S
Hot Mix Asphaltic Concrete Pavement

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 3/8 inch (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
1-1/2" (37.5 mm)	100				
1-1/4" " (31 mm)	95-100				
1" (25 mm)		100			
7/8" (22 mm)	70-90	95-100	100		
5/8 (15.5 mm)"		75-95	95-100		
1/2" (12.5 mm)	50-70			100	
3/8" (9.5 mm)		60-80	70-85	85-100	100
1/4" (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)	1-3/4" (45 mm)	1" (25 mm)	3/4" (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.	Laboratory Density (%) Max.	Stability
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 1/2-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.

340S10 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 1-1/2 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 1-1/2 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 ravels, 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). Payment for this work will be measured and paid for as Mobilization (LS) and Crack Sealing (LF).

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). Payment for this Work will be measured and paid for as Mobilization (LS) and Crack Sealing (LF).

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, PartII)

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	1-1/2" (38 mm) Thickness or Greater	Less than 1-1/2" (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	1-1/2" (38 mm) Thickness or Greater	Less than 1-1/2" (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

SPECIFIC CROSS REFERENCE MATERIALS
Special Specification Item 340S "Hot Mix Asphaltic Concrete Pavement"

City of Austin Standard Specifications

Designation	Description
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)

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
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

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

Designation	Description
Item 340	Hot Mix Asphalt Concrete Pavement

RELATED CROSS REFERENCE MATERIALS
Special Specification Item 340S "Hot Mix Asphaltic Concrete Pavement"

City of Austin Standard Specifications

Designation	Description
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

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
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. 360S
Concrete Pavement

360S.1 Description

This item shall consist of a pavement and/or base of Portland Cement concrete, with or without reinforcement as indicated on the Drawings, with or without monolithic curbs, constructed as herein specified, on prepared subgrade or base course in conformity with the thickness and typical cross sections indicated on the Drawings. Concrete to be considered of satisfactory quality provided it is made (a) of materials accepted for job, (b) in the proportions established by the Contractor and (c) mixed, placed, finished and cured in accordance with the requirements of this specification.

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.

360S.2 Submittals

The submittal requirements of this specification item may include:

Mix design option(s) of the class of concrete required on the project,

The supplier of the concrete mix design(s) and type of mixing equipment, and

Type of admixtures to be used with the concrete mixes.

360S.3 Materials

A. Cementatious Materials

Portland cement shall conform to ASTM C 150, Type I (General Purpose) and Type III (High Early Strength). Type III cement shall be used when high early strength concrete is indicated on the Drawings. If the use of high early cement is not specified and the Contractor desires to use it, the Contractor shall obtain written permission from the Engineer or designated representative prior to its use and shall assume all additional costs incurred by the use of such cement. All cement shall be of the same type and from the same source for a project unless written permission if first received from the Engineer or designated representative.

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

Bulk or sacked cement may be used and a bag shall contain 94 pounds (42.6 KG) net. All bags shall be in good condition at the time of inspection. Bulk cement shall be weighed on approved scales as herein prescribed.

All cement shall be stored in a suitable weather tight building or bin, which will protect the cement from dampness. The cement shall be so stored as to provide easy access for proper inspection. Any cement, which has become partially set or which contains hard lumps or cakes or cement salvaged from discarded or used bags, shall not be used.

Fly ash (denoted by Texas DOT designations Type A and Type B) may replace 20 to 35 percent of a mix design's Portland cement content by absolute volume. Fly ash shall not be used in mix designs with less that five (5) sacks of Portland cement per cubic yard [six and a half (6.5) sacks of Portland cement per cubic meter] unless specifically permitted by the Contract plans of project manual. Fly ash shall conform to the requirements of Item 405S, "Concrete Admixtures".

B. Admixtures

Concrete admixtures conforming to Item No. 405S, "Concrete Admixtures" may be used when approved by the Engineer or designated representative to minimize segregation, improve workability, reduce the amount of mixing water and to provide normal hot weather concreting provisions. The use of admixtures shall not alter the approved mix designs, except for water content.

C. Coarse Aggregate

Coarse aggregate shall consist of durable particles of gravel, crushed blast furnace slag and/or crushed stone of reasonably uniform quality throughout, free from injurious amounts of salt, alkali, vegetable matter or other objectionable material, either free or as an adherent coating on the aggregate. It shall not contain more than 0.25 percent by weight of clay lumps nor more than 1.0 percent by weight of shale nor more than 5.0 percent by weight of laminated and/or friable particles when tested in accordance with TxDOT Test Method Tex-413-A.

Coarse aggregate shall have a wear of not more than 45 percent when tested according to TxDOT Test Method Tex-410-A and when tested by standard laboratory methods shall meet the following grading requirements:

Retained on 1 3/4 inch (43.75 mm) sieve	0%
Retained on 1 1/2 inch (37.5 mm) sieve	0 to 5%
Retained on 3/4 inch (19.0 mm)sieve	30 to 65%
Retained on 3/8 inch (9.5 mm) sieve	70 to 90%
Retained on No. 4 (4.75 mm) sieve	95 to 100%

Loss by Decantation TxDOT Test Method *Tex-406-A. 1.0% Maximum

* In the case of aggregate made primarily from crushing of stone. If the material finer than the 200 sieve is definitely established to be the dust of fracture

essentially free from clay or shale as established by Part III of TxDOT Test Method Tex-406-A, the percent may be increased to 1.5.

When the plans do not require a monolithic pour of curb or curb and gutter, the Contractor may elect to use the following gradation of coarse aggregate for curb or curb and gutter:

Retained on 1 1/2 inch (37.5 mm) sieve	0%
Retained on 3/8 inch (9.5 mm) sieve	5 to 30%
Retained on No. 4 (4.75 mm) sieve	75 to 100%

Where the coarse aggregate is delivered on the job in 2 or more sizes or types, each type and/or size shall be batched and weighed separately.

All aggregates shall be handled and stored in such a manner as to prevent size segregation and contamination by foreign substances and maintain as nearly as possible in a uniform condition of moisture. When segregation is apparent, the aggregate shall be remixed with suitable equipment as required. At time of its use, the aggregate shall be free from frozen material and aggregate containing foreign materials will be rejected. Coarse aggregate that contains more than 0.5 percent free moisture by weight shall be stockpiled for at least 24 hours prior to use.

Adequate storage facilities shall be provided for approved materials. The intermixing of non-approved materials with approved materials either in stockpiles or in bins will not be permitted. Aggregates from different sources shall be stored in different stockpiles unless otherwise approved by the Engineer or designated representative.

D. Fine Aggregate

Fine aggregate shall be free from injurious materials of salt, alkali or vegetable matter. It shall not contain more than 0.5 percent by weight of clay lumps. When subjected to the color test for organic impurities, TxDOT Test Method Tex-408-A, the fine aggregate shall not show a color darker than standard.

Unless shown otherwise on the drawings, fine aggregate shall have an acid insoluble residue of at least 60% by weight when tested in accordance with Tex 612-J.

Unless specified otherwise, fine aggregate shall meet the following grading requirements:

Retained on 3/8 inch (9.5 mm) sieve	0%
Retained on No. 4 (4.75 mm) sieve	0 to 5%

Retained on No. 8 (2.36 mm) sieve	0 to 20%
Retained on No. 16 (1.185 mm) sieve	15 to 30%
Retained on No. 30 (600 µm) sieve	35 to 75%
Retained on No. 50 (300 µm) sieve	70 to 90%
Retained on No. 100 (150 µm) sieve	90 to 100%
Retained on No. 200 (75 µm) sieve	97 to 100%

Fine aggregate will be subjected to the Sand Equivalent Test, TxDOT Test Method Tex-203-F. The sand equivalent value shall not be less than 80.

E. Mineral Filler

Mineral filler shall consist of clean stone dust, crushed sand, crushed shell or other approved inert material. It shall meet the following requirements when tested in accordance with TxDOT Test Method Tex-401-A:

Retained on No. 30 (600 µm) sieve	0%
Retained on No. 200 (75 µm) sieve	0 to 35%

Where fine aggregate is delivered to the job in 2 or more sizes or types, each type and/or size of material shall be batched and weighed separately. Where mineral filler is used, it shall be batched and weighed separately. At the time of its use the fine aggregate shall be free from frozen material and aggregate containing foreign material will be rejected.

All fine aggregate shall be stockpiled for at least 24 hours prior to use.

F. Mixing Water

Water for use in concrete and for curing shall be free from oils, acids, organic matter or other deleterious substances and shall not contain more than 1,000 parts per million of chlorides as Cl nor more than 1,000 parts per million of sulfates as SO4.

Water from municipal supplies approved by the State Health Department will not require testing. Contractor shall sample and test water from other sources and submit test results to the Engineer or designated representative for approval 10 days prior to proposed use.

Tests shall be made in accordance with "Standard Method of Test for Quality of Water to be used in Concrete", AASHTO Method T-26.

G. Transit-mixed Concrete

The use of transit-mixed (ready-mixed) concrete will be permitted by the Engineer or designated representative provided the batching plant and mixer trucks meet requirements of quality specified herein.

When ready-mixed concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to each batch to coat the drum of the mixer or agitator truck. Delivery of concrete to the site of the work and its discharge from the truck mixer, agitator or non-agitating equipment shall be in accordance with the requirements of Item No. 410S, "Concrete Structures".

Ready-mixed concrete, batching plant and mixer truck operation shall include the following:

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

2) Sufficient trucks will be available to support continuous slab placements. The Contractor will satisfy the Engineer or designated representative that adequate standby trucks are available to support monolithic placement requirements.

3) A portion of the mixing water, required by the batch design to produce the specified slump, may be withheld and added at the job site but only with the permission of the Engineer or designated representative and under the Inspector's observation. When water is added under these conditions, it will be thoroughly mixed before any slump or strength samples are taken.

H. Joint Sealer

Unless otherwise shown on the plans, joint sealant for concrete pavement used on airport runways and/or taxiways shall be TxDOT Class 5. All other joint sealant shall be TxDOT Class 2.

As a minimum, the joint sealant shall comply with the following. The manufacturer of the joint sealant shall furnish certification that the product to be supplied meets or exceeds the specification.

1) Class 2 (Hot Poured Rubber-Asphalt). This sealer shall conform to Standard Specification Item No. 313S, “Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)The sealer must be compatible with asphaltic concrete.

2) Class 5 (Low Modulus Silicone Sealant for Concrete Pavement). This material shall conform to Item 413S, “Cleaning and/or Sealing Joints and Cracks (PCC) and shall be furnished in a one-part silicone formulation, which does not require a primer for bond to concrete. A backer rod shall be

required which will be compatible with the sealant. No bond or reaction shall occur between the rod and sealant. The sealant shall adhere to the sides of the concrete joint. It shall not crack or break when exposed to temperatures below 32°F (0°C).

The sealant material shall have the following properties:

Color	Gray
Flow, MIL-2-8802D, Sec 4.8.4, max	0.2
Working time, minutes	10
Tack-free time at 77° F +/- 2 o F (25°C +/- 1.1^{o}C), MIL-2-8802D,	
Sec 4.8.7, minutes	60
Cure time at 77°F (25oC), days	7-14
Full Adhesion, days	14-21

As Cured - after 7 days at 77°F (25°C), and 40% Relative Humidity

Elongation, minimum percent	1200
Durometer Hardness, Shore A, ASTM D 2240, min	15
Joint movement capability, percent	+100/-50
Tensile Strength, maximum elongation, percent	100
Peal strength, psi	25 (172 kPa)

I. Backer Rod

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

J. Joint Filler

Boards for expansion joint filler and for contraction and longitudinal joints shall be of the size, shape and type indicated.

Board shall be obtained from Redwood, Cypress, Gum, Southern Yellow Pine or Douglas Fir timber. They shall be solid heartwood and shall be free from sapwood, knots, clustered birdseye, checks and splits. Occasional sound or hollow birdseye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler. With the exception of Redwood and Cypress, all boards shall have a creosote or pentachlorophenol treatment of 6 pounds per cubic foot (96 kg/m3). When oven dried at 230°F (110oC) to a constant weight, the weight of the board per cubic foot (minus treatment), shall not be less than 20 pounds nor more than 35 pounds (not less than 320 nor more than 561 kgs per cubic meter).

K. Asphalt Board

Asphalt board when used as indicated shall be of required size, full depth of concrete placement and uniform thickness. When used in transverse joints, it shall conform approximately to shape of the pavement crown as indicated. Asphalt board shall consist of 2 liners of 0.016-inch (0.4 mm) asphalt impregnated paper filled with a mastic mixture of asphalt and vegetable fiber and/or mineral filler. Boards shall be smooth, flat and straight throughout and shall be sufficiently rigid to permit easy installation. Boards that crack or shatter during installing and finishing operations will not be acceptable. Board shall be furnished in lengths equal to 1/2 the pavement width or in lengths equal to the width between longitudinal joints and may be furnished in strips or scored sheets of the required shape. When tested in accordance with TxDOT Test Method Tex-524-C the asphalt boards shall not deflect from the horizontal more than 3/4 inch in 3 1/2 inches (19.3 cm in 90 cm). The asphalt board shall be placed such that they will not interfere with the bonding of the joint sealer.

L. Load Transmission Devices for Expansion and Contraction Joints

Approved load transmission devices, when indicated, shall meet the requirements specified herein:

Smooth steel bar dowels, used when indicated, shall be of the size and type indicated and shall be open-hearth, basic oxygen or electric-furnace steel conforming to the properties specified for grade 60 in ASTM A 615. The free end of dowel bars shall be smooth and free of shearing burrs.

When indicated, one end of each dowel bar shall be encased in an approved cap having an inside diameter of 1/16 inch (16 mm) greater than the diameter of the dowel bar. The cap shall be of such strength, durability and design as to provide free movement of the dowel bar and shall be approved by the Engineer or designated representative prior to use. One end of the cap shall be filled with a soft felt plug or shall be void in order to permit free movement of the dowel bar for a distance equivalent to 150 percent of the width of the expansion joint used. The dowel caps and dowel bars shall be held securely in place by bar ties as indicated on the drawings. Mechanical methods of implanting dowel bars in the plastic concrete may be used when approved by the Engineer or designated representative.

Where required, dowel bars shall be coated with a plastic material meeting the requirements indicated.

Where red lead and oil bar coating is indicated, the red lead may be of any standard commercial grade and the oil shall be clean and no lighter than Standard No. 30 SAE grade. Approved thinner and dryer may be added to the red lead, but the material upon application shall be of such consistency that will provide a uniform and heavy coating on the bar. Where asphalt bar coating is indicated, the material may be any standard grade of oil asphalt and shall be applied hot. Cutback asphalt will not be permitted for bar coating.

M. Metal Installing Devices for Joint Assembly

Metal installing devices for expansion and contraction joint assemblies (such as welded wire bar chairs, bar stakes and marker channels, channel caps, etc.) shall be as indicated or may be similar devices of equivalent or greater strength, approved by the Engineer or designated representative, that will secure joint assembly in correct position during the placing and finishing of concrete. Load transmission devices used in joint assemblies shall be secured in position by a transverse metal brace of the type and design indicated or may be secured in position by other approved devices of equivalent or greater strength that will provide positive mechanical connection between the brace and each unit (or than by wire tie) and prevent transverse movement of each load transmission device.

N. Steel Reinforcement

Steel reinforcing bars as required including tie bars shall be open-hearth, basic oxygen or electric-furnace new billet steel of Grade 60 or Grade 40 for concrete reinforcement as indicated. Bars that require bending shall be Grade 40 conforming to the requirements of ASTM A 615.

High yield reinforcing steel shall be either (a) open-hearth, basic oxygen or electric-furnace new billet steel conforming to ASTM A 615 Grade 60 or (b) rail steel bars for concrete reinforcement, conforming to ASTM A 616 Grade 60. Bars produced by piling method will not be accepted. High yield reinforcing steel bars shall be further identified by a special marking rolled into each bar. All reinforcing steel shall be deformed bars conforming to the requirements of pertinent ASTM Specifications.

Where prefabricated deformed wire mats are indicated or permitted, the wire shall be cold worked deformed steel wire conforming to the requirements of ASTM A 496, except that steel shall be made by open-hearth, electric-furnace or basic oxygen processes. The prefabricated deformed wire mats shall conform to the requirements of ASTM A 497, except that wires used shall be deformed and transverse wires shall project beyond the centerline of each edge longitudinal wire as indicated. Mats that have been bent or wires dislocated or parted during shipping or project handling shall be realigned to within 1/2 inch (13 mm) of original horizontal plane of the mat. Mats with any portion of the wires out of vertical alignment more than 1/2 inch (13 mm) after realignment and/or wires dislocated or mutilated so that, in the opinion of the Engineer, they do not represent the original mat, shall be rejected. The reinforcement may be clamped or wired so that the reinforcement will retain the horizontal and vertical alignment as indicated or as approved by the Engineer or designated representative. Deformed wire may be

used for tie bars and load transfer bars that require bending. The nominal size, area and theoretical weight of reinforcing steel wires covered by this provision are as listed in Table II. When fabricated steel bars or rod mats are indicated, the mats shall meet requirements of ASTM A 184.

Steel wire fabric reinforcement shall be of the gage and spacing indicated and shall conform to the requirements of ASTM A 82. Longitudinal and transverse wires shall be electrically welded together at all points of intersection and the welds shall be of sufficient strength that they will not be broken during handling or placing. All welding and fabrication of fabric sheets shall conform to the requirements of ASTM A 185. Welded steel wire fabric shall be furnished in sheets as indicated and steel having been previously bundled into rolls will not be accepted. An approved hinge will be permitted in each sheet to provide for each sheet longitudinally. When wire fabric is used, it will replace only the longitudinal and transverse bars. The tie bars and load transmission units at joints will not be affected.

Table II: DIMENSIONAL REQUIREMENTS FOR DEFORMED STEEL WIRE FOR CONCRETE REINFORCEMENT

Deformed Wire	Unit Weight	Diameter	Cross-Sectional Area,	Perimeter
Size No	Pounds Per Ft. (Kgs per Meter)	Inches (Centimeters)	Sq. inches (Sq, Centimeters)	Inches (Centimeters)
D-1	0.034 (.051)	0.113 (.287)	0.01 (.06)	0.355 (.902)
D-2	0.068 (.101)	0.159 (.404)	0.02 (.13)	0.499 (1.267)
D-3	0.102 (.152)	0.195 (.495)	0.03 (.19)	0.612 (1.554)
D-4	0.136 (.202)	0.225 (.572)	0.04 (.26)	0.706 (1.793)
D-5	0.170 (.253)	0.252 (.640)	0.05 (.32)	0.791 (2.009)
D-6	0.204 (.304)	0.276 (.701)	0.06 (.39)	0.867 (2.202)
D-7	0.238 (.354)	0.296 (.752)	0.07 (.45)	0.936 (2.377)
D-8	0.272 (.405)	0.319 (.810)	0.08 (.52)	1.002 (2.545)
D-9	0.306 (.455)	0.338 (.859)	0.09 (.58)	1.061 (2.695)
D-10	0.340 (.506)	0.356 (.904)	0.10 (.65)	1.118 (2.840)

D-11	0.374 (.557)	0.374 (.950)	0.11 (.71)	1.174 (2.982)
D-12	0.408 (.607)	0.390 (.991)	0.12 (.77)	1.225 (3.112)
D-13	0.442 (.658)	0.406 (1.031)	0.13 (.84)	1.275 (3.239)
D-14	0.476 (.708)	0.422 (1.072)	0.14 (.90)	1.325 (3.366)
D-15	0.510 (.759)	0.437 (1.110)	0.15 (.97)	1.372 (3.485)
D-16	0.544 (.810)	0.451 (1.146)	0.16 (1.03)	1.416 (3.600)
D-17	0.578 (.860)	0.465 (1.181)	0.17 (1.10)	1.460 (3.708)
D-18	0.612 (.911)	0.478 (1.214)	0.18 (1.16)	1.501 (3.813)
D-19	0.646 (.961)	0.491 (1.247)	0.19 (1.23)	1.542 (3.917)
D-20	0.680 (1.012)	0.504 (1.280)	0.20 (1.29)	1.583 (4.021)
D-21	0.714 (1.063)	0.517 (1.313)	0.21 (1.35)	1.624 (4.125)
D-22	0.748 (1.113)	0.529 (1.344)	0.22 (1.42)	1.662 (4.221)
D-23	0.782 (1.164)	0.541 (1.375)	0.23 (1.48)	1.700 (4.318)
D-24	0.816 (1.214)	0.553 (1.405)	0.24 (1.55)	1.737 (4.412)
D-25	0.850 (1.265)	0.564 (1.433)	0.25 (1.61)	1.772 (4.500)
D-26	0.884 (1.316)	0.575 (1.461)	0.26 (1.68)	1.806 (4.587)
D-27	0.918 (1.366)	0.586 (1.488)	0.27 (1.74)	1.841 (4.676)
D-28	0.952 (1.417)	0.597 (1.516)	0.28 (1.81)	1.876 (4.765)
D-29	0.986 (1.467)	0.608 (1.544)	0.29 (1.87)	1.910 (4.851)
D-30	1.020 (1.518)	0.618 (1.570)	0.30 (1.94)	1.942 (4.933)
D-31	1.054 (1.569)	0.628 (1.595)	0.31 (2.00)	1.973 (5.011)

O. Polyethylene Film

Polyethylene film shall be opaque pigmented white in color and shall be manufactured from virgin resin without additives or scrap. It shall be sufficiently strong and tough to permit its use under the conditions existing on street paving work without being torn or otherwise rendered unfit for the purpose during the curing period. The film shall have a minimum thickness of 4 mils (0.004 inch), shall have a minimum tensile strength of 1,700 psi at 77°F (11,720 kPa at 25°C) in the longitudinal direction and 1,200 psi at 77°F (8,275 kPa at 25°C) in the transverse direction and shall have a minimum elongation of 200 percent at 77°F (25°C)in the longitudinal direction and 150 percent at 77°F(25°C) in the transverse direction. The permissible percent moisture loss shall not exceed 2 percent after 24 hours and 4 percent after 72 hours. Tests for tensile strength and elongation will be conducted in accordance with ASTM Designation: D 882, Method A. Tests for moisture retention will be conducted in accordance with ASTM Designation: C 156.

P. Membrane Curing Compound

Membrane curing compound shall conform to Item No. 409S, "Membrane Curing", Type 2 white pigmented.

Q. Asphalt Curing

Where asphalt is to be placed on a concrete base, asphalt shall be used for curing concrete base, the material shall conform to Item No. 301S, "Asphalts, Oils and Emulsions" for RS-2 or RS-2h or as indicated on the drawings.

360S.4 Equipment

A. General

All equipment necessary for construction of this item shall be on the Project and shall be approved by Engineer or designated representative as to conditions before the Contractor will be permitted to begin construction operations on which the equipment is to be used. When approved by the Engineer or designated representative in writing, a commercial or independently operated batching plant for measuring materials outside limits of the project may be used.

B. Mixer

The mixer furnished may be either a paving mixer (operated at site of construction or centrally located), a stationary mixer (central mixer) or a paving mixer (truck mounted) that will produce adequately mixed concrete meeting the specified requirements. The mixer, or mixers, shall conform to the following requirements:

1) Each mixer shall have attached in a prominent place a manufacturer's plate showing rated capacity of the drum in terms of volume of mixed concrete and the recommended speed of rotation of the mixing drum or blades.

2) The stationary mixer (central mixer) or truck mounted paving mixer shall be operated at the manufacturer's recommended speed.

3) The size of the paving mixer shall not be less than that of a 27-E paver, as established by the Mixer Manufacturer's Bureau of Associated General Contractors. The paving mixer shall be operated at a drum speed of not less than 16 revolutions per minute and not more than 22 revolutions per minute. Pickup and throw over blades in the drum of the mixer shall be replaced when worn down 3/4 inch (19 mm) or more.

4) Each truck mounted paving mixer shall be approved by the Engineer or designated representative prior to use on the project. It shall be classified as a "paving mixer" by the manufacturer and shall be so designed that a uniform and low slump concrete (approximately 1 1/2 inch [38 mm] slump) can be mixed without aggregate size segregation. The mixer shall be capable of discharging the low slump concrete at a speed of 10 seconds per cubic yard (13 seconds per cubic meter) or faster.

5) Each mixer shall be equipped with an approved automatic device for satisfactorily timing the mix and locking the discharging device in order to prevent the discharging of the mixer before the end of the required mixing period. This timing device shall operate a sounding device to signal plainly the completion of the mixing time. When permitted by the Engineer a light signal device may be used.

6) Multiple drum mixers will be permitted provided their operation is properly synchronized. The mixing time shall be determined exclusive of the time required to transfer concrete from one drum to the next drum.

7) Each mixer shall be equipped with a water-measuring device so constructed that it will measure the water within 1 percent of the total amount required for each batch. Unless the water is to be weighed, the water measuring equipment shall include an auxiliary tank with a capacity greater than that of the measuring tank and from which the measuring tank will be filled by gravity flow. The measuring tank shall be open to the atmosphere and shall be so placed and constructed that the water for a batch can be discharged into a calibrated tank or weighing device for checking the accuracy of water measurement without seriously delaying the paving operations. The Contractor shall have a calibrated tank or weighing device available at all times at a location satisfactory to the Engineer or designated representative.

8) If a paving mixer is furnished and operated at the site of construction, it shall be equipped with a power controlled boom and bucket, so designed as to permit uniform distribution of the concrete for the full width between pavement forms. Alternate equipment for distributing concrete may be substituted when approved by the Engineer in writing, provided uniform distribution is obtained without segregation.

9) If central mixed concrete is used on the project, the Contractor shall provide equipment designed to provide uniform distribution for the concrete for the full width between pavement forms without segregation.

C. Transit-mix Trucks

When transit-mix (ready-mix) concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to the batch to coat the drum of the mixer or agitator truck. This shall be required for every load of concrete. The mixing speed shall be attained as soon as all ingredients are in the mixer. Each complete batch (containing all the required ingredients) shall be mixed not less than 70 nor more than 100 revolutions of the drum at mixing speed.

A portion of the mixing water, required by the batch design to produce the desired slump, may be withheld and added at the job site, but only with permission of the Engineer and under the Engineer's supervision. When water is added at the job site, 25 revolutions (minimum) at mixing speed, will be required to flush down the blades after charging shall be accurately measured and included in the quantity of mixing water. The introduction of the initial mixing water, except blade wash down water and that permitted in this Article shall be prior to or simultaneous with the charging of the aggregates and cementitious material.

Mixing and agitating speed shall be as designated by the mixer manufacturer. All revolutions after prescribed mixing shall be at agitating speed. Except for short periods of time during discharge, the drum shall be kept in continuous motion from the time the mixing is started until the discharge is completed.

Additional mortar, consisting of 1 sack cement, 3 parts sand and sufficient water, shall be added to the batch to coat the drum of the transit mixer or agitator truck. This shall be required for every load of concrete.

The loading of transit-mixers shall not exceed 63 percent of the drum volume. When used as an agitator only, the loading of truck mixers shall not exceed 80 percent of the drum volume.

The batching plant and transit-mix trucks shall operate under the following system:

1) A ticket system will be used that includes a copy for the construction inspector. The ticket will have machine stamped time/date of water/cement batch; weight of cement, fly ash (if applicable), water, sand and aggregates; exact nomenclature and quantities of admixture. Any item missing or incomplete on the ticket will be cause for rejection. Coded readouts may be used if approved in advance by the Engineer.

2) Sufficient trucks will be available to support continuous placements. The Contractor will satisfy the Engineer that adequate standby trucks are available to support monolithic placement when required.

3) A portion of the mixing water, required by the batch design to produce the desired slump, may be withheld and added at the job site, but only with the permission of the Engineer and under the Inspector's observation. When water is added under these conditions, it will be thoroughly mixed before any slump or strength beam samples are taken.

D. Hauling Equipment

Batch hauling equipment for the transportation of measured materials from the batching plant to the mixer shall be equipped with tight covers, which shall be used to prevent excessive evaporation of moisture or any loss of material.

If a central mixer is used, concrete may be transported to the point of delivery in truck agitators or non-agitating trucks.

If a truck mounted paving mixer is used, it may be used to transport the concrete after mixing is complete.

If non-agitator trucks are used they shall conform to the following requirements:

The bed of non-agitating hauling equipment shall be a smooth, mortar-tight, metal container. The hauling equipment shall be capable of delivering the concrete to the work site in a thoroughly mixed and uniform mass and capable of discharging the concrete at a satisfactory controlled rate without segregation. If in the opinion of the Engineer any appreciable segregation or accumulation of excess water and/or mortar occurs on the surface of the concrete, this may be cause for rejection and this method of transporting the concrete to the point of delivery shall be suspended as directed by the Engineer.

E. Subgrade or Subbase Planer and Templates

Unless a stabilized subbase is provided, an approved subbase planer shall be provided, mounted on visible rollers riding on the forms and having adjustable cutting blades which shall trim the subgrade to the exact section as indicated. The planer frame shall be heavy enough to remain on the forms at all times and shall be of such strength and rigidity that, under a test made by changing the support from the wheels to the center, it shall not develop a deflection for more than 1/8 inch (3 mm). Tractive power equipment used to pull the planer shall not be such as to produce ruts or indentations in the subgrade.

When the slip form method of paving is to be used, the subgrade planer will be operated on a prepared track grade or controlled by an electronic sensor system operated from a string line that establishes the horizontal alignment and the elevation of the subbase.

A template for checking the contour of the subbase shall be provided and operated by the Contractor. The template shall rest upon the side forms and shall be of such strength and rigidity that, under a test made by changing the support to the center, it shall not show a deflection of more than 1/8 inch (3 mm). It shall be provided with accurately adjustable rods projecting downward to the subgrade at 1-foot (30 cm) intervals and these rods shall be adjusted to the required cross section of the bottom of the slab when the template is resting upon the side forms. Where stabilized subbase is provided, use of a scratch template will be required.

F. Forms

Side forms shall be of metal of approved cross section. The preferred depth of the form shall be equal to the required edge thickness of the pavement. Forms with depth greater than the required edge thickness of the pavement will be permitted.

The length of form sections shall not be less than 10 feet (0.3 meters) and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200-foot (61 meter) radius or less. Forms shall be of ample strength and shall be provided with adequate devices for secure setting so that when in place they will withstand, without visible springing or settlement, the impact and vibration of the spreading

and finishing machinery. In no case shall the base be less than 6 inches (15.2 cm) for a form 6 inches (15.2 cm) or more in height. The forms shall be free from warps, bends or kinks and shall be sufficiently true to provide a reasonably straight edge on the concrete. The top of each form section, when tested with a straightedge shall conform to the requirements specified for the surface of the completed pavement. Sufficient forms shall be provided for satisfactory prosecution of the work.

Outside curb forms shall be of wood or metal of a section satisfactory to the Engineer or designated representative, straight, free of warp and shall be in a depth at least equal to the depth of the curb. They shall be mounted on the paving forms and securely attached thereto and maintained in true position during the placing of the concrete. Inside curb forms, if required, shall be of approved material and of such design as to provide the curb required and shall be rigidly attached to the outside forms.

G. Concrete Spreader

Use of concrete spreader shall be required and it shall be a self-propelled machine having sufficient power and traction to spread and strike off concrete without slippage on the forms. It shall be equipped with a power driven device for spreading the concrete uniformly between the forms. The spreading device may be either a reciprocating blade, a screw conveyer or a belt conveyer. The spreader shall be capable of striking off the surface of the concrete between the forms in the longitudinal direction of the slab at any required elevation.

Mechanically operated concrete spreaders of other designs, which uniformly distribute the concrete with a minimum of segregation, may be used when approved by the Engineer.

H. Slipform Paver

With prior approval, the Contractor may place concrete with slip form paver. This paver shall be equipped with a longitudinal trans-angular finishing float adjustable to crown and grade and be satisfactory to the Engineer or designated representatve. The float shall extend across the pavement practically to the side forms and/or the edge of slab. A "string line" shall be used to provide grade control for the paver.

I. Mechanical Vibratory Equipment

All concrete placed for pavement shall be consolidated by approved mechanical vibrators operated ahead of the transverse finishing machine and designed to vibrate the concrete internally and/or from the surface. Vibratory members shall extend across the pavement practically to, but shall not come in contact with the side forms. Mechanically operated vibrators shall be mounted in such manner as not to interfere with transverse or longitudinal joints. The internal-type vibrators shall be spaced at not more than 24 inches (61 cm) and shall be equipped with synchronized vibratory units. Separate vibratory units shall be spaced at sufficiently close intervals to provide uniform vibration and consolidation to the entire width of the pavement. The frequency in air of the interval spud type vibratory units shall be not less than 8,000 cycles per minute and not less than 5,000 cycles per minute for tube types and the method of operation shall be as

directed by the Engineer or designated representative. The Contractor shall have a satisfactory tachometer available for checking vibratory the elements.

The pavement vibrators shall not be used to level or spread the concrete but shall be used only for purposes of consolidation. The vibrators will not be operated where the surface of the concrete, as spread, is below the elevation of the finished surface of the pavement, except for the first lift of concrete where double strike off method of placement is employed and the vibrators shall not be operated for more than 15 seconds while the machine upon which they are installed is standing still.

The pan type vibratory units shall apply the vibrating impulses directly to the surface of the concrete. The operating frequency shall be not less than 3,500 cycles nor more than 4,200 cycles per minute in air. The Contractor shall have a satisfactory tachometer available for checking the speed of the vibratory elements.

Approved hand manipulated mechanical vibrators shall be furnished in the number required for provision of proper consolidation of the concrete along forms, at joints and in areas not covered by mechanically controlled vibrators. These vibrators shall be sufficiently rigid to insure control of the operating position of the vibrating head.

Complete and satisfactory consolidation of the concrete pavement is a most important requirement of this specification. Cores taken shall be carefully examined for voids, honeycombing or other evidence of incomplete consolidation. If such evidence is present, changes in the consolidation procedures and/or equipment will be made to insure satisfactory consolidation.

J. Finishing Equipment

1. Transverse Finishing Machine

The Transverse finishing machine shall be provided with 2 screeds accurately adjusted to the crown of the pavement, shall be self-propelled and mounted in a substantial frame equipped to ride on the forms, or may be slip form finished, and shall be so designed and operated as to strike off and consolidate the concrete.

2. Longitudinal Finishing

A transverse drag float may be used in lieu of the longitudinal finishing machine with the Engineer's approval. Finishing machines shall be maintained in a tight and good operating condition, accurately adjusted to the required crown or profile and free from deflection, wobble or vibration tending to affect the precision of finish. Machines failing to meet these requirements will be rejected by the Engineer or designated representative and the Contractor shall provide approved equipment.

Where hand finishing is permitted under this specification, the Contractor shall provide a strike template and a tamping template both of 4 by 10 inch (10 by 25 cm) lumber or equivalent metal section and at least 2 feet longer than the width of the pavement. Both templates to conform to the crown section of the pavement and the tamp, if of wood, shall have a steel face not less than 3/8 inch (9.5 mm) in thickness. The Contractor shall also provide a

longitudinal float of approved design and not less than 14 feet (4.25 meters) in length.

The Contractor shall furnish and maintain at least two standard 10-foot (3.05 meter) steel straightedges on the work site at all times during the paving operations. The Contractor shall operate same in the presence of the Engineer or designated representative.

The Contractor shall furnish a sufficient number of bridges to ride on the forms and span the pavement for finishing operations and for the installation and finishing of joints. All necessary finishing and edging tools shall be furnished as may be required to complete the pavement as indicated.

360S.5 Proportioning of Concrete

A. Proportions

Concrete shall be composed of Cementitious Materials, fine aggregate, coarse aggregate, mineral filler and/or admixture if used and water, mixed in the proportions designated by the approved Mix Design and in the manner set forth in this specification. On the basis of job and laboratory investigations of the proposed materials, the Contractor will fix proportions by weight of water, coarse aggregate, fine aggregate, cementitious materials, admixture and mineral filler where required, in order to produce concrete of the specified strength and workability for the actual delivery time and site conditions to be encountered. Where curbs are placed separately, the Engineer or designated representative. may allow aggregate gradation conforming to Class A Concrete, Item No. 403S, "Concrete for Structures".

B. Concrete Strength

The concrete mix to be designed to produce a concrete with the following requirements:

Table 1: CONCRETE PAVEMENT		
Item	Test	Value
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio gal.(liter)/sack, Maximum		6.25 (23.66)
Sacks Cement, Minimum, 4 pounds (42.6 KG) ea		6 per cubic yard (7.85 per cubic meter)
Coarse Aggregate Factor		0.65 min - 0.85 max.
Compressive Strength after 7 Day, psi	Tex-418-A	4000 (27,600)

(kPa)		
Compressive Strength after 28 day, psi (kPa)	Tex-418-A	4500 (31,000)
Maximum Concrete Mix Temperature ^{o}F (^{o}C)		95 (35)
Retarder: Regular Concrete increase in time over 360S.7(3) , minutes, Maximum		60

Table 2: HIGH EARLY STRENGTH CONCRETE		
Item	Test	Value
Cement Type		III
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio gal. .(liter)/sack, Maximum		6.25 (23.66)
Sacks Cement, Minimum, 94 pounds (42.6 KG) ea		7 per (9.16 per cubic meter)
Coarse Aggregate Factor		0.65 min-0.85 max
Slump, inches (Centimeters)	Tex-415-A	1/2 to 2 (1.25 to 5.0)
Compressive Strength, after 24 hours, psi (kPa)	Tex-418-A	2,100 (14,500)
Compressive Strength, after 3 days, psi (kPa)	Tex-418-A	2,750 (19,000)
Compressive Strength, after 7 Days, psi (kPa)	Tex-418-A	4,500 (31,000)
Compressive Strength, after 28 Days,	Tex-418-A	4,925 (34,000)

psi (kPa)		
Maximum Concrete Mix, Temperature oF (oC)		95 (35)

The Contractor may submit a mix design using high range water reducing admixtures conforming to Item No. 405S, "Concrete Admixtures" in lieu of the concrete pavement mix specified and shall meet the following requirements:

Table 3: HIGH RANGE WATER REDUCING ADMIXTURES: SUPERPLASTERSIZER CONFORMING TO SPECIFICATION ITEM NO. 405S, "CONCRETE ADMIXTURES"		
Item	Test	Value
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio, (liter)//sack, Maximum		6.25
Sacks Cement, Minimum, 94 pounds (42.6 KG) ea		6 per cubic yard(7.85 per cubic meter)
Coarse Aggregate Factor		0.65 min. - 0.85 max.
Slump, inches (cms) before Admixture	Tex-415-A	1/2 to 2 (1.25 to 5)
Slump, Inches (cms) after Admixture	Tex-415-A	4 to 10 (2.5 to 25)
Compressive Strength, after 3 days, psi (kPa)	Tex-418-A	3,125 (21,500)
Compressive Strength, after 7 days, psi, (kPa)	Tex-418-A	4,500 (31,000)
Compressive l Strength, after 28 days, psi (kPa)	Tex-418-A	4,925 (34,000)
Maximum Concrete Mix, Temperature, ^{o}F (^{o}C)		100 (37.8)
Retarder, Regular Concrete Over 360S.7C, Minutes, Maximum		120

Table 4: Over Design Required to Meet Compressive Strength Requirements1					
Number Of Tests2,3	Standard Deviation, psi (mPa)				
	300 (2.06)	400 (2.75)	500 (3.44)	600 (4.13)	700 (4.82)
15	470 (3.24)	620 (4.27)	850 (5.85)	1,120 (7.71)	1,390 (9.57)
20	430 (2.96)	580 (3.99)	760 (5.23)	1,010 (6.95)	1,260 (8.67)
30 or more	400 (2.75)	530 (3.65)	670 (4.61)	900 (6.20)	1,130 (7.78)

Notes:

1. When designing the mix, add the tabulated amounts to the minimum design strength in Tables 1, 2 or 3.Maximum water-cement or water-cementitious ratio by weight

2. Number of tests of a concrete mixture used to estimate the standard deviation of a concrete production facility. Test of another mix within 1,000 psi (6.88 MPa) of the specified strength may be used.

3. If less than 15 prior tests are available, the overdesign should be 1,200 psi (8.26 MPa) for specified strengths from 3,000 to 5,000 psi (20.65 to 34.42 MPa) and 1,400 psi (9.64 MPa) for specified strengths greater than 5,000 psi (34.42 MPa).

High range water reducing admixtures shall be capable of maintaining the original slump until placement and screeding, which may be 2 hours, without the addition of water, additional admixture or other retempering or remixing techniques.

C. Workability of Concrete

Concrete shall be uniformly plastic, cohesive and workable. Workable concrete is defined as concrete which can be placed without honeycomb and without voids in the surface of the pavement after the specified finishing machine has been over a given area twice. Workability shall be obtained without producing a condition such that free water appears on the surface of the slab when being finished as specified. Where water appears on the surface of the concrete after finishing and this condition cannot be corrected by reasonable adjustment in the batch design, the bleeding to be immediately corrected by one of the following measures or a combination of two or more of the following listed measures:

1. Redesign of the batch.

2. Addition of mineral filler to fine aggregates.

3. Increase of cement content.

4. Use of an approved air entraining agent or approved admixture.

In the event that the measures taken do not eliminate the bleeding immediately, concrete placement operations will be suspended, as directed by the Engineer or designated representative, by placing a bulkhead or "header" as indicated and

according to applicable requirements for intentional stoppage of placement of concrete under Item No. 360S, "Concrete Pavement" and will remain suspended until such time as additional trial mixes demonstrate that a non-bleeding batch design has been achieved. Failing to achieve a satisfactory laboratory batch design the Contractor will be required to use different materials and to submit samples thereof for additional trial mixes and pilot beams.

The mix will be designed with the intention of producing concrete, which will have a slump of 1 1/2 inches (3.8 cms). The slump shall not be less than 1/2 inch (1.25 cms) nor more than 2 inches (5 cms).

D. Mix Design

The Contractor shall be responsible for the design of the concrete mix. The mix design shall be prepared and sealed by a person qualified and experienced in such work. Establish proportions on the basis either of laboratory trial batches or of field experience with the materials to be employed.

When ice is used to lower the concrete temperature during hot weather concrete placement (Section 13 of Standard Specification Item No.410S, “Concrete Structures”), the Contractor shall furnish a mix design (Section 6 of Standard Specification Item No. 403S, “Concrete for Structures”) acceptable to the Engineer or designated representative for class of concrete specified. The addition of ice shall not exceed 50% of the total mix water weight.

Complete concrete mix design data shall be submitted to the Engineer or designated representative for approval at least 10 days before concrete placement begins. Submittal of the mix shall be accompanied by such test data and certifications as may be necessary to demonstrate compliance with specification requirements. Approval of this mix design shall in no way relieve the Contractor of responsibility for the quality of the concrete.

It shall also be the responsibility of the Contractor to determine and measure batch quantity of each ingredient, including water, not only for batch designs but for all concrete produced for the project, so that the mix conforms to these specifications.

Trial batches shall be made and tested using all the proposed ingredients prior to the placing of concrete and also when the aggregate and/or type, brand or source of cement or admixture is changed. When the brand and/or source of cement only is changed, the Engineer or designated representative may waive trial batches only if a prior record of satisfactory performance of the cement has been established.

Mix designs used successfully on previous or concurrent jobs may be approved by the Engineer or designated representative without trial batches if it is shown that there is no substantial change in any of the proposed ingredients.

The Contractor shall prepare a minimum of four concrete test beams of each mix design, cure and test two each at the age of 7 and 28 days. From these preliminary tests the water-cement ratio required to produce concrete of the specified strength will be selected by the Contractor for approval by the Engineer or designated representative. The Contractor may at any time present in writing a suggested mix design and if the Engineer or designated representative concurs with the suggested design, the Contractor shall conduct trial batches necessary to determine its acceptability under these specification requirements.

The Contractor shall furnish and operate the mixer approved for use on this project unless the concrete is to be furnished from a transit mix (ready-mix) plant. For mixing the concrete to be used in making the preliminary test specimens, a minimum 1 cubic yard (1 cubic meter) batch shall be mixed or a batch of sufficient size to afford proper mixing, whichever is the greater. In lieu of the above mixer and procedure, the Contractor may furnish a portable mixer of sufficient rated capacity to mix a minimum 3-sack batch; in which case, the batch mixed for the preliminary test not to be less than the rated capacity of the mixer furnished. A coating batch will be mixed prior to mixing for test beams.

No additional compensation to be allowed for equipment, materials or labor involved in making job mix design test specimens.

After the mix proportions and water-cement ratio required to produce concrete of the specified strength have been determined, placing of the concrete may be started. The strength of the concrete in the completed pavement will be determined by a minimum of four compressive strength test specimens made, cured with a minimum of two each tested at 7 and 28 days as provided in Texas DOT Bulletin C-11. Modifications of the mix design may be requested by the Contractor on basis of conformity of the strength of these test specimens with the requirements and intent of this specification.

Changes in the water-cement ratio and the mix design, including an increase in cement factor if necessary, will be made when the average 7 day and/or 28 day compressive strength of the concrete, as indicated by the last 10 compressive strength values obtained from tests of cylinders made from concrete of the same water-cement ratio, departs from the desired minimum average strength by more than 4 percent.

E. Construction Testing:

Straightedge surface testing to be carried out as prescribed above.

The Engineer shall take test cylinders for compressive strength values on a random basis. The comparative results shall consist of the average of 2 cylinders each at 7 and 28 days for regular concrete, High early strength concrete and high range water reducing admixture concrete. Tests shall be made for each 500 square yards constructed, in accordance with TxDOT Bulletin C-11. Additional tests may be taken as determined by the concrete placement conditions or for adequately determining the strength of concrete where the early opening of the pavement to traffic is dependent upon concrete strength tests. No extra compensation will be allowed for materials and work involved in fulfilling these requirements.

360S.6 Construction Methods

A. Preparation of Subgrade

Where stabilized subbase is not provided, the subgrade shall be excavated as required, all unstable or otherwise objectionable material removed and all holes, ruts and depressions filled with approved material and compacted. Rolling and sprinkling shall be performed when and to the extent required and the roadbed

shall be completed to or above the plane of the typical sections, lines and grades indicated or as established by the Engineer or designated representative. The subgrade shall be proof rolled and any soft areas shall be repaired before the forms are placed. In the event that the proof rolled subgrade is exposed to rainfall or other conditions, which may soften the subgrade, corrective measures shall be taken and the subgrade shall be proof rolled again.

The subgrade planer shall be operated from approved forms immediately ahead of paving operations and the subgrade shall be finished to the exact section of the bottom of the pavement as indicated. Where traveling form pavers are used, the subgrade planer shall operate on a prepared track grade or be controlled by electronic sensors operating from a stringline that establishes line and grade. It shall be tested with the approved template, operated and maintained by the Contractor. The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the pavement is placed and shall be kept thoroughly wetted down sufficiently in advance of placing any pavement to insure its being in a firm and moist condition for at least 2 inches (5 cms) below the prepared surface. Sufficient subgrade shall always be prepared in advance to insure satisfactory prosecution of the work.

No equipment or hauling shall be permitted on the prepared subgrade, except by special permission of the Engineer or designated representative, which will be granted only in exceptional cases and only where suitable protection in the form of 2-ply timber mats or other approved material is provided.

B. Placing and Removing Forms

The subgrade under the forms shall be firm and cut true to grade so that each form section when placed will be firmly in contact for its whole length and base width and exactly at the established grade. Any subgrade under the forms below established grade shall be corrected, using suitable material, placed, sprinkled and rolled as directed. Forms shall be staked with at least 3 pins for each 10-foot (3-meter) section. A pin shall be placed at each side of every joint. Form sections shall be tightly joined and keyed to prevent relative displacement. Forms shall be cleaned and oiled each time they are used.

Forms shall be set for a sufficient distance in advance of the point where concrete is being placed to permit a finished and approved subgrade length of not less than 300 feet (90 meters) ahead of the mixer. Conformity of the grade and alignment of forms shall be checked immediately prior to placing concrete and necessary corrections made by the Contractor. Where any form has been disturbed or any subgrade becomes unstable, the form shall be reset and rechecked. In exceptional cases, the Engineer or designated representative may require suitable stakes driven to the grade of the bottom of the forms to afford additional support. Sufficient stability of forms to support the equipment operated and to withstand its vibration without springing or settlement shall be required. If forms settle and/or deflect over 1/8 inch (3 mm) under finishing operations, paving operations shall be stopped and the forms shall be reset to line and grade.

Forms shall be leveled using cement-stabilized material containing not less than 1 1/2 sacks of cement per ton (1 2/3 sacks of cement per MG) of mix as placed. The aggregate gradation and water content shall be determined by the Contractor. The cement-stabilized material shall be sufficiently plastic to insure filling voids

underneath the paving forms. Paving equipment will not to be permitted on the forms until the cement-stabilized material has cured for at least 12 hours.

Forms shall remain in place for not less than 8 hours after the concrete has been placed. Forms shall be carefully removed in such a manner that little or no damage will be done to the edge of the pavement. Any damage resulting from this operation shall be immediately repaired. After the forms have been removed, the ends of all joints shall be cleaned and any honeycombed areas pointed up with approved mortar and the surfaces protected with curing material conforming to Item No. 409S, "Membrane Curing".

Immediately after pointing is complete, the form trench, if used, shall be filled with granular material or earth from the shoulders in such manner as to shed water from rainfall and prevent curing material from washing away from the edge of pavement. On completion of the required curing, the subgrade or shoulders adjacent to the pavement shall be placed and compacted in condition to maintain drainage.

360S.7 Concrete Mixing and Placing

A. Mixing Methods

The concrete shall be mixed in a mixer conforming to the requirements of this item.

B. Mixing

The aggregates, mineral filler if required, cementitious materials and water shall be measured separately, introduced into the mixer and mixed for a period of not less than 50 seconds nor more than 90 seconds, measured from the time the last aggregate enters the drum to the time discharge of the concrete begins. The required water shall be introduced into the mixing drum during the first 15 seconds of mixing. The entire contents of the drum shall be discharged before any materials of the succeeding batch are introduced.

The Engineer or designated representative may increase the minimum mixing time to that necessary to produce thoroughly mixed concrete based on inspection or appropriate uniformity tests. The mixing time may be varied at any time as necessary to produce acceptable concrete.

If a central mixer is used, the concrete shall be discharged into the specified hauling equipment and delivered to the road site. If truck agitators are used, the concrete shall be continuously agitated at not less than 1 nor more than 6 rpm as directed by the Engineer or designated representative.

The maximum size of the concrete batch, absolute volume, shall not exceed 120 percent of the rated size of the mixer (40.8 cubic feet maximum batch for 34 cubic foot paver-1.2 cubic meter maximum batch for 1 cubic meter paver). Spilling of material from the mixer drum shall be corrected by reducing the size of the batch. Retempering or remixing of concrete will not be permitted.

The initial batch of concrete mixed after each time the mixer is washed out shall be enriched by additional mortar. The additional mortar shall be 1 sack of cement and 3 parts of sand.

When transit-mix (ready-mix) concrete is permitted, the batching plant shall meet the requirements of Item 403S, "Concrete for Structures".

C. Placement

Unless otherwise indicated, the concrete may be placed by using forms or by use of a slipform paver. Any concrete not placed as herein prescribed within 30 minutes after mixing shall be rejected and disposed of as directed except as provided otherwise herein. If in the opinion of the Engineer or designated representative, the temperature, wind and/or humidity conditions are such that the quality of concrete will not be adversely affected, the specified placing time may be extended by a maximum of 45 minutes. Concrete with high range water reducing admixture shall not be placed after the slump has dropped by 3 inches (7.5 cms) or more. Except by specific written authorization of the Engineer or designated representative, concrete shall not be placed when the temperature is below 40oF (4.5oC) and falling but may be placed when the temperature is above 35oF (1.7oC) and rising, the temperature being taken in the shade and away from artificial heat.

When the temperature of the air is above 85oF (29.4oC), an approved retarding agent will be required in concrete. The maximum temperature of all regular concrete placed shall not exceed 95oF (35.0oC), unless otherwise specified.

When concrete is being placed in cold weather, the Contractor shall have available a sufficient supply of an approved covering material to immediately protect concrete if the air temperature falls to 32oF (0oC) or below, before concrete has been placed 4 hours. Such protection shall remain in place during the period the temperature continues below 32oF (0oC) or for a period of not more than 5 days. Neither salt nor other chemical admixtures shall be added to the concrete to prevent freezing. The Contractor shall be responsible for the quality and strength of concrete under cold weather conditions and any concrete damaged by freezing shall be removed and replaced at the Contractor's expense. Concrete shall not be placed before sunrise and shall not be placed later than will permit finishing of the pavement during sufficient natural light.

Concrete shall be placed only on approved subgrade or subbase and unless otherwise indicated on the drawings, the full width of the pavement shall be constructed monolithically. The concrete shall be deposited on the subgrade or subbase in such manner as to require as little rehandling as possible. Where hand spreading is necessary, concrete shall be distributed to the required depth by use of shovels. The use of rakes will not be permitted. Workers will not be permitted to walk in the concrete with any earth or foreign material on their boots or shoes. The placing of concrete shall be rapid and continuous.

When the concrete is to be placed in separate lanes, the junction line shall not deviate from the true line more than 1/2 inch (1.25 cm) at any point and shall be finished as indicated on the drawings.

The mixer shall not be located on completed pavement, except as herein provided, but may be located on the subgrade of that lane of the pavement being constructed, as provided under "Preparation of Subgrade". When limited space, in the opinion of the Engineer or designated representative, requires operation of the mixer on completed pavement, the mixer may be so operated provided the concrete has attained the minimum average compressive strength required and

provided suitable protection to the pavement in the form of 2 ply timber mats or otherwise approved material is provided.

Concrete shall be distributed to such depth that when consolidated and finished, the slab thickness indicated will be obtained at all points and the surface shall not, at any point, be below established grade. Special care shall be exercised in placing and spading concrete against forms and at all joints to prevent the forming of honeycombs and voids.

Concrete for the monolithic curbs shall be the same as for the pavement and if carried back from the paving mixer shall be placed within 20 minutes after being mixed. It may be placed from the separate mixer, if desired, but in any case must be placed while the pavement concrete is still plastic. When sawed joints are used, curbs shall be doweled as indicated and poured after sawing. Curbs doweled on and placed separately may be placed with an extrusion machine.

If a central mixer or batcher is used, the Contractor shall provide a system satisfactory to the Engineer or designated representative for determining that concrete delivered to the road meets the specified requirements for mixing and time of placing.

Unless otherwise indicated, 2 mixers or transit mixers will be required where the double strike off method is employed.

D. Reinforcing Steel and Joint Assemblies

All reinforcing steel, including steel, welded wire fabric reinforcement, tie bars, dowel bars and load transmission devices used in accordance with plan provisions shall be accurately placed and secured in position in accordance with details indicated on the drawings. Reinforcing bars shall be securely wired together at alternate intersections, following a pattern approved by the Engineer or designated representative and at all splices and shall be securely wired to each dowel intersected. When wire fabric is used, it shall replace only the longitudinal and transverse bars and shall be securely wired together at all splices and to each dowel intersected. When welded wire fabric is selected, the Contractor shall pour the lower half of the slab, place the welded wire fabric and place the remaining concrete. Tie bars shall be installed in the required position by the method and device indicated. Bar coating indicated and of material specified, shall be completed and the bars and coating shall be free of dirt or other foreign matter at the time of installation in the concrete.

Tightly adhered scale or rust which resists removal by vigorous wire brushing need not be removed except that excessive loss of section to the reinforcement due to rust shall be cause for rejection. Excessive loss of section shall be defined as loss of section to the extent that the reinforcement will no longer meet the physical requirements for the size and grade of steel specified.

Where indicated on the drawings, an assembly of parts at pavement joints, the assembly shall be completed, placed at required location and elevated and all parts rigidly secured in required position by the method and devices indicated on the drawings. Dowel bars shall be accurately installed in joint assemblies as indicated on the drawings, each parallel to the pavement surface and to the center line of the pavement and shall be rigidly secured in the required position by such

means as indicated that will prevent their displacement during placing and finishing of the concrete. Unless specifically authorized by the Engineer or designated representative in writing, the load transmission devices shall be accurately installed in joint assemblies indicated, each unit vertical with its length parallel to the center line of the pavement and all units shall be rigidly secured in required position by such means as indicated that will prevent their displacement during placing and finishing of the concrete. Header boards, joint filler and other material used for forming joints shall be accurately notched to receive each load transmission device. All load transmission devices shall be free of rust and clean when installed in the concrete.

The Contractor has the option of substituting welded wire fabric in place of reinforcement bars. The welded wire fabric selected shall have an area and distribution of steel at least equal to the plan requirements. The Contractor shall submit their proposed design to the Engineer for approval before any material is ordered.

If welded wire fabric is used, the entire width of the bottom layer of concrete shall be struck off to conform to the cross section and elevation indicated on the drawings. The reinforcement shall then be placed immediately upon the concrete, after which the top layer of concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 15 minutes without being covered with the top layer of concrete shall be removed and replaced with freshly mixed concrete at the Contractor's expense.

E. Joints

1. General

All transverse and longitudinal joints when required in the pavement shall be of the types indicated and shall be at required location, on required alignment, in required relationship to tie bars and joint assemblies and in accordance with details indicated. When no transverse joints are indicated, joints shall not exceed 40 feet (13.1 meters). Such stakes, braces, brackets or other devices shall be used as necessary to keep the entire joint assembly in true vertical and horizontal position. Where concrete base is overlaid by asphaltic concrete, the joints to be prepared as specified herein, but joint sealing will not be required unless indicated.

If necessary for proper installation of the sealer, excessive spalling of the joint groove shall be repaired to the satisfaction of the Engineer.

Care shall be exercised during the construction of all joints to insure that the concrete sections are completely separated by an open joint or by the joint materials and to insure that the joints will be true to the outline indicated on the drawings. The Contractor shall install joint materials, which will function as a compatible system. Joint sealer shall not be placed where a bond breaker is present.

Green concrete or wet sawed joints are permitted provided the Contractor cleans the joint within 5 minutes after cutting with a 3000 psi (20.7 mPa) water blast followed by a minimum of 7 day cure and sand blast the saw cut immediately prior to placing joint sealer.

Dry sawed joints are permitted provided the Contractor sand blasts the saw cut immediately prior to placing joint sealer.

2. Expansion Joints

Transverse expansion joints shall be formed perpendicular to the centerline and surface of pavement and shall be constructed in accordance with the sequence of operations indicated on the drawings. After the transverse finishing machine and before the longitudinal finishing machine have passed over the joint, the Contractor shall test the joint filler for correctness of position and make any required adjustment in the position of the filler and shall install the joint seal space form as indicated on the drawings. After removal of the joint seal form as indicated on the drawings, the joint seal space above the joint filler shall be thoroughly sandblasted or machine routed to remove all projecting concrete, laitance, dirt or foreign matter. The concrete faces of the joint seal space shall be left true to line and section throughout the entire length of the joint. On completion of curing of the pavement, the joint sealing filler of the type specified shall be placed as indicated. The faces of the joint seal space shall be clean and surface dry at the time joint sealing filler is placed. On completion of the joint seal, the pavement adjacent to the joint shall be left free of joint sealing material. The joint seal space shall be exactly above and not narrower than the joint filler with no concrete overhangings.

3. Weakened Plane Joints

Weakened plane joints shall consist of transverse contraction joints and longitudinal joints and shall be formed or sawed as indicated on the drawings. When the joints are sawed, the saw shall be power driven, shall be manufactured especially for the purpose of sawing concrete and shall be capable of performing the work. Saw blades shall be as indicated. Tracks adequately anchored, the chalk, string line or other approved methods shall be used to provide true alignment of the joints. The concrete saw shall be maintained in good operating condition and the Contractor shall keep a standby power saw on the project at all times when concrete operations are under way.

If membrane curing is used, the portion of the seal, which has been disturbed by sawing operations, shall be restored by the Contractor by spraying the areas with additional curing seal.

Forming, finishing and sealing of the joint seal space shall conform to this item, described above and details indicated on the drawings.

4. Contraction Joints

Transverse contraction joints shall be formed or sawed joints perpendicular to the centerline and surface of the pavement and shall be constructed by the method and in the sequence of operations as indicated. Where sawed joints are used, contraction joints at intervals indicated shall be sawed as soon as sawing can be accomplished without damage to the pavement and before 24

hours after the concrete has been placed, the exact time to be approved by the Engineer or designated representative. The remaining contraction joints shall be sawed in a uniform pattern as directed by the Engineer or designated representative and they shall be completed before uncontrolled cracking of the pavement takes place. All joints shall be completed before placing concrete in succeeding lanes and before permitting traffic to use the pavement.

5. Longitudinal Joints

Longitudinal joints shall be of the type or alternate types indicated and shall be constructed of specified materials in accordance with provisions indicated on the drawings. Longitudinal joints shall be constructed accurately to required lines, shall be perpendicular to the pavement surface at the joint and the pavement surface over and adjacent to the joint shall be finished as specified on the drawings.

Longitudinal joints shall be sawed as soon as sawing can be accomplished without damage to the pavement. Sawing shall not cause damage to the pavement and the groove shall be cut with a minimum of spalling. No traffic (including construction traffic) shall be permitted on pavement until the longitudinal joint is cut.

6. Construction Joints

Intentional stoppage of the placing of the concrete shall be at either an expansion joint or at a weakened plane joint. The following provisions shall govern for each type of joint at which the placing of concrete is stopped:

a) When the placing of concrete is stopped at an expansion joint, the complete joint assembly shall be installed and rigidly secured in required position as indicated. A bulkhead of sufficient cross sectional area to prevent deflection, accurately notched to receive the load transmission devices or dowels, as the case may be, and shaped accurately to the cross section of the pavement shall be provided and installed as a back-up for the joint filler and rigidly secured in required position to permit accurate finishing of the concrete up to the joint. After the concrete has been finished to the joint, formation of the joint seal space and finishing of the joint shall be executed as specified herein and as indicated. The backup bulkhead shall remain in place until immediately prior to the time when concrete placement is resumed, then it shall be carefully removed in such manner that no element of the joint assembly will be disturbed. The exposed portion of the joint assembly shall be free of adherent concrete, dirt or other material at the time placing of concrete is resumed.

b) When placing of concrete is stopped at a weakened plane joint, all applicable provisions of paragraph (a) above shall apply in addition to the following requirement:

The face of the bulkhead adjoining the slab end shall be notched and grooved to fit the exposed half section of the joint assembly and shall be shaped to form the slab end at the center of the joint as indicated on

the drawings. The 1/2 width of joint seal space may be formed by a strip of required section placed and removed as indicated for construction of transverse contraction joints. The Contractor shall have available a bulkhead shaped to section of the pavement. This bulkhead must be drilled to permit the continuation of all longitudinal reinforcing steel through the construction joint and shall be of sufficient section and strength to prevent deflection.

c) When load transmission devices are not provided in the design, intentional stopping of placement of concrete shall occur in the middle of a slab. Provisions shall be made to provide a bulkhead, which will accommodate tie bars of the same length, size and spacing as tie bars used for the longitudinal joints. When the concrete placement is resumed, the bulkhead shall be removed without bending tie bars or damaging the concrete. The joint seal space and sealer shall be the same as for longitudinal joints.

Immediately upon the unintended stoppage of the placing of concrete, the Contractor shall place the available concrete to a line and install the above-described bulkhead at right angles to the centerline of the pavement, perpendicular to the surface and at the required elevation. Concrete shall be placed and finished to this bulkhead. Any concrete remaining on the subgrade ahead shall be removed and disposed of as directed by the Engineer or designated representative. When placing of concrete is resumed before the concrete has set to the extent that the concrete will stand on removal of the bulkhead, the new concrete shall be rodded with the first. An edge created by a construction joint of this type shall have a joint seal space and shall be sealed as required for contraction joints.

F. Joint Sealers

1. Class 2 Material

This material shall conform to Standard Specification Item No. 313S, ""Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete).

For placement in vertical joints (curb faces, etc.) either of the following procedures may be used.

a) An amount of the mixed material may be set aside until partial curing has taken place and carefully trowelled into the joint with a suitable tool.

b) The portion of the joint in the roadway shall be poured and cured. The vertical curb faces shall then be taped or formed and the material poured into the vertical joint from the top.

2. Class 5 Material

This material together with backer rods shall be applied as indicated in accordance with manufacturer's recommendations.

G. Asphalt Board

Premolded materials, wherever used, shall be anchored to the concrete on one side of the joint by means of copper wire or nails not lighter than No. 12 B and S gage. Such anchorage shall be sufficient to overcome the tendency of the material to fall out of the joint. The Contractor shall not contaminate joints to receive Class 5 Joint Material with asphalt from the asphalt board.

H. Curbs

The curb shall be constructed in lengths equal to the adjoining pavement slab lengths and expansion joints shall be provided in the curb opposite each transverse expansion joint in the pavement. Expansion joint material shall be of the same thickness, type and quality as indicated for the pavement and shall be of the section as indicated for the curb. All expansion joints shall be carried through the curb, sidewalk and retaining walls when these items are indicated.

When sawed joints are provided for the pavement, the curb placement shall be delayed until all transverse joints have been sawed. To provide bond for the curb, dowel bars shall be placed as indicated on the drawings, while the pavement concrete is still plastic.

Weakened plane joints shall be formed in monolithic curbs at a spacing to coincide with the joints in the concrete pavement. The joints shall be formed by inserting in the curb an asphaltic board strip cut to conform to the shape of the curb. When the concrete is sufficiently set, the joint on the top and face of curb shall be grooved with an approved type of grooving tool.

A finish coat of mortar shall be applied on the exposed surfaces of the monolithic curbs. The mortar shall be composed of 1 part of Portland Cement and 2 parts of fine aggregate. A mortar coat will not be required for extruded curbs.

The curb face, lower radius and top of curb shall be plastered with the sand-cement mortar. The mortar shall be applied with a template or "mule" made to conform to the curb dimensions as indicated. All exposed surfaces of the curb shall be finished with a steel trowel and brushed to a smooth and uniform surface. The mortar finish as required shall be included in the unit price bid for this item.

I. Machine Finishing

All concrete pavement shall be finished mechanically with approved self-propelled machines, except as herein provided. Hand finishing will be permitted on the transition from a crowned section to a superelevated section without crown on curves, on straight line superelevation sections less than 300 feet (91.4 meters) in length, on that portion of a widened pavement outside normal pavement width and on sections where the pavement width is not uniform, isolated, narrow in width or required monolithic widths are greater than that of available finishing machines.

Machine finishing of pavement shall include the use of power-driven vibrators, power-driven transverse strike off and screed or such alternate equipment as may be substituted and approved under this item.

All concrete pavement shall be consolidated by a mechanical vibrator. As soon as concrete has been spread between the forms, the approved mechanical vibrator

shall be operated to consolidate the concrete and remove all voids. Hand manipulated vibrators shall be used for areas not covered by the mechanical vibratory unit.

The transverse finishing machine shall first be operated to compact and finish pavement to the required section and grade, without surface voids. The machine shall be operated over each area as many times and at such intervals as directed. At least 2 trips will be required and the last trip over a given area shall be a continuous run of not less than 40 feet (12.2 meters). After completion of finishing with the transverse finishing machine, a transverse drag float may be used.

The consistency of the concrete as placed should allow completion of finishing operations without the addition of water to the surface. When field conditions are such that additional moisture is needed for the final concrete surface finishing operation, the required water shall be applied to surface by fog spray only and shall be held to a minimum.

After finishing is complete and the concrete still workable, the surface shall be tested by the Contractor for trueness with an approved 10 foot (3.05 meter) straightedge. The straightedge shall be operated from the side of the pavement, placed parallel to the pavement centerline and passed across the slab to reveal any high spots or depressions. The straightedge shall be advanced along the pavement in successive stages of not more than 1/2 its length. Practically perfect contact of the straightedge with the surface will be required and the pavement shall be leveled to this condition, in order to insure conformity with the surface test required below after the pavement has fully hardened. Any correction of the surface required shall be accomplished by adding concrete if required and by operating the longitudinal float over the area. The surface test with the straightedge shall then be repeated.

For one lane pavement placement and uniform widening, the equipment for machine finishing of concrete pavement shall be as directed by the Engineer or designated representative but shall not exceed requirements of these specifications.

After completion of the straightedge operation, as soon as construction operations permit, texture shall be applied with 1/8 inch (3 mm) wide metal tines with clear spacing between the tines being not less than 1/4 inch (6.3 mm)nor more than 1/2 inch (12.7 mm).

If approved by the Engineer or designated representative, other equipment and methods may be used, provided that a surface texture meeting the specified requirements is obtained. The texture shall be applied transversely. It is the intent that the average depth resulting from the number of tests directed by the Engineer or designated representative be not less than 0.060 inch (1.52 mm) with a minimum texture depth of 0.050 inch (1.27 mm) for any one test when tested in accordance with TxDOT Test Method Tex-436-A. Should the texture depth fall below that intended, the finishing procedures shall be revised to produce the desired texture.

1. Emergency Procedures

The Contractor shall have available at all times hand rakes with tines for the purpose of providing textures in the event of equipment breakdown.

The Contractor also shall have available a conventional garden spray type can containing a commercially available monomolecular film compound. This shall be applied in the case of equipment breakdown or other emergencies to prevent the pavement from drying too rapidly. The use of this product will give the Contractor additional time to provide adequate texturing.

After completion of texturing and about the time the concrete becomes hard, the edge of the slab and joints shall be carefully finished with an edger and the pavement shall be left smooth and true to line.

J. Hand Finishing

Hand finishing shall be resorted to only in those conditions provided for above and upon specific authorization by the Engineer or designated representative. When hand finishing is permitted, concrete shall be struck off with an approved strike off screed to such elevation that when consolidated and finished the surface of the pavement to conform to the required section and grade. The strike template shall be moved forward with a combined transverse and longitudinal motion in the direction work is progressing, maintaining the template in contact with the forms and maintaining a slight excess of material in front of the cutting edge. The Concrete shall then be tamped with an approved tamping template to compact the concrete thoroughly and eliminate surface voids and the surface screed to required section.

After completion of a strike off, consolidation and transverse screeding, a hand-operated longitudinal float shall be operated to test and level the surface to the required grade.

Workers shall operate the float from approved bridges riding on the forms and spanning the pavement. The longitudinal float shall be held in contact with the surface and parallel to the centerline and operated with short longitudinal strokes while being passed from one side of the pavement to the other. If contact with the pavement is not made at all points, additional concrete shall be placed, if required and screed and the float shall be used to produce a satisfactory surface. Care shall be exercised to keep the ends of the float from digging into the surface of the pavement. After a section has been smoothed so that the float maintains contact with the surface at all points in being passed from one side to the other, the bridges may be moved forward half the length of the float and the operations repeated.

Other operations and surface tests shall be as required for machine finishing.

K. Surface Testing:

After the concrete has been placed 12 hours or more, the Engineer or designated representative will test the surface of the pavement with a 10-foot (3.05 meter) straightedge placed parallel to the centerline. Unless specified otherwise, the surface shall not vary from the straightedge by more than 1/16 inch per foot (5 mm per meter) from the nearest point of contact and in no case shall the maximum

ordinate from a straightedge to the pavement be greater than 1/8 inch (3 mm). Any high spots causing a departure from the straightedge in excess of that specified shall be ground down by the Contractor to meet the surface test requirements. Where the texture of the pavement is removed by extensive grinding, the texture shall be restored by grooving the concrete to meet the surface finishing specifications.

L. Curing

All concrete pavement shall be cured by protecting it against loss of moisture for a period of not less than 72 hours from the beginning of the curing operations. Immediately after finishing operations have been completed, the entire surface of the newly laid concrete shall be covered and cured in accordance with the requirements specified for whichever of the following methods the Contractor may elect. Newly laid concrete base to be overlaid by asphaltic concrete shall not be cured by "Membrane Curing" and surfaces not to be overlaid by asphaltic concrete shall not be cured by "Asphalt Curing". In all cases in which curing requires the use of water, the curing shall have prior right to water supply or supplies. Failure to provide sufficient cover material of the type the Contractor elects to use, failure to maintain saturation in wet curing methods, lack of water to adequately take care of both curing and other requirements or other failures to comply with curing requirements shall be cause for immediate suspension of concreting operations. The covering material used in curing shall be removed as necessary to saw joints or to comply with the requirements for "Surface Test". The concrete surface shall be maintained wet with a water spray if indicated and the covering material replaced immediately on completion of sawing and testing and any required surface correction.

1. Waterproofed Paper Curing

Immediately after the finishing of the surface has been completed and the concrete has taken its initial set, it shall be wetted with water applied in the form of a fine spray and covered with waterproofed paper so placed and weighted as to cause it to remain in intimate contact with the surface. Waterproofed paper used for the curing of concrete pavement shall be of a type and quality approved by the Engineer. It shall be sufficiently strong and tough to permit its use under the conditions existing on street paving work without being torn or otherwise rendered unfit for the purpose during the curing period. The paper covering shall be maintained in place continuously for not less than the specified curing period.

The waterproofed paper shall be prepared to form blankets of sufficient width to cover the entire surface and both edges of the pavement slab and such blankets shall not be more than 60 feet in length. All joints in the blankets occasioned by joining paper sheets shall lap not less than 5 inches (12.7 cms) and shall be securely sealed with asphalt cement having a melting point of approximately 180o F (82.2 oC). Blankets shall be placed to secure an overlap of at least 12 inches (30.5 cms) and this lap securely weighted to form a closed joint.

The waterproofed paper blankets shall be adequately weighted to prevent displacement or billowing due to wind and the paper folded down over the

side of the pavement shall be secured by a continuous bank of earth. Plowing of this windrow into place will not be permitted.

All tears or holes appearing in the paper during the curing period shall be immediately repaired by cementing patches over such defects. It shall be the Contractor's responsibility to prevent damage to paper blankets, which would affect their serviceability and effectiveness as a concrete curing method. Blankets may be rejected by the Engineer or designated representative at any time if it appears they do not provide an airtight covering.

Paper blankets rejected on account of pinholes or minor tears may be continued in service by folding the blanket over lengthwise, first thoroughly spraying 1/2 the blanket with the asphalt cement used for seams. The 2 thicknesses shall be firmly pressed together and well cemented. Blankets shall be of a width sufficient to cover the pavement surface and both edges. Doubled blankets may be rejected for the same cause as provided for single blankets. All paper blankets rejected by the

Engineer shall be immediately marked by the Contractor for identification and then destroyed or stored entirely separate from approved blankets.

No walking on paper shall be permitted at any time and, in locations where pedestrian traffic cannot be entirely controlled, the Contractor shall provide walkways and barricades or shall substitute other permissible curing methods on such sections of pavement.

2. Polyethylene Film Curing

Immediately after the finishing of the surface has been completed and the concrete has taken its initial set, it shall be wetted with water applied in the form of a fine spray and covered with the polyethylene film so placed and weighted as to cause it to remain in intimate contact with the surface. The polyethylene film covering shall be maintained in place continuously for not less than the specified curing period.

The film shall be prepared to form blankets of sufficient width to cover the entire surface and both edges of the pavement slab. All joints in the blankets occasioned by joining film sheets shall lap not less than 12 inches (30.5 cms). All joints shall be sealed in a manner acceptable to the Engineer or designated representative to provide a moisture-proof lap.

The polyethylene film blankets shall be adequately weighted to prevent displacement or billowing due to wind and the film folded down over the side of the pavement shall be secured by a continuous bank of earth. Plowing of this windrow into place not to be permitted.

All tears or holes appearing in the polyethylene film during the curing period shall be immediately repaired by placing acceptable moisture proof patches over such defects or by replacing the blankets. It shall be the Contractor's responsibility to prevent damage to the film blankets, which would affect their serviceability and effectiveness as a concrete curing method. Blankets may be rejected by the Engineer at any time if it appears they do not provide an airtight covering.

Polyethylene film blankets rejected on account of pinholes or minor tears may be continued in service when repaired to an airtight condition. All polyethylene film blankets rejected by the Engineer or designated representative shall be immediately marked by the Contractor for identification and then destroyed or stored entirely separate from approved blankets.

Should the film blanket be damaged or torn for any cause during the first 72 hours of the curing period such damage shall be repaired immediately.

3. Membrane Curing

Immediately after the finishing of pavement has been completed and after the free surface moisture has disappeared, the pavement shall be sprayed uniformly with a curing compound. Membrane curing shall conform to Standard Specification Item No. 409S, "Membrane Curing", Type 2 white pigmented. Should the film of compound be damaged from any cause before the expiration of 72 hours after original application, the damaged portions shall be repaired with additional compound. Unless otherwise indicated on the drawings, membrane curing shall be used when the concrete (except that concrete to be used as a base) is placed with a slip form paver.

4. Asphalt Curing

Where emulsified asphalt is used for curing concrete base, the material shall conform to Item No. 301S, "Asphalts, Oils and Emulsions", for the type and grade shown on the drawings. The rate of application may vary between the limits of 1 gallon per 180 square feet and 1 gallon per 90 square feet (1 liter per 4.4 square meters and 1 liter per 2.2 square meters). The rate of application will be determined by the Engineer or designated representative, after observation of sections where amounts varying between the above limits have been applied. If it is found necessary to add water to the emulsion for the proper distribution through the spray, this may be done upon approval of the Engineer or designated representative. When the emulsion is diluted with water the amount of the applied mixture shall be increased to give a coverage of the original emulsion between the limits as set out herein. Care shall be taken to properly mix the emulsion and water and to keep the mixture well agitated during application.

M. Protection of Pavement

The Contractor shall erect and maintain the barricades indicated on the drawings and such other standard and approved devices as will exclude public traffic and traffic of the Contractor's employees and agents from the newly placed pavement for a minimum of 14 days. Portions of the roadway or crossings of the roadbed required to be maintained open for use by traffic shall not be obstructed by above required barricades. Crossings of the pavement indicated on the drawings or by construction sequence, during the period prior to opening to traffic as herein indicated, shall be provided with an adequate and substantial bridge approved by the Engineer or designated representative.

Curb shall be backfilled to the full height of the concrete, tamped and sloped as indicated on the drawings or as directed by the Engineer. The top 4 inches (10

cms) of backfill shall be of clean, friable soil capable of supporting plant life. This material shall also be free of stones and all other debris.

N. Opening Pavement to Traffic

The pavement shall be closed to traffic, including vehicles of the Contractor, until the concrete is at least 14 days old and has attained an average compressive strength acceptable to the Engineer or designated representative. This period of closure to traffic may be extended if, in the opinion of the Engineer or designated representative, weather or other conditions make it advisable to provide an extension of the time of protection.

At the end of the 14 day period and as long thereafter as ordered by the Engineer or designated representative and if so desired by the Contractor, the pavement may be opened for use by vehicles of the Contractor provided the gross weight (vehicle plus load) of such vehicles does not exceed 14,000 pounds (6350 KGs). Such opening, however, shall in no manner relieve the Contractor from responsibility for the Contractor's work. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned and topsoil placed against the pavement edges or behind the curb where turf or vegetation is to be established before permitting vehicles thereon.

After the concrete in any section is 14 days old or as long thereafter as ordered by the Engineer, such section of pavement may be opened to all traffic indicated on the drawings or when so directed by the Engineer or designated representative. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned and 4 inches (10 cms) of top soil placed against the pavement edges and all other work performed as required for the safety of traffic. Such opening, however, shall in no manner relieve the Contractor from responsibility for the Contractor's work.

When High Early Strength Concrete, resulting from the use of Type III cement as indicated on the drawings is used, the pavement may be opened to all traffic after the concrete is 7 days old or as long thereafter as ordered by the Engineer or designated representative, subject to the same provisions governing the opening after 14 days as above indicated.

Where the Contractor desires to move any equipment not licensed for operation on public streets, on or across any pavement opened to traffic, the Contractor shall protect the pavement from damage by means of 2 ply timber mats of 2 inch (5 cm) stock or runways of heavier material laid on a layer of earth, all as approved by the Engineer or designated representative.

1. Emergency Opening to Traffic

The Engineer or designated representative may require the opening of pavement to traffic prior to the minimum time specified above under conditions of emergency, which in the Engineer's or designated representative's opinion require such action in the interest of the public. In no case will the Engineer or designated representative order opening of the pavement to traffic within less than 72 hours after the last concrete in the section is placed. The Contractor shall remove all obstructing materials, place earth against pavement edges and perform other work involved in

providing for the safety of traffic as required by the Engineer or designated representative in ordering emergency opening. Orders for emergency opening of the pavement to traffic will be issued by the Engineer or designated representative in writing.

360S.8 Penalty for Deficient Pavement Thickness or Strength

The adjustment in unit prices provided for in this item will apply only when measurement for payment is by the square yard.

It is the intent of this specification that the pavement be constructed in strict conformity with the thickness, strength and typical sections indicated on the drawings. Where any pavement is found not so constructed, the following rules relative to adjustment of payment for acceptable pavement and to replacement of faulty pavement shall govern.

A. Pavement

The pavement will be core drilled after any grinding operations have been completed for surface corrections prior to final acceptance. Locations of core tests may be selected by the Engineer or designated representative; however, spacing interval for core tests, as specified herein, shall be maintained. The thickness of the pavement will be determined by measurement of the cores in accordance with TxDOT Test Method Tex-424-A.

For the purpose of establishing an adjusted unit price for pavement, units to be considered separately are defined as 1000 linear feet of pavement in each traffic lane starting at the end of the pavement bearing the smaller station number. The last unit in each lane shall be 1000 feet plus the fractional part of 1000 feet remaining. Traffic lane width will be as shown on typical sections and pavement design standards.

For the purpose of establishing an adjusted unit price for ramps, widening, acceleration and deceleration lanes that are machine placed, isolated pavements of traffic lane width but less than 1000 feet in length and other areas designated by the Engineer or designated representative, units will be considered separately and are defined as 1000 square yards of pavement or fraction thereof.

One core will be taken at the location selected by the Engineer or designated representative or at random in each unit. When the measurement of the core from any unit is not deficient more than 0.2 inches from the plan thickness, full payment will be made. When the measurement of the core from any unit is deficient more than 0.2 inch but not more than 0.75 inch from the plan thickness, 2 additional cores will be taken from the unit and the average of the 3 cores determined. The 2 additional cores from any 1000-foot unit will be taken at intervals of not less than 300 feet. The 2 additional cores from any 1000 square yard unit will be taken at locations such that the pavement in the unit will be well represented. If the average measurement of these 3 cores is not deficient more than 0.2 inches from the plan thickness, full payment will be made. If the average thickness of the 3 cores is deficient by more than 0.2 inch but not more than 0.75 inch from the

indicated thickness, an adjusted unit price as provided below will be paid for the areas represented by these cores.

In calculating the average thickness of the pavement, measurements which are in excess of the specified thickness by more than 0.2 inch will be considered as the specified thickness plus 0.2 inch and measurements which are less than the specified thickness by more than 0.75 inch will be considered as the specified thickness less 0.75 inch.

When the measurement of any core is less than the specified thickness by more than 0.75 inch, the actual thickness of pavement in this area will be determined by taking additional cores at 10 foot intervals parallel to the center line in each direction from the deficient core until, in each direction, a core is taken which is not deficient by more than 0.75 inch. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine the length of pavement in a unit that is to be left in place without pay and/or removed and replaced as provided herein.

For new Concrete Pavement roadways, and for Concrete Pavement 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 Standard Specification Item No. 313S, “Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete), or perform other corrective measures as directed by the Engineer. Payment for this work will be included in the unit price bid for Concrete Pavement, unless included as a separate pay item in the Contract.

For new Concrete Pavement roadways constructed in accordance with the plans and specifications, if cracks greater than or equal to 1/4 inch in width develop in the pavement surface within the one year warranty period, complete replacement of pavement sections as directed by the Engineer shall be performed by the Contractor at no additional expense to the City.

Irrespective of an acceptable overall 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 thereof.

B. Price Adjustments

After any grinding or milling operations have been completed to meet the surface-testing requirement of this specification, if average thickness of pavement is deficient in thickness by more than 0.2 inch, but not more than 0.75 inch, payment will be made at an adjusted price as specified in the following table:

Concrete Pavement Deficiency	
Deficiency in Thickness Determined by Cores, Inches	Proportional Part of Contract Price Allowed

0.00 to 0.20	100 percent
0.21 to 0.30	80 percent
0.31 to 0.40	72 percent
0.41 to 0.50	68 percent
0.51 to 0.75	57 percent

Any area of pavement found deficient in thickness by more than 0.75 inch but not more than 1 inch or 1/8 of the indicated thickness, whichever is greater, shall be evaluated by the Engineer. If, in the judgment of the Engineer, the area of such deficiency should not be removed and replaced, there will be no payment for the area retained. If, in the judgment of the Engineer, the area of such deficiency warrants removal, the area shall be removed and replaced at the Contractor's entire expense, with concrete of the thickness indicated on the drawings.

Any area of pavement found deficient in thickness by more than 1 inch or more than 1/8 of the indicated thickness, whichever is greater, shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness indicated on the drawings.

No additional payment over the Contract unit price will be made for any pavement of a thickness exceeding that indicated on the drawings.

If the average compressive strength based on concrete test cylinders at 28 days is less than the specified minimum strength of the concrete, then payment will be made at an adjusted price as specified in the following table.

Pay Adjustment Factor for Deficient Compressive Strength	
Ratio of Average Strength from Test Cylinders to Specified Minimum Compressive Strength both at 28 Days	Proportional Part of Contract Price Allowed
More then 0.95	100 percent
0.90 to 0.95	85 percent
0.85 to 0.90	70 percent
0.80 to 0.85	60 percent
Less than 0.80	0 percent (Remove & Replace)

When, in the opinion of the Engineer or designated representative, the compressive strength test results appear unrepresentative, additional testing of field cores may be authorized. To be considered acceptable for consideration the

field cores shall be acquired, properly handled and tested in accordance with ASTM C 42/C 42M, "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" within 45 days of the original concrete placement date. 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 in the opinion of the Engineer or designated representative, 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.

When, in the opinion of the Engineer or designated representative, the concrete compressive strength is deemed unacceptable for the intended use of the pavement, the concrete shall be removed and replaced to the limits indicated by test results.

360S.9 Measurement

A. When indicated, concrete pavement will be measured by the square yard of surface area of completed and accepted work. The surface area shall be so measured to also include that portion of pavement slab extending beneath the curb. When concrete pavement is to be measured by the square yard and monolithic curb is required, measurements for "Monolithic Curb" will be by the linear foot complete in place.

B. When indicated on the drawing, concrete pavement, including monolithic curb when required, will be measured by the cubic yard of absolute volume of materials entering the mixture.

360S.10 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 price bid for "Concrete Pavement", of the depth indicated on the drawings, "Concrete Pavement (High Early Strength)" of the depth indicated on the drawings and "Monolithic Curb" of the type indicated on the drawings (when pavement is measured by the square yard), as required or adjusted unit price for pavement of deficient thickness as provided under "Deficient Pavement Thickness", which price shall be full compensation for shaping and fine grading the roadbed, including furnishing and applying all water required; for furnishing, loading and unloading, storing, hauling and handling all concrete ingredients, including all freight and royalty involved; for placing and adjusting forms, including supporting material or preparing track grade; for mixing, placing, finishing, sawing, cleaning and sealing joints and curing all concrete; for furnishing and installing all reinforcing steel; for furnishing all materials for sealing joints and placing longitudinal, expansion and weakened plane joints, including all steel dowel caps and load transmission devices required and wire and devices for placing, holding and supporting steel bars, load transmission devices and joint filler material in proper position, for coating steel bars where complete the work.

Excavation required by this item in the preparation of the subgrade and for completion of the parkway will be measured and paid for in accordance with provisions governing the Items of "Street Excavation" and "Borrow", respectively, with provision that yardage to be measured and paid for once only, regardless of manipulations involved. Measurement of subgrade excavation for payment shall be limited to a total width of that of pavement plus 1 foot on each side.

Sprinkling and rolling required for the compaction of the rough subgrade in advance of fine grading will be measured and paid for as indicated in the governing items of excavation. Maintenance of a moist condition of the subgrade in advance of fine grading and concrete placing will not be paid for directly but shall be included in the unit price bid, as provided above.

Payment will be made under one of the following:

Pay Item No.	360S-A:	__In. Concrete Pavement	Per Square Yard.
Pay Item No.	360S-AH:	__In. Concrete Pavement (High Early Strength)	Per Square Yard.
Pay Item No.	360S-AS:	__In. Concrete Pavement (High Range Water Reducing Admixture)	Per Square Yard.
Pay Item No.	360S-B:	Monolithic Curb	Per Linear Foot.
Pay Item No.	360S-C:	__Concrete Pavement Including Monolithic Curb	Per Cubic Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS
Standard Specification Item 360S, "Concrete Pavement"

City of Austin Standard Specification Items

Designation	Description
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 313S	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)
Item No. 403S	Concrete for Structures
Item No. 405S	Concrete Admixtures
Item No. 410S	Concrete Structures
Item No. 411S	Surface Finishes for Concrete
Item No. 413S	Cleaning and/or Sealing Joints and Cracks (PCC)

American Society for Testing and Materials, ASTM

Designation	Description
ASTM C 42/C 42M	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete"
ASTM A 82	Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184	Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 496	Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement

ASTM A 615 Specification for Deformed and Plain Billet-Steel Bars, for Concrete Reinforcement

ASTM A 616 Specification Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM C 94 Specification for Ready-Mixed Concrete

ASTM C 150 Specification for Portland Cement

ASTM C 156 Test Method for Water Retention by Concrete Curing Materials

ASTM D 2240 Test Method for Rubber Property-Durameter Hardness

ASTM D 882, Method A Test Methods for Tensile Properties of Thin Plastic Sheeting

Texas Department of Transportation: Publications

Designation	Description
Bulletin C-11	Construction Bulletin

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
TEX-203-F	Sand Equivalent Test
TEX-401-A	Sieve Analysis of Fine and Coarse Aggregate
TEX-406-A	Mineral Finer than 75 µm (No. 200) Sieve in Mineral Aggregates (Decantation Test for Concrete Aggregates)
TEX-408-A	Organic Impurities in Fine Aggregate for Concrete
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-413-A	Determination of Deleterious Materials in Mineral Aggregate

TEX-415-A	Slump of Portland Cement Concrete
TEX-416-A	Air Content of Freshly-Mixed Concrete by the Pressure Method
Tex-424-A	Obtaining and Testing Drilled Cores of Concrete
Tex-436-A	Measurement of Texture Depth by the Sand Patch Method
Tex 418-A	Compressive Strength of Cylindrical Concrete
Tex-524-C	Testing Premolded Joint Filler for Concrete
Tex-612	Acid Insoluble Residue

Texas Department of Transportation: Departmental Material Specifications

Designation	Description
DMS 8900	Fly Ash

American Association of State Highway & Transportation Officials, AASHTO Standard

Designation	Description
Method T 26	Quality of Water to be Used in Concrete

RELATED CROSS REFERENCE MATERIALS
Standard Specification Item 360S, "Concrete Pavement"

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

Designation	Description
Item 360	Concrete Pavement
Item 420	Concrete Structures

Item 421	Hydraulic Cement Concrete
Item 427	Surface Finishes for Concrete
Item 431	Pneumatically Placed Concrete
Item 520	Weighing and Measuring Equipment

Texas Department of Transportation: Departmental Material Specifications

Designation	Description
DMS-4650	Hydraulic Cement Concrete Curing Materials and Evaporation Retardants"
DMS-6100	Epoxy and Adhesives

American Society for Testing and Materials, ASTM

Designation	Description
ASTM C 685	Concrete Made By Volumetric Batching and Continuous Mixing
ASTM C-1260	Standard Test Method for Potential Alkali Reactivity of Aggregates
ASTM D-512	Test Methods for Chloride Ion in Water
ASTM D-516	Test Methods for Sulfate Ion in Water
ASTM D-4191	Test Method for Sodium in Water by Atomic Absorption
ASTM D-4192	Test Method for Potassium Water by Atomic Absorption

American Concrete Institute, ACI

Designation	Description
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
TEX-418-A	Compressive Strength of Cylindrical Concrete Specimens

Item No. 403S
Concrete for Structures

403S.1 Description

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

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

403S.2 Submittals

The submittal requirements of this specification item may include:

Mix design option(s) of the class of concrete required on the project,

The supplier of the concrete mix design(s) and type of mixing equipment, and

Type of admixtures to be used with the concrete mixes.

403S.3 Materials

Concrete shall be composed of hydraulic cement or hydraulic cement and supplementary cementing materials, water, aggregates (fine and coarse), and admixtures proportioned and mixed as hereinafter provided to achieve specified results.

A. Cementitious Materials

Hydraulic cement shall conform to ASTM C 150, Type I (General Purpose), Type II (General Purpose with Moderate Sulfate Resistance) and Type III (High Early Strength). Type I shall be used when none is specified or indicated on the drawings. Type I and Type III cements shall not be used when a Type II cement is specified or indicated on the drawings. Type III cement may be used in lieu of a Type I cement, when the anticipated air temperature for the succeeding 12 hours will not exceed 60oF (15.6oC). A Type III cement shall only be used in precast concrete or when otherwise specified or allowed. All cement shall be of the same type and from the same source for a monolithic placement.

Unless otherwise specified the cementitious material content shall be limited to no more than 700 lbs. per cubic yard (417 kg per cubic meter). When supplementary cementing materials are used, cement is defined as “cement plus supplementary cementing material.” Supplementary cementing materials include fly ash (DMS 4610), ultra-fine fly ash (DMS-4610), ground granulated blast furnace slag grade 100 or 120 (DMS-4620), silica fume (DMS-4630) and metakaolin (DMS-4635).

Supplementary cementing materials shall not be used when white hydraulic cement is specified.

Class C flyash shall not be used in sulfate-resistant concrete.

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

When sulfate-resistant concrete is required for a project, mix design options 1, 2, 3 or 4 presented in Section 403S.8, "Mix Design Options" shall be used to develop appropriate mix design utilizing Type I/II, II, V, IP or IS cement.

B. Mixing Water

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

Water from the City of Austin will not require testing. Contractor may request approval of water from other sources. Contractor shall arrange for samples to be taken from the source and tested at the Contractor's expense. When water from other sources is proposed, test reports shall be provided that indicates compliance with Table 1 before use.

Table 1: Chemical Limits for Mix Water		
Contaminant	Test Method	Maximum Concentration (ppm)
Chloride (CL) Prestressed concrete Bridge decks & superstructure All other concrete	ASTM D-512	 500 500 1,000
Sulfate (SO4)	ASTM D-516	1,000
Alkalies (NA2O + 0.658 K2O)	ASTM D-4191 & D-4192	600
Total Solids	AASHTO T-26	50,000

Water that has an adverse effect on the air-entraining agent or any other chemical admixture or on strength or time of set of the concrete shall not be used. Water used in white Portland cement concrete shall be free from iron and other impurities, which may cause staining, or discoloration.

C. Coarse Aggregate

Coarse aggregate shall consist of durable particles of crushed or uncrushed gravel, crushed blast furnace slag, crushed stone or combinations thereof; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material either free or as an adherent coating. When white hydraulic

cement is specified, the coarse aggregates used in the concrete shall be light colored. Quality shall be reasonably uniform throughout.

The coarse aggregate from each source shall not contain more than 0.25 percent by weight of clay lumps, nor more than 1.0 percent by weight of shale nor more than 5 percent by weight of laminated and/or friable particles when tested in accordance with TXDOT Test Method TEX-413-A. The coarse aggregate from each source shall have a wear of not more than 40 percent when tested in accordance with TXDOT Test Method TEX-410-A.

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

Coarse aggregate shall be washed. The Loss by Decantation (TXDOT Test Method TEX-406-A), plus allowable weight of clay lumps, shall not exceed 1 percent or the value indicated on the drawings or in the project manual, whichever is less. If material finer than the # 200 (75 micrometer) sieve is definitely established to be dust of fracture of aggregates made primarily from crushing of stone, essentially free from clay or shale as established by Part III of TXDOT Test Method TEX-406-A, the percent may be increased to 1.5. When crushed limestone coarse aggregate is used in concrete pavements, the decant may exceed 1% but not more than 3% if the material finer than the # 200 (75 micrometer) sieve is determined to be at least 67% calcium carbonate in

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

When exposed aggregate surfaces are required, the coarse aggregate shall consist of particles with at least 40 percent crushed faces. Uncrushed gravel, polished aggregates and clear resilient coatings are not acceptable for exposed aggregate finishes.

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

Table 2: Coarse Aggregate Gradation Chart (Percent Passing)

Grade	Nom. Size	2-1/2" (62.5 mm)	2" (50 mm)	1 ½" (37.5 mm)	1" (25 mm)	3/4" (19 mm)	1/2" (12.5 mm)	3/8" (9.5 mm)	No. 4 (4.75 mm)	No. 8 (2.36 mm)
1	2" (50 mm)	100	80-100	50-85		20-40			0-5	
2 (467)*	1 1/2" (37.5 mm)		100	95-100		35-70		10-30	0-5	
3	1" (50 mm)		100	95-100		60-90	25-60		0-5	

4 (57)*	1” (50 mm)			100	95-100		25-60		0-10	0-5
5 (67)*	3/4” (19 mm)				100	90-100		20-55	0-10	0-5
6 (7)*	½" (12.5 mm)					100	90-100	40-70	0-15	0-5
7	3/8" (9.5 mm)						100	70-95	0-25	
8	3/8" (9.5 mm)						100	95-100	20-65	0-10

Notes:

1. Recycled crushed concrete fine aggregate shall be limited to a maximum of 20% of the fine aggregate

2. The use of recycled crushed hydraulic cement concrete as a coarse aggregate shall be limited to Concrete Classes A, B and D (see Table 5).

D. Fine Aggregate

Fine aggregate shall be washed and consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof, with or without a mineral filler. When white hydraulic cement is specified, the fine aggregates used in the concrete shall be light colored. Quality shall be reasonably uniform throughout It shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material and it shall not contain more than 0.5 percent by weight of clay lumps in accordance with TEX-413-A. When subjected to color test for organic impurities per TXDOT Test Method TEX-408-A, it shall not show a color darker than standard.

Unless indicated otherwise on the drawings the acid insoluble residue of fine aggregate used in slab concrete subject to direct traffic shall not be less than 60 percent by weight (mass) when tested conforming to TXDOT Test Method TEX-612 J.

Unless indicated otherwise on the Drawings, fine aggregate shall be blended, when necessary, to meet the acid insoluble residue requirement.

on shall be used:

Acid Insoluble (%) = {(A1)(P1)+(A2)(P2)}/100

Where:

A1 = acid insoluble (%) of aggregate 1,

A2 = acid insoluble (%) of aggregate 2,

P1 = % by weight of A1 of the fine aggregate blend, and

P2 = % by weight of A2 of the fine aggregate blend.

When tested in accordance with TxDoT Test Method Tex-401-A, the fine aggregate, including mineral filler and combinations of aggregates, when used, shall conform to the grading requirements shown in Table 3.

Table 3: Fine Aggregate Gradation Chart1 (Grade 1 - Percent Passing)							
3/8 (9.5 mm)	No. 4 (4.75 mm)	No. 8 (2.36 mm)	No. 16 (1.18 mm)	No. 30 (600 µm)	No. 50 (300 µm)	No. 100 (150 µm)	No. 200 (75 µm)
100	95-100	80-100	50-85	25-65	10-351	0-10	0-32

Notes:

1. Recycled crushed concrete fine aggregate shall be limited to a maximum of 20% of the fine aggregate.

2. The use of recycled crushed hydraulic cement concrete as a fine aggregate shall be limited to Concrete Classes A, B and D (see Table 5).

3.

4. 0 to 6 for manufactured sand.

   Sand equivalent per TXDOT Test Method TEX-203-F shall not be less than 80 nor less than otherwise indicated on the drawings, whichever is greater.

   The fineness modulus will be determined by adding the percentages by weight retained on sieve Nos. 4, 8, 16, 30, 50 and 100 (4.75 mm, 2.36 mm, 1.18mm, 600 µm, 300 µm, and 150 µm) and dividing the sum of the six sieves by 100. For all classes of concrete except K (see Table 5), the fineness modulus shall be between 2.30 and 3.10. For Class K concrete, the fineness modulus shall be between 2.40 and 2.90, unless indicated otherwise on the Drawings.

E. Mineral Filler

Mineral filler shall consist of stone dust, clean crushed sand or other approved inert material. When tested in accordance with TxDoT Test Method Tex-401-A, it shall conform to the following gradation:

	100 percent
Passing the No. 200 (75 µm) Sieve	65 to 100 percent

F. Mortar and Grout

Unless otherwise specified, indicated on the drawings or approved by the Engineer or designated representative mortar and grout shall consist of 1 part hydraulic cement, 2 parts finely graded sand and enough water to make the mixture plastic. When required to prevent color difference, white cement shall be added to produce color required. When required by the Engineer or designated representative, approved latex adhesive may be added to the mortar. Mortar shall be provided with a consistency such that the mortar can be easily handled and

spread by trowel. Grout shall be provided of a consistency that will flow into and completely fill all voids.

G. Admixtures

All chemical admixtures including water reducing, placticizers and air entrainment shall conform to TxDoT DMS-4640, “Chemical Admixtures for Concrete”. Calcium chloride-based admixtures shall not be approved. Admixtures shall be included in the prequalified concrete admixtures list maintained by TxDot’s Construction Division. High-range water-reducing admixtures (TxDoT Type F or G) and accelerating admixtures (TxDoT Type C or E) shall not be used in bridge deck concrete.

H. Air Entrainment

Unless indicated otherwise on the drawings, all concrete classes with the exception of Class B shall be air;entained in accordance with Table 8. If the air content is more than 1-1/2 percentage points below or 3 percentage points above the required air, the load of concrete will be rejected. If the air content is more than 1-1/2 but less than 3 percentage points above the required air, the concrete may be accepted based on strength test results.

403S.4 Storage

A. Cement, Supplementary Cementing Materials and Mineral Filler

All cement, supplementary cementing materials and mineral filler shall be stored in separate and well ventilated, weatherproof buildings or approved bins, which will protect the material from dampness or absorption of moisture. Storage facilities shall be easily accessible and each shipment of packaged cement shall be kept separated to provide for identification and inspection. The Engineer or designated representative may permit small quantities of sacked cement to be stored in the open for a maximum of 48 hours on a raised platform and under waterproof covering.

B. Aggregates

The method of handling and storing concrete aggregates shall prevent contamination with foreign materials. If the aggregates are stored on the ground, the sites for the stockpiles shall be clear of all vegetation and shall be level. Aggregates shall be stockpiled in sizes to facilitate blending. If the aggregate is not stockpiled on a hard, non-contaminant base, the bottom 6-inch (150 mm) layer of the stockpile shall not be used without recleaning the aggregate.

When conditions require the use of 2 or more grades of coarse aggregates, separate stockpiles shall be maintained to prevent intermixing. Where space is limited, stockpiles shall be separated by walls or other appropriate barriers.

Aggregate shall be stockpiled and protected from the weather a minimum of 24 hours prior to use to minimize free moisture content. When stockpiles are too large to protect from the weather, accurate and continuous means acceptable to

the Engineer or designated representative shall be provided to monitor aggregate temperature and moisture. Aggregates shall be stockpiled and handled such that segregation and contamination are minimized.

The stockpiles shall be sprinkled to control moisture and temperature as necessary. A reasonably uniform moisture content shall be maintained in aggregate stockpiles.

C. Admixtures

Admixtures shall be stored in accordance with manufacturer's recommendations and shall be protected against freezing.

D. Hot Weather Concrete Mixes

Ice may be used during hot weather concrete placement (Section 13 of Standard Specification Item No. 410S, "Concrete Structures") to lower the concrete temperature; however, the Contractor shall furnish a mix design acceptable to the Engineer or designated representative for class of concrete specified. The addition of ice shall not exceed 50% of the total mix water weight.

403S.5 Measurement of Materials

Water shall be accurately metered. Fine and coarse aggregates, mineral filler, bulk cement and fly ash shall be weighed separately. Allowances shall be made in the water volume and aggregate weights during batching for moisture content of aggregates and admixtures. Volumetric and weight measuring devices shall be acceptable to the Engineer or designated representative. Measurement of materials in non-volumetric and volumetric mixers shall conform to Section 421.4.D of TxDot Specification Item 421, "Hydraulic Cement Concrete".

Batch weighing of sacked cement is not required; however, bags, individually and entire shipments, may not vary by more than 3 percent from the specified weight of 94 pounds (42.6 kilograms) per bag. The average bag weight of a shipment shall be determined by weighing 50 bags taken at random.

403S.6 Mix Design

The Contractor shall furnish a mix design acceptable to the Engineer or designated representative for the class of concrete required in accordance with Table 5. The mix shall be designed by a qualified commercial laboratory and signed/sealed by a registered Professional Engineer, licensed in the state of Texas to conform with requirements contained herein, to ACI 211.1 or TXDOT Bulletin C-11 (and supplements thereto). The maximum water- -cementitious material ratio identified in Table 5 for specific classes of concrete shall not be exceeded.

A higher-strength class of concrete with equal or lower water-to-cementituous-material ratio may be substituted for the specified class of concrete.

The mix design shall be over-designed in accordance with Table 5 in order to account for production variability and to ensure minimum compressive strength requirements are met.

Allowable mix design options are presented in Section 403S.8.

The Contractor shall perform, at the Contractor's expense, the work required to substantiate the design, including testing of strength specimens. Complete concrete design data shall be submitted to the Engineer or designated representative for approval. The mix design will be valid for a period of one (1) year provided that there are no changes to the component materials.

When there are changes in aggregates or in type, brand or source of cement, supplementary cementing material or chemical admixtures, the mix shall be evaluated as n new mix design. A change in vendor does not necessarily constitute a change in materials or source. When only the brand or source of cement is changed and there is a prior record of satisfactory performance of the cement with the ingredients, the submittal of new trial batches may be waived by the Engineer or designated representative.

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

Approved admixtures that are included in the prequalified concrete admixtures list maintained by TxDot's Construction Division may be used with all classes of concrete at the option of the Contractor provided that specific requirements of the governing concrete structure specification are met. Water reducing and retarding agents shall be required for hot weather, large mass, and continuous slab placements. Air entraining agents may be used in all mixes but must be used in the classes indicated on Table 5. Unless approved by the Engineer or designated representative, mix designs shall not exceed air contents for extreme exposure conditions as recommended by ACI 211.1 for the various aggregate grades.

403S.7 Consistency and Quality of Concrete

Concrete shall be workable, cohesive, possess satisfactory finishing qualities and of stiffest consistency that can be placed and vibrated into a homogeneous mass within slump requirements specified in Table 4 without the development of segregation or

honeycombing. No concrete will be permitted with a slump in excess of the maximums shown unless water-reducing admixtures have been previously approved. Concrete that exceeds the maximum acceptable placement slump at time of delivery will be rejected. Slump values shall be conducted in accordance with TXDOT Test Method TEX-415-A.

Consistency and quality of concrete should allow efficient placement and completion of finishing operations before initial set. Re-tempering (i.e. addition of water and reworking concrete after initial set) shall not be allowed. When field conditions are such that additional moisture is needed for final concrete surface finishing operation, the required water shall be applied to surface by fog spray only and shall be held to a minimum. Excessive bleeding shall be avoided and in no case will it be permissible to expedite finishing and drying by sprinkling the surface with cement powder.

Table 4: Slump Requirements

	Slump1, inches (mm)	
Type of Construction	Maximum	Minimum
Cased Drilled Shafts	4 (100)	3 (75)
Reinforced Foundation Caissons and Footings	3 (75)	1 (25)
Reinforced Footings and Substructure Walls	3 (75)	1 (25)
Uncased Drilled Shafts	6 (150)	5 (125)
Thin-walled Sections; 9 inches (225 mm) or less	6 ½ (165)	4 (100)
Prestressed Concrete Members1	6 ½ (165)	4 (100)
Precast Drainage Structures	6 (150)	4 (100)
Wall Sections over 9 inches (225 mm)	5 (125)	3 (75)
Reinforced Building Slabs, Beams, Columns and Walls	4 (100)	1 (25)
Bridge Decks	4 (100)	2 (50)
Pavements, Fixed-form	6 ½ (165)	4 (100)
Pavements, Slip-form	3 (75)	1-½ (37.5)
Sidewalks, Driveways and Slabs on Ground	4 (100)	2 (50)
Curb & Gutter, Hand-vibrated	3 (75)	1 (25)
Curb & Gutter, Hand-tamped or spaded	4 (100)	2 (50)
Curb & Gutter, Slip-form/extrusion machine	2 (50)	½ (12.5)
Heavy Mass Construction	2 (50)	1 (25)
High Strength Concrete	4 (100)	3 (75)
Riprap and Other Miscellaneous Concrete	6 (150)	1 (25)
Under Water or Seal Concrete	8 ½ (213)	6 (150)

1. Slump values when a high range water reducer (HRWR) is not used.

2. When a high range water reducer (HRWR) is used, maximum acceptable placement slump will be 9 in (225 mm)

During progress of the work, the Engineer or designated representative shall cast test cylinders as a check on compressive strength of concrete actually placed. The Engineer or designated representative may also perform slump tests, entrained air tests and temperature checks to ensure compliance with specifications.

Proportioning of all material components shall be checked prior to discharging. Excluding mortar material for pre-coating of the mixer drum [see section 403S.8.B and adjustment for moisture content of admixtures and aggregates, material components shall fall within the range of + 1% for water, + 2% for aggregates, + 3% for cement, +2% for fly ash and within manufacturer recommended dosage rates for admixtures except that air entrainment shall be within + 1-1/2 percentage points of the mix design requirements.

Unless otherwise specified or indicated on the drawings, concrete mix temperature shall not exceed 90°F (32oC) except in mixes with high range water reducers where a maximum mix temperature of 100°F (38oC) will be allowed. Cooling an otherwise acceptable mix by addition of water or ice during agitation will not be allowed.

Test cylinders will be required for small placements such as manholes, inlets, culverts, wing walls, etc. The Engineer or designated representative may vary the number of tests to a minimum of 1 for each 25 cubic yards (1 for each 19 cubic meters) placed over a several day period.

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

A strength test shall be defined as the average breaking strength of 2 cylinders. A minimum of four test cylinders shall be prepared; two each to be tested at 7 and 28 days. Specimens will be tested conforming to TXDOT Test Method TEX-418-A. If required strength or consistency of class of concrete being produced cannot be secured ed or without exceeding maximum water/cementitious material ratio, Contractor will be required to furnish different aggregates, use a water reducing agent, an air entraining agent or increase the cement content in order to provide concrete meeting these specifications.

Slump tests will be performed in accordance with TxDoT Test Method Tex-415-A.

Test specimens shall be cured using the same methods and under the same conditions as the concrete represented. Design strength cylinders shall be cured conforming to TXDOT Bulletin C-11 (and supplements thereto).

When control of concrete quality is by 28-day compressive tests, job control testing will rength tests. The minimum strength requirement for seven (7) day test will be 70 percent of the specified minimum 28-day compressive strength. If the required 7 day strength is not secured with the quantity of cement specified in Table 4, changes in the mix design shall be made and resubmitted for approval. For an occasional failure of the seven day compressive test, the concrete may be tested at 28 days for final evaluation.

Table 5: Classes of Concrete						
Class	Cement Sks Per CY	Minimum Strength, psi (MPa)		Maximum W/C Ratio1	Coarse Aggr. Grade 2,3,4	Air Entrain.
		28 Days	7 Days			
A	5.0 (280 kg/m3)	3000 (20.6)	2100 (14.5)	0.6	1,2,3,4, 8	Yes
B	4.0 (225 kg/m^3)	2000 (13.8)	1400 (9.7)	0.6	2,3,4,5,6,7	No
C5	6.0 (335 kg/m^3)	3600(24.8)	2520 (17.4)	0.45	1,2,3,4,5,6	Yes
D	4.5 (252 kg/m^3)	2500 (17.2)	1750 (12.1)	0.6	2,3,4,5,6,7	No
H5	6.0 (335 kg/m^3)	As indicated	As Indicated	0.45	3,4,5,6	Yes
I	5.5 (308 kg/m^3)	3500 (24.1)	2450 (16.9)	0.45	2,3,4,5	Yes
J	2.0 (112 kg/m^3)	800 (5.5)	560 (3.9)	N/A	2,3,4,5	No
S5	6.0 (335 kg/m^3)	4000 (27.6)	2800 (19.3)	0.45	2,3,4,5	Yes

Notes:

1. Maximum water-cement or water-cementitious ratio by weight

2 Unless otherwise allowed, Grade 1 coarse aggregate shall only be used in massive foundations with 4-in (100-mm) minimum clear spacing between reinforcing steel bars.

3. Grade 1 coarse aggregate grading shall not be used in drilled shafts.

4. Unless otherwise allowed, Grade 8 coarse aggregate shall be used in extruded curbs.

5. Structural concrete classes.

6. When Type II cement is used in Class C, S or A concrete, the 7-day compressive strength requirement will be 2310 psi (15.9 MPa) for Class C, 2570 psi (17.7 MPa) for Class S and 1925 psi (13.3 MPa) for Class A minimum.

Table 6: Over Design Required to Meet Compressive Strength Requirements$_1$					
Number Of Tests $_{2,3}$	Standard Deviation, psi (MPa)				
	300 (2.06)	400 (2.75)	500 (3.44)	600 (4.13)	700 (4.82)

15	470 (3.24)	620 (4.27)	850 (5.85)	1,120 (7.71)	1,390 (9.57)
20	430 (2.96)	580 (3.99)	760 (5.23)	1,010 (6.95)	1,260 (8.67)
30 or more	400 (2.75)	530 (3.65)	670 (4.61)	900 (6.20)	1,130 (7.78)

Notes:

1. When designing the mix, add the tabulated amounts to the minimum design strength in Table 5.Maximum water-cement or water-cementitious ratio by weight

2. Number of tests of a concrete mixture used to estimate the standard deviation of a concrete production facility. Test of another mix within 1,000 psi (6.88 MPa) of the specified strength may be used.

3. If less than 15 prior tests are available, the overdesign should be 1,000 psi (6.88 MPa) for specified strength less than 3,000 psi (20.65 MPa), 1,200 psi (8.26 MPa) for specified strengths from 3,000 to 5,000 psi (20.65 to 34.42 MPa) and 1,400 psi (9.64 MPa) for specified strengths greater than 5,000 psi (34.42 MPa).

Table 7: Expected Usage of Concrete Classes

Class	General Usage
A	Inlets, manholes, curb, gutter, curb & gutter, concrete retards, sidewalks, driveways, backup walls and anchors
B	Riprap, small roadside signs and anchors
C5	Drilled shafts, bridge substructure, bridge railing, culverts except top slab of direct traffic culverts, headwalls, wing walls, approach slabs, and cast-in-place concrete traffic barrier
D	Riprap
H5	Prestressed concrete beams, boxes, piling and precast concrete traffic barrier
J	Utility trench repair
S5	Bridge slabs and top slabs of direct traffic culverts

Table 8: Air Entrainment[1]

Nominal Maximum Aggregate Size In (mm)	% Air Entrainment	
	Moderate Exposure	Severe Exposure
3/8 (9.5)- Grades 7 & 8	6	7-1/2
1/2 (12.5)- Grades 6	5-1/2	7
3/4 (19)- Grades 5	5	6
1 (25)- Grades 4	4-1/2	6
1-1/2 (37.5)- Grades 2 & 3	4-1/2	5-1/2

2 (50)- Grades 2	4	5

1. For specified concrete strengths above 5,000 psi (34.42 MPa) a reduction of 1 percentage point is allowed.

403S.8 Mix Design Options

For the structural concretes identified in Table 5 (Classes C, H and S) and any other class of concrete designed using more than 520 lbs. of cementitious material per cubic yard (310 kgs per cubic meter), one of the mix design options presented below shall be sed.

-structural concretes identified in Table 5 (Classes A, B, D and I) and any other class of concrete designed using less than 520 lbs. of cementitious material per cubic yard (310 kgs per cubic meter), one of the mix design options presented below will be used, except that Class C fly ash may be used instead of Class F fly ash for Options 1, 3 and 4 unless a sulfate-resistant concrete is required.

A. Option 1: Twenty (20) to thirty-five (35) percent of the cement may be replaced with Class F fly ash.

B. Option 2: Thirty-five (35) to fifty (50) percent of the cement may be replaced with ground granulated blast-furnace slag.

C. five (35) to fifty (50) percent of the cement may be replaced with a combination of Class F fly ash, ground granulated blast furnace slag or silica fume. The combination may not include more than thirty-five (35) percent fly ash and no more than ten (10) percent silica fume.

D. Option 4: Type IP or Type IS will be used and up to ten (10) percent of the cement may be replaced with Class F fly ash, ground granulated blast-furnace slag or

E. Option 5: Thirty-five (35) to fifty (50) percent of the cement may be replaced with a combination of Class C fly ash and at least six (6) percent of silica fume, ultra fine fly ash or metakaolin. The combination may not include more than thirty-five (35) percent fly ash and no more than ten (10) percent silica fume.

F. Option 6: A lithium nitrate admixture will be added at a minimum dosage of 0.55 gal. Of thirty (30) percent lithium nitrate solution per pound of alkalis present in the

G. Option 7: When hydraulic cement only is used in the design, the total alkali contribution from the cement in the concrete does not exceed 4.0 lbs. Per cubic yard, when calculated as follows:

alkali (lbs. per CY) = .01 (lbs cement/CY) (% Na_2O equivalent in cement)

where (% Na_2O equivalent in cement) is assumed to be the maximum cement alkali content reported on the cement mill certificate.

H. re are deviations from Options 1 through 7, the following shall be performed:

Conduct tests on both coarse and fine aggregate separately in accordance with ASTM C-1260, using 440 g of the proposed cementitious in the same proportions of hydraulic cement to supplementary cementing material to be used in the mix.

2. Prior to use of the mix, a certified test report signed and sealed by a Professional Engineer, licensed in the state of Texas shall be submitted that demonstrates that ASTM C 1260 test results for each aggregate do not exceed 0.10 percent expansion.

403S.9 Mixing and Mixing Equipment

All equipment, tools and machinery used for hauling materials and performing any part of the work shall be maintained in such condition to insure completion of the work without excessive delays for repairs and replacement. Mixing shall be done in a mixer of approved type and size that will produce uniform distribution of material throughout the mass and shall be capable of producing concrete meeting requirements of ASTM C 94, Ready-mixed Concrete and these specifications. Mixing equipment shall be capable of producing sufficient concrete to provide required quantities. Entire contents of the drum shall be discharged before any materials are placed therein for a succeeding batch. Improperly mixed concrete shall not be placed in a structure. For all mixers an adequate water supply and an accurate method of measuring the water shall be provided.

The mixer may be batched by either volumetric or weight sensing equipment and shall be equipped with a suitable timing device that will lock the discharging mechanism and signal when specified time of mixing has elapsed.

A. Proportioning and Mixing Equipment

For all miscellaneous concrete placements, a mobile, continuous, volumetric mixer or a volumetric or weight batch mixer of the rotating paddle type may be used.

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

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

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

Mixing time shall conform to recommendations of manufacturer of mixer unless otherwise directed by Engineer or designated representative.

B. Ready-mixed Concrete

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

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

2. Sufficient trucks will be available to support continuous placements. The Contractor will satisfy the Engineer or designated representative that adequate standby trucks are available to support monolithic concrete

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

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

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

6. Excess concrete remaining in the drum after delivery and wash water after delivery shall not be dumped on the project site unless approval of the dump location is first secured from the Engineer or designated representative.

C. Volumetric Batching

Use of volumetric batched concrete will be permitted provided the batching and continuous mixing operations conform to ASTM C 685, “Concrete Made By Volumetric Batching and Continuous Mixing”. This type concrete shall be made from materials continuously batched by volume, mixed in a continuous mixer and delivered to the site in a freshly mixed and unhardened state. Tests and criteria for batching accuracy and mixing efficiency shall be as specified in ASTM C 685.

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

Each batching or mixing unit, or both, shall carry in a prominent place a metal plate or plates on which are plainly marked the gross volume of the unit in terms of mixed concrete, discharge speed and the weight-calibrated constant of the machine in terms of a revolution counter or other output indicator. The mixer shall produce a thoroughly mixed and uniform concrete.

The batcher-mixer unit shall contain in separate compartments all the necessary ingredients needed for the manufacture of concrete. The unit shall be equipped with calibrated proportioning devices to vary the mix proportions and it shall e Work and ASTM C 685.

D. Truck-mixed Concrete

The concrete shall be mixed in a truck mixer from 70 to 100 revolutions at the mixing speed designated by the manufacturer that will produce a uniform concrete mix. The concrete shall be delivered to the project in a thoroughly mixed and uniform mass and shall be discharged with a satisfactory degree of uniformity. Additional mixing at the job site, at the mixing speed designated by the manufacturer, may be allowed by the Engineer or designated representative as long as the concrete is discharged before the drum has revolved a total of 300 revolutions after the introduction of the mixing water to the cement and the aggregates.

Re-tempering or adding concrete chemical admixtures is only permitted at the job site when concrete is delivered in a truck mixer. Water shall not be added after introduction of mixing water at the batch plant except on arrival at the job site with approval of the Engineer or designated representative, in order to adjust the slump of the concrete. When this water is added, the mix design water-cementitious-material ratio shall not be exceeded. The drum or blades shall be turned at least 30 additional revolutions at mixing speed to ensure thorough and uniform mixing of the concrete. Water or chemical admixtures shall not be added to the batch after any concrete has been discharged.

When the concrete contains silica fume, mixing times and batching operations shall be adjusted as necessary to ensure that the material is completely and uniformly dispersed in the mix. The dispersion of the silica fume within the mix shall be verified in trial batches.

E. Hand-mixed Concrete

Hand mixing of concrete may be permitted for small placements or in case of an emergency and then only on authorization of the Engineer or designated representative. Hand-mixed batches shall not exceed a 4 cubic foot (0.113 cubic meters) batch in volume. Material volume ratios shall not be leaner than 1 part cement, 2 parts large aggregate, 1 part fine aggregate and enough water to produce a consistent mix with a slump not to exceed 4 inches (100 mm). Admixtures shall not be used unless specifically approved by the Engineer or designated representative.

403S.10 Excavation, Placing of Concrete, Finishing, Curing and Backfill

Excavation, placing of concrete, finishing, curing and backfill shall conform to Standard Specification Item No. 401S, "Structural Excavation and Backfill", Standard Specification Item No. 410S, "Concrete Structures" and Standard Specification Item No. 411S, "Surface Finishes for Concrete".

403S.11 Measurement

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

The quantities of concrete of the various classifications which constitute the completed and accepted structure or structures in place will be measured by the cubic yard (cubic meters:1 cubic meter is equal to 1.308 cubic yards), each, square yard (square meter: 1 square yard equals 0.836 square meters) or linear foot as indicated in the Contract Documents. Measurement will be as follows:

A. General

1. Measurement based on dimensions shall be for the completed structure as -measured dimensions shall not exceed those indicated on the drawings or as may have been directed by the Engineer or designated representative in writing.

2. No deductions shall be made for chamfers less than 2 inches (50 mm) in depth, embedded portions of structural steel, reinforcing steel, nuts, bolts, conduits less than 5 inches (125 mm) in diameter, pre/post tensioning tendons, keys, water stops, weep holes and expansion joints 2 inches (50 mm) or less in width.

3. No measurement shall be made for concrete keys between adjoining beams or prestressed concrete planks.

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

5. No measurement shall be made for inlet and junction box invert concrete.

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

B. Plan Quantity. For those items measured for plan quantity payment, adequate calculations have been made. If no adjustment is required by Article 403S.12, additional measurements or calculations will not be required or made.

C. Measured in Place. For those items not measured for Plan Quantity payment, measurement will be made in place, subject to the requirements of Article 403S.10.A.1 above.

403S.12 Payment

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

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

Plan Quantities will be adjusted:

A. When a complete structure element has been erroneously included or omitted from the drawings, the quantity shown on the drawings for that element will be added to or deducted from the plan quantity and included for payment. A complete structure element will be the smallest portion of a total structure for which a quantity is included on the drawings. Quantities revised in this manner will not be subject to the provisions of the "General Conditions", Article 11.

B. When the plan quantity for a complete structure element is in error by 5 percent or more, a recalculation will be made and the corrected quantity included for payment. Quantities revised in this manner will not be subject to the provisions of the "General Conditions", Article 11

C. When quantities are revised by a change in design, the "plan quantity" will be e amount involved in the design change. Quantities revised in this manner will be subject to the provisions of the "General Conditions", Article 11.

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

Payment for increased or decreased costs due to a change in design on those items measured as "Cubic Yard", "Each", "Square Foot", "Square Yard" or "Linear Foot" will be determined by Change Order. Quantities revised in this manner will be subject to the provisions of the "General Conditions", Article 11.

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

Pay Item No. 403S-CY:	(Structure or Structural Component) -	Per Cubic Yard.
Pay Item No. 403S-EA:	(Structure or Structural Component) -	Per Each.
Pay Item No. 403S-SY:	(Structure or Structural Component) -	Per Square Yard.
Pay Item No. 403S-LF:	(Structure or Structural Component) -	Per Lineal Foot.

End

SPECIFIC CROSS REFERENCE MATERIALS
Standard Specification Item 403S, "Concrete For Structures"

City of Austin Standard Specification Items

Designation	Description
Item No. 401S	Structural Excavation and Backfill
Item No. 410S	Concrete Structures
Item No. 411S	Surface Finishes for Concrete

Texas Department of Transportation: Departmental Material Specifications

Designation	Description
DMS-4640	Chemical Admixtures for Concrete
DMS-4610	Fly Ash
DMS-4620	Ground Granulated Blast-Furnace Slag
DMS-4630	Silica Fume
DMS-4635	Metakaolin

American Association of State Highway & Transportation Officials,
AASHTO Standard Method of Test for

Designation	Description
Method T 26	Quality of Water to be Used in Concrete

American Concrete Institute, ACI

Designation	Description
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

American Society for Testing and Materials, ASTM

Designation	Description
ASTM C 94	Specification For Ready-Mixed Concrete
ASTM C 150	Specification For Portland Cement
ASTM C 685	Concrete Made By Volumetric Batching and Continuous Mixing
ASTM C-1260	Standard Test Method for Potential Alkali Reactivity of Aggregates
ASTM D-512	Test Methods for Chloride Ion in Water
ASTM D-516	Test Methods for Sulfate Ion in Water
ASTM D-4191	Test Method for Sodium in Water by Atomic Absorption
ASTM D-4192	Test Method for Potassium Water by Atomic Absorption

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
TEX-203-F	Sand Equivalent Test
TEX-401-A	Sieve Analysis of Fine and Coarse Aggregate
TEX-406-A	Mineral Finer than 75 µm (No. 200) Sieve in Mineral Aggregates (Decantation Test for Concrete Aggregates)
TEX-408-A	
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-413-A	Determination of Deleterious Materials in Mineral Aggregate
TEX-415-A	Slump of Portland Cement Concrete
TEX-416-A	Air Content of Freshly-Mixed Concrete by the Pressure Method
TEX-418-A	Compressive Strength of Cylindrical Concrete Specimens
TEX-612-J	Acid Insoluble Residue

SPECIFIC CROSS REFERENCE MATERIALS (Continued)
Standard Specification Item 403S, "Concrete For Structures"

Texas Department of Transportation: Publications

Designation	Description
Bulletin C-11	Construction Bulletin

RELATED CROSS REFERENCE MATERIALS
Standard Specification Item 403S, "Concrete For Structures"

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

Designation	_____
Item 360	Concrete Pavement
Item 420	Concrete Structures
Item 421	Hydraulic Cement Concrete
Item 427	Surface Finishes for Concrete
Item 431	Pneumatically Placed Concrete

Item 520 Weighing and Measuring Equipment

Texas Department of Transportation: Departmental Material Specifications

Designation	Description
DMS-4650	Hydraulic Cement Concrete Curing Materials and Evaporation Retardants”
DMS-6100	Epoxy and Adhesives
DMS 8900	Fly Ash

Item No. 405S
Concrete Admixtures

405S.1 Description

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

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.

405S.2 Submittals

The submittal requirements of this specification item include:

A. Type and manufacturer of any proposed admixture.

B. Certification that proposed admixture meet the requirements of this specification, ASTM C260 and ASTM C494.

C. For a specific mix design, a statement of compatibility of products shall be submitted when admixtures from multiple manufacturers are proposed.

405S.3 Materials

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

(1) Air Entraining Admixture:

An "Air Entraining Admixture" is defined as a material which, when added to a concrete mixture in the proper quantity, will entrain uniformly dispersed microscopic air bubbles in the concrete mix. The admixture shall meet the requirements of ASTM Designation: C 260 modified as follows:

(a) The cement used in any series of test shall be either the cement proposed for the specific work or a "reference" Type I cement from one mill.

(b) The air entraining admixture used in the reference concrete shall be Neutralized Vinsol Resin.

(2) Water-reducing Admixture:

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

(3) Accelerating Admixture:

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

(4) Water-reducing, Retarding Admixture:

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

(5) High-range Water Reducing Admixtures:

A "High-range Water Reducing Admixture", referred to as a superplasticizer, is defined as a synthetic polymer material which, when added to a low slump concrete mixture increases the slump without adversely affecting segregation, impermeability or durability of the mix. This admixture shall conform to ASTM C 494, Type F or G.

(6) Fly Ash:

Fly ash used in Portland cement concrete as a substitute for Portland cement or as a mineral filler shall comply with TXDOT Materials Specification D-9-8900 and be listed on TXDOT's current list of approved fly ash sources. Fly ash obtained from a source using a process fueled by hazardous waste (30 Texas Administrative Code, Section 335.1) shall be prohibited. This applies to any other specification concerning the use of fly ash. Contractor shall maintain a record of source for each batch. Supplier shall certify that no hazardous waste is used in the fuel mix or raw materials.

405S.4 Certification and Product Information

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

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

405S.5 Construction Use of Admixtures

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

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

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

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

Accelerating admixtures will not be permitted in combination with Type II cement.

All mixes with air entrainment shall have a minimum relative durability factor of 80 in accordance with ASTM C 260. Dosage of air entrainment admixtures may be adjusted by the Contractor to stay within the specified tolerances for air entrainment of Standard Specification Item No. 403S, "Concrete for Structures".

405S.6 Measurement and Payment

The requirements of this specifications shall not be measured and 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 No. 405S, "Concrete Admixtures"

City of Austin Standard Specifications

Designation	*Description*
Item No. 403S	*Concrete for Structures*

American Society for Testing and Materials, ASTM

Designation	*Description*
ASTM C260	*Air-Entraining Admixtures for Concrete*
ASTM C495	*Chemical Admixtures for Concrete*

Texas Department of Transportation: Department Material Specification

Designation	*Description*
DMS-8900	*Fly Ash*

RELATED CROSS REFERENCE MATERIALS
Specification Item No. 405S, "Concrete Admixtures"

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

Designation	Description
Item 360	Concrete Pavement
Item 420	Concrete Structures
Item 421	Portland Cement Concrete
Item 427	Surface Finishes for Concrete
Item 431	Pneumatically Placed Concrete
Item 437	Concrete Admixtures
Item 520	Weighing and Measuring Equipment
Item 522	Portland Cement Concrete Plants
Item 524	Hydraulic Cement

Item No. 406S
Reinforcing Steel

406S.1 Description

This item shall govern furnishing and placement of reinforcing steel, deformed and smooth, of the size and quantity indicated on the drawings and in accordance with these specifications.

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

406S.2 Submittals

The submittal requirements of this specification item may include:

A. Evidence that the steel reinforcement producer is included on the TxDoT list of approved producing mills

B. Listing of the size, grade, type and quantity of reinforcing steel proposed for the project.

C. If welding of reinforcing steel is proposed, evidence that carbon equivalent (C.E.) of the proposed steel is at least 0.55% with a report of chemical analysis showing the percentages of elements necessary to establish C.E.

D. If epoxy coated steel is proposed, evidence that the steel reinforcement producer is included on the TxDoT list of approved epoxy coating applicators

E. If epoxy coated steel is proposed, written certification that the epoxy-coated reinforcing steel meets the requirements of this Item with a copy of the manufacturer's control tests.

F. When mechanical splices are proposed, the types of couplers proposed for use.

406S.3 Materials

A. Approved Mills

Prior to furnishing reinforcing steel, the producing mills must be included on the list of approved producing mills that is maintained by the Construction Division of the State of Texas Department of Transportation

B. Deformed Bars and Wire Reinforcement

Unless indicated otherwise on the drawings, Bar reinforcement shall be Grade 60 and deformed. Reinforcing steel must conform to one of the following:

ASTM A615/ 615M, Grades 40 or 60 (300 or 420)

ASTM A996/ 996M, Type A, Grades 40 or 60 (300 or 420)

ASTM A996/996M, Type R, Grade 60 (420), permitted in concrete pavement only (furnished as straight bars only without bends. Bend tests are not required)

ASTM A706/706M

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

The nominal size, area and weight (mass) of reinforcing steel bars covered by these specifications are as follows:

Bar Size Number 1/8th ins (mm)	Nominal Diameter, inches (mm)	Nominal Area, Sq. ins. (mm2)	Weight/Linear Foot Lbs. (kg)
2 (6)	0.250 (6.6)	0.05 (32)	0.167 (.075)
3 (10)	0.375 (9.5)	0.11 (71)	0.376 (.171)
4 (13)	0.500 (12.5)	0.20 (127)	0.668 (.303)
5 (16)	0.625 (15.5)	0.31 (198)	1.043 (.473)
6 (19)	0.750 (19.0)	0.44 (285)	1.502 (.681)
7 (22)	0.875 (22.0)	0.60 (388)	2.044 (.927)
8 (25)	1.000 (25.5)	0.79 (507)	2.670 (2.211)
9 (29)	1.128 (28.5)	1.00 (641)	3.400 (1.542)
10 (32)	1.270 (32.0)	1.27 (792)	4.303 (1.952)
11 (36)	1.410 (36.0)	1.56 (958)	5.313 (2.410)
14 (43)	1.693 (43.0)	2.25 (1552)	7.65 (3.470)

18 (57)	2.257 (57.5)	4.00 (2565)	13.60 (6.169)

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

C. Smooth Bar and Spiral Reinforcement

Smooth bars and dowels for concrete pavement must have a minimum yield strength of 60 ksi (414 MPa) and meet ASTM A615/615M. Smooth bars that are greater in diameter than a No. 3 (10 mm) designation shall conform to ASTM A615 or meet the physical requirements of ASTM A36.

Spiral reinforcement shall be either smooth or deformed bars or wire of the minimum size or gauge indicated on the drawings. Bars for spiral reinforcement shall comply with ASTM A615 Grade 40(300), ASTM A996, Type A, Grade 40 (300); or ASTM A675, Grade 80(550), meeting dimensional requirements of ASTM A615. Smooth wire shall comply with ASTM A82, and deformed wire shall comply with ASTM A496.

D. Weldable Reinforcing Steel

Reinforcing steel to be welded must comply with ASTM A706 or have a carbon equivalent (C.E.) of at most 0.55%. A report of chemical analysis showing the percentages of elements necessary to establish C.E. is required for reinforcing steel that does not meet ASTM A706 to be structurally welded. No tack welding will be allowed. All welding shall conform to the requirements of AWS D1.1/D1.1M.

The requirements above do not apply to the following miscellaneous welding applications:

Splicing reinforcing steel to extend bars in the bottom of a drilled shaft;

Attaching chairs to the reinforcing steel cage of a drilled shaft;

Armor joints and their supports;

Screed rail and form hanger supports where permitted on steel units;

Reinforcing steel to R-bars for lateral stability between prestressed beams, spirals, or bands of reinforcing bars in drilled shaft cages;

Permanent bridge deck forms;

Steel added in railing when slip-form construction is used; and

Other similar miscellaneous members that have no load carrying capacity in the completed structure.

E. Welded Wire Fabric

Wire shall conform to the requirements of the Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement, ASTM A 82 or A 496. Wire fabric, when used as reinforcement, shall conform to ASTM A 185 or A 497.

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

Size, W Number 1/100 in^2 (mm2)	Nominal Diameter inch (mm)	Nominal Area, sq. inches (mm^2)
31 (200)	0.628 (16.0)	0.310 (200)
30 (194)	0.618 (15.7)	0.300 (194)
28 (181)	0.597 (15.2)	0.280 (181)
26 (168)	0.575 (14.6)	0.260 (168)
24 (155)	0.553 (14.0)	0.240 (155)
22 (142)	0.529 (13.4)	0.220 (142)
20 (129)	0.505 (12.8)	0.200 (129)
18 (116)	0.479 (12.2)	0.180 (116)
16 (103)	0.451 (11.5)	0.160 (103)
14 (90)	0.422 (10.7)	0.140 (90)
12 (77)	0.391 (9.9)	0.120 (77)
10 (65)	0.357 (9.1)	0.100 (65)
8 (52)	0.319 (8.1)	0.080 (52)
7 (45)	0.299 (7.6)	0.070 (45)
6 (39)	0.276 (7.0)	0.060 (39)
5.5 (35)	0.265 (6.7)	0.055 (35)
5 (32)	0.252 (6.4)	0.050 (32)
4.5 (29)	0.239 (6.1)	0.045 (29)

4 (26)	0.226 (5.7)	0.040 (26)
3.5 (23)	0.211 (5.4)	0.035 (23)
3 (19)	0.195 (5.0)	0.030 (19)
2.5 (16)	0.178 (4.5)	0.025 (16)
2 (13)	0.160 (4.1)	0.020 (13)
1.5 (9)	0.138 (3.5)	0.015 (9.7)
1.2 (8)	0.124 (3.1)	0.012 (7.7)
1 (6)	0.113 (2.9)	0.010 (6.5)
0.5 (3)	0.080 (2.0)	0.005 (3.2)

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

Welded wire fabric shall be designated as follows: 6 x 12 – W16 x W8, which indicates a 6 in. (150 mm) longitudinal wire spacing and 12-in (300 mm) transverse wire spacing with smooth No. 16 (103) wire longitudinally and smooth no. 8 (52) wire transversely.

F. Epoxy Coating

Epoxy coating shall be required as indicated on the drawings. Prior to furnishing epoxy-coated reinforcing steel, the epoxy applicator must be included on the list of approved applicators that is maintained by the Construction Division of the State of Texas Department of Transportation.

The reinforcing steel shall be epoxy coated in accordance with the following.

Epoxy Coating Requirements for Reinforcing Steel

Material	Specification
Bar	ASTM A775 or A934
Wire or Fabric	ASTM A884 Class A or B
Mechanical Coupler	As indicated on the drawings

Hardware	As indicated on the drawings

The epoxy coating material and coating repair material shall comply with TxDoT's DMS-8130, "Epoxy Powder Coating for Reinforcing Steel". The applicator shall not patch more than ¼ inch total length in any foot (20 mm total length in any meter) at the applicator's plant.

The epoxy-coated reinforcing steel shall be sampled and tested in accordance with TxDoT Test Method Tex-739-I, "Sampling and Testing Epoxy Coated Reinforcing Steel".

The identification of all reinforcing steel shall be maintained throughout the epoxy coating and fabrication and until delivery to the project site.

Written certification that the epoxy-coated reinforcing steel meets the requirements of this Item shall be provided along with a copy of the manufacturer's control tests.

G. Mechanical Couplers

When mechanical splices in reinforcing steel bars are indicated on the drawings, the following types of couplers may be used:

Sleeve-filler

Sleeve-threaded

Sleeve-swaged, or

Sleeve-wedge.

H. Chairs and Supports

Chairs and Supports shall be steel, precast mortar or concrete blocks cast in molds meeting the approval of the Engineer or designated representative of sufficient strength to position the reinforcement as indicated on the drawings when supporting the dead load of the reinforcement, the weight of the workers placing concrete and the weight of the concrete bearing on the steel. Chairs shall be plastic coated when indicated on the drawings.

Chair Types and Applicable Uses	
Structural or Architectural Elements (columns, beams, walls, slabs) exposed to weather, not subjected to sand blasting, water blasting or grinding.	Galvanized steel or steel chairs with plastic coated feet.

Structural or Architectural Elements exposed to weather and subject to sand blasting, water blasting or grinding.	Stainless steel chairs.
Structural or Architectural Elements not exposed to weather or corrosive conditions.	Uncoated steel chairs
Slabs and grade beams cast on grade.	Steel chairs with a base with 9 inch² (58 cm^2) minimum area or sufficient area to prevent the chair from sinking into fill or subgrade. Precast mortar or concrete blocks meeting the requirements of this item may be used.

406S.4 Bending

The reinforcement shall be bent cold, true to the shapes indicated on the drawings. Bending shall preferably be done in the shop. Irregularities in bending shall be cause for rejection. Improperly fabricated, damaged or broken bars shall be replaced at no additional expense to the City. Damaged or broken bars embedded in a previous concrete placement shall be repaired using a method approved by the Engineer or designated representative.

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

Bends of 90 degrees and greater in stirrups, ties and other secondary bars that enclose another bar in the bend.

Bar Number in 1/8th inches (mm)	Diameter
3, 4, 5 (10, 13, 16)	4d
6, 7, 8	6d

All bends in main bars and in secondary bars not covered above.

Bar Number in 1/8th inches (mm)	Diameter
3 thru 8 (10 thru 25)	6d
9, 10, 11 (29, 32, 36)	8d
14, 18 (43, 57)	10d

406S.5 Tolerances

Fabricating tolerances for bars shall not be greater than shown on Standard (Detail) 406S-1.

406S.6 Storing

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

406S.7 Splices

Splicing of bars, except when indicated on the drawings or specified herein, will not be permitted without written approval of the Engineer or designated representative. No substitution of bars will be allowed without the approval of the Engineer or designated representative. Any splicing of substituted bars shall conform to the requirements in the Table below.

Splices not indicated on the drawings will be permitted in slabs not more than 15 inches (380 mm) in thickness, columns, walls and parapets.

Splices will not be permitted in bars 30 feet (9.1 meters) or less in plan length unless otherwise approved. For bars exceeding 30 feet (9.1 meters) in plan length, the distance center to center of splices shall not be less than 30 feet (9.1 meters) minus 1 splice length, with no more than 1 individual bar length less than 10 feet (3 meters). Splices not indicated on the drawings, but permitted hereby, shall conform to the Table

below. The specified concrete cover shall be maintained at such splices and the bars placed in contact and securely tied together.

Minimum Lap Requirements		
Bar Number in 1/8th inches (mm)	Uncoated Lap Length	Coated Lap Length
3 (10)	1 foot 4 inches (0.4 meters)	2 foot 0 inches (0.610 meters)
4 (13)	1 foot 9 inches (0.533 meters)	2 foot 8 inches (0.813 meters)
5 (16)	2 foot 2 inches (0.660 meters)	3 feet 3 inches (0.991meters)
6 (19)	2 foot 7 inches (0.787 meters)	3 feet 11 inches (1.194 meters)
7 (22)	3 feet 5 inches (1.041 meters)	5 feet 2 inches (1.575 meters)
No. 8 (25)	4 feet 6 inches (1.372 meters)	6 feet 9 inches (2.057 meters)
No. 9 (29)	5 feet 8 inches (1.727 meters)	8 feet 6 inches (2.591 meters)
No. 10 (32)	7 feet 3 inches (2.210 meters)	10 feet 11 inches (3.327 meters)
No. 11 (36)	8 feet 11 inches (2.718 meters)	13 feet 5 inches (4.089 meters)

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

Welded wire fabric shall be spliced using a lap length that includes an overlap of at least 2 cross wires plus 2 inches (50 mm) on each sheet or roll.

Splices using bars that develop equivalent strength and are lapped in accordance with the table above are permitted.

Welding of reinforcing bars may be used only where indicated on the drawings or as permitted herein. All welding operations, processes, equipment, materials, quality of work and inspection shall conform to the requirements indicated on the drawings. All

splices shall be of such dimension and character as to develop the full strength of the bar being spliced.

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

For box culvert extensions with less than 1 foot (0.3 meters) of fill, the existing longitudinal bars shall have a lap with the new bars as shown in the table above. For box culvert extensions with more than 1 foot (0.3 meters) of fill, a minimum lap of 12 inches (300 mm) will be required.

Unless otherwise indicated on the drawings, dowel bars transferring tensile stresses shall have a minimum embedment equal to the minimum lap requirements shown in the table above. Shear transfer dowels shall have a minimum embedment of 12 inches (300 mm).

406S.8 Placement

Reinforcement shall be placed as near as possible in the position indicated on the drawings. Unless otherwise indicated on the drawings, dimensions shown for reinforcement are to the centers of the bars. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch (6 mm). Cover of concrete to the nearest surface of steel shall be as follows:

	Minimum Cover, Inches (mm)
(a) Concrete cast against and permanently exposed to earth	3 (76 mm)
(b) Concrete exposed to earth or weather:	
Bar No. 6 (19) through No. 18 bars (57)	2 (51 mm)
Bar No. 5 (16), W31 (W200) or D31 (D200) wire and smaller	1 ½ (38 mm)
(c) Concrete not exposed to weather or in contact with ground:	

Slabs, walls, joists:	
Bar No. 14 (43) and 18 (57)	1 ½ (38mm)
Bar No. 11 (36) and smaller	1 (25 mm)
Beams, columns:	
Primary reinforcement, ties, stirrups, spirals	1 ½ (38 mm)
Shells, folded plate members:	
Bar No. 6 (19) and larger	1 (25 mm)
Bar No. 5 (16), W31 (W200) or D31 (D200) wire, and smaller	1 (25 mm)

Vertical stirrups shall always pass around the main tension members and be attached securely thereto.

The reinforcing steel shall be located accurately in the forms and held firmly in place before and during concrete placement by means of bar supports that are adequate in strength and number to prevent displacement and to keep the steel at the required distance from the form surface. Bars shall be supported by means of approved galvanized metal spacers, metal spacers with plastic coated tips, stainless steel spacers, plastic spacers or approved precast mortar or concrete blocks when supports are in contact with removable or stay-in-place forms. Bright basic bar supports shall be used to support reinforcing steel placed in slab overlays on concrete panels or on existing concrete slabs. Bar supports in contact with soil or subgrade shall be approved.

For bar supports with plastic tips, the plastic protection must be at least 3/32 in. (2.4 mm) thick and extend upward on the wire to a point at least ½ in. (12.5 mm) above the formwork.

For approval of plastic spacers on a project, representative samples of the plastic shall show no visible indications of deterioration after immersion in a 5 percent solution of sodium hydroxide for 120 hours.

All accessories such as tie wires, bar chairs, supports, or clips used with epoxy-coated reinforcement shall be of steel, fully coated with epoxy or plastic. When approved by the Engineer or designated representative, plastic supports may also be used with epoxy-coated reinforcement.

All reinforcing steel shall be tied at all intersections, except that where spacing is less than 1 foot (300 mm) in each direction, alternate intersections only need be tied. For reinforcing steel cages for other structural members, the steel shall be tied at enough intersections to provide a rigid cage of steel. Mats of wire fabric shall overlap each other 1 full space as a minimum to maintain a uniform strength and shall be tied at the ends and edges.

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

Mortar or concrete blocks shall be cast to uniform dimensions with adequate bearing area. A suitable tie wire shall be provided in each block, to be used for anchoring to the steel. Except in unusual cases and when specifically authorized by the Engineer, the size of the surface to be placed adjacent to the forms shall not exceed 2 1/2 inches (63.5 mm) square or the equivalent thereof in cases where circular or rectangular areas are provided. Blocks shall be cast accurately to the thickness required and the surface to be placed adjacent to the forms shall be a true plane, free of surface imperfections. The blocks shall be cured by covering them with wet burlap or mats for a period of 72 hours. Mortar for blocks should contain approximately 1 part hydraulic cement to three parts sand. Concrete for blocks should contain 850 pounds of hydraulic cement per cubic yard (500 kilograms per cubic meter) of concrete

Individual bar supports shall be placed in rows at 4-ft (1.22 meters) maximum spacing in each direction. Continuous type bar supports shall be placed at 4-ft (1.22 meters) maximum spacing. Continuous bar supports shall be used with permanent metal deck forms.

The exposure of the ends of longitudinals, stirrups and spacers used to position the reinforcement in concrete pipe and in precast box culverts or storm drains is not a cause for rejection.

Reinforcing steel for bridge slabs, top slabs of direct traffic culverts, and top slabs of prestressed box beams at all intersections, except tie only alternate intersections where spacing is less than 1 ft. (300 mm) in each direction.

For steel reinforcing cages for other structural members, reinforcement shall be supported and tied in such a manner that a sufficiently rigid cage of steel is provided. Fasten mats of wire fabric securely at the ends and edges. If the cage is not adequately supported to resist settlement or floating upward of the steel, overturning of truss bars or movement in any direction during concrete placement, permission to continue concrete placement will be withheld until corrective measures are taken. Sufficient measurements shall be made during concrete placement to insure compliance with the above.

No concrete shall be deposited until the Engineer or designated representative has reviewed the placement of the reinforcing steel and all mortar, mud, dirt, etc, shall be cleaned from the reinforcement, forms, workers' boots and tools. Do not place concrete until authorized by the Engineer or designated representative

406S.9 Handling, Placement and Repair of Epoxy-coated Reinforcement Steel

A. Handling

Systems for handling coated-reinforcement with padded contact areas shall be provided. Handling bands shall be padded to prevent damage to the coating. Bundles of coated reinforcement shall be lifted with a strongback, spreader bar, multiple supports or a platform bridge. The bundled reinforcement shall be carefully transported and stored on protective cribbing. The coated reinforcement should not be dropped or drug during handling.

B. Construction Methods

Coated reinforcement shall not be flame-cut but shall be sawn or shear-cut only when approved. Cut ends shall be coated as specified in Section C, “Repair of Coating”.

Coated reinforcement steel shall not be welded or mechanically coupled except where specifically indicated on the drawings. When welding or coupling is indicated on the drawing, the epoxy coating shall be removed at least 6 in. (150 mm) beyond the weld limits before welding and 2 in. (50 mm) beyond the limits of the mechanical coupler before assembly. After the welding or coupling operation is completed the steel shall be cleaned of oil, grease, moisture, dirt, welding contamination (slag or acid residue) and rust to a near-white finish. The existing epoxy coating shall be examined for damage and any damaged or loose epoxy shall be removed to expose sound epoxy coating.

After cleaning the coated-steel, the splice area shall be coated with epoxy repair material to a thickness of 7 to 17 mils (0.18 to 0.43 mm) after curing. A second application of the repair material shall be applied to the bar and coupler interface to ensure complete sealing of the joint.

C. Repair of Coating

The material used for coating repair shall comply with the requirements of this Item and ASTM D3963/D3963M, “Specification for Fabrication and Jobsite Handling of Epoxy-coated Reinforcing Steel Bars”. Repairs shall be made in accordance with procedures recommended by the manufacturer of the epoxy coating powder. For areas to be patched, a minimum coating thickness as required for the original coating shall be applied. All visible damage to the coating shall be repaired.

Sawed and sheared ends, cuts, breaks and other damage shall be promptly repaired before additional oxidation occurs. The areas to be repaired shall be cleaned to ensure that they free from surface contaminants. Repairs shall be made in the shop or in the field as required.

406S.10 Measurement

The measurement of quantities of reinforcement furnished and placed will be based on the calculated weight of the steel actually placed as indicated on the drawings, with no allowance made for added bar lengths for splices requested by the Contractor nor for

extra steel used when bars larger than those indicated on the drawings are used or for a higher grade of steel that is substituted with the permission of the Engineer or designated representative. Tie wires and supporting devices will not be included in the calculated weights. The calculated weight of bar reinforcement will be determined using the theoretical bar weight set forth in this item.

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

406S.11 Payment

Reinforcing steel will generally not be paid for directly, but shall be included in the unit price bid for the items of construction in which the reinforcing steel is used.

When specified in the contract bid form as a separate pay item, this item shall be paid for at the contract unit price bid per pound of "Reinforcing Steel". The unit bid price shall include full compensation for all work specified herein including furnishing, bending, fabricating, welding and placing reinforcement, for all clips, blocks, metal spacers, ties, chairs, wire or other materials used for fastening reinforcement in place and for all tools, labor, equipment and incidentals necessary to complete the work.

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

Pay Item No. 406S-RC:	Reinforcing Steel -	Per Pound.
Pay Item No. 406S-ERC:	Epoxy-Coated Reinforcing Steel -	Per Pound.

END

SPECIFIC CROSS REFERENCE MATERIALS
Standard Specification Item 406S, "Reinforcing Steel"

American Society for Testing and Materials, ASTM

Designation	Description
ASTM A 36/A 36M	Carbon Structural Steel
ASTM A 82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A 185	Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 496	Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	Deformed and Plain Billet-steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706/A 706M	Low- Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 775/A 775M	Epoxy-Coated Reinforcing Steel Bars
ASTM A 884/A 884M	Epoxy-Coated Steel Wire and Welded Wire Fabric For Reinforcement
ASTM A 934/A 934M	Epoxy-Coated Prefabricated Reinforcing Steel Bars
ASTM A 996/A 996M	Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM D3963/D3963M	Fabrication and Jobsite Handling of Epoxy-coated Reinforcing Steel Bars

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex-739-I	Sampling and Testing Epoxy Coated Reinforcing Steel

City of Austin Standard (Details)

Designation	Description
Standard 406S-1	Reinforced Steel Tolerances

Texas Department of Transportation: Departmental Material Specifications

Designation	Description
DMS 8130	Epoxy Powder Coating for Reinforcing Steel

American Welding Society

Designation	Description
AWS D1.1/D1.1M	Structural Welding Code

RELATED CROSS REFERENCE MATERIALS
Standard Specification Item 406S, "Reinforcing Steel"

City of Austin Standard Specification Items

Designation	Description
Item No. 360	Concrete Pavement
Item No. 403S	Concrete for Structures
Item No. 410S	Concrete Structures
Item No. 414S	Concrete Retaining Walls

Item No. 420S	Drilled Shaft Foundations
Item No. 830S	Traffic Signal Controller Foundation
Item No. 831S	Traffic Signal Drilled Shaft Foundation

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

Designation	Description
Item No. 360	Concrete Pavement
Item No. 420	Concrete Structures
Item No. 421	Hydraulic Cement Concrete
Item No. 422	Reinforced Concrete Slab
Item No. 423	Retaining Walls
Item No. 440	Reinforcing Steel

Item No. 408S
Concrete Joint Materials

408S.1 Description

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

408S.2 Submittals

The submittal requirements of this specification item include:

A. Type and manufacturer of all joint materials proposed for use.

B. Technical data indicating that proposed products meet the requirements specified herein.

408S.3 Materials

(1) Preformed Asphalt Board

Preformed asphalt board formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly impregnated with a suitable asphaltic binder and meeting the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete (Bituminous Type), ASTM D 994.

(2) Preformed Nonbituminous Fiber Material

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

(3) Boards

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

(4) Joint Sealer (Concrete Pavement)

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

As Supplied	
Color	Gray
Flow, MIL-2-8802D Sec. 4.8.4	0.2 maximum

Working Time, minutes	10
Tack-Free Time at 77°F ± 2F (25°C ± -1.66°C) Min. MIL-2-8802D Sec.4.8.7	60
Cure time, at 77°F (25°C), days	7-14
Full Adhesion, days	14-21
As Cured---after 7 days at 77°F (25°C) and 40% RH	
Elongation, percent minimum	1200
Durometer Hardness, Shore A, points ASTM 2240	15
Joint Movement Capability, percent	+100/-50
Tensile Strength, maximum elongation,psi (kPa)	100 (689)
Peel Strength, psi (kPa)	25 (172)

The joint sealer shall adhere to the sides of the concrete joint or crack and shall be an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperature.

(5) Backer Rod

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

(6) Joint Sealing Material

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

The material shall adhere to the sides of the concrete joint or crack and shall form an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperatures. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles. It shall cure sufficiently at an average temperature of 77°F± 3°F (25°C ± -1.66°C) so as not to pick up under wheels of traffic in a maximum of 3 hours.

Performance Requirements:

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

It shall be of such consistency that it can be mixed and poured or mixed and extruded into joints at temperatures above 60°F (1.66°C).

Penetration 77°F (25°C), 150 gm. Cone, 5 sec., max.-cm	0.90
Bond and Extension 75%, 0F, 5 cycles:	
Dry Concrete Blocks	Pass
Wet Concrete Blocks	Pass
Steel Blocks (Primed if specified by manufacturer)	Pass
Flow at 200 °F (93°C)	None
Water content % by weight, max.	5.0

Resilience:	
Original sample min. % (cured)	50
Oven-aged at 158°F (70°C) min. %	50
For Class 1-a material only, Cold Flow (10 minute)	None

(7) Rebonded Recycled Tire Rubber

This material consists of granular particles of rubber, made by grinding automobile and truck tires, securely bound together by a synthetic resin or plastic binder. The filler must be molded into sheets of the required dimensions, which meet the testing requirements of both ASTM D 1751 and ASTM D 1752, except that the requirements for asphalt content and expansion are waived. The density of the material must be at least 30 lb/ft ^{3} (440kg/m^3).

408S.4 Construction Methods

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

Asphalt, Redwood board or other materials used shall extend the full depth of the concrete and shall be perpendicular to the exposed face. All joints shall be shaped to conform to the contour of the finished section in which they are installed. All material shall be a minimum of 1/2 inch (12.5 mm) thick or as indicated. Wood materials shall be anchored to the adjacent concrete to permanently hold them in place. Joint sealer shall be installed in accordance with the manufacturer's recommendations.

The material used for side walk expansion joints shall conform to No. 3 above, unless otherwise indicated.

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

408S.5 Measurement and Payment

No additional compensation will be made for materials, equipment or labor required by this item, 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
Standard Specification Item No. 408S, " Concrete Joint Materials”

American Society for Testing and Materials (ASTM)

Designation	Description
D 994	Specification for Preformed Expansion Joint Filler for Concrete

	(Bituminous Type)
D 1751	Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
D 1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
D 2240	Standard Test Method for Rubber Property-Durameter Hardness

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex-525-C	Tests for Asphalt and Concrete Joint Sealers

Item No. 409S
Membrane Curing

409S.1 Description

This item shall govern curing concrete pavement, concrete base, pavement, curbs, gutters, retards, sidewalks, driveways, medians, islands, concrete riprap, cement stabilized riprap, concrete structures and other concrete as indicated by applying an impervious liquid membrane forming material.

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.

409S.2 Submittals

The submittal requirements of this specification item include:

A. Type and manufacturer for all membrane curing materials proposed.

B. Proposed curing procedures.

409S.3 Material

The liquid forming membrane curing compound shall comply with the "Standard Specification for Liquid Membrane-forming Compounds for Curing Concrete", ASTM C 309, Type 1-D clear or translucent, with fugitive dye or Type 2 white pigmented. The material shall have a minimum flash point of 80°F (26.7°C) when tested by the "Pensky-Martin Closed Cup Tester", ASTM D 93.

It shall be of such consistency that it can be satisfactorily applied as a fine mist through an atomizing nozzle by means of approved pressure spraying equipment at atmospheric temperatures above 40° F (4.4°C).

It shall be of such nature that it will not produce permanent discoloration of concrete surfaces nor react deleteriously with the concrete or its components. Type 1 compound shall contain a fugitive dye that will be distinctly visible not less than 4 hours nor more than 7 days after application.

Type 2 compound shall not settle out excessively or cake in the container and shall be capable of being mixed to a uniform consistency by moderate stirring and shall exhibit a daylight reflectance of not less than 60 percent of that of magnesium oxide when tested as indicated.

The compound shall produce a firm, continuous, uniform moisture impermeable film, free from pinholes and shall adhere satisfactorily to the surfaces of damp concrete. When applied to the damp concrete surface at the rate of coverage indicated, the compound shall dry to the touch in not more than 4 hours and shall not be tacky or track off concrete after 12 hours.

It shall adhere to horizontal and vertical surfaces in a tenacious film and shall not run off or show an appreciable sag, disintegrate, check, peel or crack during the required curing period.

Under traffic, the compound shall not pick up or peel and shall gradually disintegrate from the surface.

The compound shall be delivered to the job only in the manufacturer's original containers, which shall be clearly labeled with the manufacturer's name, the trade name of the material and a batch number or symbol with which test samples may be correlated.

The water retention test shall be in accordance with the following:

Percentage loss shall be defined as the water lost after the application of the curing material was applied. The permissible percentage moisture loss (at the rate of coverage specified herein) shall not exceed the following:

24 hours after application	2 percent
72 hours after application	4 percent

409S.4 Construction Methods

The membrane curing compound shall be applied after the surface finishing has been completed and immediately after the free surface moisture has disappeared. The surface shall be sealed with a single uniform coating of the specified type of curing compound applied at the rate of coverage recommended by the manufacturer and directed by the Engineer or designated representative, but not less than 1 gallon per 180 square feet (3.8 liters per 16.7 square meters) of area. The Contractor shall provide satisfactory means and facilities to properly control and check the rate of application of the compound.

The compounds shall not be applied before the surface has become dry, but shall be applied just after free moisture has disappeared.

The compound shall be thoroughly agitated during its use and shall be applied by means of approved mechanical power pressure sprayers for street and bridge applications. The sprayers used to apply the membrane to concrete exposed surfaces shall travel at a uniform speed along the forms and be mechanically driven. The equipment shall be of such design that it will insure uniform and even application of the membrane material. The sprayers shall be equipped with satisfactory atomizing nozzles. On small miscellaneous items or on interim bridge deck curing will the Contractor be permitted to use hand-powered spray equipment. For all spraying equipment, the Contractor shall provide facilities to prevent the loss of the compound between the nozzle and the concrete surface during the spraying operations.

At locations where the coating shows discontinuities, pinholes or other defects or if rain falls on the newly coated surface before the film has dried sufficiently to resist damage, an additional coat of the compound shall be applied immediately at the same rate of coverage specified herein.

To insure proper coverage, the Engineer or designated representative shall inspect all treated areas after application of the compound for the period of time designated in the specification for curing, either for membrane curing or for other methods. Dry areas are identifiable because of the lighter color of dry concrete as compared to damp concrete. All suspected areas shall be tested by placing a few drops of water on the suspected areas. If the water stands in rounded beads or small pools which can be blown along the surface of the concrete without wetting the surface, the water impervious film is present. If the water wets the surface of the concrete as determined by obvious darkening of the surface or by visible soaking into the surface, no water-impervious film is present. Should the foregoing test indicate that any area during the curing period is not protected by the required water-impervious film an additional coat or coats of the compound shall be applied immediately and the rate of application of the membrane compound shall be increased until all areas are uniformly covered by the required water-impervious film.

The compounds shall not be applied to a dry surface and if the surface of the concrete has become dry, it shall be thoroughly moistened prior to the application of the membrane by fogging or mist application. Sprinkling or coarse spraying will not be allowed.

When temperatures are such as to warrant protection against freezing, curing by this method shall be supplemented with an approved insulating material capable of protecting the concrete for the specified curing period.

If at any time there is reason to believe that this method of curing is unsatisfactory or is detrimental to the work, the Contractor, when notified, shall immediately cease the use of this method and shall change to curing by one of the other methods specified under this contract.

Curing compounds shall be compatible with the adhesion of toppings or overlays where curing has been applied to the concrete base surface in order to assure adequate bond.

When forms are stripped before the 4 minimum curing days have passed, curing shall continue by an approved method.

409S.5 Measurement and Payment

Membrane curing will not be measured for payment. The work and materials prescribed herein will not be paid for directly, but shall be included in the unit price bid for the item of construction in which these materials are used.

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification Item No. 409S, “Membrane Curing”

American Society for Testing and Materials (ASTM)

Designation	Description
C 309	Liquid Membrane-forming Compounds for Curing Concrete
D 93	Pensky-Martin Closed Cup Tester

RELATED CROSS REFERENCE MATERIALS
Specification Item No. 409S, “Membrane Curing”

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

Designation	Description
Item 360	Concrete Pavement
Item 420	Concrete Structures
Item 421	Portland Cement Concrete
Item 427	Surface Finishes for Concrete
Item 431	Pneumatically Placed Concrete
Item 437	Concrete Admixtures
Item 520	Weighing and Measuring Equipment
Item 522	Portland Cement Concrete Plants
Item 524	Hydraulic Cement

Item No. 413S
Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)

413S.1 Description

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

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

413S.2 Submittals

The submittal requirements of this specification item include:

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

413S.3 Materials

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

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

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

413S.4 Equipment

All equipment shall be in accordance with the sealant manufacturer’s recommendations. Air compressors shall be equipped with appropriate filters for removing oil and water from the air.

Any equipment, that damages dowels, reinforcing steel, Portland cement concrete, base, subbase or subgrade in the process of cleaning the joints and/or cracks, shall be discontinued and the joint and/or crack shall be cleaned by other methods approved by the Engineer or designated representative, which do not cause such damage.

413S.5 Construction Methods

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

A. Joint and Crack Preparation.

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

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

1. Joint Preparation.

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

2. Crack Preparation.

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

B. Joint and Crack Sealing

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

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

The minimum depth of sealant shall be ½ inch (12.5 mm) or a depth recommended by the sealant manufacturer and the top of the sealant shall be located 1/8 to ¼ inch (3 to 6.5 mm) below the adjacent pavement surface.

1. Primer.

If required, the primer shall be applied as soon as possible after cleaning is accomplished. The primer shall be applied uniformly at the rate recommended by the sealant manufacturer. The primer shall be applied to exposed metal surfaces before new corrosion begins and shall be allowed to cure for a minimum of thirty (30) minutes, but no longer than eight (8) hours prior to the application of the sealant, unless sealant manufacturer recommendations indicate otherwise.

2. Backer Rods.

   Backer rods shall be used to pr4event a fluid type sealant from flowing through the joint and crack and to retain the sealant at its required elevation. The application and use of backer rod shall be as recommended by the sealant manufacturer and approved by the Engineer or designated representative.

413S.6 Measurement

Accepted work performed under this item shall be included in other pay items and will not be measured and paid for unless a separate pay item is provided in the contract bid form documents.

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

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

413S.7 Payment

When included as a pay item in the contract documents, the work performed and materials furnished as provided by this item and measured in accordance with Article 413S.6, "Measurement", will be paid for at the appropriate unit bid price bid. The unit bid prices shall include full compensation for cleaning and, if necessary, grooving and/or sawing the crack/joint; furnishing, hauling and placing primer and backer rod, if necessary; furnishing, heating, hauling, and placing the crack/joint sealer; all freight involved and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

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

Pay Item No. 413S-A: _____	Sealer	Per Lineal Foot.
Pay Item No. 413S-B: _____	Sealer	Per Pound of Sealer Used.

End

SPECIFIC Cross Reference Materials
Item No. 413S, "Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)"

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

Designation	Description
Item No. 433S	Joint Sealants and Fillers
Item No. 438	Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)

Texas Department of Transportation: Departmental Materials Specifications

Designation	Description
DMS 6310	Joint Sealants and Seals

RELATED Cross Reference Materials

City of Austin Standard Specifications

Designation	Description

Item No. 301S Asphalts, Oils and Emulsions
Item No. 313S Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)

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

Designation	Description
Item No. 300	Asphalts, Oils and Emulsions
Item No. 352	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)

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.

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

This payment method includes all the work performed for " P.C. Concrete Curb" complete, at the unit bid price. The unit bid price shall include full compensation for excavation, 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.

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

This payment method includes all the work performed for "P.C. Concrete Curb" 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 other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

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

This payment method shall include all the work performed for "P.C. Concrete Laydown Curb" 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

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

This payment method includes all the work performed for "P.C. Concrete Laydown Curb" 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 other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

Pay Item No. 430S-A:	P.C. Concrete Curb and Gutter (Excavation)	Per Lineal Foot.
Pay Item No. 430S-B:	P.C. Concrete Curb and Gutter (Fine Grading)	Per Lineal Foot.
Pay Item No. 430S-C:	P.C. Concrete Curb (Excavation)	Per Lineal Foot.
Pay Item No. 430S-D:	P.C. Concrete Curb (Fine Grading)	Per Lineal Foot.
Pay Item No. 430S-E:	P.C. Concrete Laydown Curb (Excavation)	Per Lineal Foot.
Pay Item No. 430S-F:	P.C. Concrete Laydown Curb (Fine Grading)	Per Lineal Foot.

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification Item No. 430S, “P.C. Concrete Curb and Gutter”

City of Austin Standard Specifications

Designation	*Description*

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

Designation	*Description*
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

RELATED CROSS REFERENCE MATERIALS
Specification Item No. 430S, “P.C. Concrete Curb and Gutter”

City of Austin Standard Specifications

Designation	*Description*
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 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

SPECIFIC CROSS REFERENCE MATERIALS
Specification 432S, “P. C. Concrete Sidewalks”

City of Austin Standard Specifications

Designation	Description
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

Designation	Description
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

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

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

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

RELATED CROSS REFERENCE MATERIALS

City of Austin Standard Contract Documents

Designation	Description
00700	General Conditions
01500	Temporary Facilities
01550	Public Safety and Convenience

City of Austin Utilities Criteria Manual

Designation	Description
Section 5.2.3	Utility Adjustments For Roadway Construction Projects

City of Austin Standard Specifications

Designation	Description
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

433S.1 Description

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

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

433S.2 Submittals

The submittal requirements of this specification item include:

A. Class A and/or Item 360S p.c. concrete mix design,

B. Type of Installation (i.e. Type I, Flared Type I, Type II, etc.) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane),

C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

433S.3 Materials

A. Concrete

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

B. Reinforcing Steel

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

C. Expansion Joint Materials

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

D. Membrane Curing Compound

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

E. Cushion Layer

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

433S.4 Construction Methods

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

A. Subgrade Preparation

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

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

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

B. Forms

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

All forms shall be securely staked to line and grade and maintained in a true position during the placement of p.c. concrete.

C. Joints

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

D. Reinforcement

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

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

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

Splices in wire fabric shall overlap sufficiently to allow two pairs of transverse wires to be tied together and no splice of less than 6 inches (150 mm) will be permitted. Splices in the No. 3 (10 M) and No. 4 (13M) bars shall have a minimum lap of 12 inches (300 mm).

E. P.C. Concrete Placement and Finishing

The p.c. concrete shall be placed in the forms and spaced, tamped and thoroughly compacted until it entirely covers the surface and has a monolithic finish. The top surface shall be floated and troweled to a uniform smooth surface, then finished with a broom or wood float to a gritty texture unless otherwise indicated on the Drawings. The outer edges and joints shall be rounded with approved tools to a 1/4-inch (6.3 mm) radius. Care shall be exercised to prevent loss of dummy joints or rounded edges when applying the broom finish.

F. Curing

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

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

G. Incidental Work

All necessary excavation, filling and grading of the slopes, adjacent to the completed pcc driveways, will be considered incidental work pertaining to this item and will not be paid for directly.

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

433S.5 Measurement

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

433S.6 Payment

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

Payment will be made under:

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

End

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

City of Austin Standard Specifications

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

City of Austin Standard Details

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

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

City of Austin Standard Specifications

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

Item No. 439S
Parking Lot Bumper Curbs

439S.1 Description

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

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

439S.2 Submittals

The submittal requirements of this specification item include:

A. Type A Portland cement concrete design mix.

B. Reinforcing steel details.

439S.3 Materials

A. Concrete. All precast concrete shall be Class A Concrete conforming to Specification Item No. 403S, "Concrete for Structures".

B. Reinforcing Steel. All reinforcing steel shall be #3 (10M) bar conforming to Specification Item No. 406S, "Reinforcing Steel".

439S.4 Construction Methods

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

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

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

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

439S.5 Measurement

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

439S.6 Payment

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

Payment will be made under:

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

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification Item 439S "Parking Lot Bumper Curbs"

City of Austin Technical Specifications

Designation	Description
Item No. 403S	Concrete for Structures
Item No. 406S	Reinforcing Steel
Item No. 410S	Concrete Structures

RELATED CROSS REFERENCE MATERIALS
Specification Item 439S "Parking Lot Bumper Curbs"

City of Austin Technical Specifications

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

City of Austin Standards

Designation	Description
Item No. 406S-1	Reinforced Steel Tolerances

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

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

American Society for Testing and Materials

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

Item No. 602S
Sodding for Erosion Control

602S.1 Description

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

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

602S.2 Submittals

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

602S.3 Materials

A. Block and Mulch Sod

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

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

Care shall be taken at all times to retain the native soil of the roots of the sod during the process of excavating, hauling and planting. Sod material shall be kept moist from the time it is dug until it is planted. The sod existing at the source shall be watered to the extent required by the Engineer or designated representative prior to excavating.

B. Fertilizer

Fertilizer and the rate of application shall conform to the requirements of Standard Specification Item No. 606S, "Fertilizer".

C. Mulch

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

D. Water

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

E. Tacking Agents

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

602S.4 Planting Season

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

602S.5 Construction Methods

A. General

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

B. Placement

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

Pegs shall be of wood lath or similar material, pointed and driven with the flat side against the slope, 6 inches (150 mm) into the ground, leaving approximately 1/2 inch (12.5 mm) of the top above the ground. Ground staples shall not be less than

13 inches (330 mm) in length and shall be constructed of No. 11 gage (3 mm) wire that is bent to form a "U" approximately 1 inch (25 mm) in width.

C. Watering

Immediately after the area is sodded, it shall be watered with a minimum of 5 gallons of water per square yard (22.5 liters per square meter) and at 10 day intervals as needed and as directed by the Engineer or designated representative. Subsequent to the initial application water shall be applied at a minimum rate of 3 gallons per square yard (13.5 liters per square meter), as required on the Drawings or as directed by the Engineer or designated representative until final acceptance by the City or until the grass uniformly reaches a height of 2 1/2 inches (62.5 mm).

Availability of water from the Austin Water Utility will be limited as stated under the Water Conservation Standard, City of Austin Land Development Code Chapter 6-2, Article II, " Water Use Management Plan Established".

The use of potable water will be restricted as stated in City of Austin Land Development Code Sections 6-4-73, 6-4-54, 6-4-63, 6-4-64, 6-4-65, 6-4-81, 6-4-92, 15-9-37(D) and 15-9-101(B).

D. Finishing

Where applicable, the shoulders, slopes and ditches shall be smoothed after planting has been completed and shaped to conform to the desired cross sections shown on the Drawings. Any excess soil from planting operations shall be spread uniformly over adjacent areas or disposed of as directed by the Engineer or designated representative so that the completed surfaces will present a neat appearance. All sodded areas shall be rolled after the initial watering application, when sufficiently dry.

602S.6 Block Sodding

At locations indicated on the Drawings or where directed by the Engineer or designated representative, sod blocks shall be carefully placed on the prepared areas. The fertilizer shall then be applied in accordance with the applicable provisions of Item No. 606S, "Fertilizer" and thoroughly watered. When sufficiently dry, the sodded area shall be rolled or tamped to form a thoroughly compacted, solid mat. Any voids left in the block sodding shall be filled with additional sod and tamped. Surfaces of block sod which, in the opinion of the Engineer or designated representative may slide due to the height and slope of the surface or nature of the soil, shall be pegged with wooden pegs driven through the sod blocks into firm earth sufficiently close to hold the block sod firmly in place. Edges along curbs and drives, walkways, etc., shall be carefully trimmed and maintained until the sodding is accepted.

602S.7 Mulch Sodding

The sod source shall be disked in 2 directions cutting the sod thoroughly to a depth of not less than 4 inches (100 mm). Sod material shall be excavated to a depth of not more than 2 inches (50 mm) below the existing root system, being careful to avoid having soil containing no grass roots. The disked sod may be windrowed or otherwise

handled in a manner satisfactory to the Engineer or designated representative. The material shall be rejected if not kept in a moist condition.

Prior to placement of mulch sod, the cut slopes shall be scarified by plowing furrows 4 inches (100 mm) to 6 inches (150 mm) deep along horizontal slope lines at 2 foot (600 mm) vertical intervals. Excavated material from the furrows shall not protrude more than 3 inches (75 mm) above the original surface of the cut. Fertilizer shall be distributed uniformly over the area in accordance with the applicable provisions of Item No. 606S, "Fertilizer". The sod shall then be deposited upon the prepared area and spread uniformly to the thickness indicated on the Drawings.

Any section that is not true to lines and cross sections shall be remedied by the addition of sod material or by reshaping the material to meet the requirements of "Finishing"[Section 602S.5 (4)]. After the sod material has been spread and shaped, it shall be thoroughly wetted and compacted with a corrugated roller of the "Cultipacker" type. All rolling of slope areas shall be on the contour.

602S.8 Measurement

Work and acceptable material for "Sodding for Erosion Control" will be measured by the square yard (square meter: 1 square meter is equal to 1.196 square yards) complete in place with a minimum of 95 percent growth with a 2 1/2 inch (62.5 mm) stand of grass.

602S.9 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price for Bermuda Block Sodding", "St. Augustine Block Sodding", "Bermuda Mulch Sodding" or "Other Approved Grass Sodding". The prices shall each represent full compensation for completion of the work including all water applications, rolling, pegging and fertilizer as indicated on the Drawings.

Payment will be made under one of the following:

Pay Item No. 602S-A:	Bermuda Block Sodding -	Per Square Yard.
Pay Item No. 602S-B:	St. Augustine Block Sodding -	Per Square Yard.
Pay Item No. 602S-C:	Bermuda Mulch Sodding -	Per Square Yard.
Pay Item No. 602S-D*:*	Grass Sodding -	Per Square Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification 602S, “Sodding for Erosion Control”

City of Austin Land Development Code

Designation	*Description*
Chapter 4-2, Article II	Emergency and Peak Day Water Use Management

City of Austin Standard Specification Items

Designation	*Description*
Item No. 606S	Fertilizer

City of Austin Land Development Code

Designation	*Description*
Section 6-4-52	Water Use Management Plan Established
Section 6-4-53	Applicability
Section 6-4-54	Compliance Required
Section 6-4-63	Permanent Water Use Restrictions
Section 6-4-64	Water Conservation Stage One Regulations
Section 6-4-65	Water Conservation Stage Two Regulations
Section 6-4-81	Variance
Section 6-4-92	Penalty
Section 15-9-37(D)	Customer's Responsibilities
Section 15-9-101(B)	Basis for Termination of Service

RELATED CROSS REFERENCE MATERIALS
Specification 602S, "Sodding for Erosion Control"

City of Austin Standard Specification Items

Designation	*Description*
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 601S	Salvaging and Placing Topsoil
Item No. 604S	Seeding for Erosion Control
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation

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

Designation	*Description*
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 204	Sprinkling

Item No. 604S
Seeding for Erosion Control

604S.1 Description

This item shall govern the preparation of a seed bed for temporary or permanent erosion control; sowing of seeds; fertilizing; mulching with straw, cellulose fiber wood chips, and recycled paper mulch; and other management practices along and across such areas as indicated in the Drawings or as directed by the Landscape Architect, Engineer or designated representative.

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

604S.2 Submittals

The following submittal items are required in writing during construction:

A. Identification of the seed species, source, mixture, and PLS of the seed as listed on the analysis tags and certification tags from all seed bags. Seed calculation worksheet per Table 7. PLS is the percentage of seed purity multiplied by the percentage of germination plus dormant seed. The analysis tag, required on all seed sold in Texas, includes information on quality: kind and variety of seed, lot number, percent pure live seed, percent other crop seed, percent inert matter, percent weed seeds, germination percentage, and date of test. The certification tag also verifies seed quality, an assurance of seed variety and attesting to standards for germination and purity, Information provided includes class of certification, kind of crop, variety, lot number, and name and address of the owner

B. If fertilizer is proposed, results of a recent soil test (6 months old or less) of the area to be seeded, before fertilization. Soil samples shall be collected after final grading, when topsoil has been placed. The test results must include soil lab recommended additions of Nitrogen (N), Phosphorus (P), and Potassium (K) for the type of vegetation proposed, as well as soil organic matter percentage and textural class.

C. Fertilizer formulation and release rate based on a soil test (see B above).

D. For hydromulch applications, proposed application rate of seed, type of mulch and tacking agent, and other relevant information. An example of the required documentation is in Table 1.

E. Type of hydraulic seeding equipment and nozzles proposed for use.

F. If pesticide use is proposed, an IPM plan for pest removal including pesticide label, proposed application rate and timing, and MSDS sheets.

G. One gallon sample of proposed vegetative mulch.

The following submittal items are required before Substantial Completion:

A. For hydromulch applications, the complete hydromulch application log, including date, time and quantity of product units placed in the slurry tank. An example of an

application log is provided in Table 2. This log may be requested at any time during construction by the Landscape Architect, Engineer, or authorized inspector.

B. Pesticide application tracking log. As of January 1, 2012, documentation of all outdoor pesticide use on city-owned properties is required to demonstrate compliance with the EPA/TCEQ mandated Municipal Stormwater Permit, the TPDES General Pesticide Permit, City Code, and the IPM program.

Table 1: Example of proposed hydromulch application rates

				Hydro Slurry Unit (per acre rates)				
Hydro Mix	Sheet No.	Seed Mix	Acres	Seed (Bags/ ac)	Tackifier (Buckets/ ac)	Mulch (Bales/ ac)	Fertilizer (Bags/ ac)	Addl. Amendments (Bags/ac)
1	L2	A	1.0	1	100	1000	50	5
F2	L3	A	0.5	2	200	1500	50	5
3	L5	B	3.0	3	300	3000	50	5

Table 2: Example of hydromulch application log

						Hydro Slurry Unit (per acre rates)				
Date	Start Time	Finish Time	AC/ Tank	Water (gal)	Seed Mix	Seed (Bags/ ac)	Tackifier (Buckets /ac)	Mulch (Bales /ac)	Fertilizer (Bags/ ac)	Addl. Amend-ments (Bags/ac)
4/13	10:30	11:15	1.0	330	A	1	100	1000	50	5
4/17	2:00	2:30	0.5	330	A	2	200	1500	50	5
5/20	8:30	10:00	1.2	330	B	3	300	3000	50	5
					Totals	6	600	5500	127	15

604S.3. Materials

A. Seed. All seed must meet the requirements of the Texas Seed Law including the labeling requirements for showing pure live seed (PLS), name and type of seed and all other required elements of the Analysis and Certification Tags.

The seed furnished shall be of the previous season's crop and the date of analysis, shown on each bag, shall be within twelve (12) months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers, unless a specific mix is proposed for use. A sample of each variety of seed shall be furnished for analysis and testing when directed by the Landscape Architect, Engineer or designated representative.

The amount of seed planted square yard (0.84 square meters) or per acre (hectare) shall be of the type specified in sections 604S.5 and 604S.6.

B. Water. Water shall be clean and free of industrial wastes and other substances harmful to the growth of plant material or the area irrigated.

C. Top soil. Top soil shall conform to Item No. 601S.3(A).

D. Fertilizer. The fertilizer shall conform to Item No. 606S, "Fertilizer". The type and rate of fertilizer should be based on chemical tests of recent (no older than 6 months before application) representative site soil samples. Fertilizer should be applied only when plants can take them up for growth, during: 1) seed germination and plant establishment and 2) after plant establishment. Fertilizer shall not be applied within 48 hours of a potential rain event.

E. Straw Mulch or Hay Mulch. Straw Mulch shall be oat, wheat or rice straw. Hay mulch shall be prairie grass, or other hay approved by the Landscape Architect, Engineer or designated representative. The straw or hay shall be free of Johnson grass or other noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be moldy or rotted.

F. Tackifier. The tackifier shall be a biodegradable tacking agent, approved by the Landscape Architect, Engineer or designated representative.

G. Cellulose Fiber Mulch (Natural Wood). Cellulose Fiber Mulch shall be natural cellulose fiber mulch produced from grinding clean whole wood chips. The mulch shall be designed for use in conventional mechanical planting, hydraulic planting of seed or hydraulic mulching of grass seed, either alone or with fertilizers and other additives. The mulch shall be such, that when applied, the material shall form a strong, moisture-retaining mat without the need of an asphalt binder.

H Recycled Paper Mulch. Recycled paper mulch shall be specifically manufactured from post-consumer paper and shall contain a minimum of 85% recycled paper content by weight, shall contain no more than 15% moisture and 1.6% ash, and shall contain no growth inhibiting material or weed seeds. The recycled paper mulch shall be mixed with grass seed and fertilizer (see “fertilizer” above) for hydro-seeding/mulching, erosion control, and a binder over straw mulch. The mulch, when applied, shall form a strong, moisture-retaining mat of a green color without the need of an asphalt binder.

I. Mulch. Mulches, acting as seed coverings, can enhance seed germination and seedling establishment. Characteristics of ideal mulches for seeding are those that protect seeds from wind (drying), excessive solar radiation, high evapotranspiration rates, and erosion, while allowing germination and growth. Relatively coarsely shredded, weed-free vegetative mulch should be used on seed installations, especially in open, sunny areas. These materials shall be clean, free of foreign matter, and dry enough to spread evenly.

J. Pesticide. A least toxic, integrated pest management (IPM) approach shall be used to control weeds. A written request for approval of weed control products and materials shall be submitted to the City of Austin Watershed Protection Department (ERM) IPM program coordinator for approval. Additional information can be found at http://www.austintexas.gov/ipm.

604S.4 Construction Methods

A. General. The Contractor shall limit preparation of the seedbed to areas that will be seeded immediately. When seeding for permanent erosion control, weed species listed in Table 3

shall be managed by application of an appropriate herbicide and/or by physical removal by the roots before the seeding operation. The goal of weed management is to facilitate establishment of the permanent vegetative cover. Additionally, the Owner may require removal of any plant species that appears to be out-competing seeded or planted species during the construction period.

Table 3: Weed List

Weed Type	Botanical Name	Common Name
Annual Grass	Cenchrus spp.	Sandbur
Herb	Cnidoscolus texanus	Bull Nettle
Herb	Urtica spp.	Stinging Nettle
Vine	Toxicodendron radicans	Poison Ivy
Perennial Grass	Sorghum halapense	Johnson Grass
Perennial Grass	Arundo donax	Giant Cane
Perennial Grass	Phyllostachys aurea	Golden Bamboo
Summer Annual Herb	Ambrosia trifida	Ragweed
Winter Annual Herb	Rapistrum rugosum	Bastard Cabbage
Winter Annual Herb	Bromus arvensis	Japanese Brome
Winter Annual Herb	Lolium multiflorum	Annual Ryegrass

B. Preparing Seed Bed. After the designated areas have been rough graded to the lines, grades and typical sections indicated in the Drawings or as provided for in other items of this contract and for any other soil area disturbed by the construction, a suitable seedbed shall be prepared. The seedbed shall consist of a minimum of either 6 inches (150 millimeters) of approved topsoil or 6 inches (150 millimeters) of approved salvaged topsoil.

The topsoil or growing medium must be prepared so that compaction is appropriate for plant growth, and to achieve acceptable bulk density or hydrologic function. Rippers and subsoilers may be used to loosen compacted soil and roughen the surface. Disks, plows and excavator attachments are good for compaction reduction, roughening and incorporating amendments. If tracked machinery is used in seedbed preparation, cleat marks should run with the contour to prevent rills. The optimum depth for seeding shall be 1/8 to 1/4 inch (3 to 6 millimeters).

Water shall be gently applied as required to prepare the seedbed prior to the planting operation either by broadcast seeding or hydraulic planting. Seeding shall be performed in accordance with the requirements described below.

C. Watering. All watering shall comply with City Code Chapter 6-4 (Water Conservation). All seeded areas regardless of seed type and method of seeding (e.g., broadcast, hydroseed) shall be watered immediately after installation. For seed germination and establishment it is important to keep the seedbed in a moist condition favorable for the growth of plant materials.

Watering applications shall constantly maintain the seedbed in a moist condition favorable for the growth of plant materials. Watering shall continue until the plant material is at least

1-1/2 inches (40 mm) in height and accepted by the Engineer or designated representative. Supplemental watering can be postponed immediately after a half- inch (12.5 mm) or greater rainfall on the site but shall be resumed before the soil dries out.

D. Cool Season Cover Crop. From September 15 to March 1, non-native and native seeding shall include a cool season cover crop at the rate specified in Table 6. Cool season cover crops are not permanent erosion control. If installed separately from the permanently erosion control seed mix, the cool season cover crops shall be mowed to a height of less than one (1) inch after March 1, and the area shall be re-seeded at the specified seeding rate for non-native or native warm-season species (March 1 to September 15).

604S.5 Non-Native Seeding

A. Method A - Broadcast Seeding. The seed or seed mixture in the quantity specified shall be uniformly distributed over the prepared seed bed areas indicated on the Drawings or where directed by the Engineer or designated representative. If the sowing of seed is by hand, rather than by mechanical methods, the seed shall be sown in two directions at right angles to each other. If mechanical equipment is used, all varieties of seed, as well as fertilizer (if required), may be distributed at the same time, provided that each component is uniformly applied at the specified rate. After planting, the planted area shall be rolled with a corrugated roller of the "Cultipacker" type. All rolling of the slope areas shall be on the contour.

Seed Mixture and Rate of Application for Broadcast Seeding:

From March 1 to September 15, seeding shall be with hulled Bermuda Grass at a rate of 45 lbs/ac (5.0 kilograms per hectare) with a minimum PLS = 0.83. Fertilizer shall be applied if warranted by a soil test, and shall conform to Item No. 606S, "Fertilizer". Bermuda grass is a warm-season grass and is therefore considered permanent erosion control once established.

Method B - Hydraulic Planting. The seedbed shall be prepared as specified above and hydraulic planting equipment, which is capable of placing all materials in a single operation, shall be used. Information about hydromulching for temporary and permanent vegetation stabilization is in the Environmental Criteria Manual (ECM) Section 1.4.7.

Hydroseeding equipment shall be clean and free of all previous seeds, fertilizer, mulch, or any hydroseeding products used on prior jobs.

<u>March 1 to September 15</u>

Hydraulic planting mixture and minimum rate of application pounds per acre or square yard (kilograms per ha):

Hulled Bermuda Seed (min. PLS=0.83)	Fiber Mulch		Soil Tackifier
	Cellulose	Wood	
45 Lbs/ac (50.44 kg/ha)	2000 Lbs/ac (2242 kg/ha)		60.98 Lbs/ac (68.36 kg/ha)
		2500 Lbs/ac (2803 kg/ha)	65.34 Lbs/ac (73.25 kg/ha)

604S.6 Native Grass and Forb Seeding

The seed mixture shall include both grasses and forbs. The dry and moist sites grass mix shall be seeded at rates of at least 23.5 and 17.0 lb/ac (26.32 and 19.04 kg/ha), respectively and the dry and wet site forb mix shall be seeded at a rate of at least 11.5 and 9.0 lb/ac (12.88 and 10.08 kg/ha), for total application rates of 35.00 lb/ac (39.20 and 29.12 kg/ha) [dry site] and 26 lb/ac (29.12 kg/ha) [wet site]. Minimum diversity for dry sites (Table 4) is eight species of grasses and 10 species of forbs. Minimum diversity for wet sites (Table 5) is six species of grasses and seven species of forbs. The species indicated with an asterisk shall be included in all proposed mixes. Application rates may be modified, but no species shall constitute more than 20% of a seed mix. Any species proposed for installation and not included in Tables 4 or 5 shall by City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative, and shall be native to Central Texas as referenced by the LBJ Wildflower Center plant database (www.wildflower.org) or USDA plant database.

Table 4: Native Grasses and Forbs: Dry Sites

Type	Common Name	Botanical Name	Exposure	Recommended Application Rates	
				lbs/ac	kg/ha
Grass Seed Mix	Sideoats grama*	Bouteloua curtipendula	Full-part sun	7.0	7.8
	Green sprangletop*	Leptochloa dubia	Full sun	6.0	6.7
	Buffalograss	Buchloe dactyloides	Full sun	24.0	27.0
	Blue Grama Grass	Bouteloua gracilis	Full-part sun	10.0	11.2
	Canada Wild Rye	Elymus canadensis	Full-part sun	10.0	11.2
	Purple Three-Awn	Aristida purpurea	Full sun	4.0	4.5
	Cane Bluestem	Bothriochloa barbinodis	Full sun	3.0	3.3
	Galleta	Pleuraphis jamesii	Full sun	10.0	11.2
	Black Grama*	Bouteloua eripoda	Full sun	10.0	11.2
	Sand Dropseed*	Sporobolus cryptandrus	Full sun	1.0	1.1
	Alkali Sacaton	Sporobolus airoides	Full sun	0.5	1.7
	Curly Mesquite	Hilaria belangeri	Full sun	2.0	2.2
	Sand Lovegrass	Eragrostis trichodes	Full sun	2.0	2.2
	Black-Eyed Susan	Rudbeckia hirta	Full-part sun	2.0	2.2

	Illinois Bundleflower*	Desmanthus illinoens (legume)	Full-part sun shade	15.0	16.8
	Scarlet Sage	Salvia coccinea	Full-part sun shade	8.0	9.0
	Pink Evening Primrose	Oenethera speciosa	Full-part sun shade	1.0	1.1
	Drummond Phlox	Phlox drummondii	Full-part sun	8.0	9.0
	Plains Coreopsis	Coreopsis tinctoria	Full-part sun	2.0	2.2
	Greenthread	Thelesperma filifoliu	Full sun	6.0	6.7
	Purple Prairie Clover*	Dalea purpurea	Full sun	4.0	4.5
	Cutleaf Daisy	Engelmannia pinnatifida	Full-part sun	18.0	20.1
Forb Seed Mix	Partridge Pea*	Chamaecrista fasciculate	Full-part sun	20.0	22.4
	Indian Blanket	Gaillardia pulchella	Full-part sun	10.0	11.2
	Bluebonnet*	Lupinus texensis (legume)	Full sun	20.0	22.4
	Mexican Hat	Ratibida columnaris	Full-part sun	2.0	2.2
	Maximilian Sunflower	Helianthus maximilia	Full-part sun	5.0	5.6
	Prairie Coneflower	Ratibidia columnifer	Full-part sun	2.0	2.2
	Clasping Coneflower	Dracopis amplexicau	Full-part sun	3.0	3.4
	Purple Coneflower	Echinacea purpurea	Full-part sun shade	10.0	11.2
	Lemon Mint	Monarda citriodora	Full-part sun	3.0	3.4
	Huisache Daisy	Amblyolepis setigera	Full-part sun	8.0	9.0
	Texas Yellow Star	Lindheimera texana	Full-part sun	12.0	13.5
	Lanceleaf Coreopsis	Coreopsis lanceolata	Full-part sun shade	10.0	11.2
	Bush Sunflower	Simsia calva	Full-part sun	3.0	3.4
	Winecup	Callirhoe involucrata	Full-part sun shade	5.0	5.6
	Antelope horns	Asclepias asperula	Full sun	0.1	0.04
	Green milkweed	Asclepias viridis	Full sun	0.1	0.04
TOTAL Total seed mix application rate is 35.0 lb/ac (23.5 lb/ac grasses and 11.5 lb/ac forbs), to be composed of at least 8 species from the grass list and 10 species from the forb list to include the required species.					

*Required species that must be included in the mix

Table 5: Native Grasses and Forbs: Wet Sites

Type	Common Name	Botanical Name	Exposure	Recommended Application Rates	
				lbs/ac	kg/ha
Grass Seed Mix	White Tridens	Tridens albescens	Full-part sun	0.5	0.56
	Plains Bristlegrass	Setaria leucopila	Full-part sun	6.0	6.7
	Switchgrass	Panicum virgatum	Full-part sun	4.0	4.5
	Inland Sea Oats	Chasmanthium latifoliu	Shade	12.0	13.5
	Canada Wild Rye	Elymus canadensis	Full sun - shade	10.0	11.2
	Big Bluestem	Andropogon gerardii	Full sun	4.0	4.5
	Bushy Bluestem	Andropogon glomeratus	Full sun	3.0	3.4
	Green Sprangletop*	Leptochloa dubia	Full sun	2.0	2.2
	Eastern Gamagrass	Tripsacum dactyloides	Full sun - shade	3.0	3.4
Forb Seed Mix	American Basketflower	Centaurea americana	Full sun	10.0	11.2
	Common milkweed	Asclepias syriaca	Full sun	0.1	0.04
	Butterfly weed	Asclepias tuberosa	Full sun	0.1	0.04
	Blue Mistflower	Conoclinium coelestinum	Full-part sun	0.5	0.6
	Clasping Coneflower	Dracopsis amplexicaulis	Full-part sun	3.0	3.4
	Maximilian Sunflower	Helianthus maximliani	Full-part sun	4.0	4.5
	Prairie Blazing Star	Liatris pycnostachya	Full sun	2.0	2.2
	Pink Evening Primrose	Oenothera speciosa	Full sun-dappled shade	1.0	1.1
	Mexican Hat	Ratibida columnifera	Full-part sun	2.0	2.2
	Black-eyed Susan	Rudbeckia hirta	Full sun-dappled shade	2.0	2.2
	Illinois Bundleflower	Desmanthus illinoensis	Full sun-dappled shade	15.0	16.8
	Obedient Plant	Physostegia virginiana	Full sun-dappled shade	4.0	4.5
	Partridge Pea*	Camaecrista fasciculate	Full-part sun	20.0	22.4

Type	Common Name	Botanical Name	Exposure	Recommended Application Rates	
				lbs/ac	kg/ha
	Purple Prairie Clover	Dalea purpurea var purpurea	Full sun	4.0	4.5
	Pitcher Sage	Salvia azurea	Full-part sun	3.0	3.4
	Showy Tick Trefoil	Desmodium canadense	Full sun	0.5	0.6
	Winecup*	Callirhoe involucrata	Full-part sun	5.0	5.6
TOTAL Total seed mix application rate is 26.0 lb/ac (17.0 lb/ac grasses and 9.0 lb/ac forbs), to be composed of at least 8 species from the grass list and 10 species from the forb list to include the required species.					

Table 6: Cool Season Cover Crop

Common Name	Botanical Name	Exposure	Application rates	
			lbs/ac	kg/ha
Western Wheatgrass	*Pascopyrum smithii*	Full-pt sun; dappled shade	5.6	6.28
Oats	*Avena sativa*	Full sun	4.0	4.48
Cereal Rye Grain	*Secale cereale*	Full sun	34.0	38.11

One cover crop species of the listed species is required to be planted between September 15 to March 1. Contractor must ensure that any seed application requiring a cool season cover crop does not utilize annual ryegrass (*Lolium multiflorum*) or perennial ryegrass (*Lolium perenne*). Only cereal rye grain (*Secale cereale*), oats (*Avena sativa*) and western wheatgrass (*Pascopyrum smithii*) are approved as cool season cover crop.

Species substitution as necessary due to availability shall be approved by the Landscape Architect, Engineer or designated representative. Watering and fertilizer application shall follow procedures outlined above or as otherwise specified on the Drawings.

Seed shall be applied by broadcast, hydromulch, blown compost, or drill method and shall be distributed evenly over the topsoil areas. Mulching shall immediately follow seed application for broadcast and hydromulch applications.

Seed Rate Calculations

The amount of seed needed to be planted on a project shall be calculated before installation to ensure adequate seed is placed, and provided as a submittal. Table 7 is an example worksheet, followed by an example calculation. Information for calculation can be obtained from seed tags or the supplier.

Table 7. Seed Calculation Worksheet

Plant Group	Desired Seeding Rate (1bs/ac)	PLS (pure live seed)	Bulk Rate (lbs/ac)	Seeding Area (ac)	Amt. of Seed to be Installed (lbs)
Grasses					
Forbs					
TOTAL					

FORMULAE:

PLS (pure live seed) = (Purity x Germination) x 100. Can also use average PLS from seed tags.

Bulk Rate (lbs/AC) =Desired Seed Rate (lbs/AC)/PLS

Amt. of Seed to be Installed (lbs) = Bulk Rate (lbs/AC) x Seeding Area (AC)

Example:

Plant Group	Desired Seeding Rate (lbs/ac)	PLS (pure live seed)	Bulk Rate (lbs/ac)	Seeding Area (ac)	Amt. of Seed to be Installed (lbs)
Grasses	131.00	0.81	161.73	1.50*	242.60
Forbs	65.34	0.87	75.10	1.50*	112.70
TOTAL	196.34	0.84 (ave.)	236.83	1.50	355.30

604S.7 Mulch

Mulches may be used to help prevent soil erosion until final stabilization is achieved. Mulch shall be used to cover broadcasted seeds, especially in sunny, open areas, to protect them from drying out during germination.

A. Straw Mulch.

Straw mulch shall be spread uniformly over the area indicated or as designated by the Engineer or designated representative at the rate of 2 to 2 1/2 tons of straw per acre (4.5 to 5.6 megagrams of straw per hectare). The actual rate of application will be designated by the Landscape Architect, Engineer or designated representative. Straw may be hand or machine placed and adequately secured.

B. Hydromulch

Refer to ECM Section 1.4.7 for hydromulching applications.

C. Shredded Brush Mulch.

Small brush or tree limbs, which have been shredded, may be used for mulching Native for mulching Native Grass seeding.

604S.8 Management Practices

Management Practices include (1) weed management (pesticide application or mechanical removal) to so than 90 percent of the revegetation area is free of weeds listed in Table 3, and (2) reseeding areas of poor germination to achieve coverage and height per 604S.9, with no bare areas greater than 10 s.f..

Ninety (90) percent of a permanent revegetation area must be free of weeds listed in Table 3. Weeds shall be controlled in the most efficient manner possible. Management of weed species should begin early in the project, before seeding for permanent control, and extend into plant establishment, especially for perennial weeds. Manual removal or application of an appropriate herbicide may be required after the initial seeding if emergence of an annual weed species threatens establishment of sufficient preferred plant cover. Disturbance due to weed management after the initial seeding may necessitate re-seeding of the area to establish sufficient preferred plant coverage. Care should be taken to temporarily stabilize areas where physical removal of weeds has been performed to prevent erosion and sediment runoff.

The entire root system of perennial weeds shall be removed to prevent re-sprouting. Weeds may be controlled with an approved contact, systemic herbicide, provided the product is used with appropriate care and is applied in accordance with label instructions and the following guidelines:

1. Herbicide shall not be applied when the wind is greater than 8 mph (12.9 kph),
2. Herbicide shall not be applied when rainfall is expected within 24 hours,
3. Herbicide shall not contact surface water, i.e. creeks, rivers, and lakes,
4. Herbicide shall not contact desirable vegetation (a wicking method shall be used, if necessary, to accurately contact target weed only during application).

The Landscape Architect, Engineer or designated representative shall be consulted to determine appropriate weed control management when weeds are located in an environmentally sensitive location (e.g. near water or adjacent to a critical environmental feature).

At locations that fail to show an acceptable stand of planting for any reason during the initial seeding, repair and/or reseed locations as determined by the Landscape Architect, Engineer or designated representative. A successful stand of grasses and forbs for erosion control should exhibit the following:

- Seedlings with vigorous green foliage;
- Green leaves remaining throughout the summer, at least at the plant bases;
- Uniform density, with grasses and/or forbs well intermixed;
- Minimum of 95% cover; and
- No exposed soil greater than 10 s.f. in aerial extent.

The Contractor shall meet the requirements of the initial seeding, including seeding method, seed mix, and application rates, unless otherwise agreed to in writing by the Owner. Corrected deficiencies will be re-inspected and approved by the Owner, and final acceptance will be granted upon satisfactory completion.

604S.9 Measurement

Work and acceptable material for "Seeding for Erosion Control" will be measured by the square yard (meter: 1 meter equals 1.196 square yards) or by the acre (hectare: 1 hectare equals 2.471 acres), complete in place, so that all areas of the site that rely on vegetation for stability must be uniformly vegetated with a minimum of 95 percent total coverage for the non-native or native mixes, and 95 percent coverage for the native mix. Bare areas shall not exceed 16 square feet (1.5 square meters), and the average height of vegetation shall stand at a minimum of 1 1/2 inch (40 millimeters). Ninety (90) percent of the revegetated area, whether native or non-native re-vegetation, must be free of weeds listed in Table 3. Bare areas greater than 10 s.f. shall be re-prepared and reseeded as required to develop an acceptable stand of plant material.

604S.10 Payment

The work performed and materials furnished and measured will be paid for at the unit bid price for "Seeding for Erosion Control" of the method specified on the Drawings and type of mulch. The unit bid price shall include full compensation for furnishing all materials, including all topsoil, water, seed, tackifier, fertilizer or mulch and for performing all operations necessary to complete the work.

All fertilizer will be measured and paid for conforming to Item No. 606S, "Fertilizer".

Payment will be made under one of the following:

Pay Item No. 604S-A:	Non-Native Seeding for Erosion Control Method, Hydraulic Planting	Per Square Yard
Pay Item No. 604S-B:	Non-Native Seeding for Erosion Control, Broadcast Seeding	Per Square Yard
Pay Item No. 604S-C:	Non-Native Seeding for Erosion Control Method, Hydraulic Planting	Per Acre
Pay Item No. 604S-D:	Native Seeding for Erosion Control Method, Hydraulic Planting	Per Square Yard
Pay Item No. 604S-E:	Native Seeding for Erosion Control, Broadcast Seeding,	Per Square Yard
Pay Item No. 604S-F:	Native Seeding for Erosion Control Method, Hydraulic Planting	Per Acre
Pay Item No. 604S-G:	Mulch,	Per Square Yard
Pay Item No. 604S-H:	Mulch,	Per Acre
Pay Item No. 604S-I:	Topsoil and Seedbed Preparation,	Per Square Yard
Pay Item No. 604S-J:	Topsoil and Seedbed Preparation,	Per Acre
Pay Item No. 604S-K:	Watering,	Per 1000 gal (Kgal)
Pay Item No. 604S-L:	Management Practices,	Per Square Yard
Pay Item No. 604S-M:	Management Practices,	Per Acre

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification Item 604S "Seeding for Erosion Control"

City of Austin Technical Specifications

Designation	Description
Item No. 130S	Borrow
Item No. 601S	Salvaging and Placing Topsoil
Item No. 606S	Fertilizer

City of Austin Land Development Code

Designation	Description
Section 6-4	Water Conservation

RELATED CROSS REFERENCE MATERIALS
Specification Item 604S "Seeding for Erosion Control"

City of Austin Technical Specifications

Designation	Description
Item No. 601S	Salvaging and Placing Topsoil
Item No. 602S	Sodding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 607S	Slope Stabilization
Item No. 608S	Planting

City of Austin Standards (Details)

Designation	Description
627S-1	Grass Lined Swale
633S-1	Landgrading

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

Designation	Description
Item No. 160	Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 180	Wildflower Seeding
Item No. 192	Landscape Planting

608S.1 Description

This item shall govern the provision of the specified plants and other materials, the initial installation of plants and other materials, the maintenance of plantings, transplanting and any replacement of trees, plants and ground cover which are damaged, diseased or otherwise unhealthy during the warranty period or as directed by the Engineer or designated representative.

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

608S.2 Submittals

The submittal requirements for this specification item shall include:

A. A listing of each type of planting (tree, shrubs, plants, etc.), type of stock (containerized, ball and burlapped, bare root, bag grown, etc.), name (common and botanical) and size of planting (root diameter, height and spread);

B. A request, if necessary, for use by Contractor of collected stock on the site;

C. Specific information for each pesticide (including herbicide) associated with the listing including:

manufacturer,
product name,
description of chemical composition,
handling, storage and mixing requirements
application recommendations
documentation of licensed applicator(s), and
MSDS Sheets

D. Type, chemical analysis and rate of application of fertilizer

E. Proposed tree dressing, trunk wrapping and flagging tape;

F. Type, chemical analysis and rate of application of proposed transpirants

G. Documentation of irrigator license, if irrigation is required at the site.

608S.3 General

A. Plant Standards

Unless shown otherwise on the Drawings, the following published standards will apply. Standards for nursery stock will be as stated in the "American Standard for Nursery Stock", as published by the American Association of Nurserymen, Incorporated. Botanical names as shown on the Drawings will be as stated in the "Standardized Plant Names" as identified by the American Joint Committee on Horticultural Nomenclature or other referenced text including the "Manual of the

Vascular Plants of Texas for Native Flora". Pruning standards will be as established by the National Arborist Association in the "Pruning Standards for Shade Trees".

B. License Requirements

1. Pesticide.

   The Contractor shall be a licensed pesticide applicator or shall employ a licensed pesticide applicator for the treatment of insects, diseases, animals as required by the Texas Pesticide Laws and Regulations of the Texas Department of Agriculture. The Engineer or designated representative may request documentation of such certification.

2. Herbicide.

   The Contractor shall possess a permit or employ a person who possesses a permit to apply herbicide as required by the Texas Herbicide Law of the Texas Department of Agriculture. The Engineer or designated representative may request documentation of such certification.

3. Irrigation.

   The Contractor shall possess an irrigator's license issued by the State of Texas and the Texas Board of Irrigators or employ such a licensed irrigator to perform the irrigation system maintenance. The irrigation system shall be maintained under the supervision of the licensed irrigator who shall be available on the site as required by the Engineer or designated representative.

The Engineer may request documentation of such license. The Contractor shall verify and adhere to the requirements and codes of any controlling utility authorities.

608S.4 Materials

A. Plant Material

Plant material shall be first class grade, true to name and of the size indicated on the Drawings. All plants shall be healthy nursery grown unless otherwise indicated on the Drawings. When the Engineer or designated representative is furnished sufficient evidence that a specified plant cannot practically be obtained, the Engineer or designated representative may approve in writing the use of collected native material.

Nursery grown stock, either in containers or in the field, shall be nursery grown in accordance with accepted horticultural practices and under climatic conditions similar to those of the work site for at least twelve (12) months, unless specifically authorized otherwise by the Engineer or designated representative.

1. Container plants.

   Soil volume for containers shall be three-fourths (3/4) the depth of the container or greater and contain roots of the plants throughout the root ball.

   (a) Containerized Stock.

   This stock will be defined as nursery plant stock transplanted from a growing site with a ball of soil, containing an intact root system, and placed in a container and grown in that container continuously long enough for the new fibrous roots to have developed so that the root mass retains its shape and holds together after removal from the container. Containerized stock shall

have been grown in the delivered containers for at least six (6) months, but not over two (2) years.

(b) Container Grown Stock.

This stock will be defined as nursery plant stock, which has been planted in a container as a liner, seed or by other propagation method, and that:

(1) has been systematically replanted or stepped up in larger containers as required,

(2) has developed a root system in a planting medium capable of sustaining acceptable plant growth, and

(3) has become established in the container and exhibits a well-rooted condition as evidenced by the soil ball remaining intact when removed from its container.

2. Balled and Burlapped Stock.

This stock will be defined as nursery plant stock which has been removed from the growing site with a ball of soil, containing the intact root system, and encased in burlap (or other approved similar material) to hold the soil in place. Ball sizes for balled and burlapped stock shall be as shown on the Drawings.

3. Bare Root Stock.

This stock will be defined as nursery plant stock, which has been removed from the growing site with the root system substantially free of soil. The approved minimum root spread and condition shall be as shown on the Drawings.

4. Collected Stock.

This stock will be defined as nursery plant stock, which has been removed from its original native habitat. All collected stock shall specific approval of the Engineer or designated representative before it can be removed from its existing habitat. Ball sizes for collected stock shall be as shown on the Drawings and shall have sufficient diameter and depth to encompass enough fibrous and feeding root system as necessary for the full recovery of the plant. Collection may be by hand or mechanical method. For balled and burlapped or mechanical transplanting of collected plant material refer to article 608S.5.

5. Bag Grown Stock.

This stock will be defined as nursery plant stock which has been transplanted into a nonwoven fabric container which has been placed in the ground and the plant grown under nursery field conditions continuously long enough [normally one (1) month for each inch (25 mm) of bag diameter i.e., a plant with a 24 inch (600 mm) diameter bag, grown in its original planted location for 24 months] for the fibrous roots to have developed so that the root mass retains its shape and holds together after removal of the bag. The root ball shall be flat bottomed and straight sided. Ball sizes for bag grown stock shall be as shown on the Drawings. Bag grown stock shall not be pruned before delivery.

6. Other Plant Materials.

Other plant materials shall be as shown on the Drawings.

B. Rejection of Plants.

Plant material having any of the following features will be subject to rejection:

1. Undue or excessive abrasions of the bark.
2. Dried or damaged root system.
3. Dried or damaged top wood of deciduous plants or dried or damaged foliage and top woods of evergreens.
4. Prematurely opened or damaged buds or buds stripped off.
5. Disease or insect infestation, including eggs or larvae.
6. Dry, loose, cracked, broken and/or undersized balls or containers, which do not conform to sizes indicated on the Drawings.
7. Evidence of heating, molding, wind burn, sunscald, freezing, etc.
8. Container plants that are overgrown or root bound.
9. Plants with bench balls (roots repacked with soil).
10. Plant balls encased in non-bio-degradeable plastic or other impervious material.
11. Field grown or collected plants transplanted into containers less than six (6) months or more than two (2) years.
12 Trees that have been damaged, pruned, crooked or multiple leaders, unless multiple leaders are specified or are normal for the species.
13. Plants with disfiguring knots or fresh cuts of limbs over 3/4 inch (20 mm) that have not completely callused.
14. Plants that do not posses a normal balance between height and spread for the species.
15. Plant containers that are not structurally sound (tracked, bent, etc.).
16. Plants in containers less than three-fourths (3/4) planting medium depth;
17. Any endangered or threatened plants; or plants of historical significance that have been collected;
18. Any other physical damage or adverse conditions that would prevent thriving growth or cause an unacceptable appearance; or
19. Plants that do not meet the standards shown on the Drawings.

C. Delivery and Receipt of Plants

Material shall not be delivered to the project until ordered to do so in writing by the Engineer or designated representative. When the delivery order is issued, the Engineer or designated representative shall be notified of a proposed delivery of plant material at least 48 hours prior to its arrival at the project. The entire plant shall be properly protected from sun and air damage during the time period from initiation of digging until delivery on the project

Each plant material shipment shall be accompanied by an invoice indicating the number, size and name (common and botanical) of each of the kinds of plant material included in the shipment. Each kind of plant in the shipment shall be adequately identified by tags. All plants shall be individually tagged with nursery name tags designating the genus, species and variety of the plant.

No shipment of plant material shall be accepted, planted and/or heeled-in by the Contractor until such material has been inspected and accepted by the Engineer or designated representative. The Contractor shall assist the Engineer or designated representative in the inspection of material. Any plants rejected shall be immediately removed from the project and replaced.

Unless plants are placed in predug holes and planted as specified herein, they shall be heeled-in and inspected again prior to planting. If delivered to predug planting holes, balled and burlapped plants shall be planted within 1 to 6 hours depending upon the drying effect of the wind and sun. No bare rooted plants shall be placed in predug holes from the delivery truck unless actual planting occurs immediately after removal from its moist packing.

D. Plant Size

Plants will be measured when branches are in their normal position. Height and spread dimensions shown on the Drawings refer to the main body of the plant and not branch tip to tip. Plants with a spreading or semi-spreading habit will be measured by the average diameter of the spread. Plant heights will be measured by the mean height from the ground line to the top of the canopy. Caliper measurements will be taken at a point on the trunk six (6) inches [150 mm] above natural ground for trees up to four (4) inches [100 mm] in caliper and at a point twelve (12) inches [300 mm] above natural ground for trees over four (4) inches [100 mm} in caliper. The caliper size for multi-trunked plants will be determined by adding the calipers of the largest cane and one-half (1/2) the caliper(s) of the second and third largest cane(s).

When a range of size is shown on the Drawings, no plant shall be less than the minimum size and at least 40% of the plants shall be as large as the maximum size shown on the Drawings. The required measurements are the minimum sizes acceptable and are the measurements after pruning, when pruning is required.

Sizes of plants or plant types such as palms, roses, vines, groundcovers, seedings, bulbs, corms, tubers, young plants, understock, etc., will be measured in accordance with the plant standards or as indicated on the Drawings.

Container-grown plants which are well established in adequate size containers and are of equal quality and size to the specified balled plants may be accepted in lieu of balled plants; likewise, balled plants of equal quality and size may be substituted for container-grown plants when permitted by the Engineer or designated representative. Soil shall be approximately 3/4 depth of container and contain roots of the plant throughout the soil.

The ball size for a balled and burlapped plant shall be firm natural balls equal to or in excess of the ball sizes indicated on the Drawings. Collected plant material substituted for a nursery-grown plant shall have a ball or root system 1/4 greater in both diameter and depth than the nursery-grown plant for which it is substituted. The ball size shall be the average of the diameters measured 90 degrees apart.

E. Mulch

Unless indicated otherwise on the Drawings, mulch material shall consist of loose organic residue derived from plants or other granular material approved by the Engineer or designated representative. It shall be of such nature that adequate protection is provided against sun baking and quick drying out of the soil and shall not impede aeration or water penetration nor deplete the soil nitrogen. Mulch material shall be free of excess amounts of large leaves and sticks that would prevent proper dressing of the mulched surface, free of harmful substances and free of detrimental amounts of soil or other foreign matter that would promote early compaction, matting or deterioration of the mulch.

F. Peat Moss

Peat Moss shall be of sphagnum origin of commercial quality.

G. Planting Soil Mixture

The planting soil mixture shall consist of a soil mixture of 3/4 fine sandy loam, 1/8 peat moss and 1/8 leaf mold. The sandy loam shall be taken from a well drained, arable site. It shall be free of subsoil, stones, clay, roots, weeds, grass or other objectionable debris, matter or toxic wastes.

H. Water

Water shall be furnished by the Contractor and shall be clean and free of industrial wastes and other substances harmful to the growth of plants and the areas irrigated.

Availability of water from the Austin Water Utility will be limited as stated under the Water Conservation Standard, City of Austin Land Development Code Chapter 6-2, Article II, "Water Use Management Plan Established".

The use of potable water will be restricted as stated in City of Austin Land Development Code Sections 6-4-73, 6-4-54, 6-4-63, 6-4-64, 6-4-65, 6-4-81, 6-4-92, 15-9-37(D) and 15-9-101(B).

I. Fertilizer

Fertilizer shall be applied uniformly conforming to City of Austin Standard Specification tem No. 606S, "Fertilizer" at the rate indicated.

J. Pesticides including Herbicides

Pesticides including herbicides shall be of the types that are commercially available selected for the species planted or as indicated on the Drawings and shall be applied in accordance with the manufacturer's recommendations upon approval of the Engineer or designated representative.

K. Stakes and Guys

Stakes shall be 2 x 2 x 18 inch (50 x 50 x 450 mm) sound hardwood or treated pine with tapered point and chamfered tops. Guys wires shall be 2 strand 12 ga. (2.7 mm) galvanized steel wire with 1/2 inch (12.5 mm) diameter reinforced plastic or rubber hose trunk bushings and yellow plastic flagging.

L. Bracing

Bracing shall be 2 x 4 inch (50x100 mm) hardwood or metal fence posts, 6 ft. (1.8 meters) in length with guys and bushings.

M. Flagging Tape

Flagging tape shall be highly reflective, visible at night, and approved by the Engineer or designated representative.

N. Trunk Wrapping

Trunk wrapping shall be 4 inch (100 mm) wide commercial trees wrapping paper with asphalt core or the type shown on the Drawings.

O. Anti-transpirants

Anti-transpirants, intended to prevent evaporation, shall be of the types that are commercially available and approved by the Engineer or designated representative.

608S.5 Construction Methods

Immediately following delivery and acceptance at the job, all plants shall be planted or heeled-in in properly moistened material. All plants heeled-in shall be properly maintained by the Contractor until planted. The utmost care shall be exercised in handling plants to prevent injuries to the plants. The solidity of the ball or balled and burlapped plants shall be carefully preserved and such plants shall not be handled by the stems.

Plants with exposed roots shall be protected from drying out during the time the plants are removed from the heeling-in bed and until actually planted.

A. Staking of Planting Locations.

All locations of trees, shrubs and beds shall be staked in the field by the Contractor. All locations will be approved by the Engineer or designated representative prior to any excavation of plant beds or bed preparation. Stakes shall be placed and coded to denote the type of plant material.

B. Excavation of Planting Pits

1. General.

The Contractor shall not excavate plant pits more than 24 hours in advance of planting operations. Any plant pits left unattended for any length of time which may present a hazard shall be covered and/or clearly flagged as approved by the Engineer or designated representative. The walls and bottoms of all plant pits shall be scarified immediately prior to the placement of plants.

2 Pit Sizes.

Planting holes may be dug by hand or by mechanical means and shall be circular or square (according to the shape of the root ball) with vertical sides, unless otherwise indicated on the Drawings. Trimming of the sides or bottom of the hole to uniform shape will not be required. Planting pit sizes shall be as follows, unless indicated otherwise on the Drawings:

(a) A minimum horizontal dimension of twelve (12) inches [300 mm] between the root ball and the sides of the planting pit for the following plant specifications:

(1) Containers of fifteen (15) gallons or larger [56 liters or larger],

(2) Boxes of fourteen (14) inches or larger [350 mm or larger] and

(3) Root ball diameter of Balled and burlapped or bag grown plants larger than fourteen (14) inches [350 mm].

(b) A minimum horizontal dimension of two (2) times the diameter of the root ball for the following plant specifications:

(1) Containers less than fifteen (15) gallons [less than 56 liters]

(2) Root ball diameter of Balled and burlapped or bag grown plants fourteen (14) inches or less [350 mm or less]

(c) A minimum diameter for bare-root plants to permit the roots to spread without crowding or curving around the walls of the pit.

(d) Planting pits shall be excavated to a depth of at least 4 inches (100 mm) but not more than 8 inches (200 mm) greater than the depth of the root ball of balled and burlapped, containerized, container grown or bag grown plants; or the depth of the root system of bare-root plants. Pits dug to excess depths shall be backfilled and compacted to bring the pits to the specified depth. The depth of pits on slopes shall be measured at the lower side.

(e) When performing mechanical transplanting, the receiving plant pit shall be excavated with the same type of equipment used to remove the plant material or as approved by the Engineer or designated representative.

(f) Special sized holes shall be shown on Drawings.

(g) Where holes are dug with an augur and the sides of the holes become plastered or glazed, this plastered or glazed surface shall be scarified.

C. Planting Season

All planting shall be performed as shown below, indicated on the Drawings or as approved by the Engineer or designated representative.

Planting Stock	Planting dates
Containerized or Container grown	None specified
Balled and burlapped	November 15 to March 15
Bare root	January 15 to March 15
Bag grown	September 15 to April 15
Collected	As shown on the Drawings or as approved by the Engineer or designated representative

D. Backfilling

Topsoil from the planting hole may be used for backfilling provided it is kept separate from subsoil and rendered loose and friable. Additional topsoil required to backfill the holes shall be furnished in the amount directed in Subarticle 608S.4.G, 'Planting Soil Mixture' and from a source approved by the Engineer or designated representative.

E. Pruning Roots

Root pruning shall be limited to the amount necessary to prune away broken and badly damaged roots.

F. Pruning of Tops

Pruning of plants shall conform to the best horticultural practice and shall be appropriate to the various types of plants and the special requirements of each. Deciduous (non-evergreen) shrubs and trees with heavy tops shall have about 1/3 to 1/2 of the top growth removed. Plants otherwise acceptable, but with broken or badly bruised branches, shall have such branches removed with a clean cut. All cut surfaces over 1 inch (25 mm) in diameter shall be painted with an approved tree pruning compound.

G. Planting and Backfilling

In general the top of root ball shall stand after settlement of the backfill approximately level with the finish grade. When shown on the Drawings, fertilizer of the type and quantity specified shall be added on the backfill material prior to backfilling. Unless indicated otherwise on the Drawings or approved otherwise by the Engineer or designated representative, planting and backfilling shall be as follows:

1. Plant Basin

A basin, 8 to 10 inches (200 to 250 mm) deep, shall be formed by constructing a neat levee around the planting pit. The inside measurement of the basin shall be

at least the diameter of the growing plant, unless noted otherwise on the Drawings. On slopes the backfill on the lower side shall be graded in such a manner that an adequate basin will be provided.

As shown on the Drawings, either material excavated from the planting pit (excluding any rocks) or Backfill, as specified in Subarticle 608S.5.D may be used to form a basin around the plant. Excess excavated material may be scattered thinly and leveled off provided it is of such consistency and character that it can be readily scattered in an acceptable manner. If scattering of the material may interfere with drainage or mowing, all such material shall be removed and disposed of as approved by the Engineer or designated representative.

2. Depth of Transplanting

In general, plants shall be installed and covered with top soil approximately one (1) inch (25 mm) above the top of the root ball or container soil surface.

3. Bare Root Plants

After the backfill in the bottom of the planting pit has been firmed and the plant placed in the proper position, as shown on the Drawings, loose friable backfill (Subarticle 608S.5.D) or planting soil mixture (608S.4.G) shall be worked about the roots and thoroughly settled with water as the backfill is made. Care shall be taken to avoid bruising or breaking the roots. Sticks, sod, clods or other material which may form large air pockets in the soil or backfill shall not be included in the backfill.

4. Balled and Burlapped Plants

Plants of this type shall not be handled by the stems nor in such manner that the soil of the ball may be loosened. A saddle around the ball should be used for lifting. The burlap shall not be removed from the ball. After the backfill in the bottom of the pit has been firmed and the plant placed in the proper position, as shown on the Drawings, loose friable backfill shall be worked about the ball in 12 inch (300 mm) until the pit is two-thirds (2/3 full). The burlap shall then be opened on top of the root ball to expose the top one-third (1/3) of the root ball. The pit shall then be filled with water and the backfilling completed, working the backfill and water well to prevent any air pockets.

For ball supporting devices such as wire baskets, the basket shall not be removed. The plant shall be placed in the prepared planting pit in the proper position and backfill shall be placed around the ball until the pit is about one-third (1/3) full. The basket shall be carefully removed to just above the backfill, leaving the bottom portion intact. Backfilling shall be completed as described above.

5. Containerized or Container Grown Plants

At the time of planting the root ball and plant shall be carefully removed from the container to prevent damage to the plant and root ball. If in the opinion of the Engineer or designated representative a sufficient amount of soil has fallen off or the ball has been broken to such an extent as to reduce the chances of the plant to grow, the plant will be rejected. Container plants shall be acclimated to outside growing conditions. Container plants shall be placed and backfilled in the same manner as balled and burlapped plants.

6. Bag Grown Plants

Prior to planting, the fabric bag shall be removed by using a knife to cut the side of the bag from top to bottom in three or four places of equidistant around the root

ball. The bag shall be carefully peeled down and roots that do not easily peel away from the bag shall be pruned. The plastic bag shall then be pulled from under the root ball. Bag grown plants shall be placed and backfilled in the same manner as balled and burlapped plants.

H. Vegetative Watering

During the planting operations, the Contractor shall keep the ground and backfill material moist to at least 12 inches (300 mm) around the root ball. The Contractor shall be required to meet the minimum watering requirements shown on the Drawings for all circumstances by a method approved by the Engineer or designated representative. When an irrigation system is shown on the Drawings, the Contractor shall coordinate all work to insure that the irrigation system is operational as the plants are installed.

I. Anti-transpirants

When shown on the Drawings, the Contractor shall apply anti-transpirants in accordance with the manufacturer's recommendations and as approved by the Engineer or designated representative.

J. Pruning

Plants shall not be pruned immediately before delivery to the work site, unless shown otherwise on the Drawings or as approved by the Engineer or designated representative. Common nursery pruning practices are acceptable. Any necessary pruning shall be done at the time of planting as approved by the Engineer or designated representative and shall be appropriate to the various types of plants and the special requirements of each.

From 20 to 40 percent of all foliage of mechanically transplanted plants shall be removed by pruning interior branching, entangled limbs and small branches. Structural branching shall not be removed prior to planting. Branch tips shall not be removed to attain the above percentage.

K. Plant Supports and Bracing Trees

Plant supports such as staking, guying and bracing shall be as shown on the Drawings or as required by the Engineer or designated representative.

Trees shall be staked, guyed or braced for support during the same day as planted. Unless shown otherwise on the Drawings, the plants shall stand approximately vertical after staking, guying or bracing. The Contractor shall be responsible for material remaining approximately vertical and straight for all given conditions and shall repair plant supports as often as required until final acceptance of the work.

All trees 1 1/4 inches (38 mm) and greater in caliper shall be adequately braced immediately after the plants have settled. Unless otherwise indicated on the Drawings, trees 1 1/4 to 2 inches (38 to 50 mm) in diameter shall be braced with 1 brace of sawed lumber, 2 x 2 inches (50 x 50 mm), nominal size, firmly fastened to the tree at a point 5 to 6 feet (1.5 to 1.8 meters) above ground or as directed by the Engineer or designated representative. Fastening shall not be accomplished by nails, staples, wire or other materials that may damage tree. Braces shall be of sufficient length to provide bracing when firmly driven into the ground. The tree trunk shall be adequately padded with a section of flexible hose at the point of attachment with a figure 8 tie. Trees, that are 2 inches to 4 inches (50 to 100 mm) in diameter, shall be

braced with wires at a height of 6 to 8 feet (1.8 to 2.4 meters) above ground. The wires shall be firmly attached to 3 equally spaced concentric stakes that are firmly driven into the ground. The trunk of the tree shall be adequately and securely padded with rubber at the point of attachment of the wire to prevent damage. Wire shall be number 16 gauge (1.5 mm) galvanized.

Trees larger than 4 inches (100 mm) in diameter shall be braced in accordance with notes on Drawings. The Contractor shall repair braces as often as required until acceptance of the project for "Plant Establishment".

L. Safety Flagging Tape

Staking, guying or bracing, which present a hazard shall be clearly flagged as shown on the Drawings or directed by the Engineer or designate representative.

M. Tree Trunk Protection

All trees indicated on the Drawings to be wrapped shall be neatly and securely wrapped with a commercial tree wrapping material approved by the Engineer or designated representative. The tree wrapping shall begin at the base of the trunk and extend upward with a 50 percent overlap to the second whorl of branches. The tree wrapping material shall be secured at the top of wrap with soft twine or weatherproof type tape or any suitable method, approved by the Engineer or designated representative. Wire, metal bands or other material for this purpose that may cause injury or damage to plants shall not be used.

N. Mulching

All plants shall receive mulching to a depth of 2 to 3 inches (50 to 75 mm) within the water basin or across the beds unless indicated otherwise on the Drawings. A small amount of backfill shall be sprinkled on top of organic mulch to hold it in place if directed by the Engineer or designated representative. If hay is used, the depth shall be 4 inches (100 mm) loose measurement.

O. Plant Material Removal and Replacement

A plant shall be removed and replaced as directed by the Engineer or designated representative at any time during execution of the work under this Item including the Establishment Period if, in the judgement of the Engineer or designated representative, a plant is found to be in any of the following conditions:

1. Dead;
2. Dying;
3. Wilted for 48 hours or more; or
4. Any other signs of detrimental consequence.

All replacement plants shall be the same species, size and quality as originally specified. The Contractor shall make every effort to ensure that the replacement material receives any additional care and maintenance required for the replacement plants to become well established. The Engineer will require replacement of plant material until satisfied that all of the plants on the work are in a healthy, vigorous condition.

P. Maintenance and Initial Plant Replacement

The Contractor shall water the plants as often as necessary, cut the weeds and grass around the planted area including the plant basin and bracing, prune the plants, treat the plants in accordance with approved methods of horticultural practice where

insects or disease affect the plants after planting and repair or replace the bracing as may be required or as ordered by the Engineer or designated representative until the planting project has been accepted for "Plant Establishment".

If the Contractor completes the initial planting prior to March 1 for balled and burlapped and bare root plants or April 1 for bag grown plants, the Contractor will be required to replant all material found to be missing, damaged or dead during this time. This replanting shall be done between March 1 and March 15 for balled and burlapped and bare root plants, between April 1 and April 15 for bag grown plants or as directed by the Engineer or designated representative.

In the event that the planting project is not completed by March 15 for balled and burlapped and bare root plants, or by April 15 for bag grown plants and no further planting is permitted until the following "Planting Season", the partial planting will be cared for as prescribed under "Plant Establishment".

608S.6 Plant Establishment

"Plant Establishment" shall commence with the notice of substantial completion and shall extend to the following November 15 for those plantings that are completed in accordance with Subarticle 608S.5.P, ' Maintenance and Initial Plant Replacement'. In those instances where planting 'out of season' is allowed in writing by the Engineer or designated representative, "Plant Establishment" shall commence with notice of substantial completion and shall extend for a minimum of six (6) months or to the following November 15, which ever results in a later date.

For the work of "Plant Establishment", all possible means shall be employed to preserve the plants in a healthy and vigorous growing condition to insure their successful establishment. The Contractor shall perform all of the activities listed below during placement of all the plants. After the completion of the installation, as shown on the Drawings and as approved by the Engineer or designated representative, the Contractor shall perform the following activities for a period of 90 calendar days:

A. Mulching, Plant Basin and Bed Maintenance

The Contractor shall reshape or reform the existing plant basins and beds as necessary to conform to the Drawings, and as approved by the Engineer or designated representative. As a part of the plant basin and bed maintenance, weeds and grass shall be removed prior to the application of mulch. Unless otherwise shown the Drawings, the mulch shall be maintained to a minimum depth of 2 to 3 inches (50 to 75 mm).

The Contractor shall maintain the plant basins, beds and site fixtures generally free of weeds and grass or other materials detrimental to the growth of the plants or the appearance of the site. Herbicides, if approved by the Engineer or designated representative and used by the Contractor, shall be limited to the plant basin and perimeter thereof or around site fixtures as approved by the Engineer or designated representative. Extreme care shall be taken to insure that the herbicide does not come into contact with any part of the desirable plants. Under no circumstances shall the herbicide be used on days where the wind could cause drift hazard to desirable plants. The Contractor shall also follow the manufacturer's instruction for the use and application of any herbicide.

B. Plant Irrigation

The Contractor shall be required to meet the minimum watering requirements for all circumstances by a method approved by the Engineer or designated representative as stated under Subarticle 608S.5.H and/or as shown on the Drawings.

Watering equipment other than an existing irrigation system shall have adequate and accurate measuring devices as approved by the Engineer or designated representative.

C. Mowing and Trimming

The Contractor shall mow and trim the areas identified on the Drawings. The work shall be performed at the frequency as shown on the Drawings. The initial cycle shall begin when directed by the Engineer or designated representative. Mowing heights shall be as shown on the Drawings or approved by the Engineer or designated representative.

The Contractor shall use power equipment as approved by the Engineer or designated representative. Nylon cord trimmers shall not be used inside the plant basins or beds around plant material.

D. Restaking, Reguying and Rebracing of Plants.

Any damaged or destroyed stakes, guys or braces shall be replaced by the Contractor in accordance with the details shown on the Drawings. This shall include any adjustment to the staking or guying to prevent girdling of plants.

E. Pruning

When directed by the Engineer or designated representative or shown on the Drawings, plants shall be pruned by the Contractor to the satisfaction of the Engineer or designated representative. Dead or damaged limbs on trees and shrubs, including suckergrowth on trunks of trees, shall be removed. All pruning shall be accomplished with tools specifically designed for this purpose. All pruned material shall become the property of the Contractor and shall be disposed of in a manner approved by the Engineer or designated representative.

F. Insect, Disease and Animal Control

The Contractor shall treat the plants and/or the planted areas in accordance with accepted methods of horticultural practices and the Texas Department of Agriculture guidelines regarding the use of pesticides. The Contractor shall also follow the manufacturer's instructions for the use and application of any pesticides.

G. Litter Pick-Up

Unless shown otherwise on the Drawings, the Contractor shall collect and dispose of all litter within the landscaped areas. The work shall be performed at the frequency shown on the Drawings or as directed by the Engineer or designated representative.

All litter shall become the property of the Contractor and shall be disposed of in a manner acceptable to the Engineer or designated representative.

H. Fertilization

During the 90-day establishment period, the Contractor shall furnish and apply fertilizer only to those plants as shown on the Drawings. The analysis, times and rates of application shall be as shown on the Drawings. The type of fertilizer and method of application shall be as shown on the Drawings or as approved by the Engineer or designated representative.

I. Plant Removal

In the judgement of the Engineer or designated representative, any plant that is dead or dying for reasons beyond the control of the Contractor and is not to be replaced shall be removed by the Contractor to the satisfaction of the Engineer or designated representative. This shall include repair of the plant pit and the surrounding area.

608S.7 Acceptability of Plants

Between 90 to 100 days following the initial planting and initial plant replacement, the Engineer or designated representative will make an inspection of the project to determine the acceptability of the plant material. At this time, an inventory of missing, dead or rejected plant material will be made and the Contractor notified that the plants on the inventory are to be replanted the following planting season between November 15 and December 15 or as specifically permitted by the Engineer or designated representative. Plant material for the replacement planting shall meet all the requirements specified for the original plant material and shall be planted in accordance with the planting instructions listed under "Construction Methods", except that no further plant replacement will be required. Working days stated in the Contract shall apply to the initial construction period only and will not include the time necessary for replanting. A final inspection shall be made within 10 days after the replacement planting is completed.

608S.8 Measurement

Work and accepted material as prescribed for this item including "Plant Establishment" will be measured as each plant of the type and size complete and in place.

608S.9 Payment

Work performed and accepted material as prescribed by this item, measured as provided under “Measurement", will be paid for at the unit bid price bid for each plant of the type and size specified, complete and in place. The unit bid price shall include full compensation for furnishing all labor, pruning, mowing, insect control, disease control, animal control, watering, fertilizing, herbiciding, litter pickup, maintenance, tools, equipment, materials, supplies and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 608S-1:	Planting Type ___, Size in inches____	Per Each.
Pay Item No. 608S-2:	Irrigation System	Lump Sum

End

SPECIFIC CROSS REFERENCE MATERIALS

City of Austin Standard Specifications

Designation	*Description*
Item No. 606S	Fertilizer

City of Austin Land Development Code

Designation	*Description*
Section 6-4-52	Water Use Management Plan Established
Section 6-4-53	Applicability
Section 6-4-54	Compliance Required
Section 6-4-63	Permanent Water Use Restrictions
Section 6-4-64	Water Conservation Stage One Regulations
Section 6-4-65	Water Conservation Stage Two Regulations
Section 6-4-81	Variance
Section 6-4-92	Penalty
Section 15-9-37(D)	Customer's Responsibilities
Section 15-9-101(B)	Basis for Termination of Service

RELATED CROSS REFERENCE MATERIALS

City of Austin Environmental Criteria Manual

Designation	*Description*
Section 1	Water Quality Management
Section 1.4.4	Vegetative Practices
Section 1.5.0	Vegetation Criteria
Section 1.5.3	Impact Minimization and Restoration Planning
Section 1.5.3.D.6	Discussion-Plant Protection
Section 1.5.3.D.8	Salvaging Trees and Shrubs
Section 1.5.3.D.9	Transplanting Procedure
Section 2	Landscape
Section 2.4.1	Street Yard
Section 2.4 1.D	Street Yard Trees
Section 2.4 6	Irrigation of Landscape Areas
Section 2.4 6.A.1	'Owner responsibility for irrigation .....'
Section 2.7.0	Hill Country Roadway Landscape Criteria
Section 2.7.2	Design Criteria
Section 2.7.2.G	Irrigation
Section 3	Tree and Natural Area Preservation
Section 3.3.2	General Tree Survey Standards
Section 3.3.2.A.1	Diameter
Section 3.5.4.A.6	Mitigation Measures-Enforcement Criteria
Section 3.5.0	Design Criteria
Section 3.5.4	Mitigative Measures
Section 3.5.4.E	Transplanting
Section 5	Construction in Parks
Section 5.3.0	Route Selection
Section 5.3.1	Tree Survey
Appendix K	Arboricultural Practices - Parks
Appendix K, I	Tree Protection
Appendix K, II	Treatment of Minor Wounds or Breakage
Appendix N	Professional Plant List
Appendix O	Site Development Permit-Irrigation Notes
Appendix P-2	Standard Notes for Trees and Natural Area Protection
Figure 1-27	Grasses
Figure 1-33	Rare Plants in the Austin Area

City of Austin Transportation Criteria Manual

Designation	*Description*
Section 1.4.3	Classification Design Criteria-
Section 6.2.3	Transportation Criteria for Landscaping

City of Austin Standard Specifications

Designation	*Description*
Item No. 101S	Preparing Right of Way
Item No. 111S	Excavation
Item No. 601S	Salvaging and Placing Topsoil

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

Designation	*Description*
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 170	Irrigation System
Item No. 192	Roadside Planting and Establishment

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 bysteel pipe, tee posts, U posts or 2″ × 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	
Specification Item 610S, "Preservation of Trees and Other Vegetation"	
City of Austin Standard Specification Items	
Designation	Description
Item No. 606S	Fertilizer
City of Austin Standard Details	
Designation	Description
Item No. 610S-1	Tree Protection Fence Locations
Item No. 610S-2	Tree Protection Fence, Type A, Chainlink
Item No. 610S-3	Tree Protection Fence, Type B, Wood
Item No. 610S-4	Tree Protection Fence, Modified Type A, Chainlink

Item No. 610S-5	Tree Protection Fence, Modified Type B, Wood
Item No. 610S-6	Tree Protection, Tree Wells
City of Austin Transportation Criteria Manual	
Designation	Description
Section 1.3.1.C.6	Sight Distance
Section 6.2.3.A.4	Clearance Height
Figure 1-6	Desirable Sight Triangle
City of Austin Environmental Criteria Manual	
Designation	Description
Appendix P-2, Note 6	Exceptions to Installing Fences
Appendix P-2, Note 6c	Trees close to proposed buildings - - -
Appendix P-6	Remedial Tree Care Notes
Section 3.3.2.A.2	Diameter of trees - - -
Section 3.5.0	Design Criteria
Section 3.5.3.A.1	Permeable Paving
Figure 3-8	Example of Minimum Design Criteria Applied to Permeable Parking
City of Austin Land Development Code	

Designation	Description
Section 25-8-603	Tree Protection Administration
Section 25-8-623	Inspection by City Arborist

ASTM, American Society for Testing and Materials

Designation	Description
D-2729	Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

RELATED CROSS REFERENCE MATERIALS

Specification 610S, "Preservation of Trees and Other Vegetation"

City of Austin Standard Specification Items

Designation	Description
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 608S	Planting

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges	
Designation	Description
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering

Item No. 620S
Filter Fabric

620S.1 Description

This item shall govern the furnishing of materials and for placement of filter fabric as indicated on the Drawings or directed by the Engineer or designated representative. Filter Fabric shall have the capability for allowing the passage of ground water through it without transporting the soil placed around the filter fabric.

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

620S.2 Submittals

The submittal requirements of this specification item include:

A. catalog cuts,
B. samples of material selected,
C. testing results,
D. manufacturer's recommended installation procedures, and
E. manufacturer certification of compliance with this specification.

620S.3 Materials

A. General

The fabric shall be constructed exclusively of synthetic thermoplastic fibers and may be either woven or non-woven to form a mat of uniform quality. Fabric fibers may be either continuous or discontinuous and oriented in either a random or an aligned pattern throughout the fabric. The fabric shall be mildew resistant, rot proof and shall be satisfactory for use in a wet soil and aggregate environment. The fabric shall contain ultraviolet stabilizers and shall have non-raveling edges.

B. Physical Requirements

The fabric shall meet the requirements of table 1, when sampled and tested in accordance with the methods indicated in the table below.

For applications such as water quality facility underdrain wrappings that require a high flow-through rate or when specified by the Engineer, the fabric shall be woven mono-filament and meet the requirements of Table 2.

All material shall be shipped with suitable wrapping to protect the fabric during shipping and storage at the job site.

620S.4 Construction Methods

The submittal requirements shall be completed before any materials are ordered.

The "Filter Fabric" shall be installed in accordance with the manufacturer's recommendations, as indicated on the Drawings or as directed by the Engineer or

designated representative. When lapping is required, it shall be in accordance with the manufacturer's recommendations. Backfilling around the Filter Fabric shall be done in such a manner that the Filter Fabric material will not be damaged during the placement.

TABLE 1: FILTER FABRIC REQUIREMENTS

Original Physical Properties	Test Method	Requirements
Fabric weight (mass), on an ambient temperature air-dried tension free sample, expressed in oz/ sq. yd (grams/ square meter)	TxDoT Tex-616-J*	Underdrains/Slope Stabilization 4.0 (135) minimum
		Gabions and Revet Mattresses 6.0 (200) minimum
Water flow rate by falling head method, 7.9 inches (20 cm) to 3.9 inches (10 cm) on 2 inch (50 mm) ID cylinder with 1 inch (25 mm) diameter orifice, with flow rate expressed in gal/sq.ft/minute (liters/square meter/minute).	TxDoT Tex-616-J*	80 (3,260) minimum
Breaking load in either machine or cross-machine direction, expressed in pounds (newtons)	ASTM D-1682 grab method G**	100 (445) minimum
Equivalent opening size for US Standard (SI) sieves.	CW-02215	70 to 100 (212 to 150μm)
"Apparent elongation" at breaking load in either machine or cross-machine direction, expressed as percent	ASTM D-1682 grab method G**	100 maximum

* TxDoT Tex-616-J, "Testing of Construction Fibers

** ASTM D 1682 grab method G, "Test Methods for Breaking Load and Elongation of Textile Fabrics"* as modified by TxDoT Test Method Tex-616-J

*** CW-02215, US Army Corps of Engineers, Civil Works Construction Guide Specification "Plastic Filter Fabric".

TABLE 2: HIGH FLOW FILTER FABRIC REQUIREMENTS

Property	Test Method	Requirements
Fabric weight	D 3776	3.0 ounces/square yard, minimum
Ultaviolet (UV) Radiation Stability	D 4355	70% strength retained minimum, After 500 hours in xenon arc device
Mullen burst strength	D- 3786	120 pound per square inch minimum
Water Flow Rate	D-4491	275 gallons/minute/square feet, minimum

620S.5 Measurement

Work and acceptable material for "Filter Fabric" and “High Flow Filter Fabric” will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards), complete in place.

620S.6 Payment

The work performed and the materials furnished and measured as provided under "Measurement" will be paid at the unit bid price for "Filter Fabric". The unit bid price, when included in the contract as a pay item, shall include full compensation for all materials, excavation and backfilling and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 620S-A:	Filter Fabric	Per Square Yard.
Pay Item No. 620S-B:	High Flow Filter Fabric	Per Square Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification 620S, “Filter Fabric"

American Society for Testing and Materials (ASTM)

Designation	Description
D 1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
D 3776	Standard Test Method for Mass Per Unit Area (Weight) of Fabric
D 4355	Test Methods for Deterioration of Geotextiles By Exposure to Ultraviolet Light, Moisture and Heat in a Xenon Arc Type Apparatus
D 3786	Standard Test Method for Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method
D 4491	Standard Test Method for Water Permeability of Geotextiles by Permittivity

Texas Department of Transportation Manual of Testing Procedures

Designation	Description
Tex-616-J	Testing of Construction Fabrics

RELATED CROSS REFERENCE MATERIALS

City of Austin Environmental Criteria Manual

Designation	Description
Section 1.4.2.E	Rock Berm
Section 1.6.5.A.4	Sand Filtration Bed Details

City of Austin Standard Details

Designation	Description
Number 639S-1	Rock Berm
Number 661-1	Sand Bed Filtration Configurations Using Geomembrane Liner
Number 661-2	Sand Bed Filtration Configurations Using Clay Liner/No Liner Required
Number 661-3	Biofiltration Bed Configurations Using Geomembrane/Clay Liner Required

City of Austin Standard Specifications

Designation	Description
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation

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

Designation	Description
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 641S
Stabilized Construction Entrance

641S.1 Description

This item governs the construction of a stabilized pad of crushed stone located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk or parking area. The removal of the stabilized pad of crushed stone shall also be included in the item. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking or deposition of sediment onto public right of way (Environmental Criteria Manual Section 1.4.2.N.4).

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

641S.2 Submittals

The submittal requirements for this specification item shall include:

A. Source, type and gradation of rock

B. Drainage technique (i.e. drainage swale or entrance grading) proposed to prevent runoff from exiting the construction site.

641S.3 Materials

Aggregate for construction shall conform to the following gradation:

Table 1: Aggregate Gradation Chart (TEX 401-A, % Retained per sieve)	
US 5 inch (SI 125 mm)	US 3 inch (SI 75 mm)
0	100

641S.4 Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of in a manner that will not interfere with the excavation and construction of the entrance as indicated on the Drawings or as presented in Standard Details No. 641S-1. The entrance shall not drain onto the public right of way or shall not allow surface water runoff to exit the construction site.

When necessary, vehicle wheels shall be cleaned to remove sediment prior to entrance onto public right of way. When vehicle washing is required, it shall be done on an area stabilized with crushed stone, which drains into an approved sediment trap or sediment basin. All sediment shall be prevented from entering any storm drain, ditch or watercourse through use of sand bags, gravel, boards, silt fence (Standard Specification Item No 642S) or other methods approved by the Engineer or designated representative.

The entrance shall be maintained in a condition that will prevent tracking or disposition of sediment onto public right of way. This restriction may require periodic top dressing with additional stone as conditions demand, as well as the repair and/or cleanout of any measures used to trap sediment. All sediment that is spilled, dropped, washed or tracked onto public right of way must be removed immediately.

641S.5 Measurement

Acceptable work performed as prescribed in this item will be measured by unit of each stabilized construction entrance installed.

641S.6 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per lineal foot of "Stabilized Construction Entrance". The price shall include full compensation for furnishing, hauling and placing all materials, labor, tools, equipment and incidentals necessary to complete the work including inspecting, repairing, replacing and relocating existing fencing, removal of silt and removal and disposal of all materials at the completion of construction.

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

Pay Item No. 641S: Stabilized Construction Entrance Per Each.

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification 641S, "Stabilized Construction Entrance (SCE)"

City of Austin Environmental Criteria Manual

Designation	Description
Section 1.4.2.N.4	Stabilized Construction Entrance "Design Criteria"

City of Austin Standard Details

Designation	Description
Number 641S-1	Stabilized Construction Entrance

City of Austin Standard Specifications

Designation	Description
Item No. 642S	Silt Fence (SF)

RELATED CROSS REFERENCE MATERIALS

City of Austin Environmental Criteria Manual

Designation	Description
Section 1.4.2.J	Sandbag Berm
Figure 1-11	Sand Bag Berm
Section 1.4.2.G	Silt Fence

City of Austin Standard Specifications

Designation	Description
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401S	Structural Excavation and Backfill
Item No. 610S	Preservation of Trees and Other Vegetation

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

Designation	Description
Item No. 100	Preparing Right of Way

Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 168	Vegetative Watering

ITEM NO. 642S
SILT FENCE

642S.1 Description

This item shall govern the provision and placement of a silt fence fabric fence (Environmental Criteria Manual Section 1.4.5.G) including maintenance of the fence, removal of accumulated silt, removal of the silt fence and re-vegetation of disturbed areas upon completion of the project.

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

642S.2 Submittals

The submittal requirements for this specification item shall include:

A. Source, manufacturer, characteristics and test data for the silt fence fabric,

B. Manufacturer, characteristics and test data for the posts and wire fence.

C. Re-vegetation program, including:

1. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.
2. Type of mulch.
3. Type of tacking agent.
4. Type and rate of application of fertilizer.

642S.3 Materials

A. Fabric

1. General:

   The silt fence fabric shall be of nonwoven polypropylene, polyethylene or polyamide thermoplastic fibers with non-raveling edges. The silt fence fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to water while retaining sediment. The silt fence fabric shall be supplied in rolls a minimum of 36 inches (0.9 meter) wide.

2. Physical Requirements:

   The fabric shall meet the requirements presented in Table 1, when sampled and tested in accordance with the methods indicated herein, on Standard Detail No. 642S-1 and/or on the Drawings.

B. Posts:

Posts shall be steel Tee or Y-posts, not less than 4 feet (1.22 meters) in length with a minimum weight of 1.25 pounds per foot (1.86 kilograms per meter) with a minimum Brinell Hardness of 143. Hangers shall be adequate to secure fence and fabric to posts. Posts and anchor plates shall conform to ASTM A-702. Caps are required (*not specifying discretionary criteria).

C. Wire Fence:

Wire fence shall be welded wire fabric 2 in. x 4 in. 12.5 SWG, wire diameter 0.099 in (±0.005 in.), and shall conform to Standard Specification Item No. 406, "Reinforcing Steel".

TABLE 1. Silt Fence Fabric Requirements

Physical Properties	Method	Requirements
Fabric Weight in ounces per square yard (grams/square meter)	TEX-616-J[1]	5.0 minimum (150 minimum)
Equivalent Sieve Opening Size: US Standard (SI Standard sieve size)	CW-02215[2]	40 to 100 (425 to 150 □m)
Mullen Burst Strength: lbs. per sq. inch (psi) megaPascal (mPa)	ASTM D-3786[3]	280 minimum (1.9 minimum)
Ultraviolet Resistance; % Strength Retention	ASTM D-1682[4]	70 minimum

[1] TxDoT Test Method Tex-616-J, "Testing of Construction Fabrics".
[2] US Army Corps of Engineers Civil Works Construction Guide Specification CW-02215, "Plastic Filter Fabric".
[3] ASTM D-3786, " Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method".
[4] ASTM D-1682, " Test Methods for Breaking Load and Elongation of Textile Fabrics ".

642S.4 Construction Methods

The silt fence fabric shall be securely attached to the posts and the wire support fence with the bottom 12 inches (300 mm) of the material buried in a trench a minimum of 6 inches (150 mm) deep and 6 inches (150 mm) wide to prevent sediment from passing under the fence. When the silt fence is constructed on impervious material, a 12-inch (300-mm) flap of fabric shall be extended upstream from the bottom of the silt fence and weighted to limit particulate loss. No horizontal joints will be allowed in the silt fence fabric. Vertical joints shall be overlapped a minimum of 12 inches (300 mm) with the ends sewn or otherwise securely tied.

The silt fence shall be a minimum of 24 inches (0.6 meter) high. Posts shall be embedded a minimum of 12 inches (300 mm) in the ground, placed a maximum of 8 feet (2.4 meters) apart and set on a slight angle toward the anticipated runoff source. When

directed by the Engineer or designated representative, posts shall be set at specified intervals to support concentrated loads.

* Per OSHA §1926.701, 'all protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement'. Caps must be large enough to dissipate the forces of impact to prevent impalement from a reasonably foreseeable fall distance. It should be noted that the use of impalement protection caps is but one method of protection; covers or wooden troughs can be another means of meeting the guarding requirement. For City of Austin purposes, this also applies to t-posts and wooden stakes.

The silt fence shall be repaired, replaced, and/or relocated when necessary or as directed by the Engineer or designated representative. Accumulated silt shall be removed when it reaches a depth of 6 inches (150 mm).

642S. 5 Measurement

The work performed and the materials furnished under this item will be measured by the lineal foot of "Silt Fence", complete in place.

642S.6 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per lineal foot of "Silt Fence". The price shall include full compensation for furnishing, hauling and placing all materials, labor, tools, equipment and incidentals necessary to complete the work including inspecting, repairing, replacing and relocating the fence, removal of silt and removal and disposal of all materials at the completion of construction in and re-vegetation of disturbed areas.

Payment will be made under:

Pay Item No. 642S:	Silt Fence for Erosion Control	Per Lineal Foot.

END

SPECIFIC CROSS REFERENCE MATERIALS
Specification 642S, "Silt Fence"

City of Austin Environmental Criteria Manual

Designation	Description
Section 1.4.5.G	Silt Fence

City of Austin Standard Details

Designation	Description
Number 642S-1	Silt Fence

City of Austin Technical Specifications

Designation	Description
Item No. 406	Reinforcing Steel

American Society For Testing and Materials (ASTM)

Designation	Description
A-702	Specification for Steel Fence Posts and Assemblies, Hot Wrought
D-1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
D-3786	Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method

Texas Department of Transportation Manual of Testing Procedures

Designation	Description
Tex-616-J	Testing of Construction Fabrics

U.S. Army Corps of Engineers

Designation	Description
CW-02215	Civil Works Construction Guide Specification "Plastic Filter Fabric"

RELATED CROSS REFERENCE MATERIALS
Specification 642S, "Silt Fence"

City of Austin Environmental Criteria Manual

Designation	Description
Table 1-1.3	Recommended Design Values For Functional Controls
Table 1-2	Maximum Water Depth At The Barrier

City of Austin Standard Specifications

Designation	Description
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401S	Structural Excavation and Backfill
Item No. 610S	Preservation of Trees and Other Vegetation

ITEM NO. 648S
MULCH SOCK

648S.1 Description

A Mulch sock consists of material encased in a tube of mesh. It is used to intercept, settle, and filter sheet flow and pond runoff. Mulch socks provide an environmentally sensitive and cost-effective alternative to sediment fences.

648S.2 Submittals

The submittal requirements for this specification item shall include the following:

A. Mulch Material

1. A small sample of mulch material proposed to be used on the site will be provided to the engineer.
2. Provide a designated project stockpile of mulch for sampling and testing at the producer's site.
3. A copy of the lab analysis, performed by an STA-certified lab, verifying that the mulch material meets the requirements of Table 1.

Table 1

Item	Requirement	Reference Specification
Particle Size	3" minus screening process	Equivalent to TXDOT item 161, Compost, Section 1.6.2.B, Wood Chip requirements
pH	5.5 – 8.5	TMECC 04. 11-A, "1.5 Slurry pH"
Organic Matter Content	25%, dry weight basis	TMECC 05.07-A, "Loss-On-Ignition Organic Matter Method"

B. Tube Material

The CONTRACTOR shall submit a sample of the material that the CONTRACTOR proposes to use on the project. A sample of the material should be accompanied by material data sheet identifying composition, ability of the material to biodegrade, and size of openings in tube at a minimum.

648S.3 Materials

A. Mulching material can be manufactured on or off the project site and may consist of:

1. Shredded bark
2. Stump grindings
3. Composted bark

B. The mulch shall have the following composition:

1. Wood chips shall be produced from a 3-inch minus screening process (equivalent to TxDOT item 161, Compost, Section 1.6.2.B Wood Chip Requirements).
2. Large portions of silts, clays, or fine sands are not acceptable.
3. The pH of the mulch shall be between 5.5 and 8.5.
4. The organic matter content shall be greater than or equal to 25% on a dry weight basis.

C. Mulch material must be free of refuse, physical contaminants, and material toxic to plant growth. It is not acceptable for the mulch material to contain ground construction debris, biosolids, manure, or recyclable material.

D. Prior to placement, a representative sample of the mulching material must be tested and certified by the project engineer or his/her designee and accepted by the city inspector.

E. “Sock” material will be 100% biodegradable, photodegradable, or recyclable such as burlap, twine, UV photodegradable plastic, polyester, or any other acceptable material. The material mesh opening should be equal to or less than 3/8 inch (10 mm) and the material tensile strength should be equal to or greater than 44 psi (3.09 kg/cm2).

648S.4 Installation

A. Use 12 or 18 inch diameter mulch socks for all sediment control applications. This diameter of mulch sock material has proven to be the most consistent for all sediment control applications (TxDOT, April 2006).

B. Install mulch socks per Figure 1.4.5.F in the City of Austin Environmental Criteria Manual.

C. Mulch socks should be used at the base of slopes no steeper than 2:1 and should not exceed the maximum spacing criteria provided in the following table.

Slope	Max. Slope Length Between *18 in. Dia. Sock* (ft)	Max. Drainage Area (sf) per 100ft of Sock
100:1 - 50:1	100	10,000
50:1 - 30:1	75	7,500
30:1 - 25:1	65	6,500
25:1 - 20:1	50	4,800
20:1 - 10:1	25	2,600
10:1 - 5:1	15	1,300
5:1 - 2:1	10	1,000

Slope	Max. Slope Length Between *12 in. Dia. Sock* (ft)	Max. Drainage Area (sf) per 100ft of Sock
100:1 - 50:1	100	6,000
50:1 - 30:1	40	4,000
30:1 - 25:1	30	3,000
25:1 - 20:1	25	2,600
20:1 - 10:1	15	1,300
10:1 - 5:1	10	1,000
5:1 - 2:1	5	500

D. Place mulch socks at a 5 ft or greater distance away from the toe of the slopes to maximize space available for sediment deposition.

E. When placed on level contours, sheet flow of water should be perpendicular to the mulch sock at impact and unconcentrated.

F. Install mulch socks using rebar (#5 minimum with safety caps) a minimum of 48 inches in length placed on 2-ft centers. In order to prevent the movement or floating of the mulch sock during rain events or construction operations, install steel posts on alternating sides of the sock. Drive the posts into the ground to a minimum depth of 24 inches, leaving less than 12 inches of post above the exposed mulch sock.

G. In order to prevent water flowing around the ends of the mulch socks, point the ends of the socks up slope.

H. In order to prevent water from flowing between the gaps at adjacent ends of mulch socks, overlap the ends of adjacent mulch socks a minimum of 12 inches. Never stack mulch socks on top of one another.

I. Mulch Socks should be placed using ‘smiles’ and ‘j-hooks’. See ECM Section 1.4.5 G (Silt Fence)

J. For steeper slopes, an additional mulch sock can be constructed on the top of the slope and within the slope area as determined by specific field conditions. Multiple mulch socks are recommended on steeper slopes.

K. Do not use mulch socks in areas of concentrated flow as they are intended to control sheet flow only.

648S.5 Inspection and Maintenance

A. Inspect mulch socks after installation for gaps under the mulch socks and for gaps between the joints of adjacent ends of mulch socks. Contractor shall repair gaps such that no water flows under or around sock.

B. Inspect every seven days and within 24 hours of a rainfall event of 0.5 inches or greater. Replace and repair mulch socks as necessary.

C. Sediment retained by the mulch socks shall be removed when it has reached one third of the exposed height of the mulch socks.

D. Mulch socks can be vegetated or un-vegetated. Vegetated mulch socks can be left in place. The vegetation will grow in the slope, further anchoring the sock.

648S.6 Payment

The work performed and the materials furnished as prescribed by this item shall be paid for by the linear foot of mulch sock installed.

Payment will be made under:

Pay Item No. 648S:	Mulch Sock	Per Lineal Foot.

END

***SPECIFIC* CROSS REFERENCE MATERIALS**
Specification Item No. 648S, “Mulch Sock”

City of Austin Environmental Criteria Manual

Designation	Description
1.4.5.F	Mulch Sock
1.4.5.G	Silt Fence

City of Austin Standard Details

Designation	Description
648S-1	Mulch Sock

Item No. 660S
Biofiltration Medium

660S.1 – Description

This item shall govern mixing and placing medium for a biofiltration basin intended to treat storm runoff. This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

(1) Submittals

The submittal requirements of this specification item include:

A. A signed statement provided by the Contractor that:

1. A laboratory analysis has been conducted by of the actual mixture being proposed, and has been verified as meeting the specifications below. The date of the laboratory analysis must be no more than six months prior to the date of installation of the biofiltration medium. A copy of the laboratory results must be provided.
2. No "sandy loam" fill material (aka "red death") is included in the mixture.
3. Report the source of organic matter.

B. Laboratory reports of analyses results documenting that the mixture meets the following specifications:

1. Particle size distribution performed per ASTM D-422:
   - Coarse fragments + sand content of 70 - 90% by weight
   - Clay content of 3 - 10% by weight
   - Silt + clay content ≤ 27% by weight
2. Percent organic matter of 0.5 - 5% by weight per ASTM D2974 Method C

C. Contractor's statement that the biofiltration medium has been tested by a laboratory using approved procedures (copy of lab results provided below) and meets the criteria as noted in Table 1 below:

Table 1 - Biofiltration Medium Characteristics

Parameter	Results*	Criteria	Criteria Met?*
Percent Sand + Coarse Fragments (ASTMD-422)		70 - 90%	
Percent Clay (< 0.002 mm)		3 - 10%	
Percent Silt + Clay (< 0.05 mm)		≤ 27%	

Percent Organic Matter (ASTM D-2974)		0.5 - 5%	
Is any "Red Death" included in medium?		None allowed	
Is the mixture free of trash, stones, weeds, or other undesirable material?		None allowed	
Is the medium well-mixed and homogenous?		Must be homogenous	

* Laboratory Must Fill In These Cells

Table 2 - Biofiltration Medium Testing and Installation Dates

Date of Laboratory Analysis (earliest)*	
Date of Medium Installation*	
Time between Dates (months)*	
Criteria for Time Between Dates (months)	6
Is Criteria Met?*	

* Contractor Must Fill In These Cells

660S.2 – Materials

(1) The following mixture (% by volume) should create an appropriate biofiltration medium, subject to specific characteristics of the topsoil, which may exhibit considerable variability:

70-80% concrete sand per ASTM C33 and/or screened decomposed granite sand

20-30% screened bulk topsoil (chocolate loam is also acceptable)

The source materials must be free of stones, roots, or other similar objects larger than two inches. Additionally, it should be free of trash, other undesirable material, and should not contain weeds or weed seeds.

The ingredients shall be well-mixed to create a homogenous medium.

(2) Unacceptable Materials

A commercially available fill material that should not be used is typically marketed as "sandy loam." This product is often referred to by landscapers as "red death", which refers to the color of the material, and is an infertile fill material that has poor drainage characteristics. All materials shall be free of Bermuda grass, Quackgrass, Johnson grass, or other noxious weeds, their roots or seeds.

660S.3 - Construction Methods

(1) Erosion Control

Prior to commencing this work, all required erosion control and environmental measures shall be in place as indicated on the approved site plan and/or modified.

(2) Scheduling, Delivery, Storage and Signage

The biofiltration medium must be delivered to, or mixed at, the site prior to the mid-construction conference. The medium must be certified as meeting the required specifications by the project Engineer, and approved by the City Inspector. The medium must be stored on-site separate from other materials, and covered to prevent erosion of the mixture by rainfall and runoff. The medium must have a prominent tag affixed that reads "BIOFILTRATION MEDIUM FOR WATER QUALITY POND."

(3) Placement

Complete construction and stabilize all areas draining to the biofiltration basin. Permanent controls will be cleaned out and filter medium will be installed after stabilization of the site. Install geotextile fabric per the Biofiltration Bed detail provided in Standard Detail 661-3. Biofiltration medium shall be placed in lifts of 12 to 18 inches without using heavy operating equipment or compaction. Lifts should be lightly watered to encourage soil settling. The final surface must be raked flat. The project Engineer must be notified 24 hours prior to installation of the biofiltration medium and approve and certify the installation.

(4) Shrinkage

Some shrinkage of the medium is to be expected after installation, in the range of 5-15%. As a general recommendation about 20 inches of medium should be installed to achieve a depth of 18 inches.

660S.4 – Measurement

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

660S.5 – Payment

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

Payment will be made under the following:

Pay Item No. 660S**:**	Biofiltration Medium.	Per Cubic Yard.

END OF SECTION

SPECIFIC CROSS REFERENCE MATERIALS	
Specification Biofiltration Medium	
City of Austin Environmental Criteria Manual	
Designation	Description
Section 1.6.7.C	Biofiltration

RELATED CROSS REFERENCE MATERIALS	
Specification Biofiltration Medium	
City of Austin Environmental Criteria Manual	
Designation	Description
Section 1.6.5.A.4	Sand Filtration Basin Details
City of Austin Standards Details	
Designation	Description
Item No. 661-3	Biofiltration Bed Configurations Using Geomembrane/Clay Liner
City of Austin Standard Specifications	
Designation	Description
Item No. 620S	Filter Fabric

Fencing

701S.1 Description

This item shall govern furnishing and installing fencing and gates at locations shown on the Drawings or directed by the Engineer or designated representative, including all posts, bracing and accessories as specified in this Item and as indicated on the Drawings.

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

701S.2 Submittals

Prior to installation of the fencing the Contractor shall furnish the Engineer or designated representative with certification from the manufacturer that all fencing materials comply with the requirements specified in this Item.

701S.3 Materials

A. Chain Link Fabric

1. Wire fabric for fencing shall be 9 gauge (3.76 mm) steel with a minimum breaking strength of 1,290 pounds per foot (1 750 Newtons per square meter). The overall height of the fence when erected shall be the height above grade as indicated on the Drawings. The fabric shall be woven into an approximately 2-inch ± 1/8-inch (50 mm ± 3 mm) mesh such that in a vertical dimension of 23 inches (585 mm) along the diagonals of the openings there shall be at least 7 meshes. Unless indicated otherwise on the Drawings the fabric shall have a knuckled (K) and twisted (T) finish for the top and bottom selvages respectively. The wire in the fabric shall withstand a minimum tensile strength test of 75,000 psi (517 kPa) after galvanizing. Except as provided herein, the chain link fence fabric shall conform to ASTM A392, Class I or ASTM A491.
2. The fabric shall be hot dip galvanized after weaving and shall have a minimum coating of 1.2 ounces per square foot (0.4 kilograms per square meter) of uncoated surface conforming to ASTM A392, Class I.
3. Between posts the fabric shall be fastened at 12-inch (300-mm) intervals to a top and bottom tension wire. When a top rail is shown on the Drawings, the fabric shall also be fashioned in the same manner. On gate frames, the fabric shall be fastened to top and bottom of the gate frame at all 12-inch (300-mm) intervals. Steel or aluminum wire fabric ties with a minimum 9 gauge (3.76 mm) diameter shall be used.

B. Woven Wire Fencing

Woven wire fencing shall be either galvanized steel wire fencing or aluminum-coated steel wire fencing conforming to the following requirements:

1. Galvanized steel wire fencing shall conform to ASTM A116, Class 1.

2. Aluminum-coated steel wire fencing shall consist of aluminum-coated steel wire conforming to the requirement for galvanized steel wire fencing, except the wire shall be aluminum coated. The wire shall not have less than 0.40 ounce (11 grams) coating of aluminum alloy per square foot of uncoated surface in accordance with ASTM A491

C. Wire Fencing

Wire shall be either galvanized or aluminum alloy coated 9 gage (3.76 mm) steel wire conforming to the specifications for galvanized steel or aluminum alloy coated woven wire fencing above.

D. Wood Fencing

Wood for wood fencing shall be Wolmanized pine, cedar or as indicated on the Drawings. The timber shall be sound and free from all decay, shakes, splits or any other defects, which would make it structurally unsuitable for the intended purpose.

E. Metal Posts, Top Rails, Braces and Gates

Steel pipe used for posts, top rails, braces and gate frames shall conform to the specifications of ASTM A 53. Steel sections used for posts, top rails, frames and braces shall be a good commercial quality weldable steel. All material shall be new and no used, re-rolled or open seam material will be acceptable. All posts shall meet the weight and length requirements indicated. The fabric bands and steel wire ties shall conform to the gauge and spacing indicated and shall be of suitable design to fasten fabric to the posts. Wire ties of the gauge shown may be used in lieu of fabric bands. All fittings required for posts shall be pressed or rolled steel, forge steel, malleable iron or wrought iron of good commercial quality and spaced as indicated on the Drawings.

1. Line Posts

Line posts may be either C-section or tubular. Tubular line posts shall be fitted with watertight malleable iron caps. Line posts shall be furnished in sufficient quantity to provide a maximum spacing of 10 feet (3 meters)

2. Terminal Posts

All end, corner and pull posts shall be known as terminal posts and shall be of either round or square sections. All terminal posts shall be furnished with watertight malleable iron caps. Fabric shall be fastened to terminal posts by steel stretcher bars and stretcher bar bands fitted with carriage bolts and nuts of the size and spacing indicated on the Drawings.

3. Gate Posts

Gateposts shall be either round or square. All gateposts shall be furnished with watertight malleable iron caps. The fabric shall be attached to the gateposts by means of steel stretcher bars and stretcher bar bands fitted with carriage bolts and nuts of the size and spacing indicated on the Drawings.

4. Post Caps

Post caps for pipe sections shall be designed to exclude all moisture. Where a top rail is shown on the Drawings, post caps shall have an opening for the top rail. All post caps shall have a 2-inch (50-mm) skirt for rigidity. When barbed wire is allowed for topping a six-foot (1.82 meter) or higher fence (LDC Section 10-1-9) the barbed wire support arms shall be integral with post caps.

5. Gates

a. Single Swing Gate

The gate frames shall be fabricated from sections either round or square of the size and weight indicated on the Drawings and shall be filled out with the same type fabric specified for the chain link fence. All gates shall be equipped with approved malleable iron or steel latches, stops and center rest. A satisfactory locking device suitable for padlocking shall be provided. The gates shall be hung by at least 2 steel or malleable iron hinges securely fastened to the posts. Hinges shall not twist or turn under the action of the gate, shall be capable of allowing a full 180 degree opening turn, shall be so arranged that a closed gate cannot be lifted off the hinges to obtain entry and shall be easily operated by one person.

b. Double Swing Gate

Double Swing gates shall be furnished and installed as indicated on the drawings. Gates shall be of the same height as the fence and shall have a single vertical mat of barbed wire. The gates shall be hinged to swing 180 degrees from closed to open. The gates shall be complete with frames, latches, stops, keepers, hinges, fabric, braces, padlocks and three strands of barbed wire. Gates shall have intermediate members and diagonal truss rods as required for rigid construction and shall be free from sag and twist. Gates shall be fitted with vertical extension arms or shall have frame end members intended to carry barbed wire.

Hinges shall be pinned type, heavy pattern with large bearing surface and shall not twist or turn under the action of gate. Latches for double swing gates shall be plunger bar type, full gate height, and arranged to engage the gate stop. Stops shall consist of a roadway plate with anchor set in Portland Cement concrete and arranged to engage the plunger. Keepers shall consist of mechanical devices for securing and supporting the free end when in the full open position. Latches shall be arranged for padlocking with padlock accessible from sides of the gate. Gates shall be installed so that they cannot be removed without disassembly of the hardware. Hardware attachment bolt shall be penned to prevent easy removal.

6. Top Rail

The top rail shall be of size and weight indicated on the Drawings and shall be furnished in random lengths, not less than 18 feet (5.5 meters) per section with outside sleeve type couplings at least 6 inches (150 mm) long and having a wall thickness of not less than 0.70-inch (18-mm). One coupling in five shall have a heavy spring to take up expansion and contraction of the rail. The top rail shall be installed before installing chain link fabric and shall pass through post tops.

7. Braces

All braces shall be of the size, weight and length indicated on the Drawings. All braces shall be trussed with rods and turnbuckles of the dimensions indicated on the Drawings. Braces shall be installed on all terminal posts and shall extend to the adjacent line posts. All corner and pull posts shall have braces on each side of terminal.

8. Fittings, Bolts and Other Miscellaneous Hardware

All fittings, bolts and miscellaneous hardware shall be hot dip galvanized in conformance with TxDoT Standard Specification Item No. 445, “Galvanizing.

9. Tension Wire

Between posts, the fabric shall be fastened to a top and bottom tension wire or to the top rail and bottom tension wire by steel wire ties of the gauge and spacing indicated on the

Drawings. The tension wire shall be at least 7 gauge (4.5 mm) galvanized coil spring steel of good commercial quality.

Tension wire shall have a minimum coating of 0.8 ounce per square foot (0.2 kilogram per square meter) of uncoated surface when tested in conformance with ASTM A116.

10. Security Fence

The security fence shall be 8 feet (2.44 meters) high with brackets and 3 strands barbed wire.

Barbed wire, when specified on the Drawings, shall be 12-1/2 gauge wire (2.51 mm), twisted with two-point 14 gauge (2.03 mm) barbs spaced approximately 5 inches (125 mm) apart and shall conform to ASTM A121 or ASTM A585. Three strands of barbed wire will be required when a barbed wire top is specified on the Drawings.

Barbed wire support arms shall be at an angle or 45° from vertical and shall have clips for attaching three (3) strands of barbed wire to each support arm. Each support arm shall be of sufficient strength to support a 200-pound (90 kilograms) weight (mass) applied at the outer strand of barbed wire.

11. Galvanizing

Thin-wall, high-strength pipe posts shall be externally hot-dip galvanized with a minimum weight of coating of 0.9 ounce per square foot (0.3 kilogram per square meter). After galvanizing, thin-wall, high-strength pipe posts shall be externally chromated by total immersion followed by application of clear polyurethane finish.

Interior surfaces shall have a hot-dip galvanized coating, a zinc base coating with thickness 0.5 mil ± 0.2 mil (13 micrometer ± 5 micrometer). The coating shall be 94 percent zinc powder by weight (mass).

All tubular posts, rails and braces shall comply with the following salt spray performance requirements when tested in accordance with ASTM B117.

Exterior – 1250 hours to maximum 5 % red rust

Interior – 650 hours to maximum 5 % red rust

The uniformity of the zinc coating shall be determined by visual inspection. If, in the opinion of the Engineer or designated representative, visual examination is not conclusive, he may use the Preece Test as described in ASTM A239. When so tested, all items shall withstand a minimum of 6 one-minute dips except for those items designated in ASTM A153 as Class B-2, B-3, C and D, which shall withstand a minimum of 4 one-minute dips.

Careful visual inspection shall be made to determine the quality of the zinc coating. Excessive roughness, blisters, salammoniac spots, bruises and flaking if present to any considerable extent, shall provide a basis for rejection. Where practicable, all inspection and tests shall be made at the place of manufacturer prior to shipment and shall be so conducted as not to interfere unnecessarily with the progress of the work.

Damaged spelter coating shall be repaired by thoroughly wire brushing the damaged area and removing all loose, cracked or weld-burner spelter coating. The cleaned area shall be painted with 2 coats of zinc oxide-zinc dust paint conforming to the requirements of Federal Specification TT-P-641B. The paint shall be furnished at the Contractor's expense.

F. Concrete Post Anchorages

Concrete for post footings, catch blocks, anchors and other such items related to the fence construction, shall be Class B Concrete conforming to Item No. 403S, "Concrete for Structures" or as indicated on the Drawings. Maximum size of aggregate shall be 3/4 inch (19 mm). Hand mixing of concrete will be permitted on batches under 1/2 cubic yard (0.38 cubic meter). All batches exceeding this volume will be machine mixed.

Concrete shall be placed promptly and without segregation after mixing. The Contractor shall consolidate the concrete satisfactorily by tamping or vibrating. Excess excavation from footings shall be satisfactorily disposed of.

The tops of post footings shall extend slightly above ground and shall be steel troweled to a smooth finish sloped to drain away from posts. Posts, braces and other units shall be centered in footings.

G. Mowing Strip

When called out in the drawings, a mowing strip shall be Class A concrete. It shall be 24 inches (610 mm) wide and a minimum of 4 inches (100 mm) thick. Three (3) number (#3) bars shall be evenly spaced and supported along the full length of the mow strip, and a number 3 (#3) bar shall be cross-tied every 4 feet (1.2 m). Fence posts shall be installed in center of mow strip.

701S.4 Inspection and Sampling

The Contractor shall furnish, upon request of the Engineer or designated representative, samples of each component part of the fence including fittings. These samples shall be subjected to the galvanizing, weight and where required, strength tests. A sample may be taken for each project or for each shipment to a project, when requested by the Engineer or designated representative. All samples shall be furnished to the City free of charge.

If any specimen tested fails to meet the requirements of this specification, two (2) additional specimens shall be cut from the remainder of the sample and tested, both of which shall meet the requirements in every respect or the lot represented by the sample may be rejected.

701S.5 Construction Methods

The Chain Link Fence shall be erected to lines and grades established by the Engineer or designated representative in accordance with the details indicated on the Drawings. The fence shall be true to line, taut and shall comply with the best practice for fence construction of this type.

A. Clearing and Grading

The Contractor shall perform all clearing of brush, rocks and debris necessary for the installation of this fencing.

B. Erection of Posts

Posts shall be set plumb and permanently positioned and anchorages firmly set before fabric is placed. Posts shall be set in concrete, unless otherwise indicated on the Drawings.

Concrete footings shall be carried to the depth and dimensions indicated on the Drawings. Where rock is encountered within the required depth to which the post is to be erected, a hole of a diameter slightly larger than the largest dimension of the post may be drilled into the rock and the post grouted in. The regular dimensioned concrete footing as indicated on the Drawings shall then be placed between the top of the rock and required grade indicated on the Drawings. Posts shall be approximately centered in their footings. All concrete shall be placed promptly and compacted by tamping or other approved methods. Concrete shall be finished in a dome and shall be cured a minimum of 48 hours before further work is done on the posts.

Pull posts shall be placed not over 500 feet (15.25 meters) apart in straight runs and at each vertical angle point, all as directed by the Engineer or designated representative. Corner posts shall be placed at each horizontal angle point greater than 15 degrees. Corner and pull posts shall have horizontal braces and tie rods as specified above and as indicated or designated representative.

C. Erection of Top Rail and Tension Wire

The top rail and bottom tension wire and/or top and bottom tension wires shall be installed before installing the chain link fabric. The top rail shall be firmly attached in final position. Tension wires shall be within 4 inches (100 mm) of the top and bottom of the fabric and shall be pulled taut.

D. Erection of Fabric

After all posts have been permanently positioned and anchorages firmly set with the cables drawn taut with the turnbuckles, the fabric shall be placed by securing one end and applying sufficient tension to the other end to remove all slack before making attachments. Unless otherwise indicated on the Drawings, the fabric shall be cut and each span shall be attached independently at all corner posts and pull posts.

Fabric shall be fastened as indicated on the Drawings and the bottom of the fabric shall be placed a normal distance of 2 inches (50 mm) above the ground line; however, over irregular ground this distance may vary between 1 inch (25 mm) and 6 inches (150 mm) for a distance not to exceed 8 feet (2.44 meters). Any necessary backfilling required, in order to comply with these provisions, will be considered as incidental work.

E. Fence Grounding

This fence shall be grounded where a power line passes over the fence. In any case, a ground shall be provided at locations not to exceed 1,000 feet (30 meters) apart in straight runs of fence. Each individual section of fence shall have at least 1 ground. The ground shall consist of a copper-weld rod 8 feet (2.44 meters) long and a minimum of 5/8 inch (16 mm) in diameter driven or drilled in vertically until the top of the rod is approximately 6 inches (150 mm) below the top of the ground. A No. 6 solid copper conductor shall be brazed to the rod and to the fence in such a manner that each element of the fence is grounded.

F. Erection of Wood Fencing Material

After all posts have been permanently positioned and anchorages firmly set, stringers shall be placed and boards secured to the stringers. Other techniques utilizing modular precut panels may be used, when indicated on the Drawings.

701S.6 Measurement

Chain Link Fence, of each height specified, will be measured by the lineal foot of fence measured at the bottom of the fabric along the centerline of fence from center to center of terminal posts, excluding gates. Gates will be measured as each gate, complete in place.

701S.7 Payment

The work performed and material furnished as prescribed by this item, measured as provided under "Measurement" will be paid for at the unit bid price for "Chain Link Fence" of the height specified. The unit bid price shall include full compensation for furnishing and installing all fencing materials (except gates) including all miscellaneous fittings, braces, post caps, line wires, connection clips or wires; digging post holes and grouting in rock where required; furnishing and placing concrete for setting posts; furnishing and installing all electrical grounds; all hauling and handling charges; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work, including excavation, backfilling and disposal of surplus material.

Gates measured as provided under "Measurement" will be paid for at the unit bid price for "Pedestrian Gate" or "Vehicular Gate", of the type, height and opening specified. The unit bid price shall include full compensation for furnishing all materials; fabricating, preparation, hauling, handling charges and erecting, including all miscellaneous fittings, braces, latches, gate hinges, stops and center anchorage; and for all manipulations, labor, tools, equipment and incidentals necessary for complete installation.

Payment will be made under one of the following:

Pay Item No. 701*S* -AS: Chain Link Fence, - Per Lineal Foot
Pay Item No. 701*S* –B: Chain Link Pedestrian Single Swing Gate, ___Foot. x __Foot. Per Each
Pay Item No. 701S -BD: Chain Link Pedestrian Double Swing Gate, __Foot. x __Foot. Per Each
Pay Item No. 701S -CS: Chain Link Vehicular Single Swing Gate, ____Foot. x ___Foot. Per Each
Pay Item No. 701S -CD: Chain Link Vehicular Double Swing Gate, __Foot. x ___Foot. Per Each
Pay Item No. 701*S* -D: Wire Fence Per Lineal Foot
Pay Item No. 701*S* -E: Wood Fence Per Lineal Foot
Pay Item No. 701*S* -F: Wood Fence Pedestrian Gate, ___Foot. x __Foot. Per Each
Pay Item No. 701*S* -G: Wood Fence Vehicular Gate, ___Foot. x ___Foot. Per Each
Pay Item No. 701*S* -H: Security Fence, ___Foot, High Type ___ Per Lineal Foot
Pay Item No. 701*S* -T: Temporary Fence, ___Foot High, ____Type Per Lineal Foot
Pay Items No. 701S-MS: Mowing Strip Per Lineal Foot

End

SPECIFIC CROSS REFERENCE MATERIALS

City of Austin Standard Specifications

Designation	*Description*
Item No. 403S	Concrete for Structures

City of Austin Code of Ordinances, Volume I

Designation	*Description*
Section 10-1-9	Barbed Wire Fences

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

Designation	*Description*
Item No. 445	Galvanizing

American Society For Testing And Materials (ASTM)

Designation	*Description*
A 53/A 53M	Specification For Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A 116	Specification For Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
A 121	Specification For Zinc-Coated (Galvanized) Steel Barbed Wire
A 153/A 153M	Specification For Zinc-Coated (Hot-Dip) on Iron and Steel Hardware
A 239	Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron and Steel Articles
A 392	Specification For Zinc-Coated Steel Chain-Link Fence Fabric
A 491	Specification For Aluminum-Coated Steel Chain-Link Fence Fabric
A 585	Specification For Aluminum-Coated Steel Barbed Wire
B 117	Practice for Operating Salt Spray (Fog) Apparatus

Federal Specification TT-P-641B

RELATED CROSS REFERENCE MATERIALS

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

Designation	*Description*
Item No. 550	Chain Link Fence
Item No. 552	Wire Fence

Item No. 710S
Bicycle Racks

710S.1 Description

This item shall govern Class II and Class III bicycle racks and associated support medium as indicated on the Drawings.

A Class II bicycle rack shall be a rack where both wheels and the frame of a bicycle can be secured with one (1) user-supplied lock without the requirement for wheel removal. The design, type and capacity of a Class II bicycle rack shall be approved by the Engineer or designated representative

A Class III bicycle rack shall be a rack where both one wheel and the frame can be secured with a user supplied lock (see Standard Detail 710S-1, "Class III Style Bicycle Parking"). The Class III rack shall consist of either a single U/Hoop (Rack 1), multiple inverted U/Hoop (Rack 2), single post (Rack 3), or other Rack approved by the Engineer or designated representative.

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

710S.2 Submittals

The submittal requirements of this specification item include:

A. Class (i.e. II or III) Type and capacity of bicycle rack (i.e. number of bicycles served).

B. Fabrication and installation details, color and finish of the rack(s).

C. Support medium (i.e. existing slab, new pad, concrete filled excavation, etc.) and details of installation.

D. Complete manufacturer's warranty against defects for a period not less than one year from date of installation.

710S.3 Materials

A. Steel elements.

All steel shall be ASTM A-36 1010-1018 low carbon prime steel and the screws, nuts and bolts shall be tamper proof and plated with commercial zinc. The bicycle racks shall be hot dipped galvanized (ASTM A 123) unless the Drawings indicate that the rack assembly shall be provided in a specific color with a polyester-vinyl coated finish, a powder coated finish, or a polyvinyl thermoplastic finish.

B. Portland Cement Concrete

Portland cement concrete shall be Class A conforming to Specification Item No. 403S, "Concrete for Structures" or Specification Item No. 407S, "Fibrous Concrete".

C. Reinforcement

Reinforcement shall conform to Specification Item No. 406S, "Reinforcing Steel" or Specification Item No. 407, "Fibrous Concrete".

D. Expansion Joint Materials

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

E. Membrane Curing Compound

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

710S.4 Construction of Racks

A. Class II Bicycle Rack.

The Class II Rack shall consist of a locking system, which will secure both bicycle wheels and the frame with one (1) lock without the removal of either wheel.

B. Class III Bicycle Rack.

1. The Class III Rack Type 1 (Standard Detail 710S-1, sheet 1 of 3) shall consist of a one piece welded inverted U/Hoop assembly of Schedule 40 steel pipe with an minimum outside diameter (OD) of 1.5 inches (38 mm) on a minimum .25” (6.35 mm) thick base plate.

2. The Class III Rack Type 2 (Standard Detail 710S-1, sheet 2 of 3) shall consist of a single Schedule 40 steel pipe with an minimum outside diameter (OD) of 2 3/8 (60 mm) set in Portland cement concrete below the ground surface as indicated on the Drawings. The steel pipe shall be topped with a 7 1/2 inch (190 mm) polymer molded sphere that is secured with a hardened steel pin.

3. The Class III Rack Type 3 (Standard Detail 710S-1, sheet 3 of 3) shall consist of a one piece welded inverted U/Hoop assemble of Schedule 40 steel pipe with an minimum outside diameter (OD) of 2 3/8 inches (60 mm) supported with a minimum .25” (6.35 mm) thick circular base plate at one end of the rack and an in ground anchor mount on the other end.

4. The base plates can be round, square, or rectangular. If round, the diameter of the base plate must be at least 6” (150 mm) with a 4.5” (114 mm) bolt circle. If square, the base plate must be at least 4” by 4” (100 mm by 100 mm). If rectangular, the base plate must be 6” by 2” (150 mm by 50 mm). All base plates must be pre-drilled with two 3/8” (9.5 mm) diameter holes per plate for mounting. Each entire unit shall be hot dip galvanized after fabrication.

C. The bicycle racks shall be supported as indicated on the Drawings. The Class II racks and the Class III Rack Type 1 shall be supported on either existing or newly placed Portland cement concrete slabs. The Class III, Rack Types 2 and 3, can be placed on either existing or new slabs; however, these racks require additional underslab support of the steel pipe with p.c. concrete encasement as indicated in Standard Detail 710S-1 (sheets 2 and 3).

The construction of the new slabs shall be completed in accordance with Standard Specification Item Number 432S, “Concrete Sidewalks”. Unless noted otherwise on the Drawings, the slab shall be 4 inches (100 mm) in thickness.

710S.5 Installation of Bicycle Racks

Bicycle parking racks shall be installed in existing paver sidewalks, new paver sidewalks and concrete sidewalks in accordance with Standard Details 710S-3, 710S-4 and 710S-5, respectively.

710S.6 Measurement

Bicycle Parking Racks shall be measured per each, complete and in place and any new p.c. concrete slab will be measured by the square foot (square meter: 1 square meter is equal to 10.764 square feet) of surface area of "Bicycle Parking Concrete Pad".

710S.7 Payment

The installation of Bicycle Parking Racks, as described by this Specification Item, will be paid for at the unit bid price per each. The construction of a p.c. concrete bicycle-parking pad will be paid for at the unit bid price per square foot for "Concrete Bicycle Parking Pad".

The unit bid prices shall include full compensation for the specified equipment items; the excavation, removal and disposal of existing sidewalk, location, placement and installation of parking racks; all materials, including all steel pipe and plate, screws, nuts and bolts, reinforcing steel and concrete; placing and finishing the concrete pad, and all labor, tools, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 710S-A:	Class II Bicycle Rack	Per Each.
Pay Item No. 710S-B:	Class III, Type 1 Bicycle Rack	Per Each.
Pay Item No. 710S-C:	Class III, Type 2 Bicycle Rack	Per Each.
Pay Item No. 710S-D:	Class III, Type 3 Bicycle Rack	Per Each.
Pay Item No. 710S-E:	Class III, Other Type Bicycle Rack	Per Each.
Pay Item No. 710S-F:	4 inch Concrete Bicycle Parking Pad	Per Square Foot.

End

SPECIFIC CROSS REFERENCE MATERIALS
Standard Specification Item Number 710S, “Bicycle Racks”

City of Austin Standard Specifications

Designation	Description
Item No. 403S	Concrete for Structures
Item No. 406*S*	Reinforcing Steel
Item No. 407S	Fibrous Concrete
Item No. 408	Expansion Joint Materials
Item No. 409	Membrane Curing

Item No. 410	Concrete Structures
Item No. 432S	Concrete Sidewalks

SPECIFIC CROSS REFERENCE MATERIALS - Continued
Standard Specification Item Number 710S, "Bicycle Racks"

City of Austin Standard Details

Designation	Description
710S-1	Class III Style Bicycle Parking
710S-2	Class II Style Bicycle Parking
710S-3	Bicycle Rack Installation in Concrete Paver Sidewalk – Alternate 1
710S-4	Bicycle Rack Installation in Concrete Sidewalk – Alternate 1
710S-5	Bicycle Rack Installation in Sidewalk – Alternate 2

American Society for Testing and Materials (ASTM)

Designation	Description
ASTM A 36	Specification for Structural Steel
ASTM A 123	Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products

RELATED CROSS REFERENCE MATERIALS

City of Austin Standard Contract Documents

Designation	Description
00700	General Conditions
01500	Temporary Facilities
01550	Public Safety and Convenience

City of Austin Standard Specifications

Designation	Description
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Concrete
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 132S	Embankment
Item No. 201S	Subgrade Preparation
Item No. 405	Concrete Admixtures
Item No. 406	Reinforced Steel Tolerances
Item No. 411	Surface Finishes for Concrete
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 642S	Silt Fence

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

Designation	Description
Item 420	Concrete Structures
Item 421	Hydraulic Cement Concrete
Item 427	Surface Finishes for Concrete
Item 437	Concrete Admixtures
Item 440	Reinforcing Steel

American Society for Testing and Materials (ASTM)

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

Item No. **860S**
Pavement Marking Paint

860S.1 Description

This item shall govern the installation of reflectorized paint pavement marking. The width of the line shall be 4 inches (100 millimeters) and the color as indicated on the Drawings.

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

860S.2 Submittals

The submittal requirements of this specification item include:

A. Proposed paint color(s), brand names, raw materials and products for traffic paint.

B. Sampling and testing procedures and specific test results for pigment, calcium carbonate, acrylic resins and other materials used in the traffic paints.

C. Proposed shipping requirements including container type(s) (drums and/or buckets), and labeling.

D. Manufacturer's recommendations for mixing, storage and application of the traffic glass beads and traffic paint.

E. All applicable Materials Safety data Sheets for the traffic paint.

860S.3 Materials

A. Traffic Stripe Reflective Glass Traffic Beads

1. The glass spheres shall not contain more than 30 percent (by weight {mass}) irregular shaped particles when tested in accordance with TxDoT Test Method-832-B. The no. 20 (850 μm) sieve shall have a maximum of 35% by weight (mass) allowed irregular particles, based on a visual inspection.

   Unless noted otherwise on the Drawings or designated in writing by the Engineer or designated representative, the application rate of the glass traffic beads shall not be less than 6 pounds per gallon (0.7 kilograms per liter). Glass traffic beads shall be essentially free of sharp angular particles and particles showing milkiness or surface scarring or scratching. Glass traffic beads shall be water white in color.

2. The glass traffic beads shall meet the following graduation requirements when tested in accordance with TxDoT Test Method Tex-831-B:

US Sieve	SI Sieve	% weight (mass) retained
# 20	(850 μm)	3 to 10
# 30	(600 μm)	20 to 40
# 40	(425 μm)	30 to 50
# 50	(300 μm)	15 to 35
# 80	(180 μm)	0 to 10

3. Index of Refraction: The glass traffic beads, when tested by the liquid immersion method at 77^0F (25^0C), shall show an index of refraction within the range of 1.50 to 1.53.

4. Wetting: The glass traffic beads shall be capable of being readily wet with water, when tested according to TxDOT Test Method Tex-826-B.

5. Stability: The glass traffic beads shall show no tendency toward decomposition, surface etching, change in retroreflective characteristics or change in color after

   (a) One-hour exposure to concentrated hydrochloric acid at 77°F (25°C),

   (b) 24 hours exposure to weak acids, weak alkali, and

   (c) 100 hours of weather-o-meter (Atlas, Sunshine Type) exposure, ASTM G-23, Method 1, Type EH.

6. Contaminants: Glass traffic beads shall:

   (a) contain less than 1/4 of 1 percent moisture by weight (mass).

   (b) free of trash, dirt, etc.

   (c) show no evidence of objectionable static electricity when flowing through a regular traffic bead dispenser.

7. Sampling and Testing (TxDoT Test Method Tex-801-B) shall be in accordance with the latest applicable procedures included in the TxDOT Manual on Testing. Applicable test methods include but are not limited to the following:

   Tex 806-B, "Method for Determining Grind and Oversize Pigment Particles"
   Tex-810-B, "Test Method for Color and Color Stability of Opaque Colored Pigments"
   Tex-811-B, "Skinning Characteristics of Coatings"
   Tex-822-B, "Method for Determining Refractive Index of Glass Beads"
   Tex-826-B, "Water Absorption Test of Beads"
   Tex-828-B, "Determining Functional Characteristics of Pavement Markings"
   Tex-830-B, "Method for Sampling Traffic Stripe Beads"
   Tex-831-B, "Method for Determining The Gradation of Glass Traffic-Stripe Beads"
   Tex-832-B, "Methods for Determining the Roundness of Glass Spheres"

B. Pavement Marking Paint

1. Functional Requirements

   (a) All paint-type materials that are applied at ambient or slightly elevated temperatures shall conform to TxDoT Departmental Materials Specifications DMS-8200, YPT 10 and/or WPT-10 and DMS-8290.

   (b) The paint shall be homogenous, well ground to a uniform and smooth consistency and shall not skin nor settle badly nor cake, liver, thicken, curdle or gel in the container.

   (c) The paint, when applied to a bituminous pavement surface under normal field conditions at the required rate of .015 inch (0.4 mm) wet film thickness, shall have a maximum "no pickup" drying time of 15 minutes to prevent displacement or discoloration under traffic.

   (d) In preparation of the paint, the pigments shall be dispersed in the vehicle by appropriate methods so that a fineness reading of not less than 4 is obtained with a Hegman grind gauge.

(e) Consistency viscosity, measured with a Krebs-Modified-Stormer Viscometer at 77°F (25°C), shall be from 80-90 K.U (with water deleted).

(f) A thin film of paint spread on a glass plate and allowed to dry thoroughly shall not darken or show any discoloration when subjected to ultraviolet rays for a period of 5 minutes.

2. Material Requirements

(a) Raw Materials

(1) The exact brands and types of raw materials used in the wet standards are listed for the purpose of facilitating the selection of parallel materials that are equal, not only in quality and composition but also in physical and chemical behavior after aging in the finished product.

(2) After proposed brand names and types of raw materials by the City of Austin, no substitution will be allowed during the manufacture without prior agreement with the City.

(3) It shall be the responsibility of the Contractor to utilize materials that not only meet the individual raw material specification, but that also produce a coating that meets the specific formula requirements.

(4) All materials required to meet TxDoT, Federal and ASTM specifications must meet the latest specification as indicated on the Drawings in effect on the date of the proposal or invitation to bid.

(b) Pigments

(1) Titanium Dioxide:

Titanium Dioxide shall meet ASTM D-476, Type II requirements.

(2) Yellow Pigment:

Yellow Pigment CI 65 (Reddish Yellow)	
Characteristic	Values
Specific Gravity	1.74 to 1.76
Oil Absorption	20 to 30 %
Moisture	0.5 % maximum
Pigment retained on #325 (45 μm) sieve	0.1 % maximum
C.I. Number	11740
Heat Stability	266°F (130°C)

In addition to the requirements identified above, evidence shall be provided that the infrared spectrum matches the standard spectrum on file with TxDoT's Construction Division, Materials Section (CSTM)

(3) Calcium Carbonate: Calcium Carbonate shall conform to ASTM D-1199, Type GC, Grade I, with a minimum of 95% $CaCO_3$ and Type PC, with a minimum of 98% $CaCO_3$.

(c) Acrylic Traffic Resins: The acrylic traffic resin shall be similar and equal to the standard sample submitted by the manufacturer. The resin shall be approved prior to the contract award for the proposed use of the pavement paint.

Acrylic Traffic Emulsion

Characteristic	Values
Solids Content	49.5 to 50.5
Viscosity, #2 Spindle, 60 rpm, 77°F (25°C), cps	250 maximum
pH	10.0 to 10.6
Film appearance, 3 mil (75 μm) dry	Smooth, clear, continuous

In addition to the requirements identified above, evidence shall be provided that the infrared spectrum matches the standard spectrum on file with TxDot's Construction Division, Materials Section (CSTM)

(d) Miscellaneous Materials: These materials shall be similar and equal to the standard sample submitted by the vendor. The specific materials shall be approved prior to the contract award for the proposed use of the pavement paint.

1) Dispersant
   Byk 156
   Tamol 850
   Colloids 226/35
2) Surfactant
   Triton X-405
   Colloids CA-407
3) Defoamer
   Foamaster 111
   Drew 493
   Colloids 654
4) Hydroxy Ethyl Cellulose
   Natrosol 250 HBR
   Bermocoll E431FQ
   Cellosize QP - 30,000
5) Coalescent
   Texanol
   Exxate 1200
6) Preservative
   Troysan
   Dowicil 75
   Nuosept 101
7) Methyl Alcohol
   ASTM D-1152, 1.3320 maximum

(e) Standard Formulae:

The following tables represent the Standard Formulae to be followed by the manufacturer when manufacturing paint to be used by the Contractor on City of Austin paint striping contracts.

Formula: White Traffic Paint

WPT-11 - LEAD FREE WHITE TRAFFIC PAINT		
Component	Pounds	Kilograms
Acrylic Emulsion, 50% Solids, Fastrack 2706	540.	245.
Coalescent, Texanol	20.	9.1
Titanium Dioxide, Rutile, Type II, Tiona RCL-9	100.	45.4
Calcium Carbonate, Type PC, Mississippi M-60	150.	68.
Calcium Carbonate, Type GC, Hubercarb M-4	440.	199.6
Hydroxy Ethyl Cellulose, Natrosol 250 HBR (*)	0.5	0.2
Defoamer, Foamaster 111	5.	2.3
Disapersant, Colloids 226/35	9.	4.1
Surfactant, Triton X-405	2.	0.9
Methyl Alcohol	30.	13.6
Preservative, Troysan 192	2.	0.9
Water, Potable (**)	18.**	8.1**
TOTALS	1316.5	597.2

(*) The Hydroxy Ethyl Cellulose amount may be varied up to two (2) pounds [0.9 kilograms].

(**) Only 10 pounds (4.5 kilograms) shall be used in the actual manufacture of the pavement paint. The remaining 8 pounds (3.6 kilograms) shall be used as a drum float.

Formula: Yellow Traffic Paint

YPT-11 - LEAD FREE YELLOW TRAFFIC PAINT		
Component	Pounds	Kilograms
Acrylic Emulsion, 50% Solids, Fastrack 2706	540	245.
Coalescent, Texanol	20	9.1
C.I. Pigment Yellow 65, Sunglow Yellow 1244	30.	13.6
Titanium Dioxide, Rutile, Type II, Tiona RCL-9(***)	20.	9.1
Calcium Carbonate, Type PC, Mississippi M-60	150	68.
Calcium Carbonate, Type GC, Hubercarb M-4	450	204.1
Hydroxy Ethyl Cellulose, Natrosol 250 HBR (*)	0.5	0.2
Defoamer, Foamaster 111	5.	2.3
Dispersant, Colloids 226/35	9.	4.1
Surfactant, Triton X-405	2.	0.9
Methyl Alcohol	30.	13.6
Preservative, Troysan 192	2.	0.9
Water, Potable (**)	18.**	8.1**
TOTALS	1276.5	579.0

Additional Criteria for Pavement Paint

Item	Requirements
Grind Particles:	4 minimum, 8 maximum (TxDoT Test Method Tex-806-B)
Gallon Weight:	± 0.10 lbs. of theoretical gallon weight

(Liter mass:)	(± 0.012 kilograms of theoretical liter mass)
Consistency:	80 to 90 K.U.
PH:	a minimum of 9.6
Skinning:	No skinning within 48 hours (TxDoT Test Method Tex-811-B)

(*) The Hydroxy Ethyl Cellulose amount may be varied up to two (2) pounds [0.9 kilograms]

(**) Only 10 pounds (4.5 kilograms) shall be used in the actual manufacture of the pavement paint. The remaining 8 pounds (3.6 kilograms) shall be used as a drum float.

(***) Titanium Dioxide, Rutile, Special, Hilox will be allowed as a substitute in the YPT-11 formula only.

(f) Container and Marking

1) Shipment: Shipment shall be made in suitable, strong, well-sealed containers that meet this specification, State of Texas, and federal requirements and are sufficiently sturdy to withstand normal shipping and handling.

2) Drum Package Requirements. The paint shall be provided in a new, serviceable, non-leaking, 55 gallon (209 liter) lined, steel drum meeting all applicable federal regulations. Drums are to be non-returnable with full removable heads, three (3) rolling hoops and 12 gauge locking rings with 5/8 inch (15.9 millimeter) locking nut bolt. The nominal metal thickness is to be 0.044 inch (1.1 mm). Each drum is to be equipped with a natural sponge-rubber cord, high-density gasket. The rubber shall be approximately 0.4375 inch (10.9 mm) thick. The gasket, when compressed, shall produce an airtight closure when the drum is sealed.

   When a locking nut is used on drum rings, the locking nut shall be in a non-locking position while tightening the ring. After the ring is tight, the locking nut shall be secured in the locking position.

   A seal shall be affixed to each drum in a manner that the contents of the drum cannot be adulterated without destroying the seal.

3) Bucket Packaging Requirements: Paint is to be furnished in new 5 gallon (19 liter) lined, 24 gauge steel, non-leaking buckets.

4) Filling Instructions: The paint drums will be filled at 54.5 gallons (206.4 liters) by weight (mass) with a water float of 0.53 gallons (2.0 liters).

   The paint buckets will be filled at 4.95 gallons (18.75 liters) by weight (mass) with a water float of 0.05 gallons (0.18 liters).

5) Labeling: Finished paint product containers and cases shall be plainly and securely labeled with:
   a) City of Austin
   b) Name and designation of the product,
   c) Requisition number,
   d) Batch number,
   e) Manufacturing date,
   f) Gross weight, and
   g) Manufacturer's name.

   Labeling shall be prominently displayed on the sides of containers and cases and must be moisture resistant to withstand outdoor storage for a minimum of one year. When the finished product is palletized for

shipment, the labels shall be displayed on the outside fore easy identification. Once the finished product has been labeled properly, the label shall not be modified or changed in any manner without specific approval from the City of Austin. (Note: The material manufacturer shall supply a Materials Safety Data Sheet to comply with OSHA's "Hazard Communication Standard 29 CFR ξ 1910.1200").

860S.4 Construction Methods

The Contractor shall use a crew, that is experienced in the work of installing pavement markings and in the necessary traffic control for such operations on the roadway surface, and shall supply all the equipment, personnel, traffic control and materials necessary for the placement of the pavement markings as indicated on the Drawings or directed by the Engineer or designated representative. All work shall conform to the current edition of the Texas Manual of Uniform Traffic Control Devices (TMUTCD), The City of Austin Transportation Criteria Manual, Standard Details 804S-3C and 804S-3D, and this standard specification item.

The pavement surface to receive the pavement markings shall be thoroughly cleaned of all dirt, organic growth or other material that will prevent adhesion of the paint to the roadway surface.

The pavement markings shall be placed in the proper alignment with guides established on the roadway. Deviation from the alignment established shall not exceed 2 inches (50 millimeters) and in addition, the deviation in alignment of the markings being placed shall not exceed 1 inch per 200 feet (25 millimeters per 30 meters) of roadway nor shall any deviation be abrupt.

When deemed necessary by the Engineer or designated representative, the Contractor, at the Contractor's expense, shall place any additional pilot markings required to facilitate the placement of the permanent markings in the alignment specified. Any and all additional markings placed on the roadway for alignment purposes shall be temporary in nature and shall not establish a permanent marking on the roadway.

Materials used for pilot markings and equipment used to place such markings shall be approved by the Engineer or designated representative.

Paint markings on the roadway that are not in alignment or sequence as indicated shall be totally and completely removed by any effective method approved by the Engineer or designated representative, except that grinding will not be permitted.

Paint shall be applied at a rate of not less than 15 gallons nor more than 20 gallons per mile of solid 4 inch stripe (not less than 35 liters nor more than 45 liters per kilometer of solid 100-mm stripe). Application rate for solid 8-inch (200-mm) stripe shall be between 30 and 40 gallons per mile (between 70 and 90 liters per kilometer). (These rates yield wet film thickness from 15 to 20 mils [0.4 to 0.5 mm].)

Beads shall be applied to the paint markings at a uniform rate sufficient to achieve the retroreflective characteristics specified when observed conforming to TxDoT Test Method Tex-828-B. All markings placed shall have uniform and distinctive retroreflective characteristics.

Applied markings shall be protected from traffic until they have dried sufficiently so as not to be damaged or tracked by normal traffic movements.

860S.5 Equipment

Paint striping equipment used to place 4 inch (100 mm) solid or broken lines shall have the capability of placing a minimum of 60,000 linear feet (18 300 lineal meters) of marking per working day. Equipment used for placing markings in widths other than 4 inches (100 mm) shall have capabilities similar to 4 inch (100 mm) marking equipment and shall be capable of placing linear markings up to 8 inches (200 mm) in width in 1 pass.

The equipment shall be maintained in satisfactory operating condition. The equipment shall be equipped so that one 4-inch (100-mm) broken line and either 1 or 2 solid lines can be placed at the same time in alignment and spacing as indicated on the drawings. Four inch (100 mm) marking equipment will be considered as unsatisfactorily maintained if it fails to attain an average hourly placement rate of 7000 linear feet (2 100 linear meters) in any 5 consecutive working days of 7 hours or more.

The equipment shall be equipped with an automatic cutoff device (with manual operating capabilities) to provide clean, square marking ends and to provide a method of applying broken line in a stripe to gap ratio of 15 to 25. The length of the stripe shall not be less than 15 feet nor longer than 15.5 feet (less than 4.5 meters nor longer than 4.7 meters). The total length of the stripe-gap cycle shall not be less than 39.5 feet nor longer than 40.5 feet (less than 12 meters nor longer than 12.3 meters) in variance from one cycle to the next nor shall the average total length of a cycle for a road mile (1.6 kilometer) of broken line exceed 40.5 feet or be less than 39.5 feet (exceed 12.3 meters or be less than 12 meters).

The equipment shall be capable of placing lines of all widths with clean edges and of uniform cross section. Four-inch (100-mm) lines shall be 4 inches (100 mm) plus or minus 1/8 inch (3 mm). Eight inch (200 mm) lines shall be 8 inches (200 mm) minimum and 8 1/4 inches (210 mm) maximum in width.

The equipment shall be equipped with an outrigger or outriggers as required to place edge-lines as called for in the plans.

The equipment shall be equipped with traffic glass bead dispensers, 1 for each paint spray gun, placed on the equipment so that beads are applied to the paint almost instantly as the marking is being placed on the roadway surface. The traffic glass bead dispensers shall be designed and aligned so that the beads are applied uniformly to the entire surface of the marking. The traffic glass bead dispensers shall be equipped with automatic cutoff controls, synchronized with the cutoff of the marking equipment. Paint pots or tanks shall be equipped with an agitator that will keep the paint thoroughly mixed and may be either a pressurized or non-pressurized type.

860S.6 Measurement

Work for Pavement Marking Paint lines will be measured by the lineal foot (lineal meter: 1 meter equals 3.28 feet) of the various widths. Work for pavement marking, paint letter or figures will be measured by the square foot (square meter: 1 square meter equals 10.76 square feet).

860S.7 Payment

Work performed as prescribed by this item, measured as provided under "Measurement", shall be paid for at the unit bid price for "Pavement Marking Paint" per lineal foot or square foot of the various widths specified. This price shall include full compensation for furnishing

all labor, tools, equipment, materials and incidentals necessary to complete the work specified.

Payment will be made under one of the following:

Pay Item No. 860S-A:	Pavement Marking Paint, ____ In.	Per Lineal Foot.
Pay Item No. 860S-B:	Pavement Marking Paint	Per Square Foot.
Pay Item No. 860S-C:	Pavement Marking Paint (Reflectorized), __In.	Per Lineal Foot.
Pay Item No. 860S-D:	Pavement Marking Paint (Reflectorized)	Per Square Foot.

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item 860S "Pavement Marking Paint (Reflectorized)"

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex 801-B	Testing Coatings and Related Materials
Tex 806-B	Method for Determining Grind and Oversize Pigment Particles
Tex-810-B	Test Method for Color and Color Stability of Opaque Colored Pigments
Tex-811-B	Skinning Characteristics of Coatings
Tex-822-B	Method for Determining Refractive Index of Glass Beads
Tex-826-B	Water Absorption Test of Beads
Tex-828-B	Determining Functional Characteristics of Pavement Markings
Tex-830-B	Method for Sampling Traffic Stripe Beads
Tex-831-B	Method for Determining The Gradation of Glass Traffic-Stripe Beads
Tex-832-B	Methods for Determining the Roundness of Glass Spheres

Texas Department of Transportation: Departmental Materials Specifications

Designation	Description
DMS-8200	Pavement Paint
YPT-11 and/or WPT-11	Pavement Paint

American Society for Testing and Materials (ASTM)

Designation	Description
D 476	Specification for Titanium Dioxide Pigments
D 1152	Specification for Methanol (Methyl Alcohol) with Refractive Index
D 1199	Specification for Calcium Carbonate Pigments
G-23	Recommended Practice for Operating Light-and- Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Nonmetallic Materials

Federal Specifications - OSHA 29 CFR

Designation	Description
ξ 1910.1200	Hazard Communication Standard."

City of Austin Standard Details

Designation	Description
804S-3C	Parking Stalls, Crosswalk, and Stop Bars
804S-3D	General Notes

City of Austin Transportation Criteria Manual

Designation	Description
Section 8	Traffic Control

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item 860S "Pavement Marking Paint (Reflectorized)"

State of Texas Manual on Uniform Traffic Control Devices for Streets and Highways

Designation	Description
Part III	Markings
Part VI	Traffic Controls for Street and Highway Construction, Maintenance,

	Utility and Incident Management Operations
Part VI, Article D	Markings
Part VI, Article F	Control of Traffic Through Work Areas

RELATED CROSS REFERENCE MATERIALS
Specification Item 860S "Pavement Marking Paint (Reflectorized)"

City of Austin Standard Specifications

Designation	Description
Item No. 863S	Reflectorized Pavement Markers
Item No. 864S	Abbreviated Pavement Markings
Item No. 865S	Non-Reflectorized Traffic Buttons
Item No. 866S	Jiggle Bar Tile
Item No. 867S	Epoxy Adhesive
Item No. 870S	Work Zone Pavement Markings
Item No. 871S	Reflectorized Pavement Markings
Item No. 872S	Prefabricated Pavement Markings
Item No. 873S	Raised Pavement Markers
Item No. 874S	Eliminating Existing Pavement Markings and Markers
Item No. 875S	Pavement Surface Preparation For Markings

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

Designation	Description
Item No. 662	Work Zone Pavement Markings
Item No. 666	Reflectorized Pavement Markings
Item No. 667	Prefabricated Pavement Markings
Item No. 672	Raised Pavement Markers
Item No. 677	Eliminating Existing Pavement Markings and Markers
Item No. 678	Pavement Surface Preparation For Markings

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex-829-B	Method For Measuring Pavement Temperature

American Society for Testing and Materials (ASTM)

Designation	Description
D-235	Specification for Mineral Spirits
D-362	Specification for Industrial Grade Toluene
D-600	Specification for Liquid Paint Driers
D-605	Specification for Magnesium Silicate Pigment (Talc)
D-740	Specification for Methyl Ethyl Ketone
D-1210	Test Method For Fineness Of Dispersion Of Pigment-Vehicle Systems

Item No. 874S
Eliminating Existing Pavement Markings and Markers

874S.1 Description

This item shall govern the elimination of existing pavement markings of various types and sizes, and pavement markers as shown on the Drawings or as directed, in writing, by the Engineer or designated representative.

874S.2 Materials

All surface treatment material application rates shall be as directed by the Engineer or designated representative. Unless otherwise shown on the Drawings, surface treatment materials shall conform to the requirements of Specification Item 301S, “Asphalts, Oils and Emulsions”, and Specification Item 302S, “Aggregates for Surface Treatment”. Testing of surface treatment materials may be waived by the Engineer or designated representative. Asphalt and aggregate types and grades shall be as shown on the Drawings or as approved by the Engineer or designated representative.

874S.3 Construction Methods

Elimination of existing pavement markings and markers shall be accomplished by one or more of the following methods as approved by the Engineer or designated representative.

A. Markings on Asphaltic Surfaces.

1. Placement of a surface treatment a minimum of two (2) feet {600 mm} wide to cover the existing marking.
2. Placement of a surface treatment, thin overlay or microsurfacing a minimum of one (1) lane in width in areas where directional changes of traffic are involved or other areas as directed by the Engineer or designated representative. Construction methods for surface treatments shall conform to Specification Item 320S, "Two Course Surface Treatment”.

B. Markings on Concrete Surfaces.

Removal by an approved burning method.

C. Markings on Asphaltic or Concrete Surfaces.

Removal by water, water-sand blasting techniques or any other method(s) proven satisfactory to the Engineer.

D. Markers on Asphaltic or Concrete Surfaces.

Removal by any mechanical method to remove marker and adhesive.

Existing pavement markings and markers on both concrete and asphaltic surfaces shall be removed in such a manner that color and/or texture contrast of the pavement surface will be held to a minimum.

Removal of pavement markings on concrete surfaces by blast cleaning shall be accomplished in accordance with Specification Item 875S, "Pavement Surface Preparation for Markings", except for measurement and payment. Blast cleaning shall be performed in such a manner that damage to the Portland cement concrete surface is held to a minimum.

When thermoplastic pavement markings or prefabricated pavement markings are encountered, the application of heat may be used to remove the bulk of the marking material prior to blast cleaning. When heat is used, care shall be taken to prevent spalling of Portland cement concrete surfaces.

A burner may be used for complete removal of pavement markings. Broom removal or light blast cleaning may be used for removal of minor residue.

Damage to asphaltic surfaces, such as spalling, shelling, etc., that is greater than ¼ inch (6 mm) in depth and is caused by the removal of pavement markers shall be repaired by the application of a two (2) foot (600 mm) wide surface treatment for longitudinal markers with no directional change or a minimum of one (1) lane width surface treatment in areas where directional changes of traffic are involved.

Grinding is not an acceptable method of marker or marking removal. However, equipment utilizing special milling flails is considered acceptable in the removal of markings and markers on asphalt and Portland cement concrete surfaces.

874S.4 Measurement

This Specification Item will be measured by the square yard (square meter: 1 square meter is equal to 1.196 square yards) of surface treatment, thin overlay or microsurfacing (full lane width) placed; by each word, symbol or shape eliminated; by the lineal foot (lineal meter: 1 lineal meter is equal to 3.281 lineal feet) of markings eliminated; or by any other unit as shown on the Drawings.

Payment for revised quantities will be paid for at the unit price bid for that bid item.

The elimination of pavement markers required in conjunction with the elimination of longitudinal markings will not be measured for payment.

874S.5 Payment

The work performed and materials furnished in accordance with this Specification Item and measured as provided under "Measurement" will be paid for at the unit bid price for "Eliminating Existing Pavement Markings and Markers" of the various types specified. This price shall include full compensation for blast cleaning, mechanical cleaning and/or other cleaning methods; for all materials, tools, equipment and incidentals necessary to complete the Work, except as specified below.

Elimination of pavement markers when pavement markers are to be removed in conjunction with the elimination of longitudinal markings shall be included in the unit price bid for the item of construction indicated on the drawings.

Payment will be made under one or more of the following:

Pay Item 874S-A: Eliminating Existing Pavement Markings:
__inches in width, per lineal foot

Pay Item 874S-B: Eliminating Existing Work Zone Pavement Markings:
__inches in width, per lineal foot

Pay Item 874S- C: Eliminating Existing Reflectorized Thermoplastic Pavement Markings: **Words** ___inches in width per each

Pay Item 874S- D: Eliminating Existing Reflectorized Thermoplastic Pavement Markings: **Shapes** ___inches in width per each

Pay Item 874S- E: Eliminating Existing Reflectorized Thermoplastic Pavement Markings: **Symbols** ___inches in width per each

Pay Item 874S- F: Eliminating Existing Raised Pavement Markings,
____ Type' . per each

END

SPECIFIC CROSS REFERENCE MATERIALS
Specification Item No. 874S, "Eliminating Existing Pavement Markings And Markers"

City of Austin Contract Documents

Designation	Description
Section 00300U	Bid Form (Unit Prices)

City of Austin Standard Specifications

Designation	Description
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 302S	Aggregates for Surface Treatments
Item No. 320S	Two Course Surface Treatment
Item No. 875S	Pavement Surface Preparation For Markings

RELATED CROSS REFERENCE MATERIALS
Specification Item No. 874S, "Eliminating Existing Pavement Markings And Markers"

City of Austin Standard Specifications

Designation	Description
Item No. 310S	Emulsified Asphalt Treatment
Item No. 311S	Emulsified Asphalt Repaving
Item No. 312S	Seal Coat
Item No. 313S	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)
Item No. 315S	Milling Asphaltic Concrete Paving
Item No. 340S	Hot Mix Asphaltic Concrete Pavement
Item No. 341S	Paving Fabric
Item No. 350S	Heating, Scarifying and Repaving
Item No. 360	Concrete Pavement

Item No. 413S Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)
Item No. 801S Construction Detours
Item No. 803S Barricades, Signs and Traffic Handling
Item No. 860S Pavement Marking Paint (Reflectorized)
Item No. 863S Reflectorized Pavement Markers
Item No. 864S Abbreviated Pavement Markings
Item No. 865S Non-Reflectorized Traffic Buttons
Item No. 866S Jiggle Bar Tile
Item No. 867S Epoxy Adhesive
Item No. 870S Work Zone Pavement Markings
Item No. 871S Reflectorized Pavement Markers
Item No. 872S Prefabricated Pavement Markings
Item No. 873S Raised Pavement Markings

City of Austin Standard Details

Designation	Description
863S-1	Pavement Buttons (Reflectorized-Type I & Type II)
865S-1	Traffic Buttons (Non-Reflectorized)

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

Designation	Description
Item No. 302	Aggregates for Surface Treatments
Item No. 314	Emulsified Asphalt Treatment
Item No. 315	Emulsified Asphalt Seal
Item No. 316	Surface Treatments
Item No. 334	Hot Mix-Cold Laid Asphaltic Concrete Pavement
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 342	Plant Mix Seal
Item No. 351	Repairing Existing Flexible Pavement Structure
Item No. 354	Planing and/or Texturing Pavement
Item No. 358	Asphaltic Concrete Surface Rehabilitation
Item No. 360	Concrete Pavement
Item No. 421	Hydraulic Cement Concrete
Item No. 427	Surface Finishes for Concrete
Item No. 428	Concrete Surface Treatment
Item No. 662	Work Zone Pavement Markings
Item No. 666	Reflectorized Pavement Markings
Item No. 667	Prefabricated Pavement Markings
Item No. 672	Raised Pavement Markers
Item No. 677	Eliminating Existing Pavement Markings and Markers
Item No. 678	Pavement Surface Preparation For Markings

RELATED CROSS REFERENCE MATERIALS - Continued
Specification Item No. 874S, “Eliminating Existing Pavement Markings And Markers”

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex 729-I	Sampling of Traffic Markers
Tex-828-B	Determining Functional Characteristics of Pavement Markings
Tex-829-B	Method For Measuring Pavement Temperature
Tex-854-B	Evaluation Of Thermoplastic Striping For Uniformity And Thickness

Texas Department of Transportation: Departmental Materials Specification

Designation	Description
DMS-4100	Jiggle Bar Tile
DMS-4200	Pavement Markers (Reflectorized)
DMS-4300	Traffic Buttons
DMS-4210	Pavement Markers
DMS-6130	Bituminous Adhesive
DMS-8200	Pavement Paint
DMS-8220	Thermoplastic marking material
DMS-8240	Prefabricated Marking Materials
DMS-8241	Removable Tape
DMS-8290	Pavement Paint
YPT-10 and/or WPT-10	Pavement Paint

Item No. 875S
Pavement Surface Preparation For Markings

875S.1 Description

This item shall govern the surface preparation of pavement surface areas prior to placement of pavement markings or raised pavement markers.

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

875S.2 Materials

Abrasive blasting medium, when used, shall be a quality commercial product capable of producing the specified surface cleanliness without the deposition of deleterious materials on the cleaned surface. Water used in blasting operations shall be potable.

875S.3 Equipment

Equipment shall be maintained in good condition. Air compression equipment shall utilize moisture and oil traps, in working order, of sufficient capacity to remove contaminants from blasting air and prevent the deposition of moisture, oil or other contaminants on the street surface.

875S.4 Construction Methods

Widths, lengths and shapes of the prepared surfaces shall be of sufficient size to include the full area of pavement markings or raised pavement markers shown on the Drawings.

Surface preparation of Portland cement concrete surfaces shall be sufficient to remove contaminants. Damage to the street due to over-blasting shall be held to a minimum. Asphaltic surfaces shall be cleaned by brushing, washing, compressed air, high pressure water or any combination thereof to remove all forms of contamination and loose materials. All other surfaces to be cleaned by blast cleaning shall be cleaned sufficiently to remove loose and flaking materials from the street surface.

When existing markings are encountered, they shall be cleaned sufficiently to remove all loose and flaking materials. Small spots of old markings or contaminants of up to 0.5 square inch (320 mm^2) in area may remain if the contaminant is not removed by the following test:

Firmly press a 10 inch (250 mm) long, two-inch (50 mm) wide strip of monofilament tape onto the surface to be tested, leaving approximately 2 inches {50 mm} free. Grasp the free end and remove the tape with a sharp pull.

Blasting pressure and technique shall be controlled to prevent damage to the pavement surface. Portland cement concrete surfaces shall not be cleaned by grinding.

875S.5 Measurement

This Specification Item will be measured by the lineal foot (lineal meter: 1 lineal meter is equal to 3.281 lineal feet) of the various widths, by each of the various words, symbols or shapes, or by any other unit as shown on the Drawings.

Payment for revised quantities will be paid for at the unit price bid for that bid item.

875S.6 Payment

The work performed and materials furnished in accordance with this Specification Item and measured as provided under "Measurement" will be paid for at the unit bid price for "Pavement Surface Preparation for Markings" of the various types specified. This price shall include full compensation for all materials, tools, equipment, labor and incidentals necessary to complete the Work.

Payment shall be made by one or more of the following:

Pay Item 875S-A: Pavement Surface Preparation for existing pavement surface
___inches in width, for _____ Surface Type per lineal foot

Pay Item 875S-B: Pavement Surface Preparation for existing Words
___inches in width, for _____ Surface Type per each

Pay Item 875S-C: Pavement Surface Preparation for existing Shapes
___inches in width, for _____ Surface Type per each

Pay Item 875S-D: Pavement Surface Preparation for existing Symbols
___inches in width, for _____ Surface Type per each

END

SPECIFIC CROSS REFERENCE MATERIALS
Specification Item No. 874S, "Eliminating Existing Pavement Markings And Markers"

City of Austin Contract Documents

Designation	Description
Section 00300U	Bid Form (Unit Prices)

RELATED CROSS REFERENCE MATERIALS
Specification Item No. 875S, "Pavement Surface Preparation For Markings"

City of Austin Technical Specifications

Designation	Description
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 302S	Aggregates for Surface Treatments
Item No. 310S	Emulsified Asphalt Treatment
Item No. 311S	Emulsified Asphalt Repaving
Item No. 312S	Seal Coat
Item No. 313S	Rubber Asphalt Joint and Crack Sealant
Item No. 315S	Milling Asphaltic Concrete Paving
Item No. 320S	Two Course Surface Treatment
Item No. 340S	Hot Mix Asphaltic Concrete Pavement

Item No. 341S	Paving Fabric
Item No. 350S	Heating, Scarifying and Repaving
Item No. 360	Concrete Pavement
Item No. 801S	Construction Detours
Item No. 803S	Barricades, Signs and Traffic Handling
Item No. 860S	Pavement Marking Paint (Reflectorized)
Item No. 863S	Reflectorized Pavement Markers
Item No. 864S	Abbreviated Pavement Markings
Item No. 865S	Non-Reflectorized Traffic Buttons
Item No. 866S	Jiggle Bar Tile
Item No. 867S	Epoxy Adhesive
Item No. 870S	Work Zone Pavement Markings
Item No. 871S	Reflectorized Pavement Markers
Item No. 872S	Prefabricated Pavement Markings
Item No. 873S	Raised Pavement Markings
Item No. 874S	Eliminating Existing Pavement Markings and Markers

City of Austin Standard Details

Designation	Description
863S-1	Pavement Buttons (Reflectorized-Type I & Type II)
865S-1	Traffic Buttons (Non-Reflectorized)

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

Designation	Description
Item No. 302	Aggregates for Surface Treatments
Item No. 314	Emulsified Asphalt Treatment
Item No. 315	Emulsified Asphalt Seal
Item No. 316	Surface Treatments

RELATED CROSS REFERENCE MATERIALS (Continued)
Specification Item No. 875S, “Pavement Surface Preparation For Markings”

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

Designation	Description
Item No. 334	Hot Mix-Cold Laid Asphaltic Concrete Pavement
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 342	Plant Mix Seal
Item No. 351	Repairing Existing Flexible Pavement Structure
Item No. 354	Planing and/or Texturing Pavement
Item No. 358	Asphaltic Concrete Surface Rehabilitation
Item No. 360	Concrete Pavement
Item No. 421	Hydraulic Cement Concrete
Item No. 427	Surface Finishes for Concrete
Item No. 428	Concrete Surface Treatment
Item No. 662	Work Zone Pavement Markings
Item No. 666	Reflectorized Pavement Markings
Item No. 667	Prefabricated Pavement Markings
Item No. 672	Raised Pavement Markers

Item No. 677	Eliminating Existing Pavement Markings and Markers
Item No. 678	Pavement Surface Preparation For Markings

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex 729-I	Sampling of Traffic Markers
Tex-828-B	Determining Functional Characteristics of Pavement Markings
Tex-829-B	Method For Measuring Pavement Temperature
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Texas Department of Transportation: Departmental Materials Specification

Designation	Description
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DMS-8200	Pavement Paint
DMS-8220	Thermoplastic marking material
DMS-8240	Prefabricated Marking Materials
DMS-8241	Removable Tape
DMS-8290	Pavement Paint
YPT-10 and/or WPT-10	Pavement Paint

1301S.1 Description

This standard specification item shall govern furnishing and placing red granite gravel surfacing for hike and bike trails. The granite gravel surface shall be constructed in a single layer on an approved and properly prepared base course, conforming to 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 the inch-pound units are given preference followed by SI units shown within parentheses.

1301S.2 Submittals

The submittal requirements of this specification item may include:

A. Sample of decomposed red granite gravel surface material along with source identification and gradation and plasticity test results for approval, quality assurance and color;

B. Sample of red road base material or approved equivalent along with source identification and gradation and plasticity test results for approval, quality assurance and color;

C. Optimum moisture-density characteristics for decomposed red granite gravel and red road base sources;

D. Proposed trail/path construction sequence and equipment; and

E. Field density test results for in-place compacted red granite gravel and red road base.

1301S.3 Materials

The surface and base layer materials shall be tested by the City's designated laboratory and approved by the Engineer or designated representative prior to being hauled to the Project.

The decomposed red granite gravel and red road base materials or approved equivalent shall be tested according to the following TxDoT standard test methods:

a) Preparation for Soil Constants and Sieve Analysis	Tex-101-E
b) Moisture Content	Tex-103-E
c) Liquid Limit	Tex-104-E
d) Plastic Limit	Tex-105-E
e) Plasticity Index	Tex-106-E
f) Sieve Analysis	Tex-110-E
g) Laboratory Compaction	Tex-113-E
h) Field Density	Tex-115-E

The surface layer material shall be from a source approved by the City and shall be composed of a mixture of Texas decomposed unwashed granite aggregate and red clay fines that meets the following requirements:

Sieve Designation		% Passing	
US	SI		
5/8"	19 mm	100	
#40	425 μm	40 to 45	
# 200	75 μm	15 to 25	
Plasticity Index			12 to 18

The red road base material or approved equivalent shall be from a source approved by the City and shall consist of a hematite, hydrated hematite or limonite “iron” ore, occurring with or without sand, as found at or near the ground surface, which, when loaded at from the material pit, shall not contain an excess of free clay. Material containing gravel or hard pieces of ore exceeding the maximum specified size in their largest dimension shall be broken up and uniformly mixed with the remainder of the material/.

When properly slaked and tested by TxDoT methods the red road base material or approved equivalent shall meet the following requirements.

Sieve Designation		% Passing	
US	SI		
1 3/4"	45 mm	100	
7/8"	22.5 mm	65 to 90	
#40	425 μm	15 to 50	
Liquid Limit			35 maximum
Plasticity Index			12 maximum.

1301S.4 Construction

A. General

Prior to commencement of this work, all required erosion controls and tree protection measures indicated on the Drawings shall be in place. All existing utilities shall be located and protected as specified in the Standard Contract Documents, Section 00700, "General Conditions" and/or as specified on the Drawings.

Areas within the construction limits shall be cleared of all obstructions, abandoned structures, and other items as defined above. All vegetation, except trees or shrubs indicated for preservation, shall also be removed. Trees and shrubs, which are scheduled for preservation, shall be carefully trimmed as directed by the engineer or designated representative and shall be protected from scarring, barking or other injuries during construction operations in accordance with Standard Specification Item No. 610S, " Preservation of Trees and Other Vegetation". All exposed cuts over 2 inches (50 millimeters) in diameter, exposed ends of pruned limbs or scarred bark shall be treated with an approved asphalt material within 24 hours of the pruning or injury.

Construction equipment shall not be operated nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings and/or specified in the

Contract Documents. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

B. Subgrade Preparation

The subgrade shall be excavated and shaped in conformity with the typical sections shown on the drawings and to the lines and grades as established by the Engineer or designated representative. The subgrade shall be tested by “proof rolling” and shall conform to Standard Specification Item No. 236S, except that a 10-ton roller will be used prior to placement of the red road base material. Any unstable or spongy subgrade areas identified by proof rolling shall be corrected either by additional re-working, drying and compaction, or by removal and replacement of unsuitable materials.

If required the subgrade shall be wetted, reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the red road base material. The surface of the subgrade shall be finished true to line and grade as established by the Engineer or designated representative in conformity with the typical section shown on the drawings. Material excavated in the preparation of the subgrade shall be utilized in the construction of adjacent shoulders and slopes or otherwise disposed of as directed by the Engineer or designated representative. Additional material required for completion of the shoulders and slopes shall be secured from sources approved by the City of Austin.

C. Red Road Base

The Contractor shall not place red road base or approved equivalent 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 when the surface displays no damp spots and there is no evidence of “sponginess” in the subgrade.

The base material shall be delivered in approved vehicles of uniform capacity and it shall be the responsibility of the Contractor to deliver at each 100-foot (30-meter) station the required amount of specified material to yield the compacted thickness shown on the drawings. Material deposited upon the subgrade shall be spread and shaped the same day unless directed otherwise by the Engineer in writing. All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well-graded material.

In the event inclement weather or other unforeseen circumstances render impractical the spreading of the base material during the first 24-hour period, it shall be scarified and spread as early as possible as directed by the Engineer or designated

representative. If it becomes evident that insufficient material was placed, additional material as necessary shall be delivered and the entire course scarified, mixed and compacted.

The base layer shall be sprinkled as required to bring the material to optimum moisture content, then compacted in accordance with Standard Specification Item No. 210S, “Flexible Base” to the extent necessary to provide not less than 90% of the optimum density. In no case shall the material be worked at more than 2 percent above or below optimum moisture as determined by TxDoT Test Method Tex-113-E. Field density determinations shall be made in accordance with TxDoT Test Method Tex-115-E. In addition to the requirements specified for density, the full depth of 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. 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.

If the base material, due to any reason or cause, loses the required stability, density or finish before placement of the red granite gravel surface layer, it shall be recompacted and refinished at the Contractor's expense.

D. Red Granite Gravel Surface

Construction methods for the succeeding red granite gravel layer shall be the same as prescribed for the red road base layer with the exception of the compaction requirements. The surface layer shall be sprinkled as required to bring the material to optimum moisture content, then compacted in accordance with Standard Specification Item No. 210S, "Flexible Base" to the extent necessary to provide not less than 92% of the optimum density. In no case shall the material be worked at more than 2 percent above or below optimum moisture.

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

If the base material and/or surface layer due to any reason or cause, loses the required stability, density or finish prior to acceptance of the project, the base layer and/or surface layer shall be recompacted and refinished at the Contractor's expense.

1301S.5 Measurement

"Granite Gravel Hike and Bike Trail" 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.

1301S.6 Payment

This item will be paid for at the contract unit bid price for "Granite Gravel Hike and Bike Trail". The unit bid price shall include full compensation for all work specified herein, including the protection of existing trees, property and public right-of-way, traffic control measures, the furnishing, hauling, placing and compacting of all materials; for rolling, proof rolling, recompacting and refinishing; for all water required; for retesting as necessary; and for all equipment, tools, labor and incidentals necessary to complete the Work.

Payment will be made under the following:

Pay Item No. 1301S-A:	Granite Gravel Hike and Bike Trail	Per Cubic Yard.
Pay Item No. 1301S-B:	Granite Gravel Hike and Bike Trail	Per Square Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS
Specification 1301S, “Granite GravelHike and Bike Trail”

City of Austin Standard Contract Documents

Designation	Description
Section 00700	General Conditions

City of Austin Standard Specifications

Designation	Description
Item No. 201S	Subgrade Preparation
Item No. 210S	Flexible Base
Item No. 236S	Proof Rolling
Item No. 610S	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex-101-E	Preparation of Soil and Flexible Base Materials for Testing
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-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

City of Austin Standard Details

Designation	Description
1301S-1	Granite Gravel Trail