




B/CS
Unified Technical
Specifications



Water, Sewer, Street,
Drainage, and Generals
2009



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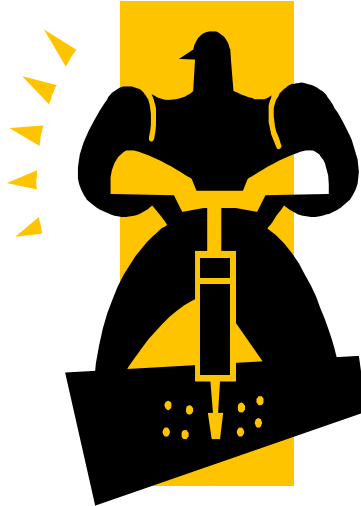
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TECHNICAL SPECIFICATIONS

General



SECTION 01 30 00

DIGITAL CONSTRUCTION PICTURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Contractor is required to photographically document site conditions prior to the start and during construction operations. Provide monthly, and within one month of the completion of work, photographs, 1200x800 pixels, 360dpi true color minimum resolution in JPEG file format showing the sequence and progress of work, devices, equipment, material and fitting installations.

1.2 MEASUREMENT AND PAYMENT

- A. The digital photographs serve as one of the methods of documentation of the work performed each month and the associated monthly invoice will not be processed without them. Photographs shall be provided for unrestricted use by the City.

1.3 SUBMITTALS

- A. Take a minimum of 20 digital photographs each week (more may be required to accurately document work). Photographs for each month shall be in a separate monthly directory with the orientation and location of the valves, manholes, pipe connections and other appurtenances annotated on the construction drawings and the photograph. Submit digital photographs and associated construction drawing with the monthly invoice on a CD-R, cumulative of all photos to date.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION

N/A

END OF SECTION

SECTION 01 55 26
TRAFFIC CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Specification includes the general description of the “TRAFFIC CONTROL” and the requirements of that plan. This specification applies to the furnishing of all labor, equipment, and materials and in performing all operations in connection with the “TRAFFIC CONTROL” in accordance with the plans and these specifications.

1.2 MEASUREMENT AND PAYMENT

The work and materials as prescribed by this item will be paid on the following schedule:

- A. 50% of the bid value shall be paid when the traffic control plan is fully implemented, and all of the initial traffic control devices have been installed and are in working order.
- B. 25% of the value will be prorated for the installation and maintenance of traffic control devices during the course of construction as a percent of the total contract value.
- C. 25% will be paid at the completion of construction and all traffic control devices are removed from the site.

1.3 SUBMITTALS

- A. The contractor shall submit a “TRAFFIC CONTROL PLAN” or modifications to the plan provided in the construction documents prior to commencing construction. All plans must be in accordance with the Texas Manual of Uniform Traffic Control Devices requirements. No plan may be implemented until approved by the Engineer.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. The “TRAFFIC CONTROL PLAN” and the installation of all devices should be continuously reviewed and updated to reflect the current stage of construction. The inspector may review minor changes; the engineer shall review major changes. The construction foreman shall provide the current “TRAFFIC CONTROL PLAN” to the inspector upon request on the site at any time during the construction of the project.

END OF SECTION

SECTION 01 58 00

**PROJECT IDENTIFICATION
(CITY OF BRYAN ONLY)**

PART 1 - GENERAL

1.1 REFERENCES

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C1 (2003) All Timber Products – Preservative Treatments by Pressure Processes

AWPA C2 (2003) Lumber, Timber, Bridge Ties and Mine Ties – Preservative Treatment by Pressure Processes

1.2 PROJECT IDENTIFICATION SIGNBOARD

A project identification signboard shall be provided in accordance with attached drawing. An image of indicating appearance of required signboard is provided in this specification section. The signboard shall be provided at a conspicuous location on the job site, city easement or right-of-way where directed by the City Engineer.

- a. The field of the sign shall consist of a 4 by 8 foot sheet of grade B-B medium density overlaid exterior plywood.
- b. Lumber shall be B or better Southern pine, pressure preservative treated in accordance with AWPA C1 and AWPA C2. Nails shall be aluminum or galvanized steel. The sign should be mounted using rectangular-timber signposts, No. 2 SYP or equivalent, 4x4 or 4x6. If 4x6 post is used, 1-1/2 inch weakening holes shall be drilled through the wide face at 4 and 18 inches above the ground. The wide face of the post shall be installed parallel with traffic. No more than 2 posts shall be mounted within a 7-foot span. The post shall be embedded into the ground a minimum of 36 inches. This support may be used in both weak and strong soils. The post may be directly embedded or may be embedded in premixed concrete, soilcrete, or approve expanding closed-cell polyurethane foam. (TxDOT Complaint Work Zone Traffic Control Devices J.2.b)
- c. The entire signboard and supports shall be given one coat of exterior alkyd primer and two coats of exterior alkyd enamel paint. The lettering and sign work shall be performed by a skilled sign painter using paint known in the trade as bulletin colors. The colors, lettering sizes, and lettering styles shall be indicated by the City Engineer. Where preservative-treated lumber is required, utilize only cured pressure-treated wood which has had the chemicals leached from the surface of the wood prior to painting.
- d. Use spray applied automotive quality high gloss acrylic enamel paint as background for the City of Bryan logo. The City of Bryan logo shall be an applied 2 millimeter film sticker/decals with background as indicated on image provided in this specification section. The weather resistant sticker/decals film shall be rated for a minimum of 2-year exterior vertical exposure. The self-adhering sticker shall be mounted to the sign with pressure sensitive, permanent acrylic adhesive.

- e. Sign paint colors (manufacturer’s numbers/types listed below for color identification only)
 - 1) Blue = Pantone 661C
 - 2) White = Bright White
 - 3) Red = Pantone 485C
- f. City of Bryan logo must retain proportions and design integrity. City of Bryan logos in electronic format may be obtained from the City of Bryan.


Logo Detail

3" Radius, 1.25" Border, 0.75" Indent, Blue on White;
 [City of Bryan Logo] 32" x 38" (see Logo Detail)
 [OLD RELIANCE] Series D
 [RD WIDENING] Series D
 [PROJECT NO. 332-D3-0734] Series D
 [2008 CIP PROGRAM] Series D
 [For Information Call: 979-209-5030] Series D
 [www.bryantx.gov] Series D

Colors:
 [B symbol] blue
 [star symbol] red
 [CITY OF BRYAN] black (font)
 [The Good Life, Texas Style.] black (font)

NOT FOR CONSTRUCTION BIDDING OR PERMIT PURPOSES
 DALE L. PICHIA, P.E., PTOE
 SERIAL NO. TX 85552

NOTE: ALL DIMENSIONS ARE IN INCHES

CIP Sign Details		DRAWN BY: DLP DATE: _____ SCALE: NTS APPR: DLP	 CITY OF BRYAN <i>The Good Life, Texas Style.</i>	This seal appearing on this document was authorized by Dale L. Pichia, P.E., PTOE. Alteration of a sealed document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act.	SHEET <div style="text-align: center; font-size: 2em; font-weight: bold;">1</div> of 1
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Old Reliance Rd Widening CITY JOB NO. 332-D3-0734

Example of Prescribed Image for CIP Project Identification Signs

SECTION 01 71 13

MOBILIZATION

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This item shall govern for the establishment of office and other facilities at the project site and the movement of personnel, construction equipment and supplies to the project site or to the vicinity of the project site in order to enable the Contractor to begin work on the other contract items that will be performed by the Contractor. The cost of the payment bond and performance bond on projects that cannot begin because of a closed construction season or for the convenience of the City will be considered part of the mobilization item under this contract.

1.2 MEASUREMENT AND PAYMENT

- A. This Item will be measured by the "Lump Sum", as the work progresses.
- B. Partial payments of the "Lump Sum" bid for mobilization will be as follows. The adjusted contract amount for construction items as used below is defined as the total contract amount less the lump sum bid for Mobilization.
 - 1. Upon presentation of a paid invoice for the payment bond, performance bond and/or required insurance, the Contractor will be paid that cost from the amount bid for mobilization.
 - 2. When 1% of the adjusted contract amount for construction items is earned, 50% of the mobilization lump sum bid or 5% of the total contract amount, whichever is less, will be paid. Previous payments under this Item will be deducted from this amount.
 - 3. When 5% of the adjusted contract amount for construction items is earned, 75% of the mobilization lump sum bid or 10% of the total contract amount, whichever is less, will be paid. Previous payments under this Item will be deducted from this amount.
 - 4. When 10% of the adjusted contract amount for construction items is earned, 90% of the mobilization lump sum bid or 10% of the total contract amount, whichever is less, will be paid. Previous payments under this Item will be deducted from this amount.
 - 5. Payment for the remainder of the lump sum bid for "Mobilization" will be made on the next monthly estimate cycle after the retainage estimate.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION

N/A

END OF SECTION

SECTION 02 41 13.13

REMOVAL OF EXISTING CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of breaking up, removing and satisfactorily disposing of existing pavement along the right-of-way or at locations shown on the Plans.

1.2 MEASUREMENT AND PAYMENT

- A. Existing pavement, concrete sidewalk and driveways, removed as prescribed above will be measured by the square yard in its original position, regardless of its thickness or the depth of covering.
- B. Existing combined concrete curb and gutter and concrete curb, removed as prescribed above, will be measured by the linear foot in its original position, regardless of its thickness or the dimensions of same.
- C. The work performed as prescribed by this item and measured as provided under "Measurement", will be paid for at the unit price bid for "Removal of Existing Concrete" (of the type specified), which price shall be full compensation for breaking up of the concrete, loading, hauling, unloading and satisfactorily storing or disposing of the material. Payment shall include all labor, tools and equipment to complete the work. Payment will not be made for unauthorized work.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. Existing pavement (with or without bituminous top), sidewalk, driveway, curb, or combined curb and gutter shall be broken up into pieces not greater than eighteen (18) inches in any dimension by air-driven machinery or other suitable means. The use of explosives will not be permitted.
- B. Where only a portion of the existing concrete is to be removed, special care shall be exercised to avoid damage to that portion of the concrete to remain in place. The existing concrete shall be cut to the neat lines shown on the Plans or established by the Engineer. Any existing concrete beyond the neat lines so established which is damaged or destroyed by these operations shall be replaced at the Contractor's expense.
- C. Existing pavement, which is to be removed, shall be loaded, hauled and neatly stored at designated sites, or otherwise disposed of as directed by the Engineer. Work performed under this item shall be inaugurated at such times and prosecuted in such manner as to cause minimum inconvenience to traffic or to the owners of adjacent property.

END OF SECTION

SECTION 03 30 00**CONCRETE**

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This specification shall govern for Portland cement concrete to be used in concrete pavement, concrete structures and other concrete construction.

1.2 MEASUREMENT AND PAYMENT

- A. In general and unless otherwise specified, no separate payment will be made for concrete as an item. The cost of concrete including all materials and equipment, furnishing and placing all reinforcing steel, and performing all labor for the manufacturing, transporting, placing, finishing, and curing of concrete will be included in the unit price bid for specific items as set forth in the Proposal. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

List of Admixtures proposed
Concrete Mix Designs and three sets of tests on the mix designs submitted.
Certification for cement conformance to specification
Test reports for all required concrete tests
Mill report/Certifications for all Reinforcing Bar.
Material Data on Control, Expansion and Contraction Joint materials and sealants.

PART 2 – PRODUCTS**2.1 MATERIALS****A. PORTLAND CEMENT:**

Cement shall be Type I, II or III Portland Cement conforming to ASTM C150, or Type IA, IIA or IIIA, conforming to ASTM C175 except as noted below.

1. Different types of cement, as prescribed above may be used in the same structure, but all cement used in any one monolithic placement shall be of the same type and brand.
2. Type III cement shall not be used when the anticipated air temperature for the succeeding 12 hours will exceed 60° F.

B. FLY ASH:

Fly Ash shall be Type C or F Fly Ash in accordance with ASTM C618. When fly ash is used, “cement” shall be defined as “cement plus fly ash”. “Cement plus fly ash” shall be composed of Type I, II or III Portland cement and 20 to 35 percent fly ash by absolute volume, except that for classes of concrete which are specified to have less than five (5) sacks of Portland cement per cubic yard, the fly ash replacement of cement shall not exceed 25 percent by absolute volume of

the specified cement content.

C. AGGREGATE:

1. Concrete aggregate shall conform to all requirements of Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges (2004) Section 421.2 E 1, 2 and 3, and ASTM C33.
2. The maximum size of aggregate shall not be larger than one-fifth of the narrowest dimension between forms of the member for which concrete is to be used nor larger than three-fourths of the minimum clear spacing between reinforcing bars.

D. WATER:

Water for use in concrete and for curing shall be from municipal supplies approved by the Texas Commission on Environmental Quality and Texas Department of Health or shall conform to the provisions of AASHTO T26 for quality of water.

E. REINFORCING STEEL:

1. The reinforcing steel shall be Grade 60.
2. Steel reinforcing bars as required, shall be of the type and size as shown on Plans and shall be open hearth new billet steel of structural, intermediate, or hard grade, or shall be rail steel concrete reinforcement bars. All steel shall be bent cold.
3. New billet steel shall conform to the requirements of the Standard Specifications for Billet-Steel Concrete Reinforcement Bars, ASTM Designation A-15.
4. When fabricated steel bar or rod mats are specified, the mats shall meet the current requirements of specifications for Fabricated Steel Bar or Rod Mats for Concrete Reinforcement ASTM Designation A-184.
5. In the event reinforcing bars manufactured outside of the Continental United States or its territories are used, two sets of tests from an independent testing laboratory acceptable to the Engineer shall be submitted showing that the steel meets the ASTM Standards for tensile strength, phosphorus content, bend, deformations and such other requirements outlined in the ASTM Standards for the grade used. These tests shall be made by and independent testing laboratory at the Contractor's expense and shall be submitted for each 25 tons of steel supplied from each individual mill.
6. At the time of placement in the concrete, reinforcing steel shall be free of dirt, loose rust, mill scale, paint, grease, oil or other deleterious materials that would impair the bonding of the concrete to the steel.
7. Reinforcement shall be accurately positioned and, unless otherwise shown or specified, shall be secured against displacement by using at intersection, annealed iron wire of not less than No. 18 gauge or suitable metal clips. It shall be supported by plastic or metal chairs or spacers. In general, reinforcement shall be placed, spliced, lapped, located, etc., in accordance with the recommendations of the Concrete Reinforcement Steel Institute or Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges (2004) Section 440.
8. Under no circumstances shall reinforcing steel or dowel bars be “stabbed” into fresh concrete. When reinforcing steel or dowel bars are required to extend beyond the slip-

formed surface, holes shall be drilled and the steel shall be epoxyed into place using a pre-approved epoxy.

F. STORAGE OF MATERIALS:

1. All cement, fly ash and mineral filler shall be stored in well-ventilated weatherproof buildings or pre-approved bins, which will protect them from dampness or absorption of moisture.
2. The method of handling and storing concrete aggregates shall prevent contamination with foreign materials. To assure uniform concrete, aggregate stockpiles shall be maintained at reasonably uniform moisture content.

2.2 TESTING REQUIREMENTS

A. CONCRETE QUALITY AND ALLOWABLE STRESSES

1. Concrete Quality:

Concrete mixes will be designed and made in sufficient number to represent the required water-cement ratios. These mixes shall comply with the requirements prescribed for strength and consistency as shown below. The Contractor shall furnish the results on trial mixes from a testing laboratory pre-approved by the Engineer.

Minimum Compressive Strength, psi at 28 days	Minimum Cement Content Sack/cubic yard	Maximum Water Content Gal/sack of cement	General Usage
1,500	3.0	11.0	Riprap
3,000	4.5	6.0	Drilled Shaft, Inlets; Manholes; Headwalls; Sidewalks; Driveways;
3,500	5.0	6.0	Concrete Pavement; curb and gutters
4,000	5.5	5.0	Bridge slab; Culverts

The slump of concrete mixtures shall be within the following limits when measured according to "Test for Slump of Portland Cement Concrete" (ASTM C142). When admixtures are used to increase the workability, the mix design shall indicate the slump before and after its introduction into the mix.

TYPE OF CONSTRUCTION	COMPRESSIVE STRENGTH OF CONCRETE, psi	MAXIMUM SLUMP (before admixtures)
Concrete Pavement	3,500	3"
Curb and Gutter	3,500	3"
Sidewalk	3,000	5"
Drilled Shafts and Footings	3,000	7"

Thin Walled Sections (9” or less)	3,000	5”
Thick Walls	By Special Design	

B. TESTS ON CONCRETE

1. During the progress of the work, compression test specimens shall be made and cured in accordance with "Standard Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field" (ASTM C31). Not less than three specimens shall be made for each test, nor less than one test for each 50 cubic yards or fraction thereof of concrete placed or for each day’s pour. These tests shall be made by an independent testing laboratory at the Owner's expense.
2. Specimens shall be tested in accordance with "Standard Method of Test for Compressive Strength of Molded Concrete Cylinders" (ASTM C39).
3. The standard age of test shall be 7 days and 28 days.
4. If the average strength of the control cylinders for any portion of the structure falls below the specified compressive strength, the Engineer shall have the right to order changes in the proportions or the cement content for the remaining portion of the structure. If the concrete minimum 28 day strength is not achieved the Engineer shall have the right to order its removal.
5. An air-entraining admixture may be used with Type I, II, or III Portland Cement in lieu of an Air-Entraining Portland Cement. The admixture shall meet the requirements of "Specifications for Air-Entraining Admixtures for Concrete" (ASTM C260). Concrete produced from either Type IA, IIA, or IIIA cement or the use of air-entraining admixtures shall have an air content from 3 to 5 percent when determined by means of the test for air-content, ASTM C231.

C. TEST CYLINDERS

Preparation of test cylinders and tests on concrete cylinders shall be made at the expense of the Owner. The cost of all failed tests shall be charged to the Contractor.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. PREPARATION OF EQUIPMENT AND PLACE OF DEPOSIT:

1. Before placing concrete, all equipment for mixing and transporting the concrete shall be cleaned. All debris shall be removed from the place to be occupied by the concrete.
2. Water shall be removed from place of deposit before concrete is placed unless otherwise permitted by the Engineer.

B. MIXING OF CONCRETE

1. The concrete shall be mixed until there is a uniform distribution of materials and shall be discharged completely, before the mixer is recharged.
2. For job-mixed concrete, the mixer shall be rotated at a speed recommended by the

manufacturer. Mixing shall be continued at least one (1) minute after all materials are in the mixer. Job-mixed concrete shall be rejected and disposed of as directed if not placed as prescribed within thirty (30) minutes after beginning of mixing. Job-mixed concrete is only allowed with written approval from the City Engineer 72-hours prior to the pour.

3. Ready-mixed concrete shall be measured, mixed and delivered in accordance with the requirements set forth in "Standard Specifications for Ready-Mixed Concrete" (ASTM C-94).

C. CONVEYING

1. Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of the materials.
2. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of a size and design to insure a continuous flow of the concrete at the delivery point, without separation of the materials.

D. TRANSPORTATION EQUIPMENT

Transportation of concrete mixed completely in a stationary mixer, from the mixer to the point of placement, shall be by truck agitator, or in a truck mixer operating at agitator speed, or in non-agitating equipment conforming to ASTM Standard C-94 except as modified herein. Truck agitators, truck mixers, and non-agitating equipment shall be capable of delivering concrete without segregation in transit. Slump tests of individual samples taken at approximately the one-quarter and three-quarter points of the load during discharge shall not vary by more than 1 inch. Vehicles transporting concrete mixed partially or completely in stationary mixers shall be equipped with discharge chutes or other devices when operating outside of the prepared subgrade, or shall be supplemented by additional transfer equipment capable of discharging or transferring the concrete from the transporting vehicle to its final position in the form without segregation.

E. FACILITIES FOR SAMPLING

Suitable facilities shall be provided for readily obtaining representative samples of aggregate from each of the bins or compartments for test purposes. Suitable facilities shall be provided for obtaining representative samples of concrete for uniformity tests. All necessary platforms, tools, and equipment for obtaining samples shall be furnished by the Contractor.

F. PLACING CONCRETE

1. The Contractor shall give the Engineer a minimum 24 hours advance notice before placing concrete to permit the inspection of forms, reinforcing steel placement and other preparations.
2. Concrete placement will not be permitted when impending weather conditions would impair the quality of the finished work.
3. Transporting Time: The maximum time interval between the addition of cement to the batch and the placing of concrete in the forms shall conform to the requirements below:

Concrete Temp (at point of placement)	Max Time (No Retarding Agent)	Max Time (with Retarding Agent)
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	Minutes)	Minutes
Non-Agitated Concrete		
Above 80 F	15	30
80 F and Below	30	45
Agitated Concrete		
Above 90 F	45	75
Above 75 F thru 90 F	60	90
75 F and Below	90	120

4. All forms, sub grade and steel shall be dampened before placement of concrete to assist with retaining moisture in the concrete.

5. Cold Weather Precautions:

Concrete shall not be placed when the ambient temperature is below 40° F and falling. Concrete may be placed when the ambient temperature is above 35° F and rising, the ambient temperature being taken in the shade and away from artificial heat. Concrete shall not be placed when the forecast predicts 72 continuous hours of temperatures less than 32° F.

The Contractor shall have available a sufficient supply of pre-approved cotton mats, polyethylene sheeting or other pre-approved covering materials to immediately protect concrete if the air temperature falls to 32° F, or below, before concrete has been in place for less than four (4) hours. Such protection shall remain in place during the period the temperature continues below 32° F, or for a period of not more than five (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.

The surface of all concrete in bents, piers, culvert walls, retaining walls, bottom of slabs, and similar formed concrete shall be maintained at 40° F or above for a period of 72 hours from the time of placements. The temperature of all concrete, including the bottom slabs (footings) of culverts placed on or in the ground, shall be maintained above 32° F for a period of 72 hours from time of placement.

Protection shall consist of providing additional covering, insulated forms or other means, and if necessary, supplementing such coverings with artificial heating.

6. Warm Weather Precautions

The following precautions shall be taken in placing, curing, and protecting the concrete when local weather records show that the maximum daily temperature is likely to exceed 95° F. The forms and the subgrade, subbase or base course shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete exceed 95° F when deposited on the subgrade, subbase or base course. The temperature of the concrete shall not exceed 85° F for bridge slabs or in the top slab of direct-traffic culverts. The aggregates and/or mixing water will be cooled as necessary to maintain the concrete temperature within the specified maximum. Concrete shall be placed in the forms continuously and rapidly at a rate of not less than 100 feet of paving lane per hour. The surface of the newly laid pavement shall be kept damp by means of a water fog or mist applied with pre-approved spraying equipment until the pavement is covered by the pre-

approved curing medium.

7. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The deposition shall be at a rate that allows the concrete to be plastic at all times and permits flow readily into the space between the rebar. Retempered concrete shall not be used and concrete shall not have a free fall of more than five (5) feet, except in the case of thin walls such as in culverts or as specified in other items. Any hardened concrete spatter ahead of the plastic concrete shall be removed.
8. Concrete deposition shall be a continuous operation until completed at the panel or section. Cold joints in a monolithic placement shall be avoided. The sequence of successive layers or adjacent portions of concrete shall be such that they can be vibrated into a homogeneous mass with the previously placed concrete. Not more than one (1) hour shall elapse between adjacent or successive placements of concrete.
9. Concrete shall be thoroughly consolidated and vibrated in the forms with pre-approved mechanical vibrators of a type considered in the design of forms.

G. FINISHING

Unless noted otherwise, apply an ordinary surface finish as the final finish to the following exposed surfaces:

- inside and top of inlets,
- inside and top of manholes,
- inside of sewer appurtenances,
- inside of culvert barrels, bottom of bridge slabs between girders and beams, and
- vertical and bottom surfaces of interior concrete beams or girders.

An ordinary surface finish shall be as follows:

- Chip away all loose or broken material to sound concrete where porous, spalled, or honeycombed areas are visible after form removal.
- Repair spalls by saw-cutting and chipping at least 1/2 in. deep, perpendicular to the surface to eliminate feather edges. Repair shallow cavities using a latex adhesive grout, cement mortar, or epoxy mortar as pre-approved. Repair large areas using concrete as directed or pre-approved.
- Clean and fill holes or spalls caused by the removal of form ties, etc., with latex grout, cement grout, or epoxy grout as pre-approved. Fill only the holes. Do not blend the patch with the surrounding concrete. On surfaces to receive a rub finish in accordance with Item 427, "Surface Finishes for Concrete," chip out exposed parts of metal chairs to a depth of 1/2 in. and repair the surface.
- Remove all fins, runs, drips, or mortar from surfaces that will be exposed. Smooth all form marks and chamfer edges by grinding or dry-rubbing.
- Ensure that all repairs are dense, well bonded, and properly cured. Finish exposed large repairs to blend with the surrounding concrete where a higher class of finish is not specified.

Finish of Bridge Slabs and related features shall be in compliance with TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges (2004) Section 420.4.

F. CURING

The concrete shall be kept wet by spraying with water after attaining its final set and before removing the forms. Bottom forms supporting floor or roof slabs shall remain in place for not less than seven (7) days. The concrete shall have attained a compressive strength of not less than 2,000 psi prior to removal of bottom forms. All other forms may be removed twenty-four hours after completion of concrete placement, providing the weather has allowed the concrete to attain its final set in less than five (5) hours. The forms shall be left on for forty-eight (48) hours whenever the temperature of the air in the shade during pouring is 90° F or over. Curing shall be continued for five days after placement of concrete. This may be done with wet mats, with two applications of Type I (White in color) Liquid-Membrane-Forming Compound meeting requirements of ASTM C309, or with waterproof curing paper meeting the requirements of ASTM C171.

G. CONSTRUCTION JOINTS

Construction joints will be made only at locations shown on the Plans unless written permission is granted by the Engineer to make additional joints. Unless otherwise required, make construction joints square and normal to the forms. Use bulkheads in the forms for all vertical joints. Thoroughly roughen the top surface of a concrete placement terminating at a horizontal construction joint as soon as practical after initial set is attained. Thoroughly clean the hardened concrete surface of all loose material, laitance, dirt, and foreign matter. The surface is to be dampened just prior to casting of concrete against the joint.

END OF SECTION

SECTION 03 30 01

CONCRETE BLOCKING OR ANCHORAGE

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This section covers the manufacture of materials and installation of concrete blocking or anchorage for thrust resistance. Concrete blocking shall be placed at bends, tees, crosses, fire hydrants, plugs, etc. in the supply line. Blocking shall also be installed for blow-offs as shown on the plans or as directed by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Restrained joints, fittings, and concrete blocking shall not be a separate bid item. Cost for work herein specified, including the furnishing of all materials, equipment, labor, and incidentals necessary to complete the work, shall be included in the unit price for water or sanitary sewer lines in place.

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. Cement shall conform to the current ASTM C150 standard and be Type I.
- B. Aggregates shall conform to the current ASTM C33 standard.
- C. Concrete strength shall be at least 2,000 psi at twenty-eight (28) days, unless otherwise shown on the plans. Concrete for blocking shall be of a quality and placed in accordance with SECTION 03 30 00 – CONCRETE. The concrete for blocking shall be class 2,000 psi concrete (class “C”).
- D. 3,000 psi sack-crete may be used but must be hydrated prior to placement.

PART 3 – EXECUTION**3.1 CONSTRUCTION METHODS****A. THRUST RESTRAINT****1. Hydrants**

The bowl of each hydrant shall be well braced against a sufficient area of unexcavated earth at the end of the trench with concrete blocking, or it shall be tied to the pipe with restrained joints as shown or directed by the City.

Tie rods, clamps, or other components of dissimilar metal shall be protected against corrosion by encasement of the entire assembly with 8-mil thick, loose polyethylene film in accordance with AWWA C105.

Thrust restraint design pressure should be equal to 200 psi.

2. Fittings

The contractor shall install concrete blocking **and** retaining glands to all tees, Y-branches, bends deflecting eleven and one-fourth degrees ($11 \frac{1}{4}^\circ$) or more, and plugs which are subject to internal pressure in excess of 10 psi. to preclude separation of joints.

If stainless steel is not used, the contractor shall protect from corrosion all steel clamps, rods, and other metal accessories used in reaction anchorages, or joint harnesses subject to submergence, or in direct contact with earth and not encased in concrete with epoxy coating or wrapped with 8 mil. polyethylene film. All bolts and nuts shall be 316 Stainless Steel.

3. Restraint Materials

Vertical and horizontal reaction blocking shall be made of concrete having a compressive strength of not less than 2,000 psi after twenty-eight (28) days.

Blocking shall be placed between solid ground and the fitting to be anchored; the area of bearing in the pipe and on the ground in each instance shall be that shown on the plans or directed by the City. The blocking shall, unless otherwise shown or directed, be so located as to contain the resultant thrust force, and so that the pipe and fitting joints will be accessible for repair.

Mechanical joints utilizing set-screw retainer glands (DIP only, use Megalug or pre-approved equal for PVC), or metal harness of tie rods or clamps shall be used **in addition to** concrete blocking. Components of dissimilar metal shall be protected against corrosion by encasement of the entire assembly with 8-mil thick, loose polyethylene film in accordance with AWWA C105.

B. PLACING CONCRETE BLOCKING

Extend 2,000 psi concrete blocking from the fitting to solid, undisturbed earth and install so that all joints are accessible for repair. The bearing area shall be as shown on the plans. If no details regarding blocking are shown on the plans, provide enough concrete bearing against the ditch to limit soil loading to 200 psf from the thrust produced at an internal pressure in the pipe of 200 psi.

Concrete shall not be placed unless all pipes, valves, fittings, forms, and reinforcement have been inspected.

Handle all concrete in such a manner to avoid segregation, separation, or loss of ingredient, or the displacement of piping, etc.

Place concrete in continuous horizontal layers not exceeding 24". Place each layer quickly enough so that the previously placed concrete is still plastic when the next layer is placed. Provide any construction joints that are necessary.

Before beginning the placement of concrete, inspect all forms, pipes, fittings, valves, etc. for alignment and rigidity. Tighten all supports and make corrections to alignment as required. Inspect all reinforcement, if any, for placement and rigidity.

Do not begin placing concrete until all forms and reinforcement have been inspected by the Engineer.

Clean all loose dirt, mud, water, and debris from the trench and forms. All surface encrusted with hardened concrete from previous placement operations shall be clean.

Clean all pipe, fittings, valves, etc. projecting from previously placed concrete before placing new concrete.

Accurately and securely place all embedded items.

END OF SECTION

SECTION 03 34 00

GROUT FILL EXISTING LINE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall govern the grout filling of existing lines where specified and/or shown on the Plans. All work shall conform to this specification

1.2 MEASUREMENT AND PAYMENT

- A. Where “Grout Fill Existing Line” is measured for payment the unit of measurement will be linear feet of line grouted, complete and in place. Payment shall be at the unit price bid in the Proposal. Unless otherwise specified or directed, mortar and/or grout will not be measured as pay quantities but will be included in the unit price bid for the specific item or items into which they are incorporated as set forth in the bid Proposal. The price for this item shall be full compensation for furnishing all equipment, labor, materials, tools and incidentals necessary to complete the work.

1.3 SUBMITTALS

- A. Mix Design
- B. Work Plan

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials shall conform to SECTION 04 05 12 - MORTAR AND GROUT

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. EXECUTION

Prior to grout filling the line, the Contractor shall verify that no live services remain connected to the line. Services found during this procedure shall be paid for using the “Sanitary Sewer Service” item. All live services shall be reconnected to an adjoining main line.

“Grout Fill Existing Line” shall require that an existing underground conduit (pipe, waterline, sewer line, storm drain line, etc.) be completely filled with a low strength cement grout. In order to achieve this, the grout to be pumped into the line shall have a consistency that will permit forced flow into the entire length of line. Blocking the line by intermediate excavation and gravity flow concrete or grout is NOT acceptable. The existing line to be grout filled shall be exposed and plugged with concrete bulkheads at both ends. In some cases this will require the excavation of the existing line and that the pipe be broken open. 3” Schedule 40 PVC shall extend through the bulkhead and using a 90 degree elbow extend up to the surface on both ends of the line to be grouted. The concrete grout shall be pumped through the 3” PVC until the grout is visible at the other

end of the conduit through the 3" PVC. No more than 15 psi shall be used to pump the grout mixture, and care should be used to avoid grout filling adjoining voids.

B. ALTERNATE EXECUTION

At the option of the Contractor, the existing line may be removed from the ground and disposed of properly. Hazardous materials removed from the ground shall require a receipt from a site certified to accept hazardous material. When this option is used, the surface must be restored to existing or better condition per the drawing details for trench embedment. Restoration of the trench and surface is subsidiary to the price of "Grout Fill Existing Line."

C. COMPOSITION

The proportions by volume or weight of cement, fine aggregate and water shall produce a plastic mixture. The degree of workability shall be consistent with the use to which the mixture is placed, and shall be pre-approved by the Engineer. The mix shall contain no coarse or medium aggregates and shall contain at least two sacks of cement per cubic yard of grout.

D. EQUIPMENT

All equipment, tools and machinery used in handling and mixing grout shall meet the approval of the Engineer. Grout shall be machine mixed in a batch type mixer.

E. REJECTION

"Grout Fill Existing Line" may be rejected for failure to meet any of the requirements of the Specifications, and specifically for:

1. Failure to successfully pump grout to the other end of the line.
2. Grout attaining initial set before use.
3. Improper mixing.

If the grout filling is rejected because of "A", all line not filled shall be removed from the ground and the trench repaired per the drawing details for trench embedment at the Contractor's expense.

END OF SECTION

SECTION 04 05 12
MORTAR AND GROUT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Mortar and grout where specified and/or shown on the Plans shall conform to this section of the Specifications. Mortar and grout shall be designated by type as set forth. The uses and purposes of said types shall be consistent with the uses and purposes as designated. For grout filling existing lines please refer to SECTION 03 34 00 – GROUT FILL EXISTING LINE.

1.2 MEASUREMENT AND PAYMENT

- A. Where mortar and/or grout are measured for payment the unit of measurement will be cubic yards of mortar and/or grout, complete and in place. Payment shall be at the unit price bid in the Proposal. However, unless otherwise specified or directed, mortar and/or grout will not be measured as pay quantities but will be included in the unit price bid for the specific item or items into which they are incorporated as set forth in the bid proposal.

1.3 SUBMITTALS

- A. Mix Design

PART 2 – PRODUCTS

2.1 MATERIALS

- A. MASONRY MORTAR shall be composed of fine aggregate thoroughly mixed with cement and water. The mixture produced shall be homogeneous with a consistency required for ease of handling and spreading by a trowel.
- B. STANDARD GROUT shall have a consistency that will permit flow into the joints, completely filling them.
- C. PIPE JOINT MORTAR shall have consistency and workability for use as dictated by accepted practices and/or as required for specific job conditions.
- D. NEAT CEMENT GROUT shall be composed of Portland Cement and water mixed to the consistency required for specific job conditions.

2.2 TESTING REQUIRMENTS

Mortar and grout may be rejected for failure to meet any of the requirements of the Specifications, and specifically for:

- A. Retempered mortar and/or grout.
- B. Mortar and grout attaining initial set before use.
- C. Improper mixing.
- D. Mortar and grout containing frozen aggregates.
- E. Mortar and grout subjected to freezing within three (3) days after being placed in the work.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

The proportions by volume or weight of cement, fine aggregate and water shall produce a plastic mixture. The degree of workability shall be consistent with the use to which the mixture is placed, and shall be pre-approved by the Engineer.

A. **CEMENT**: Cement used in mortar and grout shall be Type I or Type III Portland Cement which shall conform to the current ASTM Designation C-150.

B. **FINE AGGREGATE**: Fine aggregate to be used in mortar and grout shall consist of sand or a mixture of sands, with or without a mineral filler. The sand or mixture of sands in fine aggregate shall consist of clean, hard, durable, uncoated grains, free from lumps. Fine aggregate shall not contain deleterious substances in excess of the following percentages by weight:

- Material removed by decantation 3.0%
- Clay lumps 0.5%
- Other deleterious substances 2.0%
(such as coal, shale, coated grains, and soft, flaky particles)

Fine aggregate shall be free from an excess of harmful salts or alkali. When subjected to the color test for organic impurities the sand or mixture of sands shall not show a color darker than the standard color. The fine aggregate shall be well graded from coarse to fine, and when tested by laboratory methods shall meet the following requirements for percentages by weight:

- Retained on 3/8 inch screen 0%
- Retained on 1/4 inch screen 0 - 5%
- Retained on No. 20 mesh sieve 15 - 50%
- Retained on No. 100 mesh sieve 85 - 100%

Combining two sands of different gradations may be the most economical way to meet these specifications. If this is done, each sand shall be separately and accurately measured by volume or weight in such proportions as the Engineer may direct. Sands and mineral filler shall not be mixed prior to batching. Mineral filler and the use of it shall be pre-approved by the Engineer. In no case shall the added amount of mineral filler exceed ten (10) percent of the weight of the fine aggregate. The mineral filler, when tested by laboratory methods, shall meet the following percentages by weight:

- Retained on No. 20 mesh sieve 0%
- Retained on No. 30 mesh sieve 0 - 5%
- Retained on No. 100 mesh sieve 0 - 30%

C. **WATER**: Water for use in mortar and grout shall be reasonably clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances. Water suitable for drinking or ordinary household uses may be considered acceptable for use in mortar and grout.

D. EQUIPMENT

All equipment, tools and machinery used in handling and mixing mortar and grout shall meet the approval of the Engineer. Mortar and grout shall be machine mixed when the amount required justifies machine mixing. Machine mixers shall be of the batch type.

E. MIXING

Mortar and grout shall be mixed only in the quantities required for immediate use. Where machine mixing is indicated or directed, the fine aggregate along with the cement and water shall be measured separately, introduced into the mixer, and mixed for a period of time of not less than one and one-half (1 1/2) minutes. This is the time measured from the entry of the last aggregate into the drum until the discharging of mortar or grout. The required water shall be introduced into the mixing drum during the first fifteen (15) seconds of mixing. The entire contents of the drum shall be discharged before introducing any materials for the succeeding batch. Any hand mixing as pre-approved by the Engineer shall be done in a pre-approved watertight box, and the sequence of mixing operations shall be as follows:

1. The box shall first be filled with the required amount of sand; the sand shall be leveled with the required amount of cement spread uniformly on top of the sand; the materials shall then be dry mixed by turning not less than three (3) times with a mortar hoe; the required amount of water shall then be added and the hoe mixing continued until the batch is of uniform color and consistency.
2. All mortar and grout shall be used within one (1) hour after mixing or before any visible signs of setting become discernible. Retempering of mortar or grout will not be permitted.

The types, uses and proportions of mortar and grout shall be as follows:

TYPES	USES	SACKS OF CEMENT	CUBIC FEET OF FINE AGGREGATE
"A"	Masonry mortar	1	2
"B"	Standard grout	1	3
"C"	Pipe joint mortar	1	1
"D"	Neat cement grout	1	none

F. ADMIXTURES

Lime may be added to increase workability in an amount not to exceed ten (10) percent of the cement content of the masonry mortar. Admixtures for the purposes of curing, accelerating the setting, or lowering the freezing point will not be permitted.

END OF SECTION

SECTION 09 03 12

**CONDUCTIVE TRACE WIRE FOR
WATER PIPE INSTALLATION**

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. Install electrically continuous trace wire with access points as described herein to be used for locating pipe with an electronic pipe locator after installation.

1.2 MEASUREMENT

- A. There is no separate payment for the supply and installation of tracer wire on any construction or installation of water main by the Contractor. The Contractor shall consider the supply and installation of the tracer wire incidental to all construction of water main.

1.3 SUBMITTALS

- A. Submit manufacturer's data on materials furnished that indicate compliance with the specifications regarding materials used.
- B. Indicate on plans location of each trace wire test station.

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. Trace wire to be fourteen (14) gauge minimum solid copper with thermoplastic insulation recommended for direct burial. Wire connectors to be 3M DBR, or approved equal, and shall be watertight to provide electrical continuity. Each trace wire access point to be composed of one Copperhead® SnakePit® Magnetized Tracer Box, Test and Monitoring Station or approved equal installed in each proposed 24"x24"x6" concrete valve box collar.

2.2 TESTING REQUIREMENTS

- A. Contractor shall perform a continuity test on all trace wire in the presence of the Engineer or the Engineers' representative. If the trace wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of the wire.

PART 3 – EXECUTION

- A. Trace wire shall be installed on all water mains. The wire shall be installed in such a manner as to be able to properly trace all water mains without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire.

- B. Trace wire shall be installed in the same trench and inside bored holes and casing with pipe during pipe installation. It shall be secured to the pipe as required to insure that the wire remains adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved watertight connector to provide electrical continuity, and it shall be accessible at all trace wire access points.
- C. Trace wire access points shall in general be no more than five-hundred (500) feet and at every proposed 24" x 24" x 6" concrete valve box collar. Concentrations of multiple proposed valves near pipe intersections, i.e. tees or crosses, may require more than one access point assembly in each concrete valve box collar. Trace wire access points shall be within public right-of-way or public utility easements.
- D. At the point of connection between cast or ductile iron water mains, with any non iron water main, the tracer wire shall be properly connected to the iron pipe with a cad weld or approved equivalent. Tracer wire welds shall be completely sealed with the use of an approved mastic type sealer specifically manufactured for underground use. Mastic shall be applied in a thick coat a minimum of 2 inches thick and shall be protected from contamination by the backfill material with the use of a plastic membrane.
- E. Tracer wire shall be laid flat and securely affixed to the pipe at 10 foot intervals. The wire shall be protected from damage during the execution of the works. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At water service saddles, the tracer wire shall not be allowed to be placed between the saddle and the water main.
- F. Except for approved spliced-in connections, tracer wire shall be continuous and without splices from each trace wire access point. Where any approved spliced-in connections occur, 3M DBR water tight connectors, or approved equal, shall be used to provide electrical continuity.
- G. At all water main end caps, a minimum of 6 feet of tracer wire shall be extended beyond the end of the pipe, coiled and secured for future connections. The end of the tracer wire shall be spliced to the wire of a six pound zinc anode and is to be buried at the same elevations as the water main.
- H. For directional drilling, auguring or boring installations, four #14 tracer wires shall be installed with the pipe and connected to the tracer wire at both ends, or cad welded to the existing iron pipe at both ends.
- I. Spliced connections between the main line tracer wire and branch connection tracer wire shall only be allowed at water main tees, crosses or at iron or copper water services where a portion of the branch connection water main or water service is replaced with a non iron or non copper material. The branch connection tracer wire shall be a single tracer wire properly spliced to the main line tracer wire. Where the existing branch connection is neither iron nor copper, then the new branch connection tracer wire shall be properly spliced to the existing tracer wire on the branch connection.
- J. At all repair locations where there is existing tracer wire, the tracer wire shall be properly reconnected and spliced as outlined above.

END OF SECTION

SECTION 31 11 00
CLEARING AND GRUBBING

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section governs the furnishing of all labor, equipment, tools, and materials, and the performance of all work for clearing, grubbing, and disposal of material within the work site required for construction of a site in accordance with specification requirements.

1.2 DEFINITIONS

- A. Clearing consists of cutting off trees and brush vegetative growth to not more than a specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.
- B. Close-cut clearing consists of cutting off standing trees, brush, scrub, roots, stumps and embedded logs, removing at, or close to, existing grade and disposing of fallen timber and surface debris.
- C. Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees, and disposing of felled trees and debris.
- D. Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, and trees smaller than 50 mm trunk diameter and disposing of all fallen timber and surface debris.
- E. Grubbing consists of excavation and disposal of stumps and roots boulders and rock fragments of specified size to not less than a specified depth below existing ground surface.

1.3 MEASUREMENT AND PAYMENT

- A. This item will be measured by the acre unless otherwise shown on the bid documents.
- B. For “acre” measurement, the work performed in accordance with this item and measured as provided under “measurement” will be paid for at the unit price bid for “Clearing and Grubbing.” This price is full compensation for pruning of designated trees, and shrubs; removal and disposal of structures and obstruction; backfilling of holes; furnishing and placing concrete for plugs; and equipment, labor, tools and incidentals.

1.4 SUBMITTALS

- A. Burn permits shall be submitted to the owner prior to burning of vegetation.
- B. Notice of Intent (NOI) and Stormwater Pollution Prevention Plan (SWPPP) or cause for exemption.
- C. Proof of legal disposal of all hazardous material shall be required when hazardous material is involved.

1.5 STORAGE AND PROTECTION

- A. Prevent damage to fencing, trees, landscaping, natural features, bench marks, existing buildings, existing pavement, utility lines, site appurtenances, water courses, root systems of trees which are to remain.
- B. Repair any damaged items to approval of Engineer/Architect. Replace any trees designated to remain, if damaged, as directed by Engineer /Architect.
- C. When shown on the plans, treat cuts on trees with an approved tree wound dressing within 20 minutes of making a pruning cut or otherwise causing damage to the tree.

1.6 WASTE MANAGEMENT AND DISPOSAL

- A. Follow all local and state regulations when burning, if burning of brush is approved, pile and burn at approved locations.
- B. Testing, removal and disposal of hazardous materials will be in accordance with the contract.

PART 2 – PRODUCTS

N/A

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspect site and verify with Engineer/Architect, items designated to remain.
- B. Locate and protect utility lines. Preserve in operating condition active utilities traversing site:
 - 1. Notify Engineer/Architect immediately of damage to or when unknown existing utility lines are encountered.
 - 2. When utility lines which are to be removed are encountered within area of operations, notify Engineer/Architect in ample time to minimize interruption of service.
- C. Notify utility authorities before starting clearing and grubbing.
- D. Keep roads and walks free of dirt and debris.

3.2 CLEARING

- A. Clear areas shown on the plans of all obstructions, except those landscape features that are to be preserved. Such obstructions include but are not limited to remains of houses and other structures, foundations, floor slabs, concrete, brick, lumber, plaster, septic tank drain fields, basements, abandoned utility pipes or conduits, equipment, fences, retaining walls, and other items as specified on the plans. Remove vegetation and other landscape features not designated for preservation, curb and gutter, driveways, paved parking areas, miscellaneous stone, sidewalks, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron, and debris, whether above or below ground. Removal of live utility

facilities is not included in this item. Remove culverts, storm sewers, manholes and inlets in proper sequence to maintain traffic and drainage.

- B. In areas receiving embankment, remove obstructions not designated for preservation to 2 ft. below natural ground. In areas to be excavated, remove obstruction to 2 ft. below the excavation level. In all other areas, remove obstruction to 1 ft. below natural ground. When allowed by the plans or directed, cut trees and stumps off to ground level. Plug the remaining ends of abandoned underground structures over 3 inches in diameter with concrete to form a tight closure. Backfill, compact, and restore areas where obstructions have been removed, unless otherwise directed. Use approved material for backfilling. Accept ownership, unless otherwise directed, and dispose of removed materials and debris at location off the sight in accordance with local, state and federal requirements.

END OF SECTION

SECTION 31 23 23.53

CEMENT STABILIZED SAND BACKFILL**PART 1 – GENERAL****1.1 DESCRIPTION**

- A. At the discretion of the Engineer, Cement Stabilized Sand meeting the following specification may be allowed as trench backfill.

1.2 MEASUREMENT AND PAYMENT

- A. Cement-stabilized sand shall be considered a part of the backfill requirement for the unit installed and shall be considered subsidiary to the length of the unit bid. If the cement stabilized sand is indicated to be a separate construction item for bulk backfill then the cement stabilized sand shall be measured per cubic yard as indicated on the plans.

1.3 SUBMITTALS

- A. Mix Design

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. CEMENT - Type I Portland Cement conforming to ASTM C150.
- B. SAND - Clean durable sand meeting grading requirements for fine aggregates of ASTM C33, and the following requirements:
 - 1. Classified as SW, SP, or SM by the United Soil Classification System of ASTM D2487.
 - 2. Deleterious materials:
 - a.) Clay lumps, ASTM C142; less than 0.5 percent.
 - b.) Lightweight pieces, ASTM C123; less than 5.0 percent.
 - c.) Organic impurities, ASTM C40; color no darker than standard color.
 - d.) Plasticity index of 4 or less when tested in accordance with ASTM D4318.
 - 3. Water: Potable water, free of oils, acids, alkalis, organic matter, or other deleterious substances, meeting requirements of ASTM C94.

2.2 TESTING REQUIREMENTS

- A. Mixing plant inspections may be performed periodically. Material samples shall be collected and tested for change in material characteristics.
- B. Random samples of delivered product will be taken in the field at point of delivery for each day of placement in the work area. Specimens will be prepared in accordance with ASTM D1632 and tested for compressive strength in accordance with ASTM D1633.
- C. The cement content may be tested at the discretion of the City.

PART 3 – EXECUTION**3.1 CONSTRUCTION METHODS****A. DESIGN REQUIREMENTS**

Design sand-cement mixture to produce a minimum unconfined compressive strength of 50 pounds per square inch in 48 hours and 100 pounds per square inch in 7 days when compacted to 95% in accordance to ASTM D558 and when cured in accordance with ASTM D1632, and tested in accordance with ASTM D1633. Mix for general use shall contain a minimum of 1-½ sacks of cement per cubic yard. Mix for use as sanitary sewer embedment within 9 feet of waterlines shall contain 2 sacks of cement per cubic yard. Compact mix with moisture content between 0% to 2% above optimum.

The maximum compressive strength in 7 days shall be 400 psi. Backfill that exceeds the maximum compressive strength shall be removed by the contractor.

B. MIXING

1. Thoroughly mix sand, cement, and water in proportions specified by the Design Requirements using a pugmill-type mixer. The plant shall be equipped with automatic weight controls to ensure correct mix proportions.
2. Stamp batch ticket at plant with time of loading directly after mixing. Material not placed and compacted within 4 hours after mixing shall be rejected.

C. PLACEMENT

1. Place sand-cement mixture in 8-inch-thick lifts and compact to 95% of ASTM D558 unless other specified by the engineer. The moisture content during compaction shall be between 0% to 2% above optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water at plant.
2. Do not place or compact sand-cement mixture in standing or free water.

END OF SECTION

SECTION 31 23 33

EXCAVATING, TRENCHING, AND BACKFILLING

All excavation will meet the most current OSHA Regulations. See SECTION 31 50 50 – TRENCH SAFETY for trench safety requirements.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work to be performed under this Specification shall consist of furnishing all labor, equipment and materials and performing all operations in connection with the excavating, trenching, and backfilling for pipelines as shown on the plans and as specified herein.

1.2 MEASUREMENT AND PAYMENT

- A. All trench excavation, backfill and compaction are not considered pay items. Payment for these items shall be included in the unit price laid in the Proposal for each size of pipe at their respective depths. This unit price shall be full remuneration for performing the trench and backfill complete including grading, bell holes, sheeting, dewatering, tamping, and water soaking; and including the furnishing of sewer pipe, all equipment, labor, materials, power, teams, tools, and transportation necessary or incidental thereto; but not including tunneling, or boring, all of which will be paid for extra.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials for pipe embedment will meet TCEQ Regulations for depth of bury and class of pipe and City of Bryan Embedment Details as shown on the Plans.
- B. Concrete (For encasement or blocking) See SECTION 32 13 13 - CONCRETE.
Material shall conform to ASTM C94. The compressive strength of the concrete shall be at least 2,000 psi and shall contain at least four (4) sacks of cement per cubic yard.
- C. Cement stabilized sand. See SECTION 31 23 23.53 – CEMENT STABILIZED SAND BACKFILL.

2.2 TESTING REQUIREMENTS

- A. Compaction tests for all backfill may be required for every 200 linear feet of trench and for each twelve-inches (12”) vertically. Density tests, shall be measured as one unit for each test. The Owner shall pay for Geotechnical tests ordered that meet the requirements of the plans and specifications. Failed tests shall be charged to the Contractor. Refer to City Standard Trench Detail for compaction effort requirements.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. CONTROL OF WATER

Provide sufficient pumping equipment, in good working order, available at all times to remove any water that accumulates in excavations. When the excavation crosses a drainage

pathway, the contractor shall provide for means of alternate drainage. The discharge of dewatering equipment shall not cause damage to private or public property.

B. SHEETING, SHORING, AND BRACING

See SECTION 31 50 50 – TRENCH SAFETY.

In caving ground, or in wet, saturated, or flowing materials, the contractor shall sheet, shore, or brace the sides of the trench so as to maintain the excavation properly in place. When excavations are made adjacent to existing building or other structures or in paved streets, particular care must be taken to adequately sheet, shore, and brace the sides of the excavation to prevent undermining of, or settlement beneath, the structures or pavement. Underpinning of adjacent structures or pavement shall be done by the Contractor at his own cost and expense, in a manner satisfactory to the Engineer and when required by the Engineer. The pavement shall be removed, the void satisfactorily refilled and compacted, and the pavement replaced by the Contractor. The entire expense of such removal and subsequent replacement thereof shall be borne by the Contractor. Sheeting, shoring, and bracing shall not be left in place, unless otherwise provided for in the contract or authorized by the Engineer. The removal of sheeting, shoring and bracing shall be done in such a manner as not to endanger or damage either new or existing structure, private or public properties, and so as to avoid cave-ins or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring, or bracing shall be immediately and completely filled and compacted with suitable materials.

C. GUARANTEE

1. Guarantee the backfilling of excavation and trenches against settlement for a period of one (1) year after the final completion of the contract under which the work is performed.
2. Make all repairs or replacements made necessary by settlement, including refilling, compacting, and reseeding or resodding the upper portion of the ditch and repairing broken or settled pavements, driveways, and sidewalks within five (5) days after notice from the Engineer.

D. PREPARATION

1. Site Preparation

Prepare the construction site for construction operations by removing and disposing of all obstructions and objectionable materials in accordance with contract documents.

2. Alignment, Grade and Minimum Cover

a. General

The water and sewer mains shall be laid and maintained to lines and grades established by the plans and specifications with fittings, valves, hydrants, manholes and clean-outs at the required locations, unless otherwise pre-approved by the Engineer. Valve-operating stems shall be oriented in a manner to allow proper operation. Hydrants shall be installed plumb.

- b. Cut sheets shall be provided to the City's Inspector. The contractor shall determine the alignment and grade or elevation of the pipeline from offset stakes. The contractor shall also provide a continuous chalk line along the alignment of the trench for use by the operator of the excavating equipment. The contractor

shall provide a laser beam and grade pole to assist in grading the ditch to the proper elevation.

- c. Should the ditch be graded below the required elevation, bring subgrade to the required elevation with cement stabilized sand or rounded pea gravel. The use of excavating materials for this application will not be allowed.
- d. Where pipe grades or elevations are not definitely fixed by contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the pipe. Greater pipe cover depths may be necessary for clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevations.

3. Prior Investigation

Prior to excavation, investigation shall be made to the extent necessary to determine the location of existing underground structures and conflicts. Care should be exercised by the Contractor during excavation avoid damage to existing structures.

4. Unforeseen Obstructions

When obstructions that are not shown on the plans are encountered during the progress of work and interfere so that an alteration of the plans is required, the Engineer will alter the plans or order a deviation in line and grade or arrange for removal, relocation or reconstruction of the obstructions.

5. Clearance

When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary, with the approval of the Engineer, to provide clearance as required by federal, state or local regulations or as deemed necessary by the Engineer to prevent future damage or contamination of either structure.

E. EXCAVATION

All excavation shall meet the most current OSHA regulations.

1. Classification

Excavation of trenches for pipelines is unclassified. Soils will be classified utilizing OSHA Standards and Regulations. The Contractor shall assume that the site contains the worse type of soils and make provisions for shoring the work area.

2. Trench Excavation

a. General

The trench shall be excavated to the required alignment, depth and width and in conformance with all federal, state and local regulations for the protection of the workmen.

b. Trench Preparation

- i) Trench preparation shall proceed in advance of pipe installation for only as far as pipe will be laid that day.
- ii) The contractor shall keep the trench dry from both storm water and seepage from the sides of the trench. Discharge from any trench dewatering pumps shall be conducted to natural drainage channels, storm sewers or a pre-

approved reservoir. Do not discharge into any municipal sewer system without municipal approval. The contractor shall be responsible for cleaning any storm drain system, which was used for dewatering discharge.

- iii) Excavated material shall be placed in a manner that will not obstruct the work nor endanger the workmen, obstruct sidewalks, driveways, or other structures and shall be done in compliance with federal, state, or local regulations.

3. Pavement Removal

Removal of pavement and road surfaces shall be a part of the trench excavation, and the amount removed shall depend upon the width of trench required for installation of the pipe and the dimensions of area required for the installation of valves, hydrants, specials, manholes or other structures. The dimensions of pavement removed shall not exceed the dimensions of the opening required for installation of pipe, valves, hydrants, specials, manholes and other structures by more than twelve (12") inches in any direction, unless otherwise required or pre-approved by the Engineer.

4. Width

See City Standard Bedding and Trench Detail.

5. Bell Holes

Holes for the bells shall be provided at each joint, but shall be no larger than necessary for joint assembly and assurance that the pipe barrel will lie flat on the trench bottom. Other than noted previously, the trench bottom shall be true and even in order to provide support for the full length of the pipe barrel, except that a slight depression may be provided to allow withdrawal of pipe slings or other lifting tackle.

6. Subgrade in Earth

- a. Where a firm and stable foundation for the pipe can be obtained in the natural soil, and where special embedment is not shown on the plans, or specified herein, carefully and accurately trim the bottom of the trench to fit the lower portion of the pipe barrel. The bottom of the trench shall be firm, stable and free of standing water.
- b. If water is allowed to collect in an originally dry trench after a reasonable time has passed to complete the embedment of the pipe, as determined by the Engineer, the contractor shall place a minimum of four (4") inches of clean rounded pea gravel in the ditch and pump out all accumulated water before placing the pipe. No deleterious materials will be allowed in the gravel. No extra compensation will be allowed for this work.
- c. Where wet, soft, or spongy material is encountered in the excavation at subgrade level, the contractor shall remove such material at the direction of the Engineer and replace it with crushed stone of sufficient quantity such that when fully compacted, the subgrade is firm and stable.

7. Subgrade in Rock

- a. When excavation of rock is encountered, all rock shall be removed to provide a clearance of at least six (6") inches below and on each side of all pipe, valves and fittings for pipe sizes twenty-four (24") inches or smaller, and nine (9") inches for pipe sizes thirty (30") inches and larger. When excavation is completed, the proper embedment material shall be placed on the bottom of the trench to the previously mentioned depths, leveled and tamped.

- b. These clearances and bedding procedures shall also be observed for pieces of concrete or masonry and other debris or subterranean structures, such as masonry walls, piers or foundations that may be encountered during excavation.
- c. The installation procedures specified in this section shall be followed when gravel formations containing loose boulders greater than eight (8”) inches in diameter are encountered.
- d. In all cases, the specified clearances shall be maintained between the bottom of all pipe and appurtenances and any part, projection or point of rock, boulder or stones of sufficient size and placement, which, in the opinion of the Engineer, could cause a fulcrum point.

F. CONCRETE ENCASEMENT

The Contractor shall place 2,000 psi concrete encasement under and around pipe as shown on the embedment detail, and provide necessary anchors to prevent the pipe from floating out of place. The contractor shall remove and relay any pipes that are floated out of proper position

G. BACKFILLING

1. General

- a. The Contractor shall not begin backfilling until approval has been obtained from the Inspector. Backfilling includes refilling and consolidation of the fill in trenches and excavations up to the natural ground surface or road grade.
- b. Backfill shall be accomplished in accordance with the specified laying condition as shown on the plans.

2. Backfill Material

- a. All backfill material shall meet latest edition of ASTM D2321 unless otherwise specified by the Engineer.
- b. If excavated material is indicated on the drawings or specified for backfill, and there is a deficiency due to a rejection of part thereof, the contractor shall provide the required amount of sand, gravel or other pre-approved material.

3. Do not leave trenches open overnight without backfilling to the natural ground level. Steel plates (1/2” in thickness) may be used to cover open trenches only with the approval of the Engineer.

4. Compaction

Compaction requirements are as specified on the plans.

END OF SECTION

SECTION 31 25 13

EROSION AND SEDIMENTATION CONTROL**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. The work covered by this section consists of the installation and maintenance of all erosion siltation control devices, wash down areas, or seeding and sodding applications necessary to effectively prevent storm water pollution of adjoining or downstream areas that may occur as a direct or indirect result of the construction of this project. The contractor is responsible for creating and maintaining the storm water pollution prevention plan by utilizing the base sheets and narrative provided in the bid documents. The contractor is also responsible for submitting the Notice of Intent (NOI) and Notice of Termination (NOT) and conducting inspections as required by the Texas Commission on Environmental Quality (TCEQ.) The required forms for these activities are included in the bid documents.

The engineer will provide:

1. Base Sheets for Erosion Control Plan (ECP)
2. The Narrative for the Storm Water Pollution Prevention Plan (SWPPP)

The contractor will generate, submit, and maintain the:

1. ECP
2. SWPPP
3. NOI (if required)
4. NOT (if required)

1.2 MEASUREMENT AND PAYMENT

Erosion and Sediment Control is measured as a lump sum item.

The work and materials as prescribed by this item will be paid on the following schedule:

- A. 25% of the bid value shall be paid when the erosion control plan is fully detailed and implemented, the NOI (if required) is submitted to both TCEQ and the City Inspector, and all of the initial erosion control devices have been installed and are in working order.
- B. 50% of the value will be prorated for the installation and maintenance of erosion control devices during the course of construction as a percent of the total contract value. If the sediment trapping devices on the site appear to be un-maintained, no payment of this portion of the item shall be paid.
- C. 25% will be paid at the completion of construction when the site is stabilized, the NOT is submitted to both TCEQ and the City Inspector and all erosion control devices are removed from the site.

1.3 SUBMITTALS

- A. The contractors shall submit the initial erosion control plan along with the NOI (if required) prior to receiving a notice to proceed.
- B. If required, the Contractor is responsible for filing a “Notice of Intent” (NOI.) The contractor shall comply with all TCEQ and EPA regulations and pay the filing fees associated with the regulations. Fees associated with these regulations are subsidiary to the bid item Storm Water Prevention. The forms are available at:

<http://www.tceq.state.tx.us/assets/public/permitting/waterquality/forms/20022.pdf>
<http://www.tceq.state.tx.us/assets/public/permitting/waterquality/forms/20023.pdf>

- C. Said NOI must be postmarked two days before construction begins. NOI's and NOT's shall be submitted to the address shown on the forms. It is the Contractor's responsibility to file and provide the owner a copy of the Notice of Termination (NOT) at the completion of the project.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION

3.1 GENERAL

- A. It is the responsibility of the Contractor to utilize whatever techniques are necessary to address erosion problems as they occur during construction.
- B. Siltation control and sediment trapping devices shall be installed prior to site clearing, grading or utility construction operations. All devices should be positioned so as to effectively remove silt from storm water before it leaves the site. Of particular concern, are gravel or stone blankets placed at construction traffic exits and entrances. These controls should be closely monitored to see that they trap sediment before it reaches the existing street and drainage system.
- C. Construction activities should be phased to expose a minimum of graded area at one time. Earth exposed by the construction process shall be re-vegetated every two weeks until vegetation is established. Re-vegetation shall require seeding, hydromulching or sodding. Fresh growth of vegetation shall eliminate the need for additional re-vegetation but does not constitute stabilization.
- D. Should a construction process remove any portion of the perimeter controls, the controls should be replaced in accordance with the TCEQ guidelines. Prior to the completion of the project, all bare areas shall be re-vegetated with a cellulose fiber hydromulch seeding process or sodded.
- E. Siltation control devices placed at storm drain inlets and culverts shall be removed by the Contractor once the site has been stabilized.

3.2 MAINTENANCE AND INSPECTION

- A. The contractor shall familiarize himself with the erosion control requirements of TCEQ. The site superintendent, or his representative, shall make a visual inspection of all structural and/or natural controls and newly stabilized areas as required by TCEQ, especially after a rainfall to insure that all controls are maintained and properly functioning. Any damaged controls shall be repaired prior to the end of the work day, including re-seeding and mulching or re-sodding if necessary. All inspections shall be documented with a written report. Reports shall include the effectiveness of erosion control measures, construction activities conducted since the last report and their location. Reports shall be maintained by the Contractor along with the Erosion Control Plan per the TCEQ guidelines.
- B. The contractor is responsible for the ECP. The contractor shall continuously update the plan with all changes. Areas already stabilized shall be noted on the plan. All sediment trapping devices shall be installed as soon as practical after the area has been disturbed (never more than 14 days). All sediment trapping devices shall be cleaned when the sediment level reaches 25% capacity. Sediment shall be disposed of by spreading on site or hauling away if not suitable for fill.

- C. The Contractor shall be responsible for any and all materials, improvements, and maintenance activities necessary to keep dust, silt, and mud from leaving the work zone, including being tracked by vehicles traveling throughout the zone.
- D. Should, in the opinion of the Owner, the Contractor fail to prevent the escape of dust or contain silt and mud within the project, after due notification by the City Representative, Owner forces will be used to clean up those affected areas, and the cost of same will be deducted from the contract.
- E. Prior to Substantial Completion, the Contractor shall verify that no dust, silt, or mud exists within the work zone in deposits deeper than two inches (2”) as a result of the contractor’s containment procedures. Should the Contractor claim final completion without removing such deposits, they will be removed by Owner forces and the cost of which shall be deducted from the contract.

END OF SECTION

SECTION 31 50 00

TRENCH SAFETY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work specified under this section requires the Contractor to provide for the safety of the workmen in strict compliance with 29 CFR Part 1926 1993 (Revised as of July 1, 1996 of latest Edition or Revision to) Excavations and Applicable Subparts. The submission of a “TRENCH SAFETY PLAN” which shall fully satisfy the requirements of this specification is required prior to a notice to proceed to start the project.

1.2 MEASUREMENT

A. MEASUREMENT

Measure “Trench Safety” as shown on the bid proposal. Shoring of trench at manholes and other unusual structures to be included in this cost.

B. PAYMENT

Pay for “Trench Safety” as shown on the bid proposal. Payment to be full compensation for all work described herein. There will be no increase in the Contract price because of the incorporation of CONTRACTOR’s Trench Safety Plan or CONTRACTOR’s detailed plans and specifications for the trench safety system into the bid documents and the Construction Contract. There will be no increase in the Contract price because of modifications to CONTRACTOR’s plan and/or the CONTRACTOR’s detail plans and specifications for the trench safety system, whether or not the result of unforeseen or differing site or soil conditions.

“Trench Safety Plan” shall be included as part of the “Trench Safety” bid item and shall not be paid for as a separate pay item.

1.3 SUBMITTALS

A. CERTIFICATES

Submit manufacturer’s “Certificate of Compliance,” stating that the devices (trench boxes, speed shoring, etc.) to be used for trench safety comply with the requirements of this specification. The certificate should show the design assumptions and limitations of the device and should be sealed by an engineer registered and licensed to practice in the state of Texas.

B. TRENCH SAFETY PLAN

Submit a detailed TRENCH SAFETY PLAN for all work areas. Calculations shall be provided for any areas beyond the capacity of the trench box or speed shoring and sealed by an engineer registered and licensed to practice in the state of Texas. This plan shall include evacuation routes for personnel.

C. COMPETENT PERSON

Contractor shall have a “Competent Person” with regard to OSHA standards, on site at all times. Competent person is generally defined as an individual who, by training and experience, is knowledgeable of applicable standards, capable of identifying hazards, is

designated by the employer, and has the authority to take actions as needed. Contractor shall provide written proof showing the competent person(s) for the work being performed.

PART 2 – PRODUCTS

2.2 MATERIALS

A. MATERIALS

1. Timber

Trench sheeting materials shall be full size, a minimum of 2 inches in thickness, solid and sound, free from weakening defects such as loose knots and splits.

2. Sheet Piling

Steel sheet piling shall conform to one or more of ASTM A328/328M, ASTM A572/A572M/ ASTM A690/A690M material requirements.

3. Structural Steel

Steel for stringers (wales) and cross braces shall conform to ASTM A588.

4. Trench Boxes

Steel trench Boxes to be constructed of steel conforming to ASTM A36/A36M. Connecting bolts used to conform to ASTM A307. Welds shall conform to the requirements of AWS D1.1.

5. Miscellaneous

Miscellaneous materials to be utilized shall conform to applicable ASTM standards.

B. REFERENCED SPECIFICATIONS

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

American Society of Testing and Materials (ASTM)

ASTM A36/A36M	1997 Standard Specification for Carbon Structural Steel
ASTM A307	1997 Revision A-Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile length
ASTM A328/A328M	1996 (REV) Standard Specification for Steel Sheet Piling
ASTM A572/A572M	1997 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
ASTM A588/A588M	1997 Standard Specification for High-Strength Low-Alloy Structural Steel With 50 ksi (345 MPa) Minimum Yield Point to 4 inch (100 mm) thick
ASTM A690/A690M	1994 Standard Specification for High-Strength Low-Alloy Steel H-Pipes and Sheet Piling for Use in Marine Environments

American Welding Society, Inc. (AWS)

AWS D1.1	1998 Structural Welding Code-Steel
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Occupation Safety And Health Administration (OSHA)

29 CFR Part 1926	1993 (Revised as of July 1, 1996 of latest Edition or Revision to) Excavations and Applicable Subparts
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PART 3 – EXECUTION**3.1 CONSTRUCTION METHODS****A. GENERAL:**

The trench safety system shall be constructed, installed and maintained in accordance with the Trench Safety Plan as outlined in 131.03. Bed and backfill pipe to a point at least one (1) foot above top of pipe or other embedded items prior to removal of any portion of trench safety system. Bedding and backfill shall be in accordance to other applicable Specification Sections. Backfilling and removal of trench supports shall be in accordance with Contractor's Trench Safety Plan. Removal of trench safety system to be accomplished in such a manner to cause no damage to pipe or other embedded items. Remove no braces or trench supports until all personnel have evacuated the trench. The trench shall be backfilled to within 5 feet of natural ground prior to removal of entire trench safety system.

B. SUPERVISION:

Provide competent supervisory personnel at each trench while work is in progress to ensure Contractor's methods, procedures, equipment and materials pertaining to the safety systems in this Section are sufficient to meet requirements of OSHA Standards.

C. INSPECTION:

The CONTRACTOR shall make daily inspection of trench safety system to ensure that the system meets OSHA requirements. Daily inspection shall be made by competent personnel. If evidence of possible cave-ins or slides is apparent, all work in the trench is to cease until necessary precautions have been taken to safeguard personnel entering trench. The CONTRACTOR shall maintain permanent record of daily inspections.

D. TIMBER SHEETING

Timber sheeting and size of uprights, stringers (wales,) and cross bracing to be installed in accordance with the TRENCH SAFETY PLAN. Place cross braces in true horizontal position, spaced vertically, and secure to prevent sliding, falling or kick outs. Cross braces to be placed at each end of stringers (wales) in addition to other locations required. Cross braces and stringers (wales) to be placed at splices of uprights, in addition to other locations required.

E. STEEL SHEET PILING

Steel sheet piling of equal or greater strength may be used in lieu of timber trench shoring shown in the OSHA tables (proposed standards). Drive steel sheet piling to a least minimum depth below trench bottom as recommended by CONTRACTOR's Registered Licensed Professional Engineer providing design. Place cross braces in true horizontal position and spaced vertically. Secure to prevent sliding, falling, or kick outs. Cross braces to be placed at each end of stringers (wales), in addition to other locations required.

F. MAINTENANCE OF SAFETY SYSTEM

The safety system to be maintained in the condition as shown on the Trench Excavation and Shoring Safety Plan as designed by the CONTRACTOR's Registered Licensed Professional ENGINEER. The CONTRACTOR shall take all necessary precaution to ensure the safety systems are not damaged during their use. If at any time during its use a safety system is damaged, personnel to be immediately removed from the trench excavation area and the safety system repaired. The CONTRACTOR is to take all necessary precautions to ensure no loads, except those provided for in the plan, are imposed upon the trench safety system.

END OF SECTION

SECTION 31 78 00

PIPE BORING, JACKING, TUNNELING AND ENCASUREMENT

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. The work to be performed under this Specification shall consist of furnishing and installing all materials and equipment and performing all labor required to install pipelines crossing under highways, railroads, and streets by boring, jacking, and tunneling, as specified herein. **All sewer bores will be accomplished by dry mechanical bore unless otherwise pre-approved by the Engineer.** Water line bores may utilize the wet boring technique. All carrier pipes within the encasement conduit shall be restrained joint pipe of the type specified on the plans, or pre-approved by the Engineer.
- B. When the work per this item falls within a TxDOT or Railroad right of way, the stricter of the applicable standards apply. This requirement includes all insurance, notification, permitting, signage, etc. required by the right of way owner.

1.2 MEASUREMENT AND PAYMENT**A. MEASUREMENT**

- 1. Openings provided by boring, jacking, and tunneling (including carrier pipe) will be measured by the linear foot along the centerline of the opening, as measured from end of pipe to end of pipe placed by boring, jacking and tunneling. There will not be any classification for payment according to depth.
- 2. Concrete support slab in the pits and all other work necessary to meet the requirements of the Texas Department of Transportation, railroad company, County, and City will not be measured.
- 3. Openings provided by boring, jacking and tunneling will be paid for at the unit price bid per linear foot. The unit price bid for boring jacking and tunneling shall be full compensation for furnishing and placing all materials, labor, tools, carrier pipe, carrier pipe restraint, casing spacers, equipment, pits, concrete support slabs and incidentals necessary to complete the work.

1.3 SUBMITTALS

- A. Submit manufacturer's product data on encasement pipe.
- B. Submit manufacturer's "Certificate of Compliance" to this part of the specifications for materials furnished for the project.
- C. The Contractor or subcontractor performing the work described under this section shall demonstrate technical skill and experience in previous work of this nature. Work experience shall be submitted to the Engineer.
- D. Casing spacer data sheets demonstrating compliance with this specification.

PART 2 – PRODUCTS

2.1 MATERIALS

Steel Pipe, Ductile Iron Pipe, Reinforced Concrete Pipe, and PVC Pipe may be used as encasement material, unless otherwise shown on the plans. The nominal inside diameter of the encasement pipe shall be as indicated below, unless otherwise shown on the plans.

A. STEEL PIPE

Encasement pipe shall conform to ASTM Specification A134, Mild Carbon Steel, A139, Grade A, or AWWA C200-91 Grade B, butt-welded joints with entire circumference welded by a certified welder shall be in accordance with AWWA C200-86 Section 3. All steel casing shall have a wall thickness as shown in the table below:

Carrier Pipe Nominal Diameter	Casing Pipe Nominal Diameter	Casing Pipe Minimum Thickness ¹
6"	14"	3/8"
8"	16"	3/8"
<u>10"</u>	<u>18"</u>	<u>3/8"</u>
12"	20"	3/8"
16"	24"	3/8"
18"	30"	1/2"
24"	36"	1/2"

1. Casing Pipe Thickness for Railroad crossings shall be a minimum of 1/2-inch thick regardless of diameter.
2. Nominal diameter of casing pipe may be larger as needed for restrained joint pipe.

B. DUCTILE-IRON PIPE

Encasement pipe shall conform to the current AWWA C150 and C151 standards. Pipe shall be thickness Class 250 or greater, unless otherwise shown on the plans.

C. REINFORCED CONCRETE PIPE

Encasement pipe shall conform to the current ANSI C-76 standards. Pipe shall be Class III or IV, unless otherwise shown on the plans.

D. PVC PIPE

Encasement pipe shall conform to the current ASTM D2241 or AWWA C905 standards. Pipe shall be DR 26 or SDR 26, unless otherwise shown on the plans. PVC pipe shall be used only when specified on the plans.

E. GROUT

Grout shall be in accordance with SECTION 04 05 12 – MORTAR AND GROUT.

F. CASING SPACERS

Stainless Steel casing spacers shall be required in all casing pipes and shall be manufactured by Cascade Products, Advance Products & Systems, Inc model no. SSI8 or approved equal. The casing spacers shall be affixed to the carrier pipe at a spacing of 6'8" or per the manufacturers recommendations if less than 6'8".

G. END SEALS

End seals shall be 1/8" thick synthetic rubber secured with stainless steel banding straps. Other end seals shall be constructed only as pre-approved by the engineering inspector.

2.2 TESTING REQUIREMENTS

A. ALLOWABLE TOLERANCES

Where grades or elevations are shown on the plans for the pipeline to be installed by boring, jacking, and tunneling operations, maximum deviation of plan elevation shall be 0.2 foot. The maximum deviation of alignment over the length of the bore shall be 0.2 foot. The Engineer shall determine the corrective action to be taken for tolerances above those stated in this specification.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. ENCASEMENT REQUIREMENTS

Encasement pipe shall be required for all water mains crossing major collector and arterial street crossings. Encasement pipe for sewer mains shall be placed as required by the City Engineer. The casing pipe shall extend two feet (2') beyond the back of curb. Encasement pipes may be installed by open cut with the approval of the engineer.

B. BORE AND TUNNEL PITS

Unless more stringent requirements regarding location of bore and tunnel pits are noted on the plans, or are required by TXDOT, Railroad, County, or City, to conform to the requirements that follow:

1. The Conduit to be installed by boring, jacking and tunneling shall extend to distances as shown in the Standard Details.
2. If necessary to prevent cave-ins, sheet, shore, or brace the pit in accordance with OSHA regulations. All pits shall be covered with 1/2" thick steel plates. Steel plates shall be on-site prior to excavating the pit. If bore pits are too big to cover with steel plates, Contractor shall install chain link fence, completely and securely, around exposed pit to a height of 6 feet.
3. General: Unless otherwise noted, extend auger hole 10 feet beyond edge of pavement, railroad tie, or other structure. The hole is to be bored mechanically, using a pilot hole. An approximate 2-inch hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings, jetting will not be permitted. In unconsolidated soil formations, a gel-forming colloidal drilling fluid consisting of at least 10 percent of high-grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the pipe immediately thereafter. Overcutting in excess of one inch shall be remedied by pressure grouting the entire length of the installation.

3.2 CONSTRUCTION METHODS FOR DRY BORING

- A. All sewer bores will be accomplished by dry mechanical bore unless otherwise pre-approved by the Engineer.
- B. Only workmen experienced in boring operations shall perform the work.

- C. The use of water or other fluids in connection with the boring operation will NOT be permitted except for a minor required amount of bentonite solution for cutting head.
- D. The casing pipe shall be placed in the bore hole simultaneously while boring is being performed. Installing the encasement conduit immediately by pulling it in place from opposite the boring machine or by jacking the conduit through the bore is not acceptable. Take proper care to secure the joints of the conduit as subsequent sections are installed by welding joints. Provide a steel rail or timber cradle in the pit to support and guide the conduit in its installation.
- E. If after completion of the installation of the conduit, there is more than one inch (1") clearance between the outside of the barrel of the conduit and the wall of the bore, grouting of these voids will be required. If during construction of the bore, a cave-in occurs within the bore, grouting of the voids between the conduit and the walls of the bore will be required throughout the length of the bore.
- F. Conform to the requirements of the Texas Department of Transportation, Railroad Company, County, or City having jurisdiction over the right-of-way involved, as to details of construction methods and time of construction. All work necessary to meet the requirements of the Texas Department of Transportation, Railroad Company, County, or City will be considered incidental to the installation of the pipeline in the right-of-way. The Contractor shall abide by the more stringent of these specifications, or the specifications of the regulatory agencies.

3.3 CONSTRUCTION METHODS FOR WET BORING

- A. All sewer bores will be accomplished by dry mechanical bore unless otherwise pre-approved by the Engineer. (see above)
- B. Only workmen experienced in boring operations shall perform the work. A pilot hole must be successfully completed to the satisfaction of the engineer prior back reaming the bore.
- C. The use of water or other fluids in connection with the boring operation will be permitted only to lubricate cuttings. Jetting will not be permitted. In consolidated soil formations, a gel-forming colloidal drilling fluid consisting of at least ten (10%) percent of high-grade bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and lubricate removal of cuttings and installation of the pipe immediately thereafter.
- D. While boring is being performed, install the encasement conduit immediately by pulling it in place from opposite the boring machine or by jacking the conduit through the bore. Encasement conduit may be placed after the boring operation is complete, if permission is obtained from TXDOT, the railroad company, the City, or the County. Take proper care to secure the joints of the conduit as subsequent sections are installed, by use of cables or welding joints. Provide a steel rail or timber cradle in the pit to support and guide the conduit in its installation.
- E. If after completion of the installation of the conduit, there is more than one inch (1") clearance between the outside of the barrel of the conduit and the wall of the bore, grouting of these voids will be required. If during construction of the bore, a cave-in occurs within the bore, grouting of the voids between the conduit and the walls of the bore will be required throughout the length of the bore.
- F. Grouting material and equipment shall be on the jobsite before beginning installation of the conduit, in order that the grouting around the encasement conduit is to be started immediately after pipe is in place.

- G. Conform to the requirements of the Texas Department of Transportation, Railroad Company, County, or City having jurisdiction over the right-of-way involved, as to details of construction methods and time of construction. All work necessary to meet the requirements of the Texas Department of Transportation, Railroad Company, County, or City will be considered incidental to the installation of the pipeline in the right-of-way. The Contractor shall abide by the more stringent of these specifications, or the specifications of the regulatory agencies.

3.4 CONSTRUCTION METHODS FOR JACKING

- A. Unless otherwise specified, the methods and equipment used in jacking conduit shall be the Contractor's option, provided that the proposed method is pre-approved by the Engineer. Such approval, however, shall in no way relieve the Contractor of the responsibility for making a satisfactory installation meeting the criteria set forth herein.
- B. If, after completion of the installation of the conduit, there is more than one (1") inch clearance between the outside of the barrel of the conduit and the wall of the tunnel, the Contractor shall completely grout the conduit in place throughout its entire length. If, during the jacking operation, a cave-in occurs, the Contractor shall grout the entire conduit in place throughout its entire length.

3.5 CONSTRUCTION METHODS FOR TUNNELING

- A. Excavate the tunnel in such a manner and to such dimensions that will permit placing of the proper supports **in accordance with OSHA Regulations** necessary to protect the excavation. Make adequate provisions for the safety and health of the workmen. Use only air or electric powered equipment in the tunnel. Provide adequate illumination and ventilation.
- B. Excavate only enough earth to allow installation of the tunnel liner plate. Remove earth from within tunnel and install the next section of tunnel liner plates.
- C. After completion of the tunnel, or at intervals directed by the Engineer, grout the entire void between the tunnel lining. If after completion of the tunnel there are sags in invert of the liner that exceed 0.2 feet of a straight line projected through the tunnel, grout the invert to eliminate the sags.

3.6 SPECIAL PROVISIONS FOR BELL & SPIGOT ENCASEMENT PIPE

- A. Where pipe using bell and spigot joints is installed as encasement pipe, completely grout the voids between the outside of the encasement pipe and the inner wall of the bore or tunnel throughout the length of the pipe. If directed by the City Engineer, the joints shall be welded to prevent the joints from slipping with respect to each other.

3.7 SUPPORT OF PIPES ACROSS BORE OR TUNNEL PITS

- A. After completion of the bore or tunnel and installation of the carrier pipe with the bore or tunnel, remove all loose earth and debris from the pit down to undisturbed earth. Pour a continuous 2,000 psi concrete or cement stabilized sand support under the carrier pipe from the edge of the bore or tunnel to the first joint in the trench past the end of the pit. The concrete support shall be brought up to the horizontal centerline of the pipe.

3.8 CARRIER PIPE

- A. Carrier pipe may be pushed or pulled through the completed encasement pipe. Casing spacers by Cascade Waterworks or pre-approved equivalent should be placed on the carrier pipe to insure approximate centering within the encasement pipe and to prevent damage during installation. Care must be exercised in order to avoid metal-to-metal contact. The ends of the encasement pipe will be sealed with rubber seals and stainless steel bands. In order to avoid the transfer of earth and live loads to the carrier pipe, the space between the carrier pipe and encasement pipes shall not be filled completely.
- B. All carrier pipe installed within a casing shall be restrained. The restrained section shall extend at least five feet (5') beyond both ends of the casing pipe. Lock joint pipe, retainer glands, or restrainer gaskets may be used for this application.
- C. When ductile iron pipe is used for the carrier pipe, all ductile iron pipe shall be poly-wrapped per the specifications.

3.9 SPOILS

- A. Spoil locations shall be pre-approved by the engineering inspector. When no suitable location for spoil can be found on site, the contractor shall be required to haul and dispose of this material at no extra cost. Where spoils are to be placed on parking areas (asphalt or concrete), sidewalks, or other paved surfaces, the spoils shall be placed on a barrier to prevent the soil from embedding into the paved surface.

END OF SECTION

SECTION 32 92 13

HYDRO-MULCH SEEDING

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work covered by this section consists of furnishing all plant, labor, materials, equipment, supplies, supervision and tools and performing all work necessary to top soiling, smoothing, seeding, fertilizing, watering, maintenance and cleanups of side slopes, all in accordance with these specifications.
- B. The hydro-mulch seeding operations, together with all necessary related work, shall conform to the requirements specified in this section. The area(s) to be hydro-mulch seeded shall be as shown on the construction drawings.

1.2 MEASUREMENT AND PAYMENT

- A. The unit of measurement for all work performed and materials furnished, as described herein, will be the acre or per station as indicated in the bid documents. Measurement shall be done upon completion of the work performed within the limits shown on the drawings and as described herein. The area measured for payment will be computed to the nearest 1/10-acre or station.
- B. Payment for hydro-mulch seeding will be made at the contract unit price per acre or per station and includes topsoil (when specified), smoothing, mulch, seed fertilizer, watering, maintenance and clean-up. Additional payment shall not be made for those areas that are replanted.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. All seed must meet the requirements of the U.S. Department of Agriculture Rules & Regulations as set forth in the Federal Seed Act and the Texas Seed Law.
- B. Type of seed, purity and germination requirements, rate of application and planting dates are as follows:

TABLE 1
Application
Rate-Pounds

<u>Type</u>	<u>Per Acre</u>	<u>Planting Date</u>
Hulled Common Bermuda Grass 98/88	40	Jan. 1 to Apr. 15
Unhulled Common Bermuda Grass 98/88	40	Jan. 1 to Apr. 15
Annual Rye Grass, including Gulf	50	Jan. 1 to Apr. 15
Hulled Common Bermuda Grass 98/88	40	Apr. 15 to Oct. 1

Hulled Common Bermuda Grass 98/88	40	Oct. 1 to Jan. 1
Unhulled Common Bermuda Grass 98/88	40	Oct. 1 to Jan. 1

- C. Fertilizer shall be water soluble with an analysis of 10 percent nitrogen, 20 percent phosphoric acid and 10 percent potash. Rate of application shall be 500 pounds per acre, except during the period of April 15 through September 1, when the rate shall be reduced to 400 pounds per acre. The fertilizer shall be delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable State Fertilizer Laws and bearing the name and warranty of the producer.
- D. Mulch shall be virgin wood cellulose fiber made from whole wood chips. Within the fiber mulch material, at least 20 percent of the fibers will be 10.7 mm in length and 0.27 mm in diameter. Rate of application shall be 2000 pounds per acre. Soil stabilizers such as Terra Type III (or pre-approved equal) shall be applied at a rate of 40 pounds per acre on side slopes and Terra Tack I (or pre-approved equal) shall be applied at a rate of 40 pounds per acre on flatter portions.
- E. Wood cellulose fiber mulch, for use in the grass seed and fertilizer, shall be processed in such a manner that it will not contain germination or growth inhibiting factors. It shall be dyed an appropriate color to allow visual metering of its application. The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like ground cover, which readily absorbs water and allows infiltration to the underlying soil. Weight specifications from suppliers for all applications shall refer only to the underlying soil. Weight specifications from suppliers, shall refer only to the air dry weight of the fiber. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds and must be marked by the manufacturer to show the dry weight content. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished and that it meets all of the foregoing requirements.
- F. Water shall be free from oil, acid, alkali, salt and other substances harmful to the growth of grass. The water source shall be subject to approval, prior to use.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. **EXECUTION:** Immediately after the finished grade has been approved, begin hydro-mulching operations to reduce erosion and excessive weed growth.

Hydraulic equipment used for the application of fertilizer, seed and slurry of prepared wood fiber mulch shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend and homogeneously mix a slurry containing up to forty (40) pounds of fiber plus a combined total of 70 pounds of fertilizer solids for each 100 gallons of water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles which provide even distribution of the slurry on the area to be seeded. The slurry tank shall have a minimum capacity of 800 gallons and shall be mounted on a traveling unit, which may either be self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded, so as to provide uniform distribution without waste. The Engineer may authorize equipment with a smaller tank capacity, provided the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.

Care shall be taken that the slurry preparation takes place on the site of the work. The slurry preparation should begin by adding water to the tank when the engine is at half throttle. When the water level has reached the height of the agitator shaft, good recirculation shall be established and seed shall be added. Fertilizer shall then be added, followed by wood pulp mulch. The wood pulp mulch shall only be added to the mixture after the seed and when the tank is at least one-third filled with water. The engine throttle shall be opened to full speed when the tank is half filled with water. All the wood pulp mulch shall be added by the time the tank is two-thirds to three-fourths full. Spraying shall commence immediately when the tank is full. The operator shall spray the area with a uniform visible coat, by using the green color of the wood pulp as a guide.

- B. **APPLICATION:** The contractor shall obtain approval of hydro-mulch area preparation from the Engineer prior to application.

Operators of hydro-mulching equipment shall be thoroughly experienced in this type of application. Apply the specified slurry mix in a motion to form a uniform mat at the specified rate. Operators shall keep the hydro-mulch within the areas designated and keep from contact with other plant material. Immediately after application, thoroughly wash off any plant material, planting areas or paved areas not intended to receive slurry mix.

Keep all paved and planting areas clean during maintenance operations. Contractor shall keep hydro-mulching within the areas designated and keep from contact with other plant material. If in the opinion of the Engineer, unplanted skips and areas are noted after hydro-mulching, the contractor shall be required to seed the unplanted areas with the grasses that were to have been planted at no additional cost to owner.

- C. **CONTRACTOR'S MAINTENANCE & GUARANTEE PERIOD:** The hydro-mulch seeding shall be adequately watered until established. Any areas damaged by erosion or areas that do not have an acceptable turfing shall be redone to the satisfaction of the Engineer. Maintenance of grass areas shall be for 60 days after the completion of the project and shall consist of watering, weeding, repair of all erosion and reseeding, as necessary to establish a uniform stand of the specified grasses. Contractor shall guarantee growth and coverage of hydro-mulch planting under this contract to the effect that a minimum of 95% of the area planted will be covered with the specified planting after 60 days.

The Contractor shall be responsible for one (1) mowing every two weeks between the months of April to October. The Contractor shall also be responsible for one (1) mowing every three (3) weeks between the months of November to March. In addition, the Contractor shall water the entire sodded and hydro-mulched areas to a saturated depth of one (1) inch at least once a week between the months of April to September and at least once a month between the months of October to March.

The Contractor shall make a second application of specified hydromulch planting those bare areas not meeting specified coverage as determined by the Engineer. Such replanting is to be performed within 60 days of initial application and upon notification by the Engineer to replant.

The Contractor shall apply top dress fertilizer (delayed action), at the rate of 10 pounds per 1000 square feet at 25 days after hydro-mulching of all new lawn areas.

Top dress fertilizer shall be 16-6-8.

Prior to final inspection, the Contractor shall mow the entire right-of-way within the project limits, including weeding around existing structures.

END OF SECTION

SECTION 32 92 19

SEEDING FOR EROSION CONTROL

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. Seeding shall consist of preparing ground, providing for sowing of seeds, mulching with straw, hay or cellulose fiber and other management practices along and across such areas as are designated on the plans and in accordance with these specifications. Note that a bid item for “SEEDING” does not constitute the requirement for fertilizer, mulch, and/or mesh unless the additional requirements are stated on the plans or special conditions.

1.2 MEASUREMENT AND PAYMENT

- A. FERTILIZING: Measure by the acre or as indicated in the proposal. Payment for work under this item will be made at the contract price bid for "Fertilizing for Erosion Control", which price is full compensation for all fertilizer, equipment, materials and labor necessary for fertilizing.
- B. SEEDING: Measure by the acre or as indicated in the proposal. Payment for work under this item will be made at the contract price bid for "Seeding for Erosion Control", which price is full compensation for all seeding, watering, equipment, materials and labor necessary for seeding.
- C. STRAW MULCH SEEDING: Measure by the square yard or as indicated in the proposal. Payment for work under this item to be made at the contract price for "Straw Mulch Seeding", which price to be full compensation for all fertilizer, seed, straw mulch, equipment, watering, materials and labor necessary for fertilizing and seeding.
- D. FIBER MAT SEEDING: Measure by the square yard or as indicated in the proposal. Payment for work under this item to be made at the contract price for "Fiber Mat Seeding", which price to be full compensation for all fertilizer, seed, fiber mat, watering, equipment, materials and labor necessary for fertilizing and seeding.
- E. PAPER MESH SEEDING: Measure by the square yard or as indicated in the proposal. Payment for work under this item is to be made at the contract price for "Paper Mesh Seeding", which price to be full compensation for all fertilizer, seed, paper mesh, watering, equipment, materials and labor necessary for fertilizing and seeding.

1.3 SUBMITTALS

- A. Source of seeds
- B. Seed Mix
- C. Fertilizer
- D. Manufacturer’s data on Mulch Material
- E. Manufacturer’s data on Fiber Mat
- F. Manufacturer’s data on Paper Mesh

PART 2 – PRODUCTS

2.1 MATERIALS

- A. **GRASS SEED:** All seed must meet the requirements of the U.S. Department of Agriculture as set forth in the Rules and Regulations of the Federal Seed Act and the Texas Seed Law, including the labeling requirements for showing pure live seed, (PLS=purity x germination), name and type of seed. Seed furnished shall be of the previous season's crop and the date of analysis shown on each bag shall be within nine months of the time of use on the project. Each variety of seed shall be furnished and delivered in separate bags or containers. A sample of each variety of seed shall be furnished and delivered when directed by the Engineer. Seed which has been become wet, moldy or otherwise damaged in transit or storage will not be accepted. The amount of seed planted per acre, the type and the planting date shall be as indicated in the table below.

TABLE I

<u>Type</u>	<u>Rate of Application Planting Type in Pounds per Acre Date</u>	<u>Planting Date</u>
Unhulled Bermuda Grass	20	Jan. 1 to Apr. 1
Hulled Bermuda Grass	12	Apr. 1 to Oct. 1
Mix Bermuda & Rye in the following Proportions:		
Unhulled Bermuda Grass	12	
<u>Rye Grass</u>	50	Oct. 1 to Jan. 1

- B. **FERTILIZER:** Use pellet or granular fertilizer with analysis of 16 percent nitrogen, 20 percent phosphoric acid and zero percent potash (or 10-10-5), unless otherwise required. The container labels shall show the analysis. Powdered or caked fertilizers shall not be permitted. Unless otherwise indicated on the plans, fertilizer shall be applied uniformly at an average rate of 400 pounds per acre.
- C. **STRAW MULCH:** Straw mulch shall be oat, wheat, or rice straw. Hay mulch shall be prairie grass, bermuda grass, oat, wheat or rice stems or other hay as pre-approved by the Engineer. Do not use straw containing Johnson grass or other noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be molded or rotted. 164.5 Fiber Mat. Fiber mat to consist of machine produced mat of wood fibers, with consistent thickness throughout blanket. Use blanket with top side of netted twisted Kraft paper having high wet strength, or biodegradable extruded plastic mesh. Use blanket with a weight from 0.7 pounds per square yard to 1.0 pound per square yard.
- D. **PAPER MESH:** Use paper mesh consisting of Knitted construction of yarn with uniform openings interwoven with strips of biodegradable paper, furnished in rolls for suitable protection for outdoor storage. Use paper mesh of weight from 0.2 pounds per square yard to approximately 0.5 pounds per square yard.

PART 3 – EXECUTION**3.1 CONSTRUCTION METHODS**

- A. **GENERAL:** Fertilizing & Seeding. After areas to receive fertilizing and seeding has been completed to the lines, grades and sections shown on the plans, apply fertilizer at the uniform average rate of 400 pounds per acre. Thoroughly mix upper 3 inches of top soil with fertilizer until a uniform mixture of fertilizer and top soil is obtained. Sprinkle areas to be seeded with water, using fine spray to avoid washing or erosion of soil. Broadcast seed with sowing equipment at the rate specified above, using care to obtain uniform distribution. After broadcasting, lightly rake seeds into soil to a depth not to exceed 1/2 inch. Complete seeding by rolling with roller developing 15 to 25 pounds per inch of tread. Keep seeded areas moist for a period of 10 days immediately following placement. When watering seeded areas, use fine spray to prevent erosion of seeds or soil. Reseed any areas damaged by erosion.
- B. **STRAW MULCH SOIL RETENTION BLANKET:**
1. Fertilizing & Seeding: After ditch or slope has been completed to lines, grades and cross-sections shown on the plans, apply fertilizer and seed in accordance with the above. When seed and fertilizer are to be distributed as water slurry, mixture is to be applied within 30 minutes after all components are placed in the equipment.
 2. Mulch Application: Immediately upon completion of planting of seed and fertilizing, spray straw mulch uniformly over the area at the rate of 1 1/2 to 2 tons of hay or 2 1/2 tons of straw per acre. Mulching machine shall inject asphaltic material into straw uniformly as it leaves the equipment at the rate of 0.05 to 0.10 gallons of asphalt per square yard of mulched area. When watering seeded areas, use fine spray to prevent erosion of seeds or soil. Reseed any areas damaged by erosion for any reason. The mulching operation shall immediately follow seeding and fertilizing as a continuous operation.
- C. **FIBER MAT OR PAPER MESH SOIL RETENTION BLANKET:**
1. Fertilizing and seeding shall be in accordance with the above.
 2. Fiber Mat or Paper Mesh Installation: Place fiber mat or paper mesh within 24 hours after seeding operations have been completed. Prior to placing, clear the area to be covered of all rocks or clods over 1 1/2 inches in diameter and all sticks or other foreign material which will prevent close contact of the blanket with the soil. Area shall be smooth and free of ruts or other depressions. If as a result of a rain, prepared seed bed becomes crusted or eroded, or if eroded places, ruts or depressions exist for any reason, rework soil until smooth and reseed such areas. After area has been properly prepared, lay fiber mat or paper mesh flat, smooth and loosely without stretching or crimping material. Apply materials with lengths running parallel to the flow of water. When more than one width is required, butt or overlap edges as required by the manufacturer. Hold the material in place by means of a wire staple driven into the soil at an angle to the surface. Staple material along each edge and in a grid pattern with minimum 3 foot centers each way. In ditches and on slopes, provided additional stapling as recommended by the manufacturer.
- D. **CONTRACTOR MAINTENANCE & GUARANTEE PERIOD:** Maintenance of seeded areas shall be 60 days after successful completion of punch list items and shall consist of water and weeding, repair of all erosion and any reseeding as necessary to establish a uniform stand of the specified grasses. Contractor shall guarantee growth and coverage of seeding under this contract to the effect that a minimum of 95% of the area planted will be

covered with the specified grass after 60 days with no bare spots greater than 10 square feet. The Contractor shall be responsible for one (1) mowing every 2 weeks between the months of April to October. The Contractor shall also be responsible for one (1) mowing every three (3) weeks between the months of November to March. In addition, the Contractor shall water the entire sodded and hydro-mulched areas to a saturated depth of one (1) inch at least once a week between the months of April to September and at least once a month between the months of October to March. Contractor shall make a second application of seeding to bare areas not meeting specified coverage as determined by the Engineer. Such replanting is to be performed within 90 days of initial application and immediately upon notification by the Engineer to replant.

END OF SECTION

SECTION 32 92 23

SODDING FOR EROSION CONTROL (BLOCK SODDING)

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 – GENERAL**1.1 DESCRIPTION**

- A. Sodding for erosion control shall consist of providing and planting Bermuda grass, San Augustine grass, or other acceptable sod along or across such areas as are designated on the drawings and in accordance with the specification requirements herein outlined.

1.2 MEASUREMENT AND PAYMENT

- A. Work and acceptable material for block sodding will be measured by the square yard, complete and in place.
- B. Work performed and material furnished under “Measurement” will be paid for at the unit price bid for “Block Sodding”, which price shall be full compensation for furnishing materials, preparation of ground for planting, planting, raking, fertilizing, watering, sprinkling, maintenance, and for labor, tools, equipment and incidentals necessary to complete the work.

1.3 SUBMITTALS

- A. Contractor shall submit material data on the source of the sod including the date the sod was cut.

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. The sod shall consist of live, growing Bermuda grass, San Augustine grass, or other acceptable sod, (ninety-five percent pure), secured from sources where the soil is fertile and has been fumigated. The sod shall have a healthy virile root system of dense, thickly matted roots throughout. The sod shall be cut from the field so that there is a minimum of one-half inch of soil on the roots of the sod, and so that no roots show on the bottom of the soil. Sod shall be dense, with the grass having been mowed to 1 inch height before lifting from field. Sod shall be in a vigorous condition, dark green in color, free of disease and harmful insects. 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 free from obnoxious weeds 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.
- B. Care shall be taken at all times to retain the native soil on the roots of the sod during the process of excavation, hauling and planting. Sod material shall be kept moist from the time it is dug, until planted. When so directed by the Engineer, the sod existing at the source shall be watered to the extent required, prior to excavating. Do not stack sod for more than 36 hours between the time of cutting and the time of installation. The Engineer reserves the right to reject any sod deemed unacceptable for installation.

- C. All plantings shall be done between the average date of the last freeze in the spring and six weeks prior to the average date for the first freeze in the fall, according to the U.S. Weather Bureau.
- D. Fertilizer shall conform to the requirements of the Item, “Fertilizer” and shall be applied at the rate of 480-pounds per acre.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. Immediately after the finished grade has been approved, begin sodding operations to reduce excessive weed growth. If the sod bed is dry, immediately prior to sod installation, dampen the surface with a fine mist of water.
- B. Grass shall be turf sod, cut into 16 inch by 24 inch strips.
- C. All areas to be sodded shall be raked to true lines, free from all unsightly variations, bumps ridges or depressions. All sticks, stones, roots or other objectionable material which might interfere with the formation of a finely pulverized seed bed, shall be removed from the soil.
- D. Lay sod so that adjacent strips butt tightly, with no spaces between strips. Lay sod on mounds and slopes, with strips parallel to contours. Stagger joints. Sodded areas shall be flush with adjoining seeded areas. All sod shall, of course, be laid green side up. Tamp and roll the sod thoroughly to make contact with the sod bed, or as directed by the Engineer.
- E. Peg sod on slopes three to one or steeper with pegs driven through sod into soil, until pegs are flush with the turf. Space pegs 18 inches on center. Pegs to be 1 inch square, 6 inches long or, 6 inch lengths of lath. Commercial fertilizer as outlined in the Item, “Fertilizer” shall be applied to the entire sodded area at the prescribed rates, immediately following laying of the sod. Immediately after fertilizing, water the entire area to a saturated depth of 2-inches.
- F. Immediately after installation of the sod, remove sod clumps on soil, wash off any plant materials and pavements not to have sod. Edges along curbs and drives, walkways, etc., shall be carefully trimmed and maintained until accepted.

3.2 CONTRACTOR’S MAINTENANCE & GUARANTEE PERIOD

- A. Maintenance of sodded areas shall be for 60 days after completion of the project and shall consist of watering, weeding, repair of all erosion and resodding as necessary to establish a uniform growth of the specified grass. Contractor shall guarantee growth and coverage of the sod planted under this contract to the effect that a minimum of 95% of the area planted will be covered with the specified planting after 60 days. Sod panels that are dead or dying shall be replaced.
- B. The Contractor shall be responsible for one (1) mowing every two weeks between the months of April to October. The Contractor shall also be responsible for one (1) mowing every three (3) weeks between the months of November to March. In addition, the Contractor shall water the entire sodded and hydro-mulched areas to a saturated depth of one (1) inch at least once a week between the months of April to September and a least once a month between the months of October to March.
- C. Contractor shall make a second planting to those bare areas not meeting specified planting as determined by the Engineer. Such replanting is to be performed within 90 days of initial application and upon notification by the Engineer to replant.

END OF SECTION

SECTION 33 05 01

POLYVINYLCHLORIDE PIPE AND FITTINGS

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. The work specified under this section includes the manufacture, construction and installation of Polyvinylchloride (PVC) pipe and fittings for Water Lines and for Gravity and Pressure Sanitary Sewers.

1.2 REFERENCES

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds (Latest Edition)
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe (Latest Edition)
ASTM F 1483	Standard Specification for Oriented Poly (Vinyl Chloride), (PVCO) Pressure Pipe (Latest Edition)
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C150	Standard Specification for Portland Cement
ASTM D1598	Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
ASTM D1599	Standard Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D2122	Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D2152	Standard Test Method for Adequacy of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
ASTM D2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2564	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM F679	Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM D2672	Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement

ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4-Inch Through 12- Inch for Water Distribution (Latest Edition)
AWWA C909	Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe. 4-Inch Through 12-Inch for Water Distribution (Latest Edition)
AWWA C104	ANSI Standard for Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water
AWWA C105	ANSI Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C111	ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C116	Protective Fusion Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
AWWA C153	Ductile Iron Compact Fittings, 3 in. through 24 in. and 54 in. through 64 in. for Water Service
AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In.-48 In.

1.3 MEASUREMENT AND PAYMENT

- A. Payment shall be made at the price bid per unit length per the specification SECTION 33 11 13.1 - WATER MAIN CONSTRUCTION or SECTION 33 31 13 - SANITARY SEWAGE SYSTEM.

1.4 SUBMITTALS

- A. Submit manufacturer's data on pipe furnished, indicating compliance with the specifications regarding dimensions, thickness, weights, and materials.
- B. Submit manufacturer's "Certificate of Compliance," stating that the materials furnished comply with this specification.

1.5 STORAGE AND HANDLING

A. UNLOADING - COLD WEATHER HANDLING

As the temperature approaches and drops below freezing extra care should be used in handling during cold weather. Pipe at the bottom of a stack may become out-of-round due to the weight of material above it. Allow the pipe to recover to full initial roundness before installation. Pipe may be unloaded by hand, either by passing over the side or off

the truck end. Sliding one length on another is permissible in unloading pipe, but lengths in the bottom layer shall be lifted off of the rough surface of the truck body to avoid abrasion. Compact shipping units (palletized bundles in a wood frame) may be unloaded by conventional fork lifts.

B. STOCKPILES

Store pipe on a flat surface so as to support the barrel evenly with bell ends overhanging. Store random lengths separately where they will be readily available. Individual lengths of pipe should be stacked in piles no higher than 5 feet. Pipe shall be protected during long exposures (over 3 months) to sunlight. Do not use clear plastic sheets. Provide for air circulation under sheet.

C. STORING RUBBER RINGS

Store all rubber rings at a central point and distribute them as needed. Keep them clean, away from oil, grease, excessive heat and electric motors which produce ozone. If rubber rings are not to be used immediately, store them in their cartons, as shipped, in a cool dark place out of the direct rays of the sun.

PART 2 – PRODUCTS

2.1 MATERIALS

A. WATER LINES

1. Pipe

- a. Blue colored Polyvinyl chloride (PVC) pressure pipe, six inch (6”) through twelve inch (12”) , shall conform to the current AWWA – C900 or C909 standard, be UL listed, be approved by the Texas State Board of Insurance and the National Sanitation Foundation. PVC pipe wall thickness shall be based on a working pressure rating of 125 psi at 100° F (DR-14, Class 200 for C900 or Class 200 for C909.). The outside diameter shall be identical to ductile-iron pipe (CIOD Standard, Table 2, AWWA – C900). All pipe shall be new and have the AWWA designation, pressure class, DR pressure rating and size of pipe stamped on the outside of each joint (follow requirements of C900 2.5.2 Markings). All piping shall be new. Partial pieces from other projects shall not be approved for installation. Metal detector tape shall be installed above all PVC pipe at an elevation of 2 feet below natural ground.
- b. Blue colored PVC 4” pipe shall be SDR 21, ASTM D2241.
- c. PVC Pressure Pipe shall be designed and tested in accordance with ASTM D1598, D1599, and D2152.
- d. Fittings for PVC water pipe shall be ductile-iron, and shall conform to AWWA C153, unless otherwise specified.

Fitting joints shall be mechanical joints. Bolts and nuts for mechanical joints, or flanged ends will be of a high strength corrosion resistant low-alloy steel and shall conform to AWWA C111. Flange bolts and nuts for above ground installation shall conform to Appendix A of AWWA C115. Flange bolts and nuts for below ground installation shall be 316 stainless steel. All fittings shall be epoxy coated and lined unless stainless steel is used.

Where joints are to be restrained, use mega-lug type fitting for pipe six (6") inches in size and larger. Mega-lug type mechanical restraints with less than 6 contact points will not be allowed for six (6") inch pipe sizes and larger. Four (4") inch lines shall be restrained by mid-co restraint or pre-approved equal.

Polyethylene wrap or encasement of metal fittings shall conform to AWWA C105. Joint tape shall be self sticking PVC or 8-mil-thick polyethylene.

- e. Joints: PVC water pipe shall be furnished with an elastomeric gasket at each joint and an integral thickened bell as part of each joint. Pipe and fittings must be assembled with a non-toxic lubricant. Provisions must be made at each joint for expansion and contraction. Refer to ASTM F477, D3139 and D3212.

B. GRAVITY SANITARY SEWER

1. Pipe

Flexible pipe and fittings shall be unplasticized polyvinyl chloride gravity sewer pipe shall be green in color, made from clean, virgin, NSF approved Class 12454-B PVC conforming to ASTM D1784. All pipe shall be new and have the ASTM designation, SDR, pressure rating and size stamped on the outside of each joint. All markings shall follow requirements of ASTM D3034.

Polyvinyl chloride (PVC) gravity pipe and fittings in sizes six inch (6") through twelve inch (12") shall conform to ASTM D3034 and be UL listed and approved by the National Sanitation Foundation. Pipe and fittings shall be SDR-26. Eighteen inch (18") pipe and fittings shall be SDR-26 and conform to ASTM F-679, be UL listed and approved by the National Sanitation Foundation.

C. SEWER FORCE MAIN AND PRESSURE PIPE

1. Pipe

- a. Polyvinyl chloride (PVC) pressure pipe, four (4) inch through eight (8) inch, shall be white in color and shall conform to the current ASTM D2241, AWWA – C900, or AWWA C909 standard, be UL listed, be approved by the Texas State Board of Insurance and the National Sanitation Foundation. PVC pipe pressure class shall be equal to or greater than twice the maximum calculated pressure of the force main.
- b. Polyvinyl chloride (PVC) pressure pipe shall be SDR-21 Class 200 and conform to the ASTM D2241 standard, be UL listed and approved by the National Sanitation Foundation, and shall be white in color. The outside diameter shall be identical to steel pipe.
- c. PVC Pressure Pipe shall be designed and tested in accordance with ASTM D1598, D1599, and D2152.
- d. Fittings for PVC pressure pipe shall be ductile-iron, and shall conform to AWWA C153, unless otherwise specified. Fitting joints shall be mechanical joints. Bolts and nuts for mechanical joints, or flanged ends will be of a high strength corrosion resistant low-alloy steel and shall conform to AWWA C111. Flange bolts and nuts for above ground installation shall conform to Appendix A of AWWA C115. Flange bolts and nuts for below ground installation shall be 316 stainless steel. All fittings shall be epoxy coated and lined unless stainless steel is used. Polyethylene wrap or encasement of metal

fittings shall conform to AWWA C105. Joint tape shall be self sticking PVC or 10-mil-thick polyethylene.

Where joints are to be restrained, use mega-lug type fitting.

- e. Joints: PVC water pipe shall be furnished with an elastomeric gasket at each joint and an integral thickened bell as part of each joint. Pipe and fittings must be assembled with a non-toxic lubricant. Provisions must be made at each joint for expansion and contraction. Refer to ASTM F477, D3139 and D3212.

2.2 TESTING REQUIREMENTS

See: SECTION 33 01 30 - TESTING OF GRAVITY SEWER SYSTEMS

SECTION 33 13 10 - HYDROSTATIC TESTING (Used for Waterlines & Sanitary Sewer Force Mains)

SECTION 33 13 00 - DISINFECTION OF WATERLINES

PART 3 – EXECUTION

3.1 TRENCHING

- A. See Standard Details.

3.2 JOINT ASSEMBLY

- A. Push-on joints shall be assembled as follows:
 1. Thoroughly clean the groove and bell and insert the gasket, making sure that it faces the proper direction and that it is correctly seated.
 2. Dirt or foreign material shall be cleaned from the spigot end to a point one inch (1") beyond the reference mark. A joint lubricant shall be used and applicable recommendations of the manufacturer shall be followed.
 3. Be sure that the spigot end is beveled, as square or sharp edges may damage or dislodge the gasket and cause a leak. Push the spigot end into the bell of the pipe while keeping the joint straight. Brace the bell while the beveled end is pushed under the ring, so that previously completed joints in the line will not be closed up. Make deflection after the joint is assembled.
 4. Push the spigot end in until the reference mark on the spigot end is flush with the end of the bell. If excessive resistance to insertion of the beveled end is encountered or the reference mark does not reach the flush position, disassemble the joint, and check the position of the ring. If it is twisted or pushed out of its seat, clean the ring, bell and beveled end and repeat assembly. Be sure both lengths are in proper alignment. If the ring was not out of position, measure the distance between the reference mark and beveled end, and check it against correct values from the manufacturer. Relocate the reference mark if it is out of position.
 5. Small pipe can be pushed into the bell end with a long bar. Large pipe requires additional power, such as a jack, lever puller, or backhoe. A timber header should be used between the pipe and jack or backhoe bucket to avoid damage to the pipe.
 6. At times when pipe laying is not in progress, the open ends of pipe shall be closed by watertight plug or other means pre-approved by the Engineer. The plug shall remain

in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation should the trench fill with water.

B. Mechanical joints shall be assembled as follows:

1. Wipe clean the bell and spigot end. The spigot end, bell, and gasket should be washed with a soap solution to improve gasket seating.
2. Place the gland on the spigot end with the lip extension toward the spigot end, followed by the gasket with the narrow edge of the gasket toward the spigot end of the pipe.
3. Insert the pipe into the bell and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly. Make deflection after joint assembly but before tightening the bolts.
4. Push the gland toward the bell and center it around the pipe with the gland lip against the gasket.
5. Align bolt holes and insert bolts, with bolt heads behind the bell flange, and tighten opposite nuts to keep the gland square with the bell.
6. Tighten the nuts in accordance with manufacturer’s recommendations.

C. When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane, or where long radius curves are permitted, the amount of deflection shall not exceed that shown in Table 1. Pipes greater than twelve-inches (12”) in diameter shall not be deflected.

TABLE 1 Maximum Deflection Full Length Pipe Push-on Type Joint		
Pipe Diameter in.	Deflection Angle Deg.	Minimum Radius of Curve ft. *
6	2.5	230
8	1.9	300
12	1.3	450

* All curvature results from the bending of pipe lengths. There is no deflection at the joint.

D. Cutting and Beveling

1. A square cut is essential to insure proper assembly. Use either a tubing cutter or a miter box and carpenter's fine-toothed hand saw or hacksaw. (Do not use standard pipe cutters. The cutting wheel will crush or damage the pipe.)
2. Use a factory-finished beveled end as a guide to determine the angle and length of taper. The end may be beveled using a Pilot beveling tool which will cut the correct taper automatically or a thin steel, "cheese-grater" type of hand tool, Stanley "Sureform" No. 399.
3. With a pencil or crayon, locate the reference mark at the proper distance from the bevel end as indicated by the manufacturer.

3.3 POLYETHYLENE TUBE PROTECTION

- A. All cast iron and ductile iron fittings shall be provided with 8 mil polyethylene tube protection. Completely cover all fittings and connections with polyethylene film held securely in place with joint tape or strapping according to the provisions of AWWA C105.

3.4 EMBEDMENT

- A. Install embedment as shown on the Plans and in accordance with SECTION 31 23 33 - EXCAVATING, TRENCHING, AND BACKFILLING.

3.5 TAPPING WATER LINES

- A. Where a tap occurs within a deflected section of pipe, utilize a fitting (ie: 8” x 1” tapped tee) in lieu of tapping the pipe.
- B. The tapping sleeve specified will be the Smith-Blair 662 or the Ford FTSS_Stainless Steel Tapping Sleeve with Epoxy Coated Flange for pipe sizes 6"-24".

3.6 GRAVITY SANITARY SEWER DEFLECTION TEST

- A. The sewer line shall be tested for deflection in accordance with SECTION 33 01 30 - TESTING FOR SANITARY SEWAGE GRAVITY SYSTEM.

END OF SECTION

SECTION 33 05 02
DUCTILE IRON PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work specified under this section includes furnishing all labor, tools, equipment, materials, and supplies for the installation of Ductile Iron Pipe for Water Lines or Sanitary Sewers.

1.2 REFERENCES

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A746 Standard Specifications for Ductile Iron Gravity Sewer Pipe (Latest Revision)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104 Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water (Latest Edition)

AWWA C105 Polyethylene Encasement for Ductile Iron Pipe Systems (Latest Edition)

AWWA C111 Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings (Latest Edition)

AWWA C115 Flanged Ductile Iron Pipe with Threaded Flanges (Latest Edition)

AWWA C116 Protective Fusion Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service

AWWA C151 Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids (Latest Edition)

AWWA C150 Thickness Design of Ductile Iron Pipe (Latest Edition)

AWWA C153 Ductile Iron Compact Fittings, 3 in. through 24 in. and 54 in. through 64 in. for Water Service

AWWA C600 Ductile Iron Water Mains (Latest Edition)

1.3 MEASUREMENT

- A. Payment shall be made at the price bid per unit length per the specification SECTION 33 11 13.1 - WATER MAIN CONSTRUCTION or SECTION 33 31 13 - SANITARY SEWAGE SYSTEM.

1.4 SUBMITTALS

- A. Submit manufacturer's data on pipe furnished, indicating compliance with the specifications regarding dimensions, thickness, weights, and materials.
- B. Submit manufacturer's "Certificate of Compliance," stating that the materials furnished comply with this specification.

1.5 STORAGE AND HANDLING

- A. Pipe to be shipped in accordance with the pipe manufacturer’s recommendations and stored in a manner that the pipe is not damaged. The Contractor will replace damaged piping at no additional cost to the City.
- B. Pipe shall not be stacked higher than manufacturer’s recommendations. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Pipe in tiers shall be alternated: bell, plain end; bell, plain end. At least two (2) rows of 4” x 4” timbers shall be placed between tiers and chocks affixed to each end in order to prevent movement.
- C. Gaskets for mechanical joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.
- D. Mechanical joint bolts shall be handled and stored in such a manner that will ensure proper use with respect to types and sizes.

PART 2 – PRODUCTS

2.1 MATERIALS

A. WATER LINES

1. Pipe

Ductile iron pressure pipe shall conform to the current AWWA C151 (ANSI A21.51) standard. All pipe shall be new, and shall have the AWWA or ASTM designation, pressure class and size of pipe stamped on the outside of each joint. Ductile iron pipe shall be approved by the Underwriter’s Laboratory and shall be accepted by the State Fire Insurance Board for use in water distribution systems without penalty. Ductile iron pipe less than six (6”) inches in diameter will not be allowed. Ductile iron thickness shall conform in all respects to the current AWWA C150 standard based on a minimum of 200 psi working pressure. A special design shall be provided for large diameters or deep embedments.

Flanged pipe shall conform to AWWA C115 and be based upon a minimum of 200 psi working pressure.

Foreign made pipe shall not be accepted.

2. Joints And Gaskets

All ductile iron pressure pipe shall be furnished with one of the following types of joints, and as described in the Proposal, or shown on the Plans.

<u>Type Joint</u>	<u>Standard</u>
Mechanical Joint	AWWA C111
Flanged Ends	AWWA C115

Flange gaskets shall be full faced and conform to Appendix A of AWWA C115.

3. Fittings

Fittings for ductile iron pipe shall be of cast iron, or ductile iron, and shall conform to AWWA C153, unless otherwise specified in the proposal, special specification, or on the plans.

Fitting joints shall be mechanical, flanged, or special internally locked joint with body thickness and radii of curvature conforming to AWWA C153.

All screwed flanges shall be ductile iron.

4. Bolts And Nuts

Bolts and nuts for mechanical joints shall be of a high strength corrosion resistant low alloy steel and conform to AWWA C111. Flange bolts and nuts for above ground installation shall conform to Appendix A of AWWA C115. Flange bolts and nuts for below ground installation shall be 316 stainless steel.

5. Polyethylene Encasement

Polyethylene encasement of 8 mils thickness shall conform to AWWA C105. Joint tape shall be self sticking PVC or polyethylene, 8 mils thick.

6. Restraint

See SECTION 03 30 01 - CONCRETE BLOCKING OR ANCHORAGE.

7. Coatings

Pipe exterior to be bituminous coated and in accordance with the requirements of AWWA C151 Section 4.3. Coating and Lining or epoxy coated in accordance with AWWA C116.

8. Lining

Unless otherwise noted, all pipe shall be cement-mortar lined inside with seal coat all in accordance with AWWA C104 or epoxy coated in accordance with AWWA C116.

B. GRAVITY SANITARY SEWER LINES

1. Pipe

- a. Ductile iron gravity and pressure pipe shall conform to the current ASTM, A746, and AWWA C111 and C151 (ANSI A21.51) standard. All pipe shall be new, and shall have the AWWA or ASTM designation, pressure class and size of pipe stamped on the outside of each joint. Ductile iron pipe less than eight (8”) inches in diameter will not be allowed for sewer mains.
- b. Ductile iron thickness shall conform in all respects to the current AWWA C150/C151 standard, based on a minimum of 200 psi working pressure.
- c. Pipe to be shipped in accordance with the pipe manufacturer’s recommendations and stored in a manner that the pipe is not damaged. The Contractor will replace damaged piping at no additional cost to the City.
- d. Flanged pipe shall conform to AWWA C115, and be based upon a minimum of 200 psi working pressure.

2. Joints And Gaskets

All ductile iron pressure pipe shall be furnished with one of the following types of joints, and as described in the Proposal or shown on the Plans. Flange gaskets shall be full faced, and conform to Appendix A of AWWA C115.

<u>Type Joint</u>	<u>Standard</u>
Mechanical Joint	AWWA C111
Flanged Ends	AWWA C115

- a. All screwed flanges shall be ductile iron.
 - b. Gaskets for mechanical joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.
3. Fittings
- a. Fittings for ductile iron pipe shall be of ductile iron, and shall conform to AWWA C153.
 - b. Fitting joints shall be mechanical, flanged, or special internally locked joint with body thickness and radii of curvature conforming to AWWA C153.

4. Bolts And Nuts

Bolts and nuts for mechanical joints shall be high-strength corrosion resistant low alloy steel, and conform to AWWA C111. Flange bolts and nuts for above ground installation shall conform to Appendix A of AWWA C115. Flange bolts and nuts shall be 316 stainless steel.

Mechanical joint bolts shall be handled and stored in such a manner that will ensure proper use with respect to types and sizes.

5. Polyethylene Encasement

Polyethylene encasement shall conform to AWWA C105. Joint tape shall be self-sticking PVC or polyethylene, 8 mils thick.

6. Coatings/ Linings

All pipe and fittings shall be bituminous or epoxy coated outside and inside, all in accordance with AWWA C104 or AWWA C116. Interior lining for ductile iron sewer pipe shall conform to manufacturer's recommendations. Minimum lining thickness shall be 40 mils, regardless of material recommended.

Other acceptable lining materials are "Protecto 401" Ceramic Epoxy by Vulcan Group or pre-approved equal.

C. FORCE MAIN

Force mains shall comply with of all requirements of SECTION 33 11 13.1 – WATERLINE MAIN CONSTRUCTION.

2.2 TESTING REQUIREMENTS

See: SECTION 33 11 13.1 - WATER MAIN CONSTRUCTION or SECTION 33 31 13 - SANITARY SEWAGE SYSTEM for testing requirements.

PART 3 – EXECUTION

3.1 TRENCHING

- A. See Standard Details.

3.2 PIPE INSTALLATION

- A. All pipe fittings, services, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the material. All rejected material must be removed from the project immediately at the sole expense of the Contractor.
- B. All lumps, blisters, and excess coating shall be removed from the socket and plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit or any foreign material before the pipe is laid.
- C. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.
- D. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with pre-approved backfill material.
- E. At times when pipe laying is not in progress, the open ends of pipe shall be closed by watertight plug, or other means pre-approved by the Engineer. The plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation should the trench fill with water.

3.3 MECHANICAL JOINT ASSEMBLY

- A. Wipe clean the socket and plain end. The plain end, socket and gasket should be washed with a soap solution to improve gasket seating.
- B. Place the gland on the plain end, with the lip extension toward the plain end, followed by the gasket, with the narrow edge of the gasket toward the plain end of the pipe.
- C. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly. Make deflection after joint assembly, but before tightening the bolts.
- D. Push the gland toward the bell, and center it around the pipe with the gland lip against the gasket.
- E. Align bolt holes and insert bolts, with bolt heads behind the bell flange, and tighten opposite nuts to keep the gland square with the socket.
- F. Tighten the nuts in accordance with the manufacturer's recommendations.
- G. When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane, or where long radius curves are permitted, the amount of deflection shall not exceed manufacturer's recommendations.

3.4 PIPE CUTTING

- A. Cutting pipe for the insertion of valves, fittings, or closure pieces shall be done in a neat, workmanlike manner, without creating damage to the pipe or lining. Seal-coat bare surfaces and cut ends per manufacturer's recommendations.
- B. Cut ends and rough edges shall be ground smooth.

3.5 POLYETHYLENE TUBE PROTECTION

A. GENERAL

1. All cast iron & ductile iron pipe and fittings shall be provided with polyethylene tube protection according to the provisions of AWWA C105. Completely cover all fittings and connections with polyethylene film held securely in place with joint tape or strapping. The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding material.
2. Where polyethylene-wrapped pipe joints an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of at least two (2') feet. Secure the end with circumferential turns of tape.

3.6 EMBEDMENT

- A. Install embedment as shown on the Plans and in accordance with SECTION 31 23 33, Excavating, Trenching, and Backfilling.

3.7 REACTION ANCHORAGE AND BLOCKING

- A. The contractor shall install concrete blocking and retaining glands to all unlugged bell and spigot or all-bell tees, Y-branches, bends deflecting eleven and one-fourth degrees ($11\frac{1}{4}^\circ$) or more, and plugs which are subject to internal pressure in excess of 10 psi. to preclude separation of joints. See SECTION 03 30 01 - CONCRETE BLOCKING OR ANCHORAGE for additional details.

3.8 MINIMUM COVER

- A. See SECTION 33 11 13.1 - WATER MAIN CONSTRUCTION or SECTION 33 31 13 - SANITARY SEWAGE SYSTEM for cover requirements.

END OF SECTION

TECHNICAL SPECIFICATIONS

Drainage



SECTION 33 40 01
STORM DRAINAGE SYSTEM

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Specification includes the general description of the Storm Drainage System and the components included in that system.
- B. This is a general specification which applies to the furnishing of all plant, labor, equipment, appliances and materials and in performing all operations in connection with the construction of storm drainage systems, together with the inlets, storm drain manholes, headwalls, safety end treatments, cleanout structures and other incidentals, in accordance with the plans and these specifications.

1.2 MEASUREMENT AND PAYMENT

Payment shall be made at the price bid per unit item for furnishing and installing pipe, which bid price will include all costs for the complete pipe installation, including trenching and backfill, embedment, compaction or tamping, testing, final cleanup, and all other work not otherwise provided for in the Proposal.

A. Pipe

Payments will be made at the price bid per foot for furnishing and installing pipe, which bid price will include all costs for the complete pipe installation, including line fittings, trenching, and backfill, embedment, compaction or tamping, and all other work not otherwise provided for in bid proposal. Pipe will be measured (by horizontal distance) from the inside face of the inlet or junction box or end of pipe without adjustment for the slope of the pipe. The length of the inlet or junction box shall not constitute a payable quantity.

B. Manholes/Junction Boxes

Payment will be made at the unit price bid per each for manhole. Manholes will be measured per each.

C. Inlets

Payment will be made at the unit price bid per each for inlet by length and type. Inlets will be measured per each.

D. Headwalls

Payment will be made at the unit price bid per each for headwall by type. Headwalls will be measured per each.

E. Rock Rubble Rip Rap

Rock Rubble Rip Rap shall be measured by area as provided for in the bid proposal form.

F. Channel Grading

Channel Grading shall be measured by area as provided for in the bid proposal form.

1.3 SUBMITTALS

All submittal requirements are listed with the material specifications

PART 2 – PRODUCTS

2.1 MATERIALS

See:

SECTION 31 78 00 - PIPE BORING, JACKING AND TUNNELING

SECTION 31 23 33 - EXCAVATING, TRENCHING, AND BACKFILLING

SECTION 03 30 00 - CONCRETE

SECTION 33 40 02 - REINFORCED CONCRETE PIPE

SECTION 33 40 03 - STANDARD STORM SEWER INLETS

SECTION 33 40 05 - REINFORCED CONCRETE HEADWALLS

SECTION 33 42 16 - PRECAST BOX CULVERTS

SECTION 33 40 04 - REINFORCED CONCRETE RIPRAP

HDPE Storm Drain Pipe (to be specified by design engineer)

2.2 TESTING REQUIREMENTS

All storm pipe and storm drain systems shall be televised at the end of construction. If it is determined that the storm pipe contains foreign material (i.e. construction material, gravel, soil, etc.) the line will be required to be cleared of this foreign material and televised again.

PART 3 – EXECUTION

3.1 GENERAL

Construction methods for each material are specified in the material specifications.

A. Minimum Cover

The minimum cover for class III storm drain pipe (12” through 60”) (See SECTION 33 40 02 – REINFORCED CONCRETE PIPE) shall be two feet (2’) in areas subject to vehicular loads and one foot in non-vehicular areas as measured from the outside top of pipe vertically to finished ground or pavement surface elevation.

END OF SECTION

SECTION 33 40 02

REINFORCED CONCRETE PIPE**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This item includes the furnishing of labor, materials, equipment, and supervision in the operations required in the laying and jointing of reinforced concrete pipe.

1.2 MEASUREMENT AND PAYMENT

- A. Measurement shall be made based upon the length of pipe as laid in the field. Length of inlets and junction boxes are not included in this measurement. Pipe shall be paid for at the unit price bid in the Proposal for each size and type of pipe, which price shall be full compensation for trenching and backfilling, furnishing and laying the pipe, and furnishing all equipment, labor, materials, tools and incidentals necessary to complete the work.

1.3 SUBMITTALS

- A. Submit certification from independent testing laboratory at manufacturer expense that the pipe meets the requirements of ASTM C76/C76M and ASTM C497/C497M.

PART 2 – PRODUCTS**2.1 MATERIALS**

The Publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM C76 Standard Specification for Reinforced Concrete Culvert Storm Drain and Sewer Pipe (Latest Revision)

ASTM C443 Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Latest Revision)

- A. Reinforced Concrete Pipe
1. Reinforced concrete pipe to meet the requirements of ASTM C76. The type and wall class shall be III or IV unless otherwise shown on PLANS.
 2. Joint reinforced for rubber gasket joints to meet the requirements of paragraph 8 of ASTM C76.
 3. Joints shall be rubber gasket per ASTM C443 unless otherwise shown on PLANS. Lubricant materials for installation purposes to be per manufacturers recommendations. Mineral lubricants are not to be used.
 4. Pipe coating requirements are shown on PLANS if required.

2.2 TESTING REQUIREMENTS

Testing methods for the reinforced concrete pipe shall conform to the latest revision of ASTM C497 (Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile).

REJECTION: The pipe may be rejected for having defects or failure to meet requirements as follows:

- A. Variations in any dimension exceeding the permissible variations prescribed.
- B. A piece broken out of the bell or spigot end of such size that the water-tightness of the joint would be impaired.
- C. Any shattering or flaking of concrete or other conditions indicating an improper concrete mix.
- D. Lack of uniformity in placement of steel which might preclude all joints being typical of those tested.
- E. Cracks sufficient to impair the strength, durability or serviceability of the pipe.

PART 3 – EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

Shipment of pipe to be in accordance with the manufacturer's recommendations. Pipe to be unloaded and stored in a location where pipe will be protected from damage.

3.2 TRENCH/BACKFILL

Pipe trench excavation and backfill to be in accordance with SECTION 31 23 33 – EXCAVATING, TRENCHING, AND BACKFILLING and/or as shown on Plans or as directed by the City Engineer.

3.3 JOINTING OF PIPE

- A. Lay pipe sections in trench to true alignment and grade. Take exceptional care in placing pipe and making field joints. Avoid bumping of pipe in trench.
- B. Properly lubricate groove end of pipe and rubber gasket with lubricant. Stretch gasket over the spigot end of the pipe and carefully seat in groove. Do not twist, roll, cut, crimp, or otherwise injure gaskets or force out of position during closure of joints.
- C. Pull or push "home" pipe for closure of the joint. Correct joint rebound before backfilling of pipe.
- D. Remove foreign matter or dirt from pipe, and keep clean during and after laying.
- E. Any damages in pipe installation or prior to final acceptance is to be repaired or replaced in accordance with ASTM C76 at no additional cost to the City.
- F. Failure to conform with any of the specifications herein set forth or referenced.
- G. Failure of pipe to go completely "home" due to binding of spigot against bell.

END OF SECTION

SECTION 33 40 03

STANDARD STORM SEWER INLETS

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This item shall include Reinforced Concrete Standard Storm Sewer Inlets, which shall be constructed in true conformity with lines, grades, dimensions and designs as shown on the Plans and Standard Detail Sheet and in accordance with this Specification.

1.2 MEASUREMENT AND PAYMENT

- A. This item shall be measured and payment will be made at the unit price bid for each in the Proposal for each Standard Storm Sewer Inlet based upon length of opening. Such payment shall constitute full compensation for furnishing all labor, materials, equipment and incidentals necessary to complete the work, including excavation, forming, reinforcing steel, furnishing and placing concrete, covers, appurtenances, etc. Payment shall not be made for unauthorized work.

1.3 SUBMITTALS

- A. Manufacturers cut sheet for inlet and covers.

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. Concrete shall be 4000 psi reinforced concrete.
- B. Manhole Rings and Covers

The standard rings and covers (V-1342A) and storm plate (V-7001PL2) shall be manufactured by East Jordan Iron Works (or approved equal with approval of City Engineer.)

2.2 TESTING REQUIREMENTS

Concrete test results shall be furnished in accordance with SECTION 03 30 00 – CONCRETE.

PART 3 – EXECUTION**3.1 GENERAL**

- A. This construction of reinforced concrete inlets shall be in accordance with standard procedure and shall conform to the location, line, grade, dimension and detail as shown on the Plans and/or directed by the Engineer. All inlets shall be cast in place unless approved by the City Engineer in writing. All excavation, forming and placing of reinforcing steel shall be approved by the Engineer before any concrete is placed. All backfill for inlets shall be in accordance with the Plans.

END OF SECTION

SECTION 33 40 04

REINFORCED CONCRETE RIPRAP

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This item shall govern the furnishing and placing of riprap of concrete of the type indicated on the plans or specified by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Measurement of acceptable riprap complete in place will be made on the basis of the area actually covered.
- B. Concrete in toe walls will be measured as riprap of the type with which it is placed.
- C. The riprap quantities, measured as provided above, will be paid for at the unit prices bid in the Proposal for Reinforced Concrete Riprap, which price will be full compensation for furnishing, hauling, and placing all materials including reinforcement and for all labor, tools, equipment and incidentals necessary to complete the work.
- D. Payment for excavation of toe wall trenches, all necessary excavation below natural ground or bottom of excavated channel, shaping of slopes, will be included in the unit price bid for riprap.
- E. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

- A. Concrete Mix Designs
- B. Certification for cement conformance to specification
- C. Test reports for all required concrete tests

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. Materials for concrete shall conform to the requirements of SECTION 03 30 00 - CONCRETE. Concrete shall be of the class shown on the plans unless otherwise specified by the Engineer.

2.2 TESTING REQUIREMENTS

As specified in SECTION 32 13 13 - CONCRETE.

PART 3 – EXECUTION**3.1 GENERAL**

- A. The slopes and other areas to be protected shall be dressed to the line and grade shown on the plans prior to the placing of riprap. Riprap shall not be placed on embankment slopes until the embankment has been compacted to ninety-eight (98%) percent of Standard Density as specified in A.S.T.M. Designation D-698 or as shown on the plans.
- B. Concrete for riprap shall be placed in accordance with the details and to the dimensions shown on the plans or as established by the Engineer. Concrete riprap shall be reinforced using #4 steel bars spaced at 12 inches on center. Wire reinforcement will not be allowed.
- C. Reinforcement shall be supported properly throughout the placement to maintain its position equidistant from the top and bottom surface of the slab.
- D. If the slopes and bottom of the trench for toe walls are dry and not consolidated properly, the Engineer may require the entire area to be sprinkled, or sprinkled and consolidated before the concrete is placed. All surfaces shall be moist when concrete is placed.
- E. After the concrete has been placed, compacted and shaped to conform to the dimensions shown on the plans, and after it has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to secure a reasonably smooth surface.
- F. Immediately following the finishing operation the riprap shall be cured in accordance with SECTION 31 13 13 - CONCRETE.

END OF SECTION

SECTION 33 40 05

REINFORCED CONCRETE HEADWALLS AND ENDWALLS

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This item shall include reinforced concrete headwalls and endwalls which shall be constructed as indicated on the Plans in true conformity with the lines, grades, dimensions and designs as shown on the Plans and in accordance with this Specification.

1.2 MEASUREMENT AND PAYMENT

- A. Payment for reinforced concrete headwalls or sloped end treatments will not be considered a separate pay item but shall be considered subsidiary to the price of the drainage pipe.

1.3 SUBMITTALS

- A. Concrete Mix Designs
- B. Certification for cement conformance to specification
- C. Test reports for all required concrete tests

PART 2 – PRODUCTS**2.1 MATERIALS**

Concrete shall be reinforced concrete as specified in SECTION 33 40 05 – REINFORCED CONCRETE HEADWALLS.

2.2 TESTING REQUIREMENTS

As specified in SECTION 31 23 33 – EXCAVATING, TRENCHING, AND BACKFILLING and SECTION 03 30 00 - CONCRETE.

PART 3 – EXECUTION**3.1 GENERAL**

- A. The surface of the ground on which the headwalls are to be constructed shall be tamped and compacted to ninety-eight percent (98%) standard proctor density (ASTM D 698) to form the bottom of the headwalls and endwalls. The construction of reinforced concrete headwalls and endwalls shall be in accordance with standard procedure and shall conform to the location, line, grade and dimensions as shown on the Drawings and/or as directed by the Engineer. All excavation, forming and placing of reinforcing steel shall be approved by the Engineer before any concrete is placed.

END OF SECTION

SECTION 33 41 16

DRAINAGE CHANNEL EXCAVATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Channel Excavation shall consist of required excavation as shown on the Plans; the removal and proper disposal of all excavated materials; and constructing, shaping, and finishing of all earthwork involved in conformity with the required lines, grades and typical cross sections in accordance with Specification requirements herein outlined.
- B. If no classification is indicated on the Plans, "Unclassified Channel Excavation" shall include all materials encountered regardless of their nature or the manner in which they are removed.

1.2 MEASUREMENT AND PAYMENT

- A. All channel excavation shall be measured in its original position and the volume computed in cubic yards by the method of average end areas.
- B. All work performed as required herein and measured as provided in the bid proposal will be paid for at the unit price bid per cubic yard. The price bid shall be full compensation for furnishing all labor, material, tools, equipment, and incidentals to complete the work. This payment is to include any and all clearing, grubbing, removal of trees, stumps, trash and debris necessary to perform the work under "Drainage Channel Excavation". This payment shall also be full compensation for shaping and disposal of all material removed and/or excavated.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION

3.1 GENERAL

- A. All materials removed from the excavation shall be satisfactorily disposed of as indicated on Plans, or as directed by the Engineer. Completed work shall conform to the established alignment, grades and cross sections. During construction, the channel shall be kept drained and the work shall be prosecuted so that the flow into and through the channel is not impeded. Care shall be taken such that spoils left near the channel are not washed into the channel during rainfall events. The placement of erosion control devices may be necessary to prevent the deposition of the silt into the channel.

END OF SECTION

SECTION 33 42 16.13

PRECAST REINFORCED CONCRETE BOX CULVERTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This specification shall govern for the furnishing and placing of precast reinforced concrete box culverts of the size, type and configuration installed to the lines and grades established by the plans.

1.2 MEASUREMENT AND PAYMENT

- A. All box culverts installed in accordance with the above specifications and accepted by the Engineer shall be considered as a complete installation, in place and paid for by the linear foot as noted in the Bid Proposal complete in place, of the type, size and depth constructed. The unit price bid shall be full compensation for furnishing all material, equipment and labor for all excavation, shaping of trench bottom, jointing, laying, dewatering, sheeting, bracing, bedding, backfilling, and specials necessary to install the box sewers in accordance with this specification and of the size, type and depth as shown on the plans.

1.3 SUBMITTALS

- A. Manufacturer's certification that the Precast Reinforced Concrete Box Sections meets the required ASTM Standards.

PART 2 – PRODUCTS

2.1 MATERIAL

Precast reinforced concrete box culverts shall be manufactured in accordance with the latest revisions published by the American Society for Testing Materials of the following specifications:

- A. ASTM C789 - Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers.
- B. ASTM C850 - Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers with less than Two Feet of Cover and Subjected to Highway Loadings.

Unless otherwise specified, all boxes furnished under this specification shall be fabricated with tongue and groove joint.

PART 3 – EXECUTION

3.1 GENERAL

- A. Joints in concrete boxes shall be made watertight by the methods described herein. The Contractor shall be fully responsible for choosing methods, using workmanship and materials and such other precautions as may be necessary to secure the required water tightness.

- B. Joints shall be made with a plastic joint sealing compound supplied in preformed strips of uniform size manufactured by K.T. Snyder Company, such as "Ramnek" or approved as being equal to "Ramnek".
- C. Construction fabric shall be a woven fabric consisting only of long-chain polymeric filaments or yarns such as polypropylene, polyethelene, polyester, polyamide or polyvinylidene-chloride formed into a stable network such that the filaments or yarns retain their relative position to each other. High modulus is the essential characteristic for this application, hence non-woven fabrics have been excluded. The fabric shall be inert to commonly encountered chemicals and conform to the properties in the following table:

RESISTANCE TO INSTALLATION STRESSES

FABRIC PROPERTY	TEST METHOD	FABRIC REQUIREMENT MIN. SHIPMENT AVG.
Grab Tensile Strength, lbs.	ASTM D 1682	200
Grab Tensile Elongation, %	ASTM D 1682	20
Burst Strength, psi	ASTM D 751 (Diaphragm Method)	375
Trapezoid Tear Strength, lbs.	ASTM D 2263	100

PERFORMANCE CRITERIA DURING SERVICE LIFE

FABRIC PROPERTY	TEST METHOD	FABRIC REQUIREMENT MIN. SHIPMENT AVG.
Equivalent Opening Site, U.S. Standard Sieve	CW 002215	70 - 100
Water Flow Rate gal/min/ft ²	H, 20cm to 10cm	20
Water Permeability, K, cm/sec	CFMC-FFET-2	0.005
Modulus (Load at 10% Elongation), lbs.	ASTM D 1682	110

RESISTANCE TO ENVIRONMENTAL FACTORS

FABRIC PROPERTY	TEST METHOD	FABRIC REQUIREMENT MIN. SHIPMENT AVG.
Mildew, Rot Resistance, % Strength Retention	AATCC-30	100
Insect, Rodent Resistance, % Strength Retention	AATCC-24	100

3.2 INSTALLATION

- A. Trenches shall be excavated with suitable type equipment such as ladder type trenching machines or trench hoes or other equipment that may be approved by the Engineer. Trenches for precast box sewers shall have a width below the top of the box of not less than the outside width of the box plus 16 inches and shall be wide enough to permit making up the joints.
- B. After the trench has been excavated to the bottom, the trench shall be fine graded to the established subgrade and recompacted to a density of at least 90% of maximum as determined using ASTM D 698. Any over excavation of the subgrade shall be filled with 3 sack per cubic yard of cement stabilized sand. Cement stabilized sand shall be in accordance with SECTION 31 23 23.53 – CEMENT STABILIZED SAND BACKFILL. The Contractor shall establish the grade line in the trench from grade stakes. The Contractor shall maintain this grade control a minimum of 100 feet behind and ahead of the box laying operation. The Contractor shall, at his expense, furnish and place in position all necessary stakes, grade and batter boards for locating the work.
- C. The precast box sections shall be so laid in the trench that after the sewer is completely installed, the interior surface shall conform accurately to the grade and alignment as shown on the plans or as established and given by the Engineer. All box sections must be laid in a straight line with the tongue end of the box section pointed downstream entering the grooved end of the previously laid box section, to full depth. Caution shall be taken to not drag cement stabilized sand or earth into the annular space. Box sections shall be fitted together and matched to achieve a finished storm sewer with a smooth and uniform invert.
- D. In preparing the joints and laying the box sections, the following procedures shall be adhered to. A suitable primer of the type recommended by the manufacturer of the gasket joint sealer shall be brush applied to the tongue and groove joint surfaces and the end surfaces and allowed to dry and harden. No primer shall be applied over mud, sand or dirt or sharp cement protrusions. The surface to be primed must be clean and dry when the primer is applied.
- E. Before laying the box section in the trench, the plastic gasket sealer shall be attached around the tapered tongue or tapered groove near the shoulder or hub of each box section joint. The paper wrapper shall be removed from one side only of the two-piece wrapper on the gasket and pressed firmly to the clean, dry box section joint surface.
- F. The outside wrapper shall not be removed until immediately before pushing each box section into its final position.

- G. When the tongue is correctly aligned with the flare of the groove, the outside wrapper on the gasket shall be removed and the box section shall be pulled or pushed home with sufficient force and power (backhoe, shovel, chain hoist, ratchet hoist or winch) to cause evidence of squeeze-out of the gasket material on the inside or outside around the complete box section joint circumference. Any joint material pushed out into the interior of the box section that would tend to obstruct the flow shall be removed. Each box section shall be pulled home in a straight line with all parts of the box section on line and grade at all times.
- H. When the atmospheric temperature is below 60° F, plastic joint seal gaskets shall either be stored in an area warmed to above 70° F, or artificially warmed to this temperature in a manner satisfactory to the Engineer. Gaskets shall then be applied to box section joints immediately prior to placing each box section in the trench, followed by connection to previously laid box section.
- I. No box sewer shall be laid in a trench in the presence of water. All water shall be removed from the trench sufficiently ahead of the sewer placing operation to insure a dry, firm bed on which to place the sewer, and if necessary, the trench will continue to be dewatered until after the sewer is bedded and backfilled as directed by the Engineer. Removal of water may be accomplished by pumping, or pumping in connection with the well point installation as the particular situation may warrant. The Contractor shall satisfy himself as to the soil conditions to be encountered.
- J. Where necessary, to comply with OSHA Regulation 1926.650, the side of the trench or other excavation shall be braced and rendered secure to the satisfaction of the Engineer. Board sheeting and/or steel sheeting may be utilized as directed by the Engineer. The bracing shall be in accordance with OSHA requirements.
- K. Following compaction of the trench bottom at the established grade, the Contractor shall place a minimum of a 6 inch thickness cement stabilized sand bedding in such a manner that once the box sections are laid, the invert elevation in the box section shall conform to the plan elevations. No voids in the bedding material shall be permitted. Cement stabilized sand shall be composed of a minimum of 3 sacks of cement per cubic yard of sand.
- L. When installing concrete box culverts in an existing channel, ditch or gully, cement stabilized sand shall be placed up to the spring line of the box culvert. A six ounce per square yard non-woven filter fabric, twenty four inches wide shall be draped over the top of the concrete box at each joint and extend one foot below the spring line of the box on each side. This fabric shall be in accordance with Section 2.1 "Materials".
- M. When installing concrete boxes in a trench condition, backfill shall consist of material excavated on the site, and deemed adequate by the Engineer, or materials obtained from a suitable borrow site. Suitable materials shall be CL/CH materials as determined by the Uniform Soil Classification System that are cohesive in nature, free of debris and organic materials and acceptable to the Engineer. Backfill shall be placed in maximum eight (8) inch lifts, sprinkled as required and compacted to a density of 90% standard proctor density (ASTM D 698). Moisture content shall be controlled so that the required density is achieved at a moisture content ranging from optimum moisture to 3 percent above optimum density. A six (6) ounce per square yard non-woven filter fabric, twenty four (24) inches wide shall be draped over the top of the concrete box culverts at each joint and extend one foot below the level of stabilized sand on each side.
- N. Backfill over box sections will be permitted as installation proceeds. Prior to backfilling, the Contractor shall remove all steel sheeting and/or cut off all timber sheeting a minimum of three (3) feet below finished grade as shown by the plans. Backfill shall consist of

material excavated on the site and deemed adequate by the Engineer or materials obtained from a suitable borrow site. Suitable materials shall be CL/CH materials as determined by the Uniform Soil Classification System (ASTM D 2487) and are cohesive in nature, free of debris and organic materials and acceptable to the Engineer. Backfill shall be placed in maximum eight (8) inch lifts, sprinkled as required and compacted to a density of 90% standard proctor density (ASTM D 698). Moisture content shall be controlled so that the required density is achieved at a moisture content ranging from optimum moisture to 3 percent above optimum density.

- O. Where backfill occurs beneath a road surface the material from two (2) feet below subgrade to the established base material shall be compacted to a density of 98% standard proctor density (ASTM D 698).
- P. A seal slab shall be installed, when shown by the drawings. If precast seal slabs are used, the joint of the seal slab shall not coincide with the joint of the box.
- Q. Laboratory tests will be performed as the backfill proceeds. All backfill not meeting this specification shall be removed and recompacted to the satisfaction of the Engineer at no cost to the Owner.
- R. All surplus excavated material shall become the property of the Contractor and shall be disposed of by the Contractor.
- S. The angles in box type sewers shall be built in accordance with the plans and specifications. The cost of making these angles and all cost incidental to them shall be included in the unit price bid for box sewer.
- T. Where junction with other storm sewers are to be made, openings may be left in the walls the size of which shall be the outside dimensions of the connecting sewer. A bond length of each reinforcing bar shall be left in the opening for connecting with the concrete collar or future sewer. Where a stub sewer is to be built, the end of the concrete of the stub sewer at the box sewer shall be at the inside face of the sewer box wall. All openings shall be closed with a 12-inch thick brick bulkhead. The cost of providing bulkheads shall be included in the unit price for the box sewer.

END OF SECTION

TECHNICAL SPECIFICATIONS

Streets



SECTION 31 23 00

EXCAVATION AND EMBANKMENT

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This Section includes providing all labor, materials, tools, and equipment necessary for excavation and embankment construction to the lines, grades and cross sections indicated in the Drawings or as directed by the ENGINEER.

1.2 MEASUREMENT AND PAYMENT

- A. This item will be measured by the cubic yard. Cubic yards will be measured by the difference between the surveyed original grades and the final grades. Measurements will include all authorized excavation below grade, which are not attributed to the Contractor's carelessness, in the opinion of the Engineer.
- B. The prices bid shall be full compensation for furnishing all materials, tools, equipment, pre- and post-grade surveys and incidentals necessary to complete the work. Payment will not be made for borrow material that is not suitable to use in embankments. Payment for unauthorized work will not be made.
- C. All work required for the disposal of waste, including haul, and for the salvage, utilization in the work and disposal of salvageable materials, will not be paid for directly but shall be considered a part of "Excavation and Embankment" and included in the unit price bid for this item. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

- A. All material to be imported to the site shall be sampled at its original location and tested for acceptability. This testing shall be provided by the contractor at no expense to the owner.
- B. A list of all compaction equipment to be utilized shall be submitted for approval prior to equipment arriving on site.

PART 2 – PRODUCTS**2.1 MATERIALS****A. EXCAVATION**

1. All excavation shall be unclassified excavation, and shall consist of excavation and disposal of all materials, of whatever character, encountered in the WORK.

B. EMBANKMENT

1. Material shall consist of soil native to the work site, with or without stone or conglomerate, of a suitable quality to secure a well bonded course. Imported material shall consist of soil hauled to the work site for use in embankment operations.

2. Material for embankment shall be free of vegetation, wood, organic material, trash, bricks, broken concrete, piping, rubble, or other objectionable material. Material sources shall be selected to eliminate the introduction of hazardous materials into the work site.

C. SELECT MATERIAL

1. Material shall have a Plasticity Index between 4 and 20 and meet all other requirements of this specification.

2.2 TESTING REQUIREMENTS

- A. All embankment material placed shall be tested. Unless otherwise shown on the plans, material placed for the benefit of roadway construction shall be compacted as follows:
- B. Structural areas (roadways, slabs, sidewalks, detention pond berms, and all areas within 5 feet of any of these) shall be compacted to 95% of the maximum dry density as determined by the Standard Procter Density Test (ASTM D698) at a moisture content between optimum and +4% wet of optimum moisture content.
- C. Non-structural areas (as shown on plans) shall be compacted to 90% of the maximum dry density as computed by the Standard Procter Density Test (ASTM D698) at a moisture content between optimum and +4% wet of optimum moisture content.
- D. Tests shall be taken at a minimum of one test per every 4000 square feet of embankment per every 12” of depth. Additional tests shall be conducted at the engineer’s request. All tests meeting these requirements shall be paid for by the owner. The cost of all tests failing these requirements shall be deducted from payment for this item.

PART 3 – EXECUTION

3.1 EXCAVATION

- A. All project excavation shall conform to the requirements of this specification. The completed roadway shall conform to the established alignment, grades and cross sections.
- B. Clearing and grubbing in excavation areas must be completed prior to beginning excavation operations.
- C. Topsoil shall be removed and stockpiled for reuse on the proposed surface. Topsoil in excess of what may be used on the finished surface shall be removed from the site by the contractor at no additional charge. Topsoil shall be assumed to be 6’ deep, but shall be excavated deep enough to remove all roots and other organic material. Contractor shall first check with City to determine if the City would like to stockpile the topsoil.
- D. All suitable excavated materials shall be utilized, insofar as practicable, in constructing the required roadway sections or in uniformly widening embankments, flattening slopes, etc., as directed by the Engineer. Unsuitable roadway excavation and excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor to be disposed of at a location approved by the Engineer.

- E. If “Waste” material is to be placed on property owned by a third party, the City will need a letter from the third party stating acceptance of such fill. Fill will not be allowed in 100-year floodplain without approved permits.
- F. Waste areas shall be uniformly graded to drain, with the outer limits feathered to blend with the existing ground. Waste areas shall be seeded, capped with suitable material, or otherwise protected from long-term erosion.
- G. During construction, the roadbed and ditches shall be maintained in a condition to insure proper drainage at all times. Ditches and channels shall be constructed and maintained to avoid damage to the roadway section.
- H. Gravel or base material on all existing streets shall be salvaged and used to tie-in new construction with existing unpaved streets and gravel and flexible pavement driveways. Driveways will be adjusted to provide smooth connections to new construction and shall be restored to a condition equal to or better than that existing before work began. All salvageable asphalt, gravel or rock base material not used in the work shall remain the property of the city. Such unused materials, as designated by the Engineer, shall be hauled to the city stockpile or to other stockpile locations designated by the Engineer and closer to the project than the site above.

3.2 EMBANKMENT

- A. Prior to placing any embankment, all Clearing and Grubbing operations shall have been completed on the excavation sources and areas over which embankment is to be placed.
- B. Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable material and thoroughly compacted by approved methods before commencing embankment construction. The surface of the ground, including plowed loosened ground, or surface roughened by erosion or otherwise, shall be restored to approximately its original grade by blading or other methods. Where indicated on Plans or required by the Engineer, the ground surface thus prepared shall be compacted by sprinkling and rolling.
- C. Unless otherwise indicated on the Plans the surface of all unpaved areas, other than rock, which are to receive embankment shall be loosened by scarifying or plowing to a depth of not less than four (4) inches. The loosened material shall be re-compacted with the new embankment as hereinafter specified.
- D. Where indicated on Plans or directed by the Engineer, the surface of hillsides to receive embankment shall be loosened by scarifying or plowing to a depth of not less than four (4) inches, or cut into steps before embankment materials are placed. The embankment shall then be placed in layers, as hereinafter specified, beginning at the low side in part width layers and increasing the widths as the embankment is raised. The material which has been loosened shall be re-compacted simultaneously with the embankment material placed at the same elevation.
- E. Layers of embankment may be formed by utilizing equipment which will spread the material as it is dumped, or they may be formed by being spread by blading from piles or windrows dumped from excavating or hauling equipment in such amounts that material is evenly distributed.
- F. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position. All such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken and the embankment material mixed by blading, harrowing, disking, or similar methods.

- G. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied. It shall be the responsibility of the Contractor to secure uniform moisture content throughout the layer by such methods as may be necessary. When water is required to achieve the required moisture content, the water must be from a source which does not contain any hazardous materials. Water removed from natural sources (ponds, lakes, rivers...) shall not impact any endangered species. Potable water sources shall be metered and paid by the contractor.
- H. Where embankments are to be placed adjacent to or over existing roadbeds, the roadbed slopes shall be plowed or scarified to a depth of not less than six (6) inches and the embankment built up in successive layers, as hereinafter specified, to the level of the old roadbed before its height is increased. Then, if directed, the top of the old roadbed shall be scarified and re-compacted with the next layers of the new embankment. The total depth of the scarified and added material shall not exceed the permissible depth of layer.
- I. Trees, stumps, roots, vegetation, or other unsuitable materials shall not be placed in embankment.
- J. Except as otherwise required by the Plans, all embankment shall be constructed in layers approximately parallel to the finished grade of the roadbed, unless otherwise specified, each layer shall be so constructed as to provide a uniform slope of 1/4 inch per foot from the center line of the roadbed to the outside. Super elevated curves will require that each layer shall be constructed to conform to the super elevation required by the governing standard.
- K. Embankments shall be constructed to the grade established by the Engineer and completed embankments shall correspond to the general shape of the typical sections shown on the Plans. Each section of the embankment shall correspond to the detailed section or slopes established by the Engineer. After completion of the roadway, it shall be continuously maintained to its finished section and grade until the project is accepted.

3.3 EARTH EMBANKMENTS

- A. Earth embankments shall be defined as those composed principally of material other than rock, and shall be constructed of accepted material from approved sources.
- B. Except as otherwise specified, earth embankments shall be constructed in successive layers for the full width of the individual roadway cross section and in such lengths as are best suited to the sprinkling and compaction methods utilized.
- C. Layers of embankment may be formed by utilizing equipment which will spread the material as it is dumped, or they may be formed by being spread by blading from piles or windrows dumped from excavating or hauling equipment in such amounts that material is evenly distributed.
- D. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position. All such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken and the embankment material mixed by blading, harrowing, disking, or similar methods.
- E. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied. It shall be the responsibility of the Contractor to secure a uniform moisture content throughout the layer by such methods as may be necessary.

- F. All earth cuts, full or part width cuts in side hill which are not required to be excavated below sub-grade elevation for base and backfill, shall be scarified to a uniform depth of at least six (6) inches below grade. The material shall be mixed and reshaped by blading and then sprinkled and rolled in accordance with the requirements outlined above for earth embankments and to the same density as required for the adjacent embankment.

3.4 COMPACTION

- A. Each layer shall be compacted to the required density by suitable equipment.
- B. The depth of each layer, prior to compaction, shall not exceed that depth which will produce six (6) inch compacted thickness. Prior to and in connection with, the compaction operation each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept leveled with suitable equipment to insure uniform compaction of the entire layer.
- C. For each layer of earth embankment and select material, it is the intent of this Specification to provide the density as required herein, unless otherwise shown on the Plans. Embankment soils shall be sprinkled as required and compacted to the extent necessary to provide not less than ninety-five (95) percent of the density as determined in accordance with Texas Highway Department Test Method Tex-113-E. Field density determinations will be made in accordance with approved methods.
- D. When the Contractor states that each layer of earth embankment or select material is complete and ready for the next layer, tests as necessary will be made by the Engineer. If the material fails to meet the density specified, the course shall be reworked as necessary to obtain the specified compaction, and the compaction method shall be altered on subsequent work to obtain specified density. Such procedure shall be determined by, and subject to, the approval of the Engineer.
- E. Should the sub-grade, due to any reason or cause, lose the required stability, density, or finish before the pavement structure is placed, it shall be re-compacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the sub-grade shall be prevented by sprinkling, sealing or covering with a subsequent layer of granular material. Excessive loss of moisture shall be construed to exist when the sub-grade soil moisture content is more than four (4) percent below the optimum for the density specified.
- F. In addition to the requirements in the Roadway Excavation item of the Specifications covering the general selection and utilization of materials to improve the roadbed, embankments shall be constructed in proper sequence to receive the select material layers shown on Plans, with such modifications as may be directed by the Engineer. The layer of embankment immediately preceding the upper layer of select material shall be constructed to the proper section and grade within a tolerance of not more than 0.10 foot from the established section and grade when properly compacted and finished to receive the select material layer.

3.5 PROOF ROLLING

- A. Prior to the placement of any material on native earth, the area shall be proof rolled. The native soil shall be rolled with sufficient intensity to bring out weak spots in the sub-grade which would otherwise fail during the construction process. The proof rolling shall be completed with equipment weighing at least 20 tons with tire pressures at least 50 and no more than 150 psi. A minimum of two coverage's of the proof roller will be required each

succeeding trip of the proof roller shall be offset by not greater than one tire width. Rollers shall be operated at speed between 2 and 6 miles per hour. Areas failing this test shall be excavated to a depth not to exceed two feet and horizontally ten feet beyond the failed area in all directions. Earth removed from this area may be replaced, stabilized, or “dried out” at the discretion of the engineer. No additional payment will be made for proof rolling prior to placement of embankment.

END OF SECTION

SECTION 31 23 23
SELECTED BORROW

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of furnishing, hauling, spreading and compacting selected borrow on the roadway to bring the roadbed up to proper grade.

1.2 MEASUREMENT AND PAYMENT

- A. Work and accepted material as prescribed for this item will be measured by the cubic yard of material in vehicles as delivered on the road.
- B. Payment for selected borrow will be made by the cubic yard, as measured under measurement. Payment shall be for full compensation of securing, hauling, spreading, mixing and compacting

1.3 SUBMITTALS

- A. Atterberg Limits
- B. Sieve Analysis

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The material shall consist of soil, with or without stone or conglomerate, and of a suitable quality to secure a well bonded course. It shall be free of vegetation or other objectionable material and shall have a maximum Plasticity Index of 20 as determined by Texas Highway Department Test Method Tex-106-E.

2.2 TESTING REQUIREMENTS

- A. When necessary or as directed by the City Engineer samples of the borrow material shall be collected and tested for Atterberg Limits. In addition a Sieve Analysis shall be performed.

PART 3 – EXECUTION

3.1 GENERAL

- A. The material shall be delivered in approved vehicles of uniform capacity, and it shall be the responsibility of the Contractor to deliver the material at the proper location. The material shall be spread by the use of blades, drags, or other suitable equipment.
- B. If the material is not well mixed or contains oversized material, it shall be thoroughly mixed. After spreading, all oversized material shall be broken by raking, blading, disking, harrowing, scarifying, or other approved methods.

- C. Borrow placed in the roadbed for the purpose of bringing the roadbed to proper grade subsequent to lime stabilization, will be mixed with the existing material to form a subgrade of uniform material at proper grade.
- D. Borrow used for constructing or widening embankment will be sprinkled if necessary and compacted according to SECTION 31 23 00 – EXCAVATION AND EMBANKMENT.

END OF SECTION

SECTION 32 01 13.61

**SLURRY SEAL
(Latex Modified-MicroSurfacing)**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of a micro-surfacing system which shall be a mixture of cationic modified asphalt emulsion, mineral aggregate, mineral filler, water and other additives mixed and spread on the paved surface in accordance with these specifications and to the dimensions as shown on the plans.

1.2 MEASUREMENT AND PAYMENT

- A. Slurry Seal (Latex Modified) will be measured by the ton of 2,000 pounds of the composite "Slurry Seal (Latex Modified)" of the grade actually used in the completed and accepted work in accordance with the plans and specifications for the project. The composite Slurry Seal (Latex Modified) mixture is hereby defined as the asphalt, aggregate and additives.
- B. All material shall be weighed on certified public scales or the contractor shall place a set of standard platform truck scales at a location approved by the Engineer. Scales shall conform to the requirements of the Item, "Weighing and Measurement Equipment."
- C. 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 "Slurry Seal (Latex Modified)," of the grade specified, which price shall be full compensation for furnishing all materials and performing all operations necessary to complete the work.

1.3 WEATHER LIMITATIONS

- A. The material shall be spread only when the atmospheric temperature is at least fifty (50) degrees Fahrenheit and rising and the weather is not foggy or rainy.

1.4 STOCKPILING AND STORAGE

- A. AGGREGATE STORAGE: If the mineral aggregates are stored or stockpiled, they shall be handled in such a manner as to prevent segregation, mixing of the various materials or sizes, and contamination with foreign materials. The grading of aggregates proposed for use and as supplied to the mixing plant shall be uniform. Suitable equipment of acceptable size shall be furnished by the contractor to work the stockpiles and prevent segregation of the aggregates.
- B. STORAGE AND HEATING OF ASPHALTIC MATERIALS: The asphaltic material storage shall be ample to meet the requirements of the plant. CSS-1P asphalt emulsion shall not be heated to a temperature in excess of that specified for Grade CSS-H. All equipment used in the storage and handling of asphaltic material shall be kept in a clean condition at all times and shall be operated in such manner that there will be no contamination with foreign matter.

PART 2 – PRODUCTS

2.1 ASPHALTIC MATERIALS

- A. The asphalt emulsion used shall be a cationic slow setting type, designated as CSS-1P. The emulsion shall be modified with an approved polymer. The distillation residue of the modified emulsion shall contain a minimum of 2.0 percent rubber solids by weight, as determined by an analytical method approved by the weight, as determined by an analytical method approved by the Department. The emulsion supplier shall furnish the Department samples of the base asphalt and polymer used in the finished emulsion.
- B. The modified emulsified asphalt shall be so formulated that when the paving mixture is applied with the relative humidity at not more than 50% and ambient air temperature of at least 75°F, it will cure sufficiently that rolling traffic can be allowed in one hour with no damage to the surface.

In addition, the emulsion shall comply with the following requirements:

	<u>MIN.</u>	<u>MAX.</u>
Viscosity, Saybolt Furol at 77 F. Sec.	20	10
Storage Stability test, one day, percent	-	1
Particle charge test	Positive	
Sieve test, percent	-	0.1
*Distillation:		
Oil distillate, by volume of emulsion, percent	-	1/2
Residue, percent	60	-
Tests on Residue from Distillation:		
Penetration, 77 F., 100 g, 5 seconds	55	90
Ductility, 77 F., 5 cm/min, cm	70	-
Solubility in trichlorethylene, percent	97	-

*The standard distillation procedure shall be modified as follows:

- C. The temperature on the lower thermometer shall be brought slowly to 350°F, plus or minus 10°F, and maintained at this point for 20 minutes. Complete the total distillation in 60 minutes, plus or minus 5 minutes, from the first application of heat.

2.2 MINERAL AGGREGATE

- A. DESCRIPTION: The mineral aggregate used shall be of the type and grade specified for micro-surfacing. The aggregate shall be manufactured crushed stone such as granite, slag, limestone, chat or other high quality aggregate or combination thereof. A sand equivalent of 65 or higher is required. The aggregate shall have a weighted loss of not more than 25% when subjected to the four-cycle soundness test using magnesium sulfate in accordance with ASTM C88.

The aggregate shall have a resistance to abrasion resulting in a maximum loss of 35% when tested to ASTM C131.

- B. **GRADES:** When tested by Test Method Tex-200-F, Part I, the gradation requirements shall be as follows:

GRADE 2 (Coarse Graded Surface Course)	Percentage Aggregate By Weight
Passing 1/2" sieve	100
Passing 3/8" sieve	99-100
Passing No. 4 sieve	86-94
Passing No. 8 sieve	45-65
Passing No. 16 sieve	25-46
Passing No. 30 sieve	15-35
Passing No. 50 sieve	10-25
Passing No. 200 sieve	05-15

- C. **MINERAL FILLER:** Mineral filler shall be non-air-entrained Portland cement which is free of lumps or foreign matter.

2.3 WATER

The water shall be potable and shall be free of harmful soluble salts.

2.4 OTHER ADDITIVES

Additives supplied by the emulsion manufacturer may be added to the emulsion mix or to any of the component materials to provide control of the set time in the field.

2.5 PAVING MIXTURE

- A. **MIX DESIGN:** Before work commences, the Contractor shall submit a signed mix design covering the specific materials to be used on the project. This design shall be performed by a qualified laboratory. Once the materials are approved, no substitution will be permitted, unless first tested and approved by the laboratory preparing the mix design.

The qualified laboratory shall develop the job mix design and present certified test results for the Engineer's approval. Compatibility of the aggregate and modified CSS-1H shall be verified by the mix design. The job mix formula shall provide a minimum Marshall stability of 1,800 pounds and a flow of 6 to 16 units when tested according to the modified ASTM 1559 or AASHTO 2450 procedure. All component materials used in the mix design shall be representative of the material proposed by the Contractor for use on the project.

- B. **COMPOSITION OF MIXTURE:** The Engineer shall approve the design mix and all micro-surfacing materials and methods prior to use and shall designate the proportions to be used within the following limits.

- Residual Asphalt - 6 to 9 percent by weight of dry aggregate or 13.5 to 23 percent by volume of the aggregate
- Mineral Filler - 1.5% to 3.0% by dry weight of aggregate
- Modifier - As required to provide the specified properties (Minimum of 2.0% solids based on bitumen weight content)
- Water - As required to provide proper consistency

C. **TYPE** : The paving mixture shall consist of a uniform mixture of coarse aggregate, fine aggregate and asphaltic material. Mineral filler, and/or additives may also be required.

The mixture shall be designed so that the mineral aggregate will produce a gradation which conforms to the limitations for the master grading for the type specified herein. The gradation will be determined in accordance with ASTM C136 (Dry Sieve Analysis) and shall be based upon aggregate only. The amount of asphaltic material shall conform to the limitation for the type specified.

D. **TOLERANCE**: The aggregate portion of the paving mixture produced shall not vary from the design gradation by more than the tolerances which follow. The material passing the No. 200 sieve is further restricted to conform to the limitations for the master grading for the type specified. The asphaltic material portion of the paving mixture shall not vary from the design amount by more than the allowed tolerance and is also restricted to conform to the master limits.

	Percent by Weight or Volume as Applicable
Passing 3/8" sieve, retained on No. 4 sieve	Plus or minus 5
Passing No. 4 sieve, retained on No. 8 sieve	Plus or minus 5
Total retained on No. 8 sieve	Plus or minus 5
Passing No. 8 sieve, retained on No. 16 sieve	Plus or minus 3
Passing No. 16 sieve, retained on No. 30 sieve	Plus or minus 3
Passing No. 30 sieve, retained on No. 50 sieve	Plus or minus 3
Passing No. 50 sieve, retained on No. 200 sieve	Plus or minus 3
Passing No. 200 sieve	Plus or minus 2
Asphaltic Material	Plus or minus 0.5 by wt. or 1.2 by vol.

2.6 EQUIPMENT

A. All equipment for the handling of all materials and mixing and placing of the mixture shall be maintained in good repair and operating condition and subject to the approval of the Engineer. Any equipment found to be defective and potentially affecting the quality of the paving mixture will be replaced.

- B. The material shall be mixed by a self-propelled micro-surfacing mixing machine which shall be a continuous flow mixing unit able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler and water to a revolving multi-blade mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler and water to maintain an adequate supply to the proportioning controls. Self-loading devices which provide for the loading of all materials while continuing to lay micro-surfacing, thereby minimizing construction joints, may be used. Other methods may also be used by the Contractor if requested in writing and approved by the Engineer.
- C. Individual volume or weight controls for proportioning each material to be added to the mix shall be provided. Each material control device shall be calibrated and properly marked.
- D. The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time.
- E. The emulsion pump shall be a positive displacement type and shall be equipped with a revolution counter or similar device so that the amount of emulsion used may be determined at any time.
- F. The mixing machine shall be equipped with a water pressure system and nozzle type spray bar to provide a water spray immediately ahead of and outside the spreader box. Other methods for accomplishing this task will be considered if requested in writing to the Engineer.
- G. The mixing machine shall be equipped with an approved fines feeder that shall provide a uniform, positive, accurately metered, predetermined amount of the specified mineral filler.

PART 3 – EXECUTION

3.1 CONSTRUCTION:

- A. **GENERAL:** It shall be the responsibility of the Contractor to produce, transport, and place the specified paving mixture in accordance with these specifications and as approved by the Engineer.
- B. **SURFACE PREPARATION:** The area to be sealed shall be thoroughly cleaned of all vegetation, loose aggregate and soil. Water used in pre-wetting the surface ahead of and outside the spreader box shall be applied at a rate to dampen the entire surface without any free flowing water ahead of the spreader box.
- C. **SPREADING EQUIPMENT:** The paving mixture shall be spread uniformly by means of a mechanical type squeegee box attached to the mixer, equipped with paddles to agitate and spread the materials throughout the box. A front seal shall be provided to ensure no loss of the mixture at the road contact surface. The rear seal shall act as a final strike-off and shall be adjustable. The mixture shall be spread to fill cracks and minor surface irregularities and leave a uniform skid resistant application of aggregate and asphalt on the surface. The spreader box and rear strike-off shall be so designed and operated that a uniform consistency is achieved to produce a free flow of material to the rear strike-off. The seam where two spreads join shall be neat appearing and uniform.

- D. WORKMANSHIP: No excessive buildup, uncovered areas or unsightly appearance will be permitted on longitudinal or transverse joints.
1. Longitudinal joints shall be placed on lane lines. Excessive overlap will not be permitted. Care shall be taken to ensure straight lines along the roadway centerline, lane lines, and shoulder or curb lines. Lines at intersections will be kept straight to provide a good appearance.
 2. Care shall be exercised in areas that require handwork so that the finished surface is uniform in texture, dense and of overall good appearance comparable to that produced by the spreader box.
- E. RATE OF APPLICATION: The Slurry Seal (Latex Modified) mixture shall be applied at an application rate to achieve a coverage of 20 to 25 lbs. per square yard base on dry aggregate weight.

END OF SECTION

SECTION 32 01 13.63

SINGLE COURSE BITUMINOUS SLURRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work covered by this specification includes the design, testing, construction, and quality control required for the proper application of an emulsified asphalt slurry seal surface (slurry seal).
- B. The slurry seal shall consist of a mixture of an approved emulsified asphalt, mineral aggregate, water and specified additives, proportioned, mixed and uniformly spread over a properly prepared surface as directed by the Owner. The completed slurry seal shall leave a homogeneous mat, adhere firmly to the prepared surface, and have a skid resistant surface texture.

1.2 MEASUREMENT AND PAYMENT

- A. The slurry seal will be measured and paid for at the contract unit price per square yard, complete in place.

1.3 LIMITATIONS

- A. WEATHER: The slurry seal shall not be applied if either the pavement or air temperature is below 55 degrees F (15 degrees C) and falling, but may be applied when both pavement and air temperature are above 45 degrees F (7 degrees C) and rising. No slurry seal shall be applied when there is danger the finished product will freeze before 24 hours. The mixture shall not be applied when weather conditions prolong opening to traffic beyond a reasonable time.
- B. OTHER: No slurry seal shall be applied before 8 A.M., and must be able to support traffic by 5 P.M. Weekend work is discouraged unless conditions warrant and is approved by the Engineer.

PART 2 – PRODUCTS

2.1 GENERAL

- A. The following specifications and test methods form a part of this specification.

AASHTO - American Association of State Highway and Transportation Officials.
 ASTM - American Society for Testing and Materials
 ISSA - International Slurry Seal Association

2.2 AGGREGATE AND MINERAL FILLER

AASHTO T2 ASTM D75 - Sampling Mineral Aggregates
 AASHTO T2 ASTM C136 - Sieve Analysis of Aggregates
 AASHTO T11 ASTM C117 - Materials Finer than No. 200 in Mineral Aggregate

AASHTO T176	ASTM D2419 -	Sand Equivalent Value of Soils and Fine Aggregate
AASHTO T84	ASTM C128 -	Specific Gravity and Absorption of Fine Aggregate
AASHTO T19	ASTM C29 -	Unit Weight of Aggregate
AASHTO T96	ASTM C131 -	Resistance of Abrasion of Small Size Coarse Aggregate by use of the Los Angeles Machine
AASHTO T127	ASTM C183 -	Sampling Hydraulic Cement
AASHTO T37	ASTM D546 -	Sieve Analysis of Mineral Filler
AASHTO T104	ASTM C88 -	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulphate
	ASTM D242 -	Mineral Filler for Bituminous Paving Mixtures

2.3 EMULSIFIED ASPHALT

AASHTO T40	ASTM D140 -	Sampling Bituminous Materials
AASHTO M140	ASTM D977 -	Specification for Emulsified Asphalt
AASHTO M208	ASTM D2397 -	Specification for Cationic Emulsified Asphalt
	ISSA T102 -	Mixing, Setting and Water Resistance Test to Identify "Quick-Set" Emulsified Asphalts

2.4 SLURRY SEAL

ISSA T101	-	Guide to Sampling Slurry Mix for Extraction Test
ISSA T106	-	Measurement of Slurry Seal Consistency
ISSA T111	-	Outline Guide Design Procedure for Slurry Seal
ISSA T114	-	Wet Stripping Test for Cured Slurry Seal Mixes
ISSA T115	-	Determination of Slurry Seal Compatibility
ASTM D3910	-	Design, Testing and Construction of Slurry Seal
ASTM D2172	-	Quantitative Extraction of Bitumen for Bituminous Paving Mixtures
ISSA T139	-	Test Method to Classify Emulsified Asphalt/Aggregate Mixture Systems by Modified Cohesive Tester Measurement of Set and Cure Characteristics

2.5 EMULSIFIED ASPHALT

The emulsified asphalt shall conform to CQS-1h or CSS-1h as specified in AASHTO M208. The cement mixing test is waived.

2.6 AGGREGATE

- A. GENERAL - The mineral aggregate shall consist of natural or manufactured crushed stone such as granite, slag, limestone, or other high quality aggregates or a combination thereof.

Smooth textured sands of less than 1.25% water absorption shall not exceed 50% of the total aggregate blend.

- B. **QUALITY TESTS** - When tested according to the following tests normal aggregates shall meet the following requirements:

TEST	QUALITY	SPEC
AASHTO T170 or ASTM 2149	Cleanness	55 min.
AASHTO T104 or ASTM C88	Soundness	15% max. using NA ₂ SO ₄ or 20% max. using Mg SO ₄
AASHTO T96 or ASTM C131	Hardness	35% max.

- C. **GRADING** - When tested by AASHTO T27, ASTM C136 and ASTM C117, the aggregate (including mineral filler) shall meet the following gradation:

SIEVE SIZE	TYPE II PERCENT PASSING
3/8	100
No. 4	90-100
No. 8	65-90
No. 16	45-70
No. 30	30-50
No. 50	18-30
No. 100	10-21
No. 200	5-15

2.7 MINERAL FILLER

Portland Cement, hydrated lime, limestone dust, fly ash or other approved filler meeting the requirements of ASTM D242 shall be used if required by the mix design. They shall be considered as part of the dry aggregate.

2.8 WATER

All water shall be potable and compatible with the slurry mix. Compatibility must be insured by the Contractor.

2.9 ADDITIVES

Additives may be used to accelerate or retard the break-set of the slurry seal, or improve the resulting finished surface. The use of additives in the slurry mix (or individual materials) shall be made initially in quantities predetermined by the mix design with field adjustments if required, after approval by the Owner.

2.10 EQUIPMENT

- A. GENERAL - All equipment, tools and machines used in the performance of this work shall be maintained in satisfactory working order at all times.
- B. SLURRY MIXING EQUIPMENT - The slurry seal mixing equipment shall be a continuous flow mixing unit, either an individual unit that returns to the stockpile for reloading or a continuous run unit that is resupplied on the job. All units must have suitable means of accurately metering each individual material being fed into the mixer. All feeding mechanisms must be continuous feed and proportioning must remain constant at all times. The units shall be equipped with approved devices so that the machine can be accurately calibrated, and the quantities of materials used during any one period can be estimated. In the event these metering devices stop working, the slurry unit(s) will stop the application process until they are fixed.

The mixer shall thoroughly blend all materials to form a homogeneous mass before leaving the mixer.

- C. SLURRY SPREADING EQUIPMENT - The spreader box shall be equipped to prevent loss of slurry seal from all sides and with a flexible rear strike-off. It shall be capable of producing a uniform surface its full width. It shall have suitable means for side tracking to compensate for deviations in pavement geometry. Any type drag used shall be approved by the Owner and kept in a completely flexible condition at all times. The box shall be kept clean and build-up of asphalt and aggregate shall not be permitted.
- D. AUXILIARY EQUIPMENT - Suitable crack and surface cleaning equipment, barricading equipment, hand tools and any support equipment should be provided as necessary to perform the work.

2.11 MACHINE CALIBRATION AND VERIFICATION

- A. CALIBRATION - Each slurry mixing unit to be used in performance of the work shall be calibrated in the presence of the Owner prior to construction. No machine will be allowed to work on the project until the calibration has been completed and/or accepted.
- B. VERIFICATION - Test strips will be made by each machine after calibration and prior to construction. Test strips shall be a portion of the project. Samples of the slurry seal will be taken and verification made as to mix consistency and proportioning. Verification of rate of application will also be made. Upon failure to any of the tests, additional tests strips, at no cost to the Owner, will be required until each unit is authorized to work. Any unit failing to pass the tests after the third trial will not be permitted to work on the project. Test strips must be accepted or rejected within 24 hours after application.

PART 3 – EXECUTION

3.1 EXAMINATION/QUALITY CONTROL

- A. MATERIALS - The Contractor will permit the Owner to take samples of the aggregate and asphalt and asphalt emulsion used in the project at the Owner's discretion. Gradation and sand equivalent tests may be run on the aggregate and residual asphalt content tests on the emulsion. Test results will be compared to specifications. Tests will be run at the expense of the Owner. The Owner must notify the Contractor immediately if any test fails to meet the specifications.

- B. SLURRY SEAL - Samples of the slurry seal will be taken directly from the slurry units(s). Consistency and residual asphalt content tests may be made on the samples and compared to the specifications. Tests will be run at the expense of the Owner. The Owner must notify the Contractor immediately if any test fails to meet specifications.

The Owner may use the recorders and measuring facilities of the slurry seal unit to determine application rates, asphalt emulsion content, mineral filler and additives(s) content for an individual load.

It is the responsibility of the Contractor to check stockpile moisture content and to set the machine accordingly to account for aggregate bulking.

- C. NON-COMPLIANCE - If any two successive tests fail on the stockpile material, the job shall be stopped. It is the responsibility of the Contractor, at his own expense, to prove to the Owner that the conditions have been corrected. If any two successive tests on the mix from the same machine fail, the use of the machine shall be suspended. It will be the responsibility of the Contractor, at his own expense, to prove to the Owner that the problems have been corrected and that the machine is working properly.

3.2 LABORATORY EVALUATION

- A. GENERAL - Before work commences, the Contractor shall submit a signed original of a mix design covering the specific materials to be used on the project. This design must have been performed by a qualified laboratory. Previous lab reports covering the exact materials to be used may be accepted provided they were made during the calendar year. Once the materials are approved, no substitution will be permitted unless first tested and approved by the laboratory preparing the mix design.
- B. LABORATORY REPORT - The laboratory report will show the results of tests performed on the individual materials, comparing their values to those required by this specification. The report will provide the following information on the slurry seal mixture.

TEST PURPOSE	METHOD	SPEC
Slurry Seal Consistency	ISSA T106	2 - 3 cm
Wet Stripping Test	ISSA T114	Pass
Compatibility	ISSA T115	* Pass
Quick Set Emulsion	ISSA T102	** Pass
Wet Track Abrasion	ASTM D3919-Modified	50 gms/sq ft. max. (6 days soak)
Cohesive Test	ISSA T139	12 kg-cm, 30 min. 16 kg-cm, 60 min.

* Mixing tests must pass at the maximum expected air temperature

** Using job aggregate

The laboratory shall further report the quantitative effects of moisture content on the unit weight of the aggregate (bulking effect). The laboratory report must clearly show the proportions of aggregate, mineral filler (min and max), water (min and max), additive(s) (usage) and asphalt based on the dry aggregate weight.

3.3 COMPOSITION, RATE OF APPLICATION AND TOLERANCES

- A. COMPOSITION - The percentage of each individual material shall be as required by the laboratory report. Adjustments may be required during construction, based on field conditions. The Owner will give final approval for all such adjustments.
- B. RATE OF APPLICATION - The slurry seal mixture shall be of proper consistency at all times so as to provide the amount of mixture required by the surface condition. The average application rate as measured by the Owner shall be a minimum of 12 to maximum of 14 lbs. per s.y. based on dry aggregate weight.

The application rate must be a minimum of 10 lbs. per s.y. based on dry aggregate weight when tested in Place Paper Test or other approved test methods satisfactory to the Engineer.

- C. TOLERANCES - Tolerances for individual materials as well as the slurry seal mixture are as follows:
1. After the designed residual asphalt content is determined, a plus or minus one percentage point variation will be permitted.
 2. The percentage of aggregate passing each sieve shall not vary more than $\pm 4.0\%$ from the job mix formula.
 3. The percent of aggregate passing shall not go from the high end to the low of the specified range of any two successive sieves.
 4. The slurry consistency shall not vary more than ± 0.5 cm from the job mix formula after field adjustments.

3.4 NOTIFICATION AND TRAFFIC CONTROL

- A. NOTIFICATION - All homeowners and businesses affected by the construction shall be notified one day in advance of the surfacing. Should the work not occur on the specified day, new notification will be distributed when required. The Contractor must supply the Engineer with a tentative schedule at least 10 days in advance of placement, along with weekly schedules.
- B. TRAFFIC CONTROL - Suitable methods shall be used by the Contractor to protect the slurry seal from all type of vehicular traffic until the new surface will support the traffic without damage. Opening to traffic does not constitute acceptance of the work. The Owner shall be notified of the methods to be used.

Traffic control measures shall be in accordance with the "Texas Manual on Uniform Traffic Control Devices for Streets and Highways".

3.5 PREPARATION OF THE SURFACE

- A. GENERAL - Immediately prior to applying the slurry seal, the surface shall be cleared of all loose material, silt spots, vegetation, oil spots and other objectionable material. Any standard cleaning method will be acceptable. If water is used, cracks will be allowed to dry thoroughly before slurry sealing. Manholes, valve boxes, drop inlets and other service entrances will be protected from the slurry seal by a suitable method. The Owner shall approve the surface preparation prior to sealing.

The Contractor shall remove and properly dispose of all debris, including any accumulations in the gutter lines.

3.6 APPLICATION

- A. GENERAL - The surface should be pre-wetted by fogging ahead of the slurry box when required by local conditions. Water used in pre-wetting the surface shall be applied such that the entire surface is damp with no apparent flowing water in front of the slurry box. The rate of application of the fog spray shall be adjusted during the day to suit temperatures, surface texture, humidity and dryness of the pavement surface.
- The slurry mixture shall be of the desired consistency upon leaving the mixer and no additional materials shall be added. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that a complete coverage is obtained. Overloading of the spreader shall be avoided. No lumping, balling or unmixed aggregate shall be permitted.
- No streaks, such as those caused by oversized aggregate, will be left in the finished surface. If excess oversize develops, the job will be stopped until the Contractor proves to Owner that the situation has been corrected.
- B. JOINTS - No excessive buildup, uncovered areas or unsightly appearance shall be permitted on longitudinal or transverse joints. An excessive overlap will not be permitted on longitudinal joints. The Contractor shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the project. When possible, longitudinal joints shall be placed on lane lines. Half passes and odd width passes will be used only in minimum amounts. If half passes are used, they shall not be the last pass of any paved area.
- C. MIX STABILITY - The slurry mixture shall possess sufficient stability so that premature breaking of the slurry seal in the spreader box does not occur. The mixture shall be homogeneous during and following mixing and spreading, it shall be free of excess water or emulsion and free of segregation of the emulsion and aggregate fines from the coarser aggregate.
- D. HAND WORK - Areas which cannot be reached with the slurry seal machine shall be surfaced using hand squeegees to provide complete and uniform slurry seal coverage. The area to be hand worked shall be lightly dampened prior to mix placement and the slurry worked immediately. Care shall be exercised to leave no unsightly appearance from handwork. The same type finish as applied by the spreader box shall be required. Handwork shall be completed during the machine applying process.
- E. LINES - Care shall be taken to insure straight lines along curbs and shoulders. No runoff on these areas will be permitted. Lines at intersections will be kept straight to provide a good appearance.
- F. OPEN TO TRAFFIC - The surface shall be suitable to open to rolling traffic within a period of 2 hours after placement. Pneumatic rolling will be required on all slurry prior to opening to traffic.
- G. CLEAN-UP - All areas, such as manways, gutters and intersections, shall have the slurry seal removed as specified by the Owner. The Contractor shall remove any debris associated with the performance of the work, on a daily basis.

END OF SECTION

SECTION 32 05 16

AGGREGATE FOR SURFACE TREATMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item establishes the requirements for aggregates to be used in the construction of surface treatments.

1.2 MEASUREMENT AND PAYMENT

- A. Aggregates will not be paid for separately but will be considered as part of the unit price bid for "One Course Surface Treatment".

PART 2 – PRODUCTS

2.1 MATERIALS

- A. GENERAL: Aggregates shall be composed of sound and durable particles of gravel, crushed gravel, crushed stone, crushed slag, burned clay, burned shale or natural limestone rock asphalt. These materials shall contain not more than one (1) percent by weight of organic matter (other than native bitumen), clays, loam or pebbles coated therewith and shall contain not more than five (5) percent by weight of any one of or combination of slate, shale, schist or soft particles of sandstone when tested in accordance with Texas Highway Department Test Method Tex-217-F.

The natural limestone rock asphalt aggregate furnished shall have an average bitumen content from four to eight (4 - 8) percent by weight of naturally impregnated asphalt, as determined by Texas Highway Department Test Method Tex-215-F, and shall contain not more than two (2) percent by weight of any one of or combination of iron pyrites, or other objectionable matter, as determined by Texas Highway Department Test Method Tex-217-F.

No aggregate shall contain a total of more than five (5) percent by weight of impurities or objectionable matter listed above.

The percent of wear, as determined by Texas Highway Department Test Method Tex-410-A, for each of the materials shall not exceed thirty-five (35) percent.

The percent of wear on natural limestone rock asphalt aggregate, as determined by Texas Highway Department Test Method Tex-410-A, shall be made on that portion of the material retained on the No. 4 sieve, having a naturally impregnated asphalt content of less than one (1) percent.

Crushed gravel shall have a minimum of eighty-five (85) percent of the particles retained on the No. 4 sieve with at least on (1) crushed face.

- B. AGGREGATE TYPES :

The various types of aggregates are identified as follows:

- TYPE A Type A aggregate shall consist of gravel, crushed slag, crushed stone or natural limestone rock asphalt.
- TYPE B Type B aggregate shall consist of crushed gravel, crushed slag, crushed stone or natural limestone rock asphalt.
- TYPE C Type C aggregate shall consist of gravel, crushed slag or crushed stone.
- TYPE D Type D aggregate shall consist of crushed gravel, crushed slag or crushed stone.
- TYPE E Type E aggregate shall consist of natural limestone rock asphalt.
- TYPE F Type F aggregate shall consist of burned clay or burned shale.

C. AGGREGATE GRADES

When tested by Texas Highway Department Test Method Tex-200-F, the gradation requirements for the several grades of aggregate shall be as follows:

**PERCENT BY
WEIGHT**

GRADE 1:	Retained on 1" sieve	0
	Retained on 7/8" sieve	0 - 2
	Retained on 5/8" sieve	15 - 45
	Retained on 3/8" sieve	85 - 100
	Retained on No. 4 sieve	95 - 100
	Retained on No. 10 sieve	98 - 100
GRADE 2:	Retained on 7/8" sieve	0
	Retained on 3/4" sieve	0 - 2
	Retained on 1/2" sieve	20 - 35
	Retained on No. 4 sieve	85 - 100
	Retained on No. 10 sieve	98 - 100
GRADE 3:	Retained on 3/4" sieve	0
	Retained on 5/8" sieve	0 - 2
	Retained on 1/2" sieve	5 - 20
	Retained on No. 4 sieve	85 - 100
	Retained on No. 10 sieve	98 - 100
GRADE 4:	Retained on 5/8" sieve	0
	Retained on 1/2" sieve	0 - 2
	Retained on 3/8" sieve	5 - 25
	Retained on No. 4 sieve	85 - 100
	Retained on No. 10 sieve	98 - 100
GRADE 5:	Retained on 1/2" sieve	0
	Retained on 3/8" sieve	0 - 2
	Retained on No. 4 sieve	40 - 85
	Retained on No. 10 sieve	98 - 100

**PERCENT BY
WEIGHT**

GRADE 6:	Retained on 1/2" sieve	0
	Retained on 3/8" sieve	0 - 2
	Retained on No. 4 sieve	5 - 40
	Retained on No. 10 sieve	70 - 100
	Retained on No. 20 sieve	99 - 100
GRADE 7:	Retained on 1/4" sieve	0
	Retained on No. 4 sieve	0 - 10
	Retained on No. 20 sieve	25 - 55
GRADE 8:	Retained on No. 4 sieve	0
	Retained on No. 10 sieve	0 - 10
	Retained on No. 20 sieve	10 - 55

END OF SECTION

SECTION 32 05 17

ASPHALTS, OILS AND EMULSIONS**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This item establishes the requirements for oil asphalts, cut-back asphalts, flux oils, and emulsified asphalts to be used.

1.2 MEASUREMENT AND PAYMENT

- A. Asphalts, Oils and Emulsions will be paid for in accordance with the governing Specifications for the item(s) of construction in which they are used.

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. Terms relating to oil asphalt shall be as defined in the current "Definition of Terms Relating to Materials for Roads and Pavements", A.S.T.M. Designation D-6.
- B. The asphaltic material shall be of the grade and type shown on the Plans and/or otherwise specified, and shall meet the following requirements:
1. Oil Asphalt: The material shall be homogeneous, shall be free from water, shall not foam when heated to 347° F., and shall meet the following requirements:

TYPE-GRADE	OA-55 Min-Max	OA-65 Min-Max	OA-75 Min-Max	OA-90 Min-Max	OA-135 Min-Max	OA-175 Min-Max
Penetration at 77° F., 100 gm, 5 sec.	50 - 60	60 - 70	70 - 85	85 -100	120-150	150-200
Ductility at 77° F., 5cm/min, cms	100 ---	100 ---	100 ---	100 ---	100 ---	70 ---
Flash Point C.O.C., ° F.	450 ---	450 ---	450 ---	450 ---	450 ---	450 ---
Softening Point R. & B., ° F.	113-140	113-140	113-140	113-140	113-140	113-140
Loss at 325° F., 50 gm., 5 hrs.,%	-- 0.75	-- 0.75	-- 0.75	-- 0.75	-- 0.75	-- 0.75
Penetration of Residue, 77° F. 100 gm, 5 sec.	30 ---	40 ---	45 ---	50 ---	70 ---	90 ---
Solubility in CCI 4, %	99.5 --	99.5 --	99.5 --	99.5 --	99.5 --	99.5 --

2. Cut-Back Asphalt: The material shall be free from water and shall meet the following requirements:

TYPE-GRADE	RC-1 Min-Max	RC-2 Min-Max	MC-1 Min-Max	MC-2 Min-Max	MC-3 Min-Max
Flash Point T.O.C., °F.	80 ---	80 ---	80 ---	150 ---	150 ---
Furol Viscosity at 77° F., Sec.	-----	-----	110-150	-----	-----
Furol Viscosity at 122° F., Sec.	100-160	200-275	-----	-----	-----
Furol Viscosity at 140° F., Sec.	-----	-----	-----	150-250	300-500
The distillate shall be as follows, expressed as percent by volume of total cut-back:					
Off at 437° F.	12 ---	10 ---	--- 10	--- 2	--- 2
Off at 600° F.	25 ---	-----	25 ---	10 - 20	8 - 20
Off at 680° F.	--- 40	--- 30	--- 50	--- 27	--- 25
Off between 600° F. and 680° F.	-----	--- 5	-----	-----	-----
Tests on residue:					
Penetration at 77° F., 100 gm, 5 sec.	70 100	120-150	100-200	100-200	100-200
Ductility at 77° F., 5 cm/min., cms.	100 ---	100 ---	100 ---	100 ---	100 ---
Solubility in CCl 4, %	99.5 --	99.5 --	99.5 --	99.5 --	99.5 --

3. Flux Oil: Fluxing material shall be homogeneous. It shall show no separation of asphalt after thorough mixing and shall meet the viscosity requirements at any time within thirty (30) days after delivery.

	<u>Min.</u>	<u>Max.</u>
Furol Viscosity at 122° F., Sec.	50	100
Flash Point C.O.C., °F.	250	---
Loss on Heating, 50 gms., 5 hrs., at 325° F., %	0	5

4. Emulsions: The material shall be homogeneous. It shall show no separation of asphalt after thorough mixing and shall meet the viscosity requirements at any time within thirty (30) days after delivery.

TYPE-GRADE	EA-HVRS Min-Max	EA-HVMS Min-Max	EA-10S Min-Max	EA-11M Min-Max
Furol Viscosity at 77 ^o F., Sec.	-----	-----	30-100	30-100
Furol Viscosity at 122 ^o F., Sec.	100-300	100-300	-----	-----
Residue by Distillation, %	60 ---	60 ---	57.5-65	57.5-65
Oil Portion of Distillate, %	-----	-----	--- 2	--- 2
Sieve Test, %	--- 0.05	--- 0.05	--- 0.05	--- 0.05
Miscibility (Standard Test)	-----	-----	Passing	Passing
Coating	-----	-----	Passing	Passing
Cement Mixing, %	-----	-----	--- 2	-----
Demulsibility 50 cc of N/50 CaCl 2, %	-----	-----	-----	--- 70
Demulsibility 35 cc of N/50 CaCl 2, %	30 ---	30 ---	-----	-----
Settlement, 5 days, %	--- 3	--- 3	--- 3	--- 3
Freezing Test 3 cycles (*)	-----	-----	Passing*	Passing*
Tests on residue:				
Penetration at 77 ^o F., 100 g, 5 Sec.	100-200	100-200	100-175	100-175
Solubility in CCl 4, %	97.5 ---	97.5 ---	97.5 ---	97.5 ---
Ductility at 77 ^o F., 5 cm/min., cms.	40 ---	40 ---	40 ---	40 ---

(*) Applies only when Engineer designates material for winter use.

2.2 TESTING REQUIREMENTS

- A. The properties enumerated herein for Asphalts, Oils and Emulsions shall be determined in accordance with the applicable current A.A.S.H.O. methods except where otherwise specified.

PART 3 – EXECUTION**3.1 GENERAL**

Oil Asphalts, Cut-Back Asphalts, and the temperatures which provide optimum fluidity for uniform and easy application. No Rapid Curing Cut-Back Asphalt shall be applied at a temperature in a temperature in excess of 275° F. Recommended application temperature ranges for the types and grades of asphalts are as follows:

TYPE	GRADE	APPLICATION Minimum	TEMPERATURES Maximum
Oil Asphalts - All Types	All Grades	275° F	375° F
Cut-Back Asphalts - Rapid Curing	RC-1	80° F	150° F
	RC-2	100° F	175° F
Cut-Back Asphalts - Medium Curing	MC-1	70° F	150° F
	MC-2	100° F	200° F
	MC-3	175° F	250° F
Emulsified Asphalts - All Types	All Grades	50° F	140° F

All asphaltic materials which have been heated above 400° F. will be rejected.

END OF SECTION

SECTION 32 11 14

FLEXIBLE BASE CRUSHED LIMESTONE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of a base course composed of crusher-run broken limestone. The base shall be constructed as specified in one or more courses in conformity with the typical section shown on the Plans, and to the line and grades established by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Payment for flexible base will be made at the unit price bid in the Proposal. The price shall include preparing and rolling the sub-grade, furnishing and placing the base material, all royalty and freight, hauling and delivery on the street, spreading, shaping, dragging, sprinkling or drying, compacting and finishing; for all manipulation, labor, tools and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

- A. The Contractor shall furnish the Engineer with two copies of all test results performed by a pre-approved independent testing laboratory. The documentation shall be specifically for the material that is to be used on the project.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The material shall meet the material requirements of TX DOT 247, Type A, Grade 1. The Contractor shall be responsible for insuring that all materials delivered at the job site meet the specifications. The Engineer may require testing or retesting by an acceptable independent testing laboratory of any materials submitted. If this testing indicates the material to be unsatisfactory, the Contractor shall be required to pay for those tests, as well as supply materials which comply with said specifications. The material shall be obtained from pre-approved sources at the time of submittal, shall be crushed, and shall consist of durable particles of stone mixed with pre-approved binding materials. Unless otherwise specified on the Plans the processed material shall meet the following requirements:

- 1. Test Requirements: The processed material shall meet the following requirements when tested in accordance with procedures as outlined in TX DOT Item 247.

Retained on 1 3/4" sieve	0%
Retained on 7/8" sieve	10% - 35%
Retained on 3/8" sieve	30% - 50%
Retained on 4 mesh sieve	45% - 65%
Retained on 40 mesh sieve	70% - 85%

- a. Liquid Limit: The portion of material passing the 40 mesh sieve shall have a liquid limit of 35 or less, in accordance with TEX-104-E.
- b. Plasticity Index: The portion of material passing the 40 mesh sieve shall have a plasticity index of not less than 4 nor more than 10, in accordance with TEX-106-E.
- c. Abrasion: The crushed stone shall have an abrasion loss of not more than 40% when subjected to the Wet Ball Mill Test, TEX-116-E with a maximum of 20% increase in passing the No. 40 sieve.
- d. Triaxial Test: The crushed stone shall have a minimum compression strength of 45 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure in accordance with TEX-117-E.

2.4 EQUIPMENT

- A. All equipment shall be adequate for the purposes intended, meeting the approval of the Engineer prior to the start of work.

2.3 TESTING REQUIREMENTS

- A. The Contractor shall have field densities performed on the base for review by the Engineer. These tests shall be taken at points directed by the Engineer with a maximum of one test per construction station. The City will not pay for failing tests.
- B. Testing for required depth will be performed upon completion of the course to the lines and grades specified.

PART 3 – EXECUTION

3.1 PLACING

- A. The flexible base course shall be placed upon a previously approved sub-grade. Immediately before placing the flexible base material, the sub-grade shall be checked for conformance with the Plans and Specifications and any corrections as pre-approved by the Engineer shall be made.
- B. Material deposited upon the sub-grade shall be spread and shaped the same day. The material shall conform to the typical sections as shown on the Plans. All areas and "nests" of segregated coarse or fine materials shall be corrected or removed and replaced with well-graded material. The Contractor shall furnish and apply additional binder to the in-place material, if directed by the Engineer. Such binder material shall be carefully and evenly incorporated with the in-place material by scarifying, harrowing, brooming, or other pre-approved methods.

3.2 FINISHING AND COMPACTION

- A. The flexible base course shall be sprinkled as required and rolled until obtaining a uniform compaction and the required density.
- B. Compaction of the flexible base course shall be accomplished with a pneumatic. Rolling shall continue until the base course material has been compacted to ninety five percent (95%) of the modified density (ASTM D1557). The allowable deviation from optimum moisture content is to +4%.

- C. The shape of the course shall be maintained by blading throughout the entire compacting operation. The completed surface shall be smooth and in conformance with the typical sections shown on Plans and to the established lines and grades. Completed surfaces that deviate in excess of one-fourth (1/4) inch in cross-section and in a length of sixteen (16) feet measured longitudinally shall be connected.
- D. The method of correction shall be by loosening, adding or removing material, and reshaping and recompacting by sprinkling and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the affected areas, adding suitable material as required, and reshaping and recompactation by sprinkling and rolling.
- E. When directed by the Engineer the base course may be opened to traffic. The Contractor shall direct and distribute the traffic uniformly over the entire width of the course. During the period traffic is being directed over the course, the surface shall be satisfactorily maintained by the use of blades, drags and other equipment. Maintenance operations shall continue until starting the application of the next course or the surface course.

END OF SECTION

SECTION 32 11 16

SUBGRADE PREPARATION AND COMPACTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of scarifying, blading and rolling the sub-grade to obtain a uniform texture and a uniform density throughout the required depth as shown on the Plans.

1.2 MEASUREMENT AND PAYMENT

- A. When the Contractor thinks the sub-grade is ready for acceptance by the Engineer, he will have field densities performed on the sub-grade at his expense by an independent testing laboratory approved by the Engineer. These tests shall be taken at points directed by the Engineer with a maximum of one test per station of construction. These tests shall be performed by the method outlined in A.S.T.M. Designation D-698, or an equivalent method approved by the Engineer (Balloon Density or Harris Cup). A section will be considered satisfactory as to density when no single test indicates less than 98% Standard ASTM D-698. A written report containing the dry density, the moisture content and location of each in place sample taken shall be submitted to the Engineer.
- B. Payment for compacted sub-grade shall be included in the unit price bid for "Concrete Pavement", "Flexible Base" or "Compacted Sand Sub-base" as the case may be. Price will be full compensation for removing excess material, shaping, fine grading and compacting the sub-grade; for furnishing and hauling all materials, blading, shaping, rolling and finishing, and all labor, tools and incidentals necessary to complete the work except roadway excavation. Payment will not be made for unauthorized work.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION

3.1 GENERAL

- A. The roadbed shall be excavated and shaped in conformity with the typical sections shown on the Plans and to the lines and grades established by the Engineer. The entire roadway cross-section including an area two (2) feet back of the proposed curb line shall be bladed clear of vegetation and scarified as directed by the Engineer. All unstable or otherwise objectionable material shall be removed or broken off to a depth of not less than six (6) inches below the surface of the sub-grade. Holes or depressions resulting from the removal of such material shall be backfilled with suitable material compacted in layers not to exceed six (6) inches. All soft and unstable material and other portions of the sub-grade which will not compact readily or serve the intended purpose shall be removed as directed. No direct payment will be made for such removal, except where each separate spot or area requiring removal exceeds ten (10) cubic yards, in which case measurement and payment will be made as provided in the SECTION 31 23 00 – EXCAVATION AND EMBANKMENT.

- B. The sub-grade shall be scarified to the depth shown on the Plans and bladed and compacted in the manner directed in the section on "Finishing and Compaction". The surface of the sub-grade shall be finished to line and grade as established, and be in conformity with the typical sections shown on the Plans. Any deviation in excess of one-half (1/2) inch in cross-section and in a length of sixteen (16) feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping or compacting by sprinkling and rolling. Material excavated in the preparation of the sub-grade shall be disposed of as directed by the Engineer.

3.2 FINISHING AND COMPACTION

- A. The sub-grade course, including an area two (2) feet back of the proposed curb line, shall be sprinkled as required and rolled as directed until a uniform compaction and required density is obtained. Compaction of the sub-grade may be done using any of the rolling equipment outlined in SECTION 31 11 29.02 - ROLLING. However, required densities must be met. Should the Engineer feel that too much time is being required to obtain those densities he can require that a heavy pneumatic roller be applied. Rolling shall continue until the sub-grade has been compacted to ninety-eight (98) percent of the Standard Density (A.S.T.M. Method D-698). The allowable deviation from optimum moisture content is 0 to +4%.
- B. Rolling shall progress gradually from the sides to the center of the lane under construction, by lapping uniformly each proceeding track by at least twelve (12) inches.
- C. After rolling and watering, the sub-grade shall be checked by the use of string line or instrument. All portions that do not conform to the lines and grades as shown on the Plans, shall be scarified for at least six (6) inches and re-compacted to correct elevation.
- D. Until the base course or pavement is placed, the sub-grade shall be maintained free from ruts and depressions, in a smooth and compacted condition true to lines and grade and to the density requirements contained herein. All of the Contractor's hauling and other equipment used in such a way as to cause rutting and raveling of the sub-grade shall either be removed from the work or suitable runways or other equivalent means shall be provided to prevent rutting.
- E. The Contractor shall be responsible for maintaining and protecting the roadbed for the entire length of the project.
- F. During construction, grading of the sub-grade shall be conducted so that the berm of earth or other material does not prevent immediate drainage of water to the side. Ditches and drains along the sub-grade shall be maintained so as to drain effectively.

END OF SECTION

SECTION 32 11 26

ASPHALT STABILIZED BASE

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of a base course composed of a compacted mixture of a mineral aggregate and asphaltic material. The mixture when designed and tested in accordance with these Specifications shall meet the following requirements:
 - 1. Laboratory Density (THD BULLETIN C-14) (Unless otherwise shown on plans)
 - Minimum 92 percent
 - Optimum 96 percent
 - Maximum 99 percent
 - 2. Stability (THD BULLETIN C-14)
 - Shall not be less than 30 percent except when otherwise shown on plans. The base course shall be constructed on previously completed and approved sub-grade or sub-base, as herein provided, and in accordance with the details shown on the plans.

1.2 MEASUREMENT AND PAYMENT

- A. Asphalt concrete base shall be measured by the square yard for the thickness indicated in the Proposal.
- B. Tack coat will not be measured as a separate item. The cost of tack shall be included in the price bid for asphaltic concrete base.
- C. Prime coat will not be measured as a separate item. The cost of prime coat shall be included in the price bid for asphaltic concrete base.
- D. 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 "Hot Mix Asphaltic Base", of the type specified, which price shall be full compensation for quarrying, furnishing all materials, freight involved, for all heating, mixing, hauling, cleaning the existing base course or pavement, placing asphalt stabilized base, rolling and finishing, and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work including tack coat and prime coat when required.

PART 2 – PRODUCTS

2.1 MATERIALS

A. The mineral aggregate shall be composed of a coarse aggregate and a fine aggregate. Samples of coarse aggregate and fine aggregate shall be submitted in accordance with the methods prescribed in the Special Provisions. Approval of both material and source must be obtained from the Engineer prior to delivery. Sources of material specified on the plans as being available for use will not require prior approval. The mineral aggregate shall contain not more than 2 percent by weight of organic matter, clays, loam or pebbles coated therewith, as determined by Test Method Tex-217-F. Mineral aggregates from each source shall meet the quality tests specified herein.

1. Coarse Aggregates: The coarse aggregates shall be that part of the aggregate retained on a No. 10 sieve; shall consist of clean, tough, durable fragments of stone, crushed gravel, iron ore, slag, or combinations thereof, and be of uniform quality throughout. Coarse aggregate will be tested in accordance with Test Method Tex-406-A for decantation. Material removal will not be more than 3 percent by weight. The coarse aggregate, when subjected to the Los Angeles Abrasion Test (Test Method Tex-410-A), shall have an abrasion not exceeding 45.
2. Fine Aggregate: The fine aggregate shall be that of the aggregate passing the No. 10 sieve and shall consist of sand or screening or a combination of sand and screening. The plasticity index of that part of the fine aggregate passing the No. 40 sieve shall be not more than 6 when tested by Test Method Tex-106-E. Sand shall be composed of durable stone particles free from injurious foreign matter. Screening shall be material produced during the production of the coarse aggregate.
3. Asphaltic Material Mixture: Asphalt for the mixture shall be of the types of oil asphalt as determined by the Engineer and shall meet the requirements of Section 32 05 17 - Asphalts, Oils and Emulsions. The grade of asphalt shall be designated by the Engineer. The Contractor shall notify the Engineer of the sources of his asphalt material prior to production of the asphaltic mixture and prior to any change desired during the course of the project.
4. Tack Coat: The asphaltic material for tack coat shall meet the requirements for Cut-Back Asphalt RC-2 and may, upon instructions from the Engineer, be diluted by the approved grade of gasoline and/or kerosene, not to exceed 15 percent by volume. Asphaltic materials shall meet the requirements of Section 32 05 17 - Asphalts, Oils and Emulsions.

2.2 MIXTURES

A. The mixtures shall consist of a uniform mixture of coarse aggregate, fine aggregate, and asphaltic material. The grading of each constituent of the mineral aggregate shall be such as to produce, when properly proportioned, a mixture which will conform to the limitations for master grading.

Retained on 1 1/2" sieve 0 to 3%
 Retained on no. 10 sieve 50 to 65%

Soil contents to be as follows:

Liquid limit shall not exceed 35
 Plasticity Index shall not exceed 12

The asphaltic material shall form from 3.5 to 7 percent of the mixture by weight.

- B. The Engineer will designate the grading of the aggregate and asphalt content to be used in the mixture. The mixture produced shall not vary from the designated grading for any sieve size plus or minus 4 percent by weight, and the asphaltic material shall not vary in content by more than 0.5 percent by weight.
- C. Samples of the mixture when tested by the THD Extraction Test, Tex-210-F, shall not vary from the grading proportions of the aggregate and the asphalt content designated by the Engineer by more than the respective tolerances specified above, and shall be within the limits specified for master grading.

PART 3 – EXECUTION

3.1 GENERAL

- A. The base is to be placed in one course with a spreading and finishing machine of the type approved by the Engineer, equipped with an automatic grade control device capable of producing a surface that will meet the requirements or the specification surface test. The machine also shall have adequate paves to propel the delivery vehicles in a satisfactory manner when the mixture is dumped into the finishing machine. The finishing machine shall be equipped with a flexible spring and/or hydraulic type hitch sufficient in design and capacity to maintain contact between the rear wheels of the hauling equipment and the pusher rollers of the finishing machine while the mixture is being unloaded. Any vehicle the finishing machine cannot push or propel in such a manner as to obtain the desired line and grade without resorting to hand finishing will not be allowed to dump directly into the finishing machine. The mixture shall not be placed when the air temperature is below 50° F and is falling, but it may be placed when the air temperature is above 40° F and is rising. The air temperature shall be taken in the shade away from artificial heat. It is further provided that the prime coat, tack coat or asphaltic mixture shall be placed only when the humidity, general weather conditions and the moisture and temperature of the base, in the opinion of the Engineer, are suitable.
- B. If a prime coat is required, it will be applied but not paid for as a separate item. The tack coat of asphaltic mixture shall not be applied on a previously primed flexible base until the primed base has completely cured to the satisfaction of the Engineer.
- C. Before the asphaltic mixture is laid, the surface upon which the tack coat is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer. The surface shall be given a uniform application of tack coat when directed by the Engineer. This tack coat shall be applied, as directed by the Engineer, with an approved sprayer at a rate not to exceed .05 gallon per square yard of surface. Where the 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 by the Engineer. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform coat of the asphaltic material used for the tack coat. The tack coat shall be rolled with a pneumatic tire roller as directed by the Engineer.
- D. The mixture, prepared as specified above, shall be hauled to the work in tight vehicles previously cleaned of all foreign material. The dispatching of the vehicles shall be arranged so that all material delivered may be placed, and all rolling shall be completed during the daylight hours. In cool weather or for long hauls, canvas covers and insulating or the truck bodies may be required. The inside of the truck body may be given a light coating of oil, if necessary, to prevent mixture from adhering to the body.

- E. Generally, the mixtures shall be dumped and spread on the approved prepared surface with the specified spreading and finishing machine in such manner that when properly compacted, the finished pavement will be smooth, of uniform density, and will conform with the typical sections shown on the plans and to the lines and grades as established by the Engineer. During the application of asphaltic material, care shall be taken to prevent splattering of adjacent pavement, curb and gutter, and structures.
- F. The mixture will be spread and compacted in layers so specified on the plans or as directed by the Engineer.
- G. When the mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement or placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated when authorized by the Engineer, provided a satisfactory surface can be obtained by other approved methods.
- H. As directed by the Engineer, the pavement shall be compressed thoroughly and uniformly with the specified rollers.
- I. Rolling with the three wheel and tandem rollers shall start longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the rear wheels. Alternate trips of the roller shall be slightly different in length. On super-elevated curves, rolling shall begin at the low side and progress toward the high side. Rolling with pneumatic roller shall be done as directed by the Engineer. Rolling shall be continued until no further compression can be obtained and all roller marks are eliminated. Additional rollers shall be provided if needed. The motion of the roller shall be slow enough at all times to avoid displacement of the mixture. If any displacement occurs, it shall be corrected at once by the use of rakes and of fresh mixture where required. The roller shall not be allowed to stand on pavement which has not been fully compacted. To prevent adhesion of the surface mixture to the roller, the wheels shall be kept thoroughly moistened with water, but an excess of water will not be permitted. All rollers must be in good mechanical condition. necessary precautions shall be taken to prevent the dropping of gasoline, oil, grease or other foreign matter on the pavement, either when the rollers are in operation or when standing.
- J. The edges of the mixture 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 roller, shall be thoroughly compacted with lightly oiled tamps.
- K. The surface of the pavement, after compaction, shall be smooth and true to established line, grade and cross section, and acceptable to the Engineer. Unacceptable finished surface may be corrected by the addition of mixture, placed and finished at the entire expense of the contractor.
- L. Sections of the newly finished base course shall be cleaned prior to laying the surface course or additional base courses. No construction traffic will be allowed on the asphalt stabilized base unless authorized in writing by the Engineer.

3.2 MIXING

- A. Screening and Proportioning: The screening capacity and size of the bins shall be sufficient to screen and store the amount of aggregate required to properly operate the plant and keep the plant in continuous operation at full capacity. Provisions shall be made to enable inspection forces to have easy and safe access to the proper location on the mixing plant where representative samples may be taken from the hot bins for testing.

- B. Asphaltic material heating equipment shall be adequate to heat the amount of asphaltic material required to the desired temperature. Asphaltic material may be heated by steam coils which shall be absolutely tight. Direct fire heating of asphaltic materials will be permitted, provided the heater used is manufactured by a reputable concern and there is a positive circulation of the asphalt throughout the heater. Agitation with steam or air will not be permitted. The heating apparatus shall be equipped with a recording thermometer with a 24-hour chart that will record the temperature of the asphaltic material where it is at the highest temperature.
- C. The spreading and finishing machine shall be of a type approved by the Engineer and shall be capable of producing a surface that will meet the requirements of the typical cross section as shown on the plans.
- D. All equipment shall be maintained in good repair and operating condition and shall be approved by the Engineer.

3.3 STOCKPILING, STORAGE, PROPORTIONS AND MIXING

- A. Prior to stockpiling of aggregates the area shall be cleaned of trash, weeds and grass and be relatively smooth. Aggregates shall be stockpiled in such a manner as to prevent segregation and mixing of aggregates from one source with another. Suitable equipment of acceptable size shall be furnished by the Contractor to work the stockpiles and prevent segregation of the aggregates. The material shall be placed in layers not exceeding 2' in depth and the minimum height of each stockpile shall be 10'. No separate grading of aggregate will be required prior to delivery to the cold aggregate bin.
- B. The asphaltic material storage shall be ample to meet the requirements of the plant. Asphalt shall not be heated to a temperature in excess of 350° F. All equipment used in the storage and handling of asphaltic material shall be kept in a clean condition at all times and shall be operated in such manner that there will be no contamination with foreign matter.
- C. The feeding of various sizes of aggregate to the dryer shall be done through the cold aggregate bin and proportioning device in such a manner that a uniform and constant flow of materials in the required proportions will be maintained. The aggregate shall be dried and heated to the temperature necessary to produce mixture having the specified temperature. In no case shall the aggregate be introduced into the mixing unit at a temperature more than 375° F.
- D. The proportioning of the various materials entering into the asphaltic mixture shall be as directed by the Engineer and in accordance with these Specifications. Aggregate shall be proportioned by weight using the weight box and batching scales herein specified when the weight-batch type of plant is used and by volume using the hot aggregate proportioning device when the continuous mixer type of plant is used. The asphaltic material shall be proportioned by weight or by volume based on weight using the specified equipment.
- E. In the charging of the weight box and mixer, such methods or devices shall be used as are necessary to secure a uniform asphaltic mixture. In introducing the batch into the mixer, all mineral aggregate shall be introduced first; shall be mixed thoroughly for a period of 5 to 20 seconds, as directed to uniformly distribute the various sizes throughout the batch before the asphaltic material is added; the asphaltic material shall then be added and the mixing continued for a total mixing period of not less than 30 seconds. This mixing period may be increased, if in the opinion of the Engineer, the mixture is not uniform.

- F. The amount of aggregate and asphaltic material entering the mixer and the rate of travel through the mixer shall be so coordinated that a uniform mixture of the specified grading and asphalt content will be produced. The mixture produced from each type of mixer shall not vary from the specified mixture by more than the tolerances herein specified. The mixture shall be at a temperature designated by the Engineer but not to exceed 325° F when dumped from the mixer. The Engineer will determine the temperature and the mixture when dumped from the mixer and when dumped from the mixer shall not vary from this selected temperature more than 25° F.

END OF SECTION

SECTION 32 11 27

REWORKING BASE MATERIAL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item consists of reworking existing base material (with or without an asphaltic surface). This item also consists of the blending of new base material when specified in the Contract Documents.

1.2 MEASUREMENT AND PAYMENT

- A. Reworking Base Material by scarifying and reshaping or by scarifying, salvaging and replacing will be measured by the square yard of existing base or pavement in the original position. This is a plans quantity measurement and the quantity to be paid will be that shown in the proposal. No payment will be made for thickness or width exceeding that shown on the typical sections or provided by the Contract Documents.
- B. The bid price includes full compensation for scarifying, salvaging, mixing, spreading, blading, shaping, wetting, compacting, and finishing of new and/or existing base material and for all labor, material, tools, equipment and incidentals necessary to complete the work including warranty work performed to satisfy the guarantee. Payment will not be made for unauthorized work.
- C. When new base material is mixed with the existing base material, furnishing and delivery of the new base will be paid for in accordance with SECTION 32 11 14 - FLEXIBLE BASE CRUSHED STONE LIMESTONE.

PART 2 – PRODUCTS

2.1 TESTING REQUIREMENTS

- A. A compaction curve (ASTM D 1557) shall be developed on the mixed or blended material.
- B. In-place field density shall be determined by Nuclear Methods (ASTM D 2922) or by Sand Cone Methods (ASTM D 1556) at locations selected by the Engineer. The frequency of tests shall be at least one every 300 lineal feet or a minimum of three (3) tests, whichever is greater.
- C. The base course shall be proof rolled as directed if, in the opinion of the Engineer, the blended material is non-uniform and a representative sample cannot be obtained for developing a compaction curve.

PART 3 – EXECUTION

3.1 GENERAL

- A. The work shall be performed to the width and depth specified in the Contract Documents.
- B. Reworking base material shall consist of either scarifying and reshaping or scarifying, salvaging and replacing existing base material as defined below;

1. Scarifying consists of loosening and breaking the existing base material.
2. Reshaping consists of reworking the scarified in-place base material with or without additional new base material.
3. Salvaging consists of removing, saving and temporarily stockpiling, if necessary, the existing scarified base material.
4. Replacing consists of returning and reworking the salvaged base material, with or without additional new base material, on the prepared roadbed.

New base material, when required, shall meet the requirements of SECTION 32 11 14 – FLEXIBLE BASE CRUSHED STONE LIMESTONE.

3.2 SCARIFYING AND RESHAPING

- A. The existing base, with or without existing asphaltic concrete pavement, shall be cleaned of all objectionable materials by blading, brooming or other approved methods, prior to scarifying. After cleaning, the existing material shall be scarified for its full width and depth, unless otherwise shown on the plans. The underlying sub-grade shall not be disturbed. The material shall be broken into pieces not more than two-and-one-half (2 1/2) inches in size.
- B. After completion of scarifying, the existing base shall be mixed and shaped to conform to the lines, grades, and typical sections shown on the Plans.
- C. New base material shall be placed on the existing scarified material and uniformly mixed when required by the Contract Documents.

3.3 SCARIFYING, SALVAGING AND REPLACING

- A. The existing base, with or without existing asphaltic concrete pavement, shall be cleaned of all objectionable materials by blading, brooming or other approved methods, prior to scarifying. After cleaning, the existing material shall be scarified for its full width and depth, unless otherwise shown on the plans. The underlying sub-grade shall not be disturbed. The material shall be broken into pieces not more than two-and-one-half (2 1/2) inches in size.
- B. The scarified material shall be removed from the roadbed. The scarified material may be salvaged by placing in temporary stockpiles or windrows until preparation of the sub-grade is complete.
- C. All salvaging operations shall not interfere with traffic, proper drainage or the general requirements of the work. All material to be salvaged shall be kept reasonably free of soil from the sub-grade or roadbed.
- D. Prior to replacing the salvaged material, the sub-grade shall be constructed and shaped to conform to the requirements of the Contract Documents. This work shall be done in accordance with the provisions of applicable bid items.
- E. The salvaged material shall be deposited on the prepared sub-grade, wetted if needed, bladed and shaped to conform to the lines, grades, and typical sections shown on the Plans or as directed by the Engineer. New base material shall be placed and uniformly mixed with the salvaged material when required by the Contract Documents.
- F. All areas of segregated material shall be corrected or removed and replaced with well graded material. All salvaged material shall be kept reasonably free of objectionable materials during the replacing operations.

3.4 COMPACTION

- A. The reshaped or replaced material shall be wetted as required and compacted to a uniform density of not less than 95 percent of the modified density (ASTM D 1557) The allowable deviation from optimum moisture content is to +4%.
- B. The Contractor shall rework the base material at his expense if the material fails to meet the required density or, for any reason, loses stability and finish before the next course is placed. The method of reworking shall be by loosening, adding or removing material, and reshaping and recompacting by wetting and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the affected areas, adding suitable material as required, reshaping and recompacting.
- C. The shape of the course shall be maintained by blading throughout the entire compacting operation. The completed surface shall be smooth and in conformance with the lines, grades, and typical sections shown on Plans. The Contractor shall check the elevation by blue topping on at least fifty (50) foot centers along the centerline and curb lines. Any deviation more than one-fourth (1/4) inch from the established section and grade shall be corrected by loosening, adding or removing material, reshaping and compacting.
- D. The base shall be cured to the approval of the Engineer prior to placing the final surface on the completed base. The base course may be opened to traffic if allowed by the Engineer.

END OF SECTION

SECTION 32 11 29
LIME STABILIZATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of admixing commercial lime and/or lime slurry with the existing material, and mixing and compacting the mixed material to the required density. All work performed in this item shall be constructed as specified herein and in conformity with the typical cross-sections, lines and grades as shown on the Plans and as directed by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Lime stabilized material as described in this section will be paid for at the unit price bid in the Proposal for the lime stabilized treatment, which price shall be full compensation for scarifying, preparation below secondary grade, furnishing, distributing, and mixing the lime and for all labor, supplies, water, fuel, tools, equipment and incidentals necessary to mix and compact the stabilized soil to the density specified in these Specifications. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

Lime series Atterburg Limits

Lime series pH test (ASTM C977-83a-Annex Test Method)

Lime type

% Lime

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The lime to be used for stabilization shall meet with requirements of TX DOT DMS-6350: Lime and Lime Slurry” and DMS-6330, “Lime Sources Prequalification of Hydrated Lime and Quicklime”. Use hydrated lime, commercial lime slurry, or pebble grade quicklime.
- B. The amount of lime required for stabilization will be the percent by weight shown on the Plans, stated in the Special Provisions, or that amount which produces a pH not less than 12.4 and provides for a Plasticity Index less than 18.

2.2 TESTING REQUIREMENTS

- A. After final mixing, a pH test, Atterberg Limit test and sieve analysis shall be performed in accordance with Tex-101-E, Part III.
- B. Moisture and Density tests shall be taken at each construction station to ensure a density of at least 98% of maximum dry density at a moisture content between optimum and 4% wet of optimum in accordance with Standard Proctor (ASTM D698). All tests meeting these requirements shall be paid by the owner. The City will not pay for failing tests.

- C. When requested by the Engineers Inspector, the contractor will proof roll areas in question with a 25 ton pneumatic tired roller or approved equal after lime stabilization is complete.

PART 3 – EXECUTION

3.1. GENERAL:

- A. It is the primary requirement of this specification to produce a completed course of treated material containing a uniform line mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth as shown on the detail sheet or specified in the Special Provisions and with a smooth surface suitable for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.
- B. The Contractor is required to ensure the existing sub-grade or embankment beneath the course to be lime stabilized is of proper density, uniformity and quality. The Contractor may elect to proof roll, replace and/or compact, areas that exhibit instability. If necessary, the Contractor may need to scarify, dry and compact the existing sub-grade prior to addition of lime. All work for the preparation of the existing sub-grade will not be paid directly, but will be considered a part of “Lime Stabilization”.

3.2. APPLICATION:

- A. Lime shall be spread only on that area where the first mixing operations can be completed during the same working day.
- B. The lime shall be spread by a pre-approved screw type spreader box, bag distribution, or a pre-approved truck spreader, in the manner and at the rates directed by the Engineer. The lime shall be distributed at a uniform rate and in such a manner as to reduce the scattering of the lime by wind to a minimum. Lime shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing lime becomes objectionable. A motor grader shall not be used to spread the lime.
- C. When pebble grade quicklime is placed dry, mix the material and lime thoroughly at the time of lime application.

3.3. MIXING:

- A. The material shall be dried or wetted as directed by the Engineer, until the proper moisture content has been secured. All lime shall be mixed with the material to be treated immediately after application of lime. During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of six (6) hours or more or had excessive loss due to washing or blowing will not be accepted until totally reprocessed, refinished and retested. This will be done at the sole expense of the Contractor.
- B. The soil-lime mixture shall be sprinkled during the mixing process as directed by the Engineer, to provide optimum moisture plus four (4) percent in the mixing immediately prior to starting the compaction operation.
- C. The stabilized soil shall then be lightly sealed to allow for the mixture to mellow for 1 to 4 days. When pebble grade quicklime is used, allow the mixture to mellow for 2 to 4 days. The mixed material shall be kept moist during this period and traffic shall not be allowed

on the treated portion. The moisture content of the mixture should be within, optimum and four percent of optimum for the compactive effort specified.

- D. After mellowing, resume mixing until a homogeneous friable mixture of material and lime is obtained, such that when all nonslaking aggregates retained on the 3/4" sieve are removed, the remainder of the material shall meet the following requirements when tested from the roadway in the roadway conditions by standard laboratory sieves:

Sieve	Percent Passing
1-3/4"	100%
3/4"	85%
#4	60%

After final mixing, the stabilized soil shall be bladed and compacted as specified below.

3.4. COMPACTION:

- A. Compaction of the mixture shall begin immediately after final mixing. The material shall be aerated or sprinkled as necessary to provide the proper moisture. Compaction shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted.
- B. The course shall be sprinkled as required and compacted to the extent necessary to provide no less than ninety-eight (98) percent of the density measured by ASTM D698 at a moisture content between optimum and +4% wet of optimum moisture content. Grades shall be “blue-topped” during the compaction effort and the lime soil mixture shall be compacted to within 0.1 ft in cross-section and 0.1 ft in 16 ft measured longitudinally. In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. Depth tests shall occur every 200 lf and shall be performed after compliance with density requirements.
- C. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades. Should the material due to any reason or cause, lose the required stability, density and finish it shall be re-compacted, refinished and retested at the sole expense of the Contractor.

3.5 EQUIPMENT

- A. The machine, tools and equipment necessary for the proper prosecution of the work shall be on the project and pre-approved by the Engineer prior to the beginning of construction operations.
- B. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.
- C. To insure thorough mixing of the lime into the material to be stabilized, equipment shall be a pulverizer mixer equivalent to a Seaman Mixer, or soil stabilizing machine shall be used.
- D. Hydrated lime shall be stored and handled in closed weatherproof containers until immediately before distribution on the road. If storage bins are used they shall be completely enclosed. Hydrated lime in bags shall be stored in weatherproof buildings with adequate protection from ground dampness.

- E. If lime is furnished in trucks, each truck shall have the weight of lime certified on public scales or the Contractor shall place a set of standard platform truck scales or hopper scales at a location pre-approved by the Engineer. Scales shall be certified as to accuracy by an independent pre-approved testing laboratory.

3.6 FINISHING AND CURING OF LIME-STABILIZED MATERIAL:

- A. After the lime treated material has been compacted and brought to the required lines and grades in accordance with the typical sections, the completed section shall then be finished by rolling as directed with a pneumatic or other suitable roller sufficiently light to prevent hair cracking. The completed section shall be moist-cured for a minimum of five (5) days before further courses are added or any traffic is permitted, unless otherwise directed by the Engineer. If the sub-grade sets up sufficiently to prevent objectionable damage from traffic, the layer may be opened to traffic the day following compaction, unless otherwise directed by the Engineer.
- B. Apply seals or additional courses within fourteen (14) calendar days after final compaction, unless otherwise directed by the Engineer.

END OF SECTION

SECTION 32 11 29.01

SPRINKLING

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section shall consist of the authorized application of water on those portions of roadway shown on the Plans or as directed by the Engineer.
 - 1. Compacting and preparing roadbed excavations, roadbed embankments, backfills, subgrades, subbases, bases and surfacings.
 - 2. Preventing or alleviating dust nuisance originating within the highway right-of-way and the Project limits, which is not caused by Contractor operations at the Contractor's plants or plant setups.
 - 3. Other watering when ordered, except for Extra Work.

1.2 MEASUREMENT AND PAYMENT

- A. The water furnished and the work performed, as prescribed by this section, will be paid for in the unit price bid for the various items pertaining to the construction of embankment, sub-grade, sub-base and base. Price will include full compensation for all costs in connection with furnishing the water, including the city of Bryan tapping fee, and for all costs in connection with furnishing and operating approved sprinklers and necessary measuring devices. Payment is to include the application of the water as directed, all hauling, equipment, tools, labor, materials and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

The Contractor shall furnish and operate approved sprinklers equipped with positive and rapidly working out-off valves and approved spray bars which will insure the distribution of water in a uniform and controllable rate of application. The Contractor shall apply the water in the required quantity where shown on the Plans and/or as directed by the Engineer.

END OF SECTION

SECTION 32 11 29.02

ROLLING

PART 1 - GENERAL

1.1 DESCRIPTION

This section shall consist of the compaction of sub-grade, sub-base, base or asphaltic concrete pavements by the operation of approved power rollers, tamping rollers, or pneumatic tired rollers as herein specified and/or directed by the Engineer.

1.2 MEASUREMENT AND PAYMENT

The work prescribed by this section will not be paid for directly, but shall be considered as subsidiary work pertaining to the construction of embankments sub-grade, sub-base, base and surface, as the case may be.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION

3.1 GENERAL

A. This work shall be done only when ordered by the Engineer. The compaction shall be accomplished by the methods outlined in the SECTIONS 32 11 16 - SUB-GRADE PREPARATION AND COMPACTION, SECTION 32 11 14 - FLEXIBLE BASE CRUSHED LIMESTONE, and SECTION 32 12 16 - HOT-MIX ASPHALTIC CONCRETE PAVEMENT. Tracked or lugged equipment will not be allowed on pavements at any time. In the event indicated rollers are not sufficiently weighted, nor have sufficient tire inflation capacity to produce the required degree of compaction, additional larger sized rollers will be required at no additional expense to the city.

B. Sufficient rollers shall be provided to compact the material in a satisfactory manner.

3.2 EQUIPMENT FOR SUBGRADE, SUB-BASE AND BASE

A. PNEUMATIC TIRED ROLLERS: Large pneumatic tired rollers shall be of a type having five (5) or more tires, with each tire being inflated to a pressure of 100 pounds per square inch. Total weight of the unit when loaded shall not be less than twenty-five (25) tons. The load shall be equally distributed to all wheels and the tires shall be uniformly inflated.

1. Small pneumatic tired rollers shall consist of not less than nine (9) pneumatic tired wheels running on axles in such a manner that the rear group will not follow in the tracks of the forward group and mounted in a rigid frame and provided with a body suitable for ballast loading. The wheel base of the roller shall be not less than five (5) nor more than ten (10) feet. The front axle shall be attached to the frame in such a manner that the roller may be turned within a minimum circle. The pneumatic tired roller under working conditions shall have an effective rolling width of approximately sixty (60) inches. It shall be so designed that by ballast loading, the

load may be varied uniformly from a minimum of one hundred (100) to a maximum of four hundred (400) pounds per inch of width of tire tread.

2. The tire pressure and the compression to be provided by the pneumatic roller shall be as directed by the Engineer. Pneumatic tired rollers shall be drawn by either a suitable crawler-type tractor, a pneumatic-tired tractor or a truck of adequate tractive effort, or may be of the self-propelled type and the roller when drawn or propelled by either type of equipment shall be considered a pneumatic tired roller unit. Unless otherwise directed, pneumatic tired rollers shall be operated within a speed range from two (2) to four (4) miles per hour.
- B. **TAMPING ROLLERS:** Tamping rollers shall consist of two (2) metal rollers, drums or shells of forty (40) inches minimum diameter. Each not less than forty-two (42) inches in length and unit mounted in a rigid frame in such a manner that each roller may oscillate independently of the other. Each roller, drum or shell shall be surmounted by metal studs with tamping feet projecting not less than seven (7) inches from the surface and spaced not less than six (6) nor more than ten (10) inches measured diagonally center to center. The cross sectional area of each tamping foot measured perpendicularly to the axis of the stud, shall be not less than five (5) nor more than eight (8) square inches. The roller shall be supplemented with cleaning teeth to provide self cleaning. The roller shall be so designed that by ballast loading, the load on each tamping foot may be varied uniformly from one hundred, twenty-five (125) to one hundred, seventy-five (175) pounds per square inch of cross sectional area. The load per tamping foot will be determined by dividing the total weight of the roller by the number of tamping feet in one (1) row parallel to (or approximately so) the axis of the roller. The compression to be provided shall be as directed by the Engineer. The tamping roller shall be drawn by suitable power equipment of adequate tractive effort. Two (2) tamping rollers, consisting of four (4) cylinders, drawn by approved power equipment shall be considered a roller unit. Unless otherwise directed, tamping rollers shall be operated within a speed range of two (2) to three (3) miles per hour.

3.3 EQUIPMENT FOR HOT MIX ASPHALTIC CONCRETE PAVEMENT

- A. **POWER FLAT WHEEL ROLLERS:** Power flat wheel rollers shall be of the three (3) wheel self-propelled type only, weighing not less than eight (8) tons nor more than twelve (12) tons. Power flat wheel rollers shall be operated with a speed range from two (2) to three (3) miles per hour and/or as directed.
- B. **PNEUMATIC TIRED ROLLERS:** Pneumatic tired rollers for hot mix asphaltic concrete pavement shall conform to the Specifications as noted above for pneumatic rollers.

END OF SECTION

SECTION 32 11 34

CEMENT STABILIZATION OF MATERIAL IN PLACE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item consists of cement stabilizing existing granular type soil by pulverizing, adding Portland cement, mixing, wetting and compacting to the required lines, grades, and typical.

1.2 MEASUREMENT AND PAYMENT

- A. Payment for measured cement stabilization base will be made at the unit price bid in the Proposal. The bid price includes full compensation for loosening, preparation of secondary grade, furnishing, distributing, and mixing the cement and for all labor, material, tools, equipment and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

Supplier's certification showing specification compliance of Portland cement.

Asphaltic material for sealing.

Traffic Control Plan

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Portland cement shall be Type I and shall conform to the requirements of ASTM Designation C 150.

2.2 TESTING REQUIREMENTS

- A. A compaction curve (ASTM D698) shall be performed for each type of material which is to be stabilized.
- B. In-place field density shall be determined by Nuclear Methods (ASTM D 2922) immediately upon completion of compaction. The cement treated material shall be tested for moisture content and density at locations selected by the Engineer. The frequency of tests is at least one every 100 lineal feet or a minimum of three (3) tests, whichever is greater.

PART 3 – EXECUTION

3.1. GENERAL:

- A. The completed course shall be uniformly treated, free from loose or segregated areas, and have uniform density and moisture content its full depth. The surface shall be smooth and suitable for placing subsequent courses. The Contractor has the responsibility to regulate the sequence and continuity of work, to use the proper amount of cement, and maintain the work as necessary to meet the requirements of this specification.

- B. The Contractor shall insure that cement is adequately stored and protected from moisture before usage.
- C. All machinery, tools and equipment necessary for the proper prosecution of the work shall be on the project and available for inspection and approval by the Engineer prior to the beginning of construction operations.

3.2. PREPARATION AND PULVERIZATION

- A. The roadbed shall be shaped to conform to the lines, grades and typical sections shown on the Plans prior to beginning any cement treatment.
- B. The material to be treated shall be spread uniformly to the required cross-section, mixed and pulverized so that at least 80 percent passes the No. 4 sieve. This pulverization requirement may be waived when the material contains a substantial amount of aggregate and is approved by the Engineer.
- C. The Contractor may elect to use a cutting and pulverizing machine that will process the material to be stabilized in-place rather than excavate and windrow. This method will be permitted only if a machine is provided which will insure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a uniform surface over the entire width of the cut. The machine shall provide a visible indication of the depth of cut at all time. If this method is used the Contractor will be required to roll the subgrade prior to pulverization and correct any soft or unstable areas as directed by the Engineer.

3.3. APPLICATION

- A. Portland cement shall be spread uniformly on the soil at the specified rate. Cement shall be applied only on an area where the mixing, compacting, and finishing operations can be completed during the same working day.
- B. The cement shall be spread by an approved spreader or by bag distribution. Cement distribution shall be at a uniform rate and in a manner to minimize scattering by wind.

3.4. MIXING

- A. Single or multiple soil stabilizer mixers shall be used. The cement shall be dry-mixed with the soil prior to the addition of water. Immediately after dry-mixing, water shall be uniformly applied. After mixing, the cement treated soil shall be in a loose, evenly spread state ready for compaction. The soil and cement mixture shall not remain undisturbed for more than 30 minutes before compacting.

3.5. COMPACTION

- A. The mixture shall be wetted or dried to provide a moisture content within +4- percent of optimum and compacted until the entire depth is at a uniform density of at least 98 percent of maximum as determined by ASTM D698.
- B. Compaction shall be completed within 2 hours of the addition of water to the dry-mixed material. If the material fails to meet the moisture and density requirements within the 2 hour time frame, or for any reason or cause, lose the required stability, density and finish before the next course is placed. The treated material shall be removed and replaced unless otherwise approved by the Engineer. Removal and replacement with acceptable treated material will be at the Contractor's expense.

3.6. FINISHING AND CURING

- A. Immediately after compaction, the surface shall be bladed to a depth of 1/4 inch, removing all loosened materials. The loosened materials shall be disposed of at the Contractor's expense and at a location approved by the Engineer. The surface shall then be rolled with a pneumatic tire roller, adding small increments of moisture as needed during rolling.
- B. The completed section shall be moist cured for three (3) days or prevented from drying by addition of an asphaltic material at a rate of 0.10 to .030 gallons per square yard. The Contractor will be responsible for protecting any asphalt membrane from being picked up by traffic.
- C. The completed sections of soil cement may be opened immediately to local traffic and construction equipment, and to all traffic after the three (3) day curing period, provided the soil cement has hardened to prevent rutting and surface marring.

END OF SECTION

SECTION 32 12 13.16

**TACK COAT
(ASPHALTIC)**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of an application of asphaltic material on a completed base course, after the prime coat has sufficiently cured; or on an existing pavement; bituminous surface and/or other approved area in accordance with these Specifications.

1.2 MEASUREMENT AND PAYMENT

- A. The asphaltic material for tack coat will be measured at point of delivery on the project in gallons at the applied temperature. The quantity to be paid for shall be the number of gallons used, as directed by the Engineer.
- B. The work performed and materials furnished as prescribed by this item will be paid for at the unit price bid per gallon for "Tack Coat". This price shall be full compensation for cleaning the surface, for furnishing, heating, hauling and distributing the tack coat as specified; for all freight involved; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work. Where no pay item is provided for in the Contract Documents the work performed and materials furnished as specified by this item shall be considered as subsidiary to the appropriate bid items.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The asphaltic material used for tack coat shall meet the requirements for cut-back asphalt or emulsified asphalt as defined in SECTION 32 05 17 - ASPHALTS, OILS, AND EMULSIONS, and as approved by the Engineer. Cut-back asphalt can be made by combining 50% - 70% by volume of the asphaltic materials as specified for the type of paving mixture, with 30% -50% by volume of either gasoline and/or kerosene.
- B. The asphaltic material used for the tack coat may be further cut back by the addition of an approved grade of gasoline and/or kerosene not to exceed 15%, by volume, upon approval by the Engineer.

PART 3 – EXECUTION

3.1 GENERAL

- A. Before the tack coat is applied, the surface shall be cleaned thoroughly to the satisfaction of the Engineer. The asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor so operated to distribute the tack coat at a rate not to exceed 0.10 gallon per square yard of surface. Proper distribution shall be considered as applying the tack coat evenly and smoothly while under pressure as well as other specified requirements. Where the pavement 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 by the Engineer. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform coat of the asphaltic material used for tack coat. The tack coat shall be

applied only when the atmospheric temperature in the shade is 50° F or above and when the temperature has not been below 35° F for 12 hours immediately prior to application. The tack coat shall be rolled with a pneumatic tire roller as directed by the Engineer. During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures. The Contractor shall be responsible for cleaning splattered areas as determined and directed by the Engineer.

END OF SECTION

SECTION 32 12 13.23

PRIME COAT - ASPHALTIC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of the application of asphaltic material on the completed base course in accordance with these Specifications.

1.2 MEASUREMENT AND PAYMENT

- A. This item will not be considered a separate cost item. Cost for work herein specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work shall be included in the unit price bid for Hot Mix Asphaltic Concrete.

1.3 SUBMITTALS

- A. Supplier and Material Safety Data Sheet.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The asphaltic material used for the prime coat shall be MC-30 or RC-250. It shall meet the requirements of Texas Department of Transportation Specification 2004 Item 300 “Asphalts, Oils, and Emulsions”.

2.2 TESTING REQUIREMENTS

- A. If requested by the Engineer, the Contractor shall produce the calibration papers and certifications for the distributor being used on the project.

PART 3 – EXECUTION

3.1 GENERAL

- A. The following construction methods shall be used when applying asphaltic material:
 - 1. **SURFACE PREPARATION:** The surface shall be cleaned by sweeping, brooming or other approved methods when the base is satisfactory to receive the prime coat in the opinion of the Engineer.
 - 2. **PRIME COAT:** Prime coat shall not be applied when the atmospheric temperature is below 60 °F and falling. However, it may be applied when the temperature is above 50 °F and rising. The temperature determination shall be made by taking the temperature in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions are not suitable in the opinion of the Engineer.

3. APPLICATION: The surface shall be lightly sprinkled with water just prior to application of the asphaltic material if found necessary by the Engineer. The asphaltic material shall be applied to the cleaned base by an approved self-propelled pressure distributor. The distributor shall distribute the material evenly and smoothly under an adequate pressure for proper distribution. Uniform coverage is desired without pooling of excess material. The Contractor shall provide all necessary facilities for determining the temperature of the asphaltic material in all heating equipment and distributor. This information is to be used for determining the application rate and for securing uniformity at the junction of successive distributor loads. Asphaltic material shall be applied at a temperature consistent with and the range recommended in Texas Department of Transportation Specification 2004 Item 300 “Asphalts, Oils, and Emulsions.” The Engineer shall select the temperature of application and the Contractor shall apply the material at a temperature within 15° F of the selected temperature.
4. EQUIPMENT: All storage tanks, piping, retorts, booster tanks, and distribution equipment used in handling asphaltic material shall be kept clean and in good operating condition at all times. The equipment shall be operated in a manner which prevents contamination of the asphaltic material (with any foreign substance). It shall be the responsibility of the Contractor to provide and maintain in good working order at all times, a recording thermometer at the storage heating unit. The distributor shall have been recently calibrated and the Engineer shall be furnished an accurate and satisfactory record of the calibration. Should the yield on the applied asphaltic material appear to be in error after beginning the work, the distributor shall be re-calibrated in a manner satisfactory to the Engineer before proceeding with the work.
5. SURFACE MAINTENANCE: The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer. No traffic, hauling or placement of final surface material will be permitted over the freshly applied prime coat until authorized by the Engineer.

END OF SECTION

SECTION 32 12 16

HOT MIX ASPHALTIC CONCRETE PAVEMENT

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item covers Hot Mixed Asphaltic Concrete Paving and consists of any combinations of base, level up, and finish courses.

1.2 MEASUREMENT AND PAYMENT

- A. Unless otherwise modified by the design engineer, Hot Mix Asphaltic Concrete Paving shall be measured by the square yard of each HMA CP course in conformity with the requirements, and meeting all requirements of the plans and special provisions (if any) with regards to line, grade, compacted thickness, air voids, and final cross section.
- B. Sliding scale pay factors or alternative remedies may be applied for City capital projects at the City’s discretion. Sliding scale factors will be applied for the unit price bid for Hot-Mix Asphaltic Concrete, which fail to meet the density requirements. The sliding scale pay factors are shown in the table below. They shall be applied to each day’s production.

The table below applies to both development and capital projects. In the case of a development project the column titled “Percent Payment” does not apply.

<u>Average Percent Air Voids*</u>	<u>Alternate Remedies</u>	<u>Percent Payment</u>
8.0 or Less	Do Nothing	100
8.1 to 10.0	1” HMA CP Overlay w/ Wedge Grind	85
10.1 to 12.0	1” HMA CP Overlay w/ Wedge Grind	75
Above 12.0	Remove and Replace	Reject **

* Average of 4 samples

**If the Engineer agrees to accept densities below 88.0%, the pay factor shall be 50%.

- C. Unless otherwise modified by the design engineer, all labor, equipment and materials necessary to provide Hot Mix Asphaltic Concrete Paving in place in accordance with the plans, special provisions and these specifications will be paid for at the unit price designated in the proposal and included in the construction contract. Any tack and/or prime coat shall be considered subsidiary to the bid item “Hot Mix Asphaltic Concrete”.

1.3 SUBMITTALS

- A. Mix Design
- B. Aggregate Properties

PART 2 – PRODUCTS

2.1 MATERIALS

HMAC shall be composed only of the following materials:

- A. **MINERAL AGGREGATE:** Mineral aggregates shall consist of sound, durable stone particles of limestone, slag, or a mixture thereof of uniform quality throughout and free from dirt, organic or other deleterious material occurring either freely in the material or as a coating on the aggregate. Abrasion loss of aggregate material shall not exceed 40% (unless lightweight) when tested in accordance with the Los Angeles Abrasion Test (ASTM C-131).
- B. **MINERAL FILLER:** Mineral filler shall consist of thoroughly dry stone dust of uniform quality throughout and free from dirt, organic or other deleterious material occurring either freely in the material or as a coating on the material. The plasticity index of any mineral filler shall be less than 6.
- C. **ASPHALT:** Asphalt shall be grade PG64-22, PG 70-22 or PG76-22 as designated by the design engineer and the same shall be used on all HMAC provided for any one project.
- D. The paving mixture shall consist of a uniform mixture of aggregates, fillers and asphaltic material as required to meet the following requirements:
 - 1. **Coarse Aggregate:** Coarse aggregate (retained on the No. 10 sieve) shall be so crushed as to have a minimum of 85% of the particles retained on the No. 4 sieve with two or more mechanically induced crushed farces as determined by Tex-460-A (Part 1). Field sand, if used, shall not exceed fifteen (15%) percent of the total aggregate mix.

GRADATION AND ASPHALT CONTENT

<u>Column 1</u>	<u>Column 2</u>						<u>Column 3</u>
AGGREGATE GRADATION (ASTM C-136)	<u>TOLERANCE FOR JOB-MIX FORMULA *</u>						<u>TOLERANCE FOR COMPANY FIELD SAMPLE LAB RESULTS TO JOB MIX FORMULA **</u>
PASSING	TYPE 'D'		TYPE 'C'		TYPE 'B'		TOLERANCE
	Low %	High %	Low %	High %	Low %	High %	
1-1/4" sieve							+/- 5%
1" sieve					98	100	+/- 5%
7/8" sieve			98	100	95	100	+/- 5%
5/8" sieve			95	100	75	95	+/- 5%
1/2" sieve	98	100					+/- 5%
3/8" sieve	85	100	70	85	60	80	+/- 5%
1/4" sieve							+/- 5%
No. 4 sieve	50	70	43	63	40	60	+/- 5%
No. 10 sieve	32	42	30	40	27	40	+/- 3%
No. 40 sieve	11	26	10	25	10	25	+/- 3%
No. 80 sieve	4	14	3	13	3	13	+/- 3%
No.200 sieve	1	6	1	6	1	6	+/- 3%
VMA % Min	14		13		12		
Asphalt Content	4	8	<u>4</u>	<u>8</u>	3.5	7	+/- 0.5%

* Column 2 above is the tolerance to be used when creating the job-mix formula

** Column 3 above is the tolerance to be used when comparing the field sample lab results to the job-mix formula. The lab results must fall within the given tolerance when compared to the job-mix formula.

*** A copy of the job-mix formula must be given to the city inspector or representative prior to the placement of asphalt on the job site.

The City, at any time, may require a test be performed to determine if anti-stripping agents are needed for a particular mix. Samples not meeting the specifications listed above may be negotiated for a reduced payment if allowed by the City Engineer.

2. Laboratory Stability: When the proposed mix is prepared in accordance with TxDOT Item 340 (HVEEM Method) the stability shall be at least 35 percent.
3. Laboratory Density: When the proposed mix is prepared in accordance with ASTM D-1559 the air voids of the material as determined by ASTM D-3203 shall be between two percent (2%) and five percent (5%).

2.2 TESTING REQUIREMENTS

The following processes shall be undertaken to assure the desired quality in the constructed product:

- A. MIX VERIFICATION: The testing laboratory representative in accordance with both of the following guidelines shall take HMAC samples from the delivering trucks:
1. One sample for each day of delivery and placement.
 2. For larger jobs, the City may require two samples be taken, one in the morning and one in the afternoon.

The testing laboratory shall:

1. Note the location where the HMAC being sampled is to be placed.
2. Determine the temperature of the mix at the time the sample is taken. If the temperature is outside of the allowable range as specified in Section 3.1 of this specification, the laboratory representative shall immediately inform the paving contractor's superintendent and the City Inspector.
3. Transport the sample to the laboratory and perform the necessary tests and operations to verify the compliance with the mix design set forth by the design engineer within the tolerances given in Section 1.3 of this specification.
4. Provide written results to the tests and operations as described above to both the paving contractor's superintendent and the City Inspector within 5 working days.

- B. COMPACTION VERIFICATION: Compaction tests shall be made following the same schedule of testing as the sampling operations listed above with the City Representative determining the exact location for testing.

The testing laboratory representative shall:

1. Note the location of the compaction test performed
2. Obtain core samples of the paving via ASTM D-5361
3. Transport the cores to the laboratory and perform the necessary operation per ASTM D-3203 to determine the resulting pavement air void percentage.
4. Provide written results of the tests and operations as described above to both the paving contractor's superintendent and the City Inspector within 5 working days.

Compacted HMAC pavement meeting this specification shall have between two percent (2%) and eight percent (8%) air voids.

COMPACTED LIFT THICKNESS AND REQUIRED CORE HEIGHT

<u>Mixture Type</u>	<u>Compacted Lift Thickness</u>	
	<u>Minimum (in.)</u>	<u>Maximum (in.)</u>
<u>A</u>	<u>3.00</u>	<u>6.00</u>
<u>B</u>	<u>2.50</u>	<u>5.00</u>
<u>C</u>	<u>2.00</u>	<u>4.00</u>
<u>D</u>	<u>1.50</u>	<u>3.00</u>
<u>E</u>	<u>1.25</u>	<u>2.50</u>

- C. **THICKNESS VERIFICATION:** For each core sample taken from the finished paving, the thickness of the HMAC portion of the section shall be measured, noted and provided to the City for review. The thickness shall be as required on the table above.
- D. **FINISH SURFACE TOLERANCES:** The finish surface of the compacted pavement shall be sealed, smooth and true to the line, grade and cross section as established in the contract documents. There shall be no deviation in excess of 1/8 inch per foot of distance from the nearest point of contact when tested with a 10-foot straight edge placed parallel to the centerline of the roadway. There shall be no deviation from the straight edge in excess of 1/4 inch at any point.
- E. The hot-mix asphaltic concrete will be accepted for density based on one day’s production. Each day’s production will be divided into four sections and one cored or sawed sample will be taken for each section. Each day’s production will be accepted, with respect to density, when the average field density determined from the cores is equal to or greater than 92 percent of the maximum theoretical density as determined in accordance with ASTM D2041, and when no individual core density is less than 88.0 percent of the maximum theoretical density. If the Contractor elects to have the density testing rechecked, another group of four cores per each day’s production will be obtained. The recheck group will not be averaged with any previous tests.

PART 3 – EXECUTION

3.1 GENERAL

- A. The Contractor shall retain full control of all materials, labor methods and equipment used in the placement and compaction of HMAC paving with the following exceptions:
 - 1. Air Temperature – HMAC and/or tack coat materials shall not be placed when the air temperature is 50° F or lower and falling. Placement may be allowed if the air temperature is 40° F and rising as long as temperature is taken in shade away from artificial heat sources.
 - 2. Tack Coat – Tack coat shall be applied to clean, dry asphalt surfaces and between asphalt lifts only and shall be applied just prior to placement of HMAC materials. The Contractor shall neatly tack all gutter edges before placing any HMAC. The tack coat material shall be SS-1 applied at a rate of 0.01 to 0.02 gal/sy.

3. **HMAC Temperature** – HMAC materials shall be placed between 250° F and 340° F. Compaction is not allowed on HMAC that has cooled below 175° F at the pavement surface.
4. **Rolling Water** – Small amounts of water may be used to keep the HMAC from adhering to the placement and compaction equipment. Excessive water and/or any use of petroleum products for this purpose are not allowable.
5. **Compaction Roller Traffic** – Compaction rollers shall be kept at a slow enough speed to prevent any displacement of material. Rollers shall not be allowed to stand or park on the finished and compacted paving until after 12 hours has passed after final compaction.

END OF SECTION

SECTION 32 12 36.13

SEAL COAT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of a surface treatment composed of a single application of asphalt covered with aggregate for sealing existing pavements in accordance with these Specifications. Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer, are not suitable.

1.2 MEASUREMENT AND PAYMENT

- A. Seal-coat will be measured and computed in square yards of material "in-place".
- B. The work performed and materials furnished as prescribed and measured will be paid for at the unit price bid for "Seal-coat" which price shall be full compensation for furnishing, freight involved, preparing, hauling, and placing all materials: and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work, including the necessary rolling and sweeping.

1.3 SUBMITTALS

- A. Testing Reports showing conformance to Item No. 302 and Item No. 300 per Texas Department of Transportation Specifications 2004.
- B. Calibration papers and certifications for the distributor to be used.
- C. Material Safety Data Sheets.

1.4 WEATHER LIMITATIONS

- A. The seal coat shall be applied when the air temperature is will not drop below 75° F for a period of 72 hours.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Asphaltic materials used in the application of the seal coat shall be AC15-5TR or HFRS-2-P as prescribed in Texas Department of Transportation Specifications 2004 Item No. 300 "Asphalts Oils and Emulsions." Aggregate used shall be Type PB, Grade 4 or Grade 5 or Trap Rock Type B, Grade 5 with grading and consensus properties as specified in Texas Department of Transportation Specifications 2004 Item No. 302 "Aggregates for Surface Treatments."

2.2 CONSTRUCTION EQUIPMENT

- A. Asphaltic material shall be applied on the cleaned surface by an approved type of self-propelled pressure distributor operated as to distribute the material in the quantity specified, evenly and smoothly, under a pressure necessary for proper distribution. The contractor shall provide all necessary facilities for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two distributor loads. The distributor shall have been recently

calibrated and the Engineer shall be furnished with an accurate and satisfactory record of such calibration. After beginning the work, should the yield on the asphaltic material appear to be in error, the distributor shall be calibrated in a manner satisfactory to the Engineer before proceeding with the work. All storage tanks, piping, booster tanks, and distributors used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times, and they shall be operated in such a manner that there will be no contamination of the asphalt with foreign materials. It shall be the responsibility of the contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

2.2 TESTING REQUIREMENTS

- A. At the discretion of the Engineer, the aggregate and asphalt may be sampled and tested for conformance to Item No. 300 and 302 of the Texas Department of Transportation Specifications, 2004.

PART 3 – EXECUTION

3.1. CONSTRUCTION:

- A. GENERAL: The area to be treated shall be cleaned of dirt, dust or other deleterious matter by sweeping or other approved methods. If it is found necessary by the Engineer, the surface shall be lightly sprinkled with water just prior to the application of asphaltic material.
- B. AGGREGATE: Aggregate shall be immediately and uniformly applied and spread by an approved self-propelled continuous feed aggregate spreader, unless otherwise shown on the Plans or authorized by the Engineer in writing. The aggregate shall be applied at the rate of approximately one (1) cubic yard per 110 to 125 square yards of surface area. The rock shall be rolled to provide proper embedment of the aggregate to the asphalt.

Temporary stockpiling of aggregates on the roadway will be permitted provided the stockpiles are spaced not less than 1,000 feet apart. They are to be placed so that they neither obstruct traffic nor interfere with roadway drainage. The contractor shall be responsible for proper preparation of the temporary stockpile areas before aggregates are placed thereon, including leveling and cleaning of debris necessary for protection of the aggregate to prevent any contamination.

- C. SURFACE: All surfaces will be rolled first with self-propelled pneumatic rollers. The entire surface shall then be broomed and excess aggregate removed. The removal of the excess rock shall take place in sufficient time so that the loose rock does not begin to break down the aggregate in place.

The contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer. All holes or failures in the seal coat surface shall be repaired by use of additional asphalt and aggregate and all fat or bleeding surfaces shall be covered with approved cover material in such a manner that the asphaltic material will not adhere to or be picked up on the wheels of vehicles.

END OF SECTION

SECTION 32 12 36.14

ONE COURSE SURFACE TREATMENT**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This item shall consist of a wearing surface composed of a single application of asphaltic material covered with aggregate, constructed on the prepared base course in accordance with these specifications.

1.2 MEASUREMENT AND PAYMENT

- A. Asphaltic materials will be measured at the point of application on the road in gallons at the applied temperature. Aggregate will be measured by the cubic yard of material in vehicles at the point of stockpiling.
- B. The work performed and materials furnished as prescribed by this item will be paid for at the unit prices bid for "Asphalt" and "Aggregate" of the specified type and grade which shall be full compensation for cleaning and sprinkling the base; for furnishing, preparing, hauling, and placing all materials; for all freight; for rolling; and for all manipulations, labor, tools, equipment, and incidentals necessary to complete the work.

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. ASPHALTIC MATERIALS: The asphaltic material used shall be one or more of the materials prescribed in SECTION 32 05 17 - ASPHALTS, OILS AND EMULSIONS.
- B. AGGREGATE: The aggregate used shall be Type C, Grade 3, unless otherwise specified in the Plans and Specifications, and shall meet the requirements of SECTION 32 11 34 - AGGREGATE FOR SURFACE TREATMENTS.

PART 3 – EXECUTION**3.1. CONSTRUCTION:**

- A. GENERAL: One course surface treatment shall not be applied when the atmospheric temperature is 60° F and falling. However, it may be applied when the temperature is above 50° F and rising. The temperature must be taken in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions are not suitable in the opinion of the Engineer.

The area to be treated shall be cleaned of dirt, dust, or other deleterious matter by sweeping or other approved methods. If necessary the surface shall be lightly sprinkled with water just prior to the application of the asphaltic material.

- B. EQUIPMENT: Asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor. The distributor shall be able to distribute the material in the specified quantity evenly and smoothly under pressure. The contractor shall provide all necessary facilities for determining the temperature of asphaltic material in the heating equipment and the distributor. This will aid in determining the application rate and for securing uniformity at the junction of two distributor loads. The distributor

shall have been recently calibrated and the Engineer shall be furnished an accurate and satisfactory record of the calibration. Should the yield on the asphaltic material appear to be in error after beginning the work, the distributor shall be recalibrated in a manner satisfactory to the Engineer before proceeding with the work. All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic materials shall be kept clean and in good operating condition at all times. They shall be operated in a manner so that there will be no contamination of the asphaltic materials with foreign material.

- C. APPLICATION: Asphaltic material shall be applied for the full width of the surface treatment in one application, unless the width exceeds twenty-six (26) feet. No traffic or hauling will be permitted over the freshly applied asphaltic material. Asphaltic material shall not be applied until the contractor can assure immediate covering.
- D. AGGREGATE: Aggregate shall be immediately and uniformly applied and spread by an approved self-propelled continuous feed aggregate spreader. The aggregate shall be applied at the approximate rates indicated in the specification or as directed by the Engineer.
- E. SURFACE: The entire surface shall be broomed, bladed or raked as required by the Engineer. The surface shall also be thoroughly rolled with the type or types of rollers as specified in the Plans and Specifications and/or as approved by the Engineer. Rolling equipment shall meet the requirements for SECTION 32 11 29.02 - ROLLING. The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer.
- F. TEMPERATURE AND VISCOSITY: It shall be the responsibility of the contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times. The Engineer will select the temperature of application. This temperature will be based on the temperature-viscosity relationship that will permit application of the asphalt within the limits recommended in SECTION 32 05 17 - ASPHALTS, OILS AND EMULSIONS. The recommended range for the viscosity of the asphalt is 100 to 120 centistokes. The contractor shall apply the asphalt at a temperature within 15° F of the selected temperature.

END OF SECTION

SECTION 32 13 13

CONCRETE PAVEMENT

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification. Additional revisions are indicated with a dashed underline.)

PART 1 - GENERAL

1.1 DESCRIPTION

This item shall consist of a pavement of Portland cement concrete as herein specified on the prepared base, subbase or subgrade course in conformity with the thickness, typical cross-sections, and to the lines and grades shown on the Plans by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Concrete pavement shall be measured by the square yard of surface area of completed and accepted pavement or as shown on the bid documents. When the Plans, Specifications and Proposal required the construction of a "Monolithic Curb" the limits of measurement for concrete pavement shall be from back to back of curb.
- B. The work performed and the materials furnished under this item and measured as provided under "Measurement" shall be paid for at the unit price bid per square yard for the thickness indicated in the Proposal. The unit price bid for "Concrete Pavement" shall be full compensation for shaping and fine grading the subgrade, forming, mixing, placing, jointing, finishing and curing all concrete; for furnishing all labor, tools, equipment, materials, and incidentals necessary to complete the work..

1.3 SUBMITTALS

See SECTION 03 30 00 - CONCRETE

Paving Plan

Joint Sealing Compound

Expansion Joint Material

PART 2 – PRODUCTS

2.1 MATERIALS

See SECTION 03 30 00 - CONCRETE

2.2 TESTING REQUIREMENTS

See SECTION 03 30 00 - CONCRETE

PART 3 – EXECUTION

3.1 GRADE CONTROL

The lines and grades shown on the contract drawings for each pavement category of the contract shall be established and maintained by means of line and grade stakes. The finished pavement

grade lines and elevations shown on the contract drawings shall be established and controlled at the site of the work by the Contractor in accordance with benchmark elevations furnished by the Owner. The pavements shall be constructed to the indicated thicknesses and elevations. The tolerances permitted in thickness, smoothness, and grades are the normal deviations that may occur in pavement construction under good supervision. However, construction of pavement or any part thereof with intent to use maximum tolerances will not be permitted.

3.2 SUBGRADE, SUBBASE, BASE AND FORMS

A. EQUIPMENT:

1. Subgrade Planer: Subgrade planer mounted on visible rollers riding on the forms or edges or previously constructed slabs shall be provided for shaping the final surface of the subgrade, subbase, or base course. Any power equipment used to pull the subgrade planer shall not produce ruts or indentations in the subgrade, subbase or base course. The subgrade planer shall be equipped with steel cutting edge capable of being accurately adjusted to the required cross section. When the subgrade planer rides on the edges of the surface of previously constructed slabs, the planer shall be provided with rubber-tired rollers to prevent damage to surfaces and edges of the existing concrete.
2. Templates: The Contractor shall provide and operate a scratch template for checking the contour of the subgrade, subbase, or base course. The template or roller is to be mounted with the wheels supported on the side forms or concrete in adjacent lanes. It shall be of such strength and rigidity that under a test made by changing the support to the center the template will not show a deflection of more than 1/8 inch. The template shall be provided with adjustable rods projecting downward to the subgrade at not more than 1-foot intervals. These rods shall be adjusted to the required cross section of the bottom of the slab when the ends of the template are supported on the side forms or concrete in the adjacent lanes. The template shall be checked frequently during use to assure that the rods are in the correct position.
3. Forms: The forms shall be made of metal unless noted. Wood forms may be used on curves having a radius of 150 feet or less, as well as for fillets. Forms shall be equal in depth to the edge thickness of the slab as shown on the drawings. Forms shall be in one piece for the full depth required, except as noted. Where the drawings provide several different slab thicknesses, forms may be built up of metal or wood as provided. Forms may be increased in depth 25 percent by securely bolting or welding to the bottom a tubular metal section of the proper thickness or by securely bolting wood planks to the bottom of the steel form. The tubular metal section or wood planks shall completely cover the under side of the base of the steel form. It shall extend beyond the edge of the base a sufficient distance to provide the necessary stability against movement along the vertical face. The base width of the one-piece form, or built-up form, shall be not less than eight-tenths of the vertical height of the form.
 - a.) Metal Forms: Metal forms shall be of a cross section and shall be furnished in sections not less than 10 feet in length. Curves having a radius of 150 feet or less the length of the sections shall be 5 feet unless the sections are flexible or curved to the proper radius. Each 10-foot length of form shall be provided with at least three form braces and pin sockets. The number and spacing of the form braces and pin sockets shall be such that the form will be rigidly braced uniformly throughout its length and at the joints between form sections. Lock

joints between form sections shall be free from play or movement. Metal forms shall have such a strength that when tested as simple beam with a load equal to the weight of the heaviest machine to be used on the forms, the deflection will not exceed 1/8 inch in 10 feet. Forms shall be provided with adequate devices for secure setting to prevent springing, weaving, or settling from the impact and vibrations of the machine. Forms shall be free of warps, bends, or kinks. The top surface of a form shall not vary more than 1/8 inch in 10 feet from a true line. The face of the form shall not vary more than 1/4 inch in 10 feet from a true plane. Forms with battered top surfaces distorted faces or bases shall not be used. They are to be removed from the project site.

- b.) Wood Forms: Wood forms for curves and fillets shall be made from well-seasoned, surfaced plank or plywood. The wood shall also be straight, free from warp or bend, and not less than 2 inches in nominal thickness. Wood forms shall be furnished in sections approximately 5 feet in length and shall be provided with adequate devices for secure setting to withstand springing, weaving, or settling from the impact and vibration of the placing and finishing operations.
4. Subgrade, Subbase or Base Course: The subgrade, subbase or base course shall be tested as to crown, elevation, and density in advance of setting the forms. The subgrade prior to final planing shall be completed to or above the plane of the typical sections shown on the drawings and the lines and grades established by the drawings or as directed. Any discrepancies shall be corrected in accordance with the requirements for subgrade, subbase or base course construction as specified.
5. Form Setting: After the subgrade, subbase or base course has been prepared as described above, the forms shall be set. The subgrade, subbase, or base course under the forms shall be firm and cut true to grade so that each in place form section will be firmly in contact for its entire length and base width. The form shall be staked into position. The top of the form will conform to the requirements specified for the finished surface of the concrete, and the longitudinal axis of the upstanding leg will not vary more than 1/4 inch from the straight-edge when tested by a 12-foot straight-edge. The length and number of pins in any section shall be sufficient to hold the form at the correct line and grade. Form sections shall be tightly locked together. Conformity to the alignment and grade elevations shown on the drawings shall be checked and necessary corrections made by the Contractor immediately prior to placing the concrete. Forms shall be set well in advance of concrete placement. At least 250 feet of forms and prepared subgrade, subbase or base course shall be provided before concrete placement starts. The forms shall be cleaned and oiled each time before concrete is placed.
6. Subgrade Between Forms: The subgrade, subbase, leveling course or base course shall be free of foreign matter, waste concrete, cement and debris at all times; shall be finished to the required section of the bottom of the pavement as shown on the drawings with specified equipment; shall be tested with a template operated and maintained by the Contractor; shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade until the concrete is in place; shall be wetted down sufficiently in advance to insure a firm, moist, and satisfactory condition when the concrete is placed; shall, if required, be thoroughly wetted down the previous night or not less than 6 hours before placing the concrete; shall not be traversed with equipment or hauling on the prepared surface between forms; in cold weather shall be prepared and protected in a satisfactory condition

and entirely free from frost when the concrete is placed; and shall not be treated with chemicals to eliminate frost.

7. Form Removal: Forms shall remain in place at least 12 hours after the concrete has been placed. Should weather conditions delay the early-strength gain of the concrete, the forms shall remain in place for a longer period. Forms shall be removed without injuring the concrete. Bars or heavy tools are not to be used against the concrete in removing the forms. Any concrete damaged in form removal will be repaired promptly by the Contractor at no cost to the Owner.

3.3 FINISHING

Finishing operations shall be started immediately after placement of the concrete. The sequence of operations shall be as follows: transverse finishing, longitudinal floating, straight-edge finishing, carpet drag finishing, and finally the edging of joints. The machine method of finishing shall be employed, except that hand methods may be permitted as approved by the engineer. Finishing equipment and tools shall be maintained clean, free from hardened concrete or grout, and in an approved condition.

A. MACHINE FINISHING:

1. Equipment: The transverse and longitudinal finishing machines shall be power driven, be of ample weight and power to produce proper finishing, and be able to withstand the roughest treatment anticipated under job conditions. The transverse-finishing machine shall be designed and operated to strike off, screed, and consolidate the concrete. It shall be equipped with two screeds readily and accurately adjustable for changes in pavement crown and compensation for wear and other causes. The longitudinal - finishing machine shall be provided with a longitudinal float not less than 10 feet in length, readily adjustable to a true plane and properly stiffened to prevent distortion during use. Screed and float adjustments of these machines shall be checked at the start of each day's paving operations and as often as required. Machines that cause frequent delays due to mechanical failure shall be replaced. Finishing machines that ride the edge of a previously constructed slab shall have rubber-tired wheels to prevent damaging the surface and edges of the concrete.
2. Transverse finishing: Concrete, as soon as placed, shall be accurately struck off and screeded to the crown and cross section shown on the drawings. The final surface elevation or grade is to be non-porous when properly consolidated and finished. The finishing machine shall make at least two trips over each area of pavement, and may make one or two additional trips as necessary to properly compact the concrete and produce a surface of uniform texture, as well as true to grade. However, excessive manipulation that brings to the surface an excess of mortar and water will not be permitted. Any equipment that cannot produce the required compaction and surface finish with the indicated number of trips will be considered unsatisfactory. The top of the form or pavement edge upon which the finishing machine travels shall be kept clean by an effective device attached to the machine, and by necessary hand methods. This will insure that the travel of the machine will be maintained true without lift, wobble, or other variation that would affect the precision of the finish.
3. Longitudinal Floating: After completion of finishing with the transverse-finishing machine, the longitudinal mechanical float shall be operated to smooth and finish the pavement to grade. The float shall be operated parallel to the centerline of the pavement with a short, quick motion, and shall travel slowly along the pavement,

maintaining contact with the surface at all times. If contact with the surface is not made at all points, additional concrete as required shall be placed and screeded. The float is to be operated over the same area until a satisfactory surface is produced. In advancing the float, each new position shall lap the previous position by not less than one-half the float length.

4. Other Types of Finishing Equipment: Other types of concrete finishing equipment may be used on a trial basis. Such finishing equipment shall be approved by the Engineer before being put into service. The use of equipment that fails to produce approved results when finishing concrete of the quality and consistency required by these specifications shall be discontinued. The concrete shall then be floated and finished with equipment in the manner as specified above.
- B. HAND FINISHING: This method shall be employed only under the conditions previously specified, except as otherwise permitted and authorized by the Engineer.
1. Equipment: An approved strike and tamping template and a longitudinal float shall be provided for hand finishing. The template shall be at least 1 foot longer than the pavement width, be equipped with handles, and have edges at least 4 inches wide. The longitudinal float shall be 10 to 16 feet in length, with a cross section of an inverted T made of a 2 X 6 inch or wider plank for the base and a 2 X 8 inch plank for the vertical leg. The float shall be rigid, substantially braced, be able to maintain a plane surface on the bottom of the base, and shall have suitable handles for smooth and effective manipulation from the foot bridges. The bottom edges of the base of the float shall be rounded on a radius not exceeding 3/8 inch. Floats made of metal or a combination of wood and metal may be used provided they conform to the requirements for wood floats.
 2. Finishing and Floating: Immediately after placement, concrete shall be struck off and screeded to the crown and cross section shown on the drawing. The consolidated and furnished surface elevation shall be in accordance with the drawings or as specified. The entire surface shall be tamped, and the tamping operation is to be continued until accomplishing the required compaction and reduction of internal and surface voids. Concrete that is inaccessible to the vibrating consolidating equipment shall be consolidated with the aid of hand-manipulated vibrators under provisions of the subparagraph 125.06 (C) "Vibration". Immediately following the final tamping of the surface, the pavement shall be floated longitudinally by hand from bridges resting on the side forms and spanning but not touching the concrete. If contact with the pavement is not made at all points by the float, additional concrete shall be placed as required and screeded, and the float operated until a satisfactory surface has been produced. After a section has been smoothed so that the float maintains contact with the surface of the concrete at all points, the bridges may be moved forward half the length of the float. The operation is to be repeated over the new and previously floated surfaces.
 3. Straight-edge Finishing: Minor irregularities and score marks in the pavement surface shall be eliminated by means of long-handled wood floats and straight-edges after the longitudinal floating is completed, but while the concrete is still plastic. When necessary, excess water and laitance shall be removed from the surface transversely by means of a finishing straight-edge. The long-handled floats may be used to smooth and fill in open-textured areas in the pavement surfaces. The final finish shall be made with the straight-edges. The use of long-handled floats shall be held to a minimum as necessary to correct local surface unevenness not corrected by the longitudinal float. Long-handled floats shall not be used to float the entire pavement surface. Straight-edges shall be 12 feet in length and may be operated

from bridges and from the side of the pavement. A straight-edge operated from the side of the pavement shall be equipped with a handle 3 feet longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 12-foot straight-edge held in successive positions parallel and at right angles to the centerline of the pavement in contact with the surface. The whole area is to be covered as to detect variations. The straight-edge shall be advanced along the pavement in successive stages of not more than one-half the length of the straight-edge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straight-edge testing and finishing shall continue until the entire surface of the concrete is free from observable departure from the straight-edge, conforms to the required grade and contour and when hardened, will satisfy the surface requirements specified under subparagraph 125.13(B) "Surface Smoothness".

4. Carpet Drag Finishing: Use an artificial grass-type carpet having a molded polyethylene pile face with a blade length of 5/8 inch to 1 inch, a minimum weight of 70 ounces/square yard, and a strong, durable, rot-resistant backing material bonded to the facing. The surface of the pavement shall be dragged longitudinally in the direction of the concrete placement with the carpet drag when most of the water glaze or sheen has disappeared and before the concrete becomes non-plastic. The carpet drag should be of sufficient transverse length to span the full width of the pavement being placed and adjustable so that a sufficient longitudinal length of carpet is in contact with the concrete being placed to produce the desired texture. The leading transverse edge of the drag shall be securely fastened to a traveling bridge or a moveable support system. The carpet drag shall be cleaned and changed as required. The dragging shall be carefully done to produce a finished surface having a fine granular or sandy texture without leaving disfiguring marks. The surface of the pavement at joint edges shall be dragged as necessary with a small hand-operated drag following edge tooling. No tool marks of any kind shall be present on the finished surface.

3.4 CONSTRUCTION JOINTS

Construction joints shall be prepared for receiving the next pour by sweeping the surface of the joint clean with a stiff broom or wire brush to remove all laitance. All loose particles and debris shall be removed. The surface is to be dampened just prior to casting of concrete against the joint. Construction joints will be made only at locations shown on the Plans unless written permission is granted by the Engineer to make additional joints.

- A. LONGITUDINAL CONSTRUCTION JOINTS: Longitudinal construction joints between paving lanes shall be located as indicated on the drawings. Dowels or keys shall be installed in the longitudinal construction joints as required and in accordance with the indicated details. Metal keyway forms shall be used for forming horizontal keyways. The dimensions of the keyway forms shall not vary more than plus or minus 1/16 inch from the indicated dimensions. The keyway form shall be securely fastened to the concrete form so that it will be at the mid-depth of the pavement within a tolerance of plus or minus 1/8 inch. All longitudinal construction joints shall be edged and subsequently sawed to provide a groove at the top conforming to the indicated details and dimensions.
- B. TRANSVERSE CONSTRUCTION JOINTS: Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. All transverse construction joints in non-reinforced pavements shall be installed in the location of a

planned transverse contraction or expansion joint. Transverse construction joints located at planned transverse joints shall be of the doweled type with one end of each dowel painted and greased to permit movement at the joint. These joints shall be edged and subsequently sawed to provide a groove at the top conforming to the indicated details and dimensions. When concrete placing is resumed, the planned joint spacing shall be used beginning with the first regularly scheduled transverse joint.

3.5 EXPANSION JOINTS

Three quarter (3/4) inch expansion joints shall be provided at forty (40) feet on center or of the type, size, and spacing shown on the Plans. The expansion joint materials shall be as shown on the plans or a recycled material, 1/2" thick as manufactured by J.D. Russel Co., or approved equal. The joint sealing compound shall be Sonneborn SL-1 or approved equal. Manufacturers' recommendations must be strictly adhered to. Devices used for installing the joints shall be adequate to hold the parts of the joint in proper position while protecting the filler from damage during concreting operation. The devices shall also be removable without permanent detriment to the pavement. Adjacent sections of filler shall be fitted tightly together and held in line to insure continuity. Concrete shall be prevented from entering the expansion space. Any concrete that has flowed into a gap between an expansion joint strip and edge forms of the pavement shall be cut out immediately after removing the forms. Expansion joints shall be formed about structures and features that project through, into, or against the pavement. Joint filler must be of the type, thickness, and width as indicated or directed and installed to form a complete, uniform separation between the structure and pavement.

3.6 CONTRACTION JOINTS

- A. Contraction joints shall be provided at twenty (20) feet on center or of the type, size, and spacing shown on the Plans. Contraction joints may be either tooled or sawed but must provide a minimum depth of 1/4 of the thickness of the concrete and sealed as shown on the plans or with Sonneborn SL-1 or approved equal. When sawed joints are used, the sawing should begin as soon as the concrete has obtained adequate strength to resist raveling of the joint edges, generally between 4 and 24 hours. The joints must be flushed or blown clean immediately after sawing to keep the residue from setting up.
- B. Transverse and longitudinal contraction joints shall be of the weakened-plane or dummy type, and shall be constructed in conformance with the indicated details and dimensions. Longitudinal contraction joints shall be constructed by sawing a groove in the hardened concrete with a power-driven saw. Tie bars in longitudinal contraction joints shall be prepared and placed across joints where indicated in the plans. They shall be correctly aligned and securely held in the proper horizontal and vertical position during the placing and finishing operations to the satisfaction of the Engineer.
 1. Sawed Joints: The groove of contraction joints shall be not less than 1/4 inch nor greater than 3/8 inch in width for the entire depth of saw cut shown on the drawings. The upper portion of the groove is to be widened to not less than 3/8 inch nor more than 5/8 inch for a depth of 1/4 of the pavement thickness, plus or minus 1/8 inch, below the pavement surface.

The time of sawing shall be varied, depending on existing and anticipated weather conditions. Uncontrolled cracking of the pavement shall be prevented. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without excessive chipping, spalling, or tearing. The sawed faces of joints will be inspected for undercutting or washing of the concrete due to early sawing. If this action is sufficiently deep to cause structural weakness or

excessive cleaning difficulty, as determined by the Engineer, the sawing operation shall be delayed until directed to resume. The sawing operation shall be carried on regardless of weather conditions. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. A chalk line or other suitable guide shall be used to mark the alignment of the joints. The saw cut shall be straight from edge to edge of the pavement and shall not vary more than 1/2 inch from the true joint alignment. Before sawing a joint, the concrete shall be examined closely for cracks. The joint shall not be sawed if a crack has occurred near the location chosen for a joint. Sawing shall be discontinued when a crack develops ahead of the saw cut.

The surface of pavement cured with membrane-curing compound shall be wetted with water in the region of the intended saw cut prior to sawing to protect the curing membrane from abrasion. Workmen and inspectors shall wear clean, rubber soled footwear, and the number of persons walking on the pavement shall be limited to those actually performing the sawing operation. Immediately after each joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water until all waste from sawing is removed from the joint. Any membrane-cured surface damaged during the sawing operations shall be re-sprayed as soon as the free water disappears. The sawing equipment shall be adequate in number of units and power to complete the sawing at the required rate. An ample supply of saw blades shall be available on the job before concrete placement is started. At least one standby sawing unit in good working order shall be available at the job site at all times during the sawing operations.

2. Dowels and Tie Bars: Dowels and tie bars shall be prepared and placed across joints where indicated. They are to be correctly aligned, and securely held in the proper horizontal and vertical position during the placing and finishing operations. Dowels shall be placed by the bonded-in-place method. The portion of the dowel inside the form shall be the bonded end. Dowels may be cut to length at the mill or shop by shearing in lieu of sawing, provided the deformation from true shape caused by shearing does not exceed the diameter of the bar by more than 0.04 inch and provided such deformation does not extend more than 0.04 inch from the end of the dowel. Dowels shall be clean, straight, and cut true to length with ends square and free from burs.

In longitudinal and transverse construction joints, threaded split dowels may be used in lieu of one-piece dowels. The assembled split dowels shall have a length and diameter at least equal to that of a one-piece dowel of the required size. The screw-threaded portions of split dowels shall have a pitch diameter at least equal to the diameter of the one-piece dowel of the required size. The sleeve connector shall be of such length that when the split dowel is assembled the entire screw-threaded portions of the dowel are encased by the sleeve with dowel ends butting each other. Dowels in longitudinal and transverse construction joints shall be held securely in place by means of devices fastened to the forms.

Dowels and tie bars installed within the paving lane shall be held securely in position by means of rigid metal frames or basket assemblies. The assemblies shall consist of a framework of metal bars or wires arranged to provide rigid support for the dowels and tie bars throughout the paving operation. The assemblies shall also have a minimum of four transverse bars or wires, one of which shall be at or near each end of the dowel or tie bars with one for each end of the dowel bar at or near the subgrade. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent the dowels from rising, sliding out, or

becoming distorted under paving operations. The wires shall not be used as locking devices. The dowel-holding devices shall be held securely in the proper location by means of suitable pins or anchors. Dowels in longitudinal and transverse construction joints shall be held securely in place parallel to the surface and within 1/2 dowel diameter of the center of the slab depth. Dowels in expansion joints and tie bars installed within the paving lane shall be held securely in place with the center of the dowel or tie bar within 1/8 inch of the center of the slab depth.

The spacing of dowels in longitudinal construction joints shall be as indicated except where the planned spacing cannot be maintained due to form length or interference with form braces. Spacing shall be closer with additional dowels. Dowels in longitudinal joints shall be omitted when the center of the dowel would be located within a horizontal distance from a transverse joint equal to 1/4 of the slab thickness. The method used in holding dowels in position shall be accurate to detect errors in alignment of any dowel from its required position after the finished pavement. There shall not be an angle greater than one whose tangent is 1/96. The Contractor shall furnish a template for checking the position of the dowels.

The portion of each dowel intended to move within the concrete or expansion cap shall be coated with a thin film of grease or other approved de-bonding material. Provide dowel caps on the lubricated end of each dowel bar used in an expansion joint. Provide dowel caps filled with a soft compressive material with enough range to allow complete closure of the expansion joint.

3.7 LONGITUDINAL JOINTS

Longitudinal joints may be provided to assist in grade control or of the type, size, and frequency shown on the Plans. The longitudinal joint shall consist of a steel keyway or as shown on the plans. Manufacturer's recommendations must be strictly adhered to.

3.8 PAVEMENT PROTECTION:

The Contractor shall protect the paving against all damage prior to final acceptance of the work by the Owner. Traffic shall be excluded from the pavement by erecting and maintaining barricades and signs until the concrete is at least 3 days old or for a longer period if so directed. As a construction expedient in paving intermediate lanes between newly paved lanes, operation of the paving mixer and batch-hauling equipment will be permitted on the pavement after the pavement has been cured for seven days and the joints have been sealed or otherwise protected. Also, the subgrade planer, concrete finishing machines, and similar equipment may be permitted to ride upon the edges of the previously constructed slabs provided the concrete is more than 72 hours old and has attained a minimum flexural strength of 450 psi or a compressive strength of 2,800 psi. Additional protection to the slab edge may be required to prevent damage. The pavement carrying traffic or equipment shall be kept clean. All spillage of materials on concrete shall be cleaned up immediately upon occurrence, at no cost to the Owner.

3.9 PLAN GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS:

The finished surfaces of all pavements shall conform to the grade line and elevations shown on the contract drawings and the surface-smoothness requirements:

- A. PLAN GRADE: The finished surfaces of all pavements shall conform, within the tolerances specified and to the lines, grades, and cross sections shown on the contract drawings. The finished surfaces of the pavements shall not vary more than 0.04 foot above

or below the plan-grade line or elevation established and approved at the site of the work. The finished surfaces of new abutting pavements shall coincide at their juncture. An approved transition pavement strip of the type and width shown on the drawings or as directed shall be installed where a new pavement abuts an existing pavement to provide the required and satisfactory pavement surface at the juncture of the new and existing pavements. Further, the 0.04 foot deviation from the approved grade line and elevation will not be permitted in any area of these pavements where closer conformance with planned grade and elevation is required for the proper functioning of any and all applicable structures.

- B. **SURFACE SMOOTHNESS:** The finished surfaces of all pavements shall not deviate from the testing edge of an approved 12-foot straight-edge more than the tolerance shown for the respective pavement category of Table 350-1. In no instance shall the tolerance exceed more than 1/16 of an inch per foot.

TABLE 350-1		
Pavement Category	Direction of Testing	Tolerances
Pavements having cross slopes of 1% or less	Longitudinal Transverse	1/8 inch 3/16 inch
Pavements having cross slopes greater than 1%	Longitudinal Transverse	1/8 inch 1/4 inch

- C. **EQUIPMENT:** The Contractor shall furnish and maintain at the site one straight-edge in good condition for each longitudinal finishing machine for use by the Owner in testing the hardened portland-cement-concrete surfaces. These straight-edges shall be constructed of aluminum or other approved lightweight metal. They shall have blades with a box or box-girder cross-section with a flat bottom, adequately reinforced to insure rigidity and accuracy. Straight-edges shall be equipped with handles for operation on the pavement. The Contractor shall furnish and maintain at the site devices other than straight-edges, if approved, for surface-smoothness determinations. There shall be one such device for each longitudinal finishing machine for use by the Owner.

3.10 CURING

See SECTION 03 30 00 - CONCRETE

END OF SECTION

SECTION 32 13 16

CONCRETE PAVERS

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of the placement of a sand laying course on an approved subgrade or base and the installation of interlocking concrete pavers in the quality, shape, thickness and color specified.

1.2 MEASUREMENT AND PAYMENT

- A. Accepted work performed as prescribed by this item will be measured by the square foot of surface area.
- B. The work performed by this item will be paid for at the unit price bid for “Concrete Pavers” which price shall be full compensation for preparing the subgrade, placement of base course, placement of lateral restraint curb, installation of concrete pavers on a sand laying course and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in the manufacturing of solid concrete interlocking pavers for a minimum of four (4) years.
- B. Installer: Company specializing in the installation of solid concrete interlocking pavers with three (3) years documented experience (and accredited by the manufacturer in relation to the paver type and project requirements).

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Pavers shall be solid concrete interlocking paving units complying with ASTM Designation C936.
 - 1. The stone’s thickness shall be 80 millimeters in all areas or as shown on the plans.
 - 2. Contractor shall submit color samples for City selection prior to any construction activity relative to this item. Color shall be “River Red” or as shown on the plans.
 - 3. Cementitious Material: Portland cement shall conform to ASTM Specification C-150.
 - 4. Aggregates shall conform to ASTM Specification C-33 for Normal Weight Concrete Aggregate (no expanded shale or lightweight aggregates) except that grading requirements shall not necessarily apply.

5. Other Constituents: Coloring pigments, air-intraining agents, integral water repellants, finely ground silica, etc., shall conform to ASTM standards where applicable, or shall be previously established as suitable for use in concrete.
 6. Compressive Strength – At the time of delivery to the work site, the average compressive strength shall not be less than 8,000 psi with no individual unit strength less than 7,200 psi, with testing procedures in accordance with ASTM Standard C-140.
 7. Absorption – The average absorption shall not be greater than 5% with no individual unit absorption greater than 7%.
 8. Proven Field Performance – Satisfying field performance is indicated when units smaller in composition, and made with the same manufacturing equipment as those to be supplied to the purchaser, do not exhibit objectionable deterioration after at least one (1) year.
 9. All units shall be sound and free of defects that would interfere with the proper placing of unit or impair the strength or performance of the construction. Minor cracks incidental to the usual methods of handling in shipment and delivery, shall not be deemed ground for rejection.
 10. The purchaser or his authorized representative shall be accorded proper facilities to inspect and sample the units at the place of manufacture from lots ready for delivery.
 11. Sample and test units in accordance with ASTM Method C-140.
 - a.) Manufacturer shall provide a minimum of three (3) years testing backup data showing manufactured products that meet and exceed ASTM 936-82 when tested in compliance with ASTM C-140.
 - b.) Sampling shall be random with a minimum of nine (9) specimens per 20,000 sq.ft. per product shape and size, with repeated samples taken every additional 20,000 sq.ft. or fraction thereof.
 - c.) Test units in accordance with ASTM for compressive strength, absorption and dimensional tolerance. A minimum of three (3) specimens per test required for average value.
 12. Rejection – In case the shipment fails to conform to the specified requirements, manufacturer may sort it, and new test units shall be selected at random by the purchaser from the retained lot and tested at the expense of the manufacturer. In case the second set of test units fails to conform to the specified requirements, the entire lot shall be rejected.
 13. Expense of Tests – The expense of inspection and testing shall be borne by the Contractor unless otherwise agreed.
- B. **SAND LAYING COURSE:** the sand laying course shall be well-graded, clean, washed, sharp sand with 100% passing a 3/8” sieve size and a maximum 2% passing a No. 200 sieve size. Use concrete sand or similar. **DO NOT USE MASON SAND OR LIMESTONE SCREENING.** The sand shall contain no more than 10% of acid soluble material. The sand laying course is the responsibility of the paving stone installer.
- C. **EDGE RESTRAINT:** All edges of the installed pavers shall be restrained. The type of edge restraint shall be approved at locations and to details noted on plans.

- D. **BASE COURSE:** The material shall consist of reinforced concrete placed on a stabilized subgrade as detailed in the plans.
- E. **JOINT FILLING SAND:** The joint filling sand shall be graded, clean, washed sand with 100% passing the No. 16 sieve size and a maximum of 5-10% passing the No. 200 sieve size. The sand shall contain no more than 10% of acid soluble material.

PART 3 – EXECUTION

3.1 GENERAL

A suitable base shall be prepared as specified and detailed in the construction drawings. The base course shall be shaped to grade and the cross section with an allowable tolerance of 0-1/4" (relative to specified dimensions below finish design elevation with a 10-foot straight edge).

- A. The Contractor shall inspect and approve the finished base course prior to placement of the sand laying course.
- B. The un-compacted sand laying course shall be spread evenly over the area to be paved and then screeded to a level that will produce 1" (26mm) thickness when the paving stones have been placed and vibrated. Provide the proper level of sand such that the final elevation of paving stones will be nominally 1/4" to 3/8" higher than adjacent curb, gutters, other paving, to allow for free drainage from chambers or block edges any minor settling that may occur within the base.
- C. Once screeded and leveled to the desired elevation, the sand laying course shall not be disturbed in any way.
- D. Placement
 1. The pavers shall be placed in the approved pattern as noted or shown on the drawings. (Herringbone pattern is recommended for vehicular traffic.)
 2. The pavers shall be placed in such a manner that the desired pattern is maintained and the joints between the pavers are nominally 1/8" with no individual gap exceeding 3/16".
 3. Use string lines to hold all patterns true. Lines shall not deviate more than $\pm 1/2$ of an inch in 100 linear feet.
 4. The gaps at the edge of the paver surface shall be filled with standard pavers or with pavers cut to fit. No pavers shall be installed which are less than 1/2 of the original unit's surface area.
 5. The cutting of pavers, using a double headed breaker or a masonry saw shall leave a maximum 1/4" underbite.
 6. The finished elevation of pavers shall not deviate more than 1/4" within a 10' straight edge.
 7. When cutting precision designed areas, as directed by the engineer, a masonry saw shall be used.
 8. Pavers to be alternately selected from at least three (3) pallets, working from top to bottom of each pallet stack.

9. Pavers shall be vibrated into the sand laying course using a vibrator capable of 3,000 to 5,000 pounds compaction force with the surface clean and the joints open.
10. After vibration, washed sand shall be spread over the paver stone surface, allowed to dry, and vibrated into the joints with additional vibrator passes and brushing so as to completely fill the joints.
11. Surplus material shall be swept from the surface. (Or left on the surface during construction to insure complete filling of the joints during initial use. This sand may also provide surface protection from construction debris.)
12. Upon completion of work covered in this section, the contractor shall clean up all work by removing all debris, surplus material, and equipment from the site.
13. The re-sanding as necessary of paver joints shall be provided by Contractor for a period of 90 days after completion of work.

END OF SECTION

SECTION 32 16 13

CONCRETE CURB AND GUTTER

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of Reinforced CONCRETE CURB AND GUTTER constructed on approved subgrade in conformity with the lines and grades established by the City Engineer. CONCRETE CURB AND GUTTER shall also be in accordance with the standard section, specifications and ordinances for sidewalks adopted by the city in which CONCRETE CURB AND GUTTER is to be placed.

1.2 MEASUREMENT AND PAYMENT

- A. Concrete curb and gutter shall be measured by the linear foot of length when complete and in place.
- B. The work performed and the materials furnished and measured shall be paid for at the contract unit price bid for concrete curb and gutter. This shall include full compensation of all materials, labor, tools, equipment and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

See SECTION 03 30 00 - CONCRETE.

PART 2 – PRODUCTS

2.1 MATERIALS

This item shall consist of a mixture of reinforcing steel, coarse aggregate, fine aggregate, cement and water. The mixture shall conform to SECTION 03 30 00 - CONCRETE.

2.2 TESTING REQUIREMENTS

See SECTION 03 30 00 - CONCRETE.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. CONVENTIONALLY FORMED CONCRETE: Shape and compact subgrade, foundation, or pavement surface to the line, grade and cross section shown on the plans. Lightly sprinkle subgrade or foundation material immediately before concrete placement. Pour concrete into forms, and strike off with a template ¼ to 3/8 inches less than the dimensions of the finished curb unless otherwise approved. After initial set, plaster surface with mortar consisting of 1 part hydraulic cement and 2 parts fine aggregate. Brush exposed surfaces to a uniform texture.

- B. EXTRUDED OR SLIP FORMED CONCRETE: Hand tamp and sprinkle subgrade or foundation material before concrete placement. Provide clean surfaces for concrete placement. If required, coat cleaned surfaces with approved adhesive or coating at the rate of application shown on the plans or as directed. Place concrete with approved self-propelled equipment. The forming tube of the extrusion machine or the form of the slip form machine must be easily adjustable vertically during the forward motion of the machine to provide variable heights necessary to conform to the established grade line. Attach a pointer or gauge to the machine so that a continual comparison can be made between the extruded or slip form work and the grade guideline. Other methods may be used when approved. Finish surfaces immediately after extrusion or slip forming.
- C. JOINTS: Unless otherwise shown on the plans, the walk shall be cut transversely with a jointing tool every ten (10) feet after the concrete has been thoroughly worked and has sufficiently set. Expansion joints shall be located every forty (40) feet.
- D. CURING: After the finished concrete has sufficiently set, it shall be covered with burlap and kept wet for a period of four (4) days. As an alternate the concrete may be cured by the application of a clear membrane seal coat that will retain 85% of the original mixing water at the end of three (3) days.
- E. CLEANUP: After the construction work has been completed, the Contractor shall remove all debris, trash, excess materials, forms, stakes, empty sacks, etc. occasioned by his work from the premises. The site shall be left with a neat appearance. All excavation shall be backfilled and all excess excavated materials shall be disposed of.

END OF SECTION

SECTION 32 16 13.01
CONCRETE SIDEWALK

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification. Additional revisions are indicated by a dashed underline.)

PART 1 - GENERAL

1.1 DESCRIPTION

This item shall consist of Reinforced Concrete Sidewalk constructed on approved subgrade in conformity with the lines and grades established by the City Engineer. Sidewalks shall also be in accordance with the standard section, specifications and ordinances for sidewalks adopted by the city in which sidewalk is to be placed.

1.2 MEASUREMENT AND PAYMENT

- A. Concrete sidewalk shall be measured by the square foot of surface area when complete and in place.
- B. The work performed and the materials furnished and measured shall be paid for at the contract unit price bid for concrete sidewalk. This shall include full compensation of all materials, labor, tools, equipment and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

See SECTION 03 30 00 - CONCRETE.

PART 2 – PRODUCTS

2.1 MATERIALS

This item shall consist of a mixture of reinforcing steel, coarse aggregate, fine aggregate, cement and water. The mixture shall conform to SECTION 03 30 00 - CONCRETE.

2.2 TESTING REQUIREMENTS

See SECTION 03 30 00 - CONCRETE.

PART 3 – EXECUTION

3.1 GENERAL

- A. The subgrade shall be excavated and fine graded to a true grade. Any backfill shall be watered and tamped well ahead of the placing of the concrete. If dry, the subgrade shall be sprinkled immediately before depositing any concrete. Forms shall be metal or wood, free of warp and of a depth equal to the depth of the concrete. They shall be secured and accurately staked to line and grade and held in a true position during the placing of the concrete. Expansion joints of an approved material shall be used between the sidewalk and all abutting concrete. Placement of concrete may begin after the subgrade is thoroughly compacted and the forms, expansion joints (where necessary) and reinforcing steel are in

place. The concrete shall be thoroughly worked with a flat spade or similar tool along the forms as the pouring continues to insure the absence of honeycombs. No concrete over thirty (30) minutes old or retempered concrete shall be used. After the placing of the concrete has sufficiently advanced, the concrete shall be struck off flush with the forms. Then the concrete shall be worked with a wooden float to flush excess mortar to the surface. All exposed corners are to be edged or rounded to the radius shown on the Plans.

- B. Unless otherwise shown on the plans, the walk shall be cut transversely with a jointing tool at a width equal to the sidewalk width after the concrete has been thoroughly worked and has sufficiently set. Expansion joints shall be located every forty (40) feet.
- C. After the finished concrete has sufficiently set, it shall be covered with burlap and kept wet for a period of four (4) days. As an alternate the concrete may be cured by the application of a clear membrane seal coat that will retain 85% of the original mixing water at the end of three (3) days.
- D. After the construction work has been completed, the Contractor shall remove all debris, trash, excess materials, forms, stakes, empty sacks, etc. occasioned by his work from the premises. The site shall be left with a neat appearance. All excavation shall be backfilled and all excess excavated materials shall be disposed of.

END OF SECTION

SECTION 32 17 23.23

REFLECTORIZED PAVEMENT MARKERS (RPMs)

PART 1 - GENERAL

1.1 DESCRIPTION

This item shall govern for the furnishing and installing of raised reflectorized pavement markers (RPMs) at locations designated on the plans or as directed by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Pavement markers will be measured as each pavement marker complete and in place.
- B. The price shall be full compensation for furnishing all materials, all preparation and installation, all labor, equipment, tools and incidentals necessary to complete the work.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The RPMs shall be conform to Item No. 672, Texas Department of Transportation’s Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, June 2004; provided, however, that all buttons used on any one project shall be of the same material and same manufacture.
- B. The base of the marker shall be flat (the deviation from a flat surface shall not exceed 1/16 inch), and designed to be bonded to either asphaltic or portland cement concrete pavement, with an approved adhesive meeting the requirements stated in Test Method TEX-611-J.

2.2 OPTICAL REQUIREMENTS

The specific intensity of each reflective surface shall not be less than the following values when tested at a 0.2 angle of divergence and when the incident light is parallel to the base of the marker.

Horz. Ent. Angle	<u>Crystal</u>	<u>Amber</u>	<u>Red</u>
<u>4 degrees</u>	<u>3.00</u>	<u>2.00</u>	<u>0.75</u>
20 degrees	<u>1.50</u>	<u>1.00</u>	<u>0.30</u>

- A. ANGLE OF INCIDENCE: The angle of incidence is the angle formed by a ray from the light source to the marker, and normal to the leading edge of the marker face.
- B. ANGLE OF DIVERGENCE: The angle of divergence is the angle formed by a ray from the light source to the marker, and the returned ray from the marker to the measuring receptor.

- C. SPECIFIC INTENSITY: The specific intensity is the mean candle power of the reflected light at a given incidence and divergence angle for each foot candle at the reflector on a plane perpendicular to the incident light. (Test Method TEX-842-B)

2.3 STRENGTH REQUIREMENTS

The markers shall comply with the adhesion requirements of Test Method TEX-611-J. The marker shall withstand a falling-ball impact of 5 (five) feet without breaking, cracking or being significantly deformed when tested according to Test Method TEX-430-A. The marker shall show no change in shape or color when subjected to the requirements of Test Method TEX-846-B. The temperature shall be 140° F with the marker in a vertical position.

2.4 MARKER TYPES

The color and number of reflective surfaces of the buttons or markers shall be as designated in the Plans and Specifications.

2.5 SAMPLING

Should any of the specimens selected for strength testing, as specified in the section, "Strength Requirements", fail to comply with the strength requirements of this specification; five (5) additional specimens will be tested. The failure of any one of these five (5) specimens shall be cause for the rejection of the entire lot or shipment represented by the sample.

PART 3 – EXECUTION

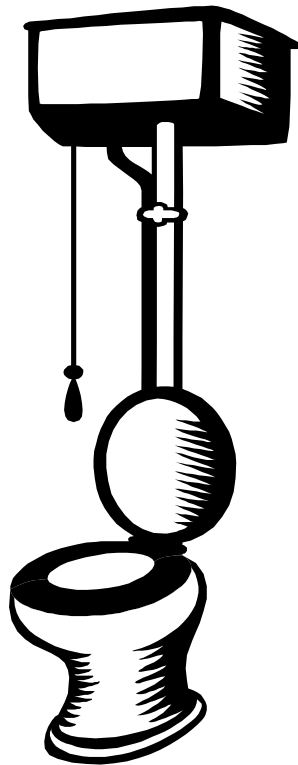
3.1 GENERAL

The RPMs shall be placed in accordance with the plans or as directed by the Engineer. The pavement surface shall be prepared by buffing, grinding, or other methods approved by the Engineer. After preparation, the surface must be free of dirt, grease, oil, moisture, loose unsound pavement, and any other material, which would adversely affect the bond of the adhesive. The wet epoxy or bituminous material shall be applied so that 100% of the bonding area of the button will be in contact and shall be of sufficient thickness so that the excess adhesive shall be forced out around the perimeter of the button. When the project is complete, the button shall be firmly bonded to the pavement. Lines formed by the buttons shall be true, and the entire installation shall present a neat appearance.

END OF SECTION

TECHNICAL SPECIFICATIONS

Sanitary Sewer



SECTION 33 01 30.13

TESTING FOR SANITARY SEWAGE GRAVITY SYSTEM

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL**1.1 DESCRIPTION**

- A. This is a general specification, which applies to the furnishing of all labor, materials, tools, and equipment to perform all operations in connection with leakage testing for completed manholes and gravity sewer pipe and deflection testing for flexible sewer pipe.

1.2 MEASUREMENT AND PAYMENT

- A. Testing of sewer lines (except for T.V. Inspection), manholes and appurtenances shall not be considered a separate pay item. T.V. Inspection will be paid for as a separate bid item. The Contractor shall supply all water for the tests, all equipment and labor necessary to convey the water into the sewer, the necessary transportation to transport test plugs and risers from one test site to another and such labor and equipment as may be required in installing test plugs, and other incidental work in conducting the tests and the cost thereof shall be included in the price for constructing the sewer, including furnishing the test plugs.

PART 2 – PRODUCTS**2.1 TESTING REQUIREMENTS****A. MANHOLE TESTING**

After completion of manhole construction, wall sealing, or rehabilitation, test manholes for leakage using Vacuum Testing or, if pre-approved by the City Engineer, Exfiltration Testing Procedures as specified herein.

1. General

Plug influent and effluent lines, including service lines, with suitably sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required in this test; follow Manufacturer's safety and installation recommendations. Place plugs a minimum of 6 inches outside of manhole walls.

2. Vacuum Testing

- a.) To perform a vacuum test, all lift holes and exterior joints shall be plugged with a non-shrink grout and all pipes entering a manhole shall be plugged.
- b.) No grout must be placed in horizontal joints before testing.
- c.) Stub-outs, manhole boots, and pipe plugs must be secured to prevent movement while a vacuum is drawn.
- d.) Contractor shall use a minimum 60 inch/lb torque wrench to tighten the external clamps that secure a test cover to the top of a manhole.

- e.) A test head must be placed at the inside of the top of a cone section, and the seal inflated in accordance with the manufacturer's recommendations.
- f.) There must be a vacuum of 10 inches of mercury inside a manhole to perform a valid test.
- g.) A test does not begin until after the vacuum pump is off.
- h.) A manhole passes the test if after 2.0 minutes and with all valves closed, the vacuum is at least 9.0 inches of mercury.

3. Hydrostatic Testing

- a.) The maximum leakage for hydrostatic testing or any alternative test methods is 0.025 gallons per foot diameter per foot of manhole depth per hour.
- b.) Seal all wastewater pipes coming into a manhole with an internal pipe plug, fill the manhole with water up to the manhole cover and maintain the test for at least one hour.
- c.) A test for concrete manholes may use a 24-hour wetting period before testing to allow saturation of the concrete.

B. GRAVITY PIPE LEAKAGE TESTING

1. General

Tests shall be made by the low-pressure air test, the infiltration test or the joint test. The infiltration test shall be used when the groundwater level is at least 2 ft above the crown of the pipe measured at the upstream manhole. The joint test shall be used for pipe sections greater than 36-inch inside diameter. The Contractor may use the joint test for pipe with a 27-inch through 36-inch average inside diameter at the approval of the Engineer or his representative. The low-pressure air test, the infiltration test and the exfiltration test shall be conducted from manhole to manhole. Trenches shall be completely backfilled and sewer line should be free of debris prior to testing. Plug all pipe outlets including laterals and secure plugs to prevent leakage blowout due to testing pressure.

2. Infiltration Test

a.) Performance:

The total infiltration, as determined by a hydrostatic head test, shall not exceed 50 gallons per inch of diameter per mile of pipe per 24 hours at a minimum test head of 2.0 feet above the crown of a pipe at an upstream manhole. For construction within the 100-year flood plain, the total infiltration shall not exceed ten gallons per inch of diameter per mile of pipe per 24 hours.

NORMAL CONSTRUCTION

SIZE OF PIPE	ALLOWABLE LEAKAGE* Gal/Min/100 Ft.
6"	0.0039
8"	0.0053
10"	0.0066
12"	0.0079
15"	0.0099
18"	0.0118
21"	0.0138
24"	0.0158
27"	0.0178
30"	0.0197
36"	0.0237

* Equivalent to 50 gal. per inch diameter per mile per 24 hours

CONSTRUCTION WITHIN 100 YR FLOOD PLAIN

SIZE OF PIPE	ALLOWABLE LEAKAGE* Gal/Min/100 Ft.
6"	0.0008
8"	0.0011
10"	0.0013
12"	0.0016
15"	0.0020
18"	0.0024
21"	0.0028
24"	0.0032
27"	0.0036
30"	0.0039
36"	0.0047

* Equivalent to 10 gal. per inch diameter per mile per 24 hours

The total leakage in cubic inches shall be the total cross-sectional area in square inches of the inside of the two risers and of any stacks in the sewer multiplied by the drop in water level in inches. For diameters not listed in chart, multiply the square of the diameter by the following chart value for 1" diameter.

DIAMETER OF RISER OR STACK	VOLUME PER INCH OF DEPTH	
	Cubic Inch	Gallon
1"	0.7854	.0034
2"	3.1416	.0136
2-1/2"	4.9087	.0212
3"	7.0686	.0306
4"	12.5664	.0544
5"	19.6350	.0850
6"	28.2743	.1224
8"	50.2655	.2176

b.) Execution:

Stop all dewatering operations and allow the groundwater to return to its normal level and allow to remain so for at least 24 hours. Leakage shall be determined by measuring the flow through the opening in the downstream plug for at least 15 minutes. Five separate measurements shall be made. The average of the measurements shall be used, discarding any one of the five measurements except the last that varies by more than 50% from the average of the other four. If the results of the tests are otherwise satisfactory, but the last of the five measurements show leakage in excess of that permitted, the tests shall be continued to determine if additional leaks may have developed during testing.

3. Air Test

a.) Performance:

The pipe shall be pressurized to 5 pounds per square inch gauge (psig) greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop 1.0 psig shall be 5 minutes per every 100 feet of pipe plus (+) 5 minutes per each service connection. Pipe sizes larger than 27 inches shall be tested as per TCEQ requirements.

The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined in this subparagraph or until failure.

b.) Execution:

Add air until the internal air pressure of the sewer line is raised to approximately 5.5 psig. Allow the air pressure to stabilize. The pressure will normally drop until the temperature of the air in the line stabilizes.

When the pressure has stabilized and is at or above the starting test pressure of 5 psig, commence the test by allowing the gage pressure to drop to 5 psig at which point the time recording is initiated. Record the drop in pressure for the test period.

4. Joint Test

The joint test may be conducted by an air test or water test. The joint and the pipe segment shall be visually inspected immediately after testing.

a.) Performance:

The pipe is to be pressurized to 3.5 psig greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 psig to 2.5 psig shall be ten seconds.

If the groundwater pressure is equal to or greater than 3.5 psig, and the sewer line or joint is not leaking the sewer line or joint is acceptable and no additional testing is required. If one or more joints are leaking, but the total amount of leakage in the sewer line being tested is equal to, or less than, the allowable leakage specified in 250.03-B-1 “Performance”, the line is acceptable and no additional testing is required provided visible leaks are repaired. Moisture or beads of water appearing on the surface of the joint will not be considered as visible leakage.

b.) Execution:

Review proper operation, safety, and maintenance procedures as provided by the manufacturer of the joint test apparatus. Move the joint test apparatus into the sewer line to the joint to be tested and position it over the joint. Make sure the end element sealing tubes straddle both sides of the joint and the hoses are attached. For the water test, the bleed-off petcock must be located at top dead center. Inflate end element sealing tubes with air in accordance with equipment and manufacturer’s instructions.

i. Air Test - Pressurize the void volume with air to 3.5 psig greater than the pressure exerted by groundwater above the pipe. The drop in pressure shall be measured over ten seconds. Five separate measurements shall be made. The average of the measurements shall be used, discarding any one of the five measurements except the last that varies by more than 50% from the average of the other four. If the results of the tests are otherwise satisfactory, but the last of the five measurements show leakage in excess of that permitted, the tests shall be continued to determine if additional leaks may have developed during testing.

ii. Water Test - Introduce water into void volume until water flows evenly from open petcock. Close the petcock and pressurize with water to 3.5 psig above the pressure exerted by ground water. The drop in pressure shall be measured over ten seconds. Five separate measurements shall be made. The average of the measurements shall be used, discarding any one of the five measurements except the last that varies by more than 50% from the average of the other four. If the results of the tests are otherwise satisfactory, but the last of the five measurements show leakage in excess of that permitted, the tests shall be continued to determine if additional leaks may have developed during testing.

C. DEFLECTION TESTING

Deflection tests shall be performed on all flexible pipes. For pipelines with inside diameters less than 27 inches, a rigid mandrel shall be used to measure deflection. For pipelines with an inside diameter 27 inches and greater, a method pre-approved by the Engineer shall be used to test for vertical deflections. Other methods shall provide a precision of two tenths of one percent (0.2%) deflection. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of 5.0%. If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices.

1. Mandrel Sizing

The rigid mandrel shall have an outside diameter (O.D.) equal to 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. All dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

2. Mandrel Design

The rigid mandrel shall be constructed of a metal or rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.

3. Method Options

Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test. A deflectometer may be approved for use on a case-by-case basis. Mandrels with removable legs or runners may be accepted on a case-by-case basis. Mechanical devices will not be used to pull the mandrel.

D. TV CAMERA INSPECTION

T.V. Camera Inspection shall be performed on all sewer pipe installed before acceptance. When the Contractor performs the inspection, the City Engineer or his representative shall be notified one working day prior so that he can view the procedure. The inspection shall be in digital video format, saved to a DVD or CD (enclosed within a protective case) and shall be given to the City Engineer or his representative for review and final records.

The lines shall be completely filled with potable water between manholes to fill the service connections and drained prior to T.V. Camera Inspection. Line shall be cleaned prior to T.V. inspection. All dirt/debris, including pipe grease, in the line which could cover a defect shall be removed. Line should be cleaned before being filled with water. Jetting of the lines in conjunction with the T.V. Inspection is prohibited. If the line to be televised is discovered to contain foreign material, which prohibits an acceptable T.V. inspection, the line shall be jetted and televised again.

Select and use closed circuit television equipment that will produce a color digital video. Produce and use closed circuit television equipment using a panorama tilt, radial viewing, pipe inspection camera that pans plus and minus 75 degrees, rotates 360 degrees, and has optical zoom from 6 or less inches to infinity. The camera must have an accurate footage counter accurate to within 1 foot per 500 foot of pipe. Footage shall be continuously

displayed on the video at all times. The camera operator shall pause at each tee, tilt camera and view up into the branch for inspection of joints and fittings maintaining a clear in focus picture at all times while zooming to the full extent of the camera. The camera operator shall stop at each fitting and change in pipe type and complete a 360 degree view of the fitting slow enough to identify all defects. Glare shall be avoided and shall not interfere with viewing the pipe segment. Maximum rate of travel for the camera shall be 30 feet per minute. DVDs or CDs shall be continuous from pipe segments between manholes. Provide DVDs or CDs with labels indicating project number, segment number, date televised, date submitted, starting manhole number, ending manhole number, pipe diameter, pipe length and street name.

The T.V. inspection shall be used to identify defective construction such as sags, debris, separated joints, etc. The City Engineer shall make all final determinations if the severity of the defect constitutes failure and subsequent removal of the segment in question.

E. RETESTS

Manholes or sewers which fail to meet the testing requirements shall be repaired and retested by the Contractor. All repairs and retesting shall be performed at the expense of the Contractor.

PART 3 – EXECUTION

3.1 GENERAL

- A. The Contractor shall notify the City Engineer or his representative when the manholes and line are ready to be tested. After the City Engineer or his representative concurs that the line is ready to be tested, the Contractor may proceed with testing. The Contractor will supply and set-up the test plugs and risers for the test and will perform the test in the presence of the City Engineer or his representative.
- B. Contractor shall take such precautions as required to prevent damage to lines and appurtenances being tested. Damage resulting from tests shall be repaired at Contractor's expense.

END OF SECTION

SECTION 33 31 13
SANITARY SEWAGE SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This is a general specification, which applies to the furnishing of all plant, labor, equipment, appliances and materials and in performing all operations in connection with the construction of sanitary sewers, together with the manholes, cleanout structures and other incidentals, in accordance with the plans and these specifications.

1.2 RELATED WORK

SECTION 31 78 00 - PIPE BORING, JACKING, & TUNNELING
SECTION 31 23 33 - EXCAVATING, TRENCHING, & BACKFILL
SECTION 33 05 01 - PVC PIPE & FITTING
SECTION 33 05 02 - DUCTILE IRON PIPE
SECTION 33 39 13 - MANHOLES
SECTION 33 39 14 - SEWER SERVICES

1.3 MEASUREMENT AND PAYMENT

- A. Payments will be made at the price bid per foot for furnishing and installing pipe, which bid price will include all costs for the complete pipe installation, including line fittings, trenching, and backfill, embedment, compaction or tamping, sterilization, testing, final cleanup, and all other work not otherwise provided for in bid proposal. Pipe will be measured (by horizontal distance) from center of fitting to center of fitting, or end of pipe without deduction for the length of intermediate fittings.

1.4 SUBMITTALS

- A. All submittal requirements are listed with the material specifications

PART 2 – PRODUCTS

2.1 TESTING REQUIREMENTS

See: SECTION 33 01 30 - TESTING OF GRAVITY SEWER SYSTEMS

PART 3 – EXECUTION

3.1 GENERAL

Construction methods for each material are specified in the material specifications.

A. MINIMUM DEPTH

The desired depth for sanitary sewer pipe shall be six feet (6') as measured from the outside top of pipe vertically to finished ground or pavement surface elevation. The minimum depth shall be two feet (2'). Where the cover is 3.5' or less, ductile iron pipe should be used and cement stabilized sand backfill required where erosion may occur.

END OF SECTION

SECTION 33 39 13

MANHOLES

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification. Additional revision is indicated by a dashed underline.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall govern the manufacture, construction, and installation of sanitary sewer manholes. All manholes shall conform to TCEQ requirements. Submittal and approval shall be required for all pre-cast design.

1.2 MEASUREMENT AND PAYMENT

- A. The depth of manholes completed shall be determined by measuring the vertical distance from the flow line of the sewer main to the top of the manhole ring and cover.
- B. Standard manholes shall be measured by the each for various size diameters and depths.
- C. The contract unit prices shall be the total compensation for furnishing all labor, materials, tools, equipment, and incidentals and performing all work, of whatever nature required, that is necessary for the completion of the manholes in accordance with the provisions of the plans and these specifications. Material or methods used to stabilize the foundation shall be subsidiary to the bid item for Manholes.
- D. Cleanouts for services shall be considered subsidiary to the price for each service connection.
- E. Drop connections will be measured for payment per each, complete in place regardless of depth.

1.3 SUBMITTALS

- A. Submit manufacturer's data on materials furnished indicating compliance with the specifications regarding dimensions, thickness, weights, and materials.
- B. Submit manufacturer's "Certificate of Compliance" stating that the materials furnished comply with this specification.

PART 2 – PRODUCTS

2.2 MATERIALS

A. CONCRETE

Refer to SECTION 03 30 00 - CONCRETE.

B. MANHOLE RINGS AND COVERS

The standard rings and covers (V-1432-3) and the water-tight ring and cover (V-2432-3) shall be manufactured by East Jordan Iron Works (or pre-approved equal.) The manhole shall bear the appropriate model number, the logo of City and the words "Sanitary Sewer". The cover shall have pick lugs cast into the surface. All manhole ring and covers shall have a 32" diameter.

C. GRADE RINGS

Grade rings shall be precast reinforced concrete. Minimum thickness shall be 2 inches by 8 inches wide by 30 inches inside diameter.

D. PRECAST REINFORCED MANHOLE SECTIONS

Precast manhole sections conform to the current ASTM C478 standard. Joints shall be O-ring gasketed. Thickness for manhole risers shall be as listed under wall “B” in the “Class Tables” of ASTM C76, Reinforced Concrete Pipe.

E. PRE-CAST MANHOLE BASES

Pre-cast manhole bases will conform to all TCEQ requirements and City Specifications for invert depths, reinforcement, base thickness and manhole depth for pipe size.

F. DROPS

Drops shall be constructed of either ductile iron as specified in SECTION 33 05 02 – DUCTILE IRON PIPE or PVC pipe as specified in Section 33 05 01 - POLYVINYLCHLORIDE PIPE AND FITTINGS. Drops shall be placed on the inside of a manhole using a cross to allow access to the vertical pipe. Cement stabilized sand should be used for all backfill.

2.2 TESTING REQUIREMENTS

See SECTION 33 01 30 - TESTING OF GRAVITY SEWER SYSTEMS.

PART 3 – EXECUTION

3.1 INSTALLATION

A. MANHOLE BASES

1. Construct manhole bases in the configuration shown on the Plans. Minimum thickness below the flowline of sewer shall be 8 inches or as shown on the details.
2. Insure that bases are constructed or installed on firm ground and that ground water is controlled. Install appropriate material for a minimum of 4” to stabilize bottom if directed to do so by the Engineer.
3. The invert of manholes shall be formed in such a fashion that they are smooth and will not obstruct flow of sewage. Provide flow channels in the manhole base equivalent to the top of the pipe by forming the concrete base and trowelling it to a smooth, even finish with a steel trowel. Slope the manhole bench from the wall line to edge of flow channel and trowel it smooth on a grade of 1 inch per foot with a liberal radius applied at flow channel intercepts.

B. PRECAST MANHOLES

1. Precast Manhole bases shall be placed on a 6” minimum depth layer of cushion sand, gravel or pre-approved material.
2. Cast bottom section of precast manhole riser ring in manhole base as shown on the Plans. Place “Synko-Flex” waterstop (or pre-approved equal) per manufacturer’s recommendations prior to setting precast starter ring.

The base shall have a minimum diameter 12 inches greater than the outside diameter of the manhole, and a minimum thickness including the area under the pipe as follows:

0' to 8' manhole 6"
greater than 8' 12"

3. All invert channels shall be smooth and accurately shaped to a semi-circular bottom conforming to the outside of the adjacent sewer section. Inverts shall be formed directly in the concrete of the manhole base or may be constructed by laying full section sewer pipe straight through the manhole and cutting out the top half after the base is constructed. Changes in the direction of the sewer and entering branches shall have a true curve of as large a radius as the size of the manhole will permit. Where the largest pipe at a manhole is less than 12", the channel depth shall be one half of the largest pipe diameter. When the largest pipe at the manhole is between 12 and 24 inches (inclusive,) the channel depth shall be three fourths of the largest pipe diameter. When the largest pipe at a manhole is greater than 24", the channel depth shall match the largest pipe. In all cases, the edges of the pipe along the invert and at the walls of the manhole shall be plastered and brush-finished. Plaster shall be non-shrink or hydraulic grout.
4. Where inlet leads, main or lateral pipe sewers enter manholes, pipes shall be cut off flush with inside of manhole any irregularities shall be grouted up with non-shrink grout. Install stub outs, where shown, to line and grade. Use one full joint of pipe, of size indicated, for stub out. Seal stub out with plug. Install plug in such a manner as to prevent seepage of leakage through stub outs. Installation of plug shall be such that it may easily be removed in future without damaging bell or groove end of stub out.
5. If manholes are constructed in streets where immediate subsequent paving or re-paving is involved, readjust the manhole ring and covers, immediately prior to the paving operations. Manholes shall be installed with joints of size and numbers required to obtain correct depth. Contractor is responsible for verifying correct manhole depth before construction. Initially, manhole tops shall be not less than 6-inches nor greater than 18-inches from final grade. If manholes are relocated in the field because of unforeseen conflicts, the Contractor is responsible for correct depth of manhole. Manhole tops shall be set as follows:
 - a.) Developed Areas: Set manhole tops 1-inch higher than existing elevation of natural ground or other final grade when specified by the Engineer.
 - b.) Undeveloped Areas: Set manhole tops flush with paved surfaces and 6-inches higher than shoulder and/or proposed final grade elevations in easements or other unpaved areas. Where manholes are located in bottom of ditches, either set manhole top by EJIW V-2342, or pre-approved equal, flush with ditch bottom and seal with solid cover, or set twelve inches above ditch top and reshape ditch around manhole.
6. Prior to placing each section of manhole riser or cone, thoroughly clean the bells and spigots to be joined.
7. Backfilling will be performed evenly and carefully around the manhole after the full strength of the concrete is attained.
8. Carefully place the O-ring gasket and check for proper alignment.
9. Plug lift holes, interior joints, and exterior joints with "Water Plug" grout.

10. Each manhole shall be individually vacuum tested according to the SECTION 33 39 13 - MANHOLES. Stub-outs, boots, and pipe plugs shall be secured to prevent movement while the vacuum is being drawn.

C. CAST-IN PLACE MANHOLES

Cast-In place manholes are not allowed without prior approval from the City Engineer. This approval shall only be in emergency situations.

D. FIBERGLASS MANHOLES

Fiberglass manholes are permitted with written approval from the City Engineer.

E. SERVICE CONNECTIONS

Service connections at manholes will meet all other requirements of this specification and shall be tied into the manhole with a manhole boot. At the time of construction, the Engineer will designate the locations of the service outlets and the depth to the top of the lateral pipe, if depth is not indicated on the plans. The minimum depth of cover over the end of the lateral pipe shall be no deeper than what is required to serve the intended lot.

F. CLEANOUT STRUCTURES

The Contractor shall construct cleanouts where shown on the plans and as specified. All backfill around and above the pipe shall be machine tamped in layers not exceeding 3-inches in depth so that no settlement shall occur after the cleanout is constructed. Cleanouts shall be provided at each service connection and located at the edge of an easement or at the right-of-way. The cleanouts shall be enclosed within a meter box which has a lid that makes the cleanout accessible set flush with the ground.

G. DROP MANHOLES

Drop manholes shall be constructed for elevation differences of 24 inches or greater as measured from the flow line of the pipe to the flow line entrance of the manhole.

END OF SECTION

SECTION 33 39 14
SEWER SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the manufacture, construction, and installation of sewer services for ordinary sewer service.

1.2 MEASUREMENT AND PAYMENT

- A. Services shall be categorized as “long” if over 15-feet in length or “short” if 15-feet or shorter and measured as “EACH” or as provided in the Bid Proposal Form.
- B. Payment will be made at the unit price bid per each for furnishing and installing services. This unit bid price will include all costs for the complete service installation, including all appurtenances, bedding, marking, cleanouts, and testing.

1.3 SUBMITTALS

- A. Submit manufacturer’s data on materials furnished, indicating compliance with the specifications regarding dimensions, thickness, weights, and materials.
- B. Submit manufacturer’s “Certificate of Compliance”, stating that the materials furnished comply with this specification.

PART 2 – PRODUCTS

2.1 MATERIALS

All materials shall be as shown on the details.

PART 3 – EXECUTION

3.1 GENERAL

A. INSTALLATION

Information supplied by the manufacturers on any and all appurtenances should be reviewed in detail before installation of the service. At the job site, prior to installation, the material should be visually inspected and any foreign material in the interior portion of the service should be removed. A detailed inspection of the service should be performed prior to installation.

- B. The services should be bedded in a fashion similar to bedding main lines as shown on the details. Cleanouts shall be provided at each service connection and located at the edge of an easement or at the right-of-way. The cleanouts shall be enclosed within a plastic box which has a lid that makes the cleanout accessible set flush with the ground.

END OF SECTION

SECTION 33 39 14.01

CONNECTION OF NEW LINES TO EXISTING MANHOLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall govern for the connecting of new sewer lines to existing manholes, where so indicated on the Plans or as directed by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Connecting new sewer lines to existing manholes will be paid for at the unit price bid in the Proposal for each connection made. The price will be full remuneration for making the connection complete, including cutting the hole in the manhole, shaping the bottom of the manhole of necessary, grouting the pipe and including the furnishing of all equipment, labor, materials, power, tools, and incidentals necessary to complete the work, except the pipe.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION

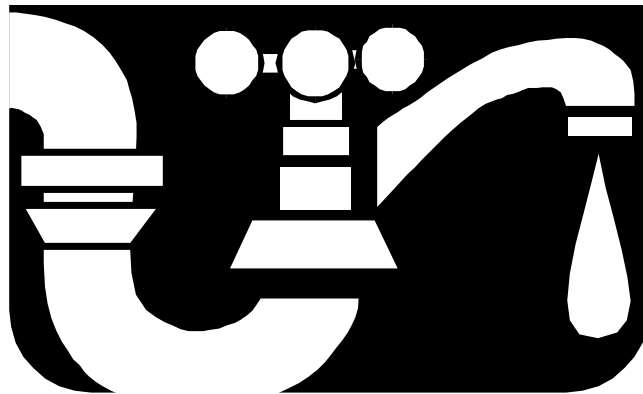
3.1 GENERAL

- A. Where new sewer lines are to be connected to existing manholes, holes of the proper size and at the proper location shall be cored into the existing manholes. Where it is necessary to provide a smooth flow through the manhole, the bottom of the manhole shall be shaped to conform to the bottom of the pipe as directed by the Engineer.
- B. Other methods in lieu of coring may be used and should be discussed with the City Engineer prior to performing. The City Inspector should be notified at the beginning of either of these processes.
- C. If the manhole can not satisfactorily be cored due to its condition, a hole shall be cut into the existing manhole. The sewer pipe shall be inserted into the hole cut in the manhole so that the end of the pipe will be flush with the inside of the manhole and the pipe shall be made smooth and water-tight with a Type "A" mortar.

END OF SECTION

TECHNICAL SPECIFICATIONS

Domestic Water



SECTION 33 11 13.1

WATER MAIN CONSTRUCTION

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 – GENERAL**1.1 DESCRIPTION**

- A. This item shall govern the construction of water mains including trenching, backfilling, pipe-laying, coupling, testing, the setting of fittings, valves and valve boxes, fire hydrants, appurtenances and wet connections. All work is to be done in accordance with the plans and specifications and paid for in accordance with the schedule of prices submitted in the Proposal.

1.2 RELATED ITEMS

See:

SECTION 31 78 00 - PIPE BORING, JACKING, & TUNNELING
 SECTION 03 30 01 - CONCRETE BLOCKING OR ANCHORAGE
 SECTION 31 23 33 - EXCAVATING, TRENCHING, & BACKFILL
 SECTION 33 05 01 - PVC PIPE & FITTINGS
 SECTION 33 05 02 - DUCTILE IRON PIPE
 SECTION 33 12 16 - VALVES
 SECTION 33 12 19 - FIRE HYDRANTS
 SECTION 33 12 13 - WATER SERVICES

1.3 MEASUREMENT AND PAYMENT

- A. PIPE: Payments will be made at the price bid per foot for furnishing and installing pipe, which bid price will include all costs for the complete pipe installation including trenching, and backfill, embedment, compaction or tamping, sterilization, testing, final cleanup, and all other work not otherwise provided for in bid proposal. Pipe will be measured (by horizontal distance) from center of fitting to center of fitting, or end of pipe without deduction for the length of intermediate fittings or valves.
- B. FITTINGS: Payment will be made at the unit price bid per each for furnishing and installing fittings and joint accessories. Fittings will be measured per each.
- C. THRUST BLOCKING: Thrust blocking shall not be a measured item.
- D. SERVICES: Services shall be measured per each. Payment for each service will include the furnishing and installing pipe, which bid price will include all costs for the complete pipe installation, including line fittings, trenching, and backfill, embedment, compaction or tamping, sterilization, testing, final cleanup, and all other work not otherwise provided for in bid proposal. See Detail or SECTION 33 12 13 – WATER SERVICES for supplementary information.

1.3 SUBMITTALS

All submittal requirements are listed with the material specifications

PART 2 – PRODUCTS

2.1 TESTING REQUIREMENTS

See: SECTION 33 13 10 - HYDROSTATIC TESTING (Used for Waterlines & Sanitary Sewer Force Mains)
SECTION 33 13 00 - DISINFECTION OF WATERLINES

PART 3 – EXECUTION

3.1 GENERAL

Construction methods for each material are specified in the material specifications.

- A. MINIMUM COVER: The minimum cover for water pipe less than or equal to twelve inches (12”) in diameter shall be four feet (4’) as measured from the outside top of the pipe vertically to finished ground or pavement surface elevation. The maximum cover shall be 5 feet (5’).

For water pipe greater than twelve inches (12”) in diameter, the maximum cover shall be five feet (5’) as measured from the outside top of the pipe vertically to finished ground or pavement surface.

END OF SECTION

SECTION 33 12 13
WATER SERVICES

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the manufacture, construction, and installation of water services for ordinary waterworks service.

1.2 MEASUREMENT AND PAYMENT

- A. Services shall be categorized as “long” if over 15-feet in length or “short” if 15-feet or shorter and measured as “EACH” or as provided in the Bid Proposal Form.
- B. Payment will be made at the unit price bid per each for furnishing and installing services. This unit bid price will include all costs for the complete service installation, including all appurtenances, bedding, marking, testing, and disinfection.

1.3 SUBMITTALS

- A. Submit manufacturer’s data on materials furnished, indicating compliance with the specifications regarding dimensions, thickness, weights, and materials.
- B. Submit manufacturer’s “Certificate of Compliance”, stating that the materials furnished comply with this specification.

PART 2 – PRODUCTS

2.1 MATERIALS

All materials shall be as shown on the details. Service saddles for PVC and Ductile Iron shall be Smith Blair No. 317 stainless steel Ford S70/S90 hinged, or Cambridge 800 series. All standard service lines shall be Type ‘K’ Copper. Tapped tee connection shall be ductile iron C153 MJ fitting.

The components for service connections shall be as listed in the following table.

Description	1-inch service	1.5-inch service	2-inch service
Corporation Stops	FB-1000-4*	FB-1000-6*	FB-1000-7*
Ball Straight Stops	B11-444-W	B11-666-W	B11-777-W
Angle Ball Curb Stops	<u>BA13-444-W*</u>	BA11-666-W	BA11-777-W

Wye for double service to be Y44-264*

Part numbers listed are Ford part numbers.

* for City of Bryan is Quick Grip fittings (Q) for City of College Station is Pack Joint fittings
 Service Saddles

<u>Description</u>	<u>Bryan</u>	<u>COCS</u>
Smith Blair 317 SS	Approved	
Cambridge 800 Series		Approved
Ford S70/S90		Approved

PART 3 – EXECUTION

3.1 GENERAL

A. INSTALLATION

Information supplied by the manufacturers on any and all appurtenances should be reviewed in detail by the Contractor before installation of the service. At the job site, prior to installation, the material should be visually inspected and any foreign material in the interior portion of the service should be removed. A detailed inspection of the service should be performed prior to installation.

Service connections shall be tapped tees in curved sections of pipe.

- B. The services should be bedded in a fashion similar to bedding main lines as shown on the details.

END OF SECTION

SECTION 33 12 16
MAIN LINE VALVES

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2008 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the manufacture, construction, and installation of waterline valves for ordinary waterworks service.

1.2 MEASUREMENT AND PAYMENT

A. GATE VALVES AND BUTTERFLY VALVES

Gate valves and butterfly valves will be measured by the each.

Payment will be made at the unit price bid per each for furnishing and installing gate valves, which bid price will include all costs for the complete gate valve installation, including extension stems, valve boxes, concrete blocking, testing, and disinfection.

Payment will be made at the unit price bid per each for furnishing and installing butterfly valves, which bid price will include all costs for the complete butterfly valve installation shown on the plans, including extension stems, valve boxes, concrete blocking, manhole, brass plug valves, bypass plumbing, corporation stops, special fittings, testing, disinfection, and all other associated work not otherwise provided for in the Proposal.

B. APPURTENANCES

Operator extensions, valve boxes, brass plug valves, manholes, and concrete blocking will not be measured items.

1.3 SUBMITTALS

- A. Submit manufacturer's data on materials furnished, indicating compliance with the specifications regarding dimensions, thickness, weights, and materials.
- B. Submit manufacturer's "Certificate of Compliance", stating that the materials furnished comply with this specification.

1.4 INSPECTION, STORAGE, AND HANDLING

- A. All valves should be unloaded carefully. The valve should be carefully lowered from the truck to the ground, not dropped. In the case of larger valves, fork trucks or slings around the body of the valve or under the skids should be used for unloading. Only hoists and slings with adequate load capacity to handle the weight of the valve or valves should be used. Do not hook hoists into or fasten chains around bypasses, yokes, gearing, motors, cylinders, or handwheels.
- B. Valves should be inspected at the time of receipt for damage in shipment. The initial inspection should verify compliance with specifications, direction of opening, size and shape of operating nut, number or turns, and type of end connections. A visual inspection of gate rings and body rings should be performed to detect any damage in shipment or scoring of the seating surfaces. Inspection personnel should look for bent stems, broken handwheels, cracked parts, missing parts and accessories, and any other evidence of

mishandling during shipment. The valve should be cycled through one complete opening-and-closing cycle. All valves sixteen (16”) inches and larger should be operated through one full operating cycle in the position in which they are to be installed.

- C. Valves should be stored in the fully closed position to prevent entry of foreign material that could cause damage to the seating surfaces. Whenever practical, valves should be stored indoors. If outside storage is required, means should be provided to protect the operating mechanisms, such as gears, motor operators, and cylinders, from the weather and foreign materials. If valves may be subject to freezing temperatures, remove water from the valve interior and close the gates tightly before storage. Valves in outside storage in cold climates should be stored with the discs in a vertical position; if the discs are in a horizontal flat position, rain water can accumulate on top of the top disc, seep into the valve body cavity, freeze, and crack the casting. Any valves damaged by weather will not be installed.

PART 2 – PRODUCTS

2.1 MATERIALS

A. APPLICABLE STANDARDS

1. AWWA – C110, C111
2. ASTM – A48, C33, C150 and C478

B. GATE VALVES

All gate valves up to and including thirty (30”) inch shall conform to the current AWWA C515 standard. All valves shall be ductile iron body, resilient seat nonrising stem, internal wedging type and new. All gate valves shall have a square nut operated valve turning clockwise to close. Brass is not allowed. Valves shall have a working pressure rating of 250 psi.

1. Resilient-Seated Gate Valves per AWWA C515

a.) General

All valves up to and including thirty (30”) inch shall have a bronze stem, resilient-seated disc, drip tight shutoff. Valves shall be manufactured by American Flow Control Series 2500 or Clow Model No. 2638 and be “Resilient Seated” (Powder Coated), or pre-approved equal.

b.) Gates, Rings and Disc

All gates shall be cast-iron with internally reinforced, molded rubber disc seat rings. All gate valves shall be manufactured with a modified wedge disc with steel reinforced, natural rubber disc seat ring. Disc shall slide on a vertical, machined guide surface and shall seat on a sloped, machined seating surface. Valves shall be tested for leakage per AWWA C515, Section 6.1.6.

- c.) Gate valves twelve (12”) inches or smaller will be installed seated on a minimum of one (1) 12”x12”x 4” solid concrete blocks. Valves larger than 12” will be seated by a poured-in-place concrete saddle. The size of this saddle is as shown on the plans.

2. Stuffing Boxes

All valves up to and including sixteen (16”) inches shall be equipped with double O-rings, provided arrangement is made for replacement under pressure of the upper O-

ring when the valve is fully open. All geared valves will be equipped with conventional packing in the main stuffing box. Valves shall be installed in a vertical position. Stuffing box and bonnet bolts and nuts shall be 304 stainless steel.

3. Operating Nuts

All valves shall be square nut operated. All valves shall open by turning to the left (counter clockwise). Operator nuts shall be two (2") inch square.

4. Miscellaneous Requirements

- a.) All exposed bolts, nuts, etc., for valves to be buried, shall be stainless steel. Cadmium plated bolts, nuts, etc., will not be accepted.
- b.) A valve nut extension will be installed to maintain 4' bury to operating nut when the operating nut is located 5' or more below finished grade after valve installation.

C. BUTTERFLY VALVES

1. Butterfly valves shall only be allowed on waterlines 18" and larger as approved by the City Engineer. Butterfly valves shall be Valvmatic, Mueller Lineseal III, Pratt Triton XR, or Dezurik and shall have "bi-directional shutoff". Butterfly valves shall conform to the current AWWA C504 standard and as modified herein.
2. The valve body is to be constructed of cast-iron or ductile-iron, and shall be short body. Valves shall be Class 150B. Valve shafts shall be stainless steel and not pass through the seat. Valve discs shall be ductile iron with stainless steel disc edge. Seat seals shall be located in the body and be Buna N or natural rubber and replaceable. Shaft seals shall be Chevron type packing of double O-rings. Bearings shall be self-lubricating type made from teflon, nylon or sintered bronze. All bolts, nuts, etc., shall be stainless steel. Cadmium plated bolts, nuts, etc., will not be accepted.
3. Manual butterfly operators shall conform to the current AWWA C504 standard, as modified herein. The valve shall close by turning the input shaft clockwise. All handwheels or nuts shall turn clockwise to close the valve. On valves intended for buried service, all exposed bolting material shall be stainless steel, including all operator flange and gland bolts. Operator housings shall be tightly gasketed and sealed against infiltration of groundwater. Manual operators equipped with a handwheel or crank shall have a mechanical advantage such that a forty (40#) pound pull on the handle or wheel rim will develop the required operating torque.

D. VALVE ENDS

1. Valves shall have mechanical joint ends. Mechanical joint ends shall conform to AWWA C111. Flanged ends shall conform to ASA B16.1, Class 125 lb. (unless otherwise noted).
2. Bolts and nuts for mechanical joints will be of high-strength low-alloy corrosion resistant steel and conform to AWWA C111. All mechanical joint glands will be ductile iron.
3. Bolts and nuts for flanged ends buried in the ground shall be Type 304 stainless steel.

E. OPERATOR EXTENSION SHAFTS

Operator extension shafts are required on all valves when the operating nut is over five (5') feet below finished grade. Extension shaft is to bring the operating nut to within four

(4') to five (5') feet of the top of the valve box. Extension shaft shall have a centering collar placed directly below operating nut and shall be bolted to valve operating nut with stainless steel set screw.

F. VALVE BOXES

A valve box shall be furnished and installed over each underground valve. The boxes shall be cast iron of the two-piece screw type, with a shaft diameter of not less than five and one-fourth inches (5-1/4") and shall have the word "WATER" stamped on the lid. Provide extension stem for all buried valves terminating in a standard 2-inch square AWWA nut within four (4') to five (5') feet of valve box cover. All parts of the valve box, base and cover shall be coated with hot bituminous varnish. The box shall be furnished complete with cast iron cover and yoke to fit over the valve body. Concrete valve box collars (24"x24"x6") shall be installed with each gate valve. Valve boxes are to be installed plumb and adjusted to their proper grade by the Contractor.

G. BRASS PLUG VALVES

One-half (1/2") inch through two (2") inch plug valves, when shown on the plans or required, shall be of all brass construction, and warranted for a water working pressure of 200 pounds per square inch. Brass plug valves smaller than two (2") inches shall be Mueller Oriseal, or pre-approved equal. Two (2") inch brass plug valves shall be Ford B11-777W or Mueller H-10284, or pre-approved equal.

H. CONCRETE

Cement shall conform to ASTM C150, Type 1. Aggregates shall conform to ASTM C33. Twenty-eight (28) day compressive strength shall equal or exceed 3,000 psi.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Any and all instruction manuals supplied by the manufacturers should be reviewed in detail before installation of the valve. At the job site, prior to installation, the valve should be visually inspected and any foreign material in the interior portion of the valve should be removed. A detailed inspection of the valve should be performed prior to installation.
1. All bolts should be protected to prevent corrosion, either with a suitable paint or by polyethylene wrapping.
 2. During installation, there exists the possibility of foreign materials inadvertently entering the valve. Valves should be installed in the closed position. The valve shall be seated on a minimum of one (1) 12"x12"x 4" solid concrete blocks. Valves larger than 12" will be seated by a poured-in-place concrete saddle in the trench to prevent settling and excessive strain on the connection to the pipe. Size of this saddle shall be shown on the plans.
 3. A valve box or vault should be provided for each valve used in a buried service application. The valve box should be installed so as not to transmit shock or stress to the valve. The valve box should be centered over the operating nut of the valve, with the box cover flush with the surface of the finished area, or such other level as directed by the City. Butterfly valves utilizing smaller bypass valves shall have a watertight manhole constructed as shown on the plans. Valve boxes should be of such a design that a traffic load on the top of the box is not transmitted to the valve.

4. Valves buried in unusually deep trenches shall have extension stems for operating the valve.
- B. Valves installed above ground or in plant piping systems should be supported in such a way as to minimize bending of the valve end connections as a result of pipe loading.
 - C. After installation and before pressurization of the valve, all pressure-containing bolting (bonnet, seal plate, bypass, and end connections) should be inspected for adequate tightness to prevent leakage. In addition, an inspection should be made for adequate tightness to prevent leakage. In addition, an inspection should be made for adequate tightness of all tapped and plug openings to the valve interior. Proper inspection at this time will minimize the possibility of leaks after pressurization of the piping system.
 - D. In order to prevent time lost searching for leaks, it is recommended that valve excavations not be backfilled until after pressure tests have been made.
 1. If valves are used to isolate test section, the test pressures should not exceed twice the rated working pressure of the valve. After the test, steps should be taken to relieve any trapped pressure in the body of the valve. The valve should not be operated in either the opening or closing direction at differential pressures above the rated working pressures.
 2. Test butterfly valves against closed valve during hydrostatic testing to insure “driptight” closure in both directions. Correct leaky valves per manufacturer’s recommendations.
 - E. Upon completion of the installation, valve location, size, make, type, date of installation, and other information deemed pertinent should be entered on permanent records and given to the Engineer.
 - F. Valves should not be installed in applications or for service other than those recommended by the manufacturer.
 1. Valves should not be installed in lines where service pressure will exceed the rated working pressure of the valve.
 2. Mainline valves shall not be used for throttling service, unless the design is specifically recommended for that purpose or approved in advance by the manufacturer and Engineer.
 3. Valves should not be used in applications for water distribution that is exposed to subfreezing temperatures unless sufficient flow is maintained through the gate valve to prevent freezing, or some other type of protection is provided to prevent freezing.
 4. Valves should not be installed at the dead end of a pipeline without proper and adequate restraint to support the valve and prevent it from blowing off the end of the line. No concrete shall be used on the valve for blocking.
 5. To prevent damage to the valve, gate valves, up to and including sixteen inches (16”) in diameter shall not be operated with input torques greater than 300 ft.-lbs. Butterfly valves should not be operated with input torques greater than sixty (60) ft.-lb.

END OF SECTION

SECTION 33 12 19

FIRE HYDRANTS**PART 1 - GENERAL****1.1 DESCRIPTION**

This section describes the manufacture, construction, and installation of fire hydrants.

1.2 MEASUREMENT AND PAYMENT**A. FIRE HYDRANTS**

Fire hydrants will be measured by the each as shown on the plans.

Payment will be made at the unit price bid per each for furnishing and installing fire hydrants, which bid price will include all costs for the fire hydrant installation, (excluding TEE), hydrant piping and fittings, hydrant gate valve, extension stems, valve boxes, concrete blocking, testing, disinfection, and all other work not otherwise provided for in the Proposal. The main line fitting is not included in the cost of the fire hydrant.

B. APPURTENANCES

Operation extensions, valve boxes, gate valves, mainline fittings, hydrant piping and fittings, anchor couplings, and concrete blocking will not be measured items and shall be considered subsidiary.

1.3 SUBMITTALS

- A. Submit manufacturer's data on fire hydrants to be furnished indicating compliance with the specifications especially regarding dimensions, materials of construction, and nozzle threads.
- B. Submit manufacturer's "Certificate of Compliance" stating that the materials furnished comply with the specifications.
- C. Upon request, flow data, indicating friction loss in PSI at the flow of 1,000 GPM from the pumper nozzle, such friction loss must not exceed 3 PSI. ISO 9001 certification.

PART 2 – PRODUCTS**2.1 APPLICABLE STANDARDS**

- A. AWWA –C110, C111, C502, and C600
- B. ASTM – C33 and C105

2.2 GENERAL

- A. All fire hydrants furnished shall conform to the requirements and test of AWWA C502-94 Standard for Dry Barrel Fire Hydrant or latest version thereof, as they pertain to the design, component materials, construction and manufacture, except as modified or supplemented hereinafter. Fire hydrants shall have a published warranty against defects in material or workmanship for a period of ten (10) years from date of manufacture. Acceptable fire hydrants are Mueller Super Centurion 250TM, American Flow Control 5-1/4" B-84-B, Clow Medallion, East Jordan Iron Works, or pre-approved equal.

1. Pressure rating -- working pressure shall be 250 psig tested to 500 psig hydrostatic pressure.
2. Flow -- friction loss shall not exceed 3.0 psig at a flow of 1000 gpm through the pumper nozzle connection when tested as prescribed in AWWA C-502 latest revision. This test must be conducted by an independent laboratory in their facility and attested to by a Professional Engineer. Documentation must accompany all requests for hydrant approval.
3. Drain valve -- must drain the barrel when the hydrant is closed, and seal shut when hydrant is opened.
4. Seat ring and Drain ring (show bushing) – must be bronze (ASTM B-62), shall work in conjunction to form an all bronze drain way, and shall have no less than two (2) openings. If they are in a cast iron shoe, they must be bronze lined and the bronze seat ring must thread into bronze drain ring (or shoe bushing) providing bronze to bronze connection. Seat rings must be “O” rings. The 6” shoe connection must be specified (flanged, A/C, M.J, etc.) having ample blocking for sturdy setting. A minimum of eight (8) bolts and nuts is required to fasten the shoe to the lower barrel.
5. Main valve – compression type closing with the pressure and must be not less than 5-1/4” in diameter. Composition of the main valve must be molded rubber or neoprene, having a durometer hardness of 95 (+) (-) 5 and must be not less than 1” thick.
6. Outlet – “Three-way” having two (2) 2-1/2” hose nozzles and one (1) 4-1/2” I.D. pumper nozzle; all National Standard Hose Coupling Thread. All nozzles shall be bronze and thread counter clockwise into the nozzle section with “O” ring pressure seals and held in place with an acceptable locking device
7. Hydrant barrel casting – inside diameter of the hydrant barrel shall not be less than six and one-eighth inches (6-1/8”).
8. Operating nut – Non-rising, pentagonal in shape, measuring 1-1/2” from point to flat at base of nut; bronze.
9. Hold-down nut – Shall incorporate an integral resilient weather seal and open counter clockwise.
10. Lubrication chamber - Must be provided with sealed top and bottom “O” rings, filled with lubricant which shall be either oil or grease, designed with thrust collar and threaded operating parts that are automatically lubricated each time the hydrant is cycled. There must not be less than two (2) “O” rings separating the lubrications reservoir from the waterway and that portion of the stem contracting these “O” rings shall be sleeved with bronze. An anti-friction device must be in place above the trust collar to further minimize operating torque.
11. Hydrant bonnet – must be attached to the upper barrel by not less than four (4) bolts and nuts, with an inserted flat rubber gasket as a pressure sea.
12. Direction to open – counter clockwise.
13. Operating stem – must be two-piece, not less than 1-1/4” diameter or 1” x 1” square (excluding threaded or machined areas) and must be connected by a breakable stem coupling near the ground line flange. Screws, pins, bolts or fasteners used in conjunction with the stem coupling must be stainless steel.
14. Exterior paint – red machinery enamel.

B. ADDITIONAL REQUIREMENTS**1. Breakable Type Construction**

Hydrants shall be traffic-model type having upper and lower barrels joined approximately two inches (2") above the ground line by a separated and breakable "swivel" flange providing 360 degree rotation of the upper barrel for proper nozzle facing. This flange must employ not less than eight (8) bolts.

2. Provisions for Extension

All hydrants shall be capable of being extended to accommodate future grade changes without excavation. Compression type hydrants that close with the flow shall have breakable type stem coupling installed at the ground line flange. Extension of this type hydrant shall be made by adding at the ground line flange, a new coupling and stem section equal to the length of the extension. Stem extensions made by adding a new section of stem to the threaded section of the stem at the top of the hydrant will not be accepted. Only one extension is allowed.

3. Bury Length

Furnish hydrants for a four (4') foot bury unless the water line grades shown on the plans indicate a deeper bury is required.

4. Operating Stems

Operating stems whose threads are located in the barrel or waterway shall be of manganese bronze, Everdur, or other high quality non-corrodible metal, and all working parts in the waterway shall be bronze to bronze.

Operating stems whose threads are not located in the barrel or waterway may be made of high-grade bronze, genuine wrought iron, or steel, and stem nuts shall be bronze. Iron or steel stems shall have a bronze, stainless steel, or other non-corrodible metal, sleeve where passing through "O"-rings. Operating threads must be sealed against contact with the water at all times regardless of open or closed position of the main valve.

The operating mechanism, safety stem coupling and main valve assembly shall be capable of withstanding 200 ft-lbs of torque against the fully open or closed positions, with no damage to the components. Downward stem travel shall be limited in the bottom of the hydrant by a one-piece lower valve plate that bottoms out in the hydrant shoe. Travel stops located in the bonnet or upper valve plate is unacceptable. The interior and the exterior of the hydrant shoe shall be fully coated with not less than 8 mils of fusion bonded epoxy.

5. Main Valve Seats

Main valve seats on compression type hydrants closing with the flow shall be of such design that incorrect positioning is impossible and that the threads will be adequately guided into position. Arrangements shall also be made to hold the main valve gasket in place during assembly. The main seat shall be made of bronze and threaded into a heavy bronze bushing in the hydrant base.

6. Seat and Drain Ring

The bronze seat shall thread directly into a bronze drain ring. This will assure easy removal of the main valve seat through the top of the hydrant shoe and all pressure seals must be "O"-rings.

7. Hydrant Heads

The hydrant shall be constructed so that the nozzles may be faced in any desired direction.

8. Mating Surfaces

All mating surfaces, such as bonnet-to-nozzle section, nozzle section-to-lower barrel, lower barrel-to-shoe, must utilize rubber gaskets for sealing and must be held in place by zinc-plated bolts and nuts. Other methods, such as snap rings, etc., will not be accepted.

9. Manufacturer Experience Record

No hydrant will be considered which has not been regularly manufactured and in successful continuous use for at least 10 years.

C. ACCESSORIES REQUIRED

1. Full face ground line flange gaskets.
2. Nozzle cap gaskets
3. Drain valve and outlet
4. Cap nuts to seal the bottom end of stem threads against contact with water
5. Harnessing lugs (Required only when shown on the plans.)
6. Nozzle cap chains

2.2 TESTING REQUIREMENTS

See SECTION 33 13 10 – HYDROSTATIC TESTING and SECTION 33 13 00 – DISINFECTION OF WATERLINES.

PART 3 – EXECUTION**3.1 CONSTRUCTION METHODS**

- A. Fire hydrant leads 18' or shorter will be restrained the entire length. Fire hydrant leads shall require a separate valve for the fire hydrant assembly.
- B. Place fire hydrants at all locations shown on the plans, or as directed by the Engineer.
- C. Set each fire hydrant upon a concrete slab not less than four inches (4") thick and not less than one (1) square foot of surface area.
- D. Place eight (8) cubic feet of crushed rock, clean gravel or other suitable material to provide reservoir capacity so that the hydrant will completely drain when closed.
- E. Set the hydrant perpendicular with large steamer nozzle facing nearest curb, and at a depth such that the center of the steamer nozzle is not less than fifteen inches (15"), nor more than eighteen inches (18") above nearest grade. Assure that the hydrant is sat at the bury line.
- F. Polyethylene encasement of 8 mils thick shall be installed on all piping and appurtenances in contact with soil and shall conform to AWWA C105. Joint tape shall be self sticking PVC or polyethylene, 8 mils thick.

END OF SECTION

SECTION 33 13 00
DISINFECTION OF WATERLINES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This specification specifies the procedure for disinfection of water systems, and in general, conforms to AWWA C651, Disinfecting Water Mains including Section 4.3.9.

1.2 MEASUREMENT AND PAYMENT

- A. Disinfection of waterlines will not be measured. Cost for work herein specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work, shall be included in the unit price bid for waterlines in the Proposal.

PART 2 – PRODUCTS

2.1 MATERIALS

A. **CHLORINE AND WATER**

1. **Chlorine**

Calcium hypochlorite, or equal, which contains sixty-five (65%) percent chlorine by weight.

2. **Water**

Water for disinfection will be metered and furnished to the Contractor at no cost. Existing water lines are to remain isolated from newly laid water lines by a physical air gap until the original copy of the negative coliform test results have been received by the City Engineer from either the County Health Department or an approved TCEQ lab.

2.2 TESTING REQUIREMENTS

A. **CHLORINE RESIDUAL-DROP DILUTION METHOD**

The drop dilution method of approximating total residual chlorine is suitable for concentrations above 10 mg/L, such as are applied in the disinfection of water mains or tanks.

1. **Apparatus**

- a.) A graduated cylinder for measuring distilled water.
- b.) An automatic or safety pipet
- c.) A dropping pipet that delivers a one-milliliter (1 ml) sample in twenty (20) drops. This pipet is for measuring the water sample and should not be used for any other purpose.
- d.) A comparator kit containing a suitable range of standards.

2. **Procedure**

- a.) Ascertain the volume of the comparator cell and using an automatic or safety pipet, add 0.5 ml of orthotolidine for each 9.5 ml of distilled water to be added.

- b.) Using a graduated cylinder, add a measured volume of distilled water.
- c.) With the dropping pipet, add the water sample a drop at a time, allowing mixing, until a yellow color is formed that matches one of the color standards.
- d.) Record the total number of drops used and the final chlorine value obtained.
- e.) Calculate the milligrams per liter residual chlorine as follows:
 - i. Multiply by twenty the number of milliliters of distilled water used in Step 2.
 - ii. Multiply product in step a. by the final chlorine value in milligrams per liter recorded in Step 4.
 - iii. Divide the product found in step b. by the total number of drops of water sample recorded in Step 4.

PART 3 – EXECUTION

3.1 GENERAL

- A. During the construction operations, workmen shall be required to use utmost care to see that the inside of pipes, fittings, jointing materials, valves, etc., which will come into contact with potable water be maintained in a sanitary condition.
- B. Every effort must be made to keep the inside of the pipe, fittings, and valves free of all foreign matter, sticks, dirt, rocks, etc. As each joint of pipe is being laid, it must be effectively swabbed so that all foreign matter is removed. Placing dry powdered chlorine in the pipeline will be permitted in conjunction with certain methods of sterilization as specified by the Engineer. All fittings and exposed open ends of pipe must be blocked with a plug or capped until the line is completed.
- C. Sterilization of the line, or any section thereof, shall not be commenced until the Engineer has approved the method, apparatus, sterilizing agent, and the section of the line.
- D. When the entire pipeline, or certain section thereof, has been completed, tested, and made ready for use, the line or section of line shall be thoroughly sterilized according to the following procedure:
 - 1. The Contractor shall provide all necessary taps to complete this section of the specifications.
 - 2. The water main shall be flushed prior to disinfection.
 - 3. The flushing velocity shall be greater than 2.5 feet per second. The rate of flow required to produce this velocity in various diameters is shown in Table 1. No site for flushing should be chosen, unless it has been determined by the Engineer or Inspector that drainage is adequate at that site. Flushing is no substitute for preventive measures taken before and during pipe laying. Certain contaminants, especially in caked deposits, resist flushing at any velocity.

TABLE 1

REQUIRED OPENINGS TO FLUSH PIPELINES (40 PSI RESIDUAL PRESSURE)

Pipe Size	Flow (gpm) Required to Produce 2.5 fps Velocity	Orifice Size (in.)	Number of Hydrant Outlet Nozzles	Size (in.) of Hydrant Outlet Nozzles
4	10	15/16	1	2-1/2
6	220	1-3/8	1	2-1/2
8	390	1-7/8	1	2-1/2
10	610	2-5/16	1	2-1/2
12	880	2-13/16	1	2-1/2
14	1200	3-1/4	2	2-1/2
16	1565	3-5/8	2	2-1/2
18	1980	4-3/16	2	2-1/2

Note: A 2-1/2” hydrant outlet nozzle will discharge approximately 1,000 gpm and a 4-1/2” hydrant outlet nozzle will discharge approximately 2,500 gpm with 40 psi residual pressure.

E. METHODS OF CHLORINE APPLICATION

1. Continuous Feed Method

Note: This method is suitable for general applications.

- a. Water from the existing distribution system, or other pre-approved sources of supply, shall be made to flow at a constant, measured rate into the newly laid pipeline. The water shall receive a dose of chlorine concentration until the water in the pipe maintains a minimum of fifty milligrams per liter (50 mg/l) available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described herein.

Note: In the absence of a meter, the rate may be determined either by placing a pitot gauge at the discharge, or by measuring the time to fill a container of known volume.

Table 2 gives the amount of chlorine residual required for each 100 feet of pipe of various diameters. Solutions of one percent (1%) chlorine may be prepared with approximately one pound (1 lb.) of calcium hypochlorite (65% strength) in 8.5 gallons of water.

TABLE 2
Chlorine Required to Produce 50 Mg/l
Concentration in 100 feet of Pipe
by Diameter

Pipe Size (in.)	100% Chlorine (lb/100ft)	1% Chlorine Solution (gal/100ft)
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88
16	0.427	5.12
18	0.540	6.48
24	0.960	11.50

Pipe Size (in.)	100% Chlorine (lb/100ft)	1% Chlorine Solution (gal/100ft)
30	1.500	18.00
36	2.160	25.90
42	2.940	35.30

- b. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least twenty-four (24) hours during which time, all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this twenty-four (24) hour period, the treated water shall contain no less than fifty (50) milligrams per liter and no more than one hundred (100) milligrams per liter chlorine throughout the length of the main. A dosage of more than the maximum allowable chlorine will require the Contractor to dilute the flush water with one of the TCEQ approved dilution chemicals. The chemical and description of procedure will be submitted in writing to the Engineer for approval.

2. Slug Method

This method is suitable for use with mains of large diameter for which, because of the volume of water involved, the continuous feed method is not practical.

- a.) Water from the existing distribution system shall be made to flow at a constant, measured rate (see C.1.a. Note) into the newly laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two (2) rates shall be proportioned so that the concentration of the water entering the pipeline is maintained at no less than 300 milligrams per liter. As the chlorinated water passes along the line, it shall expose all interior surfaces to a concentration of at least 300 mg/L for at least three (3) hours. The application shall be checked at a tap near the upstream and downstream end of the line by chlorine residual measurements made according to the procedures described herein.
- b.) As the chlorinated water flows past tees and crosses, related valves and hydrants shall be operated so as to disinfect appurtenances.

3. Dry Treatment during Installation

The dosage and application of sodium hypochlorite will be determined by the following:

- a.) Calculate weight of sodium hypochlorite required for water to be treated utilizing Table 2.
- b.) Add required amount of solution at the bell of each pipe as it is installed.

E. FINAL FLUSHING

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is less than three milligrams per liter (3 mg/l). Chlorine residual determination shall be made by the Inspector to ascertain that the heavily chlorinated water has been removed from the pipeline.

F. BACTERIOLOGIC TESTS

1. Before the water main is placed in service, a sample or samples shall be collected from points designated by the Inspector and tested for bacteriologic quality. This sample shall be collected 24 hours after final flushing. The test shall show the absence of coliform organisms before the water main may be placed in service. At least one (1) sample per one thousand (1000) feet of new line or portion thereof shall be taken. Sampling shall be supervised by the Inspector. Samples shall be submitted by the city to a TCEQ approved laboratory and/or County Health Department for analysis.
2. Samples of bacteriologic analysis shall be collected in sterile bottles obtained from the Brazos County Health Department. Samples shall be collected at points specified by the City Engineer.
3. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

G. REPETITION OF PROCEDURE

1. If the initial disinfection fails to produce samples with no coliform present, the contractor shall re-disinfect the line following the procedures stated in 695.04 of this specification until samples indicating no coliform present have been obtained. When the samples indicate no coliform present and the City Engineer has received original copies of the test report, the main may be placed in service.

3.2 PROCEDURE AFTER CUTTING INTO OR REPAIRING EXISTING MAINS

- A. The procedure outlined in this section applies primarily when mains are wholly or partially dewatered. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure present little danger of contamination and require no disinfection.

1. Trench “Treatment”

When an old line is opened, either by accident or by design, the excavation will likely be wet and badly contaminated. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.

2. Main Disinfection

- a.) Swabbing and Flushing. The following procedure is considered as a minimum that may be used.
 - i. Swabbing With Hypochlorite Solution: The interior of all pipe and fittings used to make the repair (particularly couplings and tapping sleeves) shall be swabbed with a 5 percent hypochlorite solution before they are installed.
 - ii. Flushing: Thorough flushing is the most practical means of removing contamination introduced during repairs. If valving and hydrant locations permit, flushing from both directions is recommended. Flushing shall be started as soon as the repairs are completed and continued until discolored water is eliminated.

3. Slug Method: In addition to the swabbing and flushing procedures of section B.1., the section of main in which the break is located can be flushed and chlorinated using the slug method where practical, as determined by the Engineer or Inspector. This method requires isolating the section of main, shutting off all service connections, flushing the main, and chlorinating the main as described in the Slug Method in C.2, except that the dose may be increased to as much as 500 mg/1, and the contact time reduced to as little as ½ hour. After chlorination, flushing shall be resumed and continued until discolored water is eliminated.
4. Sampling: Bacteriologic samples shall be taken after repairs to provide a record by which the effectiveness of the procedures used can be determined by the Inspector. If the direction of flow is unknown, samples shall be taken on each side of the main break.

END OF SECTION

SECTION 33 13 10
HYDROSTATIC TESTS

PART 1 - GENERAL

1.1 DESCRIPTION

This item shall consist of the hydrostatic testing of all waterlines, fire hydrants, and appurtenances.

1.2 MEASUREMENT AND PAYMENT

Testing of waterlines will not be a measured item. Cost for work herein specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work, shall be included in the unit price bid for waterlines in the Proposal.

TABLE A
 Loss in Gallons Per Hour Per Foot of Pipe

Length	4"	6"	8"	10"	12"	18"	20"	24"
50	.04	.06	.08	.10	.12	.18	.195	.235
100	.08	.12	.16	.195	.235	.355	.395	.475
200	.16	.235	.315	.395	.475	.71	.785	.945
300	.235	.355	.475	.59	.71	1.065	1.185	1.42
400	.315	.475	.63	.785	.945	1.42	1.58	1.89
500	.395	.59	.785	.985	1.185	1.775	1.975	2.365
600	.475	.71	.945	1.185	1.42	2.13	2.365	2.84
700	.555	.83	1.105	1.38	1.655	2.485	2.76	3.31
800	.63	.945	1.265	1.58	1.895	2.84	3.155	3.785
900	.71	1.065	1.42	1.775	2.13	3.195	3.55	4.26
1000	.79	1.185	1.58	1.975	2.365	3.55	3.945	4.735

Calculations Based on a Loss of 25 Gal./Diameter inch of Pipe/Mile of Pipe/Day

PART 2 – PRODUCTS

2.1 MATERIALS

A. EQUIPMENT PROVIDED BY CONTRACTOR

The contractor shall furnish pump, pipe connections and all necessary apparatus (including gauges and meters) to hydrostatically test the water lines according to this specification.

B. WATER FOR TESTING

Water for testing will be furnished by the City. All connections of new pipeline must be isolated from existing potable water lines until a negative coliform test report from the County Health Department or TCEQ approved lab has been received.

PART 3 – EXECUTION

3.1 GENERAL

- A. All water mains including water services shall be hydrostatically tested and sterilized according to SECTION 33 13 00 - DISINFECTION OF WATERLINES, prior to acceptance by the City.
- B. This section specifies hydrostatic testing of water distribution lines. The contractor shall test waterlines after backfilling, but before replacement of pavement (if applicable.)
- C. Test waterlines in sections, by pressurizing the new system to 150 psi and holding that pressure for a total test time of 4 hours.

3.2 PRESSURIZATION

- A. Each valved section of pipe shall be filled with water slowly. The test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the City Engineer.

3.3 AIR REMOVAL

- A. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation stops shall be closed and the test pressure applied twenty-four (24) hours after filling the line.
- B. At the conclusion of the pressure test, the corporation stops shall be removed and plugged, or left in place at the discretion of the City Engineer. Any added corporation cocks must be shown on as-built plans if they are to remain in place.

3.4 EXAMINATION

- A. All exposed pipe, fittings, valves, hydrants and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves or hydrants that are discovered following the test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the City Engineer.
 - 1. Allowable Pressure Loss
 - a.) For DIP and PVC

No pipe installation will be accepted if the water loss is greater than that shown in Table A. No additional leakage will be included for fittings.
 - b.) When hydrants are in the test section, the test shall be made against the closed hydrant and not the valve on the lead.
 - 2. Acceptance of Installation
 - a.) Acceptance shall be determined on the basis of allowable pressure loss. If any test of pipe discloses a pressure loss greater than that specified, the Contractor shall, at his own expense, locate and repair the defective material until the pressure loss is within the specified allowance.
 - b.) All visible leaks are to be repaired, regardless of the amount of pressure loss.

END OF SECTION