

# CITY STANDARD CONSTRUCTION SPECIFICATIONS INDEX

DIVISION 2 - SITEWORK		REV. DATE
<b>020</b>	<b>SITE ASSESSMENTS &amp; CONTROLS</b>	
	020100 Survey Monuments	10-30-14
	020400 Automated Storm Water Sampling System	*
<b>021</b>	<b>SITE PREPARATION</b>	
	021020 Site Clearing & Stripping	10-30-14
	021040 Site Grading	10-30-14
	021080 Removing Abandoned Structures	10-30-14
<b>022</b>	<b>EARTHWORK</b>	
	022020 Excavation & Backfill for Utilities	03-25-15
	022021 Control of Ground Water	10-30-14
	022022 Trench Safety for Excavations	10-30-14
	022040 Street Excavation	10-30-14
	022060 Channel Excavation	03-25-15
	022080 Embankment	10-30-14
	022100 Select Material	10-30-14
	022420 Silt Fence	10-30-14
<b>023</b>	<b>FOUNDATIONS, BORINGS, PILES &amp; CAISSONS</b>	
	023020 Jacking, Boring, Tunneling (S-65)	*
	023040 Tunnel Liner Plate (S-65A)	*
	023080 Timber Foundation Piling (S-95)	*
<b>024</b>	<b>RAILROAD &amp; MARINE</b>	
	024020 Railroad Tracks (S-130)	*
	024060 Marine Timber (S-93)	*
	024080 Timber Piling For Pier Construction (S-94)	*
<b>025</b>	<b>ROADWAY</b>	
	<b>0252.....SUBGRADES AND BASES</b>	
	025202 Scarifying and Reshaping Base Course	10-30-14
	025205 Pavement Repair, Curb, Gutter, Sidewalk & Driveway Replacement	11-09-16
	025208 Soil-Cement Base (S-17)	*
	025210 Lime Stabilization	10-30-14
	025213 Asphalt Stabilized Base (S-26)	*
	025215 Cement Stabilized Caliche Base (S-47) <u>NOT FOR USE ON CITY ROADWAYS</u>	*
	025223 Crushed Limestone Flexible Base	03-25-15
	025224 Flexible Base - Shell with Sand Admixture (S-25)	*

**NOTE-** ALL STANDARD SPECIFICATIONS SHOULD BE REVIEWED BY THE RESPONSIBLE DESIGN CONSULTANT FOR USE AS APPLICABLE TO THEIR PROJECT. THE ASTERISKED\* SPECIFICATIONS HAVE NOT BEEN RECENTLY REVIEWED FOR USE AND MAY CONTAIN OBSOLETE REFERENCES OR MATERIALS. THEY ARE INCLUDED FOR GENERAL REFERENCE ONLY AND SHOULD NOT BE USED WITHOUT CAREFUL REVIEW FOR APPLICABILITY TO THE CURRENT APPLICATION AND SPECIFIC AUTHORIZATION BY CITY.

# CITY STANDARD CONSTRUCTION SPECIFICATIONS INDEX

## 0254.....ASPHALTS AND SURFACES

025402 Planing Asphalt Surfaces (S-27A)	*
025404 Asphalts, Oils, & Emulsions	10-30-14
025407 Asphalt Recycling In Place (Hot Recycle Method) (S-27)	*
025410 Asphalt Crack Sealing (S-36)	*
025412 Prime Coat	10-30-14
025414 Aggregate for Surface Treatment	03-25-15
025416 Seal Coat	03-25-15
025418 Surface Treatment	03-25-15
025419 Slurry Seal (S-37)	*
025422 Cold Mix Limestone Rock Asphalt Pavement (S-33)	*
025424 Hot Mix Asphalt Concrete Pavement	03-25-15

## 0256.....CONCRETE WORK

025608 Inlets	03-25-15
025610 Concrete Curb & Gutter	03-25-15
025612 Concrete Sidewalks & Driveways	03-25-15
025614 Concrete Curb Ramps	03-25-15
025620 Portland Cement Concrete Pavement	03-25-15

## 0258.....TRAFFIC CONTROLS & DEVICES

025802 Temporary Traffic Controls During Construction	10-30-14
025803 Traffic Signal Adjustments	10-30-14
025805 Work Zone Pavement Markings	10-30-14
025807 Pavement Markings (Paint and Thermoplastic)	10-30-14
025813 Preformed Thermoplastic Striping, Words & Emblems	03-25-15
025816 Raised Pavement Markers	10-30-14
025818 Reference Specification - TxDOT DMS-4200 Pavement Markers (Reflectorized)	TxDOT
025828 Reference Specification - TxDOT DMS-6130 Bituminous Adhesive For Pavement Marker	TxDOT

## 026 UTILITIES

### 0262.....GENERAL

026201 Waterline Riser Assemblies	10-30-14
026202 Hydrostatic Testing of Pressure Systems	10-30-14
026204 PVC Pipe – Pressure Pipe for Wastewater Force Mains, Irrigation Systems, and Water Transmission Lines – ASTM D2241	10-30-14
026206 Ductile Iron Pipe & Fittings	10-30-14
026210 PVC Pipe – AWWA C900/C905 Pressure Pipe for Municipal Water Mains and Wastewater Force Mains	03-25-15
026212 Molecularly Oriented PVC Pipe (MOP) AWWA C909	*
026214 Grouting Abandoned Utility Lines	10-30-14

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# CITY STANDARD CONSTRUCTION SPECIFICATIONS INDEX

## **0264.....WATERLINES**

026402 Waterlines	03-25-15
026404 Water Service Lines	03-25-25
026406 Private Water Service Lines (S-112)	*
Form WS-1, Form W-2, Foundation Exhibit, Site Plan	
026409 Tapping Sleeves & Tapping Valves	03-25-15
026411 Gate Valves for Waterlines	03-25-15
026413 Butterfly Valves for Waterlines (S-85B)	*
026416 Fire Hydrants	03-25-15
026430 Bar Wrapped Concrete Steel Cylinder Pipe	10-30-14

## **0266.....WASTEWATER FORCE MAINS**

026602 Wastewater Force Main	10-30-14
026604 Air Release Valves for Wastewater (S-96)	*
026608 Polyethylene Pipe for Sliplining Force Mains (S-59A)	*
026610 Reinforces Plastic Mortar Liner Pipe for San FM's (S-67)	*
026612 Fiberglass Pipe for Slip Lining (S-67A)	*

## **027 WASTEWATER & STORM WATER**

### **0272.....GENERAL**

027200 Control of Wastewater Flows	10-30-14
027202 Manholes	03-25-15
027203 Vacuum Testing of Wastewater Manhole and Structures	10-30-14
027205 Fiberglass Manholes	03-25-15
027207 Rehabilitation of Manholes and Wetwells with Shotcrete (S-74)	*

### **0274....STORM WATER**

027402 Reinforced Concrete Pipe Culverts	03-25-15
027404 Concrete Box Culverts	10-30-14
027414 Culvert Rehabilitation Flexible Lining Process	*

### **0276.....WASTEWATER (GRAVITY)**

027602 Gravity Wastewater Lines	07-01-15
027604 Disposal of Waste From Wastewater Cleaning Operations	10-30-14
027606 Wastewater Service Lines	10-30-14
027608 Private Wastewater Services	*
Form WS-1, Form S-2, Foundation Exhibit, Site Plan	
027611 Cleaning and Televised Inspection of Conduits	03-25-15
027614 Cured in Place Pipe (CIPP) for Rehabilitation of Gravity Wastewater Line	10-30-14
027616 Profiled Wall HD Polyethylene for Slip Lining (S-73)	*
027618 Wastewater Line Rehabilitation - Pipe Bursting	03-25-15

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# CITY STANDARD CONSTRUCTION SPECIFICATIONS INDEX

## **028 SITE IMPROVEMENTS & LANDSCAPING**

028020 Seeding	03-25-15
028040 Sodding	03-25-15
028200 Mail Box Relocation	10-30-14
028300 Fence Relocation	10-30-14
028320 Chain Link Fence	10-30-14
028340 Chain Link Security Fence	10-30-14
028360 Chain Link Security Fence Special Application	*
028370 Barbed Wire Fence	10-30-14
028380 Sanitary Landfill Fence	*
028810 Recreational Equipment	*

## **DIVISION 3 - CONCRETE**

### **030 CONCRETE, GROUT**

030020 Portland Cement Concrete	10-30-14
032020 Reinforcing Steel	10-30-14
036020 Stucco and Plaster (S-123)	*
037040 Epoxy Compounds (S-44)	*
038000 Concrete Structures	03-25-15

## **DIVISION 4 - MASONRY**

### **040 MASONRY**

041020 Structural Clay Tile for Floor & Sidewalk (S-22)	*
041080 Brick Pavers	10-30-14
042020 Concrete Masonry Unit (S-121)	*

## **DIVISION 5 - METALS**

### **050 METALS**

050200 Welding	10-30-14
053700 Landfill Vehicle Scale System (S-119)	*
053820 Pre-Fabricated Steel Bridge	*
055420 Frames, Grates, Rings, & Covers	03-25-15
055440 Aluminum Grating (S-110)	*
057220 Aluminum Handrails (S-98)	*

## **DIVISION 6 – WOOD & PLASTIC**

### **060 WOOD & PLASTIC**

061810 Shelter Construction (S-102)	*
066000 Fiberglass V-Notched Weir Plate (S-111)	*

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# CITY STANDARD CONSTRUCTION SPECIFICATIONS INDEX

## DIVISION 7 – THERMAL & MOISTURE PROTECTION

### 070 BUILDINGS

070020 Asbestos Removal (S-1)	*
070120 Rough and Finish Carpentry (S-120)	*
074320 Cedar Shingle Roofing (S-4)	*
075220 Built-Up Asphalt Roof System (S-108)	*
078220 Concrete Tile Roofing (S-122)	*

## DIVISION 8 – DOORS & WINDOWS

## DIVISION 9 - FINISHES

### 090 FINISHES

097020 Exposed Aggregate Finish for Concrete Sidewalks (S-51)	*
099020 Painting (S-56)	*

## DIVISION 10 - SPECIALTIES

## DIVISION 11 - EQUIPMENT

### 110 EQUIPMENT

113100 Fiberglass Reinforced Plastic Wet Well (S-64)	*
113120 Wet Well Ventilation System (S-113)	*
113130 Chlorination System (S-19)	*

## DIVISION 12 – FURNISHINGS

## DIVISION 13 – SPECIAL CONSTRUCTION

### 130 SPECIAL CONSTRUCTION

132010 Ground Storage Tank for Water (Bolted Steel)	*
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## DIVISION 15 - MECHANICAL

### 150 MECHANICAL

#### 1506.....MECHANICAL & PROCESS PIPE & FITTINGS

150620 Plumbing (S-90)	*
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#### 1510.....MECHANICAL & PROCESS VALVES

151010 Gate Valves (S-103)	*
151020 Check Valves (S-104)	*
151030 Eccentric Plug Valves (S-105)	*
151040 Surge Relief Valves (S-106)	*
151050 Shear Gate (S-107)	*
151060 Flap Gate (Drainage) (S-76A)	*

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# CITY STANDARD CONSTRUCTION SPECIFICATIONS INDEX

## **1515.....FLOW METERS**

151502 Ultrasonic Doppler Flow Meter and Recorder (S-118) \*

## **1516.....PUMPS & COMPRESSORS**

151620 Submersible Pumps for Wastewater (S-114) \*

151630 Propeller Pumps (S-38) \*

151640 Submersible Grinder Pumps for Wastewater \*

## **DIVISION 16 - ELECTRICAL**

### **160 ELECTRICAL**

161001 Lift Station Electrical Materials (S-18) \*

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SECTION 020100  
SURVEY MONUMENTS

1. DESCRIPTION

This specification shall govern all work required for furnishing and installing survey monuments as required to complete the project.

2. MATERIALS

- a) Brass Monument Marker: 2¼" diameter brass disk with 3½" anchor rod to be provided by the City.
- b) Concrete: Class A, in accordance with Section 030020 "Portland Cement Concrete".
- c) Rebar: No. 5 deformed bar, 3½ feet long, in accordance with Section 032020 "Reinforcing Steel".

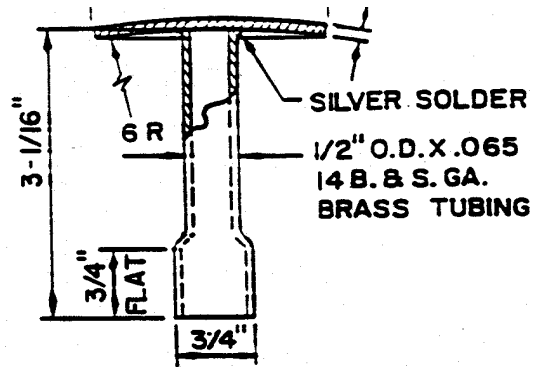
3. CONSTRUCTION METHODS

The location of survey markers shall be established in the field by the Engineer and/or his representative Surveyor. The Engineer and/or his representative Surveyor will provide four off-set stakes with intersecting string line for precise location of horizontal alignment to which the brass disk shall be positioned. The Contractor shall excavate hole and set formwork. Forms shall be placed to a tolerance which allows the precise position of the brass disk to be within one inch of the center of the concrete base. The Contractor shall place concrete in accordance with City Standard Specification Section 038000 "Concrete Structures". At the appropriate time, the Contractor shall place the brass disk (provided by the City) to its precise position in the uncured concrete. The brass disk shall be placed to within 1/4" tolerance of its intended location. Positioning of the base and brass disk will be checked by the Engineer and/or his representative Surveyor.

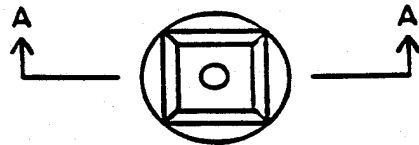
Non-compliance with specified tolerances shall result in replacement at the Contractor's expense. The properly furnished survey monument shall be neat in appearance with the exposed brass face free of cement mortar and constructed to an elevation of approximately one inch of finished grade. (See Survey Markers Detail on the following page.)

4. MEASUREMENT AND PAYMENT

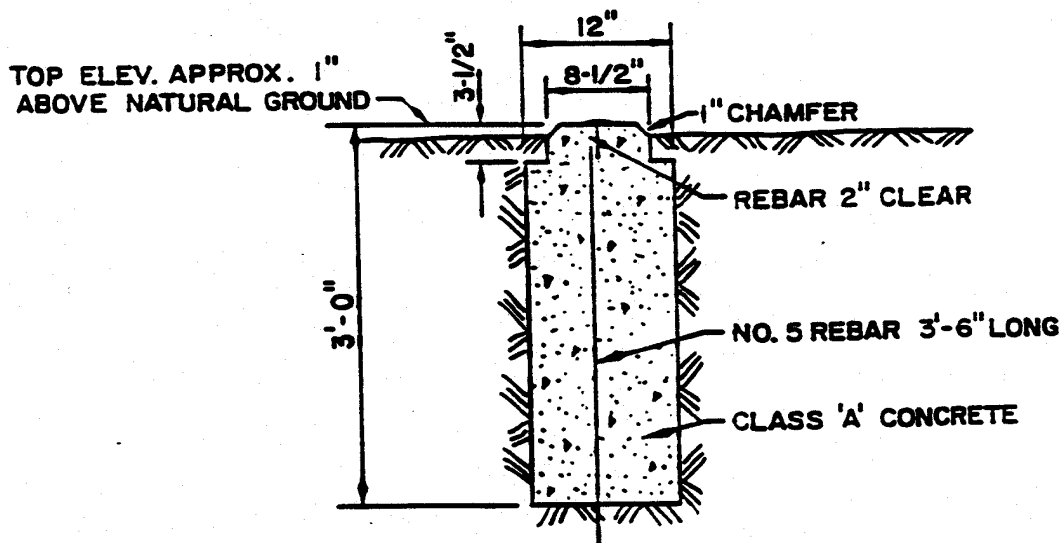
Unless otherwise specified on the Bid Form, survey monuments shall be measured as individual units for each monument placed. Payment shall be at the unit price bid, which price shall constitute full compensation for all work, materials, labor, equipment, tools and incidentals required to install the survey monuments complete in-place.



**DISC DETAIL**  
NTS.



**PLAN**



**SECTION A-A**

**SURVEY MARKERS DETAIL**

3/4" = 1'-0"



SECTION 021020  
SITE CLEARING AND STRIPPING

1. DESCRIPTION

This specification shall govern all work necessary for clearing, grubbing and stripping of objectionable matter as required to complete the project, and shall include removing and disposing of trees, stumps, brush, roots, vegetation, rubbish and other objectionable matter from the project site.

2. CONSTRUCTION METHODS

The site shall be cleared of all trees, stumps, brush, roots, vegetation, rubbish and other objectionable matter as indicated on the drawings and/or as directed by the Engineer or his designated representative. Tree stumps and roots shall be grubbed to a minimum depth of 2 feet below natural ground or 2 feet below base of subgrade, whichever is lower. Areas that underlie compacted backfill shall be stripped of all vegetation, humus and other objectionable matter encountered within the top six (6) inches of the soil. All material removed from the site under this operation shall become the Contractor's responsibility. The material shall be disposed of either at a disposal site indicated on the drawings or at a disposal site obtained by the Contractor.

3. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, site clearing and stripping or clear right-of-way shall be measured by the acre.

Payment shall be full compensation for all labor, equipment, tools and incidentals necessary for removing, handling, and disposing of objectionable matter from the site as indicated above.

SECTION 021040  
SITE GRADING

1. DESCRIPTION

This specification shall govern all work necessary for backfill and grading of the site to complete the project.

2. CONSTRUCTION METHODS

Prior to site grading, the site shall be cleared in accordance with City Standard Specification Section 021020 "Site Clearing and Stripping". Unless specified otherwise on the drawings, the existing surface shall be loosened by scarifying or plowing to a depth of not less than six (6) inches.

The loosened material shall be recompacted with fill required to bring the site to the required grades and elevations indicated on the plans.

Fill shall be uniform as to material, density and moisture content. Fill shall be free of large clods, large rocks, organic matter, and other objectionable material. No fill that is placed by dumping in a pile or windrow shall be incorporated into a layer in that position; all such piles and windrows shall be moved by blading or similar method. All fill shall be placed in layers approximately parallel to the finish grade in layers not to exceed six (6) inches of uncompacted depth, unless indicated otherwise on drawings.

The fill shall be compacted to a density which approximates that of natural ground unless indicated otherwise on drawings.

The Engineer may order proof rolling to test the uniformity of compaction. All irregularities, depressions and soft spots that develop shall be corrected by the Contractor.

Excess material from excavation, which is not incorporated into the site as fill, shall become property of the Contractor and disposed of away from the job site, unless indicated otherwise on the drawings.

3. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, site grading shall not be measured for pay, but shall be considered subsidiary to other work.

SECTION 021080  
REMOVING ABANDONED STRUCTURES

1. DESCRIPTION

This specification shall provide for the demolition, removal and disposal of abandoned structures or portions of abandoned structures, as noted on the drawings, and shall include all excavation and backfilling necessary to complete the removal. The work shall be done in accordance with the provisions of these specifications.

2. METHOD OF REMOVAL

Culverts or Sewers. Pipe shall be removed by careful excavation of all dirt on top and the sides in such manner that the pipe will not be damaged. Removal of sewer appurtenances shall be included for removal with the pipe. Those pipes which are deemed unsatisfactory for reuse by the Engineer may be removed in any manner the Contractor may select.

Concrete Structures. Unwanted concrete structures or concrete portions of structures shall be removed to the lines and dimensions shown on the drawings, and these materials shall be disposed of as shown on the drawings or as directed by the Engineer. Any portion of the existing structure outside of the limits designated for removal which is damaged by the Contractor's operations shall be restored to its original condition at the Contractor's entire expense. Explosives shall not be used in the removal of portions of the existing structure unless approved by the Engineer, in writing.

Portions of the abandoned structure shall be removed to the lines and dimensions shown on the plans, and these materials shall be disposed of as shown on the drawings or as directed by the Engineer. Any portion of the existing structure, outside of the limits designated for removal, damaged during the operations of the Contractor, shall be restored to its original condition entirely at the Contractor's expense. Explosives shall not be used in the removal of portions of the existing structure unless approved by the Engineer, in writing.

Concrete portions of structures below the permanent ground line, which will not interfere in any manner with the proposed construction, may be left in place, but removal shall be carried at least five (5) feet below the permanent ground line and neatly squared off. Reinforcement shall be cut off close to the concrete.

Steel Structures. Steel structures or steel portions of structures shall be dismantled in sections as determined by the Engineer. The sections shall be stored if the members are to be salvaged and reused. Rivets and bolts connecting steel railing members, steel beams of beam spans and steel stringers of truss spans, shall be removed by butting the heads with a "cold cut" and punching or drilling from the hole, or by such other method that will not injure the members for re-use and will meet the approval of the Engineer. The removal of rivets and bolts from connections of truss

members, bracing members, and other similar members in the structure will not be required unless specifically called for on the plans or special provisions, and the Contractor shall have the option of dismantling these members by flame-cutting the members immediately adjacent to the connections. Flame-cutting will not be permitted, however, when the plans or special provisions call for the structure unit to be salvaged in such manner as to permit re-erection. In such case, all members shall be carefully matchmarked with paint in accordance with diagrams furnished by the Engineer prior to dismantling, and all rivets and bolts shall be removed from the connections in the manner specified in the first portion of this paragraph.

Timber Structures. Timber structures or timber portions of structures to be reused shall be removed in such manner as to damage the timber for further use as little as possible. All bolts and nails shall be removed from such lumber as deemed salvable by the Engineer.

Unless otherwise specified on the drawings, timber piles shall be either pulled or cut off at the point not less than five (5) feet below ground line, with the choice between these two methods resting with the Contractor, unless otherwise specified.

Brick or Stone Structures. Unwanted brick or stone structures or stone portions of structures shall be removed. Portions of such structures below the permanent ground line, which will not in any manner interfere with the proposed construction, may be left in place, but removal shall be carried at least five (5) feet below the permanent ground line and neatly squared off.

Salvage. All material such as pipe, timbers, railings, etc., which the Engineer deems as salvable for reuse, and all salvaged structural steel, shall be delivered to a designated storage area.

Materials, other than structural steel, which are not deemed salvable by the Engineer, shall become the property of the Contractor and shall be removed to suitable disposal sites off of the right-of-way arranged for by the Contractor, or otherwise disposed of in a manner satisfactory to the Engineer.

Where temporary structures are necessary for a detour adjacent to the present structure, the Contractor will be permitted to use the material in the old structure for the detour structure, but he shall dismantle and stack or dispose of the material as required above as soon as the new structure is opened for traffic.

Backfill. All excavations made in connection with this specification and all openings below the natural ground line caused by the removal of abandoned structures or portions thereof shall be backfilled to the level of the original ground line, unless otherwise provided on the drawings. Backfill in accordance with applicable requirements of Sections 022020 "Excavation and Backfill for Utilities" and 022080 "Embankment". All open ends of abandoned pipe or other structures shall be filled or plugged as specified.

That portion of the backfill which will support any portion of the roadbed, embankment, levee, or other structural feature shall be placed in layers of the same depth as those required for placing

embankment, maximum 10" loose lifts unless otherwise specified. Material in each layer shall be wetted uniformly, if required, and shall be compacted to a minimum of 95% Standard Proctor density, unless otherwise specified. In places inaccessible to blading and rolling equipment, mechanical or hand tamps or rammers shall be used to obtain the required compaction.

That portion of the backfill which will not support any portion of the roadbed, embankment, or other structural feature shall be placed as directed by the Engineer in such manner and to such state of compaction as will preclude objectionable amount of settlement, maximum 10" loose lifts to minimum 95% Standard Proctor density unless otherwise specified.

### 3. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, the work governed by this specification shall not be measured for pay, but shall be subsidiary to the project.

SECTION 022020  
EXCAVATION AND BACKFILL FOR UTILITIES

1. DESCRIPTION

This specification shall govern all work for excavation and backfill for utilities required to complete the project.

2. CONSTRUCTION

- (1) Unless otherwise specified on the drawings or permitted by the Engineer, all pipe and conduit shall be constructed in open cut trenches with vertical sides. Trenches shall be sheathed and braced as necessary throughout the construction period. Sheathing and bracing shall be the responsibility of the Contractor (refer to Section 022022 "Trench Safety for Excavations" of the City Standard Specifications).

Trenches shall have a maximum width of one foot beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto on each side unless otherwise specified.

The Contractor shall not have more than 200 feet of open trench left behind the trenching operation and no more than 500 feet of ditch behind the ditching machine that is not compacted as required by the plans and specifications. No trench or excavation shall remain open after working hours.

For all utility conduit and sewer pipe to be constructed in fill above natural ground, the embankment shall first be constructed to an elevation not less than one foot above the top of the pipe or conduit, after which excavation for the pipe or conduit shall be made.

If quicksand, muck, or similar unstable material is encountered during the excavation, the following procedure shall be used unless other methods are called for on the drawings. If the unstable condition is a result of ground water, the Contractor, prior to additional excavation, shall control it. After stable conditions have been achieved, unstable soil shall be removed or stabilized to a depth of 2 feet below the bottom of pipe for pipes 2 feet or more in height; and to a depth equal to the height of pipe, 6 inches minimum, for pipes less than 2 feet in height. Such excavation shall be carried at least one foot beyond the horizontal limits of the structure on all sides. All unstable soil so removed shall be replaced with suitable stable material, placed in uniform layers of suitable depth as directed by the Engineer, and each layer shall be wetted, if necessary, and compacted by mechanical tamping as required to provide a stable condition. For unstable trench conditions requiring outside forms, seals, sheathing and bracing, any additional excavation and backfill required shall be done at the Contractor's expense.

- (2) Shaping of Trench Bottom. The trench bottom shall be undercut a minimum depth sufficient to accommodate the class of bedding indicated on the plans and specifications.

- (3) Dewatering Trench. Pipe or conduit shall not be constructed or laid in a trench in the presence of water. All water shall be removed from the trench sufficiently prior to the pipe or conduit planing operation to insure a relatively dry (no standing water), firm bed. The trench shall be maintained in such dewatered condition until the trench has been backfilled to a height at least one foot above the top of pipe. Removal of water may be accomplished by bailing, pumping, or by installation of well-points, as conditions warrant. Removal of well-points shall be at rate of 1/3 per 24 hours (every third well-point). The Contractor shall prevent groundwater from trench or excavation dewatering operations from discharging directly into the storm water system. Groundwater from dewatering operations shall be sampled and tested, if applicable, and disposed of, in accordance with City Standard Specification Section 022021 "Control of Ground Water".
- (4) Excavation in Streets. Excavation in streets, together with the maintenance of traffic where specified, and the restoration of the pavement riding surface, shall be in accordance with drawing detail or as required by other applicable specifications.
- (5) Removing Abandoned Structures. When abandoned masonry structures or foundations are encountered in the excavation, such obstructions shall be removed for the full width of the trench and to a depth one foot below the bottom of the trench. When abandoned inlets or manholes are encountered and no plan provision is made for adjustment or connection to the new utility, such manholes and inlets shall be removed completely to a depth one foot below the bottom of the trench. In each instance, the bottom to the trench shall be restored to grade by backfilling and compacting by the methods provided hereinafter for backfill. Where the trench cuts through utility lines which are known to be abandoned, these lines shall be cut flush with the sides of the trench and blocked with a concrete plug in a manner satisfactory to the Engineer.
- (6) Protection of Utilities. The Contractor shall conduct his work such that a reasonable minimum of disturbance to existing utilities will result. Particular care shall be exercised to avoid the cutting or breakage of water and gas lines. Such lines, if broken, shall be restored promptly by the Contractor. When active wastewater lines are cut in the trenching operations, temporary flumes shall be provided across the trench while open, and the lines shall be restored when the backfilling has progressed to the original bedding line of the sewer so cut.

The Contractor shall inform utility owners sufficiently in advance of the Contractor's operations to enable such utility owners to reroute, provide temporary detours, or to make other adjustments to utility lines in order that the Contractor may proceed with his work with a minimum of delay. The Contractor shall not hold the City liable for any expense due to delay or additional work because of utility adjustments or conflicts.

- (7) Excess Excavated Material. All materials from excavation not required for backfilling the trench shall be removed by the Contractor from the job site promptly following the completion of work involved.

(8) Backfill

A. Backfill Procedure Around Pipe (Initial Backfill)

All trenches and excavation shall be backfilled as soon as is practical after the pipes or conduits are properly laid. In addition to the specified pipe bedding material, the backfill around the pipe as applicable shall be granular material as shown on the standard details or as described in the applicable specification section, and shall be free of large hard lumps or other debris. If indicated on the plans, pipe shall be encased with cement-stabilized sand backfill as described below. The backfill shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench, in layers not to exceed ten (10) inches (loose measurement), wetted if required to obtain proper compaction, and thoroughly compacted by use of mechanical tampers to a density comparable to the adjacent undisturbed soil or as otherwise specified on the plans, but not less than 95% Standard Proctor density. A thoroughly compacted material shall be in place between the external wall of the pipe and the undisturbed sides of the trench and to a level twelve (12) inches above the top of the pipe.

B. Backfill Over One Foot Above Pipe (Final Backfill)

UNPAVED AREAS: The backfill for that portion of trench over one (1) foot above the pipe or conduit not located under pavements (including waterlines, gravity wastewater lines, wastewater force mains and reinforced concrete storm water pipe) shall be imported select material or clean, excess material from the excavation meeting the following requirements:

- Free of hard lumps, rock fragments, or other debris,
- No clay lumps greater than 2" diameter
- Moisture Content: +/-3%

Backfill material shall be placed in layers not more than ten (10) inches in depth (loose measurement), wetted if required to obtain proper compaction, and thoroughly compacted by use of mechanical tampers to the natural bank density but not less than 95% Standard Proctor density, unless otherwise indicated. Flooding of backfill is not allowed. Jetting of backfill may only be allowed in sandy soils and in soils otherwise approved by the Engineer. Regardless of backfill method, no lift shall exceed 10 inches and density shall not be less than 95% Standard Proctor density. A period of not less than twenty-four (24) hours shall elapse between the time of jetting and the placing of the top four (4) feet of backfill. If jetting is used, the top four (4) feet of backfill shall be placed in layers not more than 10 inches in depth (loose measurement), wetted if required to obtain proper compaction, and thoroughly compacted by use of mechanical tampers to the natural bank density but not less than 95% Standard Proctor density (ASTM D698).

PAVED AREAS: At utility line crossings under pavements (including waterlines, gravity wastewater lines, wastewater force mains, and reinforced concrete storm water pipe), and where otherwise indicated on the drawings, trenches shall be backfilled as shown below:

From top of initial backfill (typically twelve (12) inches above top of the pipe) to three (3) feet below bottom of road base course, backfill shall be select material meeting the requirements of 022100 "Select Material".



#### Asphalt Roadways

The upper three (3) feet of trench below the road base course shall be backfilled to the bottom of the road base course with cement-stabilized sand containing a minimum of 2 sacks of Standard Type I Portland cement per cubic yard of sand and compacted to not less than 95% Standard Proctor density.

#### Concrete Roadways

The Contractor may elect to backfill the upper three (3) feet of trench below the road base course with cement stabilized sand as noted above, or in the case of storm water pipe or box installation the Contractor may backfill and compact select material to 98% Standard Proctor density (ASTM D698) following City Standard Specification Section 022100.

### 3. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, excavation and backfill for utilities, including select material or cement-stabilized sand backfill, shall not be measured and paid for separately. It shall be considered subsidiary to the items for which the excavation and backfill is required.

SECTION 022021  
CONTROL OF GROUND WATER

1. GENERAL

1.1 SECTION INCLUDES

- A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations, and foundation beds in a stable condition, and controlling ground water conditions for tunnel excavations.
- B. Protection of excavations and trenches from surface runoff.
- C. Disposing of removed ground water by approved methods.

1.2 REFERENCES

- A. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49 kg) Rammer and 12-inch (304.8 mm) Drop.
- B. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).
- C. Federal Register 40 CFR (Vol. 55, No. 222) Part 122, EPA Administered Permit Programs (NPDES), Para.122.26(b)(14) Storm Water Discharge.

1.3 DEFINITIONS

- A. Ground water control includes both dewatering and depressurization of water-bearing soil layers.
  - 1. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts, and disposing of removed ground water by approved methods. The intent of dewatering is to increase the stability of tunnel excavations and excavated slopes; prevent dislocation of material from slopes or bottoms of excavations; reduce lateral loads on sheeting and bracing; improve excavating and hauling characteristics of excavated material; prevent failure or heaving of the bottom of excavations; and to provide suitable conditions for placement of backfill materials and construction of structures, piping and other installations.
  - 2. Depressurization includes reduction in piezometric pressure within strata not controlled by dewatering alone, as required to prevent failure or heaving of excavation bottom or instability of tunnel excavations.
- B. Excavation drainage includes keeping excavations free of surface and seepage water.

- C. Surface drainage includes the use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines as required to protect the Work from any source of surface water.
- D. Equipment and instrumentation for monitoring and control of the ground water control system includes piezometers and monitoring wells, and devices, such as flow meters, for observing and recording flow rates.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Conduct subsurface investigations as needed to identify ground water conditions and to provide parameters for design, installation, and operation of ground water control systems.
- B. Design a ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and City Standard Specification Section 022022 - Trench Safety for Excavations, to produce the following results:
  - 1. Effectively reduce the hydrostatic pressure affecting:
    - a) Excavations (including utility trenches);
    - b) Tunnel excavation, face stability or seepage into tunnels.
  - 2. Develop a substantially dry and stable subgrade for subsequent construction operations.
  - 3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities, and other work.
  - 4. Prevent the loss of fines, seepage, boils, quick condition, or softening of the foundation strata.
  - 5. Maintain stability of sides and bottom of excavations.
- C. Provide ground water control systems which may include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.
- D. Provide drainage of seepage water and surface water, as well as water from any other source entering the excavation. Excavation drainage may include placement of drainage materials, such as crushed stone and filter fabric, together with sump pumping.
- E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water away from excavations.
- F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.

- G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures, and any settlement or resultant damage caused by the ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells, or affect potentially contaminated areas. Repair damage caused by ground water control systems or resulting from failure of the system to protect property as required.
- H. Provide an adequate number of piezometers installed at the proper locations and depths as required to provide meaningful observations of the conditions affecting the excavation, adjacent structures, and water wells.
- I. Provide environmental monitoring wells installed at the proper locations and depths as required to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into the work area or into the ground water control system.
- J. Decommission piezometers and monitoring wells installed during design phase studies and left for Contractors monitoring and use, if applicable.

## 1.5 ENVIRONMENTAL REQUIREMENTS

- A. Comply with requirements of agencies having jurisdiction.
- B. Comply with Texas Commission on Environmental Quality (TCEQ) regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.
- C. Prior to beginning construction activities, file Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under the Texas Pollutant Elimination System (TPDES) General Permit No. TXR150000, administered by the Texas Commission on Environmental Quality (TCEQ). The general permit falls under the provisions of Section 402 of the Clean Water Act and Chapter 26 of the Texas Water Code.
- D. Prepare submittal form and submit to TCEQ along with application fee.
- E. Upon completion of construction, file Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under the TPDES General Permit with the TCEQ.
- F. Obtain all necessary permits from agencies with control over the use of ground water and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Because the review and permitting process may be lengthy, take early action to pursue and submit for the required approvals.
- G. Monitor ground water discharge for contamination while performing pumping in the vicinity of potentially contaminated sites.

- H. Conduct sampling and testing of ground water and receiving waters as outlined in Article 3 below.

## 2. PRODUCTS

### 2.1 EQUIPMENT AND MATERIALS

- A. Equipment and materials are at the option of Contractor as necessary to achieve desired results for dewatering.
- B. Eductors, well points, or deep wells, where used, shall be furnished, installed and operated by an experienced contractor regularly engaged in ground water control system design, installation, and operation.
- C. All equipment must be in good repair and operating order.
- D. Sufficient standby equipment and materials shall be kept available to ensure continuous operation, where required.

## 3. EXECUTION

### 3.1 GROUND WATER CONTROL

- A. Perform a subsurface investigation by borings as necessary to identify water bearing layers, piezometric pressures, and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine the drawdown characteristics of the water bearing layers.
- B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in a manner compatible with construction methods and site conditions. Monitor effectiveness of the installed system and its effect on adjacent property.
- C. Install, operate, and maintain ground water control systems in accordance with the ground water control system design. Notify the City's Construction Inspector in writing of any changes made to accommodate field conditions and changes to the Work. Revise the ground water control system design to reflect field changes.
- D. Provide for continuous system operation, including nights, weekends, and holidays. Arrange for appropriate backup if electrical power is primary energy source for dewatering system.
- E. Monitor operations to verify that the system lowers ground water piezometric levels at a rate required to maintain a dry excavation resulting in a stable subgrade for prosecution of subsequent operations.
- F. Where hydrostatic pressures in confined water bearing layers exist below excavation, depressurize those zones to eliminate risk of uplift or other instability of excavation or installed

works. Allowable piezometric elevations shall be defined in the ground water control system design.

G. Remove ground water control installations.

1. Remove pumping system components and piping when ground water control is no longer required.
2. Remove piezometers and monitoring wells when directed by the City Engineer.
3. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite grout or cement-sand grout.

H. During backfilling, dewatering may be reduced to maintain water level a minimum of 5 feet below prevailing level of backfill. However, do not allow that water level to result in uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement stabilized sand until at least 48 hour after placement.

I. Provide a uniform diameter for each pipe drain run constructed for dewatering. Remove pipe drain when it has served its purpose. If removal of pipe is impractical, provide grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout when pipe is removed from service.

J. Extent of construction ground water control for structures with a permanent perforated underground drainage system may be reduced, such as for units designed to withstand hydrostatic uplift pressure. Provide a means for draining the affected portion of underground system, including standby equipment. Maintain drainage system during operations and remove it when no longer required.

K. Remove system upon completion of construction or when dewatering and control of surface or ground water is no longer required.

L. In unpaved areas, compact backfill to not less than 95 percent of Standard Proctor maximum dry density in accordance with ASTM D 698. In paved areas (or areas to receive paving), compact backfill to not less than 98 percent of Standard Proctor maximum dry density in accordance with ASTM D 698.

### 3.2 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

A. For above ground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between every eductor well or well point and discharge header so that discharge from each installation can be visually monitored.

B. Install sufficient piezometers or monitoring wells to show that all trench or shaft excavations in water bearing materials are pre-drained prior to excavation. Provide separate piezometers for

monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for Contractor's selected method of work.

- C. Install piezometers or monitoring wells not less than one week in advance of beginning the associated excavation (including trenching).
- D. Dewatering may be omitted for portions of underdrains or other excavations, but only where auger borings and piezometers or monitoring wells show that soil is pre-drained by an existing system such that the criteria of the ground water control system design are satisfied.
- E. Replace installations that produce noticeable amounts of sediments after development.
- F. Provide additional ground water control installations, or change the methods, in the event that the installations according to the ground water control system design do not provide satisfactory results based on the performance criteria defined by the ground water control system design and by these specifications.

### 3.3 EXCAVATION DRAINAGE

- A. Contractor may use excavation drainage methods if necessary to achieve well drained conditions. The excavation drainage may consist of a layer of crushed stone and filter fabric, and sump pumping in combination with sufficient wells for ground water control to maintain stable excavation and backfill conditions.

### 3.4 MAINTENANCE AND OBSERVATION

- A. Conduct daily maintenance and observation of piezometers or monitoring wells while the ground water control installations or excavation drainage are operating in an area or seepage into tunnel is occurring. Keep system in good condition.
- B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedule.
- C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make observations, as specified.
- D. Remove and grout piezometers inside or outside the excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by the City Engineer.

### 3.5 MONITORING AND RECORDING

- A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also monitor and record water level and ground water recovery. These records shall be obtained daily until steady conditions are achieved, and twice weekly thereafter.

- B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until the Work is completed or piezometers or wells are removed, except when City Engineer determines that more frequent monitoring and recording are required. Comply with Construction Inspector's direction for increased monitoring and recording and take measures as necessary to ensure effective dewatering for intended purpose.

### 3.6 SAMPLING, TESTING AND DISPOSAL OF GROUND WATER

- A. It is the intent that the Contractor discharge groundwater primarily into the existing storm water system in accordance with City Ordinance, Article XVI, Section 55-203, *only* if the groundwater is uncontaminated and the quality of the ground water is equal to or better than the quality of the receiving stream.
- B. The Contractor shall prevent ground water from trench or excavation dewatering operations from discharging directly into the storm water system prior to testing and authorization. Ground water from dewatering operations shall be sampled and tested, and disposed of by approved methods.
- C. Laboratory analysis of groundwater and receiving water quality is to be performed by the Contractor at the Contractor's expense, prior to commencing discharge, and groundwater analysis shall be performed by the Contractor at a minimum of once per week. Contractor shall coordinate with the City Storm Water Department on all laboratory analysis. Laboratory analysis of groundwater shall also be performed at each new area of construction prior to discharge from that location.
- D. Sample containers, holding times, preservation methods, and analytical methods, shall either follow the requirements in 40 CFR Part 136 (as amended), or the latest edition of "Standard Methods for the Examination of Water and Wastewater." Any laboratory providing analysis must be accredited or certified by the Texas Commission on Environmental Quality according to Title 30 Texas Administrative Code (30 TAC) Chapters 25 for the matrices, methods, and parameters of analysis, if available, or be exempt according to 30 TAC §25.6.
- E. Analysis of the ground water discharge shall show it to be equal to or better than the quality of the first natural body of receiving water. This requires testing of both the receiving water and a sample of the ground water. All parts of this procedure shall be complete prior to any discharge of ground water to the storm water system.
- F. Steps to Determine Legitimate Discharge:
  - 1. Identify the First Receiving Water.
    - a) When the first body of water is a fresh water system (Nueces River or Oso Creek), the analysis typically fails because the local ground water will likely be too high in Total Dissolved Solids (TDS). In the case of a perched aquifer, the ground water may turn out fairly fresh, but local experience shows this to be unlikely.
    - b) If the receiving water is a marine environment, proceed with Step 2 below to compare the ground water quality to receiving water quality.



2. Compare Ground Water Discharge Quality to Receiving Water Quality.

The following table, Ground Water Discharge Limits, indicates that the parameters to compare to the receiving water are Total Dissolved Solids (TDS) and Total Suspended Solids (TSS). If the ground water results are equal to or better than the receiving water, then the discharge may be authorized as long as the discharge does not exceed the other parameters which would indicate hydrocarbon contamination. Note that the receiving water only needs to be tested initially as a baseline and the ground water shall be tested weekly to ensure compliance.

**GROUND WATER DISCHARGE LIMITS**

<b>Parameter</b>	<b>Ground Water Monitoring Frequency</b>	<b>Receiving Water Monitoring Frequency</b>	<b>Maximum Limitation</b>
Total Dissolved Solids (TDS)	Initial + Weekly	Once Prior to Discharge	< Receiving Water
Total Suspended Solids (TSS)	Initial + Weekly	Once Prior to Discharge	< Receiving Water
Total Petroleum Hydrocarbons	Initial + Weekly		15 mg/L
Total Lead	Initial + Weekly		0.1 mg/L
Benzene	Initial + Weekly		0.005 mg/L
Total BTEX	Initial + Weekly		0.1 mg/L
Polynuclear Aromatic Hydrocarbons	Initial + Monthly		0.01 mg/L

3. Analyze Ground Water for Hydrocarbon Contamination.

All other parameters listed on the Ground Water Discharge Limits table must be analyzed prior to ground water discharge to the storm water system. If no limits are exceeded, ground water discharge to the storm water system may be authorized following notification to the MS4 operator (City of Corpus Christi) and all Pollution Prevention Measures for the project are in place. Analytical results shall be on-site or readily available for review by local, state or federal inspectors. Note that this step is frequently done simultaneously with Step 2 above to shorten analytical processing time.

4. Pollution Prevention Measures.

A storm water pollution prevention plan or pollution control plan shall be developed and implemented prior to any ground water discharges to the storm water system. The plan's objectives are to limit erosion and scour of the storm water system, and minimize Total Suspended Solids (TSS) and other forms of contamination, and prevent any damage to the storm water system. Note that ground water discharges must cease immediately upon the first recognition of contamination, either by sensory or analytical methods. If the discharge of groundwater results in any damages to the storm water system, the responsible party

shall remediate any damage to the storm water system and the environment to the satisfaction of the Storm Water Department and/or any State or Federal Regulatory Agency.

5. MS4 Operator Notification.

The MS4 operator shall be notified prior to ground water discharge to the storm water system. Contractor shall contact the designated City MS4 representative to request authorization to discharge ground water to the storm water system.

Notification shall include:

Project Name:

Responsible Party:

Discharge Location:

Receiving Water:

Estimated Time of Discharge:

Linear Project: Yes / No

Pollution Prevention Measures Implemented:

Statement indicating all sampling and testing has been conducted and meets the requirements of a legitimate discharge.

G. Discharges to Wastewater System

In the event that the groundwater does not equal or exceed the receiving water quality, an alternative disposal option would include pumping to the nearest sanitary sewer system. Discharge to the sanitary sewer system requires a permit from the Wastewater Department. If discharging to temporary holding tanks and trucking to a sanitary sewer or wastewater treatment plant, the costs for these operations shall be negotiated.

Contractor shall contact the Pretreatment Group for City Utility Operations to obtain a Wastewater Discharge Permit Application for authorization to discharge to the wastewater system. Authorization approval will include review of laboratory analysis of the ground water and estimated flow data. Note that groundwater discharges must cease immediately upon the first recognition of contamination, either by sensory or analytical methods. If the discharge of groundwater results in any damages to the wastewater collection system or wastewater overflows, the responsible party shall remediate any damage to the wastewater collection system and the environment to the satisfaction of the Wastewater Department and/or any State or Federal Regulatory Agency.

- H. Other groundwater disposal alternatives or solutions may be approved by the Engineer on a case by case basis.

3.7 SURFACE WATER CONTROL

- A. Intercept surface water and divert it away from excavations through the use of dikes, ditches, curb walls, pipes, sumps or other approved means.
- B. Divert surface water into sumps and pump into drainage channels or storm drains, when

approved by the City Engineer. Provide settling basins when required by the City Engineer.

- C. Storm water that enters the excavation can be pumped out as long as care is taken to minimize solids and mud entering the pump suction and flow is pumped to a location that allows for sheet flow prior to entering a storm water drainage ditch or storm water inlet. An alternative to sheet flow is to pump storm water to an area where ponding occurs naturally without leaving the designated work area or by manmade berm(s) prior to entering the storm water system. Sheet flow and ponding is required to allow solids screening and/or settling prior to entering the storm water system. Storm water or groundwater shall not be discharged to private property.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, control of ground water will not be measured and paid for separately, but shall be considered subsidiary to other bid items.

SECTION 022022  
TRENCH SAFETY FOR EXCAVATIONS

1. DESCRIPTION

This specification shall govern all work for providing for worker safety in excavations and trenching operations required to complete the project.

2. REQUIREMENTS

Worker Safety in excavations and trenches shall be provided by the Contractor in accordance with Occupational Safety and Health Administration (OSHA) Standards, 29 CFR Part 1926 Subpart P - Excavations.

It is the sole responsibility of the Contractor, and not the City or Engineer or Consultant, to determine and monitor the specific applicability of a safety system to the field conditions to be encountered on the job site during the project.

The Contractor shall indemnify and hold harmless the City and Engineer and Consultant from all damages and costs that may result from failure of methods or equipment used by the Contractor to provide for worker safety.

Trenches, as used herein, shall apply to any excavation into which structures, utilities, or sewers are placed regardless of depth.

Trench Safety Plan, as used herein, shall apply to all methods and materials used to provide for worker safety in excavation and trenching operations required during the project.

3. MEASUREMENT AND PAYMENT

Measurement of Trench Safety shall be by the linear foot of trench, regardless of depth. Measurement shall be taken along the centerline of the trench.

Measurement for Excavation Safety for Utility Structures shall be per each excavation. Excavations include, but are not limited to, those for manholes, vaults, pits and other such structures that are incidental to utility work.

Measurement for Excavation Safety for Special Structures shall be per each excavation or by the lump sum for each special structure identified in the Proposal.

Payment shall be at the unit price bid and shall fully compensate the Contractor for all work, equipment, materials, personnel, and incidentals as required to provide for worker safety in trenches and excavations for the project.

Revision current for Texas Code Chapter 756 Subchapter C. Trench Safety.

SECTION 022040  
STREET EXCAVATION

1. DESCRIPTION

This specification shall govern all work for Street Excavation required to complete the project.

2. CONSTRUCTION METHODS

(A) Stripping and Excavation

Strip the top 6 inches in all areas to underlay compacted fill, curbs, base or pavement, by removing all humus, vegetation and other unsuitable materials. Unless otherwise noted, remove existing trees, shrubs, fences, curb, gutter, sidewalk, drives, paving, pipe and structures and other items within the graded area which interfere with new construction of finished grading.

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, provided that the material meets the requirements for roadway embankment as specified in Article 3 below. Unwanted or unsuitable roadway excavation and roadway excavation in excess of that needed for construction shall become the property of the Contractor to be disposed of by him outside the limits of the right-of-way at a location suitable to the Engineer. "Unsuitable" material encountered below subgrade elevation in roadway cuts, when declared unwanted by the Engineer, shall be replaced as directed by the Engineer with suitable material from the roadway excavation or with other suitable material.

Maintain moisture and density until covered and protected by the subbase or base course. Remove soft or wet areas found at any time, replace with suitable material, and recompact (especially utility trenches).

(B) Subgrade Preparation

That area shown on the drawings for street construction shall be cut to grade, scarified to a depth not less than 6 inches, or as otherwise indicated on the drawings, and compacted to 95% Standard Proctor density (ASTM D698) to within 0 to +3% of optimum moisture. The section may be accepted if no more than 1 in 5 of the most recent moisture or density tests is beyond  $\pm 1\%$  deviation from the required moisture or density requirement. Irregularities exceeding  $\frac{1}{2}$  inch in 16 feet shall be corrected. Soft areas found at anytime shall be removed, replaced with suitable material and compacted (especially at utility trenches). The correct moisture density relationship shall be maintained until the subgrade is protected. Excessive loss of moisture shall be prevented by sprinkling, sealing, or covering with a subsequent layer. Should the subgrade, due to any reason or cause, lose the required stability, density, or moisture before it is protected by placement of the next layer, it shall be re-compacted and refinished and retested at the expense of the Contractor until acceptable to the City.

(C) Curb Backfill and Topsoil (Sidewalks, Parkways, Islands, etc.)

Fill and compact areas behind curbs and adjacent to sidewalks and driveways within 48 hours after completion of concrete work. The top 6 inches (where disturbed by construction or where unsatisfactory material is exposed by excavation) of finish earth grade shall be clean excavated material or topsoil capable of supporting a good growth of grass when fertilized and seeded or sodded. It shall be free of concrete, asphalt, shell, caliche, debris and any other material that detracts from its appearance or hampers the growth of grass. Topsoil shall meet the requirements specified in City Standard Specification Section 028020 "Seeding".

(D) Matching Grades at Right-of-Way Line

Finish grade at the property line shall be as shown on the drawings. The Engineer may require a reasonable amount of filling on private property where the sidewalk grade is above the property elevation. Use suitable material from the excavation. Unless otherwise directed, cuts at right-of-way lines shall be made at a slope of three horizontal to one vertical (3:1) or flatter.

(E) Drainage

During construction, the roadbed and ditches shall be maintained in such condition as to insure proper drainage at all times, and ditches and channels shall be so constructed and maintained as to avoid damage to the roadway section.

All slopes which, in the judgment of the Engineer, require variation, shall be accurately shaped, and care shall be taken that no material is loosened below the required slopes. All breakage and slides shall be removed and disposed of as directed.

3. SELECTION OF ROADBED MATERIALS

Where shown on the plans, Select Material shall be utilized to improve the roadbed, in which case the work shall be performed in such manner and sequence that suitable materials may be selected, removed separately, and deposited in the roadway within limits and at elevations required. Material used for roadway embankment shall meet the requirements of City Standard Specification Section 022100 Select Material.

4. GEOGRID

If indicated on the drawings, geogrid shall be placed in the base layer according to the pavement details to provide a mechanically-stabilized aggregate base layer within the pavement structure. Geogrid shall be "Tensar TX5 Triaxial Geogrid", or pre-approved equivalent. Use (and approval) of a different product must be supported by documentation showing that the alternate pavement section will meet or exceed the required number of 18-kip equivalent single axle loads (ESAL) and structural number (SN) over the stated pavement design life, and the pavement design must be sealed and signed by a Texas professional engineer. Documentation must also include the structural design value used for the geogrid structural contribution, based on and supported by

validated test data. Alternate pavement designs shall utilize the same structural design values for other pavement structural components (HMAC, base, sub-base) as used in the original pavement design, and the pavement designs must be approved by the Engineer and the geotechnical consultant.

Contractor shall take care to protect geogrid from damage. Overlap edges of geogrid in accordance with the manufacturer's recommendations, but not less than 12 inches. Do not drive tracked equipment directly on the geogrid. Provide at least 6 inches of compacted aggregate base material over the geogrid before driving any tracked equipment over the geogrid area. Standard highway-legal rubber-tired trucks may drive over the geogrid at very slow speeds (less than 5 mph). Avoid turns and sudden starts and stops when driving on the geogrid. Any damaged geogrid shall be replaced by the Contractor at no additional cost to the City. Proper replacement shall consist of replacing the affected area adding 3 feet of geogrid in each direction beyond the limits of the affected area.

## 5. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, street excavation shall be measured and paid for by the square yard to the limits shown on the drawings including excavation for street transitions. Payment shall be full compensation for furnishing all labor, materials, tools, equipment, borrow material and incidentals necessary to complete the work.

Unless otherwise specified on the Bid Form, compacted subgrade shall be measured and paid for by the square yard to the limits shown on the drawings. Payment shall be full compensation for furnishing all labor, materials, tools, equipment, borrow material and incidentals necessary to complete the work.

Unless otherwise specified on the Bid Form, geogrid shall be measured and paid for by the square yard to the limits shown on the drawings, excluding overlaps. Payment shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals necessary to complete the work.

All work required for disposing of waste, including hauling will not be paid for directly but shall be considered subsidiary to the various contract items.

SECTION 022060  
CHANNEL EXCAVATION

1. DESCRIPTION

This specification shall govern all work for Channel Excavation required to complete the project.

2. CONSTRUCTION METHODS

Trees, stumps, brush and other vegetation shall be removed and hauled away. Excavated slopes shall be finished in conformance with the lines and grades established by the Engineer. When completed, the average plane of slopes shall conform to the slopes indicated on the drawings, and no point on completed slopes shall vary from the designated slopes by more than 0.5 foot measured at right angles to the slope. In no case shall any portion of the slope encroach on the roadbed. The tops of excavated slopes and the end of excavation shall be rounded. The bottom and sides of the ditch or channel shall be undercut a minimum depth sufficient to accommodate topsoil for seeding, sodding, or slope protection, as indicated on the drawings.

All suitable materials removed from the excavation shall be used, insofar as practicable, in the formation of embankments in accordance with City Standard Specification Section 022080 "Embankment", or shall be otherwise utilized or satisfactorily disposed of as indicated on drawings, or as directed, and the completed work shall conform to the established alignment, grades and cross sections. During construction, the channel shall be kept drained, insofar as practicable, and the work shall be prosecuted in a neat workmanlike manner.

Unsuitable channel excavation in excess of that needed for construction shall become the property of the Contractor and removed from the site and properly disposed of.

3. SELECTION OF MATERIALS

Where shown on the drawings, selected materials shall be utilized in the formation of embankment or to improve the roadbed, provided that the material meets the requirements specified in City Standard Specification Sections 022040 "Street Excavation" and 022100 "Select Material", in which case the work shall be performed in such manner and sequence that suitable materials may be selected, removed separately and deposited in the roadway within the limits and at elevations required. Concrete for lining channels, where specified on the drawings, shall be Class "A" in accordance with City Standard Specification Section 030020 "Portland Cement Concrete".

4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, channel excavation shall be measured in its original position and the volume computed in cubic yards by the method of average end areas, or by linear foot of channel or drainage ditch, as specified. Channel excavation shall include, but not be limited to, clearing and removal of vegetation, excavation, de-watering, embankment, compaction, hauling, and disposal. Channel excavation shall not include undercutting to accommodate topsoil, sod, or slope protection. Payment shall be at the bid price for the unit of measurement specified and shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work.



SECTION 022080  
EMBANKMENT

1. DESCRIPTION

This specification shall govern all work for Embankment required to complete the project.

2. CONSTRUCTION METHODS

Prior to placing embankment, the area to be covered shall be stripped of all vegetation and the material so removed shall be disposed of off the job site. Washes, gulleys, wet areas, and yielding areas shall be corrected as directed by the Engineer.

Unless otherwise indicated on the drawings, the surface of the ground which is to receive embankment shall be loosened by scarifying or plowing to a depth of not less than 6 inches. The loosened material shall be recompacted with the new embankment as hereinafter specified. Embankment shall be placed in layers not to exceed ten (10) inches uncompacted (loose) depth for the full width of the embankment, unless otherwise noted.

Where embankment is adjacent to a hillside or old roadbed, the existing slope shall be cut in steps to not less than the vertical depth of an uncompacted layer. The fill material shall be placed from the low side and compacted. Each layer shall overlap the existing embankment by at least the width indicated by the embankment slope.

Trees, stumps, roots, vegetation, debris or other unsuitable materials shall not be placed in embankment.

Each layer of embankment shall be uniform as to material, density and moisture content before beginning compaction. Where layers of unlike materials abut each other, each layer shall be feather-edged for at least 100 feet or the material shall be so mixed as to prevent abrupt changes in the soil. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position, but 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 to the end that a uniform material of uniform density is secured in each layer. Except as otherwise required by the drawings, all embankments shall be constructed in layers approximately parallel to the finished grade and each layer shall be so constructed as to provide a uniform slope of 1/4 inch per foot from the centerline of the embankment to the outside.

Each layer shall be compacted to the required density and moisture by any method, type and size of equipment that will give the required compaction. Prior to and in conjunction with the rolling 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 over the entire layer.

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 drawings. Soils for

embankment shall be sprinkled with water as required to provide not less than optimum moisture and compacted to the extent necessary to provide not less than 95% Standard Proctor density (ASTM D698). Field density determinations will be made in accordance with approved methods.

After each layer of earth embankment or select material is complete, 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.

The Engineer may order proof rolling to test the uniformity of compaction of the embankment layers. All irregularities, depressions, weak or soft spots which develop shall be corrected immediately by the Contractor.

Should the embankment, due to any reason or cause, lose the required stability, density or moisture before the pavement structure is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent layer of granular material.

### 3. SELECTION OF MATERIAL

In addition to the requirement in the excavation items 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 drawings, 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. Select material, when specified, shall meet the requirements in City Standard Specification Section 022100 "Select Material".

### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, embankment shall not be measured and paid for separately, but shall be subsidiary to other items of work.

SECTION 022100  
SELECT MATERIAL

1. DESCRIPTION

This specification shall govern the use of Select Material to be used to treat designated sections of roadways, embankments, trenches, etc. Select material shall be non-expansive sandy clay (CL) or clayey sand (SC), in accordance with the Unified Soil Classification System (ASTM D2487). Select Material shall meet the following requirements:

Free of vegetation, hard lumps, rock fragments, or other debris  
No clay lumps greater than 2" diameter  
Liquid Limit (L.L.): < 35  
Plasticity Index (P.I.) Range: 8 to 20  
Moisture Content: as specified in the drawings

2. CONSTRUCTION METHODS

Select material shall be mixed uniformly and placed in layers as indicated, not to exceed 10 inches loose depth (or 12 inches maximum for sanitary sewer trench backfill per City Standard Details for Sanitary Sewers). Unless otherwise specified, the material shall be compacted to a minimum of 95% Standard Proctor density. Each layer shall be complete before the succeeding layer is placed.

The finished surface of the select material shall conform to the grade and section shown on the drawings.

3. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, select material shall not be measured for pay, but shall be subsidiary to the appropriate bid item.

SECTION 022420  
SILT FENCE

1. DESCRIPTION

This specification shall govern all work necessary for providing and installing silt fencing required to control sedimentation and erosion during construction of the project.

2. MATERIAL REQUIREMENTS

A. Geotextile shall meet the requirements for temporary silt fence per AASHTO M288.

B. Fence Reinforcement Materials:

Silt fence reinforcement shall be one of the following systems.

Type 1: Self-Supported Fence - This system consists of fence posts, spaced no more than 8-1/2 feet apart, and geotextile without net reinforcement. Fence posts shall be a minimum of 42 inches long, embedded at least one (1) foot into the ground, and constructed of either wood or steel. Soft wood posts shall be at least 3 inches in diameter or nominal 2 x 4 inches in cross section and essentially straight. Hardwood posts shall be a minimum of 1.5 x 1.5 inches in cross section. Fabric attachment may be by staples or locking plastic ties at least every 6 inches, or by sewn vertical pockets. Steel posts shall be T or L shaped with a minimum weight of 1.3 pounds per foot. Attachment shall be by pockets or by plastic ties if the posts have suitable projections.

Type 2: Net-Reinforced Fence - This system consists of fence posts, spaced no more than 8-1/2 feet apart, and geotextile with an attached reinforcing net. Fence posts shall meet the requirements of Self-Supported Fence. Net reinforcement shall be galvanized welded wire mesh of at least 12.5-gauge wire with maximum opening size of 4 x 2 inches. The fabric shall be attached to the top of the net by crimping or cord at least every 2 feet, or as otherwise specified.

Type 3: Triangular Filter Dike - This system consists of a rigid wire mesh, at least 6-gauge, formed into an equilateral triangle cross-sectional shape with sides measuring 18 inches, wrapped with geotextile silt fence fabric. The fabric shall be continuously wrapped around the dike, with a skirt extending at least 12 inches from its upslope corner.

C. Packaging Requirements: Prior to installation, the fabric shall be protected from damage due to ultraviolet light and moisture by either wrappers or inside storage.

D. Certification and Identification: Each lot or shipment shall be accompanied by a certification of conformance to this specification. The shipment must be identified by a ticket or by labels securely affixed to the fabric rolls. This ticket or label must list the following information:

- a. Name of manufacturer or supplier
- b. Brand name and style
- c. Manufacturer's lot number or control number
- d. Roll size (length and width)
- e. Chemical composition

### 3. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, silt fence shall be measured by the linear foot. Payment shall be at the bid price for the unit of measurement specified and shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work. Payment shall include, but not be limited to, placing, maintaining and removing the silt fence.

SECTION 025202  
SCARIFYING AND RESHAPING BASE COURSE

1. DESCRIPTION

"Scarifying and Reshaping Base Course" shall consist of scarifying and reshaping the existing base course (with or without asphalt surface) to the line, grade and section as indicated on the drawings.

2. CONSTRUCTION METHODS

The existing base and surface shall be scarified to the width and depth indicated on the drawings. Subgrade shall remain undisturbed, unless indicated otherwise on the drawings. Any asphalt surfacing shall be broken into particles no larger than 2 ½ inches. The asphalt surfacing shall then be uniformly mixed with the existing base. Additional base material, where required to achieve the lines and grades shown on the drawings, shall also be added to and uniformly mixed with the existing scarified base material. If indicated on the drawings, geogrid shall be installed in the pavement section.

The base material shall be shaped and rolled after mixing and allowed to set at least 48 hours before final compaction. Moisture content shall be maintained in the material during the 48-hour period. Material shall be sprinkled with water or aerated to optimum moisture content, and compacted in layers (10-inch maximum loose depth) to a minimum density of 98% Modified Proctor density (AASHTO T180), at a moisture content on the wet side of optimum (+3% maximum). Use mechanical tamps in areas inaccessible to rollers.

Upon completion of compaction, the surface shall be smooth and shall conform to line, grade and section as shown on the drawings. Areas with any deviation in excess of 1/4 inch in cross-section, and in lengths of 16 feet measured longitudinally, shall be corrected by loosening, adding or removing material, reshaping, and re-compacting by sprinkling and rolling. Moisture content shall be maintained on the wet side of optimum (+3% maximum) until paving is complete.

If required, lime shall be applied in the amount indicated on the drawings. Lime shall be applied and the treated base mixed, cured, compacted and finished in accordance with City Standard Specification Section 025210 "Lime Stabilization."

3. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, scarifying and reshaping base course shall not be measured and paid for separately, but shall be subsidiary to other work.

SECTION 025205  
PAVEMENT REPAIR, CURB, GUTTER, SIDEWALK AND DRIVEWAY REPLACEMENT

1. DESCRIPTION

This specification shall govern the removal and replacing of all types of pavements and surfacing required to complete the project.

2. MATERIALS

Unless otherwise specified on the drawings, materials and proportions used along with this specification shall conform to the respective following specifications:

City Standard Specifications

Section 022020 "Excavation and Backfill for Utilities"

Section 022100 "Select Material"

Section 025223 "Crushed Limestone Flexible Base"

Section 025424 "Hot Mix Asphaltic Concrete Pavement"

Section 025610 "Concrete Curb and Gutter"

Section 025612 "Concrete Sidewalks and Driveways"

Section 025620 "Portland Cement Concrete Pavement"

Section 030020 "Portland Cement Concrete", Class "A" Concrete

Section 032020 "Reinforcing Steel"

Section 038000 "Concrete Structures".

3. METHOD OF CUTTING

The outline of the trench shall be marked upon the surface of the pavement to be cut, and all cuts into the pavement shall be saw-cut as nearly vertical as it is possible to make them. All unwanted materials removed shall be disposed of by the Contractor and shall not be used as backfill material.

4. BACKFILL OF TRENCH

Excavation and backfilling of trench shall be in accordance with City Standard Specification Section 022020 "Excavation and Backfill for Utilities."

## 5. REPLACING STREET AND OTHER PAVEMENT

All pavements, driveways, sidewalks, and curbs and gutters which are cut shall be replaced in a workmanlike manner, with like or better materials or per pavement repair details to be provided on the drawings.

Pavement cuts in a street for any utility requires a permit from the Director of Development Services in accordance with City Ordinance 030040, Article III Cuts and Excavations (12-17-2013). The installation of a utility that crosses the ROW at a perpendicular or near perpendicular angle and has an OD of 6" or less will not be permitted to be installed by cutting the road section. Street excavation/cut for a utility in an asphalt roadway shall include a full lane overlay or pavement repair for parallel cuts, or a 12' wide pavement repair for perpendicular cuts. Street excavation/cut for a utility in a concrete roadway shall include full panel replacement. The drawings and/or permit application should include a site specific pavement cut and restoration plan that indicates the general nature of the pavement and roadway (for examples, concrete arterial, asphalt residential) to be cut and restored, the existing pavement section (if known), the location and approximate area of the excavation/pavement repair, including the approximate length and width of the pavement repair in relation to the roadway travel lane(s).

## 6. REPLACING DRIVEWAY PAVEMENT

On all concrete driveway pavements, the replacement shall consist of a reinforced Class "A" concrete slab with a minimum thickness of six (6) inches. The type of finish for the replaced section shall be the same as that appearing on the old pavement. Reinforcement shall be #4 bars at 12 inches each way with additional diagonal bars as indicated on the drawings. Any other type shall be replaced with like or better replacement. Replacement shall, in general, be to original joint or score mark.

## 7. REPLACING SIDEWALKS

On all sidewalk pavements, the replacement shall consist of a reinforced Class "A" concrete slab four (4) inches thick. The type of finish for the replaced section shall be the same as that appearing on the old sidewalk. Replacement shall, in general, be to original joint or score marks. Reinforcement shall be 4" x 4" - W2.9 x W2.9 welded wire fabric located at mid-depth in the slab.

## 8. REPLACING CURB AND GUTTER

On all curb and gutter, the replacement shall consist of a section conforming in all details to the original section or to City of Corpus Christi Standard curb and gutter section, if required by the Engineer. Cuts through the curb shall be replaced with Class "A" concrete. Preserve the original steel reinforcing and reinforce all new curbs with three #4 bars. Adjust grades for positive drainage. Replacement shall, in general, be to original joint or score mark. For jointed concrete roadways, the joints in curb or in curb and gutter should match the concrete roadway joints.



## 9. REPAIRING STREET SHOULDERS AND UNIMPROVED STREETS

On streets or roads without curb and gutter where a shoulder is disturbed, it shall be restored to like or better condition. The shoulder surface shall be rolled to an acceptably stable condition. The requirements of City Ordinance 030040 as stated above apply also to unimproved streets unless a specific variance is granted by the Director of Development Services.

## 10. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, pavement repair shall be measured by the square yard of the type of repair specified; curb and gutter replacement shall be measured by the linear foot; and sidewalk and driveway replacement shall each be measured by the square foot. Payment will be made at the unit price bid for the completed work and shall be full compensation for all labor, materials, equipment, tools, and incidentals required to complete the work. No separate measurement or payment will be made for subgrade compaction, sand leveling course, geogrid, ordinary backfill, cement-stabilized sand backfill, flexible base, prime coat, hot-mix asphaltic concrete, etc.

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SECTION 025208  
Soil - Cement Base (S-17)

1. DESCRIPTION

This specification shall govern all work required for Soil-Cement Base necessary to complete the project.

2. MATERIALS

- 2.1 **Soil.** Soil shall consist of approved material free from vegetation or other objectionable matter encountered in the existing roadbed and other acceptance material used in preparation of the roadbed in accordance with this specification.
- 2.2 **Portland Cement.** Cement shall be either Type I or II Portland cement. The Contractor, at his option, may use bulk cement, provided the apparatus for handling, weighing and spreading the cement is approved by the Engineer in writing. Cement weighing equipment shall be as specified below.
- 2.3 **Water.** Water shall be free from substances deleterious to the hardening of the cement treatment and shall be approved by the Engineer.

3. EQUIPMENT

Equipment necessary for the proper construction of the work shall be on the project, in first-class working condition, and be approved by the Engineer, both as to type and condition, prior to the start of construction operations. The Contractor shall at all times provide sufficient equipment to enable continuous execution of the work and its completion in the required number of working days.

Portland cement treatment for materials in place may be constructed with any machine or combination of machines and auxiliary equipment that will produce results as outlined in this specification.

Mixing may be accomplished by: (1) a multiple-pass traveling mixing plant or (2) a single-pass traveling mixing plant.

The equipment provided by the Contractor shall be operated by experienced and capable workmen and shall be that necessary to provide a cement treatment meeting the requirements herein specified.

4. CONSTRUCTION METHODS

- 4.1 **General.** It is the primary requirement of this specification to secure a completed course of treated material containing a uniform Portland cement mixture free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth 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 process a sufficient quantity of material to provide full depth as shown on plans, to use the proper amount of Portland cement, maintain the work and rework the courses as necessary to meet the above requirements.

Cement treatment shall not be mixed or placed when the air temperature is below 40F and is falling, but may be mixed or placed when the air temperature is above 35F and is rising, the temperature being taken in

the shade and away from artificial heat and with the further provision that cement treatment shall be mixed or placed only when weather conditions, in the opinion of the Engineer, are suitable.

- 4.2 **Preparation of Roadbed.** Before other construction operations are begun, the roadbed shall be graded and shaped as required to construct the Portland cement treatment for material in place in conformance with the lines, grades, thickness and typical cross section shown on the plans. Unsuitable soil or material shall be removed and replaced with acceptable soil.

The sub grade shall be firm and able to support without displacing the construction equipment and the compaction hereinafter specified. Soft or yielding sub grade shall be corrected and made stable before construction proceeds.

- 4.3 **Pulverization.** The soil shall be so pulverized that, at the completion of moist-mixing, when all non-slaking aggregate retained on the No. 2 sieve are removed, the remaining material shall meet the following requirements when tested from the roadway in the roadway condition by Test Method Tex-101-E (Part III).

	Percent
Minimum passing 1-inch sieve .....	100
Minimum passing No. 4 sieve .....	80

Old bituminous wearing surface shall be pulverized so that 100 percent will pass the 2-inch sieve.

- 4.4 **Application of Cement (Road mix).** Portland cement shall be spread uniformly on the soil at the rate specified on the plans or approved by the Engineer. If a bulk cement spreader is used, it shall be positioned by string lines or other approved method during spreading to insure a uniform distribution of cement.

Cement shall be applied only to such an area that all the operations can be continuous and completed in daylight within 6 hours of such application.

The percentage of moisture in the soil, at the time of cement application, shall not exceed the quantity that will permit uniform and intimate mixture of soil and cement during dry mixing operations, and it shall not exceed the specified optimum moisture content for the soil cement mixture.

No equipment, except that used in spreading and mixing, will be allowed to pass over the freshly spread cement until it is mixed with the soil.

- 4.5 **Mixing and Processing.** Unless otherwise shown on the plans, either method (a) or (b) below may be used at the option of the Contractor.

(a) Multiple-Pass Traveling Mixing Plant. After the cement has been applied, it shall be dry-mixed with the soil. Mixing shall continue until the cement has been sufficiently blended with the soil to prevent the formation of cement balls when water is applied. Any mixture of soil and cement that has not been compacted and finished shall not remain undisturbed for more than 30 minutes.

Immediately after the dry mixing of soil and cement is complete, water as necessary shall be uniformly applied and incorporated into the mixture.

Pressurized equipment and water supply provided shall be adequate to insure continuous application of the required amount of water to sections being processed within 3 hours of application of the cement. Proper care shall be exercised to insure proper moisture distribution at all times. After the last increment of water has been added, mixing shall continue until a thorough and uniform mix has been obtained.

(b) Single-Pass Traveling Mixing Plant. After the cement has been applied it shall be sufficiently dry-mixed with the soil to prevent the formation of cement balls when water is applied. Un-pulverized soil lumps in the soil cement mixture immediately behind the mixer will not be allowed. Should this condition prevail, the Contractor shall "pre-wet" the raw soil as necessary to correct this condition.

The water shall be provided with means for visibly and accurately gauging the water application. The water shall be applied uniformly through a pressure spray bar.

After cement is spread, mixing operations shall proceed as follows:

The mixer shall in one continuous operation mix the air-dry soil and cement full depth, and the required moisture uniformly, thoroughly moist-mix the soil, cement and water, spread the completed soil cement mixture evenly over the machine processed width of the sub grade and leave it in a loose condition ready for immediate compaction. The soil and cement mixture shall not remain undisturbed, after mixing and before compacting, for more than 30 minutes.

- 4.6 **Compaction and Finishing.** The material shall be compacted to not less than 98% standard proctor unless otherwise shown on the plans. At the start of compaction, the percentage of moisture in the mixture and in un-pulverized soil lumps, based on over-dry weights, shall not be below or more than two percentage points above the specified optimum moisture content and shall be less than that quantity which will cause the soil cement mixture to become unstable during compaction and finishing. When the un-compacted soil cement mixture is wetted by rain so that the average moisture content exceeds the tolerance given at the time of final compaction, the entire section shall be reconstructed in accordance with this specification at the sole expense of the Contractor.

Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth. The loose mixture then shall be uniformly compacted to the specified density within 2 hours.

After the soil and cement mixture, excepting the top mulch, is compacted, water shall be uniformly applied as needed and thoroughly mixed in with a spike tooth harrow or equal. The surface shall then be reshaped to its required lines, grades and cross section and then lightly scarified to loosen any imprint left by the compacting or shaping equipment.

The resulting surface shall be thoroughly rolled with a pneumatic tire roller and "clipped", "skinned" or "tight bladed" by a power grader to a depth necessary to remove all loosened soil and cement from the section. The surface shall then be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. If plus No. 4 aggregate is present in the mixture; one complete coverage of the section with the flat wheel roller shall be made immediately after the "clipping" operation. When directed by the Engineer, surface finishing methods may be varied from this procedure provided a dense, uniform surface, free of surface compaction planes, is produced. The moisture

content of the surface material must be maintained at its specified optimum during all finishing operations. Surface compaction, rolling, blading and finishing shall proceed in such a manner as to produce a smooth, closely knit surface, free of cracks, ridges or loose material conforming to the crown, grade and line shown on the plans, within 3 hours of initial mixing.

## 5. CURING

5.1 **Protection and Cover.** After the cement treated course has been finished as specified herein, the surface shall be protected against rapid drying by either of the following curing methods for a period shown on plans but in no case less than 3 days or until the surface or subsequent courses are placed:

- (a) Maintain in a thorough and continuously moist condition by sprinkling.
- (b) Apply a 2-inch layer of earth on the completed course and maintain in a moist condition.
- (c) Apply a single course surface treatment. Unless shown otherwise on the plans, the asphalt shall be HFRS-2, in accordance with "Asphalts, Oils and Emulsions" in the Texas Department of Highways and Public Transportation Standard Specifications. The single course surface treatment shall be placed in accordance with Section 025418 "Surface Treatment, except HFRS-2 asphalt shall be used in lieu of AC-5 and the asphalt shall be applied at .5 gallons per square yard.

5.2 **Surface.** The surface or other base courses may be applied on the finished base as soon after completion as operations will permit.

## 6. CONSTRUCTION JOINTS

At the end of each day's construction, a straight transverse construction joint shall be formed by cutting back into the total width of completed work to form a true vertical face free of loose and shattered material.

Cement treatment for large, wide areas shall be built in a series of parallel lanes of convenient length and width meeting and approval of the Engineer.

## 7. TRAFFIC

Completed sections of cement treated material in place may be opened immediately to local traffic and to construction equipment after application of the single course surface treatment and to all traffic after the final surface course, provided the cement treated course has hardened sufficiently to prevent marring or distorting the surface by equipment or traffic.

## 8. MAINTENANCE

The Contractor shall be required, within the limits of his contract, to maintain the cement treated course in good condition until all work has been completed and accepted. Maintenance shall include immediate repairs of any defects that may occur. This work shall be done by the Contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. Faulty work shall be replaced for the full depth of treatment. It is the intent of this specification that the Contractor constructs the plan depth of cement treatment in one homogeneous mass.

9. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Soil-Cement Base shall be measured by the square yard at each application rate specified. Measurement shall include, but not be limited to, furnishing, storing and applying cement; preparation of roadbed, application of cement, mixing, watering, compacting, finishing, curing and maintenance; and all other work as specified.

SECTION 025210  
LIME STABILIZATION

1. DESCRIPTION

This specification shall consist of treating the subgrade, subbase or base by the pulverizing, addition of lime, mixing and compacting the mixed material to the required density. This specification applies to natural ground, embankment, existing pavement structure or proposed base, and shall be constructed as specified herein and in conformity with the typical sections, lines and grades as shown on the plans or as established by the Engineer.

2. MATERIALS

- (1) The lime shall be a commercially produced "Hydrated Lime" in accordance with AASHTO M216, or in accordance with TxDOT Specification Item 260. The specifications apply specifically to the normal hydrate of lime made from "high-calcium" type limestone. Hydrated lime for stabilization purposes shall be applied as a slurry.
- (2) Lime to be used for the treated subgrade, existing subbase, existing base or proposed base is determined by preliminary tests and shall be applied at a rate indicated on the drawings, but no less than 6%.

3. EQUIPMENT

The machinery, tools and equipment necessary for proper prosecution of the work shall be on the project and approved by the Engineer prior to the beginning of construction operations.

All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

Hydrated lime shall be stored and handled in closed weatherproof containers until immediately before distribution on the roadbed. 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. If lime is furnished in trucks, each truck shall have the weight of lime certified on public scales.

If lime is furnished in bags, each bag shall bear the manufacturer's certified weight. Bags varying more than 5 percent from that weight may be rejected and the average weight of bags in any shipment, as shown by weighing 50 bags taken at random, shall not be less than the manufacturer's certified weight.



#### 4. CONSTRUCTION METHODS

General - It is the primary requirement of this specification to secure a completed course of treated material containing a uniform lime mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth 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.

Application - Lime shall be spread only on that area where the first mixing operations can be completed during the same working day.

Unless otherwise shown on drawings, lime shall be applied at a rate in pounds of dry-hydrated lime per square yard, in the form of a slurry. Application rate may be varied by the Engineer, if conditions warrant, but no less than 6% must be applied.

Certification of lime quantity and quality shall be provided as required to monitor the application. Certification should be in the form of weight tickets which indicate the actual weight of dry hydrated lime,  $CA(OH)_2$ .

The application and mixing of lime with the material shall be accomplished by the method hereinafter described.

The lime shall be mixed with water in trucks with approved distributors and applied as a thin water suspension or slurry.

Mixing - The mixing procedure shall be as hereinafter described.

- (a) **First Mixing:** The material and lime shall be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until, in the opinion of the Engineer, a homogeneous, friable mixture of material and lime is obtained, free from all clods or lumps. Materials containing plastic clays or other material which will not readily mix with lime shall be mixed as thoroughly as possible at the time of the lime application, brought to the proper moisture content and left to cure 1 to 4 days as directed by the Engineer. During the curing period, the material shall be kept moist as directed.
- (b) **Final Mixing:** After the required curing time, the material shall be uniformly mixed by approved methods. If the soil binder-lime mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying or the use of other approved pulverization methods so that, when all nonslaking aggregates retained on the No. 4 sieve are removed, the remainder of the material shall meet the following requirements when tested dry by laboratory sieves:

	<u>Percent</u>
Minimum Passing 1" Sieve.....	100
Minimum Passing No. 4 Sieve.....	85

Old bituminous wearing surface shall be pulverized so that 100% will pass a 2 ½" sieve.

During the interval of time between applications and mixing, hydrated lime that has been exposed to the open air for a period of 6 hours or more, or to excessive loss due to washing or blowing, will not be accepted for payment.

Compaction - Compaction of the mixture shall begin immediately after final mixing and in no case later than 3 calendar days after final mixing, unless approval is obtained from the Engineer. The material shall be aerated or sprinkled as necessary to provide the optimum moisture. Compaction shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted as hereinafter specified.

If the total thickness of the material to be treated cannot be mixed in one operation, the previously mixed material shall be bladed to a windrow just beyond the area to be treated and the next layer mixed with lime as previously specified. The first layer of the material shall be compacted in such a manner that the treated material will not be mixed with the underlying material.

The course shall be sprinkled as required to maintain moisture content on the wet side of optimum and compacted to the extent necessary to provide the specified density. Unless shown otherwise on the drawings, all lime treated subgrades, sub-bases, and bases that are not in direct contact with surface or binder course shall be compacted to a minimum of 95% Standard Proctor density (AASHTO T99), unless otherwise specified.

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. After each section is completed, tests, as necessary, will be made by the Engineer. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements.

Rework, when required to meet pulverization requirements or density requirements, shall include the addition of lime, about 10% to 15% of the initial application rate, or as deemed necessary by the Engineer. A new optimum density will be obtained.

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 drawings and to the established lines and grades.

## 5. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, lime stabilization for bases, sub-bases and subgrade shall be measured by the square yard of lime-stabilized material in place.

Pulverizing, mixing, watering grading, compacting, working material etc., shall not be measured for pay but shall be subsidiary to other work.

Payment shall be full compensation for all materials, labor, equipment, tools, and incidentals necessary for the completion of work.

SECTION 025213  
ASPHALT STABILIZED BASE (S-26)

1. DESCRIPTION

"Asphalt Stabilized Base" shall consist of base courses, subbase courses, or foundation courses to be composed of a compacted mixture of mineral aggregate and asphaltic material mixed hot in a mixing plant.

2. MATERIALS

- (a) Asphalt: Asphalt for the mixture shall be of the type and grade as determined by the Engineer and shall meet the requirements of Section 025404 entitled "Asphalts, Oils, and Emulsions".
- (b) Tack Coat: The asphaltic material for tack coat shall meet the requirements for emulsified asphalt EA-11M or shall be a cutback asphalt made by combining 50 to 70 percent by volume of the asphaltic material specified for the paving mixture with 30 to 50 percent by volume of gasoline or kerosene. Asphaltic materials shall meet the requirements of Section 025404 entitled "Asphalts, Oils, and Emulsions".
- (c) Mineral Aggregate: The material shall consist of durable coarse aggregate particles, crushed or uncrushed, with approved binding materials and screened as necessary to meet the following gradation requirements.

<u>Square Sieve Size</u>	<u>Percent Retained By Weight</u>
2" .....	0
1-1/4" .....	0-2
#4 .....	45-75
#40 .....	60-85

The mineral aggregate shall also meet the following physical requirements.

Wet Ball Mill .....	50 max.
Plasticity Index (P.I.) .....	15 max.
Liquid Limit (L.L.) .....	55 max.
Sand equivalent value shall not be less than 40	

Testing of mineral aggregates shall be in accordance with the appropriate Texas Highway Department standard laboratory test procedures.

3. MIXTURE

The mixture shall be uniform and shall contain 6.0 percent by weight of asphaltic material. Samples of the material, when tested, shall not vary from the designated asphalt content by more than 0.5 percent dry weight (based on total mixture).

4. EQUIPMENT

Equipment used in mixing, spreading, finishing, and compacting the material shall conform to the requirements of Section 025424 entitled "Hot Mix Asphaltic Concrete Pavement", Subsection 4 entitled "Equipment".

5. STOCKPILING, STORAGE, PROPORTIONING, AND MIXING

These requirements shall be as specified in Section 025424, Subsection 5.

6. CONSTRUCTION METHODS

Construction methods shall conform to the requirements of Section 025424, Subsection 6.

7. MEASUREMENT AND PAYMENT

Asphalt stabilized base shall be measured by the square yard. Payment shall be made at the contract unit bid price, per square yard, and shall constitute full compensation for all labor, material, equipment, and incidentals necessary to complete the asphalt stabilized base course in accordance with this specification and to the lines, grades, thickness, and typical section shown on the plans.

SECTION 025215  
CEMENT STABILIZED CALICHE BASE (S-47)

NOT FOR USE ON CITY  
STREETS

1. DESCRIPTION

This specification shall govern all work required to furnish and place all cement stabilized caliche base for this project.

2. MATERIALS

1. Raw Caliche Base: Sample for testing shall be taken prior to mixing with cement.

Material shall be well graded and meet the following requirements when tested in accordance with AASHTO T27:

Sieve Size	% Passing
2"	100
1"	75-95
3/8"	40-75
No. 4	30-60
No. 10	20-45
No. 40	15-30
No. 200	5-20

The material passing the No. 40 sieve, soil binder, shall meet the following requirements:

- a. Liquid limit shall not exceed 45 when tested in accordance with AASHTO T89.
- b. Plasticity index shall not exceed 20 when tested in accordance with AASHTO T90.
- c. Linear shrinkage shall not exceed 10 when tested in accordance with THD TEX-107-E. (Note: The linear shrinkage shall be calculated from the volumetric shrinkage at the liquid limit.)

Coarse aggregate shall have an abrasion loss of not more than 55% when subjected to the Los Angeles Abrasion Test, AASHTO T96.

2. Water: Water shall be free of substances deteriorative to curing of the treated base and shall be approved by the City Engineer.
3. Cement: Cement shall be Type 1 Portland Cement in accordance with ASTM C-150. Cement shall be applied in the amount necessary to produce the desired compressive strength in the finished and cured base, depending on raw caliche used. In most cases, acceptable raw caliche will require cement in the following amount:

Percent by Weight = 7

lb. per sq. yd. for 1" depth = 5.57

In the absence of more precise data, the above amount has been used to estimate the quantity of Portland Cement in the proposal. The Engineer may increase or decrease the amount of cement at his discretion, after representative samples of the caliche have been tested.

4. Asphalt Seal: Asphalt Seal shall be MC70 in accordance with 025404.

### 3. EQUIPMENT

Equipment necessary for the proper construction of the work shall be on the project, in first-class working condition, and be approved by the Engineer, both as to type and condition, prior to the start of construction operations. The Contractor shall at all times provide sufficient equipment to enable continuous prosecution of the work and its completion in the required number of working days.

Portland Cement treatment for materials in place may be constructed with any machine or combination of machines and auxiliary equipment that will produce results as outlined in this specification.

Mixing may be accomplished by: (1) a multiple-pass traveling mixing plant or (2) a single-pass traveling mixing plant.

The equipment provided by the Contractor shall be operated by experienced and capable workmen and shall be that necessary to provide a cement treatment meeting the requirements herein specified.

### 4. CONSTRUCTION METHODS

#### 1. General:

It is the primary requirement of this specification to secure a complete course of treated material containing a uniform Portland cement mixture free from laminations or segregated areas, of uniform density and moisture content, well bound for its full depth 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 process a sufficient quantity of material to provide full depth as shown on plans, to use the proper amount of Portland cement, maintain the work and rework the courses as necessary to meet the above requirements.

Cement treatment shall not be mixed or placed when the air temperature is below 40E and is falling, but may be mixed or placed when the air temperature is above 35E F and is rising, the temperature being taken in the shade and away from artificial heat and with the further provisions that cement treatment shall be mixed or placed only when weather conditions, in the opinion of the Engineer, are suitable.

#### 2. Test Section:

The Contractor shall be required to construct a "Test Section". The first section of cement treated base shall serve as a test section. Its length shall be between 300 and 500 linear feet, typically one block. Evaluation of the equipment and procedure will be done during this section. In case it is found that the work is not satisfactory with respect to the specification requirements, the Contractor shall revise his procedures and augment or replace equipment as necessary to assure work completed in accordance with the specifications. Additional test sections may be required as directed by the Engineer. Test sections not conforming to the requirements of the specifications shall be reconstructed.

3. Placing of Base Material:

After approval of the previous course, base material shall be delivered on the road and placed in windows of uniform sections, then accurately bladed and shaped to required crown and grade to provide a base of compacted depth required by the plans.

4. Final Preparation of Section:

On the day immediately preceding processing, water, as required, shall be added and uniformly mixed full depth with the base material. This operation shall precede cement spreading by at least 12 hours. The section shall then be accurately bladed and shaped to required grade and section.

5. Application of Cement:

The specified quantity of Portland Cement required for the full depth of treatment shall be uniformly spread over the surface. Each pass of the cement spreader shall be positioned by either the curb line or a string line. Cement shall be applied only to such areas as can be completed as herein specified within the daylight hours of the same day. No equipment, except that used in spreading and mixing, will be allowed to pass over the freshly spread cement until it is mixed with the base material.

6. Mixing and Processing:

Either method (a) or (b) below may be used at the option of the Contractor.

- (a) Multiple-Pass Traveling Mixing Plant: After the cement has been applied, it shall be mixed with the base material. Mixing shall continue until the cement has been sufficiently blended with the base material to prevent the formation of cement balls when water is applied. Any mixture that has not been compacted and finished shall not remain undisturbed for more than 30 minutes.

Immediately after the mixing of base material and cement is completed, water, as necessary, shall be uniformly applied and incorporated into mixture. Proper care shall be exercised to insure proper moisture distribution at all times. After the last increment of water has been added, mixing shall continue until a thorough and uniform mix has been obtained.

- (b) Single-Pass Traveling Mixing Plant: After the cement has been applied, it shall be sufficiently mixed with the base material to prevent the formation of cement balls when water is applied. Un-pulverized soil lumps in mixture will not be allowed. Should this condition prevail, the Contractor shall "pre-wet" the raw base material as necessary to correct this condition.

The mixer shall be provided with means for visible and accurately gauging the water application. The water shall be applied uniformly through a pressure spray bar. After cement is spread, mixing operations shall proceed as follows:

The mixer shall, in one continuous operation, mix the base material and cement full depth, add the required moisture uniformly, thoroughly moist-mix the material, cement, and water, spread the completed mixture evenly over the machine processed width of the



subgrade, and leave it in a loose condition ready for immediate compaction.

The mixture shall not remain undisturbed, after mixing and before compacting, for more than 30 minutes.

7. Completion and Finishing:

The material shall be compacted to not less than 98 percent of the maximum dry density as determined by AASHTA T99 Method D. The moisture content of the mixture shall be within 3% of optimum on the wet side.

The surface, upon completion, shall be smooth and in conformity with typical sections and to the established lines and grades. Any deviation in excess of 1/4 inch in cross section and in a length of 16 feet measured longitudinally shall be corrected. All irregularity, depressions, or weak spots which develop shall be corrected by re-priming.

All sections of cement stabilized base shall be processed full width each day without longitudinal construction joints.

Any portion which has a density below that specified herein and which has not properly hardened after a suitable time interval shall be removed and replaced to meet this specification at the expense of the Contractor.

8. Asphalt Seal:

The compacted cement treated base course shall be protected against rapid drying by priming the surface in accordance with 025412. This curing seal shall be applied as soon as practicable, but not later than eight hours after the completion of final compaction. The surface shall be kept moist until the curing seal is applied. It shall be the responsibility of the Contractor to protect the primed surface until surface course is applied.

9. Traffic:

The Contractor shall not be permitted to drive heavy equipment over completed portions, but pneumatic-tired equipment required for hauling cement, and water may be permitted after the surface has hardened sufficiently to prevent the equipment from marring the surface, provided protection and cover specified herein are not impaired. The cement stabilized base may be opened to local traffic as soon as the asphalt seal has been applied and sanded or cured as necessary to prevent it from being picked up by traffic. It may be opened to all traffic after 7 days. Surface coarse shall be applied prior to opening to through traffic.

10. Maintenance:

The Contractor shall be required to maintain at his own expense the entire cement stabilized base within the limits of his contract in good condition satisfactory to the Engineer from the time he first starts work until all work shall have been completed.

Maintenance shall include immediate repairs of any defect that may occur after construction, which work shall be done by the Contractor at his own expense and repeated as often as necessary to keep the area continuously intact. Repairs are to be made in a manner to insure restoration of a uniform surface of good quality cement stabilized base. Faulty work shall be replaced for the full depth of base. Any low area shall be remedied by

replacing the material for the full depth of treatment, rather than adding a thin layer of base material to the completed work.

5. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Cement Stabilized Base will be measured by the square yard, complete in place, for the thickness specified on the plans. Areas will be measured separately for the various thicknesses of Cement Stabilized Base. Portland Cement, actually incorporated in the completed work, will be measured by the ton.

SECTION 025223  
CRUSHED LIMESTONE FLEXIBLE BASE

1. DESCRIPTION

This Specification shall govern all work for furnishing and placing Crushed Limestone Flexible Base required to complete the project.

2. MATERIAL

Crushed Limestone Flexible Base shall consist of crushed limestone produced from oversize quarried aggregate, sized by crushing and produced from a naturally occurring single source, meeting the requirements for Type 'A' material as specified in Texas Department of Transportation (TxDOT) Specification Item 247 "Flexible Base". Crushed gravel or uncrushed gravel shall not be acceptable. No blending of sources and/or additive materials will be allowed. The material shall be free of vegetation and shall be approved by the Engineer. All acceptable material shall be screened and the oversize shall be crushed and returned to the screened material in such a manner that a uniform product will be produced which meets all of the physical requirements for Grade 1-2 as specified in TxDOT Specification Item 247 "Flexible Base".

3. TESTING

The City will engage a laboratory and pay for one test each gradation, liquid limit, plasticity index, modified proctor, moisture-density relation, CBR, and necessary field densities. The Engineer may call for additional tests at any time. The cost of all retests, in case of failure to meet specifications, will be deducted from the Contractor's payment. The City will pay for proctor and soil constants and abrasion tests at the rate described in the materials testing schedule. If material changes, the Contractor shall pay the cost of additional tests required by the Engineer. The Engineer may waive testing and/or lime admix for small amounts for unimportant uses.

4. CONSTRUCTION METHODS

Prior to placement of flexible base, the surface of the previous underlying course shall be finished true to line and grade as established, and in conformity with the typical section shown on the drawings. Grade tolerance shall be generally 1/2 inch, and highs and lows must approximately balance. If called for in the drawings or elsewhere in the contract documents, geogrid, as specified in City Standard Specification Section 022040 "Street Excavation", shall be placed as indicated.

Flexible base shall be delivered and spread the same day if possible (no later than the next day).

Base shall be mixed as required to produce a uniform mixture with water. Base shall be placed in uniform lifts not to exceed 10 inch loose lifts or 8 inch compacted lifts. Moisture and density requirements shall be as indicated on the drawings, typical minimum 98% Modified Proctor

(ASTM D1557) under flexible pavements or typical minimum 98% Standard Proctor (ASTM D698) under concrete pavement and to within  $\pm 2\%$  of optimum moisture. The section may be accepted if no more than 1 of the 5 most recent moisture or density tests is outside of the specified limits, and the failed test is within  $\pm 1\%$  deviation from specified moisture or density requirements.

The surface of the compacted base, after meeting moisture and density requirements, shall be primed in accordance with City Standard Specification Section 025412 "Prime Coat".

On completion of compaction and priming, the surface shall be smooth and conform to lines, grades, and sections shown on the drawings. Areas with any deviation in excess of 1/4 inch in cross-section and in lengths of 16 feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping, and recompacting by repriming and rolling.

Moisture and density shall be maintained until the paving is complete. Excessive loss of moisture shall be prevented by sprinkling, sealing, or covering with a subsequent layer. Should the base, due to any reason or cause, lose the required stability, density, or moisture before it is protected by placement of the next layer, it shall be re-compacted, refinished, and retested at the expense of the Contractor until acceptable to the City.

## 5. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, crushed limestone flexible base shall be measured by the square yard complete in place. Payment shall be full compensation for all materials, royalty, hauling, placing, compacting, labor, equipment, tools, and incidentals necessary for the completion of work.

Prime shall be measured and paid under separate bid item if specified on the Bid Form.

Geogrid shall be measured and paid under separate bid item if specified on the Bid Form.

SECTION 025224  
FLEXIBLE BASE - SHELL WITH SAND ADMIXTURE (S-25)

1. DESCRIPTION

"Flexible Base - Shell with Sand Admixture" shall consist of a foundation course for surface course or other base courses, shall be composed of shell and binder, and shall be constructed as herein specified in one or more courses in conformity with the typical sections shown on plans and to the lines and grades as established by the Engineer.

2. MATERIALS

- (1) Shell - Shell shall consist of durable particles of shell with or without its natural binder material and may be either washed, partially washed, or unwashed.
- (2) Sand - Sand shall consist of fine sand or sandy loam and shall be practically free from roots, grass, and other foreign materials.
- (3) Flexible Base - All materials shall be obtained from sources designated on the plans or approved by the Engineer. Both the shell and sand shall be of such quality that when properly proportioned and mixed a satisfactory flexible base material will be produced. Samples for testing shall be taken prior to the compaction operations.

The Contractor will be responsible for furnishing shell and sand which, when properly mixed, will produce a satisfactory uniform mixture of 60% shell and 40% sand.

3. GRADATION

The combined material shall conform to the following requirements:

Passing 13 inch sieve ..... 90 - 100%  
Retained on No. 40 sieve ..... 45 - 65%

The material passing the NO. 40 sieve shall be known as soil binder and shall meet the following requirements:

The Liquid Limit shall not exceed ..... 35  
The Plasticity Index shall not exceed ..... 10

The Engineer may accept the material providing not more than 2 out of 10 consecutive gradation tests performed are outside the specified limit on any individual or combination of sieves by no more than 5% and where no two consecutive tests are outside the specified limit.

The Engineer may accept the material providing not more than 2 out of 10 consecutive plasticity index samples tested are outside the specified limit by no more than 2 points and where no two consecutive tests are outside the specified limit.

4. CONSTRUCTION METHODS

Immediately before placing the base material, the subgrade shall be checked as to conformity with grade and section. Grade tolerance shall be generally 2 inch, highs and lows must approximately balance.

A central mixing plan, or a road mixing machine, or a combination of machine shall be used to produce a uniform material meeting all of the requirements of this specification.

The base material shall be delivered and spread uniformly, sprinkled and compacted to 100% standard proctor density. In addition to the density requirement, the full depth of flexible base shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of flexible base is completed, tests as necessary will be made by the Engineer. 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.

In that area on which pavement is to be placed, any deviation in excess of 1/4 inch in cross section and in a length of 16 feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and re-compacting by sprinkling and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and re-compacting by sprinkling and rolling. Should the base course, due to any reason or cause, lose the required stability, density and finish before the surfacing is complete, it shall be re-compacted and refinished at the sole expense of the Contractor.

#### 5. MEASUREMENT

Measurement shall be by the square yard in place of the combined shell and sand admixture or by the cubic yard in truckloads, whichever is specified in the bid.

#### 6. PAYMENT

The unit price bid for flexible base shall be full compensation for securing and furnishing all materials, including all royalty and freight involved, furnishing scales and labor involved in weighing the material when required, all processing and loading, hauling, labor, and equipment to complete.

SECTION 025402  
PLANING ASPHALTIC SURFACES (S-27A)

1. DESCRIPTION

This specification shall govern all work required for planing an existing asphaltic concrete pavement required to complete the project.

2. EQUIPMENT

Planer shall be a self propelled planing machine capable of removing, in one pass, a.c. surface to any required thickness less than 9 inches, in a minimum of 6-foot width. The planer shall be capable of accurately and automatically establishing profile grades along each edge of the machine by referencing from the existing pavement or curb and shall have an automatic system for controlling cross slope.

The machine shall be equipped with an integral loader to remove material being cut from the surface of the roadway and discharge the cuttings into a truck, all in one operation. Adequate back-up equipment (street sweepers, loaders, water trucks, etc.) and personnel will also be provided to minimize dust and remove all cuttings. The planer shall be equipped with means to control dust created by the cutting action and shall have a manual system providing for uniformly varying the depth of cut while the machine is in motion thereby making it possible to cut flush to all inlets, manholes, or other obstructions within the paved area.

Any machine that is incapable, in the opinion of the Engineer, of meeting these requirements will not be permitted to be used. Various machines may be permitted to make trial runs to demonstrate to the Engineer the capabilities of that machine.

3. CONSTRUCTION METHODS

The pavement surface shall be removed to the depth, width, grade and cross section as shown on the plans, or as directed by the Engineer.

The Engineer may require that the pavement planing operation be referenced from an independent grade control in those areas where he deems this type of control to be appropriate. For this type of operation, the independent grade control shall be established and maintained by the Contractor in a manner acceptable to the Engineer, and the final position of it shall be acceptable to the Engineer.

In the event the entire pavement width along a section of street has not been planed to a flush surface by the end of a work period resulting in a vertical or near vertical longitudinal face extending more than 1.25 inches in height, this longitudinal face shall be sloped in a manner acceptable to the Engineer so as not to create a hazard to traffic. Traverse faces that are present at the end of a work period shall be tapered in a manner approved by the Engineer to avoid creating a hazard for traffic.

Unwanted loose material resulting from the operation shall become property of the Contractor and disposed of by the Contractor in an acceptable manner.

When located adjacent to steep curbs, pavement that cannot be removed by the planing machine shall be removed by other methods acceptable to the Engineer and the pavement and curb surface shall be cleaned of all debris and left in a neat and presentable condition.

In planed areas where traffic is permitted, "Grooved Pavement Ahead" Signs shall be erected in advance of the planed areas. Signs shall be erected prior to planing in the areas and shall be maintained in place while the planed area is overlaid. Signs shall be in accordance with the "Texas Manual on Uniform Traffic Control Devices for Streets and Highways" and "Standard Highway Sign Designs for Texas".

In planed areas where traffic is permitted, a safe and satisfactory riding surface shall exist.

Unless otherwise shown on the plans or directed by the Engineer, the grade reference used by the Contractor may be of a type approved by the Engineer. Control points, if required by the plans or Engineer, will be established for the finished grade by the Engineer. These points will be set at intervals not to exceed 50 feet. The Contractor shall set the grade reference for the sensor of the automatic control to follow from the control points established by the Engineer, and this grade reference shall have sufficient support so that the maximum deflection shall not exceed 1/16 inch per 25 feet.

The planed surface shall be smooth and true to the established line, grade and section. When tested with a 10 foot straightedge placed parallel to the centerline of the roadway or tested by equivalent or acceptable means, except as provided herein, the maximum deviation shall not exceed 1/8 inch in 10 feet. Any point in the planed surface not meeting this requirement shall be corrected as directed by the Engineer.

#### 4. MEASUREMENT & PAYMENT

Unless indicated otherwise in the Proposal, Planning Asphalt shall be measured by the square yard of pavement surface area planed. Measurement will be made only one time for an area, regardless of the number of passes required to be made in order to achieve the desired results.

Payment will be made at unit price bid and shall include, but not be limited to, all planing, cleaning, loading, hauling, signs, labor, tools, equipment and incidentals required to complete the work.



SECTION 025404  
ASPHALTS, OILS AND EMULSIONS

1. DESCRIPTION

This specification shall govern all work for asphalt cement, cut-back and emulsified asphalts, performance-graded asphalt binders, and other miscellaneous asphaltic materials required to complete the project.

2. MATERIALS

When tested according to Texas Department of Transportation Test Methods, the various materials shall meet the applicable requirements of TxDOT Specification Item 300, "Asphalts, Oils, and Emulsions" (Latest Edition).

3. STORAGE, HEATING AND APPLICATION TEMPERATURES

Store and apply asphaltic materials in accordance with TxDOT Item 300 (Latest Edition) at the lowest temperature yielding satisfactory results. Follow the manufacturer's instructions for any agitation requirements in storage and in application and storage temperatures.

4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, asphalts, oils and emulsions shall not be measured and paid for separately, but shall be considered subsidiary to the appropriate bid item.

SECTION 025407  
ASPHALT RECYCLING IN PLACE (S-27)  
(Hot Recycle Method)

1. DESCRIPTION

This specification shall govern all work required for recycling and repaving the existing asphalt pavement required to complete the project. The system shall include heating, scarifying, remixing with rejuvenator, and reshaping an existing asphalt surface followed by subsequent addition of virgin HMAC overlay course, all done in a single multi-step process.

2. MATERIALS

**HOT MIX ASPHALT CONCRETE (HMAC)** Unless indicated otherwise on the drawings, shall be Type 'D' in accordance with Section 025424 of the Standard Specifications

**REJUVENATING AGENT** shall be RA1 or as shown in the drawings and in accordance with AASHTO M14-88 "Classifying Hot-Mix Recycling Agents".

**ABBREVIATED PAVEMENT MARKINGS** unless indicated otherwise on the drawings, shall be in accordance with Section 025805 of the Standard Specifications.

3. EQUIPMENT

**The machine that heats, scarifies, rejuvenates and levels** must also lay the new hot-mix. New hot-mix must be laid within 30 seconds after scarification begins to ensure a Hot Monolithic Bond with the old pavement.

**RECYCLING/REPAVING UNIT** shall be a self-contained machine, specifically designed to accomplish the work as described above. Major components of the unit shall include heater, scarifier, gathering & mixing auger, mixing & spreading auger, and two vibratory screeds.

**HEATER** unit shall include an enclosed heating mechanism that is capable of sufficiently heating the pavement to allow scarification without braking aggregate; charring pavement; and polluting air.

**SCARIFYING** unit shall be equipped with automatic height adjustments and capable of uniformly scarifying the existing surface to a depth

of at least 1"

**REJUVENATOR APPLICATOR** shall be adjustable and capable of synchronizing application rate with machine speed.

**SCREEDS** shall be of the four section, heated, vibratory type.

#### 4. CONSTRUCTION METHODS

**EXISTING PAVEMENT** to be recycled shall be cleaned by the Contractor as required to have surface free of deleterious material during recycling.

**MANHOLE CLOVERS AND VALVE BOX** for sewers, water valves and gas valves shall be cross-referenced by the Contractor for adjustment to grade upon completion of overlay

**LONGITUDINAL SEAMS** shall have full thickness weld of recycled material with a minimum of 2-inch lap.

**HEATING** of existing pavement shall be done such that the pavement is evenly heated without differential burning or charring of asphalt. The heated material shall typically have a temperature between 235 to 285 F., when measured behind the heater scarifier.

**SCARIFICATION** of heated pavement shall be to a minimum average depth of 3/4", except for pavements immediately adjacent to manholes & valves.

**MIXING OF REJUVENATOR** with the scarified material shall be as required to provide a uniformly mixed material capable of having Hveem Stability in excess of 32% with a rejuvenator application rate of approximately .05 gal/yd<sup>5</sup>. Rejuvenator shall be applied without dilution, unless authorized otherwise by the Engineer.

**VIBRATORY SCREEDING** of recycled HMA shall follow as required to reshape the mixture to proper section and compact the recycled material to a minimum of 80% of Maximum Theoretical Density.

**NEW HMA** shall be placed over the Recycled HMA while the temperature of the Recycled HMA is still above 235 F. Unless specified otherwise on the drawings, the new HMA shall be Type 'D' in accordance with Section 025424 of the Standard Specifications and applied at a rate indicated on the drawings but not less than 80 Lb. per Square Yard.

**VIBRATORY SCREEDING** of New HMAC shall follow as required to achieve proper section and compact the New HMAC to a minimum of 80% of maximum theoretical density.

**ROLLING/COMPACTION** shall follow as required to provide a uniformly compacted mixture with an average density of at least 92% of Maximum Theoretical Density, with no individual density less than 90% of Maximum Theoretical Density in accordance with THD Specs Tex-207-F and Tex-227-F.

**TEMPORARY PAVEMENT MARKINGS** shall be placed as soon as possible after paving operation, unless indicated otherwise on the Drawings. The Contractor shall remove temporary markings as required.

#### 5. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, **ASPHALT RECYCLING** shall be measured by the square yard of pavement surface recycled. Payment shall include heating, scarifying, mixing, shaping, recompacting and all other labor materials and incidentals necessary to accomplish the work.

Unless indicated otherwise in the Proposal, **REJUVENATION AGENT** shall be measured by the gallon of Rejuvenating Agent incorporated into the recycled pavement. Payment shall include furnishing and mixing of Rejuvenating Agent complete and in place.

Unless indicated otherwise in the Proposal, **HOT-MIX ASPHALT CONCRETE (HMAC)** SHALL BE measured by the ton of HMAC provided in place.

Unless indicated otherwise in the Proposal, **MANHOLE ADJUSTMENT AND WATER VALVE ADJUSTMENT** shall be subsidiary work and not measured for pay.

SECTION 025410  
ASPHALT CRACK SEALING (S-36)

1. DESCRIPTION

This item establishes the requirements for the performance of all work necessary for asphalt crack sealing.

2. MATERIALS

- 1) Asphalt Material - The asphalt material for crack sealing shall be RC-2 with one percent (1%) anti-stripping agent added as directed by the Engineers. The temperature range for the material shall be 125 - 200 F (51.7 - 93.3 C) when applied.
- 2) Aggregate for Blotting - "Buckshot Aggregate" or Sand shall be clean and dry and conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 4 (4.75 mm)	90 - 100
No. 10 (2.00 mm)	0 - 15

3. CONSTRUCTION METHOD

- 1) Cleaning - All cracks shall be thoroughly cleaned of undesirable material by the use of an 85 to 90 CFM (2.4 to 2.6 cubic meter per minute) (Minimum Size) air compressor with hoses and attachments.
- 2) Filling Procedure - After all cracks have been thoroughly cleaned, the operator of the hand hose shall apply hot liquid asphalt and then the blotting aggregate to the cleaned cracks. Application of the liquid asphalt and blotting aggregate shall be done in such a manner to avoid an accumulation of excess material on areas adjacent to the cracks. Excess material on the cracked areas shall be removed by means of a U - shaped squeegee.

4. MEASUREMENT & PAYMENT

Unless indicated otherwise in the Proposal, **ASPHALT CRACK SEALING** shall be measured by the square yard in place to the limits shown on the plans and as directed by the Engineer. The work shall include all labor, equipment and materials necessary to complete the work.

SECTION 025412  
PRIME COAT

1. DESCRIPTION

This specification shall consist of an application of asphalt material on the completed base course and/or other approved area in accordance with this specification.

Prime Coat shall not be applied when the air temperature is below 60° F and falling, but it may be applied when the air temperature is above 50° F and is rising; the air temperature being taken in the shade and away from artificial heat. Asphalt material shall not be placed when general weather conditions, in the opinion of the Engineer, are not suitable.

2. MATERIALS

The asphalt material used for the prime coat shall be MC-30 medium-curing cutback asphalt or AE-P asphalt emulsion prime, unless otherwise specified, and when tested by approved laboratory methods shall meet the requirements of City Standard Specification Section 025404 "Asphalts, Oils and Emulsions". Blotter material shall be native sand.

3. CONSTRUCTION METHODS

When, in the opinion of the Engineer, the area and/or base is satisfactory to receive the prime coat, the surface shall be cleaned of dirt, dust, and other deleterious matter by sweeping or other approved methods. If found necessary by the Engineer, the surface shall be lightly sprinkled with water just prior to application of the asphalt material. The asphalt material shall be applied on the clean surface by an approved type of self-propelled pressure distributor so 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 asphalt 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.

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

Prime shall be applied at a temperature within the recommended range per City Standard Specification Section 025404 "Asphalts, Oils and Emulsions", with that range being 70 to 150 degrees F. Application rate shall be not less than 0.15 gallon per square yard, unless otherwise specified.

The Contractor shall be responsible for the maintenance of the surface until the Engineer accepts the work.

No traffic hauling or placement of any subsequent courses shall be permitted over the freshly applied prime coat until authorized by the Engineer. Spread blotter material before allowing traffic to use a primed surface.

Allow sufficient time for the prime coat to cure properly before applying surface treatment or asphaltic concrete pavement.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, prime coat shall be measured by the gallon of asphalt material applied. Payment shall include furnishing, heating, hauling and distributing the asphalt material as specified; for furnishing, spreading and removing sand blotter material; for all freight involved; and for all manipulation, labor, materials, tools, equipment and incidentals necessary to complete the work.

SECTION 025414  
AGGREGATE FOR SURFACE TREATMENT

1. DESCRIPTION

This specification establishes the requirements for surface aggregate to be used in the construction of surface treatments and seal coats. The type, grade, and surface aggregate classification (SAC) of aggregate shall be as specified in the applicable specification or as shown on the drawings.

2. AGGREGATE

- A. Materials. Furnish uncontaminated materials of uniform quality throughout that meet the requirements of the drawings and specifications. Materials shall meet the applicable requirements of TxDOT Specification Item 302 “Aggregates for Surface Treatments” (latest edition).

3. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, aggregate for surface treatment and seal coats shall not be measured and paid separately, but shall be subsidiary to the construction in which these materials are used.



SECTION 025416  
SEAL COAT

1. DESCRIPTION

This specification shall consist of a surface treatment composed of a single or multiple application of asphalt covered with aggregate for the sealing of existing pavements in accordance with this specification.

Seal coats shall not be applied when the air temperature is below 60°F and falling, but may be applied when the air temperature is above 50°F and rising; the air temperature being taken in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer, are not suitable.

2. MATERIALS

- (1) Asphaltic Materials. The asphaltic material used shall be AC-5 (AC-3 in winter) or other approved material as prescribed in Standard Specification Section 025404 "Asphalts, Oils and Emulsions", whichever is called for on the plans.

- (2) Aggregate.

**Single Course** - The aggregate used shall be Type PA (pre-coated aggregate), Grade 5 (1/2" maximum size), as described in specification Section 025414 "Aggregate For Surface Treatment".

**Multiple Course** - The aggregate used for multiple course seal coat shall be the same as for single course, except Grade 4 (5/8" maximum size) aggregate will be required for the first course, and Grade 5 (1/2" maximum size) aggregate will be required for the second and third (surface) courses, as shown in the plans and specifications.

3. CONSTRUCTION METHODS

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. Asphaltic material shall be applied on the cleaned surface by an approved type of self-propelled pressure distributor, so 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 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.

Asphaltic material may be applied for the full width of the seal coat in one application unless the width exceeds 26 feet. Asphaltic material shall not be applied until immediate covering with aggregate is assured. Immediately after the application of asphalt, the aggregate shall be evenly spread over the surface. Mechanical spreading devices shall be of a type approved by the Engineer. The cover material must be evenly and accurately distributed to the end that an even and smooth surface is obtained. Immediately after the aggregate has been applied, the surface shall be adequately raked and broomed to insure uniformity. As soon as proper distribution of aggregate can be obtained, the surface shall be flat-rolled with a roller having a gross weight of not less than four (4) tons and not more than ten (10) tons. The Contractor shall so arrange his work that the rolling of all aggregate applied that day shall be completed on the road before daylight. The asphalt and aggregate shall be applied at the approximate rate indicated on plans within the limits of the following schedule or as directed by the Engineer.

	<u>Gallons of Asphalt</u> <u>Per Square Yard</u>		<u>Aggregate</u> <u>Cu.Yd. to Sq.Yd.</u>	
	<u>Min.</u>	<u>Max.</u>	<u>Min.</u>	<u>Max.</u>
Asphalt Cement.. .....	0.15	0.30	1:200	1:100

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 manner that the asphaltic material will not adhere to or be picked up on the wheels of vehicles.

All storage tanks, piping, retorts, 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 manner that there will be no contamination of the asphalt with foreign material. 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 temperature of application shall be within the limits recommended in City Standard Specification Section 025404 "Asphalts, Oil and Emulsions", with that being 220 to 300 degrees F for AC-3, and 275 to 350 degrees F for AC-5.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise indicated in the Bid Form, seal coat will be measured by the square yard in place to the limits shown on the plans and as directed by the Engineer.

Payment shall be full compensation for cleaning and sprinkling the existing surface; for furnishing, preparing, hauling and placing all materials; for all freight involved; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

SECTION 025418  
SURFACE TREATMENT

1. DESCRIPTION

One-course surface treatment shall consist of a wearing surface or underseal composed of a single application of asphalt material covered with aggregate, constructed on the prepared base course or surface in accordance with this specification.

Two-course surface treatment shall consist of a wearing surface or underseal composed of two applications of asphalt material, each covered with aggregate, constructed on the prepared base course or surface in accordance with this specification.

Three-course surface treatment shall consist of a wearing surface or underseal composed of three applications of asphalt material, each covered with aggregate, constructed on the prepared base course or surface in accordance with this specification.

2. MATERIALS

1) Asphalt Materials.

The asphalt material used shall be AC-5 (AC-3 in winter) or other approved material as prescribed in Standard Specification Section 025404 "Asphalts, Oils and Emulsions".

2) Aggregate.

The aggregate used shall be Type PE pre-coated natural limestone rock asphalt as prescribed in City Standard Specification Section 025414 "Aggregate for Surface Treatment", graded as shown below.

One-Course:	Grade 4
Two-Course:	Grade 4 – 2 <sup>nd</sup> course (top) Grade 3 – 1 <sup>st</sup> course (bottom)
Three-Course:	Grade 4 – 3 <sup>rd</sup> course (top) Grade 3 – 2 <sup>nd</sup> course (middle) Grade 3 – 1 <sup>st</sup> course (bottom)

3. CONSTRUCTION METHODS

Allow sufficient time for the prime coat to cure properly before applying the surface treatment binder. 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 the asphalt material.

Asphalt material shall be applied on the clean surface by an approved type of self-propelled pressure distributor, so 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 asphalt 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 an accurate and satisfactory record of such calibration. After beginning the work, should the yield on the asphalt material appear to be in error, the distributor shall be calibrated in a manner satisfactory to the Engineer before proceeding with the work.

Asphalt material may be applied for the full width of the surface treatment in one application, unless the width exceeds 26 feet. No traffic or hauling will be permitted over the freshly applied asphalt material. Asphalt material shall not be applied until immediate covering is assured.

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.

Surface treatment shall not be applied when the air temperature is below 60° F and is falling, but it may be applied when the air temperature is above 50° F and is rising; the air temperature being taken in the shade and away from artificial heat. Asphalt material shall not be placed when general weather conditions, in the opinion of the Engineer, are not suitable.

The rates of application of the aggregate and asphalt shall be as follows or as otherwise specified:

	<u>1st Course</u>	<u>2nd Course</u>	<u>3rd Course</u>
Asphalt Cement	0.20 gal/sq.yd.	0.16 gal/sq.yd.	0.16 gal/sq.yd.
Aggregate	80 sq.yd./cu.yd.	100 sq.yd./cu.yd.	100 sq.yd./cu.yd.

The entire surface shall be broomed, bladed or raked and thoroughly rolled as required by the Engineer.

Where multiple courses are specified, each course shall be applied in the manner specified for one course surface treatment.

The Contractor shall be responsible for the maintenance of the surfaces until the Engineer accepts the work.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphalt materials shall be kept clean and in good operating condition at all times, and they shall be operated in such manner that there will be no contamination of the asphalt materials with foreign material. 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 based on the temperature-viscosity relationship that will permit application of the asphalt within the limits recommended in Standard Specification Section 025404 "Asphalts, Oils and Emulsions", with that being 220 to 300 degrees F for AC-3, and 275 to 350 degrees F for AC-5.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, surface treatment as an integral part of the final structural pavement section shall be measured in place by the square yard of surface area to the limits shown on the plans and as directed by the Engineer.

Payment shall be full compensation for all labor, materials, tools, equipment and incidentals necessary to furnish and place the type of surface treatment called for.

Surface treatment for temporary pavements shall not be measured and paid separately, but shall be subsidiary to the construction in which the surface treatment is used.

SECTION 025419  
SLURRY SEAL (S-37)

1. SCOPE: The work covered by this specification consists of furnishing all plant, labor, equipment and material and performing all operations necessary in connection with the application of a slurry seal surface upon designated areas.

2. DESCRIPTION: The slurry seal shall consist of a mixture of emulsified asphalt, mineral aggregate, and water; properly proportioned, mixed and spread on the surface as specified here in and as directed by the Engineer.

3. MATERIALS:

A. Asphalt Emulsion. The emulsified asphalt shall be type SS-1h conforming to A.S.T.M. D-977 except that the viscosity requirement shall be changed to range of 20-50.

B. Aggregate. The mineral aggregate shall consist of natural or manufactured sand, slag, crushed fines, or a combination thereof. The aggregate shall be clean and free of vegetable matter and other deleterious substances. The aggregate blend shall have a minimum sand equivalent value of not less than 45 when tested by AASHTO T176-56. Smooth textured sand of less than 1.25% water absorption shall not exceed 50% of the total combined aggregate.

C. Mineral Filler. Mineral filler shall be any recognized brand of Portland cement that is free of lumps.

D. Water. All water used with the slurry seal mixture shall be potable and free from harmful soluble salts.

4. EQUIPMENT: All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working condition.

A. Mixer. The slurry seal mixing machine shall be a continuous flow mixing unit and be capable of delivering water and also capable to deliver accurately a predetermined proportion of aggregate and asphalt emulsion to the mixing chamber and to discharge the thoroughly mixed product on a continuous basis. The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients together. No violent mixing shall be permitted.

The mixing machine shall be equipped with an approved fines feeder that provides an accurate metering device or method to introduce a predetermined amount of mineral filler into the mixer at the same time and location that the aggregate is fed. The fines feeder shall be used whenever added mineral filler is a part of the aggregate blend.

The mixing machine shall be equipped with a water pressure system and fog type spray bar, adequate for complete fogging of the surface preceding spreading equipment, with a maximum application rate of 0.05 gallons per square yard. A calibrated control for aggregate and asphalt emulsion shall be provided and capable of proportioning accurately the materials.

The machine shall be capable of a minimum speed of 60 feet per minute and shall not be allowed to exceed 180 feet per minute while in operation. Sufficient machine storage capacity to mix properly and apply a minimum of five tons of the slurry shall be provided.

B. Spreading Equipment. Attached to the mixer machine shall be a mechanical type squeegee distributor equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. It shall be maintained so as to prevent loss of slurry on varying grades and crown by adjustments to assure uniform spread. There shall be a steering device and a flexible strike-off.

C. Auxiliary Equipment. Hand squeegees, shovels, and hand equipment shall be provided as necessary to perform work.

5. PROPORTIONING: The Engineer shall approve all slurry seal materials and methods prior to mixing and application. The proportions of the mixture to be used shall be as follows unless variations are approved by the Engineer. The Contractor shall make trial batches for evaluation at this expense to determine the final blend of mineral aggregate and residual asphalt.

Aggregate:

The combined mineral aggregate shall conform to the following gradation when tested by the previous mentioned test:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8	100
#4	85 - 100
#8	65 - 90
#16	45 - 70
#30	30 - 50
#50	18 - 30
#100	10 - 21
#200	5 - 15

Emulsified Asphalt:

The amount of asphalt emulsion to be blended with the aggregate shall be such to result in a residual asphalt content of 7.5 to 13.5 percent by weight of dry aggregate.

Mineral Filler:

Mineral filler shall not exceed 3.0 percent by weight of the dry aggregate.

Water:

A minimum amount of water shall be added as necessary to produce the proper consistency and obtain a fluid and homogeneous mixture.

6. CONSTRUCTION REQUIREMENTS:

The slurry shall not be applied when either atmospheric pavement temperature is 55 F and falling but may be applied when either the atmospheric or pavement temperature is 45 F and rising. The slurry shall not be applied during period of abnormally high relative humidity.

Immediately prior to applying slurry seal, the surface shall be cleaned of all loose material, silt spots, vegetation, and other objectionable material.

All existing pavement markings shall be removed by grinding.

Any depressions, large cracks, etc., shall be patched before applying the

slurry seal surface.

The rate of application of the slurry seal shall be between 8 and 12 pounds per square yard based on dry aggregate weight.

The surface shall be fogged with water directly preceding the spreader. The slurry mixture shall be of the desired consistency when deposited on the surface and no additional elements shall be added. Total time of mixing shall not exceed four minutes. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that complete coverage is obtained, and the maximum allowable speed shall be 180 feet per minute.

Approved squeegees shall be used to spread slurry in non-accessible areas to the slurry mixer.

Excess build up of slurry on longitudinal or transverse joints will not be permitted.

The slurry seal surface shall be rolled by a pneumatic roller having a tire pressure of 50 pounds per square inch. The paved area shall be subjected to a minimum of five passes with the roller.

#### 7. MEASUREMENT AND PAYMENT:

Unless indicated otherwise in the Proposal, **SLURRY SEAL** shall be measured and paid for by the square yards of material installed and accepted. Such payment and price shall constitute full compensation for all labor, materials equipment and incidentals necessary to complete the item as specified.



SECTION 025424  
HOT MIX ASPHALTIC CONCRETE PAVEMENT (Class A)

1. DESCRIPTION

This specification shall govern all work required for furnishing and laying Hot Mix Asphalt Concrete (HMAC) surface, binder and base courses required to complete the project.

All subsurface utilities must be inspected, tested, and accepted prior to any paving.

2. MATERIALS

2.1. Aggregate. The aggregate shall consist of a blend of course aggregate, fine aggregate and, if required, a mineral filler.

2.1.1. Coarse Aggregate shall consist of that fraction of aggregate retained on a No. 10 sieve and shall consist of crushed furnace slag, crushed stone, or crushed gravel.

Deleterious material in course aggregate shall not exceed 2% per TxDOT Test Method TEX-217-F.

Course aggregate shall be crushed such that a minimum of 85% of the particles have more than one crushed face, unless noted otherwise on the plans.

Los Angeles abrasion losses for course aggregate shall not exceed 40% by weight for the surface course and 45% for the binder and base courses per TxDOT Test Method TEX-410-A.

Polish Value not less than 30 for aggregate used in the surface course per TxDOT Test Method TEX-438-A.

2.1.2. Fine Aggregate is defined as the fraction passing a No. 10 sieve and shall be of uniform quality.

Fine aggregate shall consist of screenings of material that pass the Los Angeles abrasion requirements in paragraph 2.1.1 above. Screenings shall be blended with a maximum of 15% uncrushed aggregate or field sand for Type D mixes, or a maximum of 10% uncrushed aggregate or field sand for Type A, B, and C mixes.

Grading of fine aggregate shall be as follows:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
No. 10	100
No. 200	0-15

2.1.3 Filler shall consist of dry stone dust, Portland cement, hydrated lime, or other mineral dust approved by the Engineer.

Grading of filler shall be as follows:

<u>Sieve Size</u>	<u>Minimum Percent Passing by Weight</u>
No. 30	95
No. 80	75
No. 200	55

2.2. Reclaimed Asphalt Pavement (RAP). Reclaimed asphalt pavement may be incorporated into the hot mix asphalt concrete furnished for the project, provided that the mixture is designed per the TxDOT Methods and meets the applicable provisions of said TxDOT Item 340 and this specification.

2.3. Asphalt. Asphalt Material shall be in accordance with Standard Specification Section 025404 "Asphalt, Oils and Emulsions" and AASHTO.

2.3.1. Paving Mixture:

<u>APPLICATION</u>	<u>ASPHALT GRADE</u>
Residential or low volume	PG 64-22
Collector	
Surface Course	PG 70-22
Binder Course	PG 64-22
Arterial	
Surface Course	PG 76-22
Binder Course	PG 64-22
Base Courses	PG 64-22

2.3.2. Tack Coat shall consist of an emulsion, SS-1 diluted with equal volume of water and applied at a rate ranging from 0.05 to 0.15 gallon per square yard.

### 3. PAVING MIXTURE

3.1. Mix Design. The mixture shall be designed in accordance with TxDOT Bulletin C-14 and TxDOT Test Method TEX-204-F to conform to the requirements of this specification. The Contractor shall furnish the mix design for the job-mix to be used for the project, unless shown otherwise on the drawings. The mix design shall be submitted prior to placement of the mixture.

The design procedures are actually intended to result at a job-mix with properties in compliance with these specifications, and when properly placed the job-mix will be durable

and stable. The sieve analysis of the job-mix shall be within the range of the Master Gradation and Tolerances specified herein. The job-mix shall meet the density and stability requirements as specified and shall be included with the mix design as submitted per above.

If the specific gravity of any of the types of aggregates differs by more than 0.3, use volume method.

Plot sieve analysis of job-mix; percent passing versus size on four-cycle semi-log paper or other appropriate type paper. Show tolerance limits and Limits of Master Gradation.

3.2. Master Gradation of Aggregate. The aggregate for the type of mix specified shall be within the following tabulated limits per TxDOT Test Method TEX-200-F (Dry Sieve Analysis):

Sieve Size	Type			
	A Course Base	B Fine Base	C Course Surface	D Fine Surface
1-1/2"	100			
1-1/4"	95-100			
1"		100		
7/8"	70-90	95-100	100	
5/8"		75-95	95-100	
1/2"	50-70			100
3/8"		60-80	70-85	85-100
1/4"				
No. 4	30-50	40-60	43-63	50-70
No. 10	20-34	27-40	30-40	32-42
No. 40	5-20	10-25	10-25	11-26
No. 80	2-12	3-13	3-13	4-14
No. 200	1-6*	1-6*	1-6*	1-6*
VMA % minimum	11	12	13	14

\* 2-8 when TxDOT Test Method Tex-200-F, Part II (Washed Sieve Analysis) is used.

3.3. Tolerances. The mixture delivered to the job site shall not vary from the job-mix by more than the tolerances specified below. The gradation of the produced mix shall not fall outside the Master Grading Limits, with the following exceptions: for Type B material coarser than 3/8" and for Type D material coarser than #4. Variations from job-mix shall not exceed the following limits, except as noted above:

<u>Item:</u>	<u>Tolerances Percent by Weight or Volume</u>
1" to No. 10	Plus or Minus 5.0
No. 40 to No. 200	Plus or Minus 3.0
Asphalt Weight	Plus or Minus 0.5
Asphalt Volume	Plus or Minus 1.2

3.4. Mix Properties. The mixture shall have a minimum Hveem stability of 40 for Type A, B, and C mixes, and 35 for Type D mixes per TxDOT Test Method TEX-208-F at an optimum density of 96% (plus or minus 1.5) of theoretical maximum density per TxDOT Test Methods TEX-227-F and TEX-207-F.

3.5. Sampling and Testing of Raw Materials. The Contractor shall sample materials as necessary to produce a mix in compliance with these specifications.

#### 4. EQUIPMENT

4.1. Mixing Plants. Mixing plants shall be either the weigh batching type or the drum mix type. Both types shall be equipped with satisfactory conveyors, power units, aggregate handling equipment, aggregate screens and bins (weigh batch only), and pollution control devices as required.

4.2. Truck Scales. A set of truck scales, if needed for measurement, shall be placed at a location approved by the Engineer.

4.3. Asphalt Material Heating Equipment. Asphalt material heating equipment shall be adequate to heat the required amount of material to the desired temperature. Agitation with steam or air will not be permitted. The heating apparatus shall be equipped with a recording thermometer with a 24-hour continuous chart that will record the temperature of the asphalt at the highest temperature.

4.4. Surge-Storage System. A surge-storage system may be used provided that the mixture coming out of the bins is of equal quality to that coming out of the mixer. The system shall be equipped with a gob hopper, rotating chute or other devices designed to minimize segregation of the asphalt mixture.

4.5. Laydown Machine. The laydown machine shall be capable of producing a surface that will meet the requirements of the typical cross section, of adequate power to propel the

delivery vehicles, and produce the surface tolerances herein required. It shall be wide enough to lay a 28-foot street (back-to-back of curbs) in a maximum of two passes.

4.6. Rollers. All rollers shall be self-propelled and of any type capable of obtaining the required density. Rollers shall be in satisfactory operating condition and free from fuel, hydraulic fluid, or any other fluid leaks.

## 5. STORAGE, PROPORTIONING AND MIXING

5.1. Storage and Heating of Asphalt Materials. Asphalt cement shall not be heated to a temperature in excess of that recommended by the producer. Asphalt storage equipment shall be maintained in a clean condition and operated in such a manner that there will be no contamination with foreign matter.

5.2. Feeding and Drying of Aggregates. The feeding of various sizes of aggregate to the dryer shall be done in such a manner that a uniform and constant flow of materials in the required proportions will be maintained. In no case shall the aggregate be introduced into the mixing unit at a temperature in excess of 350 degrees F.

5.3. Proportioning. All materials shall be handled and proportioned in a manner that yield an acceptable mixture as herein specified and as defined by the job-mix.

### 5.4. Mixing.

5.4.1. Weigh Batch Plant. In charging the weigh box and in charging the pugmill from the weigh box, such methods or devices shall be used as necessary to minimize segregation of the mixture.

5.4.2. Drum Mix Plant. The amount of aggregate and asphalt cement entering the mixer and the rate of travel through the mixer shall be coordinated so that a uniform mixture of the desired gradation and asphalt content will be produced.

5.4.3. The mixture produced from each type of plant shall not vary from the job-mix by more than the tolerances and restrictions herein specified. The mixture when discharged from the plant shall have a moisture content not greater than one percent by weight of total mix when determined by TxDOT Test Method TEX-212-F.

5.4.4. The mixture produced from each type of plant shall be at a temperature between 250 and 325 degrees F. After a target mixing temperature has been established, the mixture when discharged from the mixer shall not vary from this temperature by more than 25 degrees F.

## 6. CONSTRUCTION METHODS

6.1. Construction Conditions. For mat thicknesses greater than 1.5 inches, the asphalt material may be placed with a laydown machine when the air temperature is 40 degrees F and

rising but not when the air temperature is 50 degrees F and falling. In addition, mat thickness less than and including 1.5 inches shall not be placed when the temperature of the surface on which the mat is placed is below 50 degrees F.

All subsurface utilities shall be inspected, tested, and accepted prior to paving.

6.2. Prime Coat. If a prime coat is required, it shall be applied and paid for as a separate item conforming to the requirements of City Standard Specification Section 025412 "Prime Coat", except the application temperature shall be as provided above. The tack coat or asphaltic concrete shall not be applied on a previously primed flexible base until the primed base has completely cured to the satisfaction of the Engineer.

6.3. Tack Coat. Before the asphalt mixture is laid, the surface upon which the tack coat is to be placed shall be thoroughly cleaned to the satisfaction of the Engineer. The surface shall be given a uniform application of tack coat using materials and rates herein specified and/or as shown on the plans. The tack coat shall be rolled with a pneumatic tire roller as necessary. Tack coat is required before any pavement course not placed immediately following the previous course placement.

6.4. Transporting Asphalt Concrete. The asphalt mixture shall be hauled to the job site in tight vehicles previously cleaned of all foreign matter. In cool weather or for long hauls, canvas covers and insulated truck beds may be necessary. The inside of the bed may be given a light coating of lime water or other suitable release agent necessary to prevent from adhering. Diesel oil is not allowed.

6.5. Placing. The asphalt mixture shall be spread on the approved prepared surface with a laydown machine or other approved equipment in such a manner that when properly compacted, the finished surface will be smooth and of uniform density, and meet the requirements of the typical cross section as shown on the plans.

6.5.1. Flush Structures. Adjacent to flush curbs, gutters, liners and structures, the surface shall be finished uniformly high so that when compacted, it will be slightly above the edge of the curb and flush structure.

6.5.2. Construction joints of successive courses of asphaltic material shall be offset at least six inches. Construction joints on surface courses shall coincide with lane lines, or as directed by the Engineer, but shall not be in the anticipated wheel path of the roadway.

6.6. Compacting. The asphalt mixture shall be compacted thoroughly and uniformly with the necessary rollers to obtain the required density and surface tolerances herein described and any requirements as shown on the plans. Regardless of the method of compaction control followed, all rolling shall be completed before the mixture temperature drops below 175 degrees F.

6.7. In-Place Density. In-place density control is required for all mixtures except for thin, irregular level-up courses. Material should be compacted to between 96% and 92% of maximum theoretical density or between 4% and 8% air voids. Average density shall be greater than 92% and no individual determination shall be lower than 90%. Testing shall be in accordance with TxDOT Test Methods TEX-207-F and TEX-227-F.

Pavement specimens, which shall be either cores or sections of the compacted mixture, will be tested as required to determine the percent air voids. Other methods, such as nuclear determination of in-place density, which correlate satisfactorily with actual project specimens may be used when approved by the Engineer.

6.8. Thickness. The total compacted average thickness of the combined HMAC courses shall not be less than the amount specified on the drawings. No more than 10% of the measured thickness(es) shall be more than 1/4 inch less than the plan thickness(es). If so, the quantity for pay shall be decreased as deemed appropriate by the Engineer.

6.9. Surface Smoothness Criteria and Tests. The pavement surface after compaction, shall be smooth and true to the established lines, grade and cross-section. The surface shall be tested by the City with the Mays Roughness Meter. The Mays Roughness Value for each 600-foot section shall not exceed ninety inches per mile per traffic lane.

For each 600-foot section not meeting this criteria, the Engineer shall have the option of requiring that section to be reworked to meet the criteria, or paying an adjusted unit price for the surface course. The unit price adjustment shall be made on the following basis:

Adjusted Unit Price = (Adjustment Factor) X Surface Course Unit Bid Price

The adjustment factor shall be:

For Residential Streets:

Adjustment Factor =  $1.999 - 0.0111 M$

For All Other Class Streets (Non Residential)

Adjustment Factor =  $1.287 - 0.0143 M$

Where M = Mays Roughness Value

In no case shall the Contractor be paid more than the unit bid price. If the surface course is an inverted penetration (surface treatment) the Mays Roughness Value observed will be reduced by ten inches per mile, prior to applying the above criteria.

Localized defects (obvious settlements, humps, ridges, etc.) shall be tested with a ten-foot straightedge placed parallel to the roadway centerline. The maximum deviation shall not

exceed 1/8 inch in ten feet. Areas not meeting this criteria shall be corrected to the satisfaction of the Engineer.

Pavement areas having surface irregularities, segregation, raveling or otherwise deemed unacceptable by the Engineer shall be removed and replaced by the Contractor in a manner approved by the Engineer, at no additional cost to the City.

6.10. Opening to Traffic. The pavement shall be opened to traffic when directed by the Engineer. The Contractor's attention is directed to the fact that all construction traffic allowed on pavement open to the public will be subject to the State laws governing traffic on highways.

If the surface ravel, it will be the Contractor's responsibility to correct this condition at his expense.

## 7. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, hot mix asphaltic concrete pavement shall be measured by the square yard of the type and thickness of "Hot Mix Asphaltic Concrete" as shown on the drawings.

The Contractor shall provide the Engineer with copies of the "pay ticket" identifying the truck and showing the gross empty weight of the truck with driver as it arrives at the plant and the gross loaded weight of the truck with driver as it leaves the plant. The measured amount will be the difference of the loaded and empty trucks converted to tons.

Payment shall be full compensation for quarrying, furnishing all materials, freight involved; for all heating, mixing, hauling, cleaning the existing base course or pavement, tack coat, placing asphaltic concrete mixture, rolling and finishing; and for all manipulations, labor, tools, equipment, and incidentals necessary to complete the work except prime coat when required.

Prime coat, performed where required, will be measured and paid for in accordance with the provisions governing City Standard Specification Section 025412 "Prime Coat".

All templates, straightedges, scales, and other weight and measuring devices necessary for the proper construction, measuring and checking of the work shall be furnished, operated and maintained by the Contractor at his expense.

Any paving placed prior to inspection, testing, and acceptance of underground utilities may be rejected by the City and will be replaced at the Contractor's expense after correcting any subsurface utility defects. Pavement that fails to meet the in place density criteria may be rejected by the City and will be replaced at the Contractor's expense, or such pavement may, at the City's discretion, be accepted by the City and the unit price for payment shall be reduced as deemed appropriate by the Engineer.



SECTION 025608  
INLETS

1. DESCRIPTION

This specification shall govern for the construction of inlets complete in place and the materials used therein, including the installation, and the furnishing of frames, grates, rings and covers.

2. TYPES

The various types of inlets are designated on the drawings by letters or by numbers indicating the particular design of each. Each type shall be constructed in accordance with the details shown on the drawings and to the depth required by the profiles and schedules given.

3. MATERIALS

- (1) Concrete. Concrete for curb inlets shall be Class "A" concrete conforming to the requirements of City Standard Specification Section 038000 "Concrete Structures", and City Standard Specification Section 030020 "Portland Cement Concrete", except as otherwise provided on the drawings. Concrete for grate inlets, drop inlets and post inlets shall be Class "C" concrete in accordance with City Standard Specification Section 030020 "Portland Cement Concrete".
- (2) Mortar. Mortar shall be composed of one part Portland cement and two parts clean, sharp mortar sand suitably graded for the purpose by conforming in other respects to the provisions of City Standard Specification Section 030020 "Portland Cement Concrete" for fine aggregate. Hydrated lime or lime putty may be added to the mix but in no case shall it exceed 10 percent by weight of the total dry mix.
- (3) Reinforcing Steel. Reinforcing Steel shall conform to the requirements of City Standard Specification Section 032020 "Reinforcing Steel".
- (4) Concrete Blocks. Concrete blocks, when shown on the drawings, shall conform to the requirements of ASTM C 139.
- (5) Frames, Grates, Rings and Covers. Frames, grates, rings and covers shall conform to the requirements of City Standard Specification Section 055420 "Frames, Grates, Rings and Covers".
- (6) Cast Iron. Cast iron for supports and inlet units shall conform to the shape and dimensions shown on the plans. The castings shall be clean and perfect, free from sand or blow holes or other defects. Cast iron castings shall conform to the requirements of "Gray Iron Castings" ASTM A 48, Class 30.

#### 4. CONSTRUCTION METHODS

- (1) General. All concrete work shall be performed in accordance with the requirements of City Standard Specification Section 038000 "Concrete Structures", unless otherwise specified. Forms will be required for all concrete walls, except where the nature of the surrounding material is such that it can be trimmed to a smooth vertical face.
- (2) Inlets for Precast Concrete Pipe Sewers. The construction of inlets for precast concrete pipe sewers shall be done as soon as is practicable after sewer lines into or through inlet locations are completed. All sewers shall be cut neatly at the inside face of the walls of inlet and pointed up with mortar. Subgrade under cast-in-place and precast inlets shall be compacted to not less than 95% Standard Proctor density.
- (3) Inverts. The inverts passing out or through the inlet shall be shaped and routed across the floor of inlet as shown on the plans. This shaping may be accomplished by adding and shaping mortar or concrete after the base is cast or by placing the required additional material with the base.
- (4) Finishing Complete Inlets. Inlets shall be completed in accordance with the drawings. Backfilling to finish grade elevation with native material, free of debris and compacted to over 95% Standard Proctor density. Backfilling shall be in accordance with the provisions of City Standard Specification Section 022020 "Excavation and Backfill for Utilities".

#### 5. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, inlets shall be measured as individual units by each inlet, complete in place.

Extension to inlets will be measured by each extension separately from the inlet.

Excavation, backfill, frames, grates, rings and covers will be considered subsidiary to the construction of the inlets.

Payments shall be full compensation for furnishing all concrete, reinforcing steel, mortar, castings, frames, grates, rings and covers, and for all other materials, labor, tools, equipment and incidentals required to perform the work prescribed above.

SECTION 025610  
CONCRETE CURB AND GUTTER

1. DESCRIPTION

This specification shall consist of Portland cement concrete combined concrete curb and gutter or separate concrete curb with or without reinforcing steel as required, constructed on an approved subgrade or foundation material in accordance with these specifications, in conformity with the lines and grades established by the Engineer and details shown on the drawings.

2. MATERIALS

Unless otherwise specified on the drawings, materials and proportions for concrete used in construction under this specification shall conform to the requirements as specified for Class "A" Concrete under City Standard Specification Section 030020 "Portland Cement Concrete". Reinforcing steel shall conform to the requirements as specified in City Standard Specification Section 032020 "Reinforcing Steel". Expansion joint filler shall be redwood material meeting the requirements specified in City Standard Specification Section 038000 "Concrete Structures".

3. CONSTRUCTION METHODS

The foundation shall be excavated and shaped to line, grade and cross-section, and hand tamped and sprinkled. If dry, the subgrade or foundation material shall be sprinkled lightly with water and compacted to not less than 98% Standard Proctor density, or as required on the drawings. Flexible base shall be compacted to specified density and moisture immediately before concrete is deposited thereon.

Outside forms shall be of wood or metal, of a section satisfactory to the Engineer, straight, free of warp, and of a depth equal to the depth of the curb and gutter. They shall be securely staked to line and grade, and maintained in a true position during the depositing of concrete. Inside forms for the curb shall be approved material, shall be of such design as to provide the curb required, and shall be rigidly attached to the outside forms. For reinforced concrete roadways, all jointing must be reflected through the curb, including redwood expansion joints and construction joints. Driveway gutter shall be placed integrally with the driveway as shown on the City Standard Details.

The reinforcing steel shall be placed in position as shown on the typical details. Care shall be exercised to keep all reinforcing steel in its proper location.

Concrete for curb and gutter shall be mixed in a manner satisfactory to the Engineer. The curb and gutter shall be placed in sections of the length indicated on the plans, and each section shall be separated by a premolded insert or board joint of cross-section specified for the curb and gutter, and of the thickness indicated on the drawings.

After the concrete has been struck off and after it has become sufficiently set, the exposed surfaces shall be thoroughly worked with a wooden float. The exposed edges shall be rounded by the use of an edging tool to the radius indicated on the drawings. All exposed surfaces of curb and gutter, or curb, shall be brushed to a smooth and uniform surface.

The completed curb and gutter shall be cured with Type 2, white pigmented curing compound unless shown otherwise on the drawings. Other methods of curing as outlined in City Standard Specification Section 038000 "Concrete Structures" will be acceptable with a required curing period of 72 hours.

The area behind the curb shall be backfilled, tamped, and sloped as directed as soon as possible and no later than 48 hours after the removal of forms. Backfill shall be placed to the full height of the curb, or as otherwise specified.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, concrete curb and gutter or concrete curb will be measured by the linear foot for each type of curb, complete in place. Payment shall be full compensation for preparing the subgrade; for furnishing and placing all materials including reinforcing steel and expansion joint material; for furnishing, placing, shaping and tamping backfill; and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

SECTION 025612  
CONCRETE SIDEWALKS AND DRIVEWAYS

1. DESCRIPTION

This specification shall consist of sidewalks and driveways, with or without reinforcing steel, composed of Portland cement concrete, constructed as herein specified on an approved subgrade, in conformity with the lines and grades established by the Engineer and the details shown on the drawings.

2. MATERIALS

Materials and proportions used in construction under this item shall conform to the requirements as specified for Class "A" concrete under City Standard Specification Section 030020 "Portland Cement Concrete". Reinforcing steel shall conform to the requirements as specified in City Standard Specification Section 032020 "Reinforcing Steel". Expansion joint filler shall be redwood meeting the requirements specified in City Standard Specification Section 038000 "Concrete Structures". Cap seal shall be "Greenstreak" or approved equal.

3. CONSTRUCTION METHODS

The subgrade shall be excavated, compacted and shaped to line, grade and cross-section and hand tamped and sprinkled with water. Subgrade under concrete sidewalks and driveways shall be compacted to not less than 95% Standard Proctor density. The subgrade shall be within 0-3% of optimum moisture content at the time the concrete is placed.

Forms shall be of wood or metal, of a section satisfactory to the Engineer, straight, free from warp, and of a depth equal to the thickness of the finished work. They shall be securely staked to line and grade and maintained in a true position during the depositing of concrete.

The reinforcing steel shall be placed in position as shown on the drawings. Care shall be exercised to keep all reinforcing steel in its proper location.

Driveways shall incorporate the gutter in a unified concrete placement as shown in the City Standard Detail for driveways.

Sidewalks shall be constructed in sections of the lengths shown on drawings. Unless otherwise provided by the drawings, no section shall be of a length less than 8 feet, and any section less than 8 feet shall be removed by the Contractor at his own expense.

The different sections shall be separated by a premolded insert or board joint of the thickness shown on the drawings, placed vertically and at right angles to the longitudinal axis of the sidewalks. Where the sidewalk or driveways abut a curb or retaining wall, approved expansion joint material shall be placed along their entire length. Similar expansion joint material shall be placed around all obstructions protruding through sidewalks or driveways.

Concrete shall be mixed in a manner satisfactory to the Engineer, placed in the forms to the depth specified and spaded and tamped until thoroughly compacted and mortar entirely covers the surface. The top surface shall be floated with a wooden float to a gritty texture. The outer edges and joints shall then be rounded with approved tools to the radii shown on drawings.

5-foot wide sidewalks shall be marked into separate sections, each 5 feet in length, by the use of approved jointing tools. For other widths of sidewalk, joints to be spaced longitudinally to match the transverse width.

When completed, the sidewalks and driveways shall be cured with Type 2, white pigmented curing compound. Other methods of curing as outlined in City Standard Specification Section 038000 "Concrete Structures" will be acceptable with a required curing period of 72 hours.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, concrete sidewalks and driveways shall be measured by the square foot of surface area of completed sidewalks, driveways, or sidewalks and driveways, as indicated on the drawings.

Payment shall be full compensation for preparing and compacting the subgrade; for furnishing and placing all materials including concrete, reinforcing steel and expansion joint material; and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

SECTION 025614  
CONCRETE CURB RAMPS

1. DESCRIPTION

This specification shall govern all work necessary for constructing Concrete Curb Ramps required to complete the project.

2. MATERIALS

Concrete shall be Class "A" in accordance with Section 030020 "Portland Cement Concrete" of the City Standard Specifications.

Reinforcement shall be 4x4 - W2.9xW2.9 welded wire fabric ~~or~~ #4 steel reinforcing bars spaced at 12 inches each way in accordance with Section 032020 "Reinforcing Steel" of the City Standard Specifications.

3. CONSTRUCTION METHODS

The subgrade shall be shaped to line, grade and cross-section, and shall be of uniform density and moisture when concrete is placed. The subgrade shall be hand tamped and sprinkled with water to achieve the desired consistency and uniform support. Subgrade compaction shall not be less than 95% Standard Proctor density.

Ramps shall be constructed of Class "A" concrete to line and section as shown on the plans. Unless shown otherwise on the drawings, ramps shall have a minimum concrete thickness in excess of 5 inches, prior to application of the detectable warning surfacing.

Slopes, S, shall be as follows, unless shown otherwise on the drawings:

RAMPS

Ramp in direction of travel . . . . .  $S \leq 1:12$

Side slope of ramp (flare) . . . . .  $S \leq 1:10$

Cross slope . . . . .  $1:100 \leq S \leq 1:50$

ADJOINING AREAS

Landings adjacent to ramp . . . . .  $S \leq 1:20$

Driveways abutting tied sidewalks . .  $S \leq 1:10$

Width of ramp shall be 60 inches (minimum), exclusive of flare, unless specifically shown otherwise on the drawings. No ramp shall be less than 36 inches wide under any circumstances. Obstructions

shall be removed or relocated, as appropriate, or the location of the ramp may be shifted, if authorized.

Detectable warning surface shall be polymer composite material detectable warning panels as shown on the drawings. Surfacing shall be flush with abutting areas and placed using a template as required to achieve an esthetic well-defined edge. Surfacing shall be subsidiary work and will not be measured for separate pay.

Pavement markings for street crossings shall be placed such that the crosswalk is properly aligned with respect to the curb ramp. See striping details for proper alignment of pavement markings with respect to intersection and curb ramp.

Properly constructed curb ramp shall be true to line, section and grade, and shall be free of loose material and irregularities.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, concrete curb ramps shall be measured by the horizontal square foot of ramp surface area, including side flares when used. Adjoining curbs, gutters, sidewalks, and driveways will be excluded from said measurement.

Payment shall include, but not be limited to, subgrade preparation, formwork, concrete, rebar, detectable warning surfaces, borders, molding and curing required to complete the curb ramp, and shall be full compensation for all labor, materials, equipment and incidentals required to complete the work.



SECTION 025620  
PORTLAND CEMENT CONCRETE PAVEMENT

1. DESCRIPTION

This specification shall govern for the construction of Portland cement concrete pavement on a prepared subgrade or base course, in accordance with the typical sections shown on the drawings.

The concrete shall be composed of Portland cement, aggregates (fine and coarse), admixtures if desired or required, and water, proportioned and mixed as hereinafter provided.

All subsurface utilities must be inspected, tested, and accepted prior to any paving.

2. MATERIALS

(1) Cement

The cement shall be either Type I, Type II or Type III Portland cement conforming to ASTM Designation: C150, modified as follows:

Unless otherwise specified by the Engineer, the specific surface area of Type I and II cements shall not exceed 2000 square centimeters per gram (Wagner Turbidimeter – TxDOT Test Method Tex-310-D). The Contractor shall furnish the Engineer with a statement as to the specific surface area of the cement, expressed in square centimeters per gram, for each shipment.

For concrete pavements, strength requirements shall be demonstrated using flexural (beam) or compressive (cylinder) tests as required in the drawings.

Either Type I or II cement shall be used unless Type II is specified on the plans. Except when Type II is specified on the plans, Type III cement may be used when the anticipated air temperature for the succeeding 12 hours will not exceed 60°F. Type III cement shall be used when high early strength concrete pavement is specified on the drawings.

Different types of cement may be used in the same project, but all cement used in any one monolithic placement of concrete pavement shall be of the same type and brand. Only one brand of each type of cement will be permitted in any one project unless otherwise authorized by the Engineer.

Cement may be delivered in bulk where adequate bin storage is provided. All other cement shall be delivered in bags marked plainly with the name of the manufacturer and the type of cement. Similar information shall be provided in the bills of lading accompanying each shipment of packaged or bulk cement. Bags shall contain 94 pounds net. All bags shall be in good condition at time of delivery.

All cement shall be properly protected against dampness. No caked cement will be accepted.

Cement remaining in storage for a prolonged period of time may be retested and rejected if it fails to conform to any of the requirements of these specifications.

(2) Mixing Water

Water for use in concrete and for curing shall be in accordance with City Standard Specification Section 030020 "Portland Cement Concrete".

(3) Coarse Aggregate

Coarse aggregate for use in concrete mixture shall be in accordance with City Standard Specification Section 030020 "Portland Cement Concrete", Grade No. 2.

(4) Fine Aggregate

Fine aggregate for use in concrete mixture shall be in accordance with City Standard Specification Section 030020 "Portland Cement Concrete", Grade No. 1.

(5) Mineral Filler

Mineral filler shall consist of stone dust, clean crushed sand, or other approved inert material.

(6) Mortar (Grout)

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

(7) Admixtures

Calcium chloride will not be permitted. Unless otherwise noted, air-entraining, retarding and water-reducing admixtures may be used in all concrete and shall conform to the requirements of City Standard Specification Section 030020 "Portland Cement Concrete".

(8) Reinforcing Steel

Unless otherwise designated on the plans, all steel reinforcement shall be deformed bars, and shall conform to ASTM Designation: A615, Grade 60, and shall be open hearth, basic oxygen or electric furnace new billet steel in accordance with City Standard Specification Section 032020 "Reinforcing Steel".

Dowels shall be plain billet steel smooth bars conforming to ASTM Designation: A615, Grade 60, and shall have hot-dip galvanized finish.

### 3. STORAGE OF MATERIALS

All cement and aggregate shall be stored and handled in accordance with City Standard Specification Section 030020 "Portland Cement Concrete".

#### 4. MEASUREMENT OF MATERIALS

Measurement of the materials, except water, used in batches of concrete, shall be in accordance with City Standard Specification Section 030020 "Portland Cement Concrete".

#### 5. CLASSIFICATION AND MIX DESIGN

It shall be the responsibility of the Contractor to furnish the mix design to comply with the requirements herein and in accordance with THD Bulletin C-11. The Contractor shall perform, at his own expense, the work required to substantiate the design, except the testing of strength specimens, which will be done by the Engineer. Complete concrete design data shall be submitted to the Engineer for approval.

It shall also be the responsibility of the Contractor to determine and measure the batch quantity of each ingredient, including all water, so that the mix conforms to these specifications and any other requirements shown on the plans.

In lieu of the above mix design responsibility, the Contractor may accept a design furnished by the Engineer; however, this will not relieve the Contractor of providing concrete meeting the requirements of these specifications.

Trial batches will be made and tested using all of the proposed ingredients prior to placing the concrete, and when the aggregate and/or brand of cement or admixture is changed. Trial batches shall be made in the mixer to be used on the job. When transit mix concrete is to be used, the trial designs will be made in a transit mixer representative of the mixers to be used. Batch size shall not be less than 50 percent of the rated mixing capacity of the truck.

Mix designs from previous or concurrent jobs may be used without trial batches if it is shown that no substantial change in any of the proposed ingredients has been made.

This specification section incorporates the requirements of City Standard Specification Section 030020 "Portland Cement Concrete".

#### 6. CONSISTENCY

In cases where the consistency requirements cannot be satisfied without exceeding the maximum allowable amount of water, the Contractor may use, or the Engineer may require, an approved water-reducing or retarding agent, or the Contractor shall furnish additional aggregates or aggregates with different characteristics, which will produce the required results. Additional cement may be required or permitted as a temporary measure until aggregates are changed and designs checked with the different aggregates or admixture.

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

workable, cohesive, possess satisfactory finishing qualities, and of the stiffest consistency that can be placed and vibrated into a homogenous mass. Excessive bleeding shall be avoided. Slump requirements shall be as specified in Table 1.

**TABLE 1**  
**Slump Requirements**

<u>Construction Method</u>	<u>Desired Slump</u>	<u>Minimum Slump</u>	<u>Maximum Slump</u>
Concrete Pavement (slipformed)	1.5 inches	1 inch	3 inches
Concrete Pavement (formed)	4 inches	2.5 inches	6.5 inches

**NOTE:** No concrete will be permitted with slump in excess of the maximum shown.

## **7. QUALITY OF CONCRETE**

The concrete shall be uniform and workable. The cement content, maximum allowable water-cement ratio, desired slump, minimum slump, maximum slump, and the strength requirements of the class of concrete for concrete pavement shall conform to the requirements of Table 1 and Table 2 and as required herein.

During the process of the work, the Engineer will cast test beams or cylinders as a check on the flexural or compressive strength of the concrete actually placed. Testing shall be in accordance with City Standard Specification Section 030020 "Portland Cement Concrete". If the required flexural or compressive strength is not secured with the cement specified in Table 2, changes in the batch design will be made. The concrete shall meet either the minimum flexural (beam) strength (7-day or 28-day) or minimum compressive strength (7-day or 28-day) shown in Table 2.

**TABLE 2**  
**Class of Concrete for Concrete Pavement**

<u>Class of Concrete</u>	<u>Minimum Flexural (Beam) Strength</u>	<u>Minimum Compressive Strength</u>	<u>Maximum Water-Cement Ratio</u>	<u>Coarse Aggregate</u>
P*	450 psi (7 days) 570 psi (28 days)	3200 psi (7 days) 4000 psi (28 days)	5.6 gal./sack 0.50	No. 2 (1½")

\* 5% entrained air

## **8. MIXING CONDITIONS**

The concrete shall be mixed in quantities required for immediate use. Any concrete which is not in place within the limits outlined in City Standard Specification Section 038000 "Concrete Structures", Article "Placing Concrete-General", shall not be used. Re-tamping of concrete will not be permitted.

Mixing conditions shall conform to the requirements of City Standard Specification Section 030020 "Portland Cement Concrete".

#### 9. MIXING AND MIXING EQUIPMENT

Mixing and mixing equipment shall conform to the requirements of City Standard Specification Section 030020 "Portland Cement Concrete".

#### 10. READY-MIX PLANTS

The requirements for ready-mix plants shall be as specified in City Standard Specification Section 030020 "Portland Cement Concrete".

#### 11. PLACING, CURING AND FINISHING

All subsurface utilities must be inspected, tested, and accepted prior to any paving.

Subgrade preparation shall be as specified on the plans. The placing of concrete, including construction of forms and falsework, curing and finishing shall be in accordance with City Standard Specification Section 038000 "Concrete Structures". For membrane curing, curing material shall conform to Type 2, Class A curing compound, or as otherwise shown on the drawings.

#### 12. JOINTS IN CONCRETE PAVEMENT

The placing of joints in concrete pavement shall be in accordance with City Standard Specification Section 038000 "Concrete Structures" and as detailed on the drawings.

#### 13. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, the quantities of concrete for concrete pavement(s), which will constitute the completed and accepted pavement(s) in-place, will be measured by the square yard or square foot for the indicated thickness and type of cement.

Payment shall be full compensation for furnishing, hauling, mixing, placing, curing and finishing all concrete; all grouting and pointing; furnishing and placing reinforcing steel and steel dowels as shown on the plans; furnishing and placing drains; furnishing and placing metal flashing strips; furnishing and placing expansion joint material, joint filler and sealants, and contraction (control) joints required by this specification or shown on the plans; and for all forms and falsework, labor, tools, equipment and incidentals necessary to complete the work.

Any paving placed prior to inspection, testing, and acceptance of underground utilities may be rejected by the City and will be replaced at the Contractor's expense after correcting any subsurface utility defects.

SECTION 025802  
TEMPORARY TRAFFIC CONTROLS DURING CONSTRUCTION

1. DESCRIPTION

This specification shall govern all work required for Temporary Traffic Controls during construction. The work shall include furnishing, installing, moving, replacing, and maintaining all temporary traffic controls including, but not limited to, barricades, signs, barriers, cones, lights, signals, temporary detours, temporary striping and markers, flagger, temporary drainage pipes and structures, blue business signs, and such temporary devices as necessary to safely complete the project.

2. MATERIALS

Traffic control devices shall conform to the latest edition of the "Texas Manual on Uniform Traffic Control Devices", unless indicated otherwise on the Traffic Control Plan.

3. METHODS

Sufficient traffic control measures shall be used to assure a safe condition and to provide a minimum of inconvenience to motorists and pedestrians.

If the Traffic Control Plan (TCP) is included in the drawings, any changes to the TCP by the Contractor shall be prepared by a Texas licensed professional engineer and submitted to the City Traffic Engineer for approval, prior to construction. If the TCP is not included in the drawings, the Contractor shall provide the TCP prepared by a Texas licensed professional engineer and submit the TCP to the City Traffic Engineer for approval, prior to construction.

The Contractor is responsible for implementing and maintaining the traffic control plan and will be responsible for furnishing all traffic control devices, temporary signage and ATSSA certified flaggers. The construction methods shall be conducted to provide the least possible interference to traffic so as to permit the continuous movement of traffic in all allowable directions at all times. The Contractor shall cleanup and remove from the work area all loose material resulting from construction operations at the end of each workday.

All signs, barricades, and pavement markings shall conform to the BC standard sheets, TCP sheets and the latest version of the "Texas Manual on Uniform Traffic Control Devices".

The Contractor may be required to furnish additional barricades, signs, and warning lights to maintain traffic and promote motorists safety. Any such additional signs and barricades will be considered subsidiary to the pay item for traffic control. All signs, barricades, and posts will be either new or freshly painted.

The contractor and any traffic control subcontractor must be ATSSA certified for Traffic Control.

A competent person, responsible for implementation of the TCP and for traffic safety, shall be designated by the Contractor.

The name and off-hours phone number of the competent person shall be provided in writing at the Pre-Construction Conference.

The competent person shall be on site, during working hours and on call at all times in the event of off-hour emergency.

The contractor must provide temporary blue sign boards that direct traffic to businesses and driveways during each phase of construction – see example below. The sign boards may be either skid mounted or barrel mounted. The City will assist the contractor in determining which businesses and driveways will receive signage during various construction phases. The provision, installation, and removal of signage will be considered to be subsidiary to the contract items provided for “Traffic Control.”

Example Blue Sign



#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, temporary traffic controls during construction shall be measured as a lump sum. Payment shall include, but not be limited to, furnishing, installing, moving, replacing and maintaining all temporary traffic controls including, but not limited to, barricades, signs, barriers, cones, lights, signals, temporary striping and markers, flaggers, removable and non-removable work zone pavements markings and signage, channelizing devices, temporary detours, temporary flexible-reflective roadway marker tabs, temporary traffic markers, temporary drainage pipes and structures, blue business signs, and such temporary devices and relocation of existing signs and devices. Payment shall be full compensation for all labor,

equipment, materials, personnel, and incidentals necessary to provide a safe condition during construction of all phases and elements of the project and to complete the work.

Payment will be made on the following basis: The initial monthly estimate will include 50% of the lump sum bid amount minus retention (typically 5%). The balance will be paid with the final estimate, upon completion of the project.



SECTION 025803  
TRAFFIC SIGNAL ADJUSTMENTS

1. DESCRIPTION

This specification shall govern all work for Traffic Signal Adjustments required to complete the project.

2. MATERIALS

All equipment and materials for adjustments shall be provided by the Contractor, unless indicated otherwise on the drawings.

3. METHODS

The existing signal controls shall be maintained by the Contractor.

Transferring control of the adjusted signal control shall be done by the Contractor.

A minimum of 72 hours advance notice shall be provided to the City Traffic Engineer by the Contractor, prior to transferring control of the adjusted signal control or any other interim signal adjustments necessary to control traffic, unless otherwise noted on the drawings.

Manual traffic direction by the City Police Department shall be arranged and provided for by the Contractor at any signalized intersection at any time that signal control must be interrupted. The Contractor shall arrange for a representative from the City's Traffic Signals Division to be on site to inspect the process of signal control transfer, during the work.

4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, traffic signal adjustments will not be measured for pay, but shall be considered subsidiary to other work.

SECTION 025805  
WORK ZONE PAVEMENT MARKINGS

1. SCOPE. This specification covers the placement, maintenance and removal of work zone pavement markings, which are temporary pavement markings to be placed on roadways that are open to traffic during various work phases, as required to complete the project.
2. GENERAL REQUIREMENTS. The pavement marking material shall consist of an adhesive-backed reflective tape that can be applied to the pavement, Markings are to be 3M Staymark or approved equal. Markings shall be of good appearance, have straight, unbroken edges and have a color that complies with all FHWA regulations.
3. DIMENSIONS. Pavement markings shall be minimum of 3-7/8 inches wide. Lengths and spacing will be as specified.
4. COLOR. The markings, as well as retroreflected light from the markings, shall be white or yellow as called for on the drawings.
5. VISIBILITY. When in place, the pavement markings (during daylight hours) shall be distinctively visible for a minimum of 300 feet.

When in place, the pavement markings (when illuminated by automobile low-beam headlights at night) shall be distinctively visible for a minimum of 160 feet.

The above day and night visibility requirements shall be met when viewed from an automobile traveling on the roadway.

6. PLACEMENTS AND MAINTENANCE. At sunrise and sunset of each day and before each phase change, work zone pavement markings meeting all specification requirements shall be in place on all roadways on which traffic is allowed and where suitable permanent pavement markings are not in place. The transverse location of the line(s) formed by the markings shall be as determined by the Engineer.

Unless otherwise shown on the drawings, work zone markings shall be placed as follows:

<u>Condition</u>	<u>Spacing</u>	<u>Length of Stripe</u>
Straight	80 feet (approximate)	24 inches
Curve $\leq 2^\circ$	80 feet (maximum)	24 inches
Curve $> 2^\circ$	40 feet (maximum)	24 inches

The spacing of stripes may be modified by the Engineer. However, the maximum spacing specified above shall not be exceeded in any case.

The Contractor will be responsible for maintaining the work zone pavement markings for a maximum period of two weeks. If, however, the Contractor is also responsible for placing the standard pavement markings, the Contractor will be responsible for maintaining the work zone pavement markings until permanent pavement markings are in place.

7. REMOVAL. Where removal is required, it will be accomplished in accordance with instructions of the Engineer or as called for on the drawings.
8. MEASUREMENT AND PAYMENT. Unless otherwise specified on the Bid Form, work zone pavement markings shall not be measured and paid for separately, but shall be considered subsidiary to the appropriate bid item.

SECTION 025807  
PAVEMENT MARKINGS  
(PAINT AND THERMOPLASTIC)

1. DESCRIPTION

This item shall consist of markings and stripes on the surface of the roadways or parking facilities applied in accordance with this specification and at the locations shown on the drawings or as directed by the Engineer.

2. MATERIALS

Type I Pavement Marking Materials shall be in accordance with TxDOT Departmental Material Specification DMS-8220 "Hot Applied Thermoplastic". All roadway markings shall be thermoplastic.

Type II Pavement Marking Materials shall be in accordance with TxDOT Departmental Material Specification DMS-8200 "Traffic Paint" and are not to be used for roadway markings except as primer/sealer for Type 1 markings. Type II Pavement Markings shall be allowed for parking facilities if called for in the plans.

Glass Traffic Beads shall be drop-on glass beads conforming to TxDOT Departmental Material Specification DMS-8290 "Glass Traffic Beads".

3. CONSTRUCTION METHODS

- 3.1 Weather Limitations - Pavement marking shall be performed only when the existing surface is dry and clean, when the atmospheric temperature is above 40°F., and when the weather is not excessively windy, dusty, or foggy. The suitability of the weather will be determined by the Engineer.
- 3.2 Equipment - All equipment for the work shall be approved by the Engineer and shall include the apparatus necessary to properly clean the existing surface, and mechanical marking machine, and such auxiliary hand painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an approved atomizing spray-type marking machine suitable for application of pavement markings. It shall produce an even and uniform film thickness at the required coverage and shall be designed so as to apply markings of uniform cross-sections and clear-out edges without running of

spattering and within the limits for straightness set forth herein.

Suitable adjustments shall be provided on the sprayer(s) of a single machine or by furnishing additional equipment for marking the width required.

- 3.3 Preparation of Existing Surface - Immediately before application of the paint or thermoplastic, the existing surface shall be dry and entirely free from old pavement markings and markers, dirt, grease, oil, acids, laitance, or other foreign matter which could reduce the bond between the marking and the pavement. The surface shall be thoroughly cleaned by sweeping and blowing as required to remove all dirt, laitance and loose materials. Areas that cannot be satisfactorily cleaned by brooming and blowing shall be scrubbed as directed with a water solution of trisodium phosphate (10%  $\text{Na}_3\text{PO}_4$  by weight) or an approved equal solution. After scrubbing, the solution shall be rinsed off and the surface dried prior to marking.

- 3.4 Layouts and Alignments - Suitable layouts and lines of proposed stripes shall be spotted in advance of the marking application. Control points shall be spaced at such intervals as will insure accurate location of all markings.

The Contractor shall provide an experienced technician to supervise the location, alignment, layout, dimensions, and application of the markings.

At least 72 hours prior to applying the permanent pavement markings, the Contractor shall notify the Engineer and City Construction Inspector to obtain City approval for the location, alignment and layout of the pavement markings.

- 3.5 Application - Markings shall be applied at the locations and to the dimensions and spacing indicated on the plans or as specified. Markings shall not be applied until the layouts, indicated alignment, and the condition of the existing surface have been approved by the Engineer.

In the application of straight stripes, any deviation of the edges exceeding 1/2 inch in 50 feet shall be obliterated and the marking corrected. The width of the markings shall be as designated within a tolerance of 5%. All markings shall be performed to the satisfaction of the Engineer.

Paint shall be applied uniformly by suitable equipment at a rate of not less than 105 or more than 115 square feet per gallon.

The Contractor shall furnish a certified report on the quality of materials ordered for the work. This report shall not be interpreted as a basis for final acceptance. The Engineer shall be notified upon arrival of shipment for inspecting and sampling of

the materials. When required, all emptied containers shall be returned to the paint material storage or made available for tallying by the Engineer. The containers shall not be removed from the job site or destroyed without permission. The Contractor shall make an accurate accounting of the paint materials used in the accepted work.

- 3.6 Protection - After application, all markings shall be protected while drying. The fresh markings shall be protected from damage of any kind. The Contractor shall be directly responsible for protecting the markings and shall erect or place suitable warning signs, flags or barricades, protective screens or coverings as required. All surfaces shall be protected from disfiguration by spatter, splashes, spillage, drippings of paint or other materials.
- 3.7 Defective Workmanship or Material - When any material not conforming to the requirements of the specifications or drawings has been delivered to the project or incorporated in the work, or any work performed is of inferior quality, such material or work shall be corrected as directed by the Engineer, at the expense of the Contractor.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, pavement markings shall be measured by the square foot or linear foot of each type of marking. Eliminating existing pavement markings and markers will not be measured and paid for separately, but shall be subsidiary to the pavement marking items.

Payment shall be full compensation for furnishing all materials and for eliminating existing pavement markings and markers, for all preparation, layout and application of the materials, and for all labor, equipment, tools and incidentals necessary to complete the work.

SECTION 025813  
PREFORMED THERMOPLASTIC STRIPING, WORDS AND EMBLEMS

1. DESCRIPTION

This specification shall govern all work for furnishing and installing preformed thermoplastic striping, words and emblems required to complete the project.

2. PRE-CONSTRUCTION CONFERENCE

When required by the Engineer, prior to beginning work on the markings but after receipt by the Engineer of the required information, a conference will be held between the representatives of the Contractor and the Engineer to set up more completely the sequence of work to be followed and the estimated progress schedule.

3. MATERIALS

The preformed pavement marking material shall be thermoplastic material meeting the specifications of TxDOT Departmental Material Specification DMS-8220 "Hot Applied Thermoplastic," and shall be approved by the Engineer for use on this project.

4. CONSTRUCTION

- (1) General. The Contractor shall furnish all materials and equipment and perform work or services necessary for complete and proper construction of the completed system of pavement markings.
- (2) Traffic Conditions. Roadways on which markings are to be placed may be either free of traffic or open to traffic. On roadways already open to traffic, markings shall be placed under existing traffic conditions.
- (3) Dimensions. Markings will be in accordance with the color, length, width, shape, configuration and location requirements of the plans and as directed by the Engineer.
- (4) Methods. All material placement shall be in accordance with TxDOT Standard Specification Item 668 "Prefabricated Pavement Markings" and City Section 025807 "Pavement Markings (Paint and Thermoplastic)."
- (5) Surface Preparation. The pavement upon which the markings are to be placed shall be cleaned and prepared, to the satisfaction of the Engineer, prior to placement of the markings. Cleaning shall be by any effective method, approved by the Engineer that completely and effectively removes contaminants, loose materials, and conditions deleterious to proper adhesion. Surfaces shall be further prepared after cleaning by sealing or priming, as recommended by the manufacturer of the pavement marking material.

- (6) Moisture. Pavement to which the material is to be applied shall be completely dry. When questionable, pavements will be considered dry if, on a sunny day after observation for 15 minutes, no condensation occurs on the underside of a one (1) square foot piece of clear plastic that has been placed on the pavement and weighted down on the edges.
- (7) Temperature. Pavement and ambient air temperature requirements recommended by the material manufacturer shall be observed. If no temperature requirements are established by the materials manufacturer, material will not be placed if the pavement temperature is below 60 degrees F or if it is above 120 degrees F.
- (8) Clean-Up. At all times, the project site shall be kept free of all unnecessary traffic hazards. Upon completion of the work, the Contractor shall remove all rubbish from the work site, and shall clean and restore the area to a manner acceptable to the Engineer. Also, all damage done by the Contractor during the prosecution of the work must be repaired. Before acceptance, the work site must be neat and in a presentable condition throughout. No extra compensation will be allowed for fulfilling these clean-up requirements.

## 5. PERFORMANCE

- (1) Adhesion. Installed pavement markings shall adhere to the pavement sufficiently to prevent lifting, shifting, smearing, spreading, flowing or tearing by traffic.
- (2) Appearance. In addition to complying with all requirements listed herein, pavement markings shall present a neat, uniform appearance, and shall be free of unsightly conditions. Markings shall be free of ragged edges, misshapen lines or contours, and splices in transverse markings.
- (3) Visibility. The pavement marking material, in place on the roadway, shall have uniform and distinctive retro-reflectance when observed in accordance with TxDOT Test Method Tex-828-B.
- (4) Observation Period. All material, workmanship and labor furnished shall be covered by manufacturer's guarantee and/or warranty for a period of 12 months commencing on the final delivery date of the materials.

Pavement markings that fail to meet all requirements of this specification shall be removed and replaced at the expense of the Contractor within 30 working days following notification by the Engineer of such failure. All replacement pavement markings shall also meet all requirements of this specification for the same warranty period after installation.



## 6. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, preformed striping, words and emblems shall be measured by each type and color indicated on the Bid Form including preformed arrows and words or other symbols as indicated in the Bid Form.

Payment shall be full compensation for cleaning the pavement by any suitable means other than blast cleaning, for furnishing and placing all materials, and for all labor, tools, equipment and incidentals necessary to complete the work.

SECTION 025816  
RAISED PAVEMENT MARKERS

1. DESCRIPTION

This specification shall govern all work required for furnishing and installing Raised Pavement Markers required to complete the project.

2. MATERIALS

RAISED PAVEMENT MARKERS shall conform to Reference Specification Section 025818 "Pavement Markers (Reflectorized)" (TxDOT Departmental Material Specification 4200).

Unless indicated otherwise on the drawings, raised pavement markers and traffic buttons shall be of the type to be applied to the roadway surface with a non-integral adhesive. Types of raised pavement markers shall be as follows:

<u>TYPE</u>	<u>DESCRIPTION</u>
I-A	One face shall reflect amber light and the body other than the reflective face shall be yellow.
I-C	One face shall reflect white light and the body other than the reflective face shall be white, silver or light gray.
I-R	One face shall reflect red light and the body other than the reflective face shall be white, silver or light gray, or may be one-half red on the side that reflects red light.
II-A-A	Shall contain two reflective faces, each of which shall reflect amber light and the body other than the reflective faces shall be yellow.
II-B-B	Shall contain two reflective faces, each of which shall reflect blue light and the body other than the reflective faces shall be blue. (Fire Hydrant Application.)
II-C-C	Shall contain two reflective faces, each of which shall reflect white light and the body other than the reflective faces shall be white, silver or light gray.

II-C-R

Shall contain two reflective faces, one of which shall reflect white light and the other face shall reflect red light, and the body other than the reflective faces shall be white, silver or light gray, or may be one-half red on the side that reflects red light.

ADHESIVE for securing raised pavement markers to asphalt or concrete surfaces shall conform to Reference Specification Section 025828 "Bituminous Adhesive for Pavement Markers" (TxDOT Departmental Materials Specification 6130).

### 3. METHODS

PAVEMENT SURFACE to receive raised pavement markers shall be prepared such that the surface is free of loose material, grease, moisture, and other foreign material that could impair the bond with the adhesive.

ALIGNMENT AND POSITIONING of raised pavement markers shall be such that the reflective faces are aligned for proper visibility.

ADHESIVE shall be applied such that 100% of the lower surface of the marker is in contact with the adhesive and in sufficient quantity to serve as a cushion between the marker and the paved surface. Any surplus adhesive shall be removed so that the visibility of the marker is not impaired.

### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, raised pavement markers shall be measured as individual units for each type installed, if included as a bid item in the Bid Form. Payment shall include, but not be limited to, furnishing and installing markers complete with adhesive, and shall be full compensation for all labor, materials, tools, equipment and incidentals required to complete the work.

## DMS - 4200

### PAVEMENT MARKERS (REFLECTORIZED)

**EFFECTIVE DATE: JANUARY 2010**

**4200.1. Description.** This Specification governs for the pre-qualification, testing, and field evaluation requirements for reflectORIZED pavement markers (RPMs).

**4200.2. Units of Measurements.** The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

**4200.3. Material Producer List.** The Materials and Pavements Section of the Construction Division (CST/M&P) maintains the Material Producer List (MPL) of all materials conforming to the requirements of this specification. Materials appearing on the MPL, entitled "[Jiggle Bar Tiles, Pavement Markers, and Traffic Buttons](#)," require no further testing, unless deemed necessary by the Project Engineer or CST/M&P.

**4200.4. Bidders' and Suppliers' Requirements.** Before any material is allowed for use on Department projects, it must be of manufacture and product code or designation shown on the MPL.

**4200.5. Pre-Qualification Procedure.** The pre-qualification procedure consists of several steps, listed below, which are described in more detail in the following subsections:

- Pre-qualification request,
- Laboratory testing,
- Field testing,
- Provisional qualification,
- Project evaluations,
- Full qualification,
- Periodic evaluation,
- Disqualification, and
- Re-Qualification.

CST/M&P will provide notification at the completion of each step and will require confirmation from the supplier's contact person before proceeding to the next step.

Costs of sampling and testing are normally borne by the Department; however, the costs to sample, test, and conduct field evaluations for materials failing to conform to the requirements of this specification are borne by the supplier. This cost will be assessed at the rate established by the Director of CST/M&P and in effect at the time of testing and will be billed directly to the Contractor or supplier.

- A. Pre-Qualification Request.** Prospective suppliers interested in submitting their product for evaluation must submit a written request to the Texas Department of Transportation, Construction Division, Materials & Pavements Section (CP51), 125 East 11th Street, Austin, TX 78701-2483.

Include the following items with the request:

- Name and contact information, including email address for the person who will be the primary contact during the qualification process;
- Laboratory test results, from the manufacturer's lab or an independent test laboratory, showing actual test results that meet the requirements of ASTM D 4280;
- Product data sheets;
- List of locations and applications dates where the product is being evaluated or is in current use; and
- Test results from the National Transportation Product Evaluation Program (NTPEP), if available.

- B. Laboratory Testing.** Provide CST/M&P with 350 RPMs of each color and type for laboratory and field testing. Submit materials for laboratory testing and field evaluations at no cost to the Department. CST/M&P will acknowledge receipt of materials and specify a tentative completion date for laboratory testing. CST/M&P will test RPMs in accordance with Article 4200.6 and will send notification of results once laboratory testing is complete.

If laboratory testing conducted by TxDOT or by NTPEP shows RPMs do not meet the requirements of this specification, evaluation will cease, and RPMs will not be qualified. Suppliers may resubmit materials for qualification after providing documentation identifying the cause and corrective action taken.

- C. Field Testing.** Upon satisfactory completion of laboratory testing, CST/M&P will specify the location of one or more roadways selected for the 12-month field test and suggested application dates. The roadways will include:

- a concrete surface,
- a hot-mix asphalt surface, and
- a Grade 3 sealcoat.

The concrete and asphalt roadways will be full-access controlled freeways with a minimum average daily traffic (ADT) count of 35,000 vehicles, a minimum of 20% average daily truck traffic volume, and a minimum posted speed limit of 65 mph. The Grade 3 road test will be conducted on a four-lane divided highway with a minimum ADT count of 4,000 vehicles per lane, a minimum of 20% average daily truck traffic volume, and a minimum posted speed limit of 50 mph.

Providing NTPEP test results meeting the requirements of this specification may replace the concrete and hot-mix asphalt field tests on a deck for deck basis.

If TxDOT or NTPEP field testing shows RPMs do not meet the requirements of this specification, evaluation will cease, and RPMs will not be qualified. Suppliers may

resubmit materials for qualification after providing documentation identifying the cause and corrective action taken.

1. **NTPEP Testing.** Submit NTPEP test data to CST/M&P for review if available. CST/M&P will acknowledge receipt of NTPEP data and will provide results of review within one month of receipt.

The 12-month NTPEP test results for the pre-qualification of RPMs must meet the following:

- all the requirements specified in ASTM D 4280 for the tests performed by NTPEP;
  - a retention rate equal or greater than 90 % of the placed RPMs (excluding the RPMs removed for testing);
  - a visual evaluation of 3 or greater, as defined by the most recent NTPEP Project Work Plan for Field Evaluations of Raised Pavement Markers and Marker Adhesives, for the marker case and marker lens for a minimum of 90 % of the placed RPMs (excluding the RPMs removed for testing); and
  - the minimum retroreflectivity values required after 12 months on the roadway listed in Table 1.
2. **Application.** Provide the name of the contractor, the traffic control plan, and the manufacturer and product code for the adhesive at least two weeks prior to the application for CST/M&P review and approval. CST/M&P will confirm the date and location of the field evaluation installation and resolve any problems as necessary.  
  
CST/M&P will provide between fifty and one hundred RPMs of each submitted type for application from the samples submitted for laboratory testing. Testing of submitted markers occurs concurrently with a set of control RPMs, for compliance with the requirements of this specification. Control markers are those RPMs currently listed on the MPL; if the MPL is reorganized and no marker exists to act as a control, an RPM that has undergone the most recent NTPEP testing on both asphalt and concrete will be used. Supplier is responsible for application of the RPMs in the presence of CST/M&P. Application must meet all Department specifications for RPM application and traffic control as well as the manufacturer's recommendations.  
  
Notify CST/M&P of any problems or concerns with the installation within one week of application and request a re-installation, if necessary.
  3. **Evaluation.** CST/M&P will notify supplier of a suggested date for field testing evaluation at least one month prior to completion of the 12-month field trial. Provide the name of the contractor and traffic control plan for the evaluation at least 2 weeks prior to the scheduled evaluation date.  
  
Materials must meet the following requirements:
    - a. **Retention Rate.** The retention rate of the test RPMs must be no less than 5% below that of the control RPMs.

- b. Body Damage.** The test RPMs must not exhibit discoloration or body damage exceeding that of the control RPMs. They must not exhibit a repetitive form of damage or mode of failure (indicative of a design flaw) in a large percentage of the test RPMs. Body damage will be visually assessed according to NTPEP criteria.
- c. Functionality.** Four RPMs placed at 80 foot spacing or eight RPMs placed at 40 foot spacing must be functional when viewed at night from a vehicle using the low beam headlight setting. They must be functional when viewed at a minimum distance of approximately 400 ft. in the daytime. A functional marker is both visible and conspicuous.
- d. Retroreflectivity.** CST/M&P will remove twenty test RPMs from the pavement to undergo laboratory testing for retroreflectivity in accordance with Tex-842-B. Fifteen of the twenty RPMs pulled must pass the minimum reflective values shown in Table 1 (measured at 0.2° observation angle and 0° horizontal entrance angle).

**Table 1**  
**Minimum Retroreflectivity (cd/fc) After 12 Months on the Roadway**

Face	12 Mo.
Crystal	1.0
Amber	0.7
Red	0.2

- D. Provisional Qualification.** CST/M&P will grant provisional qualification after successful completion of the laboratory and field evaluations including NTPEP testing, when applicable. CST/M&P will send notification of provisional qualification, including the date of placement on the MPL, within one month after completion of the field evaluations. Failure to complete all project evaluation requirements successfully is grounds for cancellation of provisional qualification.
- E. Project Evaluation.** Once the material is provisionally qualified and listed on the MPL, provide CST/M&P with project information for the first three jobs supplied with the RPMs and additional projects if requested. RPMs must meet the same performance criteria as for the field evaluation to receive full qualification. CST/M&P will return the project evaluation results after the 12-month evaluation of each project.
- 1. Full Qualification.** CST/M&P will grant full pre-qualification and continue to list materials meeting all requirements of this specification on the MPL.

Pre-qualification requires extensive field evaluations. It is critical that no significant changes are made to the RPMs' composition, manufacturing process, or design during or after pre-qualification without notifying CST/M&P. It is also critical that the RPMs provided be uniform, with minimum variations from marker to marker. Significant changes not reported by the manufacturer or variations in product, as determined by the Director of CST/M&P, may be cause for removal from the MPL.

- 2. Failure.** CST/M&P will revoke provisional qualification for RPMs that do not meet the performance criteria and will remove the RPMs from the MPL.

Producers not qualified under this Specification may not furnish materials for Department projects and must show evidence of correction of all deficiencies before reconsideration for qualification.

- F. Periodic Evaluation.** Periodic evaluation consists of random department-initiated laboratory testing, audits, and periodic required submittals or field testing.

- 1. Department-Initiated Laboratory Testing and Audits.** The Department may conduct random sampling (per Tex-729-I) and testing on pre-qualified RPMs to identify changes in the material or nonconformity in production and to perform random audits of test reports.

- 2. Required Submittals or Field Testing.** Every 5 years, provide NTPEP data showing continued compliance with the requirements of this specification.

- G. Disqualification.** Causes for disqualification and removal from the MPL include, but are not limited to, the following:

- material fails to meet the requirements stated in this specification;
- the producer fails to report changes in the composition, manufacturing process, or design to CST/M&P;
- the producer has unpaid charges for failing samples; or
- qualified RPMs demonstrate repeated and large-scale performance problems in the field.

- H. Re-Qualification.** Suppliers disqualified and removed from the MPL may submit materials for requalification after submitting documentation identifying the cause of the problem and corrective action taken.

**4200.6. Material Requirements.** All RPMs must meet all requirements, except for requirements specified for a specific type.

**A. Reflectorized Types.**

- Type I-A must contain one face that reflects amber light. The body, other than the reflective face, must be yellow.
- Type I-C must contain one face that reflects white light. The body, other than the reflective face, must be white or silver-white.
- Type I-R must contain one face that reflects red light. The body, other than the reflective face, must be white or silver-white.
- Type II-A-A must contain two reflective faces oriented 180° to each other, each of which must reflect amber light. The body, other than the reflective faces, must be yellow.



- Type II-C-R must contain two reflective faces oriented 180° to each other, one of which must reflect white light and one of which must reflect red light. The body, other than the reflective faces, must be white or silver-white.

**B. Appearance Requirements.** The outer surface of the RPMs must be smooth except for the molding or stamping of the manufacturer's unique imprint. All corners and edges exposed to traffic must be rounded.

**C. Optical Requirements.** The RPMs must be capable of providing amber, red, or white light reflection as required by the requisition or plans.

The reflected light of each reflective face must conform to the minimum reflective specific intensity (SI) requirements listed in Table 2, measured in candelas per foot-candle (cd/fc).

**Table 2**  
**Minimum SI per Reflective Face at 0.2° Observation Angle (cd/fc)**

Horizontal Entrance Angle	Crystal	Amber	Red
0°	3.00	2.00	0.75
20°	1.50	1.00	0.30

**D. Physical Requirements.** When tested in accordance with Tex-434-A, the minimum strength of five markers must be 2,000 lb. with none exhibiting a deformation of more than 0.125 in. before achieving the minimum strength.

A random sample of five markers will be tested in accordance with Tex-434-A.

The average compression results must have a quality index value equal to or greater than 1.23. The quality index value will be calculated from the lower specification limit of 2,000 lb. load. The following equation is used to determine the quality index value:

$$Q_L = (X - LSL) / s$$

Where:

$Q_L$  = quality index value

$X$  = average result from test

$LSL$  = lower specification limit

$s$  = standard deviation from test.

**E. Heat Resistance.** The RPMs must show no change in physical or optical properties when subjected to the requirements of Tex-846-B. The temperature will be 140°F with the marker in a vertical position.

The SI of the pavement marker must not be less than 80% of its initial value after being subjected to the heat test.

**F. Impact Test.** The RPMs will be impact tested during the pre-qualification process. They will be impacted with a 20-lb. weight in the form of a 2-in. solid right-circular cylinder with a flat impact face having rounded edges falling freely through a vertical guide. The RPMs will be impacted while resting on a solid, flat, steel plate that is at least 1/2 in. thick. The RPMs will be tested at increasing heights until failure occurs. Failure will occur when the lens or body cracks. The height at which failure occurs -6 in. will be the acceptance threshold for RPMs supplied after pre-qualification.

**4200.7. Archived Versions.** Archived versions are available.

## DMS - 6130

### BITUMINOUS ADHESIVE FOR PAVEMENT MARKERS

**EFFECTIVE DATE: JANUARY 2008**

**6130.1. Description.** This Specification establishes the requirements for bituminous type hot-melt adhesive used for the placement of pavement markers. Two types are addressed: standard bituminous marker adhesive consisting of an asphalt base with homogeneously mixed mineral filler; and flexible bituminous marker adhesive consisting of a highly polymer modified asphalt.

Either adhesive must be suitable for bonding ceramic and plastic markers to hydraulic cement concrete, asphaltic concrete, and chip-sealed road surfaces and be applicable when road surface and marker temperatures are in the approximate range of 4–71°C (40–160°F).

The composition of the adhesive must be such that its properties will not deteriorate when heated to and applied at temperatures up to 218°C (425°F) using either air or oil-jacketed melters.

**6130.2. Units of Measurements.** The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

#### **6130.3. Material Requirements.**

**A. Adhesive Properties.** The adhesive must be smooth and homogeneous, containing no visible particles, and must comply with the requirements in Table 1.

**Table 1**  
**Adhesive Properties**

Property	Material	Standard Adhesive		Flexible Adhesive	
	Test Method	min	max	min	max
Softening Point, °F	ASTM D 36	200		200	
Penetration, 100 g, 5 s, 25°C (77°F), 0.1 mm	ASTM D 5	10	20	15	25 <sup>4</sup>
Flow, 5 hr., 70°C (158°F), mm			5		5 <sup>4</sup>
Heat Stability Flow, 5 hr., 70°C (158°F), mm			5		5
Viscosity, 10 rpm, 204°C (400°F), Pa-s			7.5		7.5
Flash Point, C.O.C., °F	ASTM D 92	550		550	
Ductility, 5 cm/min, 77°F, cm	AASHTO T 51	-		15	-
Flexibility, 1 in. mandrel, 90° bend, 10 s	ASTM D 3111			pass	

1. Exception to ASTM D 5329; heat the sample as described in ASTM D 5, Section 7.1.
2. Exception to ASTM D 5329; condition the sample as described in “Test Methods.”
3. As modified in “Test Methods”
4. Maximum penetration of 30 is allowed provided the result of the flow test is less than 1 mm.

**B. Asphalt Properties.** This applies to standard bituminous adhesive only. The filler-free asphalt, obtained from the Extraction and Abson recovery process, as explained in Section 6130.4, must have the properties in Table 2.

**Table 2**  
**Filler-Free Asphalt Properties**

Property	Minimum	Maximum	Test Method
Penetration, 100 g, 5 s, 25°C, (77 °F), 0.1 mm (in.)	25		ASTM D 5
Viscosity, 135°C (275°F) Pa-s (Poises)	1.2 (12)		ASTM D 2171
Viscosity Ratio, 135°C (275°F)		2.2	ASTM D 1754 and ASTM D 2171

**C. Filler Properties.** This applies to standard bituminous adhesive only. The filler material, obtained using the filler separation technique described in Section 6130.4, must have the properties in Table 3.

**Table 3**  
**Filler Properties**

Property	Minimum	Maximum	Test Method
Filler Content, wt. %	50	75	As in Section 6130.4.
Filler Fineness, % passing:			ASTM C 430, as modified in Section 6130.4.
45 µm (No. 325)	75	--	
75 µm (No. 200)	95	--	
150 µm (No. 100)	100	--	

#### 6130.4. Test Methods.

- A. Heat Stability Flow.** To determine the heat stability flow, place 1000 g of adhesive in a loosely-covered quart can, heat to 218°C (425°F) and maintain at this temperature 4 hours before performing the flow test.
- B. Extraction and Abson Recovery.** Use this procedure to separate and recover the base asphalt from the adhesive. Heat the adhesive just to the point where it will easily flow. Transfer between 125 and 150 g into a 1000-mL (1-qt.) Erlenmeyer flask containing 400 mL (13.5 fl. oz.) of trichloroethylene with a temperature of 52–66°C (125–150°F). Stir this mixture thoroughly to dissolve the asphalt. Decant the solvent-asphalt mixture. Recover the base asphalt from solvent according to Tex-211-F, but begin with the centrifuge step; the primary distillation is not necessary. Repeat the above extraction-recovery method as necessary to obtain the desired quantity of asphalt.
- C. Filler Separation Technique.** Use this procedure to separate the filler material from the asphalt and determine the filler content of the adhesive. Weigh  $10.00 \pm 0.01$  g of solid adhesive, broken into small pieces, into a centrifuge flask with approximately 100 mL (3.5 fl. oz.) volume such as that specified in ASTM D 1796. Add 50 mL (1.7 fl. oz.) of trichloroethylene to the adhesive. Swirl or stir the mixture with a fine rod, taking care not

to lose any solids. Place the sample flask in a balanced centrifuge and spin using a minimum relative centrifugal force of 150 (as determined in ASTM D 1796, Section 6.) Remove the sample flask and decant the solvent, taking care not to lose any solids. Repeatedly add more solvent, centrifuge, and decant until the solvent becomes clear and the filler appears free of asphalt. Dry the recovered filler at  $71 \pm 3^{\circ}\text{C}$  ( $160 \pm 5^{\circ}\text{F}$ ) to remove solvent. Weigh the dried filler. Filter the decanted solvent through a filter paper with a 20–25  $\mu\text{m}$  retention factor to verify there is no loss of filler. Calculate the filler content as a percentage of the original sample weight.

**D. Filler Fineness.** Use this procedure to determine the filler fineness. Use the same apparatus as described in ASTM C 430, except also use 75 $\mu\text{m}$  (No. 200) and 150  $\mu\text{m}$  (No. 100) sieves. Prepare a water solution containing 1 wt. percent of a nonionic, water-soluble surfactant, such as Triton X-100, beforehand. Thoroughly wet the 1 g dry sample in the surfactant solution and allow it to soak for 30 min. Transfer the filler completely into the 45  $\mu\text{m}$  (No. 325) sieve cup. Wash the sample with the water spray, as described in ASTM C 430, Section 5, for 2 min., adding surfactant solution as needed to disperse any clumped particles. Dry and weigh the sample and perform calculations as directed in ASTM C 430. Repeat the procedure using the other two sieve sizes.

**6130.5. Acceptance.** Bituminous adhesives are pre-qualified in accordance with Tex-538-C. Consult “[Bituminous Marker Adhesive](#)” for a list of materials currently pre-qualified under this procedure.

**6130.6. Packaging and Labeling.** Package the adhesive in self-releasing cardboard containers with essentially flat and parallel top and bottom surfaces such that the packages will stack properly. Each package must have a net weight of either 23 or 27 kg (50 or 60 lb.) and must weigh within 1 kg (2 lb.) of the stated quantity.

Self-releasing cardboard dividers, which will separate each package into sections weighing no more than 7 kg (15 lb.) each, must be part of the packaging.

Each package must display:

- the manufacturer’s name,
- net weight,
- lot or batch number, and
- a product name that clearly identifies the material as either standard or flexible bituminous marker adhesive.

**6130.7. Archived Versions.** Archived versions are available.

SECTION 026201  
WATERLINE RISER ASSEMBLIES

1. DESCRIPTION

This specification shall govern all work and materials required for proper installation of riser assemblies for waterline testing.

2. MATERIALS

Riser assemblies for 4" diameter and larger waterlines shall consist of (in order):

M. J. Plug or Cap, drilled and tapped (2")  
2" x 6" Galvanized Nipple  
2" Galvanized 90° Bend  
2" x 3' Galvanized Nipple  
2" Straight Coupling  
2" x 3' Galvanized Nipple  
2" Brass Gate Valve

3. CONSTRUCTION METHODS

The Contractor shall install riser assemblies on each end of waterlines to be tested. Note that this includes all 2" service connections. The assembly shall be wrapped in polyethylene, and concrete thrust blocking shall be applied at the base.

After the line is tested and ready for connection to the existing water system, the Contractor shall remove the riser assembly. The riser assemblies shall remain the property of the Contractor.

4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, waterline riser assemblies shall not be measured for payment. Payment for materials and labor shall be considered subsidiary to the payment for the waterline pipe.

SECTION 026202  
HYDROSTATIC TESTING OF PRESSURE SYSTEMS

1. DESCRIPTION

This specification shall govern all work necessary for hydrostatic testing the completed pressure system. The Contractor shall provide all tools, equipment, materials, labor, etc., as necessary, except as noted, and accomplish all testing under this specification.

2. MATERIALS

Water for filling the line and making tests will be furnished by the Contractor through a standard meter connection. A meter and gauges for testing shall be supplied by the Contractor. A test pump with appropriate connector points as approved by the Water Superintendent for the installation of meter and gauge shall be furnished by the Contractor. The meter shall be directly connected to the main or pipe being tested by the use of copper tubing or an approved reinforced hose. The meter shall be protected against extreme pressures by the use of a one-inch (1") safety relief valve set at the test pressure plus ten pounds per square inch (psi) and furnished by the Contractor.

3. TEST PROCEDURE

Tests shall be made only after completion of backfill as specified, and not until at least thirty-six (36) hours after the last concrete thrust block has been cast. Contractor shall coordinate hydrostatic testing with the proposed construction sequencing and phasing.

Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied. During the filling of the pipe and before applying the specified test pressure, all air shall be expelled from the pipeline.

During the test, all exposed pipe, fittings, valves, hydrants and joints shall be carefully examined. If found to be leaking, they shall be corrected immediately by the Contractor. If the leaking is due to cracked or defective material, the defective material shall be removed and replaced by the Contractor with sound material.

All pipes shall be subjected to two hydrostatic tests. The first hydrostatic test shall be a two-hour test at a pressure of 150 psi. The second test shall be no less than 48 hours after successful completion of the first hydrostatic test. The second hydrostatic test shall be for a 24-hour period at City operating pressure for waterlines or at 50 psi for wastewater force mains and effluent lines.

The maximum allowable leakage shall be as follows:

Ductile Iron Pipe, AWWA C600

$$L = \frac{S D (P)^{1/2}}{133,200} \quad \text{or} \quad L = \frac{N D (P)^{1/2}}{7,400}$$

Asbestos - Cement Pipe, AWWA C603

$$L = \frac{N D (P)^{1/2}}{4,000}$$

PVC Pipe - Uni-bell equation 99

$$L = \frac{N D (P)^{1/2}}{7,400}$$

WHERE:

L = Maximum Allowable Leakage (gallons/hour)

S = Length of Pipe Tested (feet)

N = Number of Joints in Tested Line (pipe and fittings)

D = Nominal Diameter of Pipe (inches)

P = Average Test Pressure (psi)

If the pressure system fails to meet the leakage requirements, the Contractor shall make the required repairs to the system and the system shall be retested. This procedure shall be repeated until the system complies with leakage requirements. The cost of each retest shall be \$100.

4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, hydrostatic testing of pressure systems will not be measured for pay, but shall be subsidiary to the installation of the pressure system component.



SECTION 026204  
POLYVINYL CHLORIDE PIPE  
(ASTM D 2241 Pressure Pipe for Wastewater Force Mains,  
Irrigation Systems and Water Transmission Lines)

1. DESCRIPTION

This specification shall govern all work necessary for furnishing all PVC pipe (ASTM D 2241) required to complete the project.

2. MATERIALS

PVC pipe shall be made of Class 12454-A or Class 12454-B virgin compounds as defined in ASTM D 1784 with an established hydrostatic design base of 4000 psi for water at 73.4° F.

3. DIMENSIONS

Pipe shall be manufactured to standard steel pipe O.D. (IPS), with dimensions and tolerances in accordance with ASTM D 2241.

4. JOINTS

Pipe shall have a gasket bell end with a thickened wall section integral with the pipe barrel in accordance with ASTM D 3139. The use of solvent weld pipe shall not be allowed.

5. GASKETS

Gaskets for jointing pipe shall be in accordance with ASTM F477 (for High Head).

6. PIPE PRESSURE RATING AND STANDARD DIMENSION RATIO

The pressure rating and SDR for PVC pipe (ASTM D 2241) shall be as indicated on the drawings. Pressure rating shall be based on the ISO equation in Section 4.5 of ASTM D 2241 with a maximum allowable hydrostatic design stress of 2000 psi (Safety Factor of 2.0).

7. CAUSE FOR REJECTION

Pipe shall be clearly marked in accordance with Section 9 of ASTM D 2241. Unmarked or scratched pipe shall be rejected.

## 8. CERTIFICATION

The Contractor shall furnish, in duplicate to the Engineer, a copy of the manufacturer's affidavit of compliance with this specification. Certification shall accompany each delivery of materials, to include gaskets.

## 9. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, PVC pipe (ASTM D 2241) will be measured by the linear foot along the centerline for each size installed. Measurement of pipe shall be up to, but not include, the fittings.

Payment shall include all labor, pipe, and equipment for hauling, bracing, trench excavation, testing, backfilling, and for all cleaning up and other incidentals necessary to install the pipe complete in place, per linear foot.

SECTION 026206  
DUCTILE IRON PIPE AND FITTINGS

1. DESCRIPTION

This specification shall govern all work necessary for furnishing all ductile iron pipe and fittings required to complete the project.

2. GENERAL

All ductile iron pipe shall conform to AWWA C151. The interior of pipe and fittings (excluding fittings for wastewater force mains) shall have a shop-applied cement-mortar lining (40 mils thick) in accordance with AWWA C104. The exterior of pipe and fittings shall have a coating of coal tar enamel of approximately 1 mil thick or as specified in AWWA C105. Ductile iron pipe shall be wrapped in two plies of 8-mil polyethylene in accordance with Section 026402 "Waterlines" of the City Standard Specifications.

3. FITTINGS

All fittings shall be ductile iron and in accordance with AWWA C153. Fittings shall have a pressure rating of 250 psi for sizes through 12" and 150 psi for 14" and larger sizes, unless shown differently on the drawings. Unless noted otherwise on the drawings, Mechanical Joints shall be used.

4. JOINTS

Joints for pipe shall be mechanical type or push-on type such as "Tyton Joint", or approved equal; joints for fittings shall be mechanical joints, unless shown otherwise on the drawings.

Mechanical joints shall conform to AWWA C153. Mechanical joints shall be furnished complete with joint material, Cor-ten nuts, Cor-ten bolts, glands and gaskets.

When restrained joints are indicated on the drawings, restrained joints for pipe and fittings of 12" diameter and less shall be mechanical joint with retainer gland Series 1100 by EBAA Iron or approved equal, with a minimum of 250 psi rated working pressure. Restrained joints for pipe and fittings over 12" in diameter shall be push on type with a retainer ring as LOK-RING or FLEX-RING by American Ductile Iron Pipe, or TR FLEX by U.S. Pipe, or approved equal.

Gaskets shall be of synthetic rubber. An analysis of the material used in each size gasket showing the type of synthetic rubber and that no natural rubber is present shall be supplied.

## 5. PIPE

Pressure class ductile iron pipe requirements:

<u>Diameter</u> (inches)	<u>Pressure Class</u> (psi)	<u>Wall Thickness</u> (inches)	<u>Range of Maximum Allowable Depth Cover</u> (feet) - (feet)
			A - B*
4#	350	0.25	60+
6	350	0.25	30 - 65
8	350	0.25	20 - 50
10#	350	0.26	15 - 45
12	350	0.28	15 - 44
14#	300	0.30	13 - 42
16	300	0.32	13 - 39
18	300	0.34	13 - 36
20	300	0.36	13 - 35
24	250	0.37	11 - 29
24+	x	x	x

\* Range of maximum allowable depth of pipe where:

A = Ground water, or unstable bottom, or quick condition.

B = Ideal trench conditions, and sand encasement is at an average density in excess of 90% Standard Proctor density.

# Pipe sizes not typically specified on City projects, but shown for reference.

x Requires special evaluation.

The face of bells shall be plainly marked by color coding for classes so as to be readily identified in the field.

## 6. CERTIFICATIONS

A certification shall accompany each order of pipe and fittings furnished to job site. Certification shall include the following items: indicate that pipe complies with Part 3 of this specification; indicate that fittings and joints comply with Part 4 of this specification (it should be noted that the supplier shall furnish sufficient technical material for the Engineer to determine whether or not push-on joints can comply with the "or equal" clause); and a copy of a laboratory analysis of the material used in each size gasket showing the type of synthetic rubber and that no natural rubber is present.

## 7. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, ductile iron pipe shall be measured by the linear foot along the centerline for each size of pipe installed. Measurement of pipe shall be up to, but not include, the fittings.

Ductile iron fittings shall be measured per each by the type and size, as indicated in the Bid Form.

Payment shall include all labor, materials, tools and equipment for the completed installation and testing of the waterline, together with all incidentals necessary to install the pipe and fittings complete in place.

SECTION 026210  
POLYVINYL CHLORIDE PIPE  
(AWWA C900 and C905 Pressure Pipe for Municipal Water Mains and  
Wastewater Force Mains)

1. DESCRIPTION

This specification shall govern all work necessary for furnishing all PVC pipe (AWWA C900 and C905) required to complete the project.

2. MATERIAL

PVC pipe shall be made of Class 12454-A or Class 12454-B virgin compounds, as defined in ASTM D1784 with an established hydrostatic-design-basis of 4000 psi for water at 73.4 degrees F.

3. DIMENSIONS

Pipe shall be manufactured to ductile iron pipe equivalent outside diameters.

4. JOINT

Pipe shall have a gasket bell end with a thickened wall section integral with the pipe barrel. The use of solvent weld pipe shall not be allowed.

5. GASKETS

Gaskets for jointing pipe shall be in accordance with ASTM F477 (High Head).

6. PIPE PRESSURE CLASS AND DIMENSION RATIO

Unless indicated otherwise on the drawings, pipe shall have a dimension ratio (DR) of 18 and in accordance with:

<u>Pipe Size</u>	<u>Designation</u>
4" to 12"	AWWA C900
Over 12"	AWWA C905

7. CAUSE FOR REJECTION

Pipe shall be clearly marked in accordance with AWWA Requirements. Unmarked or scratched pipe shall be rejected.

## 8. CERTIFICATION

The contractor shall furnish in duplicate to the Engineer a copy of the manufacturer's affidavit of compliance with this specification, to include gaskets. Certification shall accompany each delivery of materials.

## 9. MEASUREMENT AND PAYMENT

Unless otherwise specified in the Bid Form, PVC pipe (AWWA C900 or C905) will be measured by the linear foot along the centerline for each size of pipe installed. Measurement of pipe shall be up to, but not include, the fittings.

Payment shall include all labor, materials, tools and equipment for the completed installation, backfilling and testing of the PVC pipe, together with all incidentals necessary to install the pipe complete in place, per linear foot.

SECTION 026214  
GROUTING ABANDONED UTILITY LINES

1. DESCRIPTION

This specification shall govern all work and materials required for grouting abandoned utility lines in place.

2. MATERIALS

A. Flowable Grout:

Flowable grout (or flowable fill) shall consist of a mixture containing Portland cement, fly ash, sand, water, and "Darafill" admixture (or approved equivalent), in the amounts shown below (or otherwise proportioned to provide 100 psi compressive strength at 28 days), to achieve a paste-like consistency immediately prior to placing the flowable grout. The flowable grout mixture shall be supplied by an approved ready-mix supplier. The manufacturer's representative shall be consulted for any final adjustments to improve the flowability of the mixture. Commercially produced flowable grout may be used with approval of the Engineer.

100 lbs/ CY	Portland Cement
300 lbs/ CY	Fly Ash
2100 lbs/ CY	Sand
250 lbs/ CY	Water
6 oz/ CY	"Darafill" admixture, as manufactured by Grace Construction Products, or approved equivalent.

B. Raw Soil: Soil shall be typical clayey soil of the area. It shall be from the project site or other approved source not suspected of being contaminated. The soil shall have a Plasticity Index over 15 and a Liquid Limit not to exceed 65.

C. Lime: Lime shall be hydrated lime, calcium hydroxide, in accordance with AASHTO M 216.

D. Water: Water shall be potable.

3. CONSTRUCTION METHODS

A. Flowable Grout: Mix Portland cement, sand, fly ash, "Darafill" and water in the amounts shown above to achieve a paste-like consistency immediately prior to placing flowable grout.

B. Soil-Lime Mix Design: The following is given as a typical mix design for soil-lime mixture for trial mix. The mix design is based on damp soil with an initial water content of about 15%. The proportions of soil and lime shall not be altered. The Contractor shall determine the amount of water to be added as required to produce a mix at its liquid limit.



Trial Mix Design:

Damp Soil	1000 lb.
Lime	50 lb.
Water (approximate)	48 gal.

Consistency shall be checked with liquid limit apparatus.

- C. Placement: The Contractor shall grout abandoned lines as indicated on the drawings. Temporary pumping and venting ports shall be placed as required to provide complete filling of the abandoned line and proper placement of the grout. If segregation or "sand packing" is experienced during pumping, the Contractor shall reduce the water content of the mix or obtain other soil source (for soil-lime mixture), as required. Any damage resulting from pumping operation shall be repaired at the Contractor's expense.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, grouting abandoned utility lines shall be measured by the linear foot of abandoned-in-place pipe. Payment shall be full compensation for all labor, equipment, materials and incidentals required to mix, transport, and place the grout and restore surface at pump ports.

SECTION 026402  
WATERLINES

1. DESCRIPTION

This specification, in conjunction with the City of Corpus Christi's Water Distribution System Standards, shall govern all work necessary for the installation of all waterline facilities required to complete the project.

2. MATERIALS

**Concrete:** Concrete shall have a minimum compressive strength of 3000 psi at 28 days.

**Bedding Sand for Encasement:** Bedding sand and initial backfill around the pipe shall be granular material of low plasticity as indicated on the drawings.

**Ductile Iron Pipe and Fittings:** See City Standard Specification Section 026206.

**Polyvinyl Chloride Pipe:** See City Standard Specification Section 026210.

**Tapping Sleeves and Valves:** See City Standard Specification Section 026409.

**Gate Valves for Waterlines:** See City Standard Specification Section 026411.

**Fire Hydrants:** See City Standard Specification Section 026416.

3. CONSTRUCTION METHODS

(1) **HANDLING MATERIALS**

- a) General: The Contractor shall be responsible for the safe storage of all materials furnished to, or by him, and accepted by him, until it has been incorporated into the completed project.

All material found during the progress of the work to have cracks, flaws or other defects will be rejected, and the Contractor shall remove such defective material from the site of the work.

- b) Unloading and Distribution of Materials at Work Site: Pipe and other materials shall be unloaded at point of delivery, hauled to and distributed at the job site by the Contractor. Materials shall at all times be handled with care and in accordance with manufacturer's recommendations. Care shall be taken not to scratch PVC pipe. Excessive scratching shall be considered cause for rejection of PVC pipe. Materials may be unloaded opposite or near the place where it is to be installed provided that it is to be incorporated into the work within 10 days. The Contractor shall not distribute material in such a manner as to cause undue inconvenience to the public.

- c) Storing Materials: Materials that are not to be incorporated into the work within 10 days shall be stored on platforms. The interior of pipes and accessories shall be kept free from dirt and foreign matter.

## (2) **ALIGNMENT AND GRADE**

- a) General: All pipes shall be laid and maintained to the required lines and grades. Fittings, valves and hydrants shall be at the required locations with joints centered, spigots home and all valve and hydrant stems plumb.

Temporary support and adequate protection of all underground and surface utility structures encountered in the progress of the work shall be furnished by the Contractor.

Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, connections to sewers or drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the Contractor at the Contractor's expense, in cooperation with the owners of such utility structures.

One (1) 20-ft. section of waterline pipe shall be centered over/under gravity wastewater line at all gravity wastewater line crossings. Waterline shall be ductile iron pipe with mechanical joint fittings, in accordance with City Standard Specification Section 026206, wherever new waterline crosses under new gravity wastewater line.

Maintain a minimum of six inches (2 feet usual) vertical clearance between outsides of pipes where a new waterline crosses over a new wastewater line. Maintain a minimum of twelve inches vertical clearance between outsides of pipes where a new waterline crosses under a new wastewater line.

Alternatively, at gravity wastewater line crossings, the proposed PVC waterline may be encased in a 20-ft. joint of ductile iron pipe with a minimum pressure rating of 150 psi that is at least two nominal sizes larger than the carrier pipe. The carrier pipe shall be supported in the casing at five foot (5') intervals with spacers, or shall be filled to the spring line with clean washed sand, graded as shown in the City Standard Water Details. The casing pipe shall be centered under the gravity wastewater line as indicated on the drawings, and both ends of the casing shall be sealed with cement grout or manufactured seal.

- b) Deviation from Drawings: No deviation from the line and grade shown on the plans may be made without the written consent of the Engineer.
- c) Depth of Cover: Depth of cover will be measured from the established street grade or the surface of the permanent improvement, or from finished grade to the top of the pipe barrel. Unless otherwise shown on drawings, the minimum depth of cover shall be 36 inches. Waterlines 12" and larger located under streets shall have 48 inches of cover at all points.

(3) **TRENCH EXCAVATION AND BACKFILL**

See City Standard Specification Section 022020, "Excavation and Backfill for Utilities" and applicable City Standard Details for Water.

(4) **POLYETHYLENE WRAPPING**

All ductile iron pipe, valves and fittings, except pipe or valves which are laid in encasement pipe or in concrete valve boxes, shall be wrapped in polyethylene. The polyethylene material shall have a thickness of 8 mils and may be either clear or black. The wrapping shall be lapped in such manner that all surfaces of pipe, valves and fittings, including joints, shall have a double thickness of polyethylene. If a single longitudinal lap is made using a double thickness of polyethylene, it shall be lapped a minimum of 18 inches and the lap shall be placed in the lower quadrant of the pipe and in such a manner that backfill material cannot fall into the lap. The polyethylene shall be secured in place with binder twine at not more than 6-foot intervals. If wrapping is applied before the pipe is placed in the trench, then special care shall be taken in handling the pipe so that the wrapping will not be damaged. Care shall also be exercised in backfilling around the pipe and fittings and in blocking fittings so as not to damage the wrapping. Any wrapping that may be damaged shall be repaired in a manner satisfactory to the Engineer and so as to form the best protection to the pipes.

(5) **SAND ENCASEMENT**

All pipe and fittings that are not enclosed in concrete valve boxes or laid in encasement pipe, shall be completely encased with a minimum of eight inches (8") of sand on the bottom and sides of waterlines smaller than 16 inches in diameter, and twelve inches (12") over the top of the waterline, unless otherwise indicated on the drawings. This encasement includes the bottom, sides and top of pipe and fittings including bells, so that all portions will be encased with sand to insulate the pipe from the natural ground and from the backfill. The sand shall be compacted to a minimum of 90% Standard Proctor density. Provide twelve inches (12") of sand encasement all around the pipe for 16-inch diameter and larger waterlines.

Sand shall be placed in a manner that will not injure the polyethylene wrapping and shall be compacted under, around the side, and over the pipe in a manner that will reduce settlement to a minimum and as approved by the Engineer.

In order to reduce the amount of sand required, the trench bottom may be excavated in a rounded manner so as to maintain at least a minimum of eight inches of sand between the excavation and the pipe (twelve inches for 16-inch diameter and larger waterlines), unless otherwise indicated on the drawings.

(6) **LOWERING PIPE AND ACCESSORIES IN THE TRENCH**

- a) General: The trench shall be excavated true and parallel to the pipe center line with a minimum clearance of eight inches below the pipe bottom and with a like clearance

from the bottom of the bell to the bottom of the bell hole. The trench shall then be refilled to the proper grade with sand as specified. The placing of the encasing material shall be done in such a manner so as to be free of all natural soil rock or other foreign matter.

After final grading in the trench of the encasing material, bell holes shall be excavated at each joint.

Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and efficient execution of the work. All pipe, fittings, valves, hydrants and accessories shall be carefully lowered into the trench by means of a derrick, ropes or other suitable equipment, in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

- b) Inspection of Pipe and Accessories: The pipe and accessories shall be inspected for defects prior to lowering in the trench. Any defective, damaged or unsound pipe shall be replaced.
- c) Clean Pipe: All foreign matter or dirt shall be removed from the interior of the pipe prior to lowering into the trench. Pipe shall be kept clean both in and out of the trench at all times during the laying.

#### (7) **JOINTING PIPES**

All pipes shall be made up in accordance with manufacturer's recommendation. Pipe deflection shall not exceed 75% of the maximum amount recommended by the manufacturer.

#### (8) **CONCRETE THRUST BLOCKS**

Temporary thrust blocks or other means of carrying thrust loads generated by hydrostatic testing shall be provided at all ends of lines to be tested. Details of the end connections and method of temporary blocking shall be submitted to the Engineer for approval. After satisfactory completion of the hydrostatic testing, this temporary blocking shall be removed so that connections may be made with existing lines. This work is subsidiary to waterline installation and no separate payment will be made for it.

Temporary thrust blocks are not allowed for long term use.

#### (9) **METAL HARNESS**

Metal harness, tie rods and clamps, or swivel fittings shall be used to prevent pipe movement. Steel rods and clamps shall be galvanized or otherwise rust proofed, or coated with hot coal tar enamel, then wrapped with two layers of polyethylene wrapping.

(10) **STERILIZATION**

- a) Fittings: Valves, hydrants and fittings shall be stored on timbers and kept clean. Where soil or other substance has come in contact with the water surfaces of the fittings, the interior shall be washed and sterilized with 2% solution of calcium hypochlorite.
- b) Pipe: As each joint of pipe is laid, the Contractor, unless otherwise directed by the Engineer, shall throw powdered calcium hypochlorite (70%) through the length of the joint (one pound for each 1,680 gallons of water to give 50 ppm). When the waterline is complete, and before testing, the waterline shall be slowly filled with water between valves and allowed to stand for 48 hours. After the sterilization period is completed, lines shall be flushed by the Contractor under the direct supervision of a representative of the City Water Department. The Engineer will take sample for testing two hours after refilling. If the sample does not pass State Health Department purification standards, the procedure shall be repeated. The entire procedure shall be coordinated under the supervision of the Water Division Superintendent/Engineer.

During the sterilization process, valves shall be operated only under the supervision of the Water Division Superintendent/Engineer. There shall be a base fee of \$100 paid by the Contractor to the City for each retest that is required.

(11) **HYDROSTATIC TESTING WATER SYSTEM**

See City Standard Specification Section 026202, "Hydrostatic Testing of Pressure Systems".

(12) **WATER SERVICE CONNECTIONS**

See Standard Specification Section 026404, "Water Service Lines".

**4. MEASUREMENT AND PAYMENT**

Unless otherwise specified on the Bid Form, waterlines will be measured by the linear foot for each size installed. Payment for waterlines will be made under the appropriate pipe material item and shall include, but not be limited to, trenching, dewatering, bedding, pipe (except for fittings), restraints, temporary thrust blocking, backfill, sterilization, and hydrostatic testing. Payment shall be full compensation for all labor, materials, tools, equipment and incidentals required to complete the work.

SECTION 026404  
WATER SERVICE LINES

1. DESCRIPTION

This specification shall govern all work necessary for furnishing and installing water service lines required to complete the project. Water service lines are those lines from the City main to the meter at the property line.

2. MATERIALS

GENERAL

Service fittings shall have a minimum of 150 psi working pressure rating, unless indicated otherwise.

Fittings and materials shall be in accordance with the applicable provisions of AWWA C800.

All service connections shall require service clamps.

SERVICE CLAMP

Service clamps shall be brass saddle with two silicone bronze straps with I.P. thread and have a minimum working pressure rating of 200 psi. The saddle and nuts shall be of 85-5-5-5 brass alloy per ASTM B-62 and AWWA C800. The nuts shall have unitized washers. Straps shall be 5/8 inch high-quality silicone bronze, flattened and contoured to provide a wider bearing surface against the pipe. Clamps shall be comparable to:

Ford 202B, Smith Blair 323, Rockwell 323

CORPORATION STOP

Corporation stop shall be of brass with I.P. thread inlet and Mueller 110 compression connection outlet designed for Type K copper pipe and be comparable in design to the following:

Mueller H-15028 for 1" size  
Mueller H-15023 for 1-1/2" & 2" sizes

### ANGLE METER STOP

Angle meter stop shall have a Teflon coated bronze ball which rotates within two Buna-N rubber seats. Inlet shall be packed joint for Type K copper and be comparable in design to the following:

Ford BA43-342 for 1" service line with 5/8" x 3/4" or 3/4" meter size  
Brass gate valve required for 1-1/2" and 2" sizes

### SERVICE LINE

Service line shall be of Type K copper tube or approved one piece SDR9 polyethylene with restrained compression brass fittings and stainless steel inserts.

Other products of comparable features and equal quality may be substituted for the above items with approval of the Engineer.

### 3. CONSTRUCTION METHODS

See City Standard Specification Section 022020, "Excavation and Backfill for Utilities ".

Service lines shall be placed by the Contractor as indicated on the drawings and as directed by the Engineer.

Relocation of existing meters and changeovers to the new system shall be done only under the direct supervision of the City Water Department.

### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, water service lines shall be measured with the units indicated in the Bid Form for each size of service line. Payment for service lines shall include, but not be limited to, the following: copper tubing, corporation stop, service clamp, angle meter stop, trenching, trench safety, backfilling including pavement repair, testing, flushing, clean-up and site restoration; and shall be full compensation for all labor, equipment, tools and incidentals required for proper installation of the water service lines.



SECTION 026409  
TAPPING SLEEVES AND TAPPING VALVES

1. DESCRIPTION

This specification shall govern all work and materials required for furnishing and installing tapping sleeves, sleeves and valves required to complete the project.

2. MATERIALS

Tapping sleeves shall have a Class 125 ANSI B16.1 outlet flange of cast iron, ductile iron or stainless steel. Sleeves shall be of ductile iron or 304 or 316 stainless steel. Lugs, bolts, washers and nuts shall be of 304 or 316 stainless steel. Iron sleeves shall be of the mechanical joint or caulked joint type as manufactured by Mueller, Clow, or approved equal. Stainless steel sleeves shall be of the compression gasket type capable of providing full support of the tapped pipe, as manufactured by Ford, Smith Blair, Romac, or approved equal. Gasket materials shall be of material suitable for potable water systems.

Tapping sleeves shall be sized for the type and size of pipe to be tapped. The class of asbestos cement pipe that will most likely be encountered in the water will be Class 200 for pipes 6 inches in diameter and smaller, and Class 150 for larger pipes. It should be understood that existing pipes to be tapped may not be of the type of material and/or size that is shown on the drawings. The proper size and type of tapping sleeve shall be provided and installed regardless of what is encountered.

Tapping valves shall conform to AWWA Standards and City Standard Specification Section 026411, "Gate Valves for Waterlines".

Valve boxes shall be as described in City Standard Specification Section 026411, "Gate Valves for Waterlines".

3. CONSTRUCTION METHODS

Construction methods shall adhere to those set out in City Standard Specification Section 026402 "Waterlines", and City Standard Specification Section 022020 "Excavation and Backfill for Utilities".

4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, tapping sleeves and tapping valves shall be measured on a per each basis for each size installed. Payment for tapping sleeves and tapping valves shall include, but not be limited to, furnishing and installing the valves complete in-place including joint materials, cast iron valve box, box extension, cover, concrete collar, and all other related items such as bolting, wrapping, cement-stabilized sand encasing, backfilling and compacting; and shall be full compensation for all labor, material, tools, equipment and incidentals required to properly install the valves as indicated and specified.

SECTION 026411  
GATE VALVES FOR WATERLINES

1. DESCRIPTION

This specification shall govern all work necessary to provide and install all gate valves and valve boxes required to complete the project.

2. MATERIALS

Gate Valves

All valves shall meet the following requirements. Gate valves shall conform to AWWA Standard C515.

- 1) The gate valves shall be ductile iron resilient wedge (C515) with non-rising stems.
- 2) Valve ends shall be flanged or mechanical joint type or a combination of these as indicated or specified. A complete set of joint materials shall be furnished with each valve, except for bell ends and flanges.
- 3) Valves 16 inches and larger shall be furnished for horizontal installation – lay over.
- 4) Stem seals shall be the O-ring type on valves through 12-inch size. Valves 16 inches and larger may be equipped with stuffing boxes.
- 5) Valves shall open left (counter clockwise). Valves over 18 inches shall have the main valve stem furnished with a combination hand wheel and operating nut.
- 6) Tapping valves to be used with tapping saddles shall have one end mechanical joint.
- 7) No position indicator will be required.
- 8) Within 30 days after award of contract, the Contractor shall submit in triplicate, for approval, the following:
  - a) Certified drawings of each size and type of valve 16 inches and larger showing principal dimensions, construction details, and materials used.
  - b) On all size valves, the composition of bronze to be offered for various parts of the valve, complete with minimum tensile strength in psi, the minimum yield strength in psi, and the minimum elongation in 2" per cent.

### 3. CONSTRUCTION METHODS

#### Gate Valves

Gate valves shall be installed as indicated on the drawings.

#### Cast Iron Valve Boxes

Valve boxes shall be installed as indicated on the drawings. When valves are in the street right-of-way, the top of box shall be set flush with the pavement or surrounding ground. In cultivated areas, the top of box shall be set twelve inches (12") below natural ground and long enough to be raised to natural ground at a future date.

### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, gate valves for waterlines will be measured as a unit for each gate valve and valve box installed. Payment shall include, but not be limited to, furnishing and installing the valves complete in-place including joint materials, cast iron valve box, box extension, cover, concrete collar, and all other related items such as bolting, wrapping, cement-stabilized sand encasing, backfilling and compacting; and shall be full compensation for all labor, material, tools, equipment and incidentals required to properly install the valves as indicated and specified.

SECTION 026416  
FIRE HYDRANTS

1. DESCRIPTION

This specification shall govern all work necessary to provide all fire hydrants required to complete this project.

2. MATERIALS

**Concrete:** Concrete shall be Class "A" in accordance with Section 030020 "Portland Cement Concrete" of the City Standard Specifications, with a minimum compressive strength of 3000 psi at 28 days.

**Fire Hydrants:** The fire hydrants shall conform to AWWA C502 (or latest edition) standard specifications for fire hydrants for ordinary water works service, except for changes, additions and supplementary details specifically outlined herein:

- a) Hydrants - Hydrants shall be of the traffic model type equipped with a safety flange or collar on both the hydrant barrel and stem.
- b) Type of Shutoff - The shutoff shall be of the compression type only.
- c) Inlet Connection - The inlet shall be ASA A-21.11 1964 mechanical joint for six-inch (6"), Class 150 ductile iron pipe. A complete set of joint material shall be furnished with each hydrant.
- d) Delivery Classifications - Each hydrant shall have two hose nozzles and one pumper nozzle.
- e) Bury Length - The hydrants shall be furnished in the bury length as indicated on drawings.
- f) Diameter (Nominal Inside) of Hose and Pumper Nozzles - The hose nozzles shall be two and one-half inches (2-½") inside diameter and the pumper nozzle shall be four inches (4") inside diameter.
- g) Hose and Pumper Nozzle Threads - The hose nozzles shall have two and one-half-inch (2-½") National Standard thread (7-½ threads per inch). The pumper nozzle shall have size (6) threads per inch with an outside diameter of 4.658 inches, pitch diameter of 4.543 inches, and a root diameter of 4.406 inches.
- h) Harnessing Lugs - None required.
- i) Nozzle Cap Gaskets - Required.
- j) Drain Openings - Required.

- k) Tapping of Drain Opening - Tapping of the drain opening for pipe threads is not required.
- l) Nozzle Chain - Not required.
- m) Direction to Open - The hydrants shall open left (counter clockwise).
- n) Color of Finish Above Ground Line - That portion of the hydrant above the ground line shall be painted chrome yellow.
- o) Shape and Size of Operating and Cap Nuts - The operating and cap nuts shall be tapered pentagon one and one-fourth inches (1-1/4") point to face at base and one and one-eighth inches (1-1/8") point to face at top of nut.
- p) Nozzle Cap Chains - Hydrants shall be furnished without nozzle cap chains.
- q) Size of Fire Hydrant - The main valve opening shall not be less than five and one-quarter inches (5-1/4") inside diameter.
- r) Valve Facing - The main valve facing of the hydrant shall be rubber with 90± Durometer hardness. When the main valve lower washer and stem nut are not an integral casting then the bottom stem threads shall be protected with a bronze cap nut and a bronze lock nut.
- s) Barrel Sections - The hydrant shall be made in two or more barrel sections with flanges connecting the barrel to the elbow and to the packing plate.
- t) Breakable Coupling - Hydrants shall be equipped with a breakable coupling on both the barrel section and the stem. The couplings shall be so designed that in case of traffic collision the barrel and stem collar will break before any other part of the hydrant breaks.
- u) Hydrant Adjustment - The hydrant shall be designed as to permit its extension without excavating after the hydrant is completely installed.
- v) Breakable Collars, Barrel and Stem - Weakened steel or weakened cast iron bolts that are used in the breakable barrel couplings will not be acceptable.
- w) Operating Stem - Stems that have operating thread located in the waterway shall be made of manganese bronze, Everdure, or other high quality non-corrodible metal. Stems that do not have operating threads located in the waterway must be sealed by a packing gland or "O"-ring seal located between the stem threads and waterway. Iron or steel stems shall be constructed with a bronze sleeve extending through the packing or "O"-ring seal area. The sleeve shall be of sufficient length to be in the packing gland "O"-ring seal in the both open and closed positions of the main valve. The sleeve shall be secured to the steel stem so as to prevent water leakage between the two when subjected to 300 pounds hydrostatic test pressure.

- x) Drain Valve Mechanism - Drain valves operating through springs or gravity are not acceptable.
- y) Operating Stem Nut - The operating stem nut shall be designed to prevent seepage or rain, sleet, and the accumulation of dust between the operating nut and the hydrant top.
- z) Packing Gland or "O"-Ring Seal - Fire hydrants having the threaded part of the stem at the hydrant top shall be equipped with a packing gland or an "O"-ring seal immediately below the threaded section of the stem.

### 3. CONSTRUCTION METHODS

Fire hydrants shall be installed as shown on drawings. Minimum burial length shall be 3 feet. Breakable couplings shall be located at least 2 inches and less than 6 inches above finish grade.

Hydrants and fittings shall be stored on timber and kept clean. The interior surfaces of hydrants and fittings shall be washed and sterilized with approved sterilizing agent, if requested by the Engineer at the time of installation.

### 4. CERTIFICATION

The manufacturer shall furnish to the Engineer two (2) certified sets of prints showing complete details and dimensions of the hydrant.

The manufacturer shall furnish to the Engineer one (1) certified copy of the physical tests of all metals used in the manufacture of the fire hydrant that is normally manufactured and that will meet these specifications.

### 5. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, fire hydrants will be measured as a unit per each. Payment shall include, but not be limited to, furnishing and installing the complete fire hydrant assembly with valve, 6-inch line and fitting on the main; and shall be full compensation for all labor, materials, tools, equipment and incidentals required to properly complete the work.

SECTION 026430  
BAR WRAPPED CONCRETE STEEL CYLINDER PIPE

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Furnishing and installing new bar wrapped concrete steel cylinder pipe and fittings for buried water lines for sizes 20 inches to 60 inches.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
1. No separate payment will be made for bar wrapped concrete steel cylinder pipe under this Section. Include cost in price for water lines.
  2. Maintain, on site, minimum of two 3-degree and two 5-degree grade angle adapters. When used during construction, adapter will be paid at unit price.
  3. Refer to Special Provision A-4 Method of Award Explanation of Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). Not used.

1.03 REFERENCES

- A. AASHTO Standard Specifications for Highway Bridges.
- B. AREMA Manual of Railway Engineering, Volume II, Chapter 15.
- C. ASTM A 615- Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- D. ASTM C 33 Standard Specification for Concrete Aggregates.
- E. ASTM C 35 Standard Specification for Inorganic Aggregates for Use in Gypsum Plaster
- F. ASTM C 150 Standard Specification for Portland Cement.
- G. ASTM C 497 Standard Test Method for Concrete Pipe, Manhole Sections, or Tile, Testing.
- H. ASTM D 512 Standard Test Methods for Chloride Ion in Water.

- I. ASTM C 1107 (CRD C-621) .Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- J. ASTM D 1293 .Standard Test Methods for pH of Water.
- K. ASTM E 165 .Standard Test Methods for Dye Protection
- L. ASTM E 340 .Standard Test Method for Macroetching Metals and Alloys.
- M. ASTM E 709 .Standard Test methods for Magnetic Particle Testing.
- N. ASTM E 1032 .Standard Test Methods for Radiographic Examination of Weidments.
- O. ANSI/AWS A3.0 .Standard Welding Terms and Definitions.
- P. AWWA C 206 .Standard for Field Welding of Steel Water Pipe.
- Q. AWWA C 207 .Standard for Steel Pipe Flanges for Waterworks Service .Sizes 4 in. through 144 in.
- R. AWWA C 301 .Standard for Pre-stressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids.
- S. AWWA C 303 .Standard for Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
- T. AWWA C 304 .Standard for Design of Pre-stressed Concrete Cylinder Pipe.
- U. AWWA M 9- Concrete Pressure Pipe.
- V. NSF 61 .Drinking Water System Components .Health Effects.
- W. SSPC SP 7- Surface Preparation Specifications No.7 Brush Off Blast Cleaning.

#### 1.04. SUBMITTALS

- A. Conform to requirements of CC 01 33 02 Shop Drawings.
- B. Submit shop drawings and certification signed and sealed by Professional Engineer registered in State of Texas showing following:
  - 1. Manufacturer's pipe design calculations.
  - 2. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, welding procedures, fabrication, fitting, flange, and special details, with plan view of each pipe segment sketched, detailing pipe invert elevations, horizontal



bends, welded joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Drawings. Do not start production of pipe and fittings prior to review and approval by the Engineer. Provide final approved lay schedule on CD-Rom in Adobe portable document format (\*PDF).

3. Include hot tapping procedure.
  4. Submit certification from manufacturer that design was performed for project in accordance with requirements of this section
- C. Submit inspection procedures to be used by manufacturer and for quality control and assurance for materials and welding. Submit standard repair procedures that describe in detail shop and field work to be performed. Repair defects such as substandard welds, excessive radial offsets (misalignment), pitting, gouges, cracks, etc.
- D. Submit following within 45 days after manufacturing of pipe and fittings.
1. Steel:
    - a. Steel reports as required in AWWA C 303, Section 5.2.5.
    - b. Results of other tests of steel reinforcement required in AWWA C 303, Section 5.2.
  2. Test Results.
    - a. Hydrostatic testing, acid etching, magnetic particle and x-ray weld test reports as required.
    - b. Compressive strength (7 and 28 day) test results for each type of coating and lining mix design.
  3. Submit pipe manufacturer's certification that Bar Wrapped Steel Cylinder Pipe:
    - a. Cylinder assembly has been hydrostatically tested at factory.
    - b. Mortar coatings and linings were applied or allowed to cure at temperature above 32 degrees Fahrenheit.
- E. Submit following nonshrink grout for special applications:
- I. Manufacturer's technical literature including specifications for mixing, placing, and curing grout.
  2. Results of tests performed by certified independent testing laboratory showing conformance to ASTM C 1107, Nonshrink Grout and requirements of this specification.
  3. Certification product is suitable for use in contact with potable water.

- F. Submit certification for welder and welding operator demonstrating their certification within past 6 months in accordance with AWWA C 206. Indicate certified procedures and position each welder is qualified to perform.
- G. Calibrate within last 12 months for equipment such as scales, measuring devices, and calibration tools used in manufacture of pipe. Each device used in manufacture of pipe is required to have tag recording date of last calibration. Devices are subject to inspection by the Engineer.

#### 1.05 QUALITY CONTROL

- A. Manufacturer to have permanent quality control department and laboratory facility capable of performing inspection and testing required. Inspection procedures and manufacturing process are subject to inspection by the Engineer. Perform manufacturer tests and inspections required by AWWA C 303 as modified by these Specifications. Correct nonconforming conditions.
  - 1. Cylinder and Joint Ring Assembly:
    - a. Review mill certifications for conformance requirements of Specifications.
    - b. Perform physical testing of each heat of steel for conformance to applicable ASTM standards.
    - c. Inspect physical dimensions and overall condition of joint rings and cylinder/joint ring assembly to verify compliance with requirements of AWWA C 303. Maximum allowable thickness variation of cylinder shall not be less than determined thickness.
    - d. Test cylinder/joint ring weld for tensile strength. Test one specimen for each 500 cylinder/joint ring assemblies in addition to those tests required by AWWAC30I.
    - e. Reject pipe with dented steel cylinders.
  - 2. Bar Rod
    - a. Review mill certifications for conformance to requirements of Specifications.
    - b. Inspect rod spacing during placement on cylinder.
    - c. Test rod splices for each production run or minimum of once a week, whichever is less, for conformance with minimum strength criteria.
  - 3. Pipe Lining Coating:

- a. Review mill certificates for each load of cement for conformance to ASTM C 150.
  - b. Perform sieve analyses weekly for each source of coarse and fine aggregate for conformance to ASTM C 33.
  - c. Inspect kiln recorder charts daily to confirm proper curing environment.
  - d. Verify mortar thickness on each size of pipe to a tolerance of 1/16th of an inch of required thickness.
  - e. Perform absorption tests in accordance with ASTM C 497, Method A, on cured mortar samples taken from pipes.
  - f. Check mortar batch proportions, moisture content and slurry application rate. Check coating thickness over wire on each pipe.
  - g. Check physical integrity of cured mortar coating. Check cured mortar coating for soundness on every pipe in field in addition to manufacturing plant.
  - h. Reject pipe with cracks in mortar coating exceeding 0.01 inches wide.
4. Protective Coatings: Check daily application rate and resulting dry film thickness.
- B. Gaskets.
1. Randomly test rubber cord for diameter, tensile strength, elongation, compression set, hardness, and specific gravity after oven aging on one out of 100 gaskets.
  2. Stretch test each gasket splice to twice its unstretched length and inspect for defects.
- C. Weld Testing
1. Perform macroetching tests for complete penetration production welds on normal production weld tests. Complete joint penetration welds are defined in ANSI/AWS A3.0. Verify complete joint penetration by means of macroetch of joint weld cross section, in accordance with ASTM E 340.
  2. Perform ultrasonic or x-ray testing of manual welds for fittings and special pipes. Perform dye penetration testing of manual lap welds for fittings and special pipes and for joint ring weld onto cylinder.
  3. Perform minimum of one set of weld test specimens in accordance with ANSL'AWS A3.0 on each size, grade and wall thickness at minimum of every 3,000 feet of pipe manufactured; but perform no less than one test per project by each welding machine and each operator.
- D. Cast four standard test cylinders each day for each 50 cubic yards of concrete mortar coating or portion thereof for each coating and lining mix design placed in day. Perform compressive

strength test at 28 days. No cylinder test result shall be less than 80 percent of specified strength. Reject pipe that does not meet minimum strength requirements.

- E. Make available copy of Physical and Chemical testing reports for steel cylinders and provide reports at request of the Engineer.
- F. Check physical dimensions of pipe and fittings: Physical dimensions to include at least pipe lengths, pipe I.D., pipe O.D. and bend angles.

#### 1.06 INSPECTION

- A. The Engineer and/or Owner's representative may witness manufacture and fabrication of pipe and appurtenances. Independent testing laboratory under contract to the Engineer or Owner may perform tests at direction of the Engineer to verify compliance with these specifications. Provide assistance to accomplish such testing, including equipment and personnel, at no additional cost to City.

### PART 2 PRODUCTS

#### 2.01 BAR WRAPPED STEEL CYLINDER PIPE

- A. Furnish pipe by same manufacturer.
- B. Provide bar wrapped steel cylinder pipe in conformance with AWWA C 303 and AWWA M 9, except as modified herein. Produce pipe cylinder to conform to AWWA C 303 except modify Section 4.5 to require that total cross-sectional area of bell ring plus cross-sectional area of bar reinforcement over bell ring exceed circumferential steel area in like length of barrel area by one-third.
- C. Use of pipe from inventory is permitted only if specifications and certifications are met. Provide testing records for such pipe.
- D. Do not use bar wrapped steel cylinder pipe in aerial crossings, exposed or other unburied areas.
- E. Pipe Manufacturer.
  - 1. Must have minimum of 5 years of manufacturer's pipe installations that have been in successful and continuous service.
  - 2. Must maintain on site or in plant minimum of four 22.5° bends per 10,000 linear feet of water line. Any combination of bends may be substituted at manufacturer's option (i.e. two 11.25° bends are equivalent to one 22.5° bend and will be counted as one fitting). Must be capable of delivering bends to job site within 12 hours of notification. These fittings are in addition to any fittings called out on Drawing and must be available at all times.

F. Pipe Design Conditions:

1. Working pressure: 90 psi.
2. Hydrostatic field test pressure: 150 psi
3. Maximum pressure due to surge: 150 psi.
4. Minimum pressure due to surge: -10 psi.
5. Unit weight of soil: 120 pcf minimum, unless otherwise specified.
6. Minimum trench width: As shown on the drawings or indicated in Technical Specification 02317 –Excavation and Backfill for Utilities.
7. Pipe and Fittings: Designed to withstand most critical simultaneous application of external loads including construction loads and internal pressures.
8. Design: Design pipe and fittings to withstand most critical simultaneous application of external loads and internal pressures. Base design on minimum of AASHTO HS-20 loading, AREA E-80 loads and depths of bury as indicated on Drawings. Design pipes with Marston's earth loads for transition width trench for all heights of cover.
  - a. Calculate moments and thrusts in wall based on earth load.
9. Increase longitudinal steel area (cylinder thickness) to prevent cylinder stress from exceeding 40 percent of minimum yield point at rated working pressure and 67 percent of minimum yield point at rated maximum surge pressure where pipe and fittings are subjected to longitudinal stresses induced by restrained joints or thrust blocks.
10. Groundwater Level: Design for most critical ground water level condition.
11. Modulus of elasticity (E) 30,000,000 psi.
12. Design stress due to working pressure to be no greater than 50 percent of minimum yield, and stress not to exceed 16,500 psi for mortar coated pipe.
13. Design stress due to maximum hydraulic surge pressure to be not greater than 75 percent of minimum yield, and stress not to exceed 24,750 psi for mortar coated pipe.
14. Modulus of soil reaction (E) < 1500 psi. If E> 1000 psi, do not use silty sand (SM) for embedment.
15. Deflection lag factor (DI) 1.2.
16. Bedding constant (K) 0.1.
17. Fully saturated soil conditions:  $h_w = h$  = depth of cover above top of pipe.

18. Inside diameter of casing or tunnel liner must be minimum of 4" or greater than diameter of carrier pipe for small diameter water lines. Inside diameter of casing or tunnel liner *must* be minimum of 8" or greater than diameter of carrier pipe for large diameter water lines.
19. Exclude structural benefits associated with primary liner in design of pipe in tunnel installations.
  - a. Design pipe and joints to carry loads including overburden and lateral earth pressures, subsurface soil and water loads, grouting, other conditions of service, thrust of jacks, and stresses anticipated during handling and construction loads during installation or pipe.
  - b. Do not use internal removable stiffeners for pipe in tunnel, unless approved by the Engineer.
  - c. External welded stiffeners shall be permitted in design calculations for pipe, provided wall thickness is minimum of 1/2 inch. Minimum clearances specified between exterior pipe wall and tunnel liner applies to distance between outside diameter of external welded stiffener and tunnel liner.
20. Design pipe for transmitting potable water.
21. Tunnel and Augered Sections: Provide constant outside diameter from bell to spigot end for pipe. Exclude structural benefits associated with primary liner. Design pipe and pipe joints to carry loads including but not limited to: overburden and lateral earth pressures, subsurface soil, grouting, other conditions of service, thrust of jacks, and any stress anticipated during handling and installation.

G. Coatings and Linings:

1. Material:
  - a. Lining: Provide Portland cement; ASTM C 150, Type I or II, as shown on the drawings or as required elsewhere in the Construction Documents.
  - b. Coating: Provide Portland Cement ASTM C 150, Type II with maximum of 5% tricalcium aluminate and pipe shall be placed with 6" cover of cement stabilized sand (between Sta 113+00 to Sta 255+00) or use Type V.
2. Water Absorption Test: ASTM C 497, Method A; perform on samples of cured mortar coating taken from each working shift. Cure mortar coating samples in same manner as pipe.
  - a. Test Value: Average minimum of 3 samples taken from same working shift, no greater than 9 percent for average value, and 11 percent for individual value.

- b. Test Frequency: Perform tests each working shift until conformance to absorption requirements has been established by 10 consecutive passing test results, at which time testing may be performed weekly. Resume testing for each working shift if absorption test results fail until conformance to absorption requirements is reestablished by 10 consecutive passing test results.
3. Apply one coat of primer to exposed steel parts of steel bell and spigot rings. Prior to coating, blast clean in accordance with SSPC-SP7 (Brush Off Blast Cleaning). Apply primer in accordance with manufacturer's recommendations.
4. Coat and line access inlets, service outlets, test inlets and air release/vacuum relief riser pipe with same coating and lining of main pipe in accordance with AWWA C 303, Section 4, unless otherwise indicated on Drawings.
5. Do not defer placing of coating of any portion of pipe length. Verify cement mortar coating thickness on each size of pipe by nondestructive method before removing pipe from coating machine.
6. Remove and replace disbonded lining or coating. Reject pipe requiring patches larger than 100 square inches or 12 inches in greatest dimension. Allow no more than one patch on either lining or coating of pipe. Provide WELD-CRETE Probond Epoxy Bonding Agent ET-150, parts A and B; Sikadur 32 Hi-Mod, or approved equal bonding agent for pipe patching.

H. Fittings and Specials:

1. Design fittings to same internal and external loads as straight pipe.
2. Manufacture in accordance with Technical Specification Section 02518 .Steel Pipe and Fittings for Large Diameter Water Lines.
3. Provide fabricated bends or fittings with minimum radius of 2-1/2 times pipe diameter.
4. Design test plugs to withstand forces generated by hydrostatic test and test pressure from either side. Do not exceed 50% of minimum yield for design stresses due to hydrostatic pressure. Assume opposite side of plug may not contain water.
5. Provide no specials less than 4 feet in length unless indicated on Drawings or approved by the Engineer.
6. Butt Straps for Closure Piece: Provide at locations indicated on Drawings or authorized by the Engineer. Minimum 12-inch-wide split butt strap; minimum plate thickness equal to thinnest member being joined; fabricated from material equal in chemical and physical properties to thinnest member being joined. Permit no angular deflection at butt-strap joints.

7. Provide minimum 6 inch welded outlet for inspecting each closure section, unless access manway is within 40 feet of closure section.
  8. Provide Densco petroleum based tape or approved equal for exposed portions of nuts and bolts.
- I. Joints:
1. AWWA C 303 rubber-gasketed or welded bell-and-spigot type except where flanged joints are required for valves and fittings as shown on Drawings. Refer to Technical Specification Section 02511 Water Lines for details on joints and jointing.
  2. Rubber-Gasketed Joints: Double weld bell and spigot ring onto steel cylinder. In thrust areas, double weld bell and spigot onto steel cylinder.
  3. Restrained Joints: Restrain joints by welding or harnessing joints.
    - a. Design Pressure: 1.5 times working pressure.
    - b. Harnesses Joints: AWWA M 9, clamp or snap ring type, except where prohibited.
    - c. Groundwater Level: Assumed to be equal to natural ground surface.
    - d. Provide restrained joint pipe with adequate cylinder thickness to transmit full thrust generated by internal pressure across joints.
      - 1) Calculate distance of restrained joints based on resistance along each leg of bend with thrust based on bend angle. Provide restrained joints between stations identified in Article 3.06 RESTRAINED PIPE REQUIREMENTS.
      - 2) Cylinder thickness not to be less than that defined in AWWA C 303, Table 2, and minimum nominal cylinder thickness.
      - 3) Allow cylinder thickness to reduce linearly from maximum calculated thickness to minimum thickness required by design over required length (as determined in Paragraph 2.01 J.3.d.1) of restrained joints.
      - 4) Provide full circumferential welds at joints required to be welded.
- J. Use only fully circumferentially welded joints in areas considered potentially petroleum contaminated, within tunnels and under foreign pipelines. Perform welding in accordance with Technical Specification Section 02518 Steel Pipe and Fittings for Large Diameter Water Lines.
- K. Pipe Flanges: AWWA C 207 for standard steel flanges of pressure class corresponding to pipe class.
- L. Pipe Lengths: Provide pipe sections in standard lengths with minimum length of 16 feet and maximum length as indicated on shop Drawings and approved by the Engineer. Gasketed joints are allowed on standard lengths of pipe. Non-standard pipe lengths



must be approved by the Engineer and joints must be welded as specified herein to achieve equal to or greater than standard pipe length before gasketed joints can be used. Internally and externally mark each pipe section with durable marking to show location and pipe pressure.

- M. Hydrostatic Test of Cylinder: In accordance with AWWA C 303, at point of manufacture. Hold test for minimum 2 minutes for thorough inspection of cylinder. Repair or reject cylinders revealing leaks or cracks.
- N. Transport fittings with end caps. Remove end caps just prior to installation.
- O. Transport fittings 36 inches in diameter and larger with stalls. Remove stalls after completion of backfill.
- P. Provide radius of curve as indicated on Drawings unless approved by the Engineer. Make curves and bends by deflecting joints, by use of beveled joints, or by combination of two methods, unless otherwise indicated on Drawings. Do not exceed deflection angle recommended by pipe manufacturer. Provide beveled pipe sections of standard length used in curved alignment, except when shorter sections are required to limit radius of curvature. In such case, provide sections throughout curve of substantially equal length.
- Q. When manufacturing straight pipe sections, manual welding is allowed for following:
  - 1. Tack welding of coils and plates during continuous pipe making process.
  - 2. Rewelding and repairing structural defects in plate and automatic machine welds.
  - 3. Attaching new coil of steel to previous coil.

## 2.02 BAR ROD

- A. Conform to requirements of ASTM A 615, AWWA C 303 and this specification.
- B. Test foreign manufactured rod by local independent laboratory.
- C. Rod manufacturer is responsible for performing mechanical tests required in ASTM A 615.
- D. Pipe manufacturer is responsible for requiring rod manufacturer to submit certified results of chemical and mechanical tests, performed by rod manufacturer. Pipe manufacturer is responsible for performing mechanical tests, and is required to attest to such in affidavit of compliance.
- E. Do not use rod with visible pitting.

## 2.03 GROUT FOR JOINTS AND SPECIAL APPLICATION

- A. Joint Grout:

1. Cement Grout Mixture: One part cement to two parts of fine, sharp clean sand. Mix interior joint mortar with as little water as possible until very stiff but workable. Mix exterior joint mortar with water until it has consistency of thick cream.
2. Water: Potable water with total dissolved solids less than 1000 mg/l; ASTM D 512 chloride ions less than 100 mg/l for slurry and mortar cure; ASTM D 1293 pH greater than 6.5. Use potable water with 2SGppm limit on chlorides and sulfates.
3. Portland Cement: ASTM C 150, Type II with a maximum *of* 5% tricalcium aluminate. and pipe shall be placed with 6" cover of cement stabilized sand (between Sta. 113+00 to Sta. 255+00) or use Type V as shown on the drawings or as required elsewhere in the Construction Documents. Provide one type of cement for entire project.
4. Sand:
  - a. Interior joints: ASTM C 35 fine graded plaster sand.
  - b. Exterior joints: ASTM C 33 natural sand with 100 percent passing No. 16 sieve.
5. Mix cement grout to specific gravity of 19 lb/gallon or greater as measured by grout/slurry balance. Use balance manufactured grout/slurry by Baroid or approved equal. Perform test in presence of and as requested by the Engineer. Add additional cement grout or water to mixed cement grout to bring mix to proper moisture content or specific gravity. Discard cement grout mixed more than 20 minutes that is not at proper moisture content or specific gravity.

B. Nonshrink Grout for Special Applications, Patches and Repairs.

1. Conform to requirements of ASTM C 1107, Nonshrink Grout.
2. Pre-blended factory-packaged material manufactured under rigid quality control.
3. Contain non-metallic natural aggregate, be non-staining and non-corrosive.
4. Meeting NSF 61 Standard suitable for use in contact with potable water supply.
5. Exterior: Highly flowable to fill joint wrapper without leaving voids or trapped air. Interior capable of being placed with plastic consistency.
6. Non-bleeding and non-segregating at fluid consistency.
7. Contain no chlorides or additives which may contribute to corrosion of bar *wrapped* steel cylinder pipe.
8. Free of gas-producing, gas-releasing agents.

9. Resist attack by oil or water.
  10. Mix, place, and cure in accordance with manufacturer's recommendations. Upon 72 hours' notice, provide services of qualified representative of nonshrink grout manufacturer to aid in use of product under job conditions.
  11. Mix nonshrink grout to specific gravity of 17.7 lb/gallon or greater as measured by grout/slurry balance. Use grout/slurry balance manufactured by Baroid or approved equal. Perform test in presence of and as requested by the Engineer. Add additional non-shrink grout to mixed non-shrink grout to bring to proper moisture content or specific gravity. Discard grout mixed more than 20 minutes that is not at proper moisture content or specific gravity.
  12. Compressive strength: ASTM C 1107 2500 psi minimum 7-day unconfined; 5000 psi minimum 28-day unconfined.
- C. Finished surface of lining and interior joint to be comparable to surface rubbed with No. 16 Carborundum stone. Rub joint mortar sufficiently to bring paste to surface, to remove depressions and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Leave interior with clean, neat and uniform-appearing finish.
- D. Joint Wrapper: Minimum width of 9 inches for 33-inch diameter and smaller; minimum width of 12 inches for diameters greater than 33-inch hemmed at edge to allow threading with minimum 5/8-inch wide steel strap. Provide minimum 6-inch wide Ethafoam strip sized, positioned, and sewn such that two circumferential edges of Ethafoam are 12-inches from outer edge of wrapper.

#### 2.04 CATHODIC PROTECTION

- A. Connect each joint of pipe with bonding straps or approved devices to maintain continuity of current. Provide bonding straps free of foreign material.
- B. Electrically isolate main line from other connections. Use insulating type joints or non-metallic pipe unless otherwise indicated on Drawings.
- C. Provide flange adapter with insulating kit as required when connecting new piping to existing piping.

#### 2.05 INSPECTION AND SHIPPING

- A. Permit the Engineer to inspect pipes or witness pipe manufacturing. Inspection shall, not relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications. Should the Engineer elect not to inspect manufacturing, testing, or finished pipes, it in no way implies approval of products or tests.

- B. Manufacturer's Notifications to Customer: Should the Engineer wish to see specific pipes during manufacturing process, manufacturer shall provide the Engineer with minimum of three (3) weeks advance notice of when and where production of those pipes will take place.
- C. Repair damage to pipe or protective lining per manufacture specifications before final acceptance.
- D. Shipping: Where required, provide pipe and fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.

### **PART 3 EXECUTION.**

#### **3.01 INSTALLATION**

- A. In the event of conflict between City Standard Specification Section 050200 - Welding, and the requirements of this specification, Specification Section 050200 will govern.
- B. Conform to requirements of City Standard Specification Section 026402 .Waterlines. Do not install pipe without approved lay schedule.
- C. Install stulls prior to placement of pipe, bends, and fittings to prevent deflection during installation. Provide stulls consisting of timber struts with end blocks shaped to fit curvature of interior surface of pipe or other appropriate configuration and material. Firmly edge and secure stulls to blocks so that they will remain intact position during handling and installation. Provide stulls adequate to resist loads encountered without structural failure to stull members or damage to pipe. Where applicable, place stalls at such lengths so as to elongate vertical diameter of pipe as required to suit trench conditions encountered.
- D. Install pipe within six months of pipe being manufactured.
- E. Manufacturer shall make available services of representative, throughout project duration when deemed necessary by the Engineer, to advise aspects of installation including but not limited to handling, storing, cleaning and inspecting, coatings and linings repairs, and general construction methods affecting pipe.
- F. Bedding and Backfilling
  - 1. Conform to requirements of City Standard Specification Section 022020- Excavation and Backfill for Utilities.
  - 2. Take necessary precautions during bedding and backfilling operations to prevent deformation or deflection of cylindrical shape of pipe by more than allowable pipe deflection.
  - 3. Do not move trench support system (trench safety system) once bedding material is compacted.

4. Align pipe at proper grade prior to joint connection and do not shift after jointing operation has been completed.
  5. Excavate outside specified trench section for bell holes, and for spaces sufficient to permit removal of slings. Provide bell holes at proper locations for unrestricted access to joint. Form bell holes large enough to facilitate joint wrapping and to permit visual examination of process. Enlargement of bell holes as required or directed by the Engineer or Engineer's designated representative. Subsequent backfilling thereof shall not be considered as authorized additional excavation and backfill. Backfill bell holes and spaces to satisfaction of the Engineer.
  6. Remove blocking after placing sufficient backfill to hold pipe in position.
- G. Follow non-shrink grout manufacturer's specifications for nonshrink grouting.
- H. Store pipe at job-site with securely-fastened plastic end caps to maintain moist pipe interior. Promptly replace damaged end caps to avoid shrinkage or cracking of cement-mortar lining. Immediately replace damaged plastic end caps. Do not leave uncapped for more than 4 hours.
- I. Deviation of installed pipe in any one pipe section from line and grade shown on approved shop drawing layout shall not exceed 2 inches from grade and 3 inches from line. No deviation from line and grade at contact interfaces are allowed.
- J. Use adequate surveying methods, procedures and employ competent surveying personnel to ensure pipe sections are laid to line and grade and within stipulated tolerances. Measure and record, in form approved by the Engineer, in-place survey data for pipe laid each day and submit copy of data to the Engineer at end of that day. Survey data to include unique pipe number, deflection angle at pipe joint and whether beveled ends were used, invert elevation at pipe joint, deviation of joint from project line, deviation of joint from project grade, inside pipe joint lap measured at top, bottom, and at springline (each side).
- K. Static Electricity:
1. Properly ground steel pipeline during construction as necessary to prevent build-up of static electricity.
  2. Electrically test where required after installation of pipeline is complete.

### 3.02 DEFLECTION

- A. Allowable deflection from specified diameter determined as follows:  
Allowable Deflection  $(D)^2/4000$ , (D= Nominal inside pipe diameter in inches.)
- B. Deflection may be measured by the Engineer at any location along pipe. Arithmetical averages of deflection are not acceptable.

- C. If deflection exceeds that specified, remove entire portion of deflected pipe section and install new pipe as directed by the Engineer at no cost to City.

### 3.03 CLOSURES AND APPROVED PIPE MODIFICATIONS.

- A. No modifications of standard pipe for closures shall be permitted in the field. No field cutting of pipe or exposure of bar wire is permitted without written approval from the Engineer.
- B. Pipe manufacturer's representative and the Engineer to entirely witness closures and approved pipe modification efforts.
- C. Provide minimum lap of 4 inches between member being joined and edge of butt strap. Weld on both interior and exterior, unless otherwise approved by the Engineer.
- D. Provide full circumferential welds on joints required to be welded. Employ independent, certified testing laboratory, approved by the Engineer, to perform weld tests on field welds. Include cost of such testing in contract unit price for water lien. Use magnetic particle test method for lap welds or X-ray methods for butt welds, for 100 percent of joint welds. Maintain records of tests. If defective weld is revealed, repair defective weld, and retest. Use wire and flux from same manufacturer throughout an entire project.
- E. Fill wrapper in field and allowing excess grout water to seep out. Refill wrapper as necessary. When joint mortar level has stabilized and begun to mechanically stiffen, lap Ethafoam wrapper over top of joint, and secure in place.
- F. Stretch test each gasket splice to twice its unstretched length and inspect for defects.

### 3.04 VISIBLE CRACKS

- A. No visible cracks longer than 6 inches, measured to be within 15 degrees of line parallel to pipe longitudinal axis, are permitted except:
  - 1. In surface laitance of centrifugally cast concrete,
  - 2. In sections of pipe with steel reinforcing collars or wrappers, or
  - 3. Within 12 inches of pipe ends.
- B. Repair interior lining cracks that exceed 1/16-inch (0.0625 inches) wide.
- C. Reject pipe with exterior coating cracks that exceed 0.01 inches wide.
- D. Immediately remove pipe from site if pipe has cracks exceeding limitations and cracks are not repairable.

### 3.05 FIELD REPAIR PROCEDURES FOR COATING/LINING

- A. Areas less than or equal to 6 inches in diameter: Patch honeycomb and minor defects in concrete surfaces with nonshrink grout conforming to section 2.03 B. Use only manual or small (low pressure) air chisels to chip away mortar coating or lining. Cut out unsatisfactory material and replace with nonshrink grout, securely bonded to existing coating or lining. Finish junctures between patches and existing concrete as inconspicuous as possible. Strike off nonshrink grout flush with surrounding surface after patch has stiffened sufficiently to allow for greatest portion of shrinkage. Finish surface in accordance with lining requirements.
- B. Pipe with defective coating areas greater than 6 inches in diameter cannot be used. Immediately remove pipe from project.
- C. Reject pipe if steel cylinder is dented while making field repair. Immediately remove pipe from project.

### 3.06 RESTRAINED PIPE REQUIREMENTS

#### Restrained Pipe Required to Resist Thrust

Baseline Station	ID of Pipe (in)	Deflection Angle (deg).	Plane of Deflection	Depth of Cover (ft)	Restrained Length (ft)	From Station	To Station
55+03	42	90.0	Horizontal	6	138	53+65	56+41
114+85	42	29.0	Horizontal	4	66	114+19	115+51
120+13	42	19.0	Horizontal	5	37	119+76	120+50
123+88	42	26.5	Horizontal	10	29	123+59	124+18
127+72	42	14.0	Horizontal	5	27	127+45	127+99
137+88	42	59.0	Horizontal	9	69	137+19	138+57
140+59	42	35.0	Horizontal	6	59	140+00	141+18
144+10	42	25.0	Vertical	5	62	143+48	144+72
144+26	42	34.0	Horizontal	4	77	143+48	145+03
144+42	42	22.5	Vertical	5	56	143+86	144+98
145+06	42	22.5	Vertical	5	56	144+50	145+62
145+29	42	22.5	Vertical	5	56	144+73	145+85
173+18	42	20.5	Horizontal	4	81	172+37	173+99
183+59	42	55.0	Horizontal	5	178	181+81	185+37
244+24	30	22.5	Vertical	5	43	243+81	244+67
244+40	30	22.5	Vertical	5	43	243+97	244+83
307+75	30	45.0	Horizontal	4	128	306+47	309+03
307+80	30	45.0	Horizontal	4	128	306+52	309+08
308+03	30	22.5	Horizontal	4	38	307+64	308+41
309+64	30	90.0	Horizontal	4	138	308+26	311+02
332+39	30	22.5	Vertical	4	49	331+90	332+88
332+63	30	22.5	Vertical	5	43	332+20	333+06

## Restrained Pipe Required to Resist Thrust (continued)

Baseline Station	ID of Pipe (in)	Deflection Angle (deg).	Plane of Deflection	Depth of Cover (ft)	Restrained Length (ft)	From Station	To Station
333+59	30	22.5	Vertical	5	43	333+16	334+02
333+84	30	22.1	Vertical	4	48	333+36	334+32
337+68	30	22.9	Vertical	4	50	337+18	338±18
337+96	30	22.5	Vertical	12	24	337+72	338+20
341+84	30	22.5	Vertical	12	24	341+60	342±08
342+15	30	22.5	Vertical	4	49	341+66	342±64
364+31	30	30.0	Horizontal	3	62	363+69	363±94
366+30	30	30.0	Horizontal	3	62	365+68	366±92

Note: ABOVE TABLE SHOWS LOCATIONS ONLY WHERE CALCULATED RESTRAINT > 20'

### PART 4 MEASUREMENT AND PAYMENT.

#### 4.01 Measurement

Unless otherwise specified on the Bid Form, pipe will be measured by the linear foot along the centerline of installed, in place, bedded, restrained, and accepted pipe.

#### 4.02 Payment

Payment will be made per linear foot installed pipe, to include handling, bedding, restraining, connecting, and testing pipe for proper installation acceptance.



SECTION 026602  
WASTEWATER FORCE MAIN

1. DESCRIPTION

This specification shall govern all work required for the installation of all wastewater force mains required to complete the project.

2. GENERAL REQUIREMENTS

1. All work shall be done in a workmanlike manner, in accordance with the drawings and specifications.
2. Prior to construction, the Contractor shall submit, for approval, certificates of inspection in duplicate to the Engineer from the pipe and fittings manufacturer(s) that said materials supplied have been inspected at the plant and meet the requirements of this specification.
3. It shall be the responsibility of the Contractor to keep on hand extra fittings and pipe, as he may deem necessary to make adjustments due to unknown obstructions, or to replace defective materials without delay to the project. When defective materials are discovered, they shall be immediately marked and removed from job site.
4. All pipe and fittings shall be clearly marked with trademark of manufacturer, batch number, location of plant, ASTM/ANSI/AWWA designation, size, pressure rating, class/SDR, and pressure rating.
5. Wastewater marking tape shall be continuously applied along the top of the force main, except at joints. The tape shall be green and 2 inches wide and state "Sewer".

3. MATERIALS

- A. **Ductile Iron Pipe Fittings:** See City Standard Specification Section 026206.
- B. **PVC Pipe (AWWA C900 or C905):** See City Standard Specification Section 026210.
- C. **Concrete:** Concrete shall have a minimum compressive strength of 3000 PSI at 28 days.

- D. **Bedding Sand for Encasement:** Sand shall be as indicated on the drawings.
- E. **Non-Standard Fittings:** Fittings having non-standard dimensions or fabricated especially for this project shall have a minimum pressure rating of 250 psi and durability comparable to that of the system. Drawings and specifications for non-standard fittings shall be submitted for approval of the Engineer prior to construction. Couplings and adapters for DIP and PVC connections shall be considered non-standard fittings.
- F. **Ceramic Epoxy Lining for Ductile Iron Pipe Fittings:** When indicated in the drawings or Special Provisions, the interior of DI pipe and fittings shall be furnished with a factory applied ceramic epoxy lining. Lining material shall be Protecto 401 Ceramic Epoxy Lining, of 40 mils nominal dry thickness. The epoxy shall be fused to the interior of the pipe by heat, forming a securely bonded lining.
1. **Operating Limits:** The lining shall have the capability of withstanding operating temperatures from 0° F to 170° F and withstanding sewage with a minimum pH of 4.0.
  2. **Application:** The interior surface of each pipe shall be blast-cleaned to remove high temperature oxide film and to form an anchor pattern over the entire surface prior to heating and lining. Epoxy lining is to cover the inner surface of the pipe, extending from the plain or beveled end to the rear of the gasket socket.
  3. **Adhesion:** Pipe shall be checked at the point of manufacture to assure bond of the lining to the pipe. Any indication of separation of lining from pipe is cause for rejection. .
  4. **Entrapped Material:** Any sizeable protrusion in the lining, obviously caused by lining over foreign materials, shall be cause for rejection.
  5. **Separations:** Linings which have separations caused during the lining operation shall be rejected.
  6. **Damages to Lining:** Injurious mechanical damage, such as chuck marks and gouges, extending to bare metal are not acceptable. The pipe having such a defect shall be rejected.
  7. **Lining Thickness:** Linings of nominal 40 mil thickness shall generally equal or exceed 40 mil throughout the pipe. At pipe ends, lining thickness may taper for a distance of 4 inches from the ends, to a minimum of 20 mil thickness. However, the lining shall not deviate by more than 5 mil from the 40 mil nominal thickness as required through the pipe. The lining thickness of each pipe and fitting shall be taken at the point of manufacture using a general electric magnetic dry film thickness device, digital coating thickness gauge, Positector 2000, or approved

equal. Pipe and/or fittings with a lining thickness less than the minimum specified shall be rejected.

8. **Bell and Plain End Overcoat:** The bell socket and the last 2 inches of the plain end of each pipe shall be coated on the inside and outside with a factory applied mastic or epoxy coating. This coating shall be a minimum of 10 mil thickness and shall be Koppers 300M, Industrial Ruff Stuff, Roskote Mastic A-938, or equal.
9. **Pinholes and/or Holidays:** The inside surface of each pipe or fitting shall be free of pinholes, holiday discontinuities and any blister type surface imperfections. The manufacturer shall check each pipe and fitting for holidays at the point of manufacture with a high voltage holiday detection device. Tinker & Rasor Model AP-W, or approved equal. Testing shall be conducted at the voltage as calculated in Section 3: Testing and Voltages of the "Recommended Practice for High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation" as published by the National Association of Corrosion Engineers (NACE) Technical Practices Committee. All actual holiday testing procedures shall conform to NACE standard RP-02-74 and American Society for Testing Materials (ASTM) Designation: G62- (latest) "Standard Test Methods for Holiday Detection in Pipeline Coatings." No holidays, misses or skips larger than a pinhole will be accepted for repair. A maximum of 6 holidays, as defined in ASTM Standard G62 and as determined by the detection test described above, on any one standard pipe length, fitting or special may be repaired with epoxy.
10. **Independent Testing Laboratory Representation:** All testing as specified herein including the lining thickness test and the holiday test shall be witnessed by a representative from an approved independent testing laboratory. The independent laboratory shall be a member of the American Council of Independent Laboratories. Manufacturer must submit for approval by the City the name of the testing laboratory and actual qualifications of actual representative that will witness the testing. The manufacturer shall furnish three (3) copies of report by independent testing laboratory depicting results of all testing witnessed by the independent laboratory.
11. **Field Testing:** Each pipe and fitting is subject to inspection in the field by the City for conformance to these specifications prior to installation. Any defects as specified herein with any pipe or fittings shall be grounds for rejection.
12. **Sealing Cut Ends and Repairing Field Damaged Areas:** Remove burrs from field cut ends and smooth out edge of epoxy lining. Remove all traces of oil or lubricant used during field cutting operation. All areas of loose lining associated with the cutting operation shall be removed and the exposed metal cleaned by sanding or scraping. For larger areas, roughen the bare pipe surface with a small chisel to provide an anchor pattern for the epoxy. The epoxy lining shall be "stripped" back by chiseling, cutting or scraping about 1" to 2" into well adhered

lined area before patching. After removal of loose lining and dirt, the area to be patched shall be "scratched" or "gouged" to offer an anchor pattern for the epoxy. Include an overlap of 1" to 2" of roughened epoxy lining in the area to be epoxy coated. The roughening shall be done with a rough grade emery paper (40 grit), rasp, or small chisel. Avoid honing, buffing, or wire brushing since these tend to make surface to be repaired too smooth. With the area to be sealed or repaired absolutely clean and suitably "roughened," apply a thick coat of two-part coal tar epoxy. The detailed mixing and application procedure for the epoxy shall follow the epoxy manufacturer's instructions. This heavy coat of epoxy shall be "worked" into the scratched surface by brushing. The Contractor shall maintain a supply of epoxy on the job site as required to seal cut ends and repair damaged pipe when encountered. Epoxy shall be of the type recommended or supplied by the pipe manufacturer.

13. **Warranty:** A five year warranty shall be furnished by the manufacturer on the serviceability of the lining. This warranty shall include, but not be limited to the statement, at any time up to the end of the fifth year from the date of pipe shipment:
- a. The lining shall not have disbound.
  - b. The lining shall not have suffered any appreciable underfilm migration.
  - c. The interior pipe metal, at points of pinholes or holidays, shall not have suffered detrimental deterioration.
  - d. The lining shall have maintained its smooth surface characteristics.

Contractor and/or manufacturer shall not make any exemption or exception to the above stated conditions or warranty within the limits as stated in this specification section.

14. **Certification:** The manufacturer shall furnish notarized certificates of compliance stating that the lining conforms to all requirements of these specifications.

#### 4. CONSTRUCTION METHODS

##### **4.1 HANDLING AND STORAGE OF MATERIALS**

- A. **General:** The Contractor shall be responsible for the safe storage of all materials furnished to or by him and accepted by him until the materials have been incorporated in the completed project.

All material found during the progress of the work to have cracks, flaws or other defects will be rejected, and the Contractor shall remove such defective material from the site of the work.

- B. **Unloading and Distribution of Materials at Work Site:** Pipe and other materials shall be unloaded at point of delivery, hauled to, and distributed at the job site by the Contractor. Materials shall at all times be handled with care and in accordance with manufacturer's recommendations. Care shall be taken not to scratch PVC pipe. Excessive scratching shall be considered cause for rejection of PVC pipe. Materials may be unloaded opposite or near the place where it is to be installed provided that it is to be incorporated into the work within ten days. The Contractor shall not distribute material in such a manner as to cause undue inconvenience to the public.
- C. **Storing Materials:** Materials that are not to be incorporated into the work within 10 days shall be stored on platforms. The interior of pipes and accessories shall be kept free from dirt and foreign matter.

#### 4.2 INSTALLATION

- A. **Alignment and Grade:** All pipes shall be laid and maintained to the required line and grade.

Temporary support and adequate protection of all underground and surface utility structures encountered in the progress of the work shall be furnished by the Contractor.

Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, connections to sewers or drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the Contractor at the Contractor's expense, in cooperation with the owners of such utility structures.

Force Mains shall be laid with no less than 36 inches of cover, unless indicated otherwise in the drawings. Greater depths will be permitted when required to avoid conflicts with existing structures.

Lines shall be laid to grade which permit entrapped air to flow to a high point for release through an air release valve as shown on the drawings. The Contractor shall investigate well in advance of pipe laying for conflicts which may necessitate the readjustment of planned line and grade.

- B. **Trench Excavation and Backfill:** See City Standard Specification Section 022020 "Excavation and Backfill for Utilities and Sewers", and drawings.
- C. **Force Main Connection to Existing Manhole:** Where new force main is connected to existing manhole, the manhole shall be prepared to receive the proposed force main and restored after connection. Manhole inverts shall be repaved as necessary to provide a smooth flowing system.
- D. **Polyethylene Encasement:** All metallic pipe, valves and fittings, except those

which occur in encasement pipe or in concrete valve boxes, shall be wrapped in polyethylene. The polyethylene material shall have a thickness of 8 mils and may be either clear or black. The wrapping shall be lapped in such a manner that all surfaces of pipe valves and fittings, including joints, shall have a double thickness of polyethylene. If a single longitudinal lap is made using a double thickness of polyethylene, it shall be lapped a minimum of 18 inches and the lap shall be placed in the lower quadrant of the pipe and in such a manner that backfill material cannot fall into the lap. The polyethylene shall be secured in place with binder twine at not more than 6-foot intervals. If wrapping is applied before the pipe is placed in the trench, then special care shall be taken in handling the pipe so that the wrapping will not be damaged. Care shall also be exercised in backfilling around the pipe and fittings and in blocking fittings so as not to damage the wrapping. Any wrapping that may be damaged shall be repaired in a manner satisfactory to the Engineer and so as to form the best protection to the pipes.

- E. **Sand Encasement:** Sand shall be granular soil of low plasticity such that 30% minimum passes a #4 sieve and no more than 20 % passes a #200 sieve, and the plasticity index (PI) shall not exceed 10. Soils with a Unified Classification of SW and SP, or AASHTO Classification of A3 and some A2 soil shall be required.
- F. **Pre-Placement Inspection:** Prior to lowering into trench, all pipe and accessories shall be inspected for defects. All foreign matter or dirt shall be removed from the interior of the pipe prior to lowering into trench. Pipe shall be kept clean at all times during the laying.
- G. **Jointing Pipe and Fittings:** All pipes and fittings shall be made up in accordance with manufacturer's recommendation. Pipe deflection shall not exceed 75% of the maximum amount recommended by the manufacturer.
- H. **Concrete Thrust Blocks:**

Temporary thrust blocks or other means of carrying thrust loads generated by hydrostatic testing shall be provided at all ends of lines to be tested. Details of the end connections and method of temporary blocking shall be submitted to the Engineer for approval. After satisfactory completion of the hydrostatic test, this temporary blocking shall be removed so that connections may be made with existing lines. This work is subsidiary and no separate payment will be made for it.
- I. **Restrained Joints and Fittings:** Metal harness, tie rods and clamps or restrained fittings shall be used to prevent movement when soil conditions will not withstand thrust blocking. Steel rods and clamps shall be galvanized or otherwise rust-proofed or coated with hot coal tar enamel then wrapped with two layers of polyethylene wrapping.

#### 4.3 HYDROSTATIC TESTING WASTEWATER FORCE MAIN

See City Standard Specification Section 026202, Hydrostatic Testing of Pressure Systems.

#### 5. MEASUREMENT AND PAYMENT

Unless otherwise specified in the Bid Form, wastewater force mains will be measured by the linear foot along the centerline of pipe. Payment shall include, but not be limited to, trenching, dewatering, pipe, bedding, thrust blocks, fittings, restraints and backfill, and shall be full compensation for all labor, materials, equipment, tools and incidentals required to complete the work at the unit price bid.

SECTION 027200  
CONTROL OF WASTEWATER FLOWS  
(TEMPORARY BYPASS PUMPING SYSTEMS)

1. GENERAL

1.1 DESCRIPTION

- A. This specification shall govern all work necessary for designing, installing, implementing, operating, and maintaining a temporary bypass pumping and flow control system, as provided by the Contractor for the purpose of diverting wastewater flow around the work area for the duration necessary to complete the work (i.e., control of wastewater flows). The Contractor shall furnish all materials, labor, equipment, power, maintenance, and incidentals required to maintain continuous and reliable wastewater service in all lines for the duration of the project.

1.2 SUBMITTALS

- A. **Bypass Pumping Plan Form:** It shall be the Contractor's responsibility to legibly and thoroughly complete, in its entirety, the attached Bypass Pumping Plan Form and submit it to the Engineer and/or the appropriate City staff for review and approval, prior to the installation of any pumping system proposed for use.

Unless the bypass pumping is associated with an emergency work order, the standard approval protocol is as follows: The Contractor prepares and submits the plan to the Engineer a minimum of 7 days prior to mobilizing to site. The Engineer reviews the bypass plan and coordinates approval with Engineering Services and the Operating Department. Engineer and City will put forth a reasonable level of effort to expedite the review and approval process. No deviation from the procedure shall be allowed.

- B. **Bypass Pumping Plan Schematic:** In addition to the above referenced form, the Contractor shall also furnish a sufficiently detailed schematic drawing identifying the approximate location of all bypass pumping system components. The schematic drawing shall clearly label parallel/crossing streets, identify landmark structures, and depict the locations of all pumps and piping.

At a minimum, the bypass pumping plan schematic drawing and associated attachments should include the following items:

- 1) Pump curves showing designed operation point for this specific project
- 2) Approximate location of bypass system pumping components
- 3) Location of manhole or access point for suction and discharge
- 4) Configuration, routing, location and depth of the suction and discharge piping
- 5) General arrangement/type of additional support equipment.
- 6) Temporary pipe supports, anchoring and thrust restraint blocks, if required
- 7) Traffic Control Plan and Traffic Department permit if the bypass is within the right-of-way.
- 8) Description of the method for removing pressure and all wastewater from existing force mains being taken out of service, if necessary.
- 9) All other City-department and Regulatory requirements.



- 10) Sewer plugging locations, method, and types of plugs
- 11) Method of protecting discharge manholes or structures from erosion and damage.

### 1.3 RESPONSIBILITY / AUTHORITY

- A. It is essential to the operation of the existing wastewater system that there is no interruption in the flow of wastewater throughout the duration of the project. The Contractor shall be completely responsible for designing, scheduling, providing, installing, operating, fueling and maintaining the temporary bypass pumping system in a manner that does not cause or contribute to overflows, releases, or spills of wastewater from the wastewater or bypass system. The Contractor shall neither anticipate nor expect any assistance from the City of Corpus Christi departments for any of the bypass operation.
- B. Contractor shall provide a responsible employee to man the bypass system 24 hours per day, 7 days per week during operation. The monitoring employee shall be properly trained, experienced, and mechanically qualified such that they can quickly and effectively address any potential emergency and non-emergency situations associated with the bypass system which must remain in operation. The wastewater and bypass systems should be inspected at least once every 2 hours. The Contractor shall be responsible for ensuring that the wastewater collection system is not compromised during bypass installation or operation, and contractor shall ensure that the system operates properly during this period.
- C. The Contractor shall consider and be responsible for the impacts on the collection system area, both upstream and downstream of the bypass and shall maintain the system in a manner that will protect public and private property from damage and flooding. Upstream impacts may include, but are not limited to backups and overflows. Downstream impacts may include, but are not limited to surcharges and overflows.
- D. Contractor shall make all effort to minimize spills of raw wastewater during the improvements and bypassing. All spills and sanitary sewer overflows shall immediately be reported to the City at 361-826-2489 and the Contractor shall be solely responsible for wash down, clean-up and disinfection of said spillages or overflows to the satisfaction of the owner at no additional cost to the City of Corpus Christi.
- E. The City is permitted through the Texas Commission on Environmental Quality to operate the wastewater system. The final authority comes from the City as to the operation of the wastewater system and as such it reserves the right to halt the bypassing operation at any time in order to maintain public health and safety.

## **2. PRODUCTS**

### **2.1 MATERIALS**

#### **A. Bypass Pumps**

- a. Pumps shall be fully automatic self-priming pumps that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric or diesel powered. Pre-approved manufacturers are Godwin or Rain-for-Rent. Approved equals may be considered by the Engineer if they meet all requirements in this specification but Contractor shall provide submittal package for Engineer's review and approval prior to installation. Pumps shall be equipped with critically silenced, sound attenuated enclosures with a maximum 65 dB (10-feet from pump), a diesel day tank with a minimum 24-hour runtime without refuel, and automatic start/stop controls for each pump.
- b. Pumping capacity of the bypass pump shall be capable of handling the flow conditions at all times and shall provide a minimum of 1.5 times the existing capacity of whatever line or lift station is being bypassed.
- c. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. In critical installations, as determined by the Engineer, one standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.

#### **B. Suction and Discharge Piping: Determined according to pump size, flow calculations, system operating conditions, manhole depth, and length of suction piping in accordance with the pump manufacturers specifications and recommendations. In order to prevent the accidental spillage of flows, all discharge systems shall be temporarily constructed of heavy-duty pipe with positive restrained joints.**

##### **a. High Density Polyethylene (HDPE)**

- i. Homogeneous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, blisters, or other deleterious faults. Defective areas shall be cut out and butt-fusion welded as per manufacturer's recommendations.
- ii. Assembled and joined at site using couplings, flanges, or butt-fusion method to provide leak proof joint, as per manufacturer's recommendations and ASTM D-2657.
- iii. Fusing must be performed by personnel certified as fusion technicians by manufacturer of HDPE pipe and/or fusing equipment. Fused joints shall be watertight and have tensile strength equal to that of pipe.
- iv. HDPE is required to be used in or adjacent to environmentally sensitive areas.

##### **b. Polyethylene Plastic Pipe (PE)**

- i. High density solid wall and following ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-DR) based on outside diameter, ASTM D1248 and ASTM D3550
- ii. Homogeneous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, blisters, or other deleterious faults.

##### **c. Quick-Disconnect Steel Galvanized Pipe and Heavy-Duty Flexible Hoses**

- i. Must consist of heavy-duty steel with high tensile strength, x-ray welded, abrasion resistant and suitable for intended service with a maximum pressure rating of at least 174 PSI
  - ii. Bauer quick-disconnect fittings/joints shall be restrained and watertight. Joints shall consist of vacuum sealing O-rings to help pumps prime faster and perform at their designed flow rates with no leaks, even at high pressure ratings
  - iii. Joints shall provide 30-degree articulation at every coupling and shall not require perfect alignment to make each connection.
  - iv. The galvanized couplings shall not be hindered by sand, mud, and grit.
- d. Valves and Fittings
  - i. Contractor shall provide valves and fittings as necessary and in accordance with the approved pipe materials shown above.
- e. Plugs
  - i. Selected and installed according to size of line to be plugged, pipe, manhole configurations, and based on specific application.
  - ii. Prior to use, Engineer may inspect plugs for defects which may lead to failure.
  - iii. Contractor shall provide additional plugs in the case of failure
- f. Miscellaneous
  - i. When temporary piping crosses local streets/roadways and private driveways, Contractor shall provide traffic ramps or covers designed, installed, and maintained for H-20 loading requirements while in use.

### **3. EXECUTION**

#### **3.1 SCHEDULING & COORDINATION**

- A. Unless the bypass pumping is associated with an emergency work order, the Contractor shall provide a minimum of 48 hour notice to the Engineer and Wastewater Department for the startup of bypass operations once the completed bypass plan has been approved by the design engineer. Unless needed otherwise for emergency work, no bypassing shall be initiated on Friday, Saturday or Sunday, or the day immediately preceding a City holiday.
- B. Inclement Weather: The Contractor shall not be allowed to commence bypass operation should inclement weather be forecast for the period of the scheduled improvements.
- C. Under special circumstances, as identified by the Engineer, where critical lines with large service areas are being bypassed, the Contractor is responsible for setting up a meeting between the Engineer/City/Operating Department to affirm and coordinate the approved bypass plan and to verify the intended site installation conforms to the approved plan. Engineer may also require the bypass system to be in service for at least 24-hours prior to taking existing gravity lines or force mains out of service to demonstrate reliability.
- D. Before beginning bypass operations, the Engineer/City Operating Department must be notified for field verification of pumps, piping, and equipment, etc., to ensure the site installation conforms to the approved plan.

- E. Before beginning bypass operations, the Contractor shall confirm appropriate emergency contact information has been provided to the City and Engineer on the Bypass Pumping Plan Form including emergency cell phone number of bypass operators/monitors responsibly manning the bypass system 24 hours per day along with the project superintendent and pump supplier.
- F. The Contractor can work extended hours, if approved by the Engineer, to perform the improvements during the bypass operation. Work during extended hours cannot create a nuisance for the neighbors.
- G. Once a lift station is taken out of service and bypass operations begun, work shall be continuous on the lift station improvements until all improvements are completed and the lift station is returned to normal service.
- H. The Contractor shall cease bypass pumping operations and return flows to the new and/or existing wastewater system when directed by the Owner. This may be expected if the bypass system is not in accordance with this specification or if inclement weather is in the forecast.

### 3.2 INSTALLATION & OPERATIONS

- A. Installation of Temporary Force Mains
  - a. Force mains may be placed along shoulder of road, medians, and/or outside of pavement. Do not place in streets or sidewalks without Engineers approval.
  - b. When temporary piping crosses local streets/roadways and/or private driveways, Contractor shall provide traffic ramps or covers designed, installed, and maintained for H-20 loading requirements while in use.
  - c. When traffic ramps cannot be used, install temporary piping in trenches and cover with temporary pavement, as approved by the Engineer.
- B. Discharge piping to gravity lines or manholes shall be designed in such a manner as to prevent discharge from contacting manhole walls or benching with as minimal turbulence as possible.
- C. Plugging or blocking of wastewater flows shall incorporate a primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the wastewater flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.
- D. The Contractor shall not cut existing force mains or gravity lines until it is determined that the containment area in place is sufficient for handling any wastewater within the pipe.
- E. Some locations may require multiple bypass systems. If bypass system is provided with air release valves, then the valve drains shall be piped to a manhole for discharge.
- F. Upon completion of the bypass pumping operations, remove piping, restore property to pre-construction condition and restore pavement.

#### **4. MEASUREMENT AND PAYMENT**

Unless otherwise specified in the Bid Form, Control of Wastewater Flows (Temporary Bypass Pumping Systems) shall not be measured for pay but will be considered subsidiary to the applicable pay item, to include all material, labor, equipment and supervision necessary to complete the bypass design, planning, coordination, installation, operation, maintenance and removal.

## BYPASS PUMPING PLAN FORM

Date: \_\_\_\_\_

Project Title: _____		No.: _____
Engineer: _____	Contractor: _____	
Service Area: _____	Lift Station No. (if applicable): _____	
Start Date & Time: _____	Completion Date & Time: _____	
Sewer Line Size being Bypassed: _____	Estimated Peak Flow: _____	
Line Plugging Method & Locations: _____		
Suction Manhole or Lift Station Number and Depth: _____		
Discharge Manhole or Lift Station Number and Depth: _____		
Maximum Surge Depth Allowed: _____		
Bypass Force Main Size, Material & Length: _____		
Pump Description: (Self-Priming, Critically Silenced, and Automatic Level Controls Required)		
Make, Model, Suction/Discharge Size: _____		Diesel or Electric
Total Number of Pumps/Standby Pumps: _____		
Total & Firm Capacity (GPM @ TDH): _____		
Vacuum Trucks (if required, number and capacity): _____		
Contractor Personnel Manning Bypass System (24 hours/day):		
Name: _____	Phone: _____	
Name: _____	Phone: _____	
Emergency Contacts:		
Name: _____	Phone: _____	
Name: _____	Phone: _____	
Additional Notes:		

### Required Checklist:

YES NO

- |                          |                          |  |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | Schematic drawing providing details of proposed bypass pumping system, routing of bypass lines (using manhole numbers and/or lift station names as applicable), equipment location, and proposed sequencing. |
| <input type="checkbox"/> | <input type="checkbox"/> | Has traffic control plan been appropriately modified to facilitate the bypass pumping equipment?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Pumps: Self-priming & Critically Silenced. Provide pump curve with Bypass plan. (Requirement).   |
| <input type="checkbox"/> | <input type="checkbox"/> | Contractor shall coordinate with Supplier for appropriate instruction and training on pump operation.  |
| <input type="checkbox"/> | <input type="checkbox"/> | Have emergency and/or backup provisions been made for quick pump change out in the case of system failure?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Contractor has confirmed no rain (less than 1/2-in) in the forecast?   |

Prepared by:

Reviewed by:

\_\_\_\_\_  
Contractor Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Wastewater Representative

\_\_\_\_\_  
Date

SECTION 027202  
MANHOLES

1. DESCRIPTION

This specification shall govern the furnishing of all materials and construction of manholes composed of a concrete base and concrete walls as shown on the drawings, to the lines, grades and dimensions shown on drawings or established by the Engineer.

2. MATERIALS

Concrete for cast-in-place storm water manholes and storm water junction boxes shall be Class C (3,600 psi at 28 days). Manholes for wastewater shall be made from fiberglass only, in accordance with City Standard Specification Section 027205 "Fiberglass Manholes".

Mortar for plastering shall be one (1) part Portland cement to three (3) parts clean hard and sharp mortar sand, free of all foreign substances or injurious alkalis.

Reinforcing steel, where used, shall conform to the requirements of Section 032020 "Reinforcing Steel". All wastewater manhole rings and covers for streets shall be East Jordan Iron Works, Inc. product V1430 CV or V1420/1480 Z1, or pre-approved equal, and shall have the seating surface of ring and cover machined to secure a snug fit per the City Standard Wastewater Details. All storm water manholes shall be East Jordan Iron Works, Inc. product V1168 assembly, and for school zones shall be a bolted assembly per the City Standard Storm Water Details. Steps are not required for wastewater and storm water manholes.

Joint material for precast concrete manholes shall be Ram-Nek Flexible Plastic Gaskets as manufactured by K. T. Snyder Company, Houston, Texas, or an approved equal.

3. EXCAVATION

The Contractor shall do all necessary excavation for the various manholes, conforming to size and dimensions shown on plans plus a maximum of four (4) feet working room. Excavation shall not be carried to greater depth than required. Subgrade under manhole footings shall be compacted to not less than 95% Standard Proctor density. Shoring shall be the responsibility of the Contractor and shall be installed as necessary. Shoring shall not be removed or backfilled around until entire manhole is completed, unless authorized by the Engineer. Shoring shall remain in place at least twenty-four (24) hours after concrete work has been completed.

#### 4. CONCRETE MANHOLES (STORM WATER ONLY)

(1) Formed-in-Place Manholes:

Where formed concrete is used, forms shall be built to dimensions shown on the standard details. Inserts and openings shall be formed so concrete will not be injured during process of stripping forms. Forms shall be braced and tied to prevent spreading or bulging, and shall meet approval of the Engineer prior to placing concrete. Forms shall remain in place for minimum of twenty-four (24) hours, and shall be removed within a maximum time of seven (7) days after completion of concrete work. Reinforcing steel, if required, shall be as shown on the plans.

The bottom of manholes shall be carefully formed and inverted smoothly when finished, with pipes cut to fit inside surface of walls.

(2) Precast Manholes

Precast manholes shall allow unobstructed view of all pipes connected to the manhole. Precast manholes shall be designed to support HS-20 traffic loading and designed by a Texas licensed professional engineer. The upper 18 inches of the corbel shall be brick to facilitate subsequent grade adjustment. Either concentric or eccentric cones may be required. Where not specified, eccentric cones shall be used. Manhole designs shall be submitted for approval by the Engineer.

#### 5. GENERAL CONSTRUCTION METHODS

All items shall be installed as the work progresses and as shown on the standard details. Work shall be completed and finished in a careful workmanlike manner, with special care being given to sealing joints around all pipe extending through walls of the manholes. After finishing walls, the bottom of the manhole shall be completed by adding sufficient concrete to shape the bottom in conformity with requirements on the plans. Where old manholes are adjusted to meet new lines and grades, all old masonry or concrete shall be thoroughly cleaned and wetted before joining new masonry or concrete to it. HDPE adjustment rings are to be used to match roadway grade. A maximum of 18" of adjustment rings may be utilized.

#### 6. BACKFILLING/LEAKAGE TESTING

Backfilling around the manholes shall commence as soon as concrete or masonry has been allowed to cure the required time and forms and shoring have been removed. Backfill shall be placed in layers of not more than six inches (6") and compacted to a minimum of 95% Standard Proctor density before next layer is installed. Wastewater manholes shall withstand a leakage test not to exceed the values stated in City Standard Specification Section 027205 "Fiberglass Manholes", except that an additional 10 percent of loss will be permitted for each additional two feet head over a basic two-foot internal head.



## 7. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, manholes shall be measured by each individual structure built, and paid for at the unit price bid per each, of the size, type and depth specified, complete in-place, and meeting the approval of the Engineer. "Complete in-place" shall mean all labor, materials, tools, equipment and incidentals necessary to furnish and install the manholes, excavation, compaction, backfilling, dewatering, concrete foundation, connections, adjustment rings, ring and cover, concrete work, leakage testing, video inspection, and adjust the manholes to finish grade.

Extra depth for wastewater manholes over six feet in depth shall be measured by the vertical foot and shall be paid for at the price bid per vertical foot for "Extra Depth for Manholes".

Rehabilitation of existing manholes with fiberglass inserts shall be measured by each individual structure rehabilitated, and paid for at the unit price bid per each, of the size, type and depth specified, complete in-place, and meeting the approval of the Engineer. "Complete in-place" shall mean all labor, materials, tools, equipment and incidentals necessary to furnish and install the rigid fiberglass manhole inserts, make connections, grout the annular space, backfilling, adjustment rings, ring and cover, concrete work, leakage testing, and adjust the manholes to finish grade.

SECTION 027203  
VACUUM TESTING OF WASTEWATER MANHOLES AND STRUCTURES

1. DESCRIPTION

This specification governs all work and materials necessary to perform vacuum testing of new or existing wastewater manholes. Manholes may be tested after installation with all connections (existing and/or proposed) in place. Vacuum testing may be performed prior to or after backfilling by the installer. Final acceptance, in accordance with the requirements of this specification, will consist of vacuum testing of the completed and installed structure (manhole) in place to include manhole/adjustment rings and manhole casting.

2. MATERIALS

Vacuum testing shall consist of a minimum of the following:

- (a) Engine.
- (b) Vacuum Pump.
- (c) Hose.
- (d) Test Head device capable of sealing opening in manhole casting as required.
- (e) Pneumatic Test Plugs - these plugs shall have a sealing length equal to or greater than the diameter of the connecting pipe to be sealed.

3. PROCEDURE

- (a) The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.
- (b) A vacuum of 10 inches of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of mercury.
- (c) The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values indicated in Table 1.
- (d) If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a satisfactory test is obtained.

**TABLE 1 - Minimum Test Times for Various Manhole Diameters (ASTM C1244)**

<b>Depth</b>	<b>Diameter (inches)</b>				
<b>(feet)</b>	<b>42</b>	<b>48</b>	<b>54</b>	<b>60</b>	<b>72</b>
	<b>Time (seconds)</b>				
<b>8</b>	17	20	23	26	33
<b>10</b>	21	25	29	33	41
<b>12</b>	25	30	35	39	49
<b>14</b>	30	35	41	46	57
<b>16</b>	34	40	46	52	67
<b>18</b>	38	45	52	59	73
<b>20</b>	42	50	53	65	81
<b>22</b>	46	55	64	72	89
<b>24</b>	51	59	64	78	97
<b>26</b>	55	64	75	85	105
<b>28</b>	59	69	81	91	113
<b>30</b>	68	74	87	98	121

**4. TESTING AND CERTIFICATION**

- (a) Testing shall be done by the Contractor and witnessed by the Engineer or his designated representative. All manholes and structures shall be tested as finished and completed for final acceptance.
- (b) ANY DEFECTIVE WORK OR MATERIALS shall be corrected or replaced by the Contractor and retested. This shall be repeated until all work and materials are acceptable.

**5. MEASUREMENT AND PAYMENT**

Unless otherwise indicated on the Bid Form, vacuum testing of wastewater manholes and structures will not be measured for pay. Such items shall be considered subsidiary to pay items applicable for Fiberglass Manholes, complete and in-place.

SECTION 027205  
FIBERGLASS MANHOLES

1. DESCRIPTION

This specification shall govern all work required for providing, installing and adjusting fiberglass manholes required to complete the project.

2. GENERAL

Fiberglass manholes shall be installed at the locations indicated on the drawings.

3. MATERIALS

A. Manholes

Fiberglass manholes shall be fabricated in accordance with ASTM D3753-“Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells,” latest edition, and the referenced design criteria as follows:

1. ASTM C581 Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service
2. ASTM D695 Standard Test Method for Compressive Properties of Rigid Plastics
3. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
4. ASTM C923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
5. ASTM D2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
6. ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
7. ASTM D2584 Standard Test Method for Ignition Loss of Cured Reinforced Resins
8. ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
9. ASTM F794 Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
10. ASTM C32 Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)

The minimum wall thickness for all fiberglass manholes at all depths shall be 0.50 inch. The inside diameter of the manhole barrel shall be a minimum of 48 inches or as otherwise specified on the drawings, but shall not be less than 1.5 times the nominal pipe diameter of the largest pipe, whichever is larger. A concentric reducer over the barrel shall have a

minimum inside diameter of 31.75 inches at the top, unless otherwise indicated on the drawings.

#### B. Manhole Pipe Connectors

Manhole pipe connectors for Sanitary Sewer Application shall be made of corrosion resistant plastic. The connector shall eliminate leaks around the pipe entering the manhole wall and shall permit pipe movement without loss of seal integrity, and shall be in conformance with ASTM D3212. Material for elastomeric seal in push-on joints shall meet the requirements of ASTM F477. Material for rubber sleeve shall meet the requirements of ASTM C443. Manhole pipe connectors between 4 inches and 15 inches shall be Inserta Tee from Fowler Mfg., or approved equal.

Manhole pipe connection for Storm Sewer Application shall be made with Ram-Nek flexible plastic gasket material as manufactured by K.T. Snyder Company of Houston, Texas, or approved equal, and wrapped with Class 'A' Subsurface Drainage Geotextile, AASHTO M288.

#### C. Manhole Base

Concrete shall be Class 'A' in accordance with City Standard Specification Section 030020 "Portland Cement Concrete".

Caulk for seal between fiberglass manhole and concrete cast-in-place base shall be Epo-Flex epoxy (gun grade consistency) as manufactured by Dewey Supply of Corpus Christi, Texas, or approved equal.

Precast reinforced concrete manhole base shall be in accordance with the requirements of ASTM C478, as shown on the construction plans and detail drawings.

#### D. Inflow Inhibitors

Inflow inhibitors shall be installed in sanitary manholes. They shall be of 316 stainless steel with an equivalent thickness of not less than 18 gauge, and load tested in excess of 3000 pounds. The inhibitor shall rest on the lip of the seating surface of the manhole ring and shall not exceed a depth of 6.5 inches. The seating surface of the inhibitor shall have an attached gasket on the weight-bearing side. The inhibitor shall have a gas relief valve made of Nitrite and shall operate at a one (1) psi differential pressure. The inhibitor shall be fitted with a handle of 3/16 plastic coated stainless steel cable attached to the insert body with a 6# 316 stainless steel rivet. The inhibitor shall be constructed of materials that withstand highly corrosive sewer gases.

#### E. Ring and Cover

Manhole ring and cover for all manholes shall be for street application and shall be as indicated on the drawings. Manholes 5 feet in diameter and larger shall require a nominal 3-foot ring and cover, as specified on the drawings. HDPE adjustment rings are to be used for

grade adjustments. A maximum of 18" of adjustment rings may be utilized.

#### F. Flowable Grout

Flowable grout (or flowable fill) shall consist of a mixture containing Portland cement, fly ash, sand, water, and "Darafill" admixture (or approved equivalent), in the amounts shown below (or otherwise proportioned to provide 100 psi compressive strength at 28 days), to achieve a paste-like consistency immediately prior to placing the flowable grout. The flowable grout mixture shall be supplied by an approved ready-mix supplier. The manufacturer's representative shall be consulted for any final adjustments to improve the flowability of the mixture. Commercially produced flowable grout may be used with approval of the Engineer.

100 lbs/ CY	Portland Cement
300 lbs/ CY	Fly Ash
2100 lbs/ CY	Sand
250 lbs/ CY	Water
6 oz/ CY	"Darafill" admixture, as manufactured by Grace Construction Products, or approved equivalent.

#### 4. CONSTRUCTION METHODS

**General:** The limits of excavation shall allow for placing and removing forms, installing sheeting, shoring, bracing, etc. The Contractor shall pile excavated material in a manner that will not endanger the work and will avoid obstructing sidewalks, driveways, power poles, drainage structures, streets, etc. Subgrade under manhole footings shall be compacted to not less than 95% Standard Proctor density.

**Vertical Sides:** When necessary to protect other improvements, the Contractor shall maintain vertical sides on the excavation. The limits shall not exceed three feet outside the footing on a vertical plane parallel to the footing except where specifically approved otherwise by the Engineer. The Contractor shall provide and install any sheeting, shoring, and bracing as necessary to provide a safe work area as required to protect workmen, structures, equipment, power poles, etc. The Contractor shall be responsible for the design and adequacy of all sheeting, shoring and bracing. The sheeting, shoring, and bracing shall be removed as the excavation is backfilled.

**Sloping Sides:** In unimproved areas where sufficient space is available, the Contractor will be allowed to back slope the sides of the excavation. The back slope shall be such that the excavation will be safe from caving. Safety requirements shall govern the back slope used.

**De-watering:** The Contractor shall keep the excavation free from water by use of cofferdams, bailing, pumping, well pointing, or any combination, as the particular situation may warrant. All de-watering devices shall be installed in such a manner as to provide clearance for construction, removal of forms, and inspection of exterior of form work. It is the intent of these specifications that the foundation be placed on a firm dry bed. The foundation bed shall be kept in a de-watered condition for a sufficient period of time to

insure the safety of the structure, but in no case shall de-watering be terminated sooner than seven (7) days after placing concrete. All de-watering methods and procedures are subject to the approval of the Engineer. The excavation shall be inspected and approved by the Engineer before work on the structure is started. The Contractor shall provide a relatively smooth, firm foundation bed for footings and slabs that bear directly on the undisturbed earth without additional cost to the City, regardless of the soil conditions encountered. The Engineer will be the sole judge as to whether these conditions have been met. The Contractor shall pile excavated material in a manner that will not create an unsafe condition.

**Unauthorized Over-Excavation:** Excavation for slabs, footings, etc., that rest on earth, shall not be carried below the elevation shown on the drawings. In the event the excavation is carried below the indicated elevation, the Contractor shall bring the slab, footing, etc., to the required grade by filling with concrete.

**Wall Preparation for Pipe Penetrations:** For sanitary sewer application, pipe penetrations for pipe sizes 4-inch through 15-inch shall be made with appropriately sized core drill bits recommended by the manufacturer. Pipe penetrations other than described above and as authorized by the Engineer shall be made as follows: cut shall be equal to the outside diameter of pipe to pass through it, plus 1/2 inch. Cuts are to be made using electric or gasoline powered circular saw with masonry blade. Impact type tools shall not be used.

**Handling:** Manholes shall be handled and stored in a safe manner as necessary to prevent damaging either the manhole or the surroundings. If manhole must be moved by rolling, the ground which it traverses shall be smooth and free of rocks, debris, etc. Manholes shall be lifted as specified by the manufacturer.

**Height Adjustment:** If necessary, utilize HDPE adjustment rings to adjust the manhole to the correct grade elevation. A maximum of 18" of adjustment rings may be utilized.

**Installation:** Lower manhole into wet concrete until it rests at the proper elevation, and a minimum of six (6) inches into concrete, then plumb.

**Backfill Material:** Unless shown otherwise on the drawings, initial backfill around manholes (from subgrade to five feet (5') above the top of the concrete footing) shall be flowable grout. The remaining final backfill around manholes shall be cement-stabilized sand, or approved equal, containing a minimum of 2 sacks of standard Type I or Type II Portland cement per cubic yard of sand, free of large hard lumps, rock fragments or other debris. The material shall be free of large lumps or clods which will not readily break down under compaction. This material shall be subject to approval by the Engineer. Backfill material shall be free of vegetation or other extraneous material. Topsoil should be stockpiled separately and used for finish grading around the structure, if necessary.

**Schedule of Backfilling:** The Contractor may begin backfilling around manhole as soon as the concrete has been allowed to cure and the forms removed.

**Compaction:** Backfill shall be placed in layers not to exceed 6 inches compacted thickness and mechanically tamped to at least 95% Standard Proctor density (ASTM D698). Backfill shall be placed in such a manner as to prevent any wedging action against the structure.

**Contractor shall follow operational requirements for bypass pumping as set forth in City Standard Specification Section 027200 "Control of Wastewater Flows".**

## **5. TESTING**

Manholes shall be tested for leakage by either of two tests as specified by the Engineer.

Water Leakage Test:

The Contractor shall provide water, labor, and materials for testing.

Testing shall be as follows:

1. With sewers plugged, the manhole shall be filled with water.
2. The manhole shall be checked after 24 hours have elapsed.
3. Water loss shall not exceed 2.4 gallons per foot of depth for the 24-hour period for 4-foot diameter manholes, or 3.0 gallons per foot of depth for the 24-hour period for 5-foot diameter manholes. Water loss shall not exceed 0.6 gallon per foot of diameter per foot of depth for the 24-hour period for all sizes of sanitary manholes.
4. If the manhole is within 9 feet of a waterline that is not or cannot be encased, the manhole shall be tested for no leaks and no noticeable loss of water shall be experienced for the 24-hour period.

If water loss is excessive, the Contractor shall correct the problem and the manhole shall be retested.

Vacuum Test:

Vacuum testing shall be in accordance with City Standard Specification Section 027203 "Vacuum Testing of Wastewater Manholes and Structures".

## **6. GRADE ADJUSTMENT OF EXISTING FIBERGLASS MANHOLES**

The adjustment of the ring and cover is to be achieved by removal or addition of HDPE grade adjustment rings that rest above the fiberglass corbel. If the ring and cover must be lowered to the extent that the new elevation cannot be achieved by removal of adjustment rings and it is necessary to remove a section of the fiberglass manhole, this work shall be done as described below.

Note that manhole repair kits are available for this work.

Remove the appropriately sized section of the existing manhole from the vertical manhole wall at least 6 inches below the seam where the corbel meets the vertical wall.



Excavate evenly around the manhole as required.

Mark, cut and remove the required section of the manhole. Make a square cut as necessary for a good butt splice.

Grind and clean ends of fiberglass that are to be re-united.

Replace and align the top. Fiberglass a 6-inch strip along the outside seam all around with two layers of mat with one layer of woven roving sandwiched between.

After the outside has set, go on the inside and fill any voids in the seam with epoxy or material provided by the manhole manufacturer for use in such application.

After the putty has set, fiberglass a 6-inch strip on the inside as previously done on the outside.

After curing, backfill with cement-stabilized sand, as described above, compacted to a minimum of 95% Standard Proctor density (ASTM D698) or as directed by the Engineer or his designated representative.

## 7. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, fiberglass manholes shall be measured per each for each size (diameter) of manhole indicated.

Payment shall be made at the unit price bid and shall fully compensate the Contractor for all materials, labor, tools, equipment, and incidentals required to complete the work. Payment shall include, but not be limited to; excavation, dewatering, compaction, concrete foundation, manhole assembly, connections, cast iron frame and cover, adjustment to finish grade, concrete work, backfill, leakage testing, bypass pumping, and other work as required to complete the fiberglass manhole.

Extra depth for a sanitary manhole over 6 feet in depth will be measured by the vertical foot of depth in excess of 6 feet and bid as "Extra Depth for Manhole (Wastewater)".

Rehabilitation of existing manholes with fiberglass inserts shall be measured by each individual structure rehabilitated, and paid for at the unit price bid per each, of the size, type and depth specified, complete in-place, and meeting the approval of the Engineer. "Complete in-place" shall mean all labor, materials, tools, equipment and incidentals necessary to furnish and install the rigid fiberglass manhole inserts, make connections, grout the annular space with flowable grout, backfilling, leakage testing, and adjust the manholes to finish grade.

SECTION 027402  
REINFORCED CONCRETE PIPE CULVERTS

1. DESCRIPTION

This specification shall govern the furnishing and placing of reinforced concrete pipe culverts and the material and incidental construction requirements for reinforced concrete pipe sewers. The culvert pipe shall be installed in accordance with the requirements of these specifications to the lines and grades shown on the plans, and shall be of the classes, sizes and dimensions shown thereon. The installation of pipe shall include all joints or connections to new or existing pipe, headwalls, etc., as may be required to complete the work.

2. MATERIALS

1. General. Except as modified herein, materials, manufacture and design of pipe shall conform to ASTM C-76 for Circular Pipe. All pipe shall be machine made or cast by a process which will provide for uniform placement of the concrete in the form and compaction by mechanical devices which will assure a dense concrete. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete will not be acceptable for use in precast concrete pipe.
2. Design. All pipe shall be Class III (Wall "B") unless otherwise specified on the plans. The shell thickness, the amount of circumferential reinforcement and the strength of the pipe shall conform to the specified class as summarized in ASTM C-76 for Circular Pipe.
3. Sizes and Permissible Variations.
  - a. Variations in diameter, size, shape, wall thickness, reinforcement, placement of reinforcement, laying length and the permissible underrun of length shall be in accordance with the applicable ASTM Specification for each type of pipe as referred to previously.
  - b. Where rubber gasket pipe joints are to be used, the design of the Joints and Permissible Variations in Dimensions shall be in accordance with ASTM C-443.
4. Workmanship and Finish. Pipe shall be substantially free from fractures, large or deep cracks and surface roughness. The ends of the pipe shall be normal to the walls and centerline of the pipe within the limits of variations allowed under the applicable ASTM specification.
5. Curing. Pipe shall be cured in accordance with the applicable ASTM Specification for each type of pipe as referred to above.
6. Marking. The following information shall be clearly marked on each section of pipe:

- a. The class of pipe.
  - b. The date of manufacture.
  - c. The name or trademark of the manufacturer.
  - d. Marking shall be indented on the pipe section or painted thereon with waterproof paint.
7. Minimum Age for Shipment. Pipe shall be considered ready for shipment when it conforms to the requirements of the tests specified herein.
8. Inspection. The quality of materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the Engineer at the pipe manufacturing plant. In addition, the finished pipe shall be subject to further inspection by the Engineer at the project site prior to and during installation.
9. Causes for Rejection. Pipe shall be subject to rejection on account of failure to conform to any of the specification requirements. Individual sections of pipe may be rejected because of any of the following:
- a. Fractures or cracks passing through the shell, except for a single end crack that does not exceed the depth of the joint.
  - b. Defects that indicate imperfect proportioning, mixing and molding.
  - c. Surface defects indicating honeycombed or open texture.
  - d. Damaged ends, where such damage would prevent making a satisfactory joint.
10. Repairs. Pipe may be repaired if necessary, because of occasional imperfections in manufacture or accidental injury during the handling, and will be acceptable if, in the opinion of the Engineer, the repairs are sound and properly finished and cured and the repaired pipe conforms to the requirements of the specifications.
11. Rejections. All rejected pipe shall be plainly marked by the Engineer and shall be replaced by the Contractor with pipe that meets the requirements of these specifications. Such rejected pipe shall be removed immediately from the worksite.
12. Jointing Materials. Unless otherwise specified on the plans, the Contractor shall have the option of making the joints by any of the following methods:
- a. Ram-Nek, a pre-formed plastic base joint material manufactured by K. T. Knyder Company, Houston, Texas, or an approved equal. Use of Talcote as joint material will not be not permitted. Ram-Nek joint material and primer shall be supplied for

use on pipe in the following sizes, which is the minimum that will be required. Additional Ram-Nek may be required if, in the opinion of the Engineer, a proper joint is not secured.

<u>Pipe Size</u>	<u>Primer Per 100 Jts.</u>	<u>Cut Lengths Per Joint</u>
12"	1.5 gals.	1½ pcs 1" x 2'-5"
15"	1.9 gals.	2 pcs 1" x 2'-5"
18"	2.7 gals.	1½ pcs 1½" x 3'-5"
21"	3.8 gals.	2 pcs 1½" x 3'-5"
24"	6.2 gals.	2 pcs 1½" x 3'-5"
30"	8.5 gals.	2½ pcs 1½" x 3'-5"
36"	9.5 gals.	3 pcs 1¾" x 3'-5"
42"	12.0 gals.	3½ pcs 1¾" x 3'-5"
48"	15.0 gals.	4 pcs 1¾" x 3'-5"
54"	20.0 gals.	4½ pcs 1¾" x 3'-5"
60"	25.0 gals.	5 pcs 1¾" x 3'-5"
66"	30.0 gals.	5½ pcs 1¾" x 3'-5"
72"	32.0 gals.	6 pcs 2" x 3'-5"
84"	35.0 gals.	7 pcs 2" x 3'-5"

- b. TYLOX Types "C", "C-P" or "CR" rubber gaskets, as applicable, as manufactured by Hamilton Kent Manufacturing Company, Kent, Ohio, or approved equal. All gaskets, lubricants, adhesives, etc., shall be manufactured, constructed, installed, etc., as recommended by the manufacturer of the rubber gasket material and conform to ASTM Designation: C-443. In addition, the Contractor shall furnish to the City, for approval, manufacturer's brochures detailing the complete use, installation, and specifications of concrete pipe and rubber gaskets before any rubber gasket material is used on the project. All rubber gaskets shall be fabricated from synthetic rubber.
- c. Cement Mortar is prohibited from jointing pipe except at manholes, pipe junctions, etc., or where specifically approved by the Engineer.
- d. Geotextile for wrapping pipe joints shall be Class "A" subsurface drainage type in accordance with AASHTO M288.

### 3. CONSTRUCTION METHODS

Reinforced concrete pipe culverts shall be constructed from the specified materials in accordance with the following methods and procedures:

1. Excavation. All excavation shall be in accordance with the requirements of City Standard Specification Section 022020 "Excavation and Backfill for Utilities," except where tunneling or jacking methods are shown on the plans or permitted by the Engineer. When pipe is laid in a trench, the trench, when completed and shaped to receive the pipe, shall be of sufficient width to provide free working space for satisfactory bedding and jointing and thorough tamping of the backfill and bedding material under and around the pipe. The Contractor shall make such temporary provisions as may be necessary to insure adequate drainage of the trench and bedding during the construction operation. Pipe shall be placed such that the identification markings are visible at the top prior to backfill.
2. Bedding. The pipe shall be bedded in accordance with the bedding details shown on the drawings. Bedding shall not be measured for pay, but shall be subsidiary to other work.

If the subgrade of the trench is unstable, even if this condition occurs at relatively shallow depths, full encasement of the pipe with crushed stone shall be required.

3. Laying Pipe. Unless otherwise authorized by the Engineer, the laying of pipe on the prepared foundation shall be started at the outlet (downstream) end with the spigot or tongue end pointing downstream, and shall proceed toward the inlet (upstream) end with the abutting sections properly matched, true to the established lines and grades. Where bell and spigot pipe are used, cross trenches shall be cut in the foundation to allow the barrel of the pipe to rest firmly upon the prepared bed. These cross trenches shall be not more than two inches larger than the bell ends of the pipe. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trench without disturbing the prepared foundation and the sides of the trench. The ends of the pipe shall be carefully cleaned before the pipe is placed. As each length of pipe is laid, the mouth of the pipe shall be protected to prevent the entrance of earth or bedding material. The pipe shall be fitted and matched so that when laid in the bed, it shall form a smooth, uniform conduit. When elliptical pipe with circular reinforcing or circular pipe with elliptical reinforcing is used, the pipe shall be laid in the trench in such position that the markings "TOP" or "BOTTOM" shall not be more than 5 degrees from the vertical plane through the longitudinal axis of the pipe.

For pipe over 42 inches in diameter, the Contractor may drill two holes not larger than 2 inches in diameter, in the top of each section of the pipe, to aid in lifting and placing.

The holes shall be neatly drilled, without spalling of the concrete, and shall be done without the cutting of any reinforcement. After the pipe is laid, the holes shall be filled with mortar and properly cured, and placed such that they are visible from the top for inspection prior to backfill.

Multiple installations of reinforced concrete pipe shall be laid with the center lines of

individual barrels parallel. When not otherwise indicated on plans, the following clear distances between outer surfaces of adjacent pipe shall be used.

Diameter of Pipe	18"	24"	30"	36"	42"	48"	54"	60" to 84"
Clear Distance Between Pipes	0'-9"	0'-11"	1'-1"	1'-3"	1'-5"	1'-7"	1'-11"	2'-0"

4. Jointing.

- a. If the use of Portland cement mortar joints is allowed, all pipe shall be jointed tight and sealed with stiff mortar, composed of one part Portland cement and two parts sand, so placed as to form a durable water-tight joint. The installation shall be as required by the Engineer.
- b. Joints using Rubber Gaskets: Where rubber gasket pipe joints are required by the plans, the joint assembly shall be made according to the recommendations of the gasket manufacturer. Water-tight joints will be required when using rubber gaskets.
- c. Joints using Cold-Applied Preformed Plastic Gaskets shall be made as follows:

A suitable prime 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 primer is applied.

Before laying the pipe in the trench, the plastic gasket sealer shall be attached around the tapered tongue or tapered groove near the shoulder or hub of each pipe 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 pipe joint surface. The outside wrapper shall not be removed until immediately before pushing the pipe into its final position.

When the tongue is correctly aligned with the flare of the groove, the outside wrapper on the gasket shall be removed and the pipe shall be pulled or pushed home with sufficient force and power (backhoe shovel, chain hoist, ratchet hoist or winch) to cause the evidence of squeeze-out of the gasket material on the inside or outside around the complete pipe joint circumference. The extruded gasket material shall be smoothed out over the joint on the exterior and interior of the pipe. Any joint material pushed out into the interior of the pipe that would tend to obstruct the flow shall be removed. (Pipe shall be pulled home in a straight line with all parts of the pipe on line and grade at all times.) Backfilling of pipe laid with plastic gasket joints may proceed as soon as the joint has been inspected and approved by the Engineer. Special precautions shall be taken in placing and compacting backfill to

avoid damage to the joints.

When the atmospheric temperature is below 60 degrees F, plastic joint seal gaskets shall either be stored in an area warmed to above 70 degrees F, or artificially warmed to this temperature in a manner satisfactory to the Engineer. Gaskets shall then be applied to pipe joints immediately prior to placing pipe in the trench, followed by connection to previously laid pipe.

- d. Pipe Joints for storm sewers shall be wrapped with geotextile material. The geotextile wrap shall be at least 2 feet wide and shall be centered on each joint.
5. After the pipe has been placed, bedded and jointed as specified, filling and/or backfilling shall be done in accordance with the applicable requirements of City Standard Specification Section 022020 "Excavation and Backfill for Utilities." If unstable conditions are encountered, fully encase the pipe with crushed stone as described above. When mortar joints are allowed, no fill or backfill shall be placed until the jointing material has been cured for at least six (6) hours.

Special precautions shall be taken in placing and compacting the backfill to avoid any movement of the pipe or damage to the joints. For side drain culverts and all other culverts where joints consist of materials other than mortar, immediate backfilling will be permitted.

6. Unless otherwise shown on the plans or permitted in writing by the Engineer, no heavy earth moving equipment will be permitted to haul over the structure until a minimum of 4 feet of permanent or temporary compacted fill has been placed thereon. Pipe damaged by the Contractor's equipment shall be removed and replaced by the Contractor at no additional cost.

7. Cleaning and Television Inspection. All enclosed reinforced concrete pipe and manholes installed on this project shall be cleaned and televised in accordance with City Standard Specification Section 027611 "Cleaning and Televised Inspection of Conduits."

#### 4. MEASUREMENT

Unless otherwise specified on the Bid Form, reinforced concrete pipe will be measured by the linear foot. Such measurement will be made between the ends of the pipe barrel along its central axis. Where spurs or branches, or connections to existing pipe lines are involved, measurement of the spur or new connecting pipe will be made from the intersection of its center axis with the outside surfaces of the pipe into which it connects. Where inlets, headwalls, catch basins, manholes, junction chambers, or other structures are included in lines of pipe, that length of pipe tying into the structure wall will be included for measurement but no other portion of the structure length or width will be so included.

For multiple pipes, the measured length will be the sum of the lengths of the barrels measured as prescribed above.

## 5. PAYMENT

Payment for reinforced concrete pipe measured as prescribed above will be made at the contract unit price bid per linear foot for the various sizes of "Reinforced Concrete Pipe" of the class specified.

Payment shall be full compensation for furnishing and transporting the pipe; hauling and placing of earth cushion material where required for bedding pipe; for the preparation and shaping of beds; for hauling, placing and jointing of pipes; for furnishing and installing geotextile pipe joint wrapping; for end finish; for all connections to existing and new structures; for cleaning and television inspection; and for all other items of materials, labor, equipment, tools, excavation, backfill and incidentals necessary to complete the culvert or storm sewer in accordance with the plans and these specifications.



SECTION 027404  
CONCRETE BOX CULVERTS

1. DESCRIPTION

This specification shall govern all work required for constructing, furnishing, and installing reinforced concrete box culverts required to complete the project.

All reinforced concrete boxes for this project shall be precast concrete in accordance with TxDOT Standards for precast box culverts and the details shown on the drawings for the appropriate height of fill, and design shall conform to ASTM C1577.

Alternate designs of precast boxes will be considered for approval upon submission of shop drawings detailing the box and certifications that the box, as designed, is structurally comparable to or better than the box shown in the contract drawings and is designed to support HS20 loading per ASSHTO M273. The shop drawings and certifications shall be signed and sealed by a Texas registered professional engineer.

2. MATERIALS

1. Concrete. Unless otherwise shown on the plans, Class "C" concrete shall be used for cast-in-place boxes, conforming to the requirements of City Standard Specification Section 030020 "Portland Cement Concrete" and City Standard Specification Section 038000 "Concrete Structures", except that Class "S" concrete will be required for top slabs of direct traffic cast-in-place boxes.

Concrete for precast (machine-made) boxes shall meet the requirements of ASTM C76 Sections: "Cement", "Aggregates" and "Mixture", and shall have a minimum 28-day compressive strength of 5,000 psi.

2. Reinforcement. Reinforcing steel shall conform to the requirements of City Standard Specification Section 032020 "Reinforcing Steel" and the details shown on the plans.
3. Jointing. Materials for jointing shall conform to the requirements of City Standard Specification Section 027402 "Reinforced Concrete Pipe Culverts".
4. Membrane Curing. Materials for membrane curing shall conform to City Standard Specification Section 038000 "Concrete Structures".
5. Geotextile. Geotextile fabric for wrapping joints shall be Class 1 geotextile for subsurface drainage with an average opening size (AOS) of 0.22mm and in accordance with AASHTO M288.

3. FABRICATION

The requirement of City Standard Specification Section 030020 "Portland Cement Concrete" and City Standard Specification Section 038000 "Concrete for Structures" shall govern for cast-in-place concrete box culverts and for precast (formed) boxes except where otherwise specified herein.

Forms for precast (machine-made) boxes shall be made of steel. Forms for cast-in-place boxes and precast (formed) boxes may be either wood or steel.

Forms shall be mortar-tight and of sufficient strength to prevent excessive bulging or misalignment of adjacent boxes. They shall be constructed to permit their removal without damage to the concrete. Offsets at form joints shall not exceed one-eighth inch (1/8"). Forms shall be clean and free of extraneous matter when concrete is placed.

Positive means of supporting steel cages in place throughout forming and concrete placement shall be required and subject to the approval of the Engineer. Welding of reinforcing steel will be permitted only where shown on the plans. Welding shall be done by a qualified welder and shall conform to industry standards.

Precast (machine-made) boxes shall be cast by a process which will provide for uniform placement of the concrete in the forms and compaction by mechanical devices which will assure dense concrete. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete shall not be acceptable for use in precast (machine-made) boxes.

#### 4. TESTING AND CERTIFICATION

1. Physical Requirements. Precast boxes shall meet the requirement of ASTM C1577. Testing shall be done by a materials engineering testing laboratory which meets the requirements for membership in the American Council of Independent Laboratories.
2. Fabrication Tolerances. Precast boxes shall conform to the following tolerances: When two box sections are fitted together on a flat surface, in proper alignment and in the position they will be installed, the longitudinal opening at any point shall not exceed one inch (1").

Not more than four lifting holes may be provided in each box to facilitate handling. They may be cast-in, cut into the fresh concrete after form removal or drilled, and shall not be more than 2 inches in diameter or 2 inches square. Cutting or displacement of the reinforcement will not be permitted. Spalled areas around the holes shall be repaired. Concrete boxes shall be given an "Ordinary Surface Finish" in accordance with Section 038000 "Concrete Structures".

3. Certification. Certification of quality shall be provided with each delivery of materials to the job site by the manufacturer. Certification shall be a written report by the materials engineering testing laboratory.

#### 5. DEFECTS AND REPAIRS

Fine cracks or checks on the surface of the member which do not extend to the plane of the nearest reinforcement will not be cause for rejection unless they are numerous and extensive. Cracks which extend into the plane of the reinforcing steel but are acceptable otherwise, shall be repaired in an approved manner.

Small damaged or honeycombed areas which are purely surficial in nature may be repaired. Excessive damage, honeycombing or cracking will be subject to structural review. Repairs shall be sound, properly finished, and cured in conformance with the pertinent specifications. When fine cracks or hairline cracks on the surface indicate poor curing practices, further production of precast boxes shall be discontinued until corrections are made and proper curing provided.

## 6. CONSTRUCTION METHODS

Excavation and backfill shall be in accordance with City Standard Specification Section 022020 "Excavation and Backfill for Utilities" and City Standard Details for Stormwater. Bedding for precast concrete box culverts located under pavements shall consist of 6 inches of cement-stabilized sand containing a minimum of 1½ sacks of Standard Type I or Type II Portland cement per cubic yard of sand and compacted to not less than 95% Standard Proctor density.

Unless otherwise shown on the plans, the Contractor may use any of the jointing materials, except rubber gaskets, and shall comply with the jointing requirements specified in the City Standard Specification Section 027402 "Reinforced Concrete Pipe Culverts".

All box joints shall be wrapped with geotextile fabric. The wrap shall be at least two (2) feet wide and centered on the joints.

Lifting holes shall be filled with mortar or concrete and cured to the satisfaction of the Engineer.

## 7. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, concrete box culverts shall be measured by the linear foot for each size of box installed. The measurement will be made between the ends of the box along the centerline. For boxes used in the multiple barrel structures, the measured length will be the sum of the lengths of all barrels.

Payment shall be made at the contract bid price and shall fully compensate the Contractor for furnishing, transporting and installing the box culverts; for bedding materials and bed preparation including compaction; for excavation and backfill of trenches; for all connections to existing and new structures; and for all labor, materials, tools, equipment and incidentals required to complete the work as shown on the contract drawings and as specified herein.

SECTION 027602  
GRAVITY WASTEWATER LINES

1. DESCRIPTION

This specification shall govern all work required for furnishing, handling and installing gravity wastewater lines required to complete the project.

2. MATERIALS

A. Pipe and Fittings:

1. POLY-VINYL CHLORIDE (PVC) PIPE and fittings shall be in accordance with the following:

6" Gravity Sewer Pipe	ASTM D3034	DR 26	
8" Gravity Sewer Pipe	ASTM D3034	DR 26	
10" Gravity Sewer Pipe	ASTM D3034	DR 26	
12" Gravity Sewer Pipe	ASTM D3034	DR 26	
15" Gravity Sewer Pipe	ASTM D3034	DR 26	
18" Gravity Sewer Pipe	ASTM F679	DR 26	
24" Gravity Sewer Pipe	ASTM F679	DR 26	
30" Gravity Sewer Pipe	ASTM F679	DR 26	
36" Gravity Sewer Pipe	ASTM F679	DR 26	PS115
42" Gravity Sewer Pipe	ASTM F679	DR35	PS46
48" Gravity Sewer Pipe	ASTM F679	DR35	PS46

Pipe and fittings shall have push-on compression gasket joints in accordance with ASTM D3212 and shall be a non-blue color.

2. POLY-VINYL CHLORIDE (PVC) PRESSURE PIPE shall be AWWA C900 or C905 integral green (non-blue color) with a minimum pressure rating of not less than 150 psi, made of Class 12454-A or Class 12454-B virgin compounds, as defined in ASTM D1784. One (1) 20-ft. section of PVC pressure pipe, with appropriate adapters or as an encasing pipe over the carrier pipe, shall be used for gravity wastewater lines at all waterline crossings, and shall be centered under/ over the waterline as indicated on the drawings.

Maintain a minimum of 2 feet vertical clearance between outsides of pipes where a new waterline crosses over a new non-pressurized wastewater line. Maintain a minimum of 6 inches vertical clearance between outsides of pipes where a new waterline crosses over a pressurized wastewater line. In all instances of water crossing wastewater, center a joint of water pipe over the wastewater pipe such that a minimum of 9 feet of horizontal offset exists from each water joint to the wastewater carrier pipe.

Alternatively, at waterline crossings, the PVC gravity wastewater pipe may be encased in a 20-ft. joint of pressure pipe with a minimum pressure rating of 150 psi that is at least two nominal sizes larger than the carrier pipe. The carrier pipe shall be supported in the casing at five foot (5') intervals with spacers, or shall be filled to the spring line with clean washed sand. The casing pipe shall be centered under/over the waterline as indicated on the drawings, and both ends of the casing shall be sealed with cement grout or manufactured seal.

B. Bedding and Backfill Materials:

1. BEDDING AND INITIAL BACKFILL is that material from beneath the pipe to an elevation 12 inches above the top of the pipe. The bedding and initial backfill material shall be in accordance with Table 1 on Wastewater Standard Details, Sheet 3, unless otherwise specified.
2. FINAL BACKFILL is that material placed on the initial backfill. The material shall be in accordance with City Standard Specification Section 022020 "Excavation and Backfill for Utilities" and as shown on the standard details.

3. CONSTRUCTION METHODS

A. Trench Excavation:

See City Standard Specification Section 022020 "Excavation and Backfill for Utilities."

B. Handling of Materials:

1. HANDLING AND CARE of pipe shall be the responsibility of the Contractor. Pipe shall be unloaded at the point of delivery, hauled to and distributed at the site by the Contractor. Materials shall be handled with care and in accordance with the manufacturer's recommendations.
2. STORAGE AND SECURITY of materials shall be provided by the Contractor. Any material delivered to the site that is not to be incorporated into the work within 10 working days shall be properly stored off the ground. Stacking and handling of materials shall be done as recommended by the manufacturer.
3. REJECTED OR DEFECTIVE materials are those having cracks, flaws or other defects. Rejected materials shall be marked by the Engineer and removed from the job site by the end of the day by the Contractor.
4. DISTRIBUTION OF MATERIALS at the work site shall be allowed provided that they are incorporated into the work within 10 working days. Materials shall not be placed on private property, unless written permission has been obtained from the owner by the Contractor. Materials shall not be placed within five feet of the back of curb or edge of pavement without permission of the Engineer or the designated representative.

C. Alignment and Grade:

1. All pipe shall be laid and maintained to the required line and grade.
2. NO DEVIATIONS from design line and grade shall be allowed, unless authorized by the Engineer.
3. The Contractor shall provide offsets and cut sheets. The Contractor may use batter boards, laser, or other approved methods necessary to construct the wastewater line to design line and grade.

D. Pipe Placement:

1. GENERAL: Proper implements, tools, etc., shall be used by the Contractor for safe and efficient execution of work. All pipes shall be carefully lowered into the trench by suitable equipment in such a manner as to prevent damage. Under no circumstances shall pipe be dropped or dumped into the trench. The Contractor shall not lay pipe in the trench until the bedding and condition of the trench have been approved by the Engineer. The trench shall be free of water and maintained in that condition until the pipe has been laid, the joints have been completed, and the initial backfill has been completed. All pipe markings shall be placed face up for inspection prior to backfill.
2. CLEAN PIPE: All foreign matter or dirt shall be removed from the interior of the pipe before lowering pipe into trench. The interior of pipe shall be maintained free of dirt during the remaining installation operations.

E. Jointing Pipe:

POLY-VINYL CHLORIDE (PVC) PIPE shall have mating surfaces of the gasketed joint wiped clean of dirt and foreign matter. A lubricant recommended by the coupling manufacturer shall be applied to the bell and spigot mating surfaces just prior to joining. The spigot shall then be centered on grade into the bell of the previous pipe and shall be shoved home to compress the joint and to assure a tight fit between the inner surfaces. Pipe shall not be assembled in reverse order by pushing bell onto spigot. When the pipe is being thusly installed, bell holes shall be excavated in the bedding material. When the joint has been made, the bell hole shall be carefully filled with material to provide for adequate support of the pipe. The spigot shall be centered within 1/4 inch of the home line marked on the spigot.

F. Bedding and Initial Backfill:

POLY-VINYL CHLORIDE (PVC) PIPE: Bedding and initial backfill of PVC pipe shall be in accordance with the details provided in the drawings. Bedding shall be well tamped regardless of type. The type of bedding required shall depend upon the depth of cut and ground water condition and shall be as specified below:

### BOTTOM OF TRENCH IN GROUNDWATER

<u>Depth of Cut</u>	<u>Required Bedding</u>
Less than 20 feet	Gravel or Crushed Stone
Over 20 feet	Crushed Stone

### BOTTOM OF TRENCH NOT IN GROUND WATER

<u>Depth of Cut</u>	<u>Required Bedding</u>
Less than 15 feet	Sand, Gravel, or Crushed Stone
Less than 20 feet	Gravel or Crushed Stone
Over 20 feet	Crushed Stone

G. Final Backfill:

See City Standard Specification Section 022020 "Excavation and Backfill for Utilities."

H. Bypass Pumping:

Contractor shall follow operational requirements for bypass pumping as set forth in Specification Section 027200 Control of Wastewater Flows.

#### 4. TESTING AND CERTIFICATION

A. Leakage Testing: (Required for all types of pipe)

1. EQUIPMENT FOR LEAKAGE TESTING shall be furnished and installed by the Contractor. The Contractor shall test the entire system for leaks. This work shall be witnessed by the Engineer.
2. POLY-VINYL CHLORIDE (PVC) PIPE shall be tested in accordance with Uni-Bell Plastic Pipe Association - Standard UNI-B-6 "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe"; the requirements of which are summarized by the following equation:

$$T = 0.00237D^2L \quad [\text{Equation 1}]$$

Where: T = Minimum allowable time (seconds) for a pressure drop of one (1) psi gage pressure

D = Nominal pipe diameter (inches)

L = Length of pipe run (feet)

The test section shall be plugged and subjected to a test pressure not in excess of five (5) psi. The time required for a one (1) psi pressure drop shall be measured and shall not exceed the value obtained in Equation 1 above.

B. Deflection Testing: (Required for PVC Pipe)

1. EQUIPMENT FOR DEFLECTION TESTING shall be provided by the Contractor. Mandrels shall be provided by the Contractor and will be of machined rigid corrosion-resistant pipe with a length not less than 1.5 diameters. Mandrels will be sized for SDR 26 PVC pipe at 5% deflection. The outside diameter of the standard mandrels shall be as follows:

<u>Nominal Size (inches)</u>	<u>Mandrel O.D. (inches)</u>
8	7.11
10	8.87
12	10.55
15	12.90
18	15.76
21	18.56
24	20.87
27	23.51
30	27.14

2. TESTING shall be done by the Contractor and witnessed by the Engineer. All pipe shall be tested for deflection no less than 30 days after placement of backfill. The Contractor may wish to check pipe immediately after backfilling for job control. However, this shall not qualify as acceptance testing. No pipe can be tested for formal acceptance until it has been in place, complete with backfill, for at least 30 days.
3. Belly: Pipe shall be rejected if belly exceeds 5% based on the readings from the video inspection.

C. Retesting:

ANY DEFECTIVE WORK OR MATERIALS shall be corrected or replaced by the Contractor and retested. This shall be repeated until all work and materials are acceptable

D. Cleaning and Televising:

All wastewater lines and manholes installed on this project shall be cleaned and televised in accordance with Standard Specification Section 027611 "Cleaning and Televised Inspection of Conduits".

5. SOIL BORINGS

The City does not assume responsibility for subsurface information. Soil data and other subsurface information, if shown on the drawings or in the appendix, are without warranty as to correctness of fact or interpretation.



## 6. BRACING AND SHORING

Trenching operation shall comply with Worker Safety Requirements for Excavation and Trenching Operations. If, for whatever reason, the trench width at the top of pipe must exceed that width indicated in the bedding details, the Contractor shall modify bedding as required by the Engineer to accommodate the additional load on the pipe.

## 7. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, gravity wastewater lines shall be measured by the linear foot for each size and depth of wastewater line installed, as follows:

- A. Between centers of manholes.
- B. From the center of a manhole to the end of the line.
- C. From the end of an existing stub to the end of the line or center of the existing manhole.

Depth shall be measured from flow line of pipe to ground surface over centerline of the pipe at the time of construction. Measurements to be made at manholes, at intervals not to exceed fifty feet, and at breaks in ground profile.

Bedding shall not be measured for pay, but shall be considered subsidiary to pipe, unless included as a separate bid item in the Bid Form.

Unless otherwise specified on the Bid Form, de-watering shall not be measured for pay, but shall be considered subsidiary unless included as a separate bid item in the Bid Form for well-pointing.

Payment shall be full compensation for all labor, materials, equipment, pipe, bedding, de-watering, hauling, trench excavation and backfill, leakage and deflection testing, cleaning, televising, bypass pumping, and all cleaning up and other incidentals necessary to install the pipe complete in-place.

SECTION 027604  
DISPOSAL OF WASTE FROM WASTEWATER  
CLEANING OPERATIONS

1. SCOPE:

This specification governs all work required for disposal of waste from wastewater cleaning operations required to complete the project.

2. METHODS:

Grit, rubble, dislodged bricks and other such inorganic waste that is removed during cleaning shall not be allowed to continue down stream of the operation. Organic solids that remain in suspension would be allowed to continue downstream through the wastewater system.

A weir or other suitable trap shall be installed and maintained by the Contractor for the collection of such waste.

This material shall be de-watered and delivered by the Contractor to a facility that is authorized to receive it. If this material is free of organic sludge and is sufficiently de-watered to pass the paint filter test, it would be acceptable for disposal at the Elliott Sanitary Landfill subject to prior approval of the facility and the associated disposal fees.

The Contractor has the option of using the City's de-watering facilities. The City has six drying beds, each with a 1-foot high containment wall each with an area of about 2,300 square feet. These drying beds are at the Greenwood Wastewater Treatment Plant, 1541 Saratoga. The Contractor would be required to haul and handle the material to, at and from the facility as well as the restoration of drying beds. Restoration of the drying beds includes the removal of all the de-watered material and the replacement of the existing sand bed with new sand. All work required within the treatment plant, including the replacement of sand shall be in accordance with the requirements set forth by the Plant Supervisor. The use of the drying beds would be subject to prior approval of the facility and the associated de-watering fees.

If the City's facilities are used for de-watering or disposal of waste, the Contractor shall be responsible for making contact with the appropriate Solid Waste or Wastewater Officials or both, making all arrangements for the use of City facilities, scheduling of delivery and pickup, etc. Materials and handling operations shall meet the requirements set forth by said Officials. Failure to meet these requirements shall be cause for rejection of the materials by either the landfill or the treatment plant operations. Proper disposal of this waste shall be responsibility of the Contractor. The Contractor shall provide the Engineer with written documentation of the proper disposal of this waste.

3. MEASUREMENT & PAYMENT:

Unless otherwise specified on the Bid Form, this work shall be considered subsidiary to the project.

SECTION 027606  
WASTEWATER SERVICE LINES

1. SCOPE:

This specification governs all work and materials necessary to construct the wastewater service lines required to complete the project. Wastewater service lines are those lines, constructed in public right-of-way, from the service tee on the main up to and including the cleanout at the property line.

2. MATERIALS:

Pipe and fittings for wastewater service lines shall be PVC in accordance with ASTM D2665 and ASTM D3311 with a minimum size of 4 inches. Solvent cement for PVC shall comply with ASTM D2564. No co-mingling of different materials except through the use of proper adaptors. Adaptors shall have a stainless steel or fiberglass shear ring.

3. CONSTRUCTION METHODS:

Where possible, service tees or wyes shall be placed along the main as required for services (no taps).

The minimum size pipe for services shall be 4-inch diameter for residential and 6-inch diameter for commercial. Minimum slope for 4-inch pipes shall be 1/8 inch per foot ( $S=1\%$ ), and minimum slope for 6-inch pipes shall be 1/16 inch per foot ( $S=0.5\%$ ). Wastewater service lines shall cross under water mains.

The Contractor shall be responsible for establishing alignment and maintaining grade for the proposed service.

Trenches shall be excavated in such a manner that will minimize damage to surface improvements. After installation, the excavated material shall be tamped into the trench to not less than the density specified in City Standard Specification Section 022020 "Excavation and Backfill for Utilities," and the surface restored to a condition acceptable to the Engineer. Wastewater service lines shall be bored, jettted or jacked under sidewalks, driveways, and other such improved surfaces, unless otherwise authorized by the Engineer.

Service lines shall be leakage tested with the wastewater main.

Contractor shall follow operational requirements for bypass pumping as set forth in Specification Section 027200 Control of Wastewater Flows

#### 4. MEASUREMENT AND PAYMENT:

Unless otherwise specified on the Bid Form, wastewater service lines shall be measured as individual units for each connection made to the main. Payment shall include, but not be limited to, the line from the tee on the main to, and including, the cleanout at the property line. Payment shall be full compensation for all labor, materials, equipment, trench safety, bypass pumping and incidentals necessary for wastewater service lines required to complete the project.

SECTION 027611  
CLEANING AND TELEVISED INSPECTION OF CONDUITS

1. SCOPE

This specification shall govern for all work, equipment, supervision and materials required to provide for cleaning and remote CCTV inspection and documentation of wastewater or other lines and manholes as required.

2. TECHNICAL REQUIREMENTS

2.1 General

Closed circuit television inspection will typically be done under one or more of the conditions listed below. Requirements for on-screen labeling during each line segment set up, televising, video file labeling and hard copy inspection reports will be specifically addressed. The Contractor shall neither request nor receive assistance from the City, in the performance of work described in this specification. Unless otherwise specified and at Contractors expense, the Contractor shall provide for the control of wastewater flows and monitoring of the collection system for back-ups and surcharges, while flow control devices are in place.

It shall be the responsibility of the Contractor(s) to adhere to all applicable OSHA rules and regulations while performing any and all City-related projects or jobs (to include, but not necessarily limited to "Confined Space Entry").

2.2 Inspection Equipment and Methods

Electronic media shall be used to record the condition of all the segments of the mains and the manholes, tap locations and unusual situations during inspection. The inspection imaging shall be made on color professional grade DVD format for each line segment. All observations will require both audio and on-screen display. The camera shall transit through the wastewater line in either direction at a speed not greater than 30 feet per minute, stopping as necessary to permit proper documentation of the wastewater line's condition. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. A television camera with pan and tilt capability will be required. The camera, television monitor, and other components of the video systems shall be capable of producing picture quality to the satisfaction of the City.

The capture system shall have the capability of recording, digitizing and storing single frames of video images and "real time" live video, as well as collecting, storing and printing wastewater line inspection data for graphic display and report generation. The imaging capture system shall store digitized picture images, have the ability to export picture files to industry standard formats (jpg, bmp, and tif), be transferable to DVD and be printed at no cost to the City. Use of proprietary software is discouraged; however, if the Contractor provides the software and

three licenses to the City, proprietary software COMPATIBLE with the City's GIS and existing database systems in use may be approved. However, in every case all observations will be recorded using the City approved PACP codes.

### 2.3 Flow Control / By-Passing

This procedure will be used on all previously accepted (City owned) line segments. Except for new wastewater line acceptance inspections, the line shall be dewatered during inspection. A water jet cleaning unit will normally be running in the line in advance of the television camera to allow the highest quality picture available. Dewatering shall remove standing water and fog from the line segment to provide 360 degree view of the pipe being televised. Too high water level or the camera being submerged will be grounds for rejection of the inspection.

All wastewater flows from intersecting lines shall typically be controlled through the use of in-line plugs for vacuum trucks and are considered subsidiary to the inspection for all line sizes. Plugs in intersecting lines shall be installed by the Contractor with no assistance from the City. The Contractor shall also monitor the upstream system for back-ups and surcharges, which may lead to Sanitary Sewer Overflows (SSOs). The Contractor shall immediately report to the City Call Center (361) 826-2489 all sanitary sewer overflows. Flow Control devices shall be installed in accordance with all applicable OSHA requirements, including, but not necessarily limited to confined space protocol.

### 2.4 Evaluation of Existing Lines for Potential Repairs/Rehabilitation – Pre CCTV:

Cleaning and televising using a CCTV camera may be needed to traverse each line segment from manhole to manhole as specified in the work order. When an obstruction prevents the camera from proceeding, the obstruction will be recorded on the initial setup and a reverse setup will be attempted to view the pipe and obstruction from the other side. If the camera fails to pass through the entire section, the inspection shall be considered complete and no additional inspection will be required. However, the line segment evaluation form, as well as the graphic report, shall note full line length and the length traveled from each manhole set-up. All inspection efforts on the line segment will be recorded on the same tape / disk. The Contractor must exert all reasonable effort to televise the entire length of a segment of wastewater line, or to assist the repair crews with usable information for point repair. Prior to transiting the line the video display initially is to include upstream and downstream manhole numbers, pipe size / material, adjacent street names and the date. During the transit the display must show the continuous distance from the insertion manhole with an accuracy of  $\pm 1\%$  of the actual length to help mark observations on the report form. The video must have narrative documentation of notable observations. The Inspection Report shall consist of condition observations recorded using City-approved computer software generated formats, generally conforming to NASSCO and PACP codes. Specifically, items considered notable include: deviations in alignment and grade; abnormal conditions of the pipe barrel and joints; locations

and quantities of any sources of infiltration or inflow; dropped, broken, properly / improperly installed service taps; debris, roots or other impediments to flow and any other condition that may prevent either the proper completion of the inspection, or affect any proposed rehabilitation process. Evaluation of existing lines includes associated manhole inspection.

## 2.5 Evaluation After Repairs / Rehabilitation Post CCTV:

Following repairs or rehabilitation to existing lines (by Contractor), a CCTV camera shall travel through required line segment to televise. The intent of this process is to inspect the interior of the line to determine the location of repairs, and extent of any unacceptable work. Prior to transiting the line the video display initially is to include upstream and downstream manhole numbers, pipe size / material, adjacent street names and the date. During the transit the display must show the continuous distance from the insertion manhole with an accuracy of +/- 1% of the actual length to help mark observations on the report form. Specifically, items such as detailed inspection of the repaired area using pan-and-tilt equipment will be shown in the Inspection Report, including digital photographs of acceptable or inadequate and/or questionable work. The video must include narrative documentation of notable observations, and be cross referenced to the Inspection Report. The Inspection Report shall consist of condition observations recorded using City-approved computer-software generated formats conforming to NASSCO and PACP codes.

## 2.6 New Pipeline Inspection:

Upon completion of the installation of new lines, including any appurtenances such as manholes, service connections, etc., a CCTV camera shall traverse through each completed line segment. The intent of this process is to inspect the interior of the completed line to determine the location of service taps and extent of omissions and/or any unacceptable work on the pipeline or manholes, such as sags, infiltration, gapped joints, protruding gaskets, etc. Prior to transiting the line, the initial video shall initially include the upstream and downstream manhole designations, pipe size, project name and other pertinent information. When inspecting / documenting new wastewater line conditions, the Contractor must conduct a specific inspection for the presence of sags in the newly installed line. The approved method involves the use of an inclinometer on the camera. The belly tolerance is 5% or less for acceptable pipe installation. Any deviation from the 5% belly tolerance limit must be approved by the applicable Utility Operating Department.

The graphic report will note the start and stop of sags and approximate maximum depth. During the transit the display must show the continuous distance from the insertion manhole with an accuracy of  $\pm 1\%$  of the actual length to help mark observations on the Inspection Report form. The video must include narrative documentation of notable observations, and be cross referenced to the Inspection

Report. The Inspection Report shall consist of condition observations recorded using approved computer-software generated formats. Specifically, items such as deviations in alignment and grade causing bellies / sags; abnormal conditions of the pipe barrel and joints; locations and quantities of any sources of infiltration or inflow; dropped, broken, properly / improperly installed service taps or any other condition that may assist the Utilities Department in determining the quality of the pipeline installation.

## 2.7 Manhole Inspection:

A CCTV camera shall traverse the manhole from top to bottom to record the condition of the manhole and invert for structural condition and sources of infiltration on the manhole and invert. The initial video display must show the entry manhole number, location / street address, date and depth.

- a. The requirement is to commence capturing video at ground level. The video must be steady while panning and lowering to clearly record condition of the ring, corbel, the walls, and pipeline penetrations. The camera is to rotate during descent to inspect typical conditions and all penetrations. At the bottom of the manhole the complete invert will be inspected / viewed for infiltration and general condition. A washed out picture due to sunlight or shaking will be rejected for payment
- b. This manhole information may be retained on the same DVD if the line segment is also being investigated, or, if inspection is issued as a separate work order, a separate DVD and report will be required. As with pipeline inspection, digital photographs of key points of note must accompany the report and DVD. These would include seals on pipeline penetration, infiltration locations and other anomalies.
- c. The format of the Manhole Inspection Report will be as proposed by the Contractor and, following discussion, mutually approved by the Utilities Department and the Contractor. A sample form is included at the end of this specification. It will contain as a minimum:

location & I.D.number	manhole diameter
manhole material	depth of manhole
condition of ring / cover	evidence of infiltration
condition of walls	presence of inflow inhibitor
condition of pipe mouths	presence of coatings
condition of invert	location: street / easement
above invert penetrations	

## 2.8 CCTV Set-up:

- a. A CCTV set-up includes all of the work, equipment, supervision, personnel, and materials needed to traverse a line segment.



## 2.9 CCTV Reverse Set-up:

A CCTV reverse set-up is an attempt to view the line segment from the other side due to an obstruction encountered during the initial set-up.

## 3. CLEANING REQUIREMENTS

- 3.1 Clean **ALL** debris such as dirt, gravel, rocks, grease, roots and other organic/inorganic debris from existing lines and manholes to allow for inspection to proceed.

The Contractor will be required to clean the line segment using hydraulic equipment. The debris being removed from the pipeline shall be removed from the collection system at the receiving manhole, and not be allowed to be merely moved to the next line segment. Debris shall be properly disposed of in accordance with local, state and federal regulations.

The Contractor shall have the option of dewatering debris removed from cleaning operations on this project at the Greenwood WWTP, located at 1541 Saratoga Blvd., Corpus Christi, Texas 78415. The Contractor shall coordinate with the City Utilities Department at all times (see also City Standard Specification Section 027604 Disposal of Waste from Wastewater Cleaning Operations).

The City has six drying beds, each with a 1-foot high containment wall each with an area of about 2,300 square feet. The Contractor would be required to haul and handle the material to, at and from the facility as well as the restoration of drying beds. Restoration of the drying beds includes the removal of all the de-watered material and the replacement of the existing sand bed with new sand. All work required within the treatment plant, including the replacement of sand shall be in accordance with the requirements set forth by the Plant Supervisor. The use of the drying beds would be subject to prior approval of the facility and the associated de-watering fees.

If the City's facilities are used for de-watering or disposal of waste, the Contractor shall be responsible for making contact with the appropriate Solid Waste or Wastewater Officials or both, making all arrangements for the use of City facilities, scheduling of delivery and pickup, etc. Materials and handling operations shall meet the requirements set forth by said Officials. Contractor shall coordinate with the Wastewater Pre-Treatment Coordinator to acquire the appropriate manifest documentation and shall also provide a copy of the landfill disposal weight ticket/receipt to the Engineer. Failure to meet these requirements shall be cause for rejection of the materials by either the landfill or the treatment plant operations. Proper disposal of this waste shall be responsibility of the Contractor. The Contractor shall provide the Engineer with written documentation

of the proper disposal of this waste. The Contractor shall not be paid until this documentation is provided.

#### 4. DELIVERABLES

4.1 The Contractor is required to provide the Engineer both narrated CCTV **DVD** and computer software-generated Inspection Report products, as a result of each inspection. Acceptable submissions become the property of the City.

- a. Quality Control: camera distortion, inadequate lighting, dirty or submerged lens and blurry or hazy pictures determined to be the fault of the Contractor will be cause for rejection of the inspection effort. If the quality of the deliverables does not meet with City approval, the Contractor shall repeat the documenting process at no cost to the City.
- b. DVD: for each inspection, one properly labeled color, professional grade, DVD, recorded in standard play (SP) mode, will be required. The DVD will display continuous distance from the insertion manhole, and include narrative observations at notable points, with correlating information shown in the Inspection Report. Labeling of the DVD(s) will include, either typed or neatly printed the following information on the dust cover:

Project Name	Street Name	Tape Number
Contractor	Upstream MH #	Downstream MH #
Date	Survey / Post / New	Work Order #
Pipe Size	Material	Project #

- c. Inspection Reports: inspection reports are to be from City-approved and software-generated formats on 8½" x 11" paper, in color to improve definition of problem areas, and delivered with the DVD. Each report shall include the same information as noted for the DVD labels, plus the following additional information: pipe diameter, pipe material, manhole diameters & depths, whether this is a "reverse" set-up, direction of flow arrow, and total length of the pipeline. Notable observations are to be shown in the report as digital color photos, with up to four images per page. One report is required for each line segment. Note that the final approval for the use of the Contractor's proposed software will be needed before the first inspection. The Contractor shall submit to the City a sample of the proposed report for review and approval by the City.

#### 5. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Proposal, Pre-CCTV (Cleaning and Televised Inspection of existing lines to potentially be rehabilitated) and Post CCTV (Televised Inspection for acceptance of new lines or rehabbed lines) of Wastewater Lines shall not be measured for pay, but will be considered subsidiary to the appropriate bid item.

Cleaning and Televised Inspection of Wastewater Lines includes an inspection of all manholes entered, crossed, or associated with the line being inspected.

Reverse CCTV Set-Up shall not be allowed for acceptance televising as obstructions should not be encountered in new pipe that would require the Contractor to relocate to another manhole (upstream or downstream) of the original manhole.

**CITY OF CORPUS CHRISTI**  
**TELEVISED INSPECTION REPORT DATA REQUIREMENTS**  
**[On screen at start of each set-up and on Inspection Report]**

Pipe Material \_\_\_\_\_

Contractor \_\_\_\_\_

SECTION 027614  
CURED-IN-PLACE-PIPE (CIPP) FOR REHABILITATION OF  
GRAVITY WASTEWATER LINE

1. SCOPE

This specification shall govern for all work necessary for installing CIPP required to complete the project.

2. REFERENCE SPECIFICATIONS

This specification references ASTM D5813, ASTM F1216, ASTM D 2122, ASTM C581, and ASTM D790 which is made a part hereof by such reference and shall be the latest edition and revision thereof. ASTM F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube, shall govern when not addressed by this specification.

3. GENERAL

The CIPP shall be installed in an existing pipe and designed to provide chemical resistance, prevent exfiltration and infiltration, and support all external loads acting on it. The process is defined as the rehabilitation of wastewater lines by pull-in or inversion of a thermosetting resin impregnated flexible tube into existing wastewater pipe, with one layer or more, capable of carrying resin, withstand installation pressure and curing temperature, utilizing a water column. Curing is accomplished by circulating hot water (or other approved fluid) throughout the length of the new tube to cure the thermosetting resin into a hard impermeable pipe with the plastic coated outer layer that is compatible with the resin system used. The new pipe shall extend the full length of the original pipe (i.e. from manhole to manhole), and shall provide a structurally sound, jointless, closefitting, Cured-In-Place-Pipe without delamination or lifts, and with uniformly smooth interior providing hydraulic flow equal to or greater than the existing wastewater pipe in original condition.

4. MATERIALS

Only materials from pre-approved manufacturers shall be allowed for this work. Pre-approved manufacturers are, Insituform, Inliner, and U-liner.

CIPP shall be properly sized Type III cured-in-place thermosetting resin wastewater pipe in accordance with ASTM D5813. The tube shall consist of one or more layers of flexible needled felt or an equivalent nonwoven or woven material or a combination of nonwoven and woven materials, capable of carrying resin, withstanding installation pressures and curing temperatures. The flexible felt fiber tube shall be fabricated to a size that when installed it will neatly fit the internal circumference of the existing pipe specified by the Engineer. An allowance shall be made for some circumferential stretching during inversion. The minimum length shall effectively span the distance from the inlet to the outlet of the respective manholes unless otherwise specified. The Contractor shall verify the circumference of the host pipe and the lengths in the field before impregnation of the tube with the resin. Individual insertion runs

can be made over one or more manhole sections as determined in the field by the Contractor and approved by the qualified factory field service representative and Construction Engineer.

- 4.1 Tube: The tube shall consist of one or more layers of flexible needled felt or an equivalent nonwoven or woven material or a combination of nonwoven and woven materials that are compatible with the resin system used and are capable of supporting and carrying resin. The tube shall be capable of withstanding installation procedures and curing temperatures. Longitudinal and circumferential joints between multiple layers of a tube should be staggered to not overlap. The tube shall be fabricated to fit its final in-place position in the existing pipe, with allowance for stretch as recommended by the tube manufacturer. The elongation or expansion of the flexible tube during installation, both longitudinally and circumferentially should be limited to 5-10% to minimize reduction of the finished wall thickness.
- 4.2 Tube Coating: The inside or outside surface, or both, of the tube shall be coated with a plastic flexible material that is compatible with the tube and the resin system used. The coating shall allow visual inspection of the proper impregnation of the tube fabric with resin. The final inside flexible plastic coating will form the inner layer of the finished pipe and is required to contain the impregnated resin in the tube.
- 4.3 CIPP Wall: The layers which constitute the pipe wall must be such that when the thermosetting resin cures the Cured-In-Place-Pipe has no delamination, dry spots or lifts.

The minimum allowable wall thickness for CIPP shall be per Table 1 and as directed by the Engineer after review of TV inspection. (Table 1)

Table 1 - Wall Thickness For CIPP			
H (Ft)	DR		T (in.)
	Sound Host Pipe	Deteriorated Host Pipe	
<10	60	50	$T = \frac{D}{DR}$
10-15	50	40	
15-20	45	35	
20-25	40	30	
>25	40	25	
H, Height of cover over pipe (ft) T = Wall Thickness of CIPP (in)			
DR, Dimension Ratio, D/T D= Nominal Diameter (in)			

When cured, the CIPP must form a mechanical bond with the conduit and the wall color of the interior pipe surface of the CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made. Unless otherwise specified, the Contractor shall furnish a general purpose, unsaturated, polyester resin, and catalyst system compatible with the inversion or pull-in process that provides cured physical strengths specified herein. The existing sewers, where designated or required shall be lined using material and workmanship which can be adapted to the restrictions of the work site.

The Contractor shall not begin this phase of the work until there is sufficient material on hand to complete the job and required submittals as per 4.4 are submitted to the qualified factory field service representative and Construction Engineer, prior to use of the lining material.

4.4 Submittal: The following items shall have submittals and shall be in conformance with the requirements of Special Provisions.

4.4.1 RESIN:

- a. Submit technical data sheet showing physical and chemical properties for the proposed resin to be used in the project.
- b. Submit test results to show compliance with ASTM C581 - Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures Intended for Liquid Services.

4.4.2 TUBE:

- a. Submit technical data sheet showing physical properties.

4.4.3 CIPP:

- a. Prepare and submit curing schedule.
- b. Submit copies of curing log sheets with temperature reading prior to curing, during curing and during cool down for each installation section. Must be submitted at least weekly.
- c. Submit, copies of all test results performed by the Contractor's Independent Testing Laboratory for test listed in Section 9, testing.
- d. Submit Contractor's Quality Control Plan and/or Procedures showing control conditions used during impregnation of the resin to ensure proper materials and proper dispersion is achieved in the wet out process.
- e. Submit pre-installation TV inspection video after cleaning, and Acceptance TV inspection video after rehabilitation as per City Standard Specification Section 027611.

## 5. CONSTRUCTION METHODS

5.1 Pre-Installation Procedures: The following installation procedures shall be adhered to unless otherwise approved by the City's Engineer.

5.1.1 Safety: The Contractor shall carry out his operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving work on an elevated platform and entry into a confined space or the use of steam.

5.1.2 Access: It shall be the responsibility of the Contractor to locate and designate all manhole access points open and accessible for the work, and provide rights of access to these points. Traffic routing shall be per traffic control plan approved by the City Traffic Engineer. If a street must be closed to traffic because of the orientation of the sewer, the Contractor shall submit a proposed traffic control and detour plan for approval to the City Traffic Engineer.

- 5.1.3 Pre-Installation Cleaning: It shall be the responsibility of the Contractor to remove all debris that is located within the wastewater pipe. The Contractor is responsible for the disposal of all debris removed from the sewers during the cleaning operation per City Standard Specification Section 027604.
- 5.1.4 Pre-Installation Inspection: Inspection of wastewater pipe shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit television inspection. The interior of the pipe shall be carefully inspected to determine that the line is free any conditions which may prevent proper installation of the CIPP. A videotape and log per Section City Standard Specification Section 027611 shall be submitted to the Engineer prior to installation.
- 5.1.5 Bypassing Wastewater: The Contractor shall provide for continuous sewage flow as necessary. Bypass pumping shall be made by plugging the line upstream and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. Discharge into storm sewer shall not be allowed. All bypass pumping must be per City Standard Specification Section 027200 Control of Wastewater Flows.
- 5.1.6 Point Repairs & Line Obstructions: It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, roots protruding service or other obstruction that would impede flow thru the CIPP. Displaced joints, missing portions of pipe or other occurrences that may not be rectified by thru-the-pipe methods shall be repaired as a point repair, when directed by the Engineer. The Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. PVC pipe, in accordance with City Standard Specification Section 027602 Gravity Wastewater Lines, shall be used as a host replacement pipe for the CIPP.
- 5.1.7 Service: The Contractor shall maintain continuous wastewater service without disruptions.
- 5.1.8 Public Notification: A public notification program shall be implemented and shall, as a minimum, require the Contractor to be responsible for contacting each home or business connected to the wastewater line and informing them of the work to be conducted, and when their wastewater service will be affected. The Contractor shall provide the following:
- 5.1.8.1 Written notice to be delivered to each home or business describing the work, schedules, how it affects them, and a local telephone of the Contractor they can call to discuss the project or any problems which could arise.
- 5.1.8.2 Personal contact and attempted written notice the day prior to the beginning of work being conducted on the section relative to the residents affected.
- 5.1.8.3 Personal contact with any home or business which cannot be reconnected within the time stated in the written notice.

## 6. INSTALLATION PROCEDURES



- 6.1 Wet-Out: The Contractor shall identify the location where the tube will be impregnated (“wet-out”) with resin using distribution rollers and vacuum to saturate the tube felt fiber thoroughly prior to installation. The Contractor shall allow the qualified factory field service engineer and Construction Engineer to inspect the materials and wet-out procedure at the designated location. A catalyst system or additive compatible with the resin and the tube shall be used. The amount of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. Handling of the resin-impregnated flexible tube to prevent resin setting until it is ready for insertion and during installation shall be the responsibility of the Contractor.

A vacuum impregnation process shall be used. To insure a thorough wet-out, the point of vacuum shall be as recommended by the manufacturer and per ASTM F1216.

- 6.2 Insertion: The wetted tube shall be inserted through an existing manhole or other approved access by means of an inversion or pull-in process and the application of a water column sufficient to fully extend it to the next designated manhole or termination point. The tube end shall initially be turned inside out and attached to a platform ring or standpipe. The inversion water column will be adjusted to be of sufficient height to cause the impregnated tube to invert from manhole-to-manhole and hold the tube tight against the existing pipe wall, to produce dimples at side connections, and flared ends at the manholes.

If the pull-in method is used, the impregnated primary liner is towed into the host pipe through the existing manhole with a cable winch. The primary liner shall be floated into place virtually eliminating stresses on the material. Proper lubrication may be needed for longer and thicker liners. The secondary liner should then be inverted with the column of water to inflate the primary liner. This may extrude small amount of resin through the perforations of the outer coating of the primary liner. For the pull-in method, insertion of the new liner shall in no case exceed 800 linear feet.

- 6.3 Curing: After the insertion is completed, the Contractor shall supply a suitable heat source and water recirculation system capable of delivering hot water uniformly throughout the section to effect a consistent cure of the resin. The curing temperature shall be that recommended by the resin/catalyst system manufacturer and shall be maintained at such temperature. The Contractor shall follow a schedule to cure the liner and submit the schedule to the Engineer. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge shall be placed between the impregnated tube and the invert of the original pipe at the manhole(s) to determine the temperature during the resin curing process. The Contractor shall continue uninterrupted heating until the desired temperature is achieved, shall accurately measure temperatures at both ends of the pipe and maintain a curing log of CIPP temperatures at the upstream and downstream manholes during curing to document that proper temperatures and cure times have been achieved.

Initial cure shall be considered completed when the exposed portions of the CIPP appear to be hard and the remote temperature sensing device indicates the cure period to be of adequate duration as recommended by the resin/catalyst system manufacturer and modified for the inversion process.

- 6.4 Cool-Down: The Contractor shall cool the hardened CIPP to a temperature below 100 degrees Fahrenheit before relieving the water column. Cool water may be added to the water column while draining hot water from a small hole at the opposite end of the CIPP so that a constant water column height is maintained until cool-down is completed. Care shall be taken in the release of the water column so that a vacuum will not be developed that could damage the newly installed CIPP. Do not discharge water in excess of 100 degree Fahrenheit into the wastewater system.
- 6.5 Warranty: The finished CIPP shall be continuous over the entire length of an inversion run and be free from visual defects such as foreign inclusions, dry spots, pinholes, lifts and delamination. It shall also meet the leakage requirements or pressure test specified below. The finished CIPP shall be warranted for one year after the acceptance of the Project. During the warranty period any defects which will affect the integrity or strength of the CIPP shall be repaired at the Contractor's expense in a manner mutually agreed to by the City and the Contractor.

## 7. SEALING OF MANHOLES

If the CIPP fails to make a tight seal at a manhole, the Contractor shall apply a seal at that point. The seal shall be of a material compatible with the CIPP material. Do not leave any annular gaps. Seal the annular space with a 1/2 inch diameter activated oakum band soaked in chemical sealant. Seal any annular spaces greater than 1/2 inch with manhole wall repair material. Finish off the seal with a non-shrink all solids epoxy placed around the pipe opening from inside the manhole in a band at least 4 inches wide. Complete the sealing procedure for each liner segment immediately after the liner is cured.

## 8. SERVICE CONNECTIONS

After the CIPP has been cured in place, the Contractor shall reopen the existing active service connections as designated by the Engineer. This shall generally be done without excavation, and in the case of non-man entry pipe, from the interior of the pipeline by means of a television camera and a robotic cutting device that reestablishes the service connection to not less than 100% capacity. Cutting devices that use high pressure water shall not be used since they may cause damage to the service. When fiberglass or other reinforcing fibers are used, that may cause wicking at service openings, the service opening edges must be sealed with a resin mixture compatible with the tube resin. The Contractor shall certify he has a minimum of two complete working cutter units plus spare key components on the site before each insertion.

## 9. TESTING

- 9.1 Chemical Resistance: The CIPP shall meet the chemical resistance requirements of ASTM F 1216, Appendix X2. The test specimens shall be capable of exposure for a minimum of one month at a temperature of 73.4°F. During this period the CIPP test specimens should lose no more than 20% of their initial flexural strength and flexural modulus when tested in accordance with Section 8 of ASTM F1216. In Appendix X2, Table X2.1 presents a list of chemical solutions that serve as a recommended minimum requirement for the chemical-resistant

properties of CIPP in standard domestic wastewater applications. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.

- 9.2 Leakage Testing: The water leakage testing of the CIPP shall be tested using an exfiltration test method, when directed by the Engineer. This test shall be in accordance with ASTM F 1216, 8.2.
- 9.3 Wall Thickness Test: This thickness shall be measured in accordance with ASTM D 2122.
- 9.4 Samples: Per ASTM F 1216. 8.1, the preparation of two CIPP samples is required for each insertion segment. One sample from each of the following two methods:
  - 9.4.1 The sample should be cut from a section of cured CIPP at an intermediate manhole or at the termination point that has been inverted or pull-in through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags.
  - 9.4.2 The sample should be fabricated from material taken from the tube and the resin/catalyst system used and cured in a clamped mold placed in the down tube when circulating heated water is used and in the silencer when steam is used.
  - 9.4.3 The samples for each of these cases should be large enough to provide a minimum of three specimens and a recommended five specimens for flexural testing and also for tensile testing, if applicable. The Short-term Flexural (Bending) Properties testing should be in accordance with Test Methods ASTM D 790 and shall have a minimum flexural modulus of 250 ksi and a minimum tensile strength of 2500 psi.
  - 9.4.4 The samples taken for the measurement of the liner thickness shall be as described in this Specification, section 9.3.

## 10. POST INSPECTION

Post CCN of the CIPP rehabilitated line is required for acceptance inspection.

## 11. CLEAN-UP

Prior to acceptance, the Contractor shall clean and restore the project area affected by these operations.

## 12. PATENTS

The insertion process is patented and is installed by licensed Contractors. The Contractor shall warrant to the City and his Engineer that the methods, materials and equipment used herein, where covered by license is furnished in accordance with such license and the prices included

on the Bid Form include applicable royalties and fees in accordance with such license. The Contractor shall warrant and save harmless the City and his Engineer against all claims for patent infringement and any loss thereof.

### 13. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, Cured-In-Place Pipe for rehabilitation shall be measured and paid for by the linear foot, for each size (Nominal Diameter, DR, and Height of cover over host pipe) specified, complete in place. The liner will be measured and paid for based on the distance between centers of upstream and downstream manholes.

Point repairs for CIPP shall not be measured for pay but will be considered subsidiary to any CIPP bid item.

SECTION 027618  
WASTEWATER LINE REHABILITATION / PIPEBURSTING

1. SCOPE

This specification shall govern all work necessary to rehabilitate gravity wastewater lines by pipebursting, wherein a horizontal boring technique utilizing a cutting/expansive tool head fragments the existing pipe, and a fusion welded, high density polyethylene pipe is drawn into the resulting tunnel.

2. MATERIALS

2.1 Polyethylene:

ASTM Designation: D-3350 with a cell classification of 335434B D or E (with inner wall of light color). In addition, the liner shall be manufactured of polyethylene resins classified as Type III, Class C, Category 5, Grade P34, as tabulated in specifications in the older ASTM Designation, D-1248. This material shall also conform to the design criteria as specified in Plastic Pipe Institute (PPI) Designation: PE3408.

2.2 Dimensions: The pipe shall be (SDR 17, IPS) per ASTM F714 of the nominal diameter as shown on the plans and specified in the Bid Form, unless TCEQ requirements for water and wastewater line separation require pressure rated pipe of at least 150 psi, in which case DR 11, IPS pipe shall be utilized. At this pressure rating, a larger pipe may be required to maintain equivalent flow characteristics and hydraulic radius to the existing wastewater line.

2.3 Quality: All pipe shall be homogenous throughout, and shall be free of visible cracks, holes, foreign materials, blisters, or other deleterious faults. All materials shall be of the highest quality and highest performance. It shall be the product of a manufacturer actively engaged in research, development, and the manufacturer of said materials.

3. CONSTRUCTION METHODS

3.1 Pipe Jointing: Sections of the polyethylene (PE) liner pipe shall be joined by the butt-fusion method and performed in strict conformance with the pipe manufacturer's recommendations using approved equipment. The Contractor shall make arrangements to have a technical representative of the pipe manufacturer present for the start-up of the butt-fusion jointing and training of the contractor's personnel, or arrangements shall be made for the pipe manufacturer's representative to remain on the job until all jointing has been completed. When requested by the Engineer, samples of butt-fusion joints shall be furnished by the contractor for laboratory

testing. The test of such samples shall clearly demonstrate joint integrity, strength, etc.

- 3.2 Insertion Pits: The location and number of insertion pits shall be determined by the Contractor to maximize insertion lengths and keep the number of excavations to a minimum. The insertion pit size shall be the minimum necessary to perform insertion operations. Locations of insertion pits shall be acceptable to the Engineer.

Removal of obstructions and point repairs shall be done as necessary. This work shall be done in accordance with Section 022020 of the City Standard Specifications, "Excavation and Backfill for Utilities."

- 3.3 Pulling Pipe: New polyethylene pipe shall be pulled immediately behind the pipe bursting equipment in accordance with the manufacturer's procedures. The machine shall be specifically designed and manufactured for the pipe insertion process.

The Contractor shall install all pulleys, rollers, bumpers, alignment control devices, and other equipment, required to protect existing manholes, and to protect the pipe from damage during installation. Lubrication may be used as recommended by the pipe manufacturer. Under no circumstances shall the pipe be stressed beyond 50% of its tensile strength at yield, that being 22,600 lb. for an 8" SDR 17 pipe. Provide a suitable pull measuring device connected to the winch or pulling system.

Upon commencement, insertion shall be continuous without interruption, if possible.

Terminal sections of pipe that are joined within the insertion pit shall be connected with a 1/4" thick neoprene gasket and a stainless steel band clamp having a minimum of 4 bolt/nut drawn down fixtures. The butt gap between pipe ends shall not exceed 1/2".

The installed pipe shall be allowed the manufacturer's recommended amount of time, but not less than 24 hours, for relaxation prior to any reconnection of service lines, sealing of the annulus, or backfilling the insertion pit. Sufficient excess length shall be allowed to provide for this occurrence.

- 3.4 Service Connections: All service connections shall be identified, excavated, and disconnected prior to pipe bursting. After the new main has been pulled into place, allowed to recover, and secured to the manhole walls, each service shall be reconnected to the new main. Services shall be connected by the use of an approved pre-fabricated saddle. The pre-fabricated saddle shall be equipped with a neoprene gasket installed between the saddle and the liner pipe so that a complete water seal is accomplished when the two-piece saddle is placed around the polyethylene pipe and pulled together with stainless steel bands. Drill hole in main shall be flush with the inside diameter of the saddle. Continuous service shall be maintained.

- 3.5 Annulus Sealing: The relaxed pipe shall be cut 4" inside of manholes and any annular space sealed. The annular space may be sealed with a mechanical device, chemical seal, or quick-setting concrete. The method chosen shall be approved by the Engineer prior to construction. The sealant shall extend at least 8-inches past the outside of the manhole wall. The sealant shall form a smooth transition above the liner projection into the manhole. The sealant shall be applied 3" beyond the annulus on the inside wall of the manhole. The complete joint shall be uniform and water-tight.
- 3.6 Backfill: The insertion pit(s) shall be backfilled with an approved granular material from the invert to a minimum of 12" above the pipe. The balance of the insertion pit may be backfilled using approved material taken from the excavation. All backfilling shall be accomplished in such a manner as to achieve a 95% Standard Proctor density.
- 3.7 By-Pass Wastewater Flows: It shall be the responsibility of the Contractor to maintain continuous flow of wastewater, during execution of work. This includes flow of all mains, laterals, and services. Pumps and by-pass lines shall be of adequate capacity to handle all flows. Dumping of raw sewage on private or city property shall not be allowed. By-pass shall be made by pumping the sewage into the downstream manhole or adjacent system, or other methods as may be approved by the Owner and the Engineer. All bypass pumping must be per City Standard Specification Section 027200 "Control of Wastewater Flows."

4. DELIVERY, STORAGE AND HANDLING OF MATERIALS:

The Contractor shall be responsible for all handling and security of the materials.

5. CLEANUP:

The Contractor shall clean up the area around the work area and restore surface improvements to a like or better condition as existed prior to construction. All pavement shall be repaired as specified. All broken pipe and other unwanted material shall become property of the Contractor and hauled off and disposed by the Contractor.

6. TELEVISION INSPECTION:

Television inspection of pipeline shall be performed by experienced personnel, in accordance with City Standard Specification 027611. Television inspection shall be per the following:

Post Construction video DVD of each wastewater line shall include voice description and stationing of each service indicated. Data and stationing shall be visually displayed on video.

By-pass or diversion of flow shall be done by the Contractor as necessary to obtain acceptable video.

If any portion of the inspection DVD be deemed inadequate by the City, the Contractor shall re-video that portion to the satisfaction of the City at no additional expense to the City. DVDs of all work shall be furnished to the City prior to acceptance of work. One copy shall become property of The City and retained by the City.

7. TESTING:

After the proposed line has been completed, internally inspected with video camera and record as required. DVD shall be furnished to the City prior to acceptance of work.

Manholes and services are to be tested as described elsewhere.

8. MEASUREMENT AND PAYMENT:

Unless indicated otherwise in the Bid Form, Wastewater Rehabilitation / Pipebursting will be measured by the linear foot for each size and depth range installed. Payment shall include, but not be limited to, all materials, labor, equipment and incidentals required for (other than pavement repair) trenching, installing the new line, surface restoration, clean-up, televised inspection, and other work as may be required.



SECTION 028020  
SEEDING

1. DESCRIPTION

This specification shall govern all work necessary for tilling, fertilizing, planting seeds, mulching, watering and maintaining vegetation required to complete the project.

2. MATERIALS

2.1 FERTILIZER: All fertilizer shall be delivered in bags or clearly marked containers showing the analysis, name, trademark and warranty. The fertilizer is subject to testing by the State Chemist in accordance with the Texas fertilizer law. Fertilizer shall have an analysis of 12-12-12 (percent of nitrogen, phosphoric acid and potash) as determined by the Association of Official Agricultural Chemists. Fertilizer shall be free flowing and uniform in composition.

2.2 SEED: Seed shall be labeled and meet the requirements of the Texas Seed Law. Labels shall indicate purity, 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 twelve months of delivery to the project.

The quantity of "Commercial Seed" required to equal the quantity of "Pure Live Seed" shall be computed by the following formula:

$$\text{Commercial Seed} = \text{Pure Live Seed} \times \frac{10,000}{\% \text{ Purity} \times \% \text{ Germination}}$$

The quantity of pure live seed and type required are indicated below. Mixture A or C shall be used for this project, depending on the time of the year planting is performed.

<u>COMMON NAME</u>	<u>SCIENTIFIC NAME</u>	<u>LB/ACRE OF PURE LIVE SEED</u>		
		<u>FOR MIXTURES</u>		
		<u>A</u>	<u>B</u>	<u>C</u>
Green Sprangletop	Leptochloa Dubia	1.4	1.4	-
Sideoats Grama (premier)	Bouteloua Curtipendula	0.6	-	0.6
Bermudagrass (Hulled)	Cynodon Dactylon	7.0	7.4	-
Bermudagrass (Unhulled)	Cynodon Dactylon	-	-	30.0
K-R Bluestem	Andropogon Ischaemum	1.2	1.2	1.5
Buffalograss	Buchloe Dactyloides	-	4.2	-
Annual Ryegrass	Lolium Multiflorum	5.0	5.0	20.0

Mixture - A: Recommended for clay or tight soil planted between December 1 thru May 1.

Mixture - B: Recommended for sandy soil planted between December 1 thru May 1.

Mixture - C: Recommended for all soils planted between May 2 thru November 30.

2.3 MULCH: Mulch shall be either the straw type or wood cellulose fiber type.

Straw Type mulch shall be of straw from stalks of domestic grain, Bermudagrass or cotton hulls, or other approved by the Engineer.

Wood Cellulose Fiber Type mulch shall have no growth inhibiting ingredients and shall be dried with a moisture content less than 10% by weight. Fibers shall be dyed an appropriate color to facilitate visual metering and application of mulch. The cellulose fiber shall be manufactured so that after addition and agitation in slurry tank with fertilizers, seeds and other approved additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry; when sprayed on the ground, the material shall form a uniform cover impregnated with seeds; the cover shall allow added water to percolate to the underlying soil. The fiber material shall be supplied in packages of not more than 100 lb. gross weight and shall be marked by the manufacturer to indicate the dry weight content.

2.4 EQUIPMENT: The fertilizing, seeding and/or mulching operations shall be accomplished with equipment suitable to the required function. It shall be of current design and in good operating condition. Special seeding and mulching equipment must also meet the following requirements:

Seeder - Equipment for applying a seed-fertilizer mix shall be a hydraulic seeder designed to pump and discharge a waterborne, homogeneous slurry of seed and fertilizer. The seeder shall be equipped with a power driven agitator and capable of pressure discharge.

Straw Mulch Spreader - Equipment used for straw mulch application shall be trailer mounted, equipped with a blower capable of 2000 r.p.m. operation, and that will discharge straw mulch material through a discharge boom with spout at speeds up to 220 feet per second. The mulch spreader shall be equipped with an asphalt supply and application system near the discharge end of the boom spout. The system shall apply asphalt adhesive in atomize form to the straw at a predetermined rate. The spreader shall be capable of blowing the asphalt-coated mulch, with a high velocity airstream, over the surface at a uniform rate, forming a porous, stable erosion-resistant cover.

Wood Cellulose Fiber Mulch Spreader - Equipment used for this application of fertilizer, seeds, wood pulp, water and other additives shall have a built-in agitation system with sufficient capacity to agitate, suspend and homogeneously mix a slurry containing up to 40 lbs. of fiber plus the required fertilizer solids for each 100 gallons of water. It shall have sufficient agitation and pump capacity to spray a slurry in a uniform coat over the area to be mulched.

### 3. CONSTRUCTION METHODS

**3.1 PREPARATION OF SEEDBED:** The area to be treated along with requirements for seed, fertilizer and other treatments, shall be done as indicated on the drawings and as specified below.

Clearing – Refer to City Standard Specification Section 021020, "Site Clearing and Stripping".

Grading - Refer to City Standard Specification Section 021040, "Site Grading".

Tilling - The area to be seeded shall be tilled to a depth of 4 to 6 inches by disking, plowing, or other approved methods until soil condition is acceptable.

Topsoiling – If the native soils are not conducive to the establishment and maintenance of grass growth, or if called for on the drawings, topsoil shall be placed over the area to be seeded to a depth of 5 inches after tilling. Topsoil shall have a pH range of 5.5 to 7; shall contain between 2 and 20 percent organic material content in accordance with ASTM D5268; and shall be free of stones larger than one inch, debris, and extraneous materials harmful to plant growth.

**3.2 FERTILIZING:** Fertilizer shall be uniformly applied at a rate of 400 lb/acre, after tilling. Fertilizing and seeding shall be done concurrently. If seeds and fertilizer are distributed in a water slurry, the mixture shall be applied to the area to be seeded within 30 minutes after all the components have come into contact.

**3.3 SEEDING:** The seed mixture shall be uniformly distributed at the rate specified above.

Broadcast Seeding - Seed shall be placed with fertilizer, after tilling. After planting, the area shall be rolled on contour with a corrugated roller.

Straw Mulch Seeding - Seed shall be placed with fertilizer, after tilling. After placement of the seed and fertilizer mixture, straw mulch shall be uniformly placed at a rate of 2 tons per acre. As soon as the mulch has been spread, it shall be anchored to the soil a minimum depth of 3 inches by use of a heavy, dulled disk harrow, set nearly straight. Disks shall be set approximately 9 inches apart.

Straw Mulch With Asphalt Seeding - Seed, fertilizer and straw mulch shall be placed as described in "Straw Mulch Seeding" with the following two exceptions: 1) An asphalt-water emulsion shall be applied to the mulch near the discharge end of the boom spout at a rate of 300 to 600 gallons per acre. 2) Mechanical anchoring by disking will not be required.

Asphalt Mulch Seeding - The seed and fertilizer shall be placed as described for "Broadcast Seeding". After the area has been rolled, the area shall be watered sufficiently to assure a uniform moisture to a minimum depth of 4 inches. An asphalt-water emulsion shall be applied at a rate of 1500 to 1800 gallons per acre, immediately after watering. Asphalt shall be applied to the area in such a manner that a complete film is obtained and the finished surface shall be

comparatively smooth.

Wood Cellulose Fiber Mulch Seeding - After tilling, mulch shall be applied. Wood cellulose fibers shall be added to the hydraulic seeder after the proportionate amounts of seed, fertilizer, water and other approved materials are added. Application shall be 1500 lb./acre on flats, 2000 lb./acre on slopes up to 3:1, and 2500 lb./acre on slopes steeper than 3:1. One hundred (100) pounds of fiber per acre shall be used when asphalt is to be applied over cellulose mulch. The mulch shall provide a uniform cover over the soil surface.

Asphalt Over Wood Cellulose Fiber Mulch Seeding - "Wood Cellulose Fiber Mulch Seeding" shall be done as described above. After mulch has been placed, an asphalt-water emulsion shall be uniformly spread over the mulch at a rate of 1200 gallons per acre.

3.4 MAINTENANCE: The Contractor shall water, repair and reseed areas as required for a period of 45 days or until growth has been established, whichever is longer. This includes erosion damage. Maintenance does not include mowing or weed control, unless indicated on the plans. If at any time the seeded area becomes gullied or otherwise damaged, or the seeds have been damaged or destroyed, the affected portion shall be re-established to the specified condition prior to acceptance of the work.

3.5 GUARANTEE: The Contractor shall assure 95% of the seeded area has established grass growth at 45 calendar days after seeding, unless indicated otherwise on the drawings. Where established, grass growth is defined as at least one plant per square foot with no bare spots larger than three (3) square feet. The Contractor shall re-establish grass growth as directed by the Engineer during the one-year warranty period.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, seeding will be measured by the horizontal square yard of area seeded within the areas designated on the drawings. Areas disturbed by the Contractor that are outside of the designated areas (such as field office, laydown/ storage area, stockpile areas, etc.) shall be seeded by the Contractor for erosion control per the stormwater pollution prevention plan but will not be measured for payment.

Payment shall be full compensation for all labor, materials, tools, equipment and incidentals necessary to complete the work, and shall include, but not be limited to, tilling soil, topsoiling, fertilizing, planting, mulching, watering and maintaining vegetation. Payment shall be due and payable only after grass growth has been established as described above.

SECTION 028040  
SODDING

1. DESCRIPTION

This specification shall govern all work necessary for furnishing and placing sod as required to complete the project.

2. MATERIALS

Fertilizer: All fertilizer used shall be delivered in bags or containers with clearly marked analysis. A granulated fertilizer shall be used with an analysis of 10-20-10. These figures represent the percent of nitrogen, phosphoric acid and potash nutrients, respectively, as determined by the methods of the Association of Official Agricultural Chemists. The rate of application shall be not less than 350 pounds per acre (7.23 lb. per 100 SY). In the event that it is necessary to substitute a fertilizer with a different analysis, it shall be granulated fertilizer with a lower concentration. The total nutrients applied per unit area shall not be less than the specified amount of each nutrient.

Sod: Sod shall consist of live Bermuda grass with thickly matted roots throughout the soil and with a minimum thickness of 3 inches or 0.25 foot, or live St. Augustine with thickly matted roots throughout the soil with a minimum thickness of 1 inch or 0.08 foot. The Contractor shall not use sod where grass is thinned out. Grass shall be mowed and raked to remove all weeds and long stems prior to extraction at the source. Sod and soil shall be kept moist at all times during the sodding process. Care must be taken at all times to retain native soil on the root system.

Water: Water shall be free from oils, acids, alkalis, and salts that may inhibit grass growth. Unless indicated otherwise on the drawings, water shall be provided by the City and shall be transported and applied by the Contractor.

3. CONSTRUCTION METHODS

Spot Sodding: Prior to planting, the area to be sodded shall be graded and shaped. Squares of sod with a minimum width of 3 inches shall be planted in rows on 15-inch centers in both directions. Sod shall be placed so that it is firmly against the bottom of the hole, and the top of the sod shall not be more than 1/2 inch below finished grade. Soil shall be firmly packed against all sides of the sod. Soil shall not be allowed to cover the sod except for soil incidental to raking, provided that the quantity of soil is not enough to hinder the growth. Areas to be spot sodded shall be indicated on the drawing or as directed by the Engineer in field. After sod has been planted, the area shall be fertilized and watered.

Block Sodding: Prior to planting, the area to be sodded shall be graded and shaped. Sod blocks shall be uniformly placed over the prepared area. The sodded area shall then be fertilized and watered. After the area is sufficiently dry, the area shall be rolled or tamped to form a thoroughly compacted mat. Any voids in the mats shall be filled with additional sod and tamped. If, in the opinion of the Engineer, slopes may cause displacement, areas to be block sodded shall be indicated on the drawings or as directed by the Engineer in the field.

Mulch Sodding: The sod source shall be disked in two directions cutting the sod thoroughly to a depth of not less than 4 inches or more than 10 inches, being careful to avoid having soil containing no grass roots. The disked sod may be windrowed or otherwise handled in a manner satisfactory to the Engineer. The material shall be rejected if not kept in a moist condition.

Prior to placing mulch sod, the cut slopes shall be scarified by plowing furrows 4 inches to 6 inches deep along horizontal slope lines at 2-foot vertical intervals. Excavated material from the furrows shall not protrude more than 3 inches above the original surface of the cut. Fertilizer shall be distributed uniformly over the area. The sod shall then be dumped upon the prepared area and spread uniformly to the required approximate thickness shown on the plans.

Any section not true to lines and cross section shall be remedied by the addition of sod material. After the sod material has been spread and shaped, it shall be compacted with a corrugated roller of the "Cultipacker" type. All rolling of slope areas shall be on the contour. The area to be mulch sodded shall be indicated on the drawings or as directed by the Engineer in the field.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, spot sodding and block sodding shall be measured by the square yard taken in a horizontal plane.

Payment shall include, but not be limited to, excavation, transporting, storing and placing of sod, and application of fertilizer and water.

SECTION 028200  
MAIL BOX RELOCATION

1. DESCRIPTION

This specification shall govern all work for relocation of mail boxes required to complete the project.

2. REQUIREMENTS

Where mail is delivered to residents by means of roadside mail boxes, the Contractor shall maintain access to these mail boxes throughout the course of construction. Due to the existing location of mailboxes, the Contractor shall, in some cases, be required to move the boxes to temporary locations. Upon completion of construction, the Contractor shall be required to erect the moved mailboxes to a permanent location. Any materials or labor required for either the temporary or permanent move shall be considered subsidiary, and no direct payment shall be made.

It is the intent of this item to provide the residents with mailbox facilities at least equal to or better than those existing prior to construction.

In all cases, the temporary and permanent locations of all moved mail boxes shall be in accordance with U. S. Postal Service requirements with regard to height, distance from roadway, accessibility, etc. It shall be the Contractor's responsibility to contact the U. S. Postal Service and gather information as to their requirements.

3. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, mail box relocation shall not be measured for pay but will be considered subsidiary to the appropriate item.

SECTION 028300  
FENCE RELOCATION

1. DESCRIPTION

This specification shall govern all work necessary to accomplish the relocation of any fence that needs to be moved to complete this project. The necessity and the time schedule for relocation of any given fence shall be determined by the Engineer.

2. MATERIALS

Whenever possible, all or part of the existing fence materials shall be used in constructing the relocated fence. Any materials damaged or destroyed as a result of removal of the fence from its existing location shall be replaced with materials of equal or better quality at the expense of the contractor.

3. CONSTRUCTION METHODS

It is the intent of this specification that fences be reconstructed to original condition (condition at time just prior to commencement of construction on this project). Unless otherwise specified, no fence shall be replaced until the area surrounding its new location has been worked to its finished grade. Any fence that is damaged while being removed shall be repaired prior to being reset or replaced with like kind.

4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, fence relocation shall be measured by the linear foot of relocated fence (not fence removed from original location).

Payment shall constitute full compensation for removal, replacement, necessary repairs, and all other work related to the relocation of fences.



SECTION 028320  
CHAIN LINK FENCE

1. DESCRIPTION

This specification governs for the design, construction, and the requirements of the component parts and accessories for chain link fence.

2. MATERIALS

All materials shall meet the requirements as indicated below or as otherwise specified on the plans.

1. Fabric - The fabric width shall be as shown on the plans. The fabric shall be 9 gage wire woven into 2-inch mesh hot-dip galvanized after fabrication. Fabric 48 inches and under shall be furnished with knuckling at one selvage and twisting and barbing at the other. Fabric 60 inches high and over shall have twisting and barbing on both selvages. Except as herein provided, chain link fence fabric shall conform to the specifications of ASTM Designation: A392, Class I.
2. Barbed Wire - Barbed wire shall conform to ASTM A121, unless specified otherwise. Barbed wire shall consist of three strands of 12½ gage wire with 14 gage point barbs spaced approximately 5 inches apart. Galvanizing for barbed wire shall conform to ASTM Designation: A121, Class 2.
3. Posts, Braces and Gates - Steel pipe used for posts, braces and gate frames shall conform to the specifications of ASTM Designation: A120. Steel sections shall be of good commercial quality weldable steel. Posts, frames and braces shall be as specified below or as otherwise specified.

(a) Line Posts

1. 2-inch nominal diameter steel pipe.
2. 1⅞-inch 2¼-inch "H" section of high carbon steel; minimum weight 4.1 pounds per linear foot.

(b) End and Corner Posts

1. 2½" nominal diameter steel pipe.
2. 2½" square tubular steel; minimum weight 5.79 pounds per linear foot.

(c) Swing Gate Posts

Swing and gate posts shall conform to ASTM Designation: A120 and shall be in the following sizes:

<u>Pipe Size</u> <u>(O.D. Nominal)</u>	<u>Square</u> <u>(Tubular)</u>	<u>Gate Length</u>
2.875 in.	2.5 in.	Up to 6 feet
4.0 in.	3.0 in.	7 feet to 12 feet
6.625 in.	-	13 feet and above

(d) Gate Frames

Gate frames shall be standard heavy type, welded, watertight, rigid frame with adequate internal bracing and tension members to prevent sagging. Furnish hinges, latches, stops, keepers and similar items as approved. Gates to swing open 180 degrees with keepers to hold gates in open position. Furnish latches with provisions for padlocking. On gates of 4-foot length or less, provide latches that automatically engage when gate is swung shut. The size of gate frame members shall be as follows unless otherwise specified. Gates shall be provided with a positive means of maintaining the gate in the closed position.

<u>Use and Section</u>	<u>O. D. or Dimensions, Nominal</u>	
	<u>Round</u>	<u>Square</u>
Frame for fabric 6' and less, and leaf widths not exceeding 8'	1.66"	1.5"
Frame for fabric over 6' or gate leafs over 8' width	1.9"	2.0"
Internal braces	1.66"	1.5"
Top rails and post braces	1.66"	-

4. Top Rails - Top rails shall be 1.66 inches O.D. nominal tubular; lengths of not less than 18 feet conforming to ASTM Designation: A120 and shall be fitted with couplings for connecting the lengths into a continuous run. The couplings shall be not less than 6 inches long, with 0.070 inch minimum wall thickness, and shall allow for expansion and contraction of the rail. The top rail shall pass through the base of line post barbed wire extension arm and fasten securely to terminal posts.

5. Bracing - Bracing shall be provided for each gate, corner, pull and end post for use when top rail is omitted or with fabric over 6 feet, and shall consist of round tubular steel, 1.66 inches O.D. nominal conforming to ASTM Designation: A120. Bracing shall extend to each adjacent line post at approximately mid-height of the fabric. A truss consisting of a rod not less than 3/8 inch nominal diameter from the line post back to the gate, corner, pull or end post with a turnbuckle or other approved method of adjustment shall also be included.
6. Barbed Wire Extension Arm - Use standard 45 degree, 3 wire, barbed wire extension arms on posts, except end and gate posts on which use standard post top. Provide hole for top rail. Barbed wire extension arms shall conform to ASTM Designation: A153.
7. Tension Wire - If top rail is not specified, a top tension wire shall be provided. Spiraled or crimped tension wire shall be not less than #7 gage and shall conform to ASTM Designation: A116, Class 3. Ties or clips shall be provided for attaching each wire to the fabric at intervals not exceeding 2 feet.
8. Stretcher Bars - Stretcher bars shall not be less than 3/16 by 3/4 inch steel conforming to ASTM Designation: A153. Stretcher bars shall not be less than 2 inches shorter than the full height of the fabric with which they are used. One stretcher bar shall be provided for each gate and end post and two for each corner and pull post.
9. Ties, Bands or Clips - Ties of 9 gage steel wire shall be provided in sufficient number for attaching the fabric to all line posts at intervals not exceeding 15 inches.

Bands or clips of adequate strength shall be provided in sufficient number for attaching the fabric and stretcher bars to all terminal posts at intervals not exceeding 15 inches. Tension bands and brace bands shall be formed from flat or beveled steel and shall have a minimum thickness of 0.115 inch and a minimum width of 7/8 inch, and shall conform to ASTM Designation: A153.

### 3. CONSTRUCTION METHODS

Maximum post spacing shall be 10 feet unless specified otherwise. Concrete footings shall be Class "A" Concrete (see City Standard Specification Section 030020 "Portland Cement Concrete") of the following dimensions:

<u>Type of Post</u>	<u>Fabric Height</u>	<u>Hole Diameter</u>	<u>Hole Depth</u>	<u>Post Embedment</u>
Line	3'-4'	6"	24"	21"
Line	5'	8"	30"	27"
Line	6'-12'	9"	38"	36"
Terminal	3'-5'	10"	32"	30"
Terminal	6'-12'	12"	38"	36"

Erect fencing to follow natural ground surface, but adjust minor irregularities in grade as directed. Construct fence to true alignment.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, chain link fence shall be measured by the linear foot of fence measured at the bottom of the fabric along the centerline of fence from center to center of terminal posts, excluding gates. Gates will be measured per each gate, complete in place.

Payment shall be by the linear foot, as measured above, for the height specified unless otherwise specified. Gates will be paid for as measured above and as described in the Bid Form unless otherwise specified. Payment shall be full compensation for furnishing and installing all materials, and for all labor, tools, equipment and incidentals required to construct the fence as required by the plans and these specifications.

SECTION 028340  
CHAIN LINK SECURITY FENCE

1. DESCRIPTION

This specification shall govern all work and materials required for providing chain link security fence for this project.

2. MATERIALS

Wire Fabric fencing shall be 9 gauge steel with a minimum tensile strength of 80,000 psi. Mesh size shall be 2-inch - 1/16 inch between parallel wires. Top edge of fabric shall be twisted and barbed on 6 foot height fencing and shall be knuckled salvage on 4 foot fencing. Bottom edge of all fencing shall be twisted and barbed.

Tie clips of 6-gauge steel shall be furnished in sufficient quantity to fasten fabric to top tension wire or to top rail at 24-inch intervals. Ties shall be furnished to fasten the fabric to bottom tension wire at 24 inch intervals. The fabric shall be tied to line posts at 15-inch intervals.

Line Post shall be provided at a maximum spacing of 10 feet and be of the following sizes:

<u>Fabric Height</u>	<u>Pipe Size</u>	<u>H-Beam Section</u>	<u>Embedment</u>
		<u>Size</u> <u>Wt./Ft.</u>	<u>Size</u> <u>Length</u>
4 ft.	1.90" O.D.	2.72# 1.875" x 1.625"	2.70# 24"
6 ft.	2.375"O.D.	3.65# 2.25" x 1.95"	4.10# 30"

Corner Post and End Post shall be of the following sizes:

<u>Fabric Height</u>	<u>Pipe Section</u>	<u>Embedment Length</u>
	<u>Size</u>	<u>Wt./Ft.</u>
4 ft.	2.375" O.D.	3.65# 30"
6 ft.	2.875" O.D.	5.79# 42"

Gate Post shall be of the following sizes:

<u>Gate Leaf</u>	<u>Pipe Section Size</u>	<u>Embedment Length Wt./Ft.</u>	
to 6 ft.	2.875" O.D.	5.79#	36"
6 to 13 ft.	4.0 " O.D.	9.10#	42"
13 to 18 ft.	6.625" O.D.	18.97#	48"

Post caps for pipe sections shall be designed to exclude all moisture. Where barbed wire is specified, extension arms shall be integral with post caps. Where top rail is specified, post caps shall have an opening for top rail. All posts caps shall have a 2-inch skirt for rigidity.

Top rail, where called for, shall be 1.625 inch O.D. steel pipe weighing 2.27#/foot. Top rail shall be furnished in random lengths not less than 18 feet per section and shall be joined with outside sleeve, steel couplings not less than 6 inches long and having a wall thickness of not less than 0.70 inch. Couplings shall be designed to allow for expansion movement of the top rail.

Tension wire for top finish, where no top rail is specified, shall be 7-gauge high carbon steel wire. Tension wire shall be furnished for bottom edge of all fence fabric.

Trussed bracing shall be furnished for each panel adjacent to a terminal, pull, corner, or gatepost. Compression member shall be 1.625 inch O.D. pipe as specified for top rail material. Tension members shall be 3/8 inch diameter steel rods with turnbuckles.

For 6-foot fences with top tension wire, braced panels shall consist of horizontal pipe brace, located approximately 4 inches below top of fabric, a diagonal pipe brace, attached at the midpoint of the terminal post and at the bottom of the adjacent line post, and a truss rod, attached to the top of the adjacent line post, extending diagonally to the bottom of the terminal post.

For 6-foot fences with top rail, braced panels shall consist of a horizontal pipe brace, midway between top and bottom of fence fabric, with a truss rod expending from midpoint of the line post diagonally to bottom of terminal post.

Four-foot fences with top rail shall be braced with a truss rod connected to the bottom of the terminal post and extending to top of adjacent line posts.

Four-foot fences without top rail shall have a horizontal brace pipe at the top of adjacent line posts.

Four-foot fences without top rail shall have a horizontal brace pipe at the top of the fabric and a diagonal truss rod installed as described above.

Gates shall be fabricated from 1.90 inch O.D. pipe weighing 2.72#/foot. Fabric on gates shall be the same as that specified for fencing. The following accessories shall be furnished for each gate:

Corner and tee fittings of malleable iron or pressed steel having means for attaching diagonal bracing members.

Hinges of malleable iron providing for full 180 degree swing with bottom hinges to be ball and socket type.

Diagonal braces consisting of 3/8 inch diameter truss rods with turnbuckles, two to each gate frame. Vehicle gates shall have vertical 1.90 inch O.D. pipe brace at center of each gate leaf.

Latches for single gates shall have a single fork latch with padlock eye; double leaf gates shall have two fork latches mounted on center plunger rod with padlock eye.

Hold backs shall be provided for each leaf of vehicular gates, employing a semi-automatic hold back catch to be anchored at least 12 inches into a 12 inch diameter by 24 inch deep concrete footing.

A malleable iron center rest, designed to receive the plunger rod, to be anchored at least 12 inches into a 12-inch diameter by 24 inch deep concrete footing, shall be provided for all double leaf gates.

The top of all gate frames shall align with the fencing top rail. Vehicular gates shall be 4 inches greater in overall height than the adjacent fencing so as to extend to within 2 inches of pavement between 6-inch curbs, if curbs are designated on the plans.

Barbed wire, where specified, shall be 12 gauge with barbs spaced approximately 5 inches apart. Three strands of barbed wire will be required where barbed wire top is specified.

Barbed wire support arms shall be at an angle of 45 degrees from vertical and shall have clips for attaching 3 strands of barbed wire. Each support arm shall be of sufficient strength to support a 200 lb. weight applied at the outer strand of barbed wire.

Stretcher bars shall not be less than 3/16" inch by 3/4" inch flat steel and not more than 2 inches shorter than the fabric height. One stretcher bar shall be provided for each gate and end post. Two stretcher bars shall be provided for each corner and pull posts. Stretcher bars shall be attached to terminal posts with 1 inch x 1/8 inch flat

steel bands with 3/8 inch carriage bolts at intervals not exceeding 15 inches.

Miscellaneous fittings and fasteners shall be furnished in sufficient quantities to erect all fencing materials in a proper manner.

Approval of fence materials shall be obtained from the Engineer prior to erection.

Galvanizing and Aluminum Coating. All material used in "Chain Link Security Fence" shall be hot dip zinc coated as specified by the following, except that the fabric may be aluminum coated:

All posts and pipe: ASTM Designation: A 120 (1.8 oz/sf).

All H-beam sections: ASTM Designation: A 123 (2.0 oz/sf).

Fence fabric: ASTM Designation: A 392, Class 1 (1.2 oz/sf) or ASTM Designation: A 491 (0.40 oz/sf).

Tension wire, barbed wire: ASTM Designation: A 121, Class III (0.80 oz/sf).

Post caps, stretcher bars, miscellaneous fittings: ASTM Designation: A 153.

Weight of zinc coating for all items shall be determined in accordance with ASTM Test Designation: A 90 except for core wire which shall have a galvanized coating weighing not less than 0.35 ounces of zinc per square foot. Field welds and cuts shall be touched-up with an approved zinc coating.

### 3. CONSTRUCTION METHODS

Clearing and Grading. The Contractor shall perform all clearing of brush, rocks and debris which may be necessary for the installation of this fencing. The Engineer will stake out the locations for corner posts and terminal posts in this installation. The fencing panels between corner and terminal posts shall generally follow the finished ground elevations. However, the Contractor shall grade off minor irregularities in the path of the fencing as necessary to limit the variation of grade under the bottom edge of fence fabric to a distance of not more than six inches and not less than two inches to the ground.

Post Spacing. Maximum spacing for line posts shall be 10 feet 0 inches. Pull posts shall be located not more than 500 feet apart and at each change in direction exceeding 20 degrees, both horizontally and vertically. Runs of fencing over 500 feet but less than 1,000 feet shall have a pull post in the center of the run.

Postholes. Holes for concrete footings for all posts shall be drilled to the dimensions listed in the following tables:



#### Holes for Line and End Posts

<u>Type Post</u>	<u>Fabric Height</u>	<u>Min.Hole Diameter</u>	<u>Min.Hole Depth</u>	<u>Post Embedment</u>
Line	4'	9"	30"	24"
Line	6"	10"	36"	30"
End	4'	12"	36"	30"
End	6'	12"	48"	42"

#### Holes for Gate Posts

<u>Gate Post Size</u>	<u>Min. Hole Diameter</u>	<u>Min. Hole Depth</u>	<u>Post Embedment</u>
2.875" O.D. x 5.79#	12"	42"	36"
4" O.D. x 9.10#	18"	48"	42"
6.625" O.D. x 18.97#	18"	54"	48"

Where solid rock is encountered without an overburden of soil, line posts shall be set a minimum depth of 12 inches, and end, corner, gate and pull posts a minimum of 18 inches into the solid rock. The hole shall have a minimum diameter one inch greater than the largest dimension of the post section to be set. After the post is set and plumbed, the hole shall be filled with grout consisting of one part Portland cement and three parts clean, well-graded sand. Other grouting materials may be used if approved or specified by the Engineer. The grout shall be thoroughly worked into the hole so as to leave no voids. The grout shall be crowned to carry water from the post.

Where solid rock is covered by an overburden of soil or loose rock, the posts shall be set to the full depth shown in Table above unless the penetration into solid rock reaches the minimum depths specified above, in which case, the depth of penetration may be terminated. Concrete footings shall be constructed from the solid rock to the top of the ground. Grouting will be required on the portion of the post in solid rock.

Excavated material from footings shall be removed from the job site by the Contractor.

Concrete for Footings. Concrete for footings shall be Class "B" concrete in accordance with Section 030020, unless otherwise specified on plans. All concrete footings shall be cast up to finish grade and crowned 2 inches to shed water. Excess concrete not used in the footings, and any other construction debris, shall be removed from the site.

Fabric Erection. The fence fabric shall be erected by securing one end and applying sufficient

tension to the other end to remove all slack before making attachments. The fabric shall be cut and each span shall be attached independently at all corner posts and pull posts. Fastening to end, pull, corner and gateposts shall be with stretcher bars which shall be secured to the posts with stretcher bar bands at intervals not exceeding 15 inches. Fence fabric shall generally follow the finished contour of the site with the bottom edge of fabric located 2 inches above the grade. In uneven areas, the ground shall be graded so that the maximum distance between bottom of fabric and ground is limited to 6 inches.

Electric grounds. Grounding rods shall be at least 5/8 inch diameter by 8 feet long "copperweld" rods driven or drilled into the soil so that the top of the rod is approximately 6 inches below grade. A No. 6 solid copper conductor shall be clamped to the ground rod and the bottom tension wire of the fence with cast bronze clamps with bronze or stainless steel bolts and washers. Each 1,000-foot of fence shall be provided with a ground located near the center of the run. At least one electrical ground shall be installed for each fenced closure. A ground shall be provided directly under the point where a power line passes over the fence.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, chain link security fence shall be measured by the linear foot. Measurement shall include but not be limited to furnishing and erecting all fence materials, gates, caps, concrete, ground wires, and cleanup. Payment shall be made at the unit price bid and shall fully compensate the Contractor for all materials required, all labor, all tools, all equipment and all other incidentals required to complete the work as shown on the contract drawings and as specified herein.

SECTION 028370  
BARBED WIRE FENCE

1. DESCRIPTION

This specification shall govern all work required for furnishing and installing all barbed wire fences and gates required to complete the project.

2. GENERAL

Barbed wire fences shall be Class D four-strand barbed wire in accordance with FAA Item F-161 (10/24/74).

3. MATERIALS

Wire.

- a. Woven Wire (Zinc-coated). The woven wire fencing shall be 7-bar, 26-inch field fence with top and bottom wires No. 10 ASW gauge, and filler and stay wire No. 12 ½ ASW gauge. Stay wires shall be spaced 6 inches apart. All wire shall be smooth galvanized steel wire conforming to Fed. Spec. RR-F-221, Type B. All wires shall be two-dip and spaced to match existing fencing.
- b. Barbed Wire (Zinc-coated). Zinc coated barbed wire shall be two-strand twisted No. 12 ½ ASW gauge galvanized steel wire with 4-point barbs of No. 14 ASW gauge galvanized steel wire. All wire shall conform to Fed. Spec. RR-F221, Type A. The barbs shall be spaced approximately 4 inches apart. The wire will be placed in the same number and at the same heights as the existing adjoining fence
- c. Barbed Wire (Copper-covered). Copper-covered steel barbed wire shall conform to Fed. Spec. RR-F221, Type A.
- d. Barbed Wire (Aluminum-coated). Aluminum-coated steel barbed wire shall be two strand twisted No. 12 ½ ASW gauge. The 4-point barbs of No. 14 ASW gauge aluminum-coated steel wire shall be spaced approximately 5 inches apart. The steel wire shall have a tensile strength of between 60,000 and 80,000 pounds per square inch and the aluminum coating shall have a minimum weight of 0.30 ounce per square foot of wire surface on the No. 12 ½ ASW gauge line wire and 0.25 ounce per square foot of wire surface on the No. 14 ASW gauge barbs. The wire will be placed in the same number and at the same heights as the existing adjoining fence

- e. Bracing Wire (Zinc-coated). Wire used for cable for bracing shall be No. 9 smooth galvanized soft wire.

Fence Posts, Gates, Rails, Braces and Accessories. These items, when specified, shall conform to the requirements of Fed. Spec. RR-F-183 and shall be zinc coated.

Concrete. Concrete shall be Class B in accordance with City Standard Specification Section 030020.

#### 4. CONSTRUCTION METHODS

General. The fence shall be constructed in the locations shown on the plans and as specified herein using new materials, and all work shall be performed in a workmanlike manner satisfactory to the Engineer. The route of the fence is indicated on the drawings. The existing fence with the exception of gates shall become property of the Contractor and shall be removed from the site. The new fence shall be placed along the right-of-way or easement line. The Contractor shall span the opening below the fence with barbed wire fastened to stakes of the required length at locations of small natural or drainage ditches where it is not practical to conform the fence to the general contour of the ground surface. The new fence shall be permanently tied to terminals of existing fences whenever required by the Engineer. The finished fence shall be plumb, taut, true to line and ground contour, and complete in every detail.

When directed, in order to keep stock on adjoining property enclosed at all times, the Contractor shall arrange the work so that construction of the new fence will immediately follow the removal of existing fences. The length of unfenced section at any time shall not exceed 300 feet or such length that the stock can be kept in the proper field. The work shall progress in this manner and at the close of the working day the newly constructed fence shall be tied to the existing fence. Any openings in the fence shall be guarded when stock is using the adjoining property.

Clearing Fence Line. The site of the fence shall be sufficiently cleared of obstructions, and surface irregularities shall be graded so that the fence will conform to the general contour of the ground. The fence line shall be cleared to minimum width of 10 feet on each side of the centerline of the fence. This clearing shall consist of the removal of all stumps, brush, rocks, trees, or other obstructions which will interfere with proper constructions of the fence. The area shall be mowed. Stumps within the cleared area of the fence shall be removed. When shown on the plans or as directed by the Engineer, the existing fences, which coincide with or are in a position to interfere with the new fence locations shall be removed by the Contractor as part of the construction work unless such removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other material acceptable to the Engineer and shall be compacted properly with tampers.

The work shall include the handling and disposal of all material cleared, excavated or removed, regardless of the type, character, composition, or condition of such material encountered.

Installing Posts. All posts shall be spaced at 16'-6" maximum spacing. Corner, brace, anchor, end, and gate posts shall be set in concrete bases as shown on the plans. The top of the base shall be slightly above the ground surface, trowel finished, and sloped to drain. Holes of full depth and size for the concrete bases for posts shall be provided even if blasting of rock or other obstructions is necessary. All line posts may be either driven or set in dug holes to a penetration of 3 feet. All post setting shall be done carefully and to true alignment. Dirt removed for placing posts, anchor bars, flanges, etc., shall be replaced, tamped, and leveled. When posts are driven, care shall be exercised to prevent marring or buckling of the posts. Damaged posts shall be replaced at the Contractor's expense. No extra compensation will be made for rock excavation. Rock excavation shall not be grounds for extension of time.

Bracing. All corner, anchor, end, and gateposts shall be braced. Anchor posts shall be set at approximately 500-foot intervals and braced to the adjacent posts.

Installing Wire. All barbed wire and woven wire shall be placed on the same side of the posts as the existing adjoining fence, or as directed, at the same height and number as the existing adjoining fence. The woven wire shall be carefully stretched and hung without sag and with true alignment. Care shall be taken not to stretch the wire so tightly that it will break in cold weather or pull up corner and/or brace posts. All horizontal wires shall be fastened securely to each post by fasteners or clips designed for use with the posts furnished. The woven wire shall be wrapped around all end posts, corner posts and gate posts, and the ends of all horizontal wires shall be tied with snug, tight twists. The wire shall be secured to prevent slipping up and down the post. Barbed wire strands shall be stretched and each strand secured to each post to prevent slipping out of line or becoming loose. At all end posts, corner posts and gate posts, the barbed wire shall be securely wrapped and anchored once about the post from the outside and secured against slipping by tying the ends with snug, tight twists. However, on spans of less than 100 feet, both ends of the span need not be wrapped around the posts. The bottom wire of the woven wire fencing shall clear the ground by not more than 4 inches or less than 1 inch at any place.

Splicing Wire. Splicing in barbed wire and woven wire will be permitted if made with an approved galvanized bolt-clamp splice or a wire splice made as follows: The ends of each wire shall be carried 3 inches past the splice tool and wrapped around the other wire for at least six turns in opposite directions. After the tool is removed, the space occupied by it shall be closed by pulling the ends together. The unused ends of the wire shall be cut close to make a neat, workmanlike job.

Existing Fence Connections. Wherever the new fence joins an existing fence, either at a corner or at the intersection of straight fence lines, a corner post or anchor post shall be set at the junction and braced and anchored the same as herein described for corner posts.

If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace span.

Gates. See the gate schedule in the drawings for location, size and description of proposed gate work where new gates are required. Gates will typically be cantilever type roller gates. The Contractor shall submit shop drawings of the gate and assembly for pre-approval by the Engineer prior to bid openings. The gate and assembly shall meet the following general requirements: Gates shall be of the double gate type with a combined clear opening of 30 feet. Roller assembly shall be of a type designed to support the gate without ground rollers. Rollers shall be mounted on steel gatepost with a minimum diameter of 4 inches. Gatepost shall be placed in 12" diameter post holes excavated to a minimum depth of 48 inches. Gatepost shall be embedded in a hole a minimum of 36" with the remainder of the hole being filled with Class B concrete. The gate frame shall be constructed of galvanized steel pipe with a minimum diameter of 2 inches for exterior member and 1-5/8 inches for internal braces. The size of the gate frame shall be approximately 3'-6" x 22'-0". The gate barrier wire shall be NE 6 gauge 2" wire. The gate shall be installed with a lock assemble located at the center of the 30 foot opening. The lock assemble shall provide lateral support and be doweled into concrete at mid-opening and shall not obstruct traffic when the gate is open.

## 5. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, Barbed Wire Fence shall be measured and paid for under City Standard Specification Section 028300 "Fence Relocation", and shall be full compensation for furnishing all materials and for all preparation, erection, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

SECTION 030020  
PORTLAND CEMENT CONCRETE

1. DESCRIPTION

This specification shall govern for the materials used; for the storing and handling of materials; and for the proportioning and mixing of concrete for culverts, manholes, inlets, curb and gutter, sidewalks, driveways, curb ramps, headwalls and wingwalls, riprap, and incidental concrete construction.

The concrete shall be composed of Portland cement, aggregates (fine and coarse), admixtures if desired or required, and water, proportioned and mixed as hereinafter provided.

2. MATERIALS

(1) Cement

The cement shall be either Type I, II or III Portland cement conforming to ASTM Designation: C150, modified as follows:

Unless otherwise specified by the Engineer, the specific surface area of Type I and II cements shall not exceed 2000 square centimeters per gram (Wagner Turbidimeter – TxDOT Test Method Tex-310-D). For concrete piling, the above limit on specific surface area is waived for Type II cement only. The Contractor shall furnish the Engineer, with each shipment, a statement as to the specific surface area of the cement expressed in square centimeters per gram.

For cement strength requirements, either the flexural or compressive test may be used.

Either Type I or II cement shall be used unless Type II is specified on the plans. Except when Type II is specified on the plans, Type III cement may be used when the anticipated air temperature for the succeeding 12 hours will not exceed 60°F. Type III cement may be used in all precast prestressed concrete, except in piling when Type II cement is required for substructure concrete.

Different types of cement may be used in the same structure, but all cement used in any one monolithic placement shall be of the same type and brand. Only one brand of each type will be permitted in any one structure unless otherwise authorized by the Engineer.

Cement may be delivered in bulk where adequate bin storage is provided. All other cement shall be delivered in bags marked plainly with the name of the manufacturer and the type of cement. Similar information shall be provided in the bills of lading accompanying each shipment of packaged or bulk cement. Bags shall contain 94 pounds net. All bags shall be in good condition at time of delivery.

All cement shall be properly protected against dampness. No caked cement will be accepted.

Cement remaining in storage for a prolonged period of time may be retested and rejected if it fails to conform to any of the requirements of these specifications.

## (2) Mixing Water

Water for use in concrete and for curing shall be free from oils, acids, organic matter or other deleterious substances and shall not contain more than 1000 parts per million of chlorides as CL nor more than 1000 parts per million of sulfates as  $SO_4$ .

Water from municipal supplies approved by the State Health Department will not require testing, but water from other sources will be sampled and tested before use in structural concrete.

Tests shall be made in accordance with the "Method of Test for Quality of Water to be Used in Concrete" (AASHTO Method T26), except where such methods are in conflict with provisions of this specification.

## (3) Coarse Aggregate

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

Unless otherwise specified on the plans, coarse aggregate will be subjected to five cycles of the soundness test in accordance with TxDOT Test Method Tex-411-A. The loss shall not be greater than 12 percent when sodium sulfate is used, or 18 percent when magnesium sulfate is used.

Permissible sizes of aggregate shall be governed by Table 4 and Table 1, except that when exposed aggregate surfaces are required, coarse aggregate gradation will be as specified on the plans.

When tested by approved methods, the coarse aggregate, including combinations of aggregates when used, shall conform to the grading requirements shown in Table 1.



**TABLE 1**  
**Coarse Aggregate Gradation Chart**

Percent Retained on Each Sieve										
<u>Aggregate Grade No.</u>	<u>Nominal Size</u>	<u>2-½ In.</u>	<u>2 In.</u>	<u>1-½ In.</u>	<u>1 In.</u>	<u>¾ In.</u>	<u>½ In.</u>	<u>⅜ In.</u>	<u>No. 4</u>	<u>No. 8</u>
1	2 in.	0	0 to 20	15 to 50		60 to 80			95 to 100	
2 (467)*	1-½ in.		0	0 to 5		30 to 65		70 to 90	95 to 100	
4 (57)*	1 in.			0	0 to 5		40 to 75		90 to 100	95 to 100
8	¾ in.						0	0 to 5	35 to 80	90 to 100

\*Numbers in parenthesis indicate conformance with ASTM C33.

The aggregate shall be washed. The Loss by Decantation (TxDOT Test Method Tex-406-A) plus the allowable weight of clay lumps, shall not exceed one percent, or the value shown on the plans, whichever is smaller.

(4) Fine Aggregate

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

The fine aggregate shall produce a mortar having a tensile strength equal to or greater than that of Ottawa sand mortar when tested in accordance with TxDOT Test Method Tex-317-D.

Where manufactured sand is used in lieu of natural sand for slab concrete subject to direct traffic, the acid insoluble residue of the fine aggregate shall be not less than 28 percent by weight when tested in accordance with TxDOT Test Method Tex-612-J.

When tested by approved methods, the fine aggregate or combination of aggregates, including mineral filler, shall conform to the grading requirements shown in Table 2.

TABLE 2  
Fine Aggregate Gradation Chart

<u>Aggregate Grade No.</u>	<u>Percent Retained on Each Sieve</u>							
	<u>3/8 In.</u>	<u>No. 4</u>	<u>No. 8</u>	<u>No. 16</u>	<u>No. 30</u>	<u>No. 50</u>	<u>No. 100</u>	<u>No. 200</u>
1	0	0 to 5	0 to 20	15 to 50	35 to 75	70 to 90	90 to 100	97 to 100

**NOTE 1:** Where manufactured sand is used in lieu of natural sand, the percent retained on the No. 200 sieve shall be 94 to 100.

**NOTE 2:** Where the sand equivalent value is greater than 85, the retainage on the No. 50 sieve may be 70 to 94 percent.

Fine aggregate will be subjected to the Sand Equivalent Test (TxDOT Test Method Tex-203-F). The sand equivalent shall not be less than 80 nor less than the value shown on the plans, whichever is greater.

For concrete Classes 'A' and 'C', the fineness modulus as defined below for fine aggregates shall be between 2.30 and 3.10.

The fineness modulus will be determined by adding the percentages by weight retained on the following sieves, and dividing by 100; Nos. 4, 8, 16, 30, 50 and 100.

(5) Mineral Filler

Mineral filler shall consist of stone dust, clean crushed sand, or other approved inert material.

(6) Mortar (Grout)

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

(7) Admixtures

Calcium Chloride will not be permitted. Unless otherwise noted, air-entraining, retarding and water-reducing admixtures may be used in all concrete and shall conform to the following requirements:

A "water-reducing, retarding admixture" is defined as a material which, when added to a concrete mixture in the correct quantity, will reduce the quantity of mixing water required to produce concrete of a given consistency and will retard the initial set of the concrete.

A "water-reducing admixture" is defined as a material which, when added to a concrete mixture in the correct quantity, will reduce the quantity of mixing water required to produce concrete of a given

consistency.

- (a) Retarding and Water-Reducing Admixtures. The admixture shall meet the requirements for Type A and Type D admixture as specified in ASTM Designation: C494, modified as follows:
- (1) The water-reducing retarder shall retard the initial set of the concrete a minimum of 2 hours and a maximum of 4 hours, at a specified dosage rate, at a temperature of 90°F.
  - (2) The cement used in any series of tests shall be either the cement proposed for specific work or a "reference" Type I cement from one mill.
  - (3) Unless otherwise noted on the plans, the minimum relative durability factor shall be 80.

The air-entraining admixture used in the referenced and test concrete shall be neutralized Vinsol resin.

- (b) Air-Entraining Admixture. The admixture shall meet the requirements of ASTM Designation: C260, modified as follows:
- (1) The cement used in any series of tests shall be either the cement proposed for specific work or a "reference" Type I cement from one mill.
  - (2) Unless otherwise noted on the plans, the minimum relative durability factor shall be 80.

The air-entraining admixture used in the referenced concrete shall be neutralized Vinsol resin.

### 3. STORAGE OF CEMENT

All cement shall be stored in well-ventilated weatherproof buildings or approved bins, which will protect it from dampness or absorption of moisture. Storage facilities shall be ample, and each shipment of packaged cement shall be kept separated to provide easy access for identification and inspection.

The Engineer may permit small quantities of sacked cement to be stored in the open for a maximum of 48 hours on a raised platform and under waterproof covering.

### 4. STORAGE OF AGGREGATE

The method of handling and storing concrete aggregate shall prevent contamination with foreign materials. If the aggregates are stored on the ground, the sites for the stockpiles shall be clear of all vegetation and level. The bottom layer of aggregate shall not be disturbed or used without recleaning.

When conditions require the use of two or more sizes of aggregates, they shall be separated to prevent intermixing. Where space is limited, stockpiles shall be separated by physical barriers.

Methods of handling aggregates during stockpiling and subsequent use shall be such that segregation will be minimized.

Unless otherwise authorized by the Engineer, all aggregate shall be stockpiled at least 24 hours to reduce the free moisture content.

## 5. MEASUREMENT OF MATERIALS

The measurement of the materials, except water, used in batches of concrete, shall be by weight. The fine aggregate, coarse aggregate and mineral filler shall be weighed separately. Where bulk cement is used, it shall be weighed separately, but batch weighing of sacked cement will not be required. Where sacked cement is used, the quantities of material per batch shall be based upon using full bags of cement. Batches involving the use of fractional bags will not be permitted.

Allowance shall be made for the water content in the aggregates.

Bags of cement varying more than 3 percent from the specified weight of 94 pounds may be rejected, and when the average weight per bag in any shipment, as determined by weighing 50 bags taken at random, is less than the net weight specified, the entire shipment may be rejected. If the shipment is accepted, the Engineer will adjust the concrete mix to a net weight per bag fixed by an average of all individual weights which are less than the average weight determined from the total number weighed.

## 6. CLASSIFICATION AND MIX DESIGN

It shall be the responsibility of the Contractor to furnish the mix design, using a coarse aggregate factor acceptable to the Engineer, for the class(es) of concrete specified. The mix shall be designed by a qualified concrete technician to conform with the requirements contained herein and in accordance with the THD Bulletin C-11. The Contractor shall perform, at his own expense, the work required to substantiate the design, except the testing of strength specimens, which will be done by the Engineer. Complete concrete design data shall be submitted to the Engineer for approval.

It shall also be the responsibility of the Contractor to determine and measure the batch quantity of each ingredient, including all water, so that the mix conforms to these specifications and any other requirements shown on the plans.

Trial batches will be made and tested using all of the proposed ingredients prior to placing the concrete, and when the aggregate and/or brand of cement or admixture is changed. Trial batches shall be made in the mixer to be used on the job. When transit mix concrete is to be used, the trial designs will be made in a transit mixer representative of the mixers to be used. Batch size shall not be less than 50 percent of the rated mixing capacity of the truck.

Mix designs from previous or concurrent jobs may be used without trial batches if it is shown that no

substantial change in any of the proposed ingredients has been made.

The coarse aggregate factor shall not be more than 0.82, except that when the voids in the coarse aggregate exceed 48 percent of the total dry loose volume, the coarse aggregate factor shall not exceed 0.85. The coarse aggregate factor shall not be less than 0.70 for Grades 1, 2 and 3 aggregates.

If the strength required for the class of concrete being produced is not secured with the cement specified in Table 4, the Contractor may use an approved water-reducing or retarding admixture, or he shall furnish aggregates with different characteristics which will produce the required results. Additional cement may be required or permitted as a temporary measure until the redesign is checked.

Water-reducing or retarding agents may be used with all classes of concrete at the option of the Contractor.

When water-reducing or retarding agents are used at the option of the Contractor, reduced dosage of the admixture will be permitted.

Entrained air will be required in accordance with Table 4. The concrete shall be designed to entrain 5 percent air when Grade 2 coarse aggregate is used and 6 percent when Grade 3 coarse aggregate is used. Concrete as placed in the structure shall contain the proper amount as required above with a tolerance of plus or minus 1.5 percentage points. Occasional variations beyond this tolerance will not be cause for rejection. When the quantity of entrained air is found to be above 7 percent with Grade 2 coarse aggregate or above 8 percent for Grade 3 coarse aggregate, additional test beams or cylinders will be made. If these beams or cylinders pass the minimum flexural or compressive requirements, the concrete will not be rejected because of the variation in air content.

## 7. CONSISTENCY

In cases where the consistency requirements cannot be satisfied without exceeding the maximum allowable amount of water, the Contractor may use, or the Engineer may require, an approved water-reducing or retarding agent, or the Contractor shall furnish additional aggregates or aggregates with different characteristics, which will produce the required results. Additional cement may be required or permitted as a temporary measure until aggregates are changed and designs checked with the different aggregates or admixture.

The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When field conditions are such that additional moisture is needed for the final concrete surface finishing operation, the required water shall be applied to the surface by fog spray only, and shall be held to a minimum. The concrete shall be workable, cohesive, possess satisfactory finishing qualities, and of the stiffest consistency that can be placed and vibrated into a homogenous mass. Excessive bleeding shall be avoided. Slump requirements will be as specified in Table 3.

TABLE 3  
Slump Requirements

<u>Concrete Designation</u>	<u>Desired Slump</u>	<u>Max. Slump</u>
Structural Concrete:		
(1) Thin-Walled Sections (9" or less)	4 inches	5 inches
(2) Slabs, Caps, Columns, Piers, Wall Sections over 9", etc.	3 inches	4 inches
Underwater or Seal Concrete	5 inches	6 inches
Riprap, Curb, Gutter and Other Miscellaneous Concrete	2.5 inches	4 inches

**NOTE:** No concrete will be permitted with slump in excess of the maximums shown.

## 8. QUALITY OF CONCRETE

### General

The concrete shall be uniform and workable. The cement content, maximum allowable water-cement ratio, the desired and maximum slump and the strength requirements of the various classes of concrete shall conform to the requirements of Table 3 and Table 4 and as required herein.

During the process of the work, the Engineer or his designated representative will cast test cylinders or beams as a check on the compressive or flexural strength of the concrete actually placed. Test cylinders must be picked up by the testing lab within 24 hours.

A test shall be defined as the average of the breaking strength of two cylinders or two beams, as the case may be. Specimens will be tested in accordance with TxDOT Test Methods Tex-418-A or Tex-420-A.

Test beams or cylinders will be required as specified in the contract documents. For small placements on structures such as manholes, inlets, culverts, wingwalls, etc., the Engineer may vary the number of tests to a minimum of one for each 25 cubic yards placed over a several day period.

All test specimens, beams or cylinders, representing tests for removal of forms and/or falsework shall be cured using the same methods, and under the same conditions as the concrete represented.

"Design Strength" beams and cylinders shall be cured in accordance with THD Bulletin C-11.

The Contractor shall provide and maintain curing facilities as described in THD Bulletin C-11 for the purpose of curing test specimens. Provision shall be made to maintain the water in the curing tank at temperatures between 70°F and 90°F.

When control of concrete quality is by twenty-eight-day compressive tests, job control will be by seven-day compressive tests which are shown to provide the required twenty-eight-day strength, based on results from trial batches. If the required seven-day strength is not secured with the cement

specified in Table 4, changes in the batch design will be made.

TABLE 4  
Classes of Concrete

Class of Concrete	Sacks Cement per C.Y. (min.)	Minimum Compressive Strength (f <sub>c</sub> ) 28-Day(psi)	Min. Beam Strength 7-Day (psi)	Maximum Water-Cement Ratio (gal/sack)	Coarse Aggregate No.
A*	5.0	3000	500***	6.5	2-4-8*****
B*	4.5	2500	417	8.0	2-4-8*****
C*	6.0	3600	600***	6.0	1-2-4**
D	6.0	3000	500	7.0	2-4
S	6.5	4000	570	5.0	2-4

\*Entrained Air (slabs, piers and bent concrete).

\*\*Grade 1 Coarse Aggregate may be used in foundation only (except cased drilled shafts).

\*\*\*When Type II Cement is used with Class C Concrete, the 7-day beam break requirement will be 550 psi; with Class A Concrete, the minimum 7-day beam break requirement will be 460 psi.

\*\*\*\*Permission to use Grade 8 Aggregate must have prior approval of the Engineer.

## 9. MIXING CONDITIONS

The concrete shall be mixed in quantities required for immediate use. Any concrete which is not in place within the limits outlined in City Standard Specification Section 038000 "Concrete Structures", Article "Placing Concrete-General", shall not be used. Retamping of concrete will not be permitted.

In threatening weather, which may result in conditions that will adversely affect the quality of the concrete to be placed, the Engineer may order postponement of the work. Where work has been started and changes in weather conditions require protective measures, the Contractor shall furnish adequate shelter to protect the concrete against damage from rainfall, or from freezing temperatures. If necessary to continue operations during rainfall, the Contractor shall also provide protective coverings for the material stockpiles. Aggregate stockpiles need be covered only to the extent necessary to control the moisture conditions in the aggregates to adequately control the consistency of the concrete.

## 10. MIXING AND MIXING EQUIPMENT

All equipment, tools, and machinery used for hauling materials and performing any part of the work shall be maintained in such condition to insure completion of the work underway without excessive delays for repairs or replacements.

The mixing shall be done in a batch mixer of approved type and size that will produce uniform

distribution of the material throughout the mass. Mixers may be either the revolving drum type or the revolving blade type, and shall be capable of producing concrete meeting the requirements of these specifications.

After all the ingredients are assembled in the drum, the mixing shall continue not less than 1 minute for mixers of one cubic yard or less capacity plus 15 seconds for each additional cubic yard or portion thereof.

The mixer shall operate at the speed and capacity designated by the Mixer Manufacturers Bureau of the Associated General Contractors of America. The mixer shall have a plate affixed showing the manufacturer's recommended operating data.

The absolute volume of the concrete batch shall not exceed the rated capacity of the mixer.

The entire contents of the drum shall be discharged before any materials are placed therein for the succeeding batch.

The first batch of concrete materials placed in the mixer for each placement shall contain an extra quantity of sand, cement and water sufficient to coat the inside surface of the drum.

Upon the cessation of mixing for any considerable length of time, the mixer shall be thoroughly cleaned.

The concrete mixer shall be equipped with an automatic timing device which is put into operation when the skip is raised to its full height and dumping. This device shall lock the discharging mechanism and prevent emptying of the mixer until all the materials have been mixed together for the minimum time required, and it shall ring a bell after the specified time of mixing has elapsed.

The water tank shall be arranged so that the amount of water can be measured accurately, and when the tank starts to discharge, the inlet supply shall cut off automatically.

Whenever a concrete mixer is not adequate or suitable for the work, it shall be removed from the site upon a written order from the Engineer and a suitable mixer provided by the Contractor.

Pick-up and thro-over blades in the drum of the mixer which are worn down more than 10 percent in depth shall be repaired or replaced with new blades.

Improperly mixed concrete shall not be placed in the structure.

Job mix concrete shall be concrete mixed in an approved batch mixer in accordance with the requirements stated above, adjacent to the structure for which the concrete is being mixed, and moved to the placement site in non-agitating equipment.

## 11. READY-MIX PLANTS

A. General. It shall be the Contractor's responsibility to furnish concrete meeting all requirement of the governing specification sections, and concrete not meeting the slump, workability and consistency requirements of the governing specification sections shall not be



placed in the structure or pavement.

Ready-Mixed Concrete shall be mixed and delivered by means of one of the following approved methods.

- (1) Mixed completely in a stationary mixer and transported to the point of delivery in a truck agitator or a truck mixer operating at truck agitator or truck mixer agitation speed. (Central-Mix Concrete)
- (2) Mixed complete in a truck mixer and transported to the placement site at mixing and/or agitating speed (Transit-Mix Concrete), subject to the following provisions:
  - (a) Truck mixers will be permitted to transport concrete to the job site at mixing speed if equipped with double actuated counters which will separate revolutions at mixing speed from total revolutions.
  - (b) Truck mixers equipped with a single actuated counter counting total revolutions of the drum shall mix the concrete at the plant not less than 50 nor more than 70 revolutions at mixing speed, transport it to the job site at agitating speed and complete the required mixing before placing the concrete.
- (3) Mixed completely in a stationery mixer and transported to the job site in approved non-agitating trucks with special bodies. This method of transporting will be permitted for concrete pavement only.

#### B. Equipment.

- (1) Batching Plant. The batching plant shall be provided with adequate bins for batching all aggregates and materials required by the specifications.

Bulk cement shall be weighed on a scale separate from those used for other materials and in a hopper entirely free and independent of that used for weighing the aggregates.

- (2) Mixers and Agitators.

- (a) General: Mixers shall be of an approved stationary or truck-type capable of combining the ingredients into a thoroughly mixed and uniform mass.

Facilities shall be provided to permit ready access to the inside of the drum for inspection, cleaning and repair of blades.

Mixers and agitators shall be subject to daily examination for changes in condition due to accumulation of hardened concrete and/or wear of blades, and any hardened concrete shall be removed before the mixer will be permitted to be used. Worn blades shall be repaired or replaced with new in

accordance with the manufacturer's design and arrangement for that particular unit when any part or section is worn as much as 10 percent below the original height of the manufacturer's design.

- (b) Stationary Mixers: These shall conform to the requirements of Article "Mixing and Mixing Equipment". Truck mixers mounted on a stationary base will not be considered as a stationary mixer.
- (c) Truck Mixers: In addition, truck mixers shall comply with the following requirements:

An engine in satisfactory working condition and capable of accurately gauging the desired speed of rotation shall be mounted as an integral part of the mixing unit for the purpose of rotating the drum. Truck mixers equipped with a transmission that will govern the speed of the drum within the specified revolutions per minute (rpm) will not require a separate engine.

All truck mixers shall be equipped with actuated counters by which the proper number of revolutions of the drum, as specified in Article 11. A. above, may be readily verified. The counters shall be read and recorded at the start of mixing at mixing speeds.

Each until shall have adequate water supply and accurate metering or gauging devices for measuring the amount used.

- (d) Agitators: Concrete agitators shall be of the truck type, capable of maintaining a thoroughly mixed and uniform concrete mass and discharging it within the same degree of uniformity specified for mixers. Agitators shall comply with all of the requirements for truck mixers, except for the actual mixing requirements.

### C. Operation of Plant and Equipment.

Delivery of ready-mixed concrete shall equal or exceed the rate approved by the Engineer for continuous placement. In all cases, the delivery of concrete to the placement site shall assure compliance with the time limits in the applicable specification for depositing successive batches in any monolithic unit. The Contractor shall satisfy the Engineer that adequate standby trucks are available.

A standard ticket system will be used for recording concrete batching, mixing and delivery date.

Tickets will be delivered to the job inspector.

Loads arriving without ticket and/or in unsatisfactory condition shall not be used.

When a stationary mixer is used for the entire mixing operation, the mixing time for one cubic yard of concrete shall be one minute plus 15 seconds for each additional cubic yard or portion thereof. This mixing time shall start when all cement, aggregates and initial water have entered the drum.

The mixer shall be charged so that some of the mixing water will enter the drum in advance of the cement and aggregate. All of the mixing water shall be in the drum by the end of the first one-fourth of the specified mixing time. Water used to flush down the blades after charging shall be accurately measured and included in the quantity of mixing water. The introduction of the initial mixing water, except blade wash down water and that permitted in this Article, shall be prior to or simultaneous with the charging of the aggregates and cement.

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

When Ready-Mix Concrete is used, additional mortar (one sack cement, three parts sand and sufficient water) shall be added to the batch to coat the drum of the mixer or agitator truck, and this shall be required for every load of Class C concrete only and for the first batch from central mix plants.

A portion of the mixing water, required by the batch design to produce the desired slump, may be withheld and added at the job site, but only with permission of the Engineer and under his supervision. When water is added under the above conditions, it shall be thoroughly mixed as specified below for water added at the job site.

Mixing speed shall be attained as soon as all ingredients are in the mixer, and each complete batch (containing all the required ingredients) shall be mixed not less than 70 nor more than 100 revolutions of the drum at mixing speed except that when water is added at the job site, 25 revolutions (minimum) at mixing speed will be required to uniformly disperse the additional water throughout the mix. Mixing speed shall be as designated by the manufacturer.

All revolutions after the prescribed mixing time shall be at agitating speed. The agitating speed shall be not less than one (1) nor more than five (5) rpm. The drum shall be kept in continuous motion from the time mixing is started until the discharge is completed.

## 12. PLACING, CURING AND FINISHING

The placing of concrete, including construction of forms and falsework, curing and finishing, shall be in accordance with City Standard Specification Section 038000 "Concrete Structures".

## 13. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, the quantities of concrete of the various classifications which will constitute the completed and accepted structure(s) in-place will be measured by the cubic yard, per each, square foot, square yard or linear foot, as the case may be. Measurement will be as shown on the drawings and/or in the Bid Form.

Payment shall be full compensation for furnishing, hauling, mixing, placing, curing and finishing all concrete; all grouting and pointing; furnishing and placing drains; furnishing and placing metal flashing strips; furnishing and placing expansion joint material required by this specification or shown on the plans; and for all forms and falsework, labor, tools, equipment and incidentals necessary to complete the work.

SECTION 032020  
REINFORCING STEEL

1. DESCRIPTION

This specification shall govern the furnishing and placing of reinforcing steel, deformed and smooth, of the size and quantity designated on the plans and in accordance with these specifications.

2. MATERIALS

Unless otherwise designated on the plans, all bar reinforcement shall be deformed, and shall conform to ASTM Designation: A 615, Grades 60 or 75, and shall be open hearth, basic oxygen, or electric furnace new billet steel.

Large diameter new billet steel (Nos. 14 and 18), Grade 75, will be permitted for straight bars only.

Where bending of bar sizes No. 14 or No. 18 of Grade 60 is required, bend testing shall be performed on representative specimens as described for smaller bars in the applicable ASTM Specification. The required bend shall be 90 degrees around a pin having a diameter of 10 times the nominal diameter of the bar.

Spiral reinforcement shall be smooth (not deformed) bars or wire of the minimum diameter shown on the plans, and shall be made by one or more of the following processes: open hearth, basic oxygen, or electric furnace. Bars shall be rolled from billets reduced from ingots and shall comply with ASTM Designation: A 306, Grade 65 minimum (references to ASTM Designation: A 29 is voided). Dimensional tolerances shall be in accordance with ASTM Designation: A 615, or ASTM Designation: A 615, Grade 60, except for deformations. Wire shall be cold-drawn from rods that have been hot-rolled from billets and shall comply with ASTM Designation: A 185.

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

Report of chemical analysis showing the percentages of carbon, manganese, phosphorus and sulphur will be required for all reinforcing steel when it is to be welded.

The nominal size and area and the theoretical weight of reinforcing steel bars covered by this specification are as follows:

<u>Bar Size Number</u>	<u>Nominal Diameter, In.</u>	<u>Nominal Area, Sq. In.</u>	<u>Weight per Linear Foot, Pounds</u>
2	0.250	0.05	0.167
3	0.375	0.11	0.376
4	0.500	0.20	0.668
5	0.625	0.31	1.043
6	0.750	0.44	1.502
7	0.875	0.60	2.044
8	1.000	0.79	2.670
9	1.128	1.00	3.400
10	1.270	1.27	4.303
11	1.410	1.56	5.313
14	1.693	2.25	7.6
18	2.257	4.00	13.60

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

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

<u>Gauge Number</u>	<u>Equivalent Diameter, Inches</u>	<u>Gauge Number</u>	<u>Equivalent Diameter, Inches</u>
0	0.3065	8	0.1620
1	0.2830	9	0.1483
2	0.2625	10	0.1350
3	0.2437	11	0.1205
4	0.2253	12	0.1055
5	0.2070	13	0.0915
6	0.1920	14	0.0800
7	0.1770		

### 3. BENDING

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

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

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

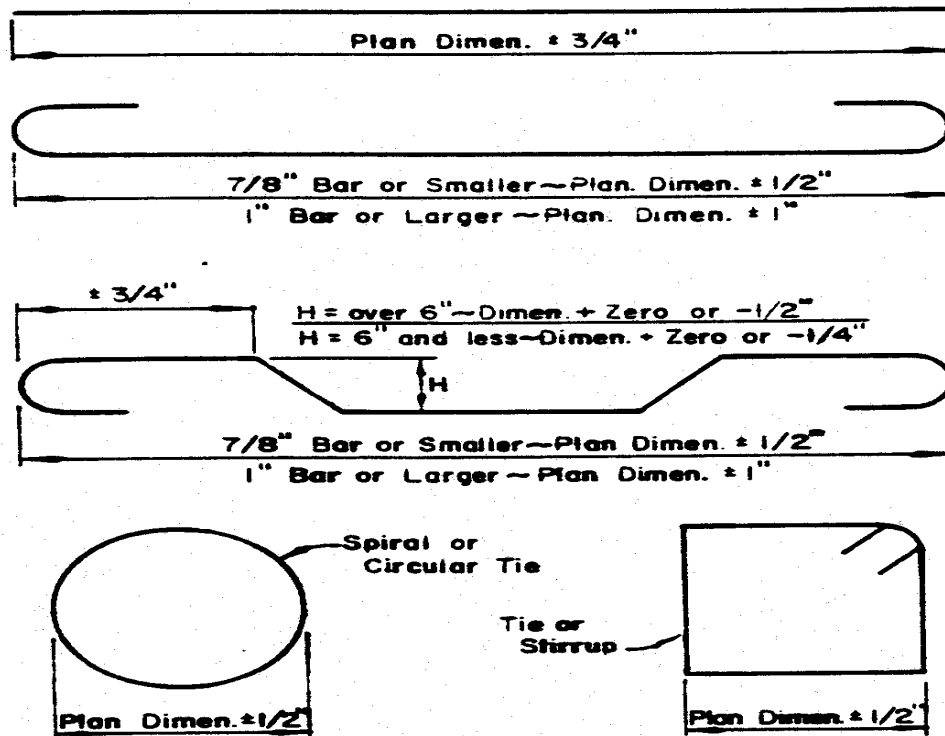
	<u>Grade 60</u>
#3, #4, #5	4d
#6, #7, #8	5d

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

	<u>Grade 60</u>	<u>Grade 75</u>
#3 thru #8	6d	--
#9, #10	8d	--
#11	8d	8d
#14, #18	10d	--

#### 4. TOLERANCES

Fabricating tolerances for bars shall be within 3 percent of specified or as follows:



#### 5. STORING

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

#### 6. SPLICES

No splicing of bars, except when provided on the plans or specified herein, will be permitted without written approval of the Engineer.

Spllices will not be permitted in main reinforcement at points of maximum stress. When permitted in main bars, spllices in adjacent bars shall be staggered a minimum of two splice lengths.

TABLE 1  
Minimum Lap Requirements

<u>Lap</u>		<u>Uncoated</u>	<u>Coated</u>
Lap in inches	≥	40d	60d

Where: d = bar diameter in inches

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

End preparation for butt welding reinforcing bars shall be done in the field. Delivered bars shall be of sufficient length to permit this practice.

For box culvert extensions with less than one foot of fill, the existing longitudinal bars shall have a 20-diameter lap with the new bars. For box culvert extensions with more than one foot of fill, a minimum of 6 inches lap will be required.

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

## 7. PLACING

Reinforcement shall be placed as near as possible in the position shown on the plans. Unless otherwise shown on the plans, dimensions shown for reinforcement are to the centers of the bars. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than one-twelfth of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than one-quarter inch. Cover of concrete to the nearest surface of steel shall meet the above requirements but shall never be less than one inch or as otherwise shown on the plans.

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

All reinforcing steel shall be tied at all intersections, except that where spacing is less than one foot in each direction, alternate intersections only need be tied.

Before any concrete is placed, all mortar shall be cleaned from the reinforcement. Precast mortar or concrete blocks to be used for holding steel in position adjacent to formed surfaces shall be cast in molds meeting the approval of the Engineer and shall be cured by covering with wet burlap or cotton



mats for a period of 72 hours.

The blocks shall be cast in the form of a frustum of a cone or pyramid with the smaller face placed against the forms.

A suitable tie wire shall be provided in each block, to be used for anchoring to the steel. Except in unusual cases, and when specifically otherwise authorized by the Engineer, the size of the surface to be placed adjacent to the forms shall not exceed two and one-half inches square or the equivalent thereof in cases where circular or rectangular areas are provided. Blocks shall be cast accurately to the thickness required, and the surface to be placed adjacent to the forms shall be a true plane free of surface imperfections.

Reinforcement shall be supported and tied in such manner that a sufficiently rigid case of steel is provided. If the cage is not adequately supported to resist settlement or floating upward of the steel, overturning of truss bars or movement in any direction during concrete placement, permission to continue concrete placement will be withheld until corrective measures are taken. Sufficient measurements shall be made during concrete placement to insure compliance with the first paragraph of Article 7 of this specification.

Mats of wire fabric shall overlap each other sufficiently to maintain a uniform strength and shall be fastened securely at the ends and edges.

No concrete shall be deposited until the Engineer has inspected the placement of the reinforcing steel and given permission to proceed.

#### 8. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, reinforcing steel is considered subsidiary to the various items shown in the Bid Form and shall not be measured and paid for as a separate item.

SECTION 37040  
EPOXY COMPOUNDS (S-44)

1. DESCRIPTION

This specification shall govern all work necessary to provide and apply Epoxy compounds.

2. MATERIALS (USE - TYPE)

- (1) Epoxy Bonding Compound for bonding new concrete to hardened concrete or other structural material: Epoxy Bonding Compound shall be a two component, 100% solids, moisture insensitive system. Epoxy shall be "FX-752 Bonding Agent" as manufactured by Fox Industries Inc. of Baltimore, Maryland or "Sikastix 370, Sikadur Hi-Mod" as manufactured by Sika Chemical Corporation of Lyndhurst, New Jersey or approved equal.
- (2) Epoxy Grout for Epoxy patch on non-horizontal surfaces to concrete: Epoxy Compound shall be a low-modulus, high viscosity, moisture insensitive system. Epoxy shall be "Sikastix 360, Skadur Lo-Mod Gel" as manufactured by Sika Chemical Corporation, or approved equal.

3. CONSTRUCTION METHODS

- (1) Bond new concrete to existing concrete:
  - a. Surface Preparation: The existing concrete or structural surface to which the new concrete is to be bonded shall be cleaned. The existing surface shall be made free from dust, laitance, grease, curing compounds, waxes and all foreign material. Cleaning shall be done by sandblasting, mechanical abrasion, or (by washing only if authorized by the Engineer). During application of bonding compound, surface may be dry, moist, or wet, but surface shall be free of standing water.
  - b. Proportioning and Mixing: The epoxy shall be proportioned and mixed in strict accordance with the manufacturers instructions. The epoxy shall be used in a neat condition (without aggregate filler).
  - c. Application of Epoxy: The epoxy bonding compound shall be applied to the prepared surface with the minimum allowable coverages as follows:

Concrete (float finished, cleaned by washing) 75 SF/gal

Concrete (rough finish, cleaned by sandblast or mechanical abrasion) 50 SF/gal

Other surfaces as specified on the drawings
  - d. Concrete Overlay: The concrete overlay shall be in accordance with the drawings or 030020 of standard specifications. The concrete overlay shall be applied over the epoxy within a period of time which SHALL NOT EXCEED 60% of the tack free time of the epoxy. It is important for the Contractor to note that these times vary with the temperature and pot time. The following allowable times (60% of tack free time, where the tack free time is the period of time from initial mixing of the two components until the thin film of epoxy hardens) are provided below. The allowable times must be

determined from the tack free times which are provided by the manufacturer. The following allowable times are averages and provided only as an aid to the Contractor:

Temperature	Allowable Elapse Time from Mixing Epoxy Until Placing Concrete Overlay
90°F	40 min.
80°F	12 hrs.
70°F	22 hrs.
60°F	32 hrs.

If the allowable period of time is allowed to elapse before concrete overlay can be placed, another layer of epoxy shall be applied prior to placement of the concrete.

(2) Epoxy Grout for patch to non-horizontal surfaces to concrete:

- a. Surface Preparation: The surface shall be prepared as described in (1) Bond new concrete to existing concrete Part a.
- b. Proportioning and Mixing: The epoxy shall be proportioned and mixed in strict accordance with the manufacturer instruction. The epoxy may be mixed with dry masonry sand. Sand shall conform to A.S.T.M. C-144 with 100% passing a No. 8 sieve and not more than 15% to 35% passing a No. 50 mesh sieve. The amount of sand filler shall not exceed 3/4 to 1 (loose sand to epoxy by volume).
- c. Application: Epoxy shall be applied in strict accordance with manufacturer instructions. Area adjacent to work shall be cleaned free of epoxy spills as to provide a neat appearance before work will be accepted.

#### 4. GENERAL PRECAUTION

The Contractor is advised to become familiar with type of epoxy, method of application, and its basic limitations prior to using the epoxy.

#### 5. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Epoxy Compounds shall be considered subsidiary to the appropriate bid item.

SECTION 038000  
CONCRETE STRUCTURES

1. DESCRIPTION

This specification shall govern for construction of all types of structures involving the use of structural concrete, except where the requirements are waived or revised by other governing specifications.

All concrete structures shall be constructed in accordance with the design requirements and details shown on the plans; in conformity with the pertinent provisions of the items contracted for; the incidental specifications referred to; and in conformity with the requirements herein.

2. MATERIALS

(1) Concrete. All concrete shall conform to the provisions of City Standard Specification Section 030020 "Portland Cement Concrete".

The class of concrete for each type of structure or unit shall be as specified on the plans or by pertinent governing specifications.

(2) Expansion Joint Material.

(a) Preformed Fiber Material. Preformed fiber expansion joint material shall be of the dimensions shown on the plans. The material shall be one of the following types, unless otherwise noted on the plans:

1. Preformed Bituminous Fiber Materials shall meet the requirements of ASTM Designation: D1751 "Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)".
2. Preformed Non-Bituminous Fiber Material shall meet the requirements of ASTM Designation: D1751 "Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)", except that the requirements pertaining to bitumen content, density and water absorption shall be voided.

3. Redwood.

(b) Joint Sealing Materials. Unless otherwise shown on the drawings, joint sealing material shall conform to the following requirements. The material shall adhere to the sides of the concrete joint or crack and shall form an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperatures.

1. Class 1-a. (Two-Component, Synthetic Polymer, Cold-Extruded Type). Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles. This type is specifically designed for vertical or sloping joints and hence not self-leveling. It shall cure sufficiently at an average temperature of 77 degrees F  $\pm$  3 degrees F in a maximum of 24 hours. For performance requirements see under 2.(2)(b)2. below.
2. Class 1-b. (Two-Component, Synthetic Polymer, Cold-Pourable, Self-Leveling Type). Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles. It shall cure sufficiently at an average temperature of 77 degrees F  $\pm$  3 degrees F in a maximum of 3 hours.

Performance Requirements: Class 1-a and Class 1-b joint materials, when tested in accordance with TxDOT Test Method Tex-525-C, shall meet the above curing times and the following requirements:

It shall be of such consistency that it can be mixed and poured, or mixed and extruded into joints at temperatures above 60 degrees F.

Penetration, 77° F.:	
150 gm. cone, 5 sec., max., cm.....	0.90
Bond and Extension 75%, O° F, 5 cycles:	
Dry Concrete Blocks.....	Pass
Wet Concrete Blocks.....	Pass
Steel Blocks...(Primed if specified by manuf.).	Pass
Flow at 200° F.....	None
Water Content % by weight, max.....	5.0
Resilience:	
Original sample min. % (cured).....	50
Oven aged at 158° F min. % .....	50
For Class 1-a Material Only:	
Cold Flow (10 min.).....	None

(c) Asphalt Board. Asphalt Board shall consist of two liners of 0.016-inch asphalt impregnated paper, filled with a mastic mixture of asphalt and vegetable fiber and/or mineral filler. Boards shall be smooth, flat and sufficiently rigid to permit installation. When tested in accordance with TxDOT Test Method Tex-524-C, the asphalt board shall not deflect from the horizontal more than one inch in three and one-half inches (1" in 3½").

(d) Rebonded Neoprene Filler. Rebonded neoprene filler shall consist of ground closed-cell neoprene particles, rebonded and molded into sheets of uniform thickness, of the dimensions shown on plans.

Filler material shall have the following physical properties and shall meet the requirements of ASTM Designation: D1752 "Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction", Type 1, where applicable:

<u>PROPERTY</u>	<u>METHOD</u>	<u>REQUIREMENT</u>
Color	ASTM D1752, Type 1	Black
Density	ASTM D1752, Type 1	40 lb./ft <sup>3</sup> Min.
Recovery	ASTM D1752, Type 1	90% Min.
Compression	ASTM D1752, Type 1	50 to 500 psi
Extrusion	ASTM D1752, Type 1	0.25 inch Max.
Tensile Strength	ASTM D1752, Type 1	20 psi Min.
Elongation		75% Min.

The manufacturers shall furnish the Engineer with certified test results as to compliance with the above requirements and a 12 inch x 12 inch x 1 inch sample from the shipment for approval.

(3) Curing Materials.

(a) Membrane curing materials shall comply with ASTM Designation: C 309 "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete", Type 1 clear or translucent, or Type 2 white-pigmented. The material shall have a minimum flash-point of 80 degrees F when tested by the "Pensky-Martin Closed Cup Method".

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

It shall be of such nature that it will not produce permanent discoloration of concrete surfaces nor react deleteriously with the concrete or its components. Type 1 compound shall contain a fugitive dye that will be distinctly visible not less than 4 hours nor more than 7 days after application. The compound shall produce a firm, continuous, uniform moisture impermeable film free from pinholes and shall adhere satisfactorily to the surfaces of damp concrete. It shall, when applied to the damp concrete surface at the rate of coverage specified herein, be dry to the touch in not more than 4 hours, and shall adhere in a tenacious film without running off or appreciable sagging. It shall not disintegrate, check, peel or crack during the required curing period.

The compound shall not peel or pick up under traffic and shall disappear from the surface of the concrete by gradual disintegration.

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

The water retention test shall be in accordance with TxDOT Test Method Tex-219-F. Percentage loss shall be defined as the water lost after the application of the curing material was applied. The permissible percentage moisture loss (at the rate of coverage specified herein) shall not exceed the

following:

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

Type 1 (Resin Base Only) curing compound will be permitted for slab concrete in bridge decks and top slabs of direct traffic culverts.

(b) Mat curing of concrete is allowed where permitted by Table 1 in this specification or where otherwise approved by the Engineer.

### 3. EXPANSION JOINTS

Joints and devices to provide for expansion and contraction shall be constructed where and as indicated herein or on the plans.

All open joints and joints to be filled with expansion joint material, shall be constructed using forms adaptable to loosening or early removal. To avoid expansion or contraction damage to the adjacent concrete, these forms shall be loosened as soon as possible after final concrete set to permit free movement without requiring full form removal.

Prior to placing the sealing material, the vertical facing the joint shall be cleaned of all laitance by sandblasting or by mechanical routing. Cracked or spalled edges shall be repaired. The joint shall be blown clean of all foreign material and sealed. Where preformed fiber joint material is used, it shall be anchored to the concrete on one side of the joint by light wire or nails, to prevent the material from falling out. The top one inch (1") of the joint shall be filled with joint sealing material.

Finished joints shall conform to the indicated outline with the concrete sections completely separated by the specified opening or joint material.

Soon after form removal and again where necessary after surface finishing, all projecting concrete shall be removed along exposed edges to secure full effectiveness of the expansion joints.

### 4. CONSTRUCTION JOINTS

The joint formed by placing plastic concrete in direct contact with concrete that has attained its initial set shall be deemed a construction joint. The term "monolithic placement" shall be interpreted to mean at the manner and sequence of concrete placing shall not create construction joints.

Construction joints shall be of the type and at the locations shown on the plans. Additional joints will not be permitted without written authorization from the Engineer, and when authorized, shall have details equivalent to those shown on the plans for joints in similar locations.

Unless otherwise provided, construction joints shall be square and normal to the forms. Bulkheads shall be provided in the forms for all joints, except when horizontal.

Construction joints requiring the use of joint sealing material shall be as detailed on the plans. The

material will be specified on the plans without referenced to joint type.

A concrete placement terminating at a horizontal construction joint shall have the top surface roughened thoroughly as soon as practicable after initial set is attained. The surfaces at bulkheads shall be roughened as soon as the forms are removed.

The hardened concrete surface shall be thoroughly cleaned of all loose material, laitance, dirt or foreign material, and saturated with water so it is moist when placing fresh concrete against it. Forms shall be drawn tight against the placing of the fresh concrete.

## 5. FORMS

(1) General. Except where otherwise specified, forms may be of either timber or metal.

Forms for round columns exposed to view shall be of steel, except that other materials will be allowed with written permission of the Engineer.

Forming plans shall be submitted to the Engineer for approval as specified. Forms shall be designed for the pressure exerted by a liquid weighing 150 pounds per cubic foot. The rate of placing the concrete shall be taken into consideration in determining the depth of the equivalent liquid. For job fabricated forms, an additional live load of 50 pounds per square foot shall be allowed on horizontal surfaces. The maximum unit stresses shall not exceed 125 percent of the allowable stresses used by the Texas Department of Transportation for the design of structures.

Commercially produced structural units used in formwork shall not exceed the manufacturer's maximum allowable working load for moment, shear or end reaction. The maximum working load shall include a live load of 35 pounds per square foot of horizontal form surface, and sufficient details and data shall be submitted for use in checking formwork details for approval.

Forms shall be practically mortar-tight, rigidly braced and strong enough to prevent bulging between supports, and maintained to the proper line and grade during concrete placement. Forms shall be maintained in a manner that will prevent warping and shrinkage.

Offset at form joints shall not exceed one-sixteenth of an inch (1/16").

Deflections due to cast-in-place slab concrete and railing shown in the dead load deflection diagram shall be taken into account in the setting of slab forms.

All forms and footing areas shall be cleaned of any extraneous matter before placing concrete.

Permission to place concrete will not be given until all such work is completed to the satisfaction of the Engineer.

If, at any stage of the work, the forms show signs of bulging or sagging, the portion of the concrete causing such condition shall be removed immediately, if necessary, and the forms shall be reset and securely braced against further movement.



(2) Timber Forms. Lumber for forms shall be properly seasoned, of good quality, and free from imperfections which would affect its strength or impair the finished surface of the concrete. The lumber used for facing or sheathing shall be finished on at least one side and two edges and shall be sized to uniform thickness.

Form lining will be required for all formed surfaces, except for the inside of culvert barrels, inlets and manholes; surfaces that are subsequently covered by backfill material or are completely enclosed; and, any surface formed by a single finished board. Lining will not be required when plywood forms are used.

Form lining shall be of an approved type such as Masonite or plywood. Thin membrane sheeting, such as polyethylene sheets, shall not be used for form lining.

Forms may be constructed of plywood not less than one-half inch in thickness, with no form lining required. The grain of the face plies on plywood forms shall be placed parallel to the span between the supporting studs or joists.

Plywood used for forming surfaces that remain exposed shall be equal to that specified as B-B Plyform Class I or Class II Exterior, of the U. S. Department of Commerce, National Bureau of Standards and Technology, latest edition.

Forms or form lumber to be reused shall be maintained clean and in good condition. Any lumber which is split, warped, bulged, marred, or has defects that will produce inferior work, shall not be used and, if condemned, shall be promptly removed from the work.

Studs and joists shall be spaced so that the facing form material remains in true alignment under the imposed loads.

Wales shall be spaced close enough to hold forms securely to the designated lines and scabbed at least 4 feet on each side of joints to provide continuity. A row of wales shall be placed near the bottom of each placement.

Facing material shall be placed with parallel and square joints and securely fastened to supporting studs.

Forms for surfaces receiving only an ordinary finish and exposed to view shall be placed with the form panels symmetrical, i.e., long dimensions set in the same direction. Horizontal joints shall be continuous.

Molding specified for chamfer strips or other uses shall be made of materials of a grade that will not split when nailed and which can be maintained to a true line without warping. Wood molding shall be mill cut and dressed on all faces. Unless otherwise provided, forms shall be filleted at all sharp corners and edges with triangular chamfer strips measuring three-quarter inch (3/4") on the sides.

Forms for railing and ornamental work shall be constructed to standards equivalent to first-class millwork. All moldings, panel work and bevel strips shall be straight and true with nearly mitered joints designed so the finished work is true, sharp and clean cut.

All forms shall be constructed to permit their removal without marring or damaging the concrete. The forms may be given a slight draft to permit ease of removal.

Metal form ties of an approved type or a satisfactory substitute shall be used to hold forms in place and shall be of a type that permits ease of removal of the metal as hereinafter specified.

All metal appliances used inside of forms for alignment purposes shall be removed to a depth of at least one-half inch (1/2") from the concrete surface. They shall be made so the metal may be removed without undue chipping or spalling, and when removed, shall leave a smooth opening in the concrete surface. Burning off of rods, bolts or ties will not be permitted.

Any wire ties used shall be cut back at least one-half inch (1/2") from the face of the concrete.

Devices holding metal ties in place shall be capable of developing the strength of the tie and adjustable to allow for proper alignment.

Metal and wooden spreaders which are separate from the forms shall be removed entirely as the concrete is being placed.

Adequate clean-out openings shall be provided for narrow walls and other locations where access to the bottom of the forms is not readily attainable.

Prior to placing concrete, the facing of all forms shall be treated with oil or other bond breaking coating of such composition that it will not discolor or otherwise injuriously affect the concrete surface. Care shall be exercised to prevent coating of the reinforcing steel.

(3) Metal Forms. The foregoing requirements for timber forms regarding design, mortar-tightness, filleted corners, beveled projections, bracing, alignment, removal, reuse and wetting shall also apply to metal forms, except that these will not require lining, unless specifically noted on the plans.

The thickness of form metal shall be as required to maintain the true shape without warping or bulging. All bolt and rivet heads on the facing sides shall be countersunk. Clamps, pins or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or line up properly shall not be used. Metal shall be kept free from rust, grease or other foreign materials.

## 6. PLACING REINFORCEMENT

Reinforcement in concrete structures shall be placed carefully and accurately and rigidly supported as provided in the City Standard Specification Section 032020 "Reinforcing Steel". Reinforcing steel supports shall not be welded to I-beams or girders.

## 7. PLACING CONCRETE-GENERAL

The minimum temperature of all concrete at the time of placement shall be not less than 50 degrees F.

The consistency of the concrete as placed should allow the completion of all finishing operations without the addition of water to the surface. When conditions are such that additional moisture is needed for finishing, the required water shall be applied to the surface by fog spray only, and shall be held to a minimum amount. Fog spray for this purpose may be applied with hand operated fogging equipment.

The maximum time interval between the addition of cement to the batch and the placing of concrete in the forms shall not exceed the following:

<u><b>Air or Concrete Temperature</b></u>	<u><b>Maximum Time</b></u>
<u><b>Non-Agitated Concrete:</b></u>	
Above 80 degrees F	15 minutes
Up to 80 degrees F	30 minutes
<u><b>Agitated Concrete:</b></u>	
Above 90 degrees F	45 minutes
75 degrees F to 90 degrees F	60 minutes
35 degrees F to 74 degrees F	90 minutes

The use of an approved retarding agent in the concrete will permit the extension of each of the above temperature-time maximums by 30 minutes for direct traffic culverts, and one hour for all other concrete except that the maximum time shall not exceed 30 minutes for non-agitated concrete.

Before starting work, the Contractor shall inform the Engineer fully of the construction methods he proposes to use, the adequacy of which shall be subject to the approval of the Engineer.

The Contractor shall give the Engineer sufficient advance notice before placing concrete in any unit of the structure to permit the inspection of forms, reinforcing steel placement, and other preparations. Concrete shall not be placed in any unit prior to the completion of formwork and placement of reinforcement therein.

Concrete mixing, placing and finishing shall be done during daylight hours, unless adequate provisions are made to light the entire site of all operations.

Concrete placement will not be permitted when impending weather conditions will impair the quality of the finished work. If rainfall should occur after placing operations are started, the Contractor shall provide ample covering to protect the work. In case of drop in temperature, the provisions set forth in Article "Placing Concrete in Cold Weather" of this specification shall be applied.

The placing of concrete shall be regulated so the pressures caused by the plastic concrete shall not exceed the loads used in form design.

The method of handling, placing and consolidation of concrete shall minimize segregation and displacement of the reinforcement, and produce a uniformly dense and compact mass. Concrete shall not have a free fall of more than 5 feet, except in the case of thin walls such as in culverts. Any hardened concrete spatter ahead of the plastic concrete shall be removed.

The method and equipment used to transport concrete to the forms shall be capable of maintaining the rate of placement approved by the Engineer. Concrete may be transported by buckets, chutes, buggies, belt conveyors, pumps or other acceptable methods.

When belt conveyors or pumps are used, sampling for testing will be done at the discharge end. Concrete transported by conveyors shall be protected from sun and wind, if necessary, to prevent loss of slump and workability. Pipes through which concrete is pumped shall be shaded and/or wrapped with wet burlap, if necessary, to prevent loss of slump and workability. Concrete shall not be transported through aluminum pipes, tubes or other aluminum equipment.

Chutes, troughs, conveyors or pipes shall be arranged and used so that the concrete ingredients will not be separated. When steep slopes are necessary, the chutes shall be equipped with baffle boards or made in short lengths that reverse the direction of movement, or the chute ends shall terminate in vertical downspouts. Open troughs and chutes shall extend, if necessary, down inside the forms or through holes left in them. All transporting equipment shall be kept clean and free from hardened concrete coatings. Water used for cleaning shall be discharged clear of the concrete.

Each part of the forms shall be filled by depositing concrete as near its final position as possible. The coarse aggregate shall be worked back from the face and the concrete forced under and around the reinforcement bars without displacing them. Depositing large quantities at one point and running or working it along the forms will not be allowed.

Concrete shall be deposited in the forms in layers of suitable depth but not more than 36 inches in thickness, unless otherwise directed by the Engineer.

The sequence of successive layers or adjacent portions of concrete shall be such that they can be vibrated into a homogenous mass with the previously placed concrete without a cold joint. Not more than one hour shall elapse between adjacent or successive placements of concrete. Unauthorized construction joints shall be avoided by placing all concrete between the authorized joints in one continuous operation.

An approved retarding agent shall be used to control stress cracks and/or unauthorized cold joints in mass placements where differential settlement and/or setting time may induce stress cracking.

Openings in forms shall be provided, if needed, for the removal of laitance of foreign matter of any kind.

All forms shall be wetted thoroughly before the concrete is placed therein.

All concrete shall be well consolidated and the mortar flushed to the form surfaces by continuous working with immersion type vibrators. Vibrators which operate by attachment to forms or reinforcement will not be permitted, except on steel forms. At least one stand-by vibrator shall be

provided for emergency use in addition to those required for placement.

The concrete shall be vibrated immediately after deposit. Prior to the beginning of work, a systematic spacing of the points of vibration shall be established to insure complete consolidation and thorough working of the concrete around the reinforcement, embedded fixtures, and into the corners and angles of the forms. Immersion type vibrators shall be inserted vertically, at points 18 to 30 inches apart, and slowly withdrawn. The vibrator may be inserted in a sloping or horizontal position in shallow slabs. The entire depth of each lift shall be vibrated, allowing the vibrator to penetrate several inches into the preceding lift. Concrete along construction joints shall be thoroughly consolidated by operating the vibrator along and close to but not against the joint surface. The vibration shall continue until thorough consolidation, and complete embedment of reinforcement and fixtures is produced, but not long enough to cause segregation. Vibration may be supplemented by hand spading or rodding, if necessary, to insure the flushing of mortar to the surface of all forms.

Slab concrete shall be mixed in a plant located off the structure. Carting or wheeling concrete batches over completed slabs will not be permitted until they have aged at least four (4) full curing days. If carts are used, timber planking will be required for the remainder of the curing period. Carts shall be equipped with pneumatic tires. Curing operations shall not be interrupted for the purpose of wheeling concrete over finished slabs.

After concrete has attained its initial set, at least one (1) curing day shall elapse before placing strain on projecting reinforcement to prevent damage to the concrete.

The storing of reinforcing or structural steel on completed roadway slabs generally shall be avoided and, when permitted, shall be limited to quantities and distribution that will not induce excessive stresses.

## 8. PLACING CONCRETE IN COLD WEATHER

(1) Cast-in-Place Concrete. Concrete may be placed when the atmospheric temperature is not less than 35 degrees F. Concrete shall not be placed in contact with any material coated with frost or having a temperature less than 32 degrees F.

Aggregates shall be free from ice, frost and frozen lumps. When required, in order to produce the minimum specified concrete temperature, the aggregate and/or the water shall be heated uniformly, in accordance with the following:

The water temperature shall not exceed 180 degrees F, and/or the aggregate temperature shall not exceed 150 degrees F. The heating apparatus shall heat the mass of aggregate uniformly. The temperature of the mixture of aggregates and water shall be between 50 degrees F and 85 degrees F before introduction of the cement.

All concrete shall be effectively protected as follows:

(a) The temperature of slab concrete of all unformed surfaces shall be maintained at 50 degrees F or above for a period of 72 hours from time of placement and above 40 degrees F for an additional 72 hours.

(b) The temperature at the surface of all concrete in piers, culverts walls, retaining walls, parapets, wingwalls, bottoms of slabs, and other similar formed concrete shall be maintained at 40 degrees F or above for a period of 72 hours from time of placement.

(c) The temperature of all concrete, including the bottom slabs of culverts placed on or in the ground, shall be maintained above 32 degrees 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 covering with artificial heating. Curing as specified under Article "Curing Concrete" of this specification shall be provided during this period until all requirements for curing have been satisfied.

When impending weather conditions indicate the possibility of the need for such temperature protection, all necessary heating and covering material shall be on hand ready for use before permission is granted to begin placement.

Sufficient extra test specimens will be made and cured with the placement to ascertain the condition of the concrete as placed, prior to form removal and acceptance.

(2) Precast Concrete. A fabricating plant for precast products which has adequate protection from cold weather in the form of permanent or portable framework and covering, which protects the concrete when placed in the forms, and is equipped with approved steam curing facilities, may place concrete under any low temperature conditions provided:

(a) The framework and covering are placed and heat is provided for the concrete and the forms within one hour after the concrete is placed. This shall not be construed to be one hour after the last concrete is placed, but that no concrete shall remain unprotected longer than one hour.

(b) Steam heat shall keep the air surrounding the concrete between 50 degrees F and 85 degrees F for a minimum of three hours prior to beginning the temperature rise which is required for steam curing.

(c) For fabricating plants without the above facilities and for job site precast products, the requirements of the Article "Curing Concrete" of this specification shall apply.

The Contractor is responsible for the protection of concrete placed under any and all weather conditions. Permission given by the Engineer for placing concrete during freezing weather will in no way relieve the Contractor of the responsibility for producing concrete equal in quality to that placed under normal conditions. Should concrete placed under such conditions prove unsatisfactory, it shall be removed and replaced at no additional cost.

## 9. PLACING CONCRETE IN WATER

Concrete shall be deposited in water only when specified on the plans or with written permission by the Engineer. The forms or cofferdams shall be sufficiently tight to prevent any water current passing through the space in which the concrete is being deposited. Pumping will not be permitted during the concrete placing, nor until it has set for at least 36 hours.

The concrete shall be placed with a tremie, closed bottom-dump bucket, or other approved method, and shall not be permitted to fall freely through the water nor shall it be disturbed after it has been placed. The concrete surface shall be kept approximately level during placement.

The tremie shall consist of a water-tight tube 14 inches or less in diameter. It shall be constructed so that the bottom can be sealed and opened after it is in place and fully charged with concrete. It shall be supported so that it can be easily moved horizontally to cover all the work area and vertically to control the concrete flow.

Bottom-dump buckets used for underwater placing shall have a capacity of not less than one-half cubic yard. It shall be lowered gradually and carefully until it rests upon the concrete already placed and raised very slowly during the upward travel; the intent being to maintain still water at the point of discharge and to avoid agitating the mixture.

The placing operations shall be continuous until the work is complete.

## 10. PLACING CONCRETE IN BOX CULVERTS

In general, construction joints will be permitted only where shown on the plans.

Where the top slab and walls are placed monolithically in culverts more than 4 feet in clear height, an interval of not less than one (1) nor more than two (2) hours shall elapse before placing the top slab to allow for shrinkage in the wall concrete.

The base slab shall be finished accurately at the proper time to provide a smooth uniform surface. Top slabs which carry direct traffic shall be finished as specified for roadway slabs in Article "Finish of Roadway Slabs". Top slabs of fill type culverts shall be given a reasonably smooth float finish.

## 11. PLACING CONCRETE IN FOUNDATIONS AND SUBSTRUCTURE

Concrete shall not be placed in footings until the depth and character of the foundation has been inspected by the Engineer and permission has been given to proceed.

Placing of concrete footings upon seal concrete courses will be permitted after the caissons or cofferdams are free from water and the seal concrete course cleaned. Any necessary pumping or bailing during the concreting operation shall be done from a suitable sump located outside the forms.

All temporary wales or braces inside cofferdams or caissons shall be constructed or adjusted as the work proceeds to prevent unauthorized construction joints in footings or shafts.

When footings can be placed in a dry excavation without the use of cofferdams or caissons, forms may be omitted, if desired by the Contractor and approved by the Engineer, and the entire excavation filled with concrete to the elevation of the top of footing; in which case, measurement for payment will be based on the footing dimensions shown on the plans.

## 12. TREATMENT AND FINISHING OF HORIZONTAL SURFACES EXCEPT ROADWAY SLABS

All unformed upper surfaces shall be struck off to grade and finished. The use of mortar topping for surfaces under this classification will not be permitted.

After the concrete has been struck off, the surface shall be floated with a suitable float. Sidewalks shall be given a wood float or broom finish, or may be striped with a brush, as specified by the Engineer. Other surfaces shall be wood float finished and striped with a fine brush leaving a fine-grained texture.

## 13. FINISH OF ROADWAY SLABS

As soon as the concrete has been placed and vibrated in a section of sufficient width to permit working, the surface shall be approximately leveled, struck off and screeded, carrying a slight excess of concrete ahead of the screed to insure filling of all low spots. The screed shall be designed rigid enough to hold true to shape and shall have sufficient adjustments to provide for the required camber. A vibrating screed may be used if heavy enough to prevent undue distortion. The screeds shall be provided with a metal edge.

Longitudinal screeds shall be moved across the concrete with a saw-like motion while their ends rest on headers or templates set true to the roadway grade or on the adjacent finished slab.

The surface of the concrete shall be screeded a sufficient number of times and at such intervals to produce a uniform surface, true to grade and free of voids.

If necessary, the screeded surface shall be worked to smooth finish with a long handled wood or metal float of the proper size, or hand floated from bridges over the slab.

When required by the Engineer, the Contractor shall perform sufficient checks with a long handled 10-foot straightedge on the plastic concrete to insure that the final surface will be within the tolerances specified below. The check shall be made with the straightedge parallel to the centerline. Each pass thereof shall lap half of the preceding pass. All high spots shall be removed and all depressions over one-sixteenth inch (1/16") in depth shall be filled with fresh concrete and floated. The checking and floating shall be continued until the surface is true to grade and free of depressions, high spots, voids or rough spots.

Rail support holes shall be filled with concrete and finished to match the top of the slab.

### Surface Texturing.

Perform surface texturing using a either carpet drag or metal tining as indicated on the drawings. Complete final texturing before the concrete has attained its initial set. Draw the carpet drag



longitudinally along the pavement surface with the carpet contact surface area adjusted to provide a satisfactory coarsely textured surface. A metal-tine texture finish is required using a tining machine unless otherwise shown on the plans. Provide the metal-tine finish immediately after the concrete surface has set enough for consistent tining. Operate the metal-tine device to obtain grooves spaced at 1 in., approximately 3/16 in. deep, with a minimum depth of 1/8 in., and approximately 1/12 in. wide. Do not overlap a previously tined area. Use manual methods for achieving similar results on ramps and other irregular sections of pavements. Repair damage to the edge of the slab and joints immediately after texturing. Do not tine pavement that will be overlaid.

Upon completion of the floating and/or straight edging and before the disappearance of the moisture sheen, the surface shall be given a broom or burlap drag finish. The grooves of these finishes shall be parallel to the structure centerline. It is the intent that the average texture depth resulting from the number of tests directed by the Engineer be not less than 0.035 inch with a minimum texture depth of 0.030 inch for any one test when tested in accordance with TxDOT Test Method Tex-436-A. Should the texture depth fall below that intended, the finishing procedures shall be revised to produce the desired texture.

After the concrete has attained its final set, the roadway surface shall be tested with a standard 10-foot straightedge. The straightedge shall be placed parallel to the centerline of roadway to bridge any depressions and touch high spots. Ordinates of irregularities measured from the face of the straightedge to the surface of the slab shall not exceed one-eighth of an inch (1/8"), making proper allowances for camber, vertical curvature and surface texture. Occasional variations, not exceeding three-sixteenth of an inch (3/16") will be acceptable, if in the opinion of the Engineer it will not affect the riding qualities.

When directed by the Engineer, irregularities exceeding the above requirements shall be corrected.

In all roadway slab finishing operations, camber for specified vertical curvature and transverse slopes shall be provided.

#### 14. CURING CONCRETE

The Contractor shall inform the Engineer fully of the methods and procedures proposed for curing; shall provide the proper equipment and material in adequate amounts; and shall have the proposed methods, equipment and material approved prior to placing concrete.

Inadequate curing and/or facilities, therefore, shall be cause for the Engineer to stop all construction on the job until remedial action is taken. All concrete shall be cured for a period of four (4) curing days except as noted herein.

## EXCEPTIONS TO 4-DAY CURING

<u>Description</u>	<u>Required Curing</u>
Upper Surfaces of Bridge Slabs and Top Slabs of Direct Traffic Culverts	8 curing days (Type I or III) cement 10 curing days (Type II cement)
Concrete Piling (non-prestressed)	6 curing days

When the air temperature is expected to drop below 35 degrees F, the water curing mats shall be covered with polyethylene sheeting, burlap-polyethylene blankets or other material to provide the protection required by Article "Placing Concrete in Cold Weather" of these specifications.

A curing day is defined as a calendar day when the temperature, taken in the shade away from artificial heat, is above 50 degrees F for at least 19 hours (colder days if satisfactory provisions are made to maintain the temperature of all surfaces of the concrete above 40 degrees F for the entire 24 hours). The required curing period shall begin when all concrete therein has attained its initial set.

The following methods are permitted for curing concrete subject to the restrictions of Table 1 and the following requirements for each method of curing.

(1) Form Curing. When forms are left in contact with the concrete, other curing methods will not be required except for cold weather protection.

(2) Water Curing. All exposed surfaces of the concrete shall be kept wet continuously for the required curing time. The water used for curing shall meet the requirements for concrete mixing water as specified in the specification Section 030020 "Portland Cement Concrete". Seawater will not be permitted. Water which stains or leaves an unsightly residue shall not be used.

(a) Wet Mat. Cotton mats shall be used for this curing method. They shall be placed as soon as possible after the surface has sufficiently hardened to prevent damage to the concrete. (See Article, "Placing Concrete" of this specification.) Damp burlap blankets made from nine-ounce stock may be placed on the damp concrete surface for temporary protection prior to the application of the cotton mats which may be placed dry and wetted down after placement.

The mats shall be weighted down adequately to provide continuous contact with all concrete surfaces where possible. The surfaces of the concrete shall be kept wet for the required curing time. Surfaces which cannot be cured by contact shall be enclosed with mats and anchored positively to the forms or to the ground so that outside air cannot enter the enclosure. Sufficient moisture shall be provided inside the enclosure to keep all surfaces of the concrete wet.

(b) Water Spray. This curing method shall consist of overlapping sprays or sprinklers that keep all unformed surfaces continuously wet.

(c) Ponding. This curing method requires the covering of the surfaces with a minimum of two inches (2") of clean granular material, kept wet at all times, or a minimum of one-inch

(1”) depth of water. Satisfactory provisions shall be made to provide a dam to retain the water or saturated granular material.

(3) Membrane Curing. This consists of curing concrete pavement, concrete pavement (base), curbs, gutters, retards, sidewalks, driveways, medians, islands, concrete riprap, cement-stabilized riprap, concrete structures and other concrete as indicated on the plans by impervious membrane method.

Unless otherwise provided herein or shown on the plans, either Type 1-D or Type 2 membrane curing compound may be used where permitted except that Type 1-D (Resin Base Only) will be required for slab concrete in bridge decks and top slabs of direct traffic culverts.

**TABLE 1**

		<b><u>REQUIRED</u></b>		<b><u>PERMITTED</u></b>	
	<b><u>STRUCTURE UNIT DESCRIPTION</u></b>	<b><u>WATER FOR CURING</u></b>	<b><u>MEMBRANE FOR INTERIM CURING</u></b>	<b><u>WATER FOR CURING</u></b>	<b><u>MEMBRANE FOR INTERIM CURING</u></b>
1	Top slabs of direct traffic culverts	X	X		
2	Top surface of any concrete unit upon which concrete is to be placed and bonded at a later interval (Stub walls, risers, etc.). Other superstructure concrete (wing walls, parapet walls, etc.)	X			
3	Concrete pavement (base), curbs, gutters, retards, sidewalks, driveways, medians, islands, concrete structures, concrete riprap, etc.			X*	X*
4	All substructure concrete, culverts, box sewers, inlets, manholes, retaining walls			X*	X*

\*Polyethylene sheeting, burlap-polyethylene mats or laminated mats to prevent outside air from entering will be considered equivalent to water or membrane curing for items 3 and 4.

Membrane curing shall not be applied to dry surfaces, but shall be applied just after free moisture has disappeared. Formed surfaces and surfaces which have been given a first rub shall be dampened and shall be moist at the time of application of the membrane.

When membrane is used for complete curing, the film shall remain unbroken for the minimum curing period specified. Membrane which is damaged shall be corrected immediately by reapplication of membrane. Unless otherwise noted herein or on the plans, the choice of membrane type shall be at the option of the Contractor. Only one type of curing compound will be permitted on any one structure.

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

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

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

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

To insure proper coverage, the Engineer shall inspect all treated areas after application of the compound for the period of time designated in the governing specification for curing, either for membrane curing or for other methods. Should the foregoing indicate that any area during the curing period is not protected, an additional coat or coats of the compound shall be applied immediately, and the rate of application of the membrane compound shall be increased until all areas are uniformly covered.

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

If at any time there is reason to believe that this method of curing is unsatisfactory or is detrimental

to the work, the Contractor, when notified, shall immediately cease the use of this method and shall change to curing by one of the other methods specified under this contract.

## 15. REMOVAL OF FORMS

Except as herein provided, forms for vertical surfaces may be removed when the concrete has aged not less than one day (24 hours) when Type I and Type II cement is used, and not less than one-half day (12 hours) when Type III cement is used, provided it can be done without damage to the concrete.

Forms for inside curb faces may be removed in approximately three hours provided it can be done without damage to the curb.

## 16. FINISHING EXPOSED SURFACES

Concrete shall be finished as required in the specification Section for the respective item or as otherwise specified on the plans.

An ordinary surface finish shall be applied to all concrete surfaces either as a final finish or preparatory to a higher finish.

Ordinary Surface Finish shall be as follows:

After form removal, all porous or honey-combed areas and spalled areas shall be corrected by chipping away all loose or broken material to sound concrete.

Feather edges shall be eliminated by cutting a face perpendicular to the surface. Shallow cavities shall be repaired using adhesive grout or epoxy grout. If judged repairable by the Engineer, large defective areas shall be corrected using concrete or other material approved by the Engineer.

Holes and spalls caused by removal of metal ties, etc., shall be cleaned and filled with adhesive grout or epoxy grout. Exposed parts of metal chairs on surfaces to be finished by rubbing, shall be chipped out to a depth of one-half inch (1/2") and the surface repaired.

All fins, runs, drips or mortar shall be removed from surfaces which remain exposed. Form marks and chamfer edges shall be smoothed by grinding and/or dry rubbing.

Grease, oil, dirt, curing compound, etc., shall be removed from surfaces requiring a higher grade of finish. Discolorations resulting from spillage or splashing of asphalt, paint or other similar material shall be removed.

Repairs shall be dense, well bonded and properly cured, and when made on surfaces which remain exposed and do not require a higher finish, shall be finished to blend with the surrounding concrete.

## 17. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, no direct measurement or payment will be made for the work to be done or the equipment to be furnished under this specification, but it shall be considered subsidiary to the particular items required by the plans and the contract documents.

SECTION 041080  
BRICK PAVERS

1. Scope:

The work under this section consists of furnishings of materials, labor, transportation, tools and service required for the execution of all brick paving on a concrete setting bed and installing other brick units as shown on the drawings and as specified herein.

2. Related Work Included Under Other Sections:

Pedestrian concrete setting base - 4" concrete sidewalk conforming to City Standard Specification Section 025612 – Concrete Sidewalks and Driveways and Section 038000 Concrete Structures.

Vehicular concrete setting base – concrete pavement conforming to City Standard Specification Section 025620 Portland Cement Concrete Pavement and Section 038000 Concrete Structures

3. Materials:

1. Pedestrian Brick Pavers (Clay)- Nominal 4x8x1 as manufactured by Endicott Clay Products Company, Medium/Iron Spec, or approved equal, to match existing pavers at existing walks and plaza at site. Units shall be submitted to the Engineer for approval.
2. Pedestrian Brick Pavers (Concrete) – Nominal 4"x8"x1 3/4" Holland 4.5 cm paver from Pavestone, or approved equal, to match existing pedestrian pavers on Chaparral St.
3. Vehicular Grade Pavers (Concrete) – Nominal 4" x 8" x 3 1/8" Holland 8 cm paver from Pavestone, or approved equal, to match existing vehicular pavers on Chaparral St. and/or Shoreline Blvd.
4. Joint Filler - for expansion joints shall be as specified on the drawings.
5. Caulking - for expansion joints shall be as specified on the drawings.
6. Concrete Setting Bed for pedestrian pavers- shall be conventional mortar leveling bed with Laticrete 3701 admixture installed over concrete walks or as shown on drawings.
7. Adhesive Material for pedestrian pavers - Paving brick shall be set with Laticrete 4237 thin set mortar suitable for exterior use or as shown on drawings. See drawings for location of pavers.

8. Concrete bed for vehicular pavers to be as shown on drawings.
9. Jointing material for vehicular pavers to be as shown on drawings.

4. Sample:

Construct a sample area of each type of brick pavement not less than 200 square feet in size. Sample will be constructed as part of the project and if approved, will be accepted as part of the final paving. However, should the sample fail to meet the Engineer's approval, it shall be removed and reconstructed until approved.

5. Installation of Paving Brick:

1. Brick shall be installed in accordance with the scale and dimensions on the drawings. Brick shall be laid in running bond with tight joints.
2. Setting beds shall be smoothed and leveled. Pavers will then be laid in a trowled adhesive bed.
3. No chipped or cracked brick units shall be incorporated into the work. Where brick units must be cut, they shall be saw cut to provide sharp, clean edges. Angled cuts and gaps at the edges of the pavement will not be acceptable.
4. Cleaning of the brick paving surface shall be done within 24 hours after removal of surface mortar by scrubbing the surface with one or more muriatic acid solutions using a long handled brush with stiff fiber bristles, continuing until the brick paving is clean, free of mortar and showing its true color. After the surface has been cleaned thoroughly with the acid solution, it shall be flushed with clear water to prevent further action of the acid. Muriatic acid solution shall be one part acid, fifteen (15) parts water.
5. Expansion joint filler shall be installed where indicated and where brick paving abuts walls, concrete paving, or other restraining items. Expansion joint material shall never be carried through the brick paving.

6. Measurement & Payment

Unless otherwise specified on the drawings, work and accepted material as prescribed for this specification will be measured by the square foot of surface of completed brick paver sidewalk or roadway as indicated in the drawings.



The work performed and materials furnished as prescribed by this specification and measured as provided under "Measurement" will be paid for at the unit bid for "Brick Pavers" which prices shall each be full compensation for preparing the subgrade; for furnishing and placing all materials, including all reinforced steel and expansion joint materials; and all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

SECTION 042020  
CONCRETE MASONRY UNIT (S-121)

1. GENERAL

Scope: Furnish all labor, materials, transportation, services, tools and equipment to properly execute work for Concrete Masonry Unit.

2. MATERIALS

Concrete masonry units shall conform to ASTM C90 and C129 and shall include hollows, solids, closers, jamb units, headers and special shapes and sizes required. Linear shrinkage as determined by ASTM C426 shall not exceed .03%.

Mortar shall be Type S consisting of 1 part Portland cement, 1 part Type S hydrated lime and 6 parts sand. Portland cement shall be Type I, II, or III as per ASTM C150. Hydrated lime shall be Type S as per ASTM C207. Sand shall be as per ASTM C144. Water shall be drinkable. Mortar shall be natural.

Joint reinforcement shall be made from cold drawn steel wire as per ASTM A82, and shall consist of two deformed side rods welded at 16" intervals to a continuous diagonal cross rod forming a truss design and shall be galvanized after fabrication.

Provide bolts and rods fabricated from not less than 16 ga. sheet metal or 3/8" diameter rod stock, unless otherwise indicated.

3. EXECUTION

Mixing Mortar: All materials shall be mixed a minimum of 5 minutes in a mechanical batch mixer. All mortar shall be used within 2 1/2 hours of initial mixing.

Erection: Bond pattern shall be running bond. Joints shall be 3/8". Mortar joints which are exposed and have become "thumbprint" hard shall be tooled with a round jointer. Masonry units shall be laid plumb and true to lines.

Joint reinforcement in all concrete masonry unit walls shall be in every other horizontal course and shall be continuous. Side rods shall be lap 6" at splices.

Cleaning:

- a. Holes in exposed masonry shall be pointed and defective joints cut out and repaired.
- b. Exposed masonry shall be protected against staining by wall coverings, and excess mortar shall be wiped off as work progresses. All exposed masonry shall be thoroughly cleaned.

4. Measurement & Payment

Concrete Masonry Unit shall be measured and paid at the unit price bid.

## SECTION 050200

### WELDING

#### 1. DESCRIPTION

This specification shall govern for the field welding of structural steel and reinforcing steel.

Provisions are made herein for the welding of the types of steel listed in Table 1, using the manual shielded metal-arc process, semi-automatic (manual) gas metal-arc welding and flux cored arc welding processes. Other welding processes may be permitted with the specific approval of the Engineer and with qualification of the welding procedure.

#### 2. STRUCTURAL STEEL GENERAL

Final welds including tack welds to be incorporated therein shall be by a certified welder; certified welder being previously certified by tests as prescribed in the "Code for Welding in Building Construction," ASW D1.0-69, of the American Welding Society, to perform the type of work required. Miscellaneous welds may be made by a qualified welder; qualified welder being an experienced welder who is capable of making good welds of sound quality, but does not have certification papers; miscellaneous welds being welds that have no load carrying capacity in the completed structure. Tack welds shall be cleaned and fused thoroughly with the final weld. Defective, cracked or broken tack welds shall be removed.

Welds shall be as required by the contract or erection drawings. The location or size shall not be changed without approval of the Engineer.

The welder shall place his identification mark with crayon or paint near the groove welds made by him.

No welding will be allowed when the air temperature is lower than 20° F, when surfaces are wet or exposed to rain, snow or wind, or when operators are exposed to inclement conditions that will hamper good workmanship.

Any moisture present at the point of welding shall be driven off by heat before welding commences. Windbreaks shall be required for the protection of all welding operations.

There shall be no temporary welds for transportation, erection or other purpose on main members, except at locations more than one-sixth the depth of the web from the flanges of beams and girders, as approved by the Engineer.

On A514 steel, all groove welds in main members and in flanges of beams and girders subject to tensile stress or reversals of stress shall be finished smooth and flush on all surfaces, including edges, by grinding in the direction of applied stress, leaving the surfaces free from depressions. Chipping may be used provided it is followed by such grinding. Parts joined by groove welds connecting plates of unequal thickness or width shall have a smooth transition between offset surfaces at a slope not greater than one in four with the surface of either part. The surfaces shall be ground so that the radii at the points of transition will be four (4) inches minimum.

All groove welds, except when produced with the aid of backing, shall have the root of the initial weld gouged, chipped or otherwise removed to sound metal before welding is started from the second side, except that back gouging will not be required when welding steel piling or armor joints with E6010 electrodes. The back side shall be thoroughly cleaned before placing back-up pass.

When backing for welds is left in place to become a part of the structure, it shall be a single length insofar as possible. Where more than a single length is needed, they shall be joined by full penetration butt welds. The surfaces of this butt weld shall be ground flush as necessary to obtain proper fit-up in the weld joint.

Before welding over previously deposited metal, all slag shall be removed, and the weld and adjacent base metal shall be cleaned. This requirement shall apply equally to successive layers, successive beads and the crater area.

Arc strikes outside the area of permanent welds must be avoided on all steels. Where they do occur, resulting cracks and blemishes shall be ground out to a smooth contour and checked to insure soundness.

Stringer bead technique shall be used where possible for groove welds on all types of steel. Weaving will not be permitted for A514 steel except in welding vertically upward, when a weave not exceeding two electrode diameters is permissible for manual shielded metal-arc welding.

In all welding processes, the progression for all passes in vertical welding shall be upward using a back step sequence.

Groove welds shall begin and terminate at the ends of a joint on extension bars. Edge preparation and thickness of extension bars shall be the same as that of the member being welded and shall extend a minimum of three-quarter (3/4) inch beyond the joint. Extension bars shall be removed with a cutting torch upon completion and cooling of the weld, and the flange edges shall be ground smooth.

Any defects exposed by the grinding shall be cleaned, filled with weld metal, and reground to a uniform finish. All grinding shall be parallel to the flange. Excess grinding of the parent metal shall be avoided.

### 3. FILLER METAL

Electrodes for manual shielded metal-arc welding shall conform to the requirements of the latest edition of "Specifications for Mild Steel Covered Arc-Welding Electrodes", AWS A5.1, or to the requirements of the latest edition of "Specifications for Low Alloy Steel Covered Arc-Welding Electrodes," AWS A5.5.

All electrodes and combination of electrode and shielding for gas metal-arc welding for producing weld metal with a minimum specified yield point not exceeding 60,000 psi shall conform to the requirements in the latest edition of, "Specification for Mild Steel Electrodes for Gas Metal-Arc Welding," AWS A5.18, or "Specification for Mild Steel Electrodes for Flux Cored Arc Welding," AWS A5.20, applicable for the classifications producing weld metal having a minimum impact strength of 20 ft.-lb., Charpy V-notch, at a temperature of 0° F or below.

For weld metal with a minimum specified yield strength exceeding 60,000 psi, the Contractor shall demonstrate that each electrode and flux or combination of electrode and shielding medium proposed for use will produce low alloy weld metal having the mechanical properties listed in Table A.

The mechanical properties shall be determined from a multiple pass weld made in accordance with the test requirements of the latest edition of AWS A5.18 or AWS A5.20, as applicable.

**TABLE A**  
**Required Mechanical Properties for GMAW and FCAW Electrodes**

GMAW Grade	FCAW Grade	Tensile Strength psi - Min	Yield Strength psi - Min	Elongation, % in 2 inches Min	Impact Strength ft-lb @ 0°F- Min
E80S	E80T	80,000	65,000	18	20
E90S	E90T	90,000	78,000	17	20
E100S	E100T	100,000	90,000	16	20
E110S	E110T	110,000	98,000	15	20

The mechanical property tests for Grades E100S, E110S, E100T and E110T shall be made using ASTM A 514 base material.

Class of electrode required will be as shown in Table 1 (below). Electrodes shall be used with the type of current, the polarity and in the positions permitted by AWS A5.1 and A5.5 for manual shielded metal-arc welding. AWS A5.18 and A5.20 Specifications shall govern for gas metal-arc welding and flux cored arc welding.

**TABLE 1**  
**CLASSIFICATIONS OF ELECTRODES PERMITTED**

<u>TYPE OF STEEL</u>	<u>MAIN MEMBERS</u>		<u>SECONDARY MEMBERS</u>		
	<u>Groove &amp; Fillet Welds</u>		<u>Groove &amp; Fillet Welds</u>		
Steel Piling,	E6010	E60T-8	E60XX	E60T-8	E70S-2
A53 Pipe,	E6011	E70S-1B	E70XX	E7XT-1	E70S-3
A500,	E7016	E70S-2	E70S-1B	E7XT-5	E70S-6
A501,	E7018	E70S-3	E70S-2	E7XT-6	E70S-7
Armor Joints		E70S-6	E70S-3	E7XT-8	
		E-70S-7	E70S-6		
			E70U-1		
A36,	E7016	E70S-2	E7016	E70S-2	
A441,	E7018	E70S-3	E7018	E70S-3	
A572-Grade 50	E7XT-1	E70S-6	E7XT-1	E70S-6	
A588,	E7XT-5	E70S-7	E7XT-5	E70S-7	
A242 Deck Plates	E7XT-6		E7XT-6		
API Pipe	E7XT-8		E7XT-8		
A514	E11018M	E110S	E11018M	E110S	
2½" Thick or Less	E110T		E110T		
A514	E10018M	E100S	E10018M	E100S	
Over 2½" Thick	E100T		E100T		
A588, A242,	E8018, C-3		E8018, C-3		
A618 Weathering	E80T <sup>(3)</sup>	E80S <sup>(3)</sup>	E80T <sup>(3)</sup>		
Steel			E80S <sup>(3)</sup>		
Reinforcing Steel	E7016	E7018			
A572 Grades	E8016	E80T			
60 and 65	E8018	E80S			
for Light Towers					

1. Use of the same type electrode with the next higher mechanical properties, in accordance with AWS A5.1 or A5.5, than those listed will be permitted.
2. In joints involving base metals of different yield points or strengths, low hydrogen electrodes applicable to the lower strength base metal may be used.

Before use, all electrodes with low hydrogen coverings conforming to AWS A5.1 shall be dried for not less than two hours between 450 and 500 degrees F and electrodes with low hydrogen coverings conforming to AWS A5.5 for not less than one hour at a temperature between 700 and 800 degrees F. Immediately after drying, electrodes shall be stored in ovens held at a temperature of at least 250 degrees F. E70 electrodes not used within four hours, E80 within two hours, and E110 within one-half hour after removal from the storage oven shall be redried before use. Electrodes with flux which has been wet, cracked or otherwise damaged, shall not be used. When used for welding A514 steel, electrodes shall be dried at least one hour at temperatures between 700 and 800 degrees F before being used. Electrodes may be redried only once.

Suitable facilities for drying and storage of electrodes shall be furnished at the job site, along with thermometers for checking and controlling the oven temperature.

In humid atmospheres, the times allowed for use without redrying may be reduced.

When gas or gas mixture is used for gas metal-arc welding, it shall be of a welding grade having a dew point of -40° F or lower. The gas manufacturer shall furnish certification to the Engineer that the gas or gas mixture is suitable for the intended application and will meet the dew point requirements.

Welding wire coils removed from the original package shall be protected or stored to keep their characteristics or welding properties intact. Rusty coils, or portions of coils, that are rusty shall not be used.

### **Preheat**

Preheat ahead of welding both groove and fillet welds (including tack welding) will be required as shown in Table 2. Any moisture present at the point of welding shall be driven off by preheating before welding begins. When the base metal is below the required temperature, it shall be preheated so the parts being welded are not less than the specified temperature within three inches (3") of the point of welding.

Preheat and interpass temperatures must be sufficient to prevent crack formation. The preheat temperatures shown in Table 2 are minimum and higher preheats may be necessary in highly restrained welds.

Preheating equipment shall be adequate to maintain the entire joint at or above the specified temperature. When possible, a joint shall be completely welded before it is allowed to cool below the specified temperature, but shall always be welded sufficiently to prevent cracking before cooling is permitted.

Usually preheat and interpass temperatures shall not exceed 400° F for thickness up to 1½ inches and 450° F for greater thickness. These temperatures shall never be exceeded on A514 steel.

The welder shall have and use approved equipment for checking preheat and interpass temperatures at all times while welding is in progress.

For all groove welds, preheat temperature shall be measured on the side opposite to which the heat is applied at points about three inches (3") away from the joint.

**TABLE 2**  
**MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR**  
**MANUAL SHIELDED METAL-ARC WELDING, FLUX**  
**CORED ARC WELDING OR GAS METAL-ARC WELDING**

Thickness of Thickness Part at Point of Welding (Inches)	MANUAL OR SEMI-AUTOMATIC GAS METAL-ARC WELDING, FLUX CORED ARC WELDING OR MANUAL SHIELDED METAL-ARC WELDING	
	<u>With Low Hydrogen Electrodes</u>	
	ASTM A36; A242; A441 A572 Grades 42, 45 and 50; A588	ASTM A514
To 3/4, inclusive	50° F	50° F
Over 3/4 to 1½, inclusive	70° F	125° F
Over 1½ to 2½, inclusive	150° F	175° F
Over 2½	225° F	225° F

- (1) These temperatures are the minimum required for the thinner material shown for each increment, and higher preheat on a step basis will be required for the thicker material within each increment. Preheat and interpass temperatures must be sufficient to prevent crack formation and welding shall be carried continuously to completion or to a point that will assure freedom from cracking before the joint is allowed to cool below the minimum specified preheat and interpass temperature. Temperatures above those shown may be required for highly restrained welds.
- (2) When E7010 electrodes are permitted for tacking or temporary root pass, the material shall be preheated to 400° F.
- (3) When joining steels of different strengths or thickness with groove welds, the preheat and interpass temperatures for the higher strength steel and the average plate thickness shall be used. For fillet welds, the preheat shall be used for the higher strength steel and the thickest plate being welded.
- (4) When the base metal temperature is below 32° F, preheat to at least 70° F and maintain this minimum temperature during welding.
- (5) Heat input when welding A514 steel shall not exceed the steel producer's recommendations.
- (6) When moisture is present on the base metal, it shall be preheated to 200° F before welding is started.

#### 4. QUALITY OF WELDS

Weld metal shall be sound throughout.

There shall be no cracks in any weld or weld pass.

There shall be complete fusion between the weld metal and the base metal and between successive passes throughout the joint.



Welds shall be free from overlap and the base metal free from undercut more than one one-hundredth inch (1/100") deep when its direction is transverse to the primary stress in the part that is undercut. Undercut shall not be more than one thirty-second inch (1/32") deep when its direction is parallel to the primary stress in the part that is undercut.

All craters shall be filled to the full cross section of the welds.

All welds on A514 steel shall be visually examined for longitudinal or transverse cracks not less than 48 hours after completion of the welding.

## 5. CORRECTIONS

When welding is unsatisfactory or indicates inferior workmanship, the following corrective measures will be required by the Engineer whose specific approval shall be obtained for making each correction.

When requirements prescribe the removal of part of the weld or a portion of the base metal, removal shall be by oxygen gouging or arc-air gouging.

Oxygen gouging shall not be used on A514 steel or A588 weathering steel. All surfaces shall be ground after arc-air gouging.

Backgouging of splices in beams and girders or cutouts of defective welds shall be done by a welder qualified to make beam and girder splices.

Where corrections require the deposition of additional weld metal, the sides of the area to be welded shall have sufficient slope to permit depositing new metal.

Defective or unsound welds shall be corrected either by removing and replacing the entire weld, or as follows:

**Excessive convexity.** Reduce to size by grinding off the excess weld metal.

**Shrinkage cracks.** Cracks in base metal, craters and excessive porosity. Remove defective portions of base and weld metal down to sound metal and replace with additional sound weld metal.

**Undercutting, undersize and excessive concavity.** Clean and deposit additional weld metal.

**Overlapping and incomplete fusion.** Remove and replace the defective portion of weld.

**Slag inclusions.** Remove the parts of the weld containing slag and replace with sound weld metal.

**Removal of adjacent base metal during welding.** Clean and form full size by depositing additional weld metal.

Where corrections require the deposition of additional weld metal, the electrode used shall be smaller than that used for making the original weld. Surfaces shall be cleaned thoroughly before re-welding.

A cracked weld shall be removed throughout its length, unless the extent of the crack can be ascertained to be limited, in which case the weld metal shall be removed 2 inches (2") beyond each end of the crack and repairs made.

Where work performed after the making of a deficient weld has made the weld inaccessible or has caused new conditions making the correction of the deficiency dangerous or ineffectual, the original conditions shall be restored by removal of welds or members, or both, before making the necessary corrections, or else the deficiency shall be compensated by additional work according to a revised design approved by the Engineer.

Improperly fitted and misaligned parts shall be cut apart and re-welded.

Members distorted by the heat of welding shall be straightened by mechanical means or by the carefully supervised application of a limited amount of localized heat. Heated areas shall not exceed 1200° F as measured by Tempil-sticks or other approved methods for steel up to 65,000 psi yield strength. Parts to be heat straightened shall be substantially free of stress from external forces, except when mechanical means are used in conjunction with the application of heat.

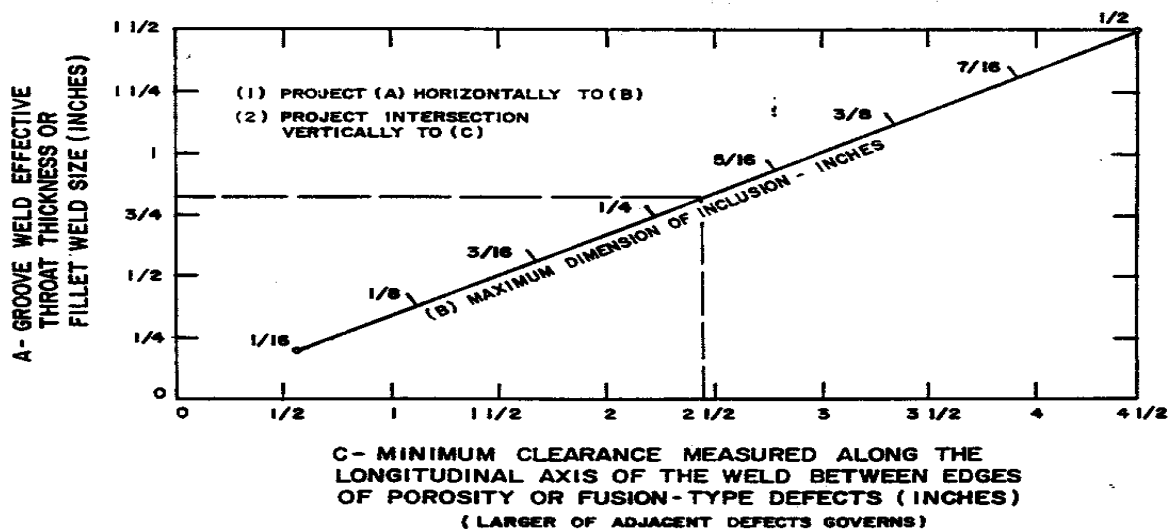
Heat straightening of A514 steel shall be done only under rigidly controlled procedures, subject to the approval of the Engineer. In no case shall the maximum temperature of the steel exceed 1100° F. Sharp kinks and bends shall be cause for rejection of the material.

## 6. RADIOGRAPHIC INSPECTION

All groove welds designed to carry primary stresses shall be subject to radiographic inspection. When subjected to such inspections, the presence of any of the following defects in excess of the limits indicated will result in rejection of the defective weld until corrected.

1. Sections of welds shown to have any cracking, regardless of length or location, incomplete fusion, overlapping, or inadequate penetration shall be judged unacceptable.
2. Inclusions less than one-sixteenth inch (1/16") in greatest dimension including slag, porosity and other deleterious material, shall be permitted if well dispersed so that the sum of the greatest dimensions of the inclusions in any linear inch of welded joint shall not exceed three-eighth inch (3/8").
3. Inclusions one-sixteenth inch (1/16") or larger in greatest dimension shall be permitted provided such defects do not exceed the limits shown on Figure 1 or in subparagraph (2) above.
4. There shall be no inclusion greater than one-sixteenth inch (1/16") within one inch of the edge of part or member at the joint or point of restraint.

**FIGURE 1**  
**STANDARDS FOR ALLOWABLE INCLUSIONS**



NOTES:

- (1) The distance from the edge of an inclusion to the edge of a plate or to any intersecting weld shall be equal to or greater than the clearance between inclusions.
- (2) Inclusions with any dimension greater than 1/2 inch are not acceptable.
- (3) For joint thickness greater than 1 1/2 inches, the minimum allowable dimension and spacing of inclusions shall be the same as for 1 1/2-inch joints.
- (4) Values of (B) obtained by projecting horizontally from (A) are maximum values. Any value of (B) smaller than the maximum is satisfactory.
- (5) Values of (C) obtained by projecting vertically from (B) are minimum values. Any value of (C) larger than the minimum is satisfactory.

Radiographic inspection shall be made of A514 steel not less than 48 hours following the completion of the welding. For other steels, nondestructive inspection may begin immediately after welding and cleaning or grinding is completed.

Definitions:

Porosity signifies gas pockets or any similar generally globular type voids.

Fusion-type defect signifies slag inclusions and similar elongated defects.

## 7. REINFORCING STEEL - GENERAL

Provisions are made herein for the welding of reinforcing steel by the manual shielded metal-arc process. Other processes may be permitted with the specific approval of the Engineer or may be specified on the plans.

Splicing of reinforcing steel by welding shall be done only at locations approved by the Engineer.

## 8. BASE METAL

Reinforcing steel to be welded shall be new billet steel conforming to ASTM Designation: A615, and shall also conform to the following chemical composition:

Maximum Carbon	0.40 Percent
Maximum Manganese	1.30 Percent

## 9. FILLER METAL

Low hydrogen electrodes as specified in Table A will be required for all welding of reinforcing steel. Drying of electrodes shall be as specified in Article 3, "Filler Metal" for Structural Steel.

## 10. PREHEAT AND INTERPASS TEMPERATURE

Minimum preheat and interpass temperatures for reinforcing steel shall be as shown in Table 3.

**TABLE 3**  
**PREHEAT AND INTERPASS TEMPERATURE FOR REINFORCING STEEL**

<u>CARBON RANGE</u>	<u>NO. 7 &amp; SMALLER</u>	<u>NO. 8 &amp; LARGER</u>
Up to and including 0.30	None	100
0.31 to 0.35 inclusive	None	150
0.36 to 0.40 inclusive	100	250
Unknown	250	400

For widening projects, use carbon content and bar size of new steel to determine preheat required.

## 11. JOINT TYPES

For all bars No. 8 and larger, butt splices shall be required. For No. 7 bars and smaller, lap splices shall be required.

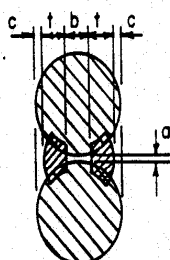
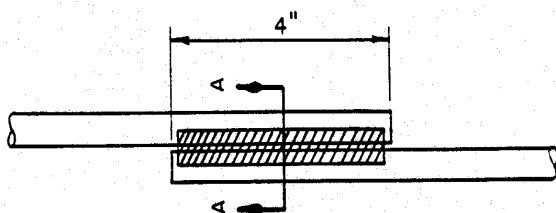
Fillet welds in lap splices shall be a minimum of 4 inches in length and shall be welded on each side of the lap joint. For bars No. 5 and smaller, welding from one side of the lap will be permitted by the Engineer when it is impractical to weld from both sides of the joint, and the weld shall be a minimum of 6 inches in length.

Lap welds shall meet the requirements specified in Table 4.

Where possible, all butt splices shall be made in the flat position. All butt splices, except horizontal, shall be as shown in Figure 2 with the back-up strip required. Horizontal splices shall be as shown in Figure 3.

**TABLE 4**  
**REQUIRED DIMENSIONS FOR LAP SPLICES**

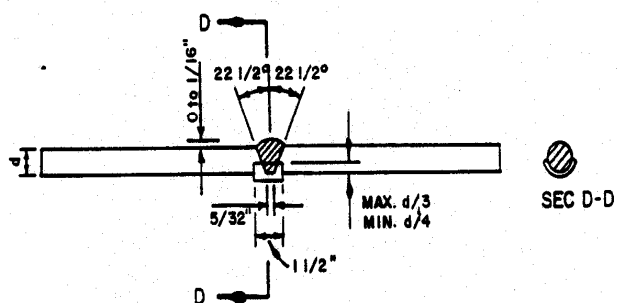
<u>BAR SIZE</u>	<u>"a"</u>	<u>"b"</u> <u>(Max.)</u>	<u>"t"</u> <u>(Min.)</u>	<u>"c"</u> <u>(Max.)</u>	<u>ELECTRODE</u> <u>SIZE</u>
No. 4	0.04 in.	1/8 in.	1/8 in.	1/16 in.	1/8 in.
No. 5	0.05 in.	1/8 in.	3/16 in.	1/16 in.	5/32 in.
No. 6	0.06 in.	1/8 in.	1/4 in.	1/16 in.	5/32 in.
No. 7	0.07 in.	3/16 in.	5/16 in.	1/16 in.	5/32 in.



SEC. A-A (ENLARGED)

TABLE 4

Required Dimensions for Lap Splices



Butt weld in flat position



BUTT WELD WITH BAR IN HORIZONTAL POSITION

FIGURE 2

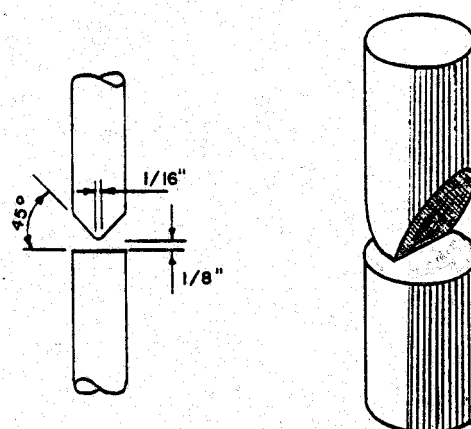


FIGURE 3

## 12. WIDENING PROJECTS

In general, the new reinforcing steel shall be either lap or butt spliced directly to the bar to be extended. When the reinforcement in the old portion of a structure is found to be of the wrong spacing, dowel bars long enough to develop the welded lap or butt splice and also develop the bar in bond, as required in City Standard Specification Section 032020 "Reinforcing Steel", shall be welded to the old steel, and the new reinforcement placed at the correct spacing without welding to the old steel. No measurement or payment will be made for the dowels but will be subsidiary to the other items in the contract.

Both old and new reinforcement shall be cleaned thoroughly prior to the preparation of the joint.

## 13. RADIOGRAPHIC INSPECTION

When so designated on the plans, welded butt splices shall be radiographed. Weld quality shall be as follows: There shall be no cracks and the sum of the greatest dimensions of porosity and fusion-type defects shall not exceed one-tenth of the nominal bar diameter in inches.

## 14. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, welding will not be measured for pay, but will be considered subsidiary to the various other bid items in the Bid Form.

SECTION 055420  
FRAMES, GRATES, RINGS AND COVERS

1. DESCRIPTION

This specification shall govern for the furnishing and installation of frames, grates, rings and covers for inlets, manholes and other structures in accordance with those details. Steel shall conform to the requirements of ASTM Designation: A36 "Standard Specification for Carbon Structural Steel".

2. MATERIALS

Welded steel grates and frames shall conform to the member size, dimensions and details shown on the plans and shall be welded into an assembly in accordance with those details. Steel shall conform to the requirements of ASTM Designation: A36.

Castings, whether Carbon-Steel, Gray Cast Iron or Ductile Iron, shall conform to the shape and dimensions shown on the plans and shall be clean substantial castings, free from burnt-on sand or blow holes, and shall be reasonable smooth. Runners, risers, fins, and other cast-on pieces shall be removed from the castings and such areas ground smooth. Bearing surfaces between manhole rings and covers or grates and frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter contact area. Pairs of machined castings shall be matchmarked to facilitate subsequent identification at installation.

Steel castings shall conform to the requirements of ASTM Designation: A27 "Standard Specification for Steel Castings, Carbon, for General Application". Grade 70-36 shall be furnished unless otherwise specified.

Cast Iron castings shall conform to the requirements of ASTM Designation: A48 "Standard Specification for Gray Iron Castings", Class 30.

Ductile iron castings shall conform to the requirements of ASTM Designation: A536 "Standard Specification for Ductile Iron Castings". Grade 60-40-18 shall be used otherwise specified.

3. CONSTRUCTION METHODS

Frames, grates, rings and covers shall be constructed of the materials as specified and in accordance with the details shown on the plans, and shall be placed carefully to the lines and grades indicated on the plans or as directed by the Engineer.

All welding shall conform to the requirements of the latest American Welding Society Specifications. Frames, grates, rings and covers shall be given one coat of a commercial grade red lead and oil paint and two coats of commercial grade aluminum paint.



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

Commercial grade galvanized bolts and nuts shall be used. The zinc coating shall be uniform in thickness, smooth and continuous.

#### 4. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, frames, grates, rings and covers will not be measured for payment, but shall be considered subsidiary to other bid items.