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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".

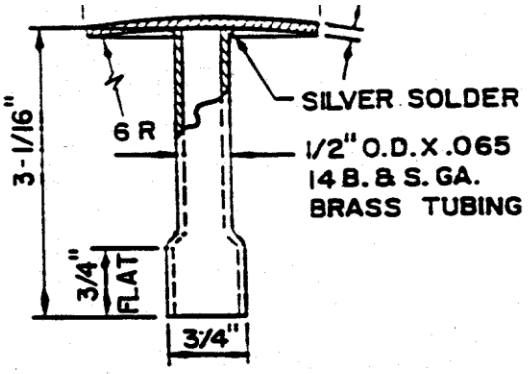
3. CONSTRUCTION METHODS

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.)

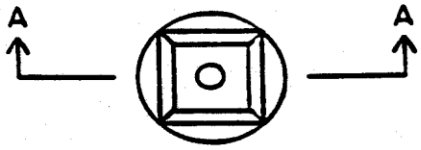
4. MEASUREMENT AND PAYMENT

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.

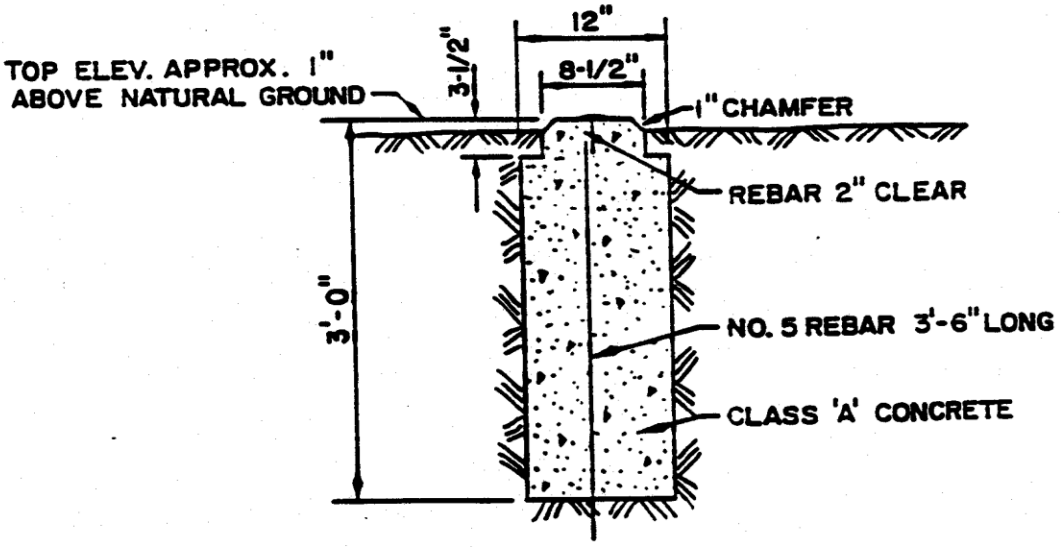


DISC DETAIL

N.T.S.



PLAN



SECTION A-A

SURVEY MARKERS DETAIL

3/4" = 1'-0"

SECTION 020400
AUTOMATED STORMWATER SAMPLING SYSTEM

1. DESCRIPTION

This specification shall govern all equipment and software required for the installation of automated storm water sampling systems for collecting storm water samples in remote locations to meet EPA NPDES requirements for storm water discharges to receiving waters of the United States.

2. EQUIPMENT CERTIFICATION

The contractor shall submit the manufacturer's certification and technical specification for each piece of equipment used in the storm water sampling system stating that the equipment furnished meets or exceeds the specifications herein. Three copies of all submittals shall be made sufficiently in advance of site mobilization to allow inspection and confirmation. Improperly packaged or labeled materials shall be rejected and removed from the job site.

3. SAMPLING STATION

The storm water sampling station shall consist of equipment for measuring flow and collecting storm water samples from conduits or open channels. The basic station shall consist of a programmable measurement and control module with telecommunications capability, a peristaltic pump, and one or more bottles to collect the sample, a temperature measuring device and a rain gauge. Flow measurement shall be performed by an ultrasonic-Doppler flow meter in conjunction with a primary device or the Manning equation. Land-line network communications shall be used at the site. The components of the system shall be rated to NEMA-4X standards or installed in NEMA-4X enclosures. The system shall be enclosed in a vandal resistant lockable welded housing structure.

4. CONTROL STATION

Multiple stations shall be monitored and controlled remotely from an IBM-compatible PC with Storm Control software. Software shall be compatible with existing software on City equipment. The communication protocol used on this system shall be compatible with Campbell Scientific, Inc.’s proprietary PC 208 Software. Storm Control software shall provide the capability to initialize the remotely situated stations, monitor and control their operation and download recorded data. Campbell Scientific, Inc. software (PC208) is required as a minimum to address issues of compatibility.

5. MEASUREMENT AND CONTROL MODULE WITH WIRING PANEL

The measurement and control module shall be programmable controller with built-in data logging capability and facilities for exciting and measuring analog and digital sensors and devices. It shall have a 9-pin communication port which will be used to connect a hand-held console, or to connect remote communication facilities. The module shall be a precision instrument with an instruction set specifically selected for measuring environmental parameters. It shall have a set of eight digital ports which may be programmed as input or output channels to control the sensors or sense their condition. The electronic components shall be housed in an environmentally sealed canister. The canister shall fit into a wiring panel to facilitate field connections. Several levels of electrical transient protection shall be provided in the wiring panel and the electronics canister.

Specifications: Campbell CR10X or approved equal.

A. Input/output
   Analog Inputs: 12 single-ended or 6 differential
   Digital Control/Status Ports: 8 programmable

Pulse Inputs: 2
Excitation Outputs: 3
Switched 12 Volt Port: 1
9-Pin Serial I/O Port: 1

B. Analog Inputs:
Range: +/- 2.5,7.5,25,250,2500 millivolts, software selectable
Resolution: 0.33,1.00,3.33,33.3,333 respectively
Accuracy: 0.2% of FSR over -25 to +50 degrees C
0.1% of FSR over 0 to +40 degrees C
Normal Mode Rejection: 70 dB
DC Common Mode Rejection: >140 dB
Input Resistance: 200 gigohms

C. Excitation Outputs
Range: +/- 2500 millivolts
Resolution: 0.67 millivolts
Accuracy: Same as voltage input

D. Digital Control/Status Ports
Output Voltages: High 5.0 +/- 0.1 V; Low, 0.1 V
Input State: High 3.0 to 5.5 V; Low -0.5 to +0.8 V

E. Clock Accuracy: +/- 1 minute per month

F. Memory: 32K ROM; 128K RAM

G. System Power Requirements: 9.6 to 16 volts.

6. WATER SAMPLING EQUIPMENT

The water sampling equipment shall be ISCO 6700 sampler or approved equal and shall consist of a Controller/Pump assembly, a sample container, a base assembly which holds the sample container and a supply of ice, and a suction line. The Controller/Pump assembly shall consist of a peristaltic pump, a drive motor, a liquid detector, and control electronics housed in a NEMA-4X enclosure. Sample volumes shall be programmed by means of an integral control panel on the sampler. Sampling will be controlled in real-time by electrical signals to a control port. The sampler base shall be capable of holding a 19-liter glass sample container and a supply of ice.

The sample container shall be high quality borosilicate glass. The sample container closure shall be Teflon. With the exception of a short section of silicon hose in the peristaltic pump, the sample suction line shall be Teflon. Suction line shall be provided in continuous runs from each station enclosure to the intake structure in the water stream. All materials that come in contact with the water sample shall be constructed of Teflon, borosilicate glass, or stainless steel. Prior to installation in the water stream, all components shall undergo a rigorous cleaning protocol to remove the potential for contamination of trace metals and organic compounds.

A. Specifications:
Controller/Pump
Sample Volume Accuracy: +/- 10 ml or +/- 10% of programmed volume, whichever is greater
Sample Volume Repeatability: +/- 5 milli liters or +/- 5% of the average sample volume in a set, whichever is greater
Suction Lift: 28 Feet
Line Transport Velocity: 3.0 feet/second at 3 foot suction head
2.2 feet/second at 25 foot suction head

Enclosure: NEMA 4-X, 6

Sampler Housing, Bottle Container
Height: 35 inches maximum
Diameter: 19.96 inches
Capacity: 1-19 liter bottler with stopper

Sample Bottle
Capacity: 19 liters
Material: Borosilicate
Stopper: Solid PFTE with clamp mechanism for transportation
Solid PFTE with 7/16 centered hole for sampling

Suction Line:
3/8 inch I.D. solid-wall FEP Teflon, with wall thickness of 0.063 +/- 0.006 inches.

B. Cleaning Protocol:
Prior to installation at a site to be sampled, all components that will come in contact with the sample shall be cleaned using appropriate methods to remove low-level organic and trace metal contaminants. This will include all bottles, bottle stoppers, Teflon and silicone tubing, and intake strainers. Cleaning shall be to levels equal to or below project detection limits.

After cleaning, but prior to installation, ten percent of all bottles and Teflon tubing shall have equipment blank analyses performed. The blanks shall be analyzed for the contaminants of concern to the Program. If the limits shown below are exceeded, the entire lot of bottles or tubing shall be re-cleaned and blanks will be reanalyzed. This process is required until documentation can be provided to the City that equipment blanks are free of all contaminants of concern at no additional pay.

Detection limits used for analysis:
One (1) part per million for Total Organic Compounds (TOC)
One (1) part per billion for zinc, copper, and lead
Two (2) parts per billion for nickel

7. Thermistor

A temperature sensor using a thermistor Campbell 107B or approved equal shall be housed in a waterproof enclosure with a cable attached. The unit shall be suitable for burial or immersion in water.

Specifications:
Accuracy: +/- 1.0 degrees C over -40 to +55 degrees C
+/- 0.1 degrees C over -35 to +48 degrees C

8. SITE ENCLOSURE:

The site enclosure shall be a top-opening, lockable steel box of welded construction with louvers located on the front and sides for ventilation. It shall be designed to be vandal resistant with carriage bolts used to attach hinges and other components that are not welded. Two hasps shall be provided for padlocks. Protective covers shall be welded over the hasps to discourage cutting of the padlocks.

Specifications

Dimensions: 36 inches high x 42 inches wide x 30 inches deep with open bottom
Material: 12 Gauge Steel
Color: White paint applied over primer on both inside and outside
Mounting: 2 inch wide internal base flange with 1/2 inch diameter holes
Cooling: Ventilation is provided by hooded louvers located near the bottom of the enclosure on the front and back and near the top of the enclosure on each side.

9. FLOW MEASUREMENT:

An ultrasonic Doppler flow-measurement device ISCO 4150 or approved equal shall be used to measure the average particle velocity across the liquid stream. A pressure sensitive liquid level sensing device shall be incorporated into the transducer housing. The flow measuring device shall be capable of providing real-time velocity, depth, and battery voltage measurements upon command from the Measurement and Control Module with a RS 232 interface. The flow shall be calculated in the Measurement and Control Module from the average velocity and depth provided by the flow meter and the channel geometry.

Specifications:

Velocity Range: -5 to 20 feet/second
Depth Range: 0.1 to 10 feet
Temperature Range:
Logger/Controller: -18 to 60 degrees C Operating
Probe: 0 to 71 degrees C Operating
0 to 50 degrees C Compensated

10. COMMUNICATIONS:

Land-line communications shall be provided with a modem that interfaces with the Measurement and Control Module 9-pin serial port and a public land-line switched telephone network. The modem shall be capable of communication with a Hayes-compatible modem and an IBM-compatible PC.

Specifications:

A. Standards: Bell 212a, CCITT V.22
B. Baud Rates: 300,1200
C. Operation: Full-duplex over standard phone lines
D. Operating temperature: -25 to +50 degrees C

11. REMOTE STORM CONTROL:

The Storm Control software shall be compatible with existing hardware and software which is owned by the City. The network of Sampling Stations will be monitored and controlled from an IBM-compatible PC equipped with a VGA monitor, appropriate modems, and Storm Control software. The Storm Control software shall provide menu selectable programs to allow an operator to remotely initialize operation, monitor and modify the operation of any of the Sampling Stations, and terminate the operation, all in real time. The software shall have the capability of retrieving logged data remotely from the station at a later time after the event is completed. Data retrieved from each of the station sites shall be stored sequentially in a data base for that site. The Storm Control software shall use the facilities of Campbell Scientific, Inc. PC208 Data Logger Support Software.

The PC208 Data Logger Support Software is a suite of programs that run on an IBM-

compatible PC using the DOS Operating System. PC208 provides proprietary telecommunications protocols to communicate with the Campbell CR10X Data Logger both in real-time and in batch mode. It also has data editing and graphical display facilities.

12. RAIN GAUGE:

An electric tipping bucket rain gauge Texas Electronics 525 or approved equal shall be provided.

Specifications

Resolution:	0.01 inches per tip
Accuracy:	1.0% at 2 inches/hour or less
Signal Output:	Momentary unconditioned switch closure of 135 ms average duration.
Material:	Body: Anodized aluminum Receiving Orifice: Gold anodized spun aluminum knife edge collector ring.
Environmental:	0 to +50 degrees C 0 to 100% humidity
Cable:	2-conductor shielded with plastic cover, length is customized to site requirements.

13. SOLAR PANEL:

A solar electric panel shall be provided.

Specifications

Rated Power:	20.0 Watts
Current (typical at load)	1.38 Amps
Voltage (typical at load)	14.5 Volts
Short Circuit Current (typical)	1.60 Amps
Open Circuit Voltage (typical)	18.0 Volts
Module Leakage Current	<50 uA at 3000 VDC electrical voltage isolation
Normal Operating Cell Temp.	42 C +/- 2 C
Environment	-40 C to 90 C, 0 to 85% humidity
Materials	Layered with ethylene vinyl acetate (EVA)

14. SOLAR PANEL REGULATOR:

A solar panel regulator shall be provided.

Specifications

Input Voltage Max	60 VDC VOC
Input Voltage Min	15.0 VDC
Input Current Max	10 A
Charge Stop Voltage	14.35 VDC
Current Consumption	55 mA
Operating Temperature	-40 degrees C to +65 degrees C
Operating Humidity	up to 100%
Encapsulation	Fully Potted with Polymer Resin

Packaging	Injection molded, impact and UV resistant, ABS plastic enclosure

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, and on roadway projects (Clear ROW), to include all items from ROW line to ROW line within the project limits as indicated on the plans to be removed as part of the project and/or not specifically covered by another bid item.

2. CONSTRUCTION METHODS

The site shall be cleared of all trees, stumps, brush, roots, vegetation, rubbish, concrete items that are indicated to be removed, and other objectionable matter as indicated on the drawings and/or as directed by the OAR or his designated representative. Tree stumps and roots shall be grubbed to a minimum depth of 2’ below natural ground or 2’ below base of subgrade, whichever is lower. Areas that will underlie new compacted backfill shall be stripped of all vegetation, humus and other objectionable matter encountered within the top 6” 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 (site projects) or clear right-of-way (roadway projects) 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.

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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 be 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 AND UTILITIES

1. DESCRIPTION

This specification shall provide for the demolition**,** removal and disposal of abandoned structures or portions of abandoned structures or utilities 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 and Pipe. 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 utility appurtenances shall be included for removal with the pipe. Those pipes which are deemed unsatisfactory for reuse by the OAR may be removed in any manner the Contractor may select. Pipe that is not removed must be grout-filled per City Standard Details.

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 OAR. 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 OAR, 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 OAR. 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 OAR, 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 5' 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 OAR. 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 OAR. 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 OAR 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 OAR.

Unless otherwise specified on the drawings, timber piles shall be either pulled or cut off at the point not less than 5' 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 5' below the permanent ground line and neatly squared off.

Salvage. All material such as pipe, timbers, railings, etc., which the OAR 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 OAR, 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 OAR.

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 grout filled or plugged as specified on the drawings and City Standard Details.

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, and within 0-3% of optimum moisture, 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. The final 3' up to the bottom of the road base shall be backfilled with cement stabilized sand. If any portion of the excavation lies within 1' of the back of roadway curb (or within 1' of the pavement edge if there is no curb), the final 3' up to the bottom of the road base shall be backfilled with cement stabilized sand. The cement stabilized sand backfill shall be uniformly moistened and mixed at the rate of 1.5 sacks/CY.

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 OAR 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 and within 3% of optimum moisture unless otherwise specified.

3. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form for select significant items, the work governed by this specification shall not be measured for pay but shall be subsidiary to pay items under Specification Section 021020 "Site Clearing and Stripping" or Section 022040 "Street Excavation".

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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 OAR, 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 1' 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' of open trench left behind the trenching operation and no more than 500' 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 pipe to be constructed in fill above natural ground, the embankment shall first be constructed to an elevation not less than 1' 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' below the bottom of pipe for pipes 2' or more in height; and to a depth equal to the height of pipe, 6" minimum, for pipes less than 2' in height. Such excavation shall be carried at least 1' 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 OAR, 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 lease 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 and Utilities. 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 1' 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 1' below the bottom of the trench. In each instance, when abandoned utilities are to be removed, 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 OAR.

(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 10" (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 12" above the top of the pipe.

B. Backfill Over 1' Above Pipe (Final Backfill)

UNPAVED AREAS: The backfill for that portion of trench over 1' 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 10" 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 OAR. Regardless of backfill method, no lift shall exceed 10" and density shall not be less than 95% Standard Proctor density. A period of not less than 24 hours shall elapse between the time of jetting and the placing of the top 4' of backfill. If jetting is used, the top 4' of backfill shall be placed in layers not more than 10" 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).

If any portion of a utility trench lies within 1' of the back of roadway curb, the trench shall be backfilled per requirements beneath paved areas, including cement stabilization, as stated below.

PAVED AREAS: At utility lines 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 12” above top of the pipe) to 3’ below bottom of road base course, backfill shall be select material meeting the requirements of 022100 “Select Material”.

Asphalt Roadways

The upper 3’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 1.5 sacks of Standard Type I Portland cement per cubic yard of sand uniformly moistened, mixed, and compacted to not less than 95% Standard Proctor density.

Concrete Roadways

The Contractor may elect to backfill the upper 3’ 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. <u>All parts of this procedure shall be complete prior to any discharge of ground water to the storm water system.</u>

F. Steps to Determine Legitimate Discharge:

1. Identify the First Receiving Water.

   a) When the first body of water is a <u>fresh</u> 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

Parameter	Ground Water Monitoring Frequency	Receiving Water Monitoring Frequency	Maximum Limitation
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, which is all excavation of the lines and grades of the proposed roadbed to include at least 1' behind the curb, as required to complete the project.

2. CONSTRUCTION METHODS

(A) Stripping and Excavation

Strip the top 6" in all areas that will underlay proposed compacted fill, curbs (to at least 1' beyond the proposed back of curb), 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 OAR, provided that the material meets the requirements for roadway embankment as specified in Article 3 below. Unwanted or unsuitable roadway excavation and roadway excavation (cut) in excess of that needed for construction (fill) 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 OAR. "Unsuitable" material encountered below subgrade elevation in roadway cuts, when declared unwanted by the OAR, shall be removed and hauled off and replaced as directed by the OAR with suitable material from the roadway excavation or with other suitable or select material as required by the plans and specifications.

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). Moisture and density requirements extend 12" into the subgrade per pay item '12" Compacted Pavement Subgrade' or similar item.

(B) Subgrade Preparation

That area shown on the drawings for street construction, to include at least one foot behind the proposed back of curb, shall be cut to grade, scarified to a depth not less than 6", 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 ±1% deviation from the required moisture or density requirements. Irregularities exceeding 1/2" in 16' shall be corrected. Soft areas found at any time shall be removed, hauled off, and replaced with suitable material and compacted (especially at

utility trenches). The correct moisture density relationship shall be maintained until the subgrade is protected by the base and/or subsequent pavement course. 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" (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 OAR 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 ensure 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 OAR, 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.

(F) Uniform Pavement Construction

Pavement sections are to be constructed in a uniform manner that is full width of the roadway and not in narrow strips, to include subgrade and base sections, which should always be full width sections. Half street construction shall only be allowed with prior permission that is generally required only to preserve continuous traffic access. The subgrade and base sections shall each be constructed in a uniform and monolithic manner to the full roadway width, except when specifically approved otherwise for purposes of allowing for continuous vehicle access during reconstruction of an existing roadway or in cases where the available ROW prohibits full street construction.

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 OAR 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”. Do not drive tracked equipment directly on the geogrid. Provide at least 6” 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’ 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 and including to 1’ behind the proposed back of curb. 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, any existing pavement to be removed which is beyond the limits of excavation for the proposed street footprint (to 1’ behind the proposed back of curb) shall be subsidiary to the bid item for Clear ROW.

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, to include 1’ behind the proposed back of curb. 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 023020
JACKING, BORING OR TUNNELING (S-65)

1. DESCRIPTION

This specification shall govern provisions of the required opening for the installation of conduits by the methods of jacking, boring, or tunneling as shown on the plans and in conformity with this specification.

2. MATERIALS

Unless indicated otherwise in the drawings, casing pipe shall be smooth pipe with minimum yield strength of 35,000 psi. Minimum casing wall thickness shall be as follows:

Casing Diameter (Inches)	Minimum Wall Thickness (Inches)
Less than 12	1/4
Over 12 to 18	5/16
Over 18 to 22	3/8
Over 22 to 28	7/16
Over 28 to 34	1/2
Over 34 to 42	9/16
Over 42 to 48	5/8
Over 48	Specified by Engineer

3. CONSTRUCTION REQUIREMENTS

Where encasement or carrier pipe is required to be installed under railroad embankments or under highways, streets, or other facilities by jacking, boring or tunneling methods, construction shall be made in a manner that will not interfere with the operation of the railroad, highway, or other facility, and will not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the engineer, until such time as the backfill has been completed and then shall be removed from the site.

The drilling of pilot holes for the alignment of pipe prior to its installation by jacking, boring or tunneling will not be a requirement but may be necessary to maintain grade. The drilling of pilot holes will be considered as incidental work and the cost thereof shall be included in such contract pay items as are provided in the proposal and contract.

The contractor shall take the proper precautions to avoid excavating earth beyond the limits of excavation needed to install the conduit. All damages by excavating, either to surface or subsurface structures, shall be repaired or replaced by the contractor at his own cost and expense.

The removal of any obstruction that may be found to conflict with the placing of this pipe will not be measured for payment or paid for as a separate contract pay item. The removal of any such obstruction will be included in such contract pay items as are provided in the proposal and contract.

The contractor shall dispose of all surplus materials at his own cost and expense at site approved by the engineer.

4. SAFETY REQUIREMENTS

Suitable bracing, shoring and barricading shall be placed as necessary to provide a safe condition. Proper ventilation for excavations and tunnels shall

be required. Any excavation that remains open after working hours shall be covered with a steel plate of sufficient thickness to support traffic.

5. CONSTRUCTION BY JACKING

If the grade of the pipe at the jacking end is below the ground surface, suitable pipes or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. This excavation shall not be carried to greater depth than is required for placing of the guide and jacking timbers and no nearer the roadbed than the minimum distance shown on the plans.

At the other end of the pipe, an approach trench shall be excavated accurately to grade. All open trenches and pits shall be braced and shored in such a manner as will adequately prevent caving or sliding of the walls into the open trench or pit.

Heavy-duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head not less than 6 inches larger than the outside diameter of the pipe, usually of timber and suitable bracing between jacks and jacking head, shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. The jacking head shall be of such weight and dimensions that it will not bend or deflect when an opening for the removal of excavated material as the jacking proceeds. A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides that are straight and securely braced together in such manner to support the section of the pipe and to direct it in the proper line and grade. All timber and other materials used in the construction of the jacking assembly will be of such quality and dimensions that they will withstand all stresses to which they are subjected in such a manner as to insure even pressures on the pipe during jacking operations. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe.

As the jacking proceeds, the embankment material shall be excavated slightly in advance of the pipe in such a manner to avoid making the excavation larger than the outside diameter of the pipe, with the excavated material being removed through the pipe. The excavation for the underside of the pipe, for at least one third of the circumference of the pipe, shall conform to the contour and grade of the pipe. The excavation for the top half of the pipe shall conform closely to the outside diameter of the pipe and a clearance greater than 2 inches will not be permitted. All voids between the pipe and the earth shall be filled with non-shrinking grout. Grout holes shall be provided in the pipe.

The grouting shall follow immediately upon completion of the jacking operation.

All carrier pipes installed by jacking shall be supported as required by the plans.

The distance that the excavation shall extend beyond the end of the pipe depends on the character of the materials, but it shall not exceed 2 feet in any case. The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line grade established by the engineer will be permitted only to the extent of 1 inch per 10 feet, maximum of 6 inches, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans.

When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable; to prevent the pipe from becoming firmly

set in the embankment.

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

The pits or trenches excavated to facilitate jacking operation shall be filled immediately after the jacking of the pipe has been completed unless an encasement only has been installed; in which case, the trenches and pits shall be left open until the carrier pipe has been laid through and manholes have been built if required. The pits or trenches shall then be backfilled in accordance with 022020, Excavation and Backfill for Utilities & Sewers.

7. CONSTRUCTION BY BORING

The hole shall be bored mechanically with a suitable boring assembly designed to produce a smooth, straight shaft and so operated that the completed shaft will be at the established line and grade. The size of the bored hole shall be of such diameter to provide ample clearance for bells or other joints.

Voids outside the casing shall be grouted with non-shrinking grout and will be considered subsidiary work. In addition to the requirements stated above, the applicable provisions of "Construction By Jacking", in regard to the construction of trench, tolerance in line and grade, method of operation, backfilling, etc., shall govern for construction by boring.

7. CONSTRUCTION BY TUNNELING

The tunnel shall be excavated in such a manner and to such dimensions, which will permit placing of the proper supports necessary to protect the excavation. The contractor shall take the proper precautions to avoid excavating earth beyond the limits of excavation shown on the plans. All damages by excavating, either to surface or subsurface structures, shall be repaired or replaced by the contractor at his own cost and expense.

If required by the plans or if required for safety, suitable steel or timber sheeting, shoring and bracing shall be used to support the sides and roof of the excavation. Supports may be left in place provided that they clear the steel liner plate or carrier pipe. No separate payment will be made for supports left in place. Nothing contained herein shall prevent the contractor from placing such temporary or permanent supports as he deems necessary, nor shall it be construed as relieving the contractor from his full responsibility for the safety of the work, and for all damages to persons and property.

Liner plate shall be place when the foundation is in a condition satisfactory to the engineer. Tunnel dimensions shall be minimum dimensions and subsequent grout fill around the perimeter of the liner plate, shall be at the expense of the contractor. The liner plate shall be laid true to line and grade. Tolerance in line and grade shall be as specified in, "Construction by Jacking".

The void between the tunnel wall and the tunnel lining shall be backfilled with non-shrinking grout having a minimum compressive strength of 1000 pounds per square inch at 28 days. Grout shall not be placed inside the liner plate.

All pipe damaged during construction operations shall be repaired or removed and replaced by the contractor at his entire expense.

8. JOINTS

If corrugated galvanized metal pipe is used, joints may be made by field bolting

or by connecting bands, whichever is feasible. If reinforced concrete pipe 24 and larger in diameter with tongue and groove joints is used for the encasement pipe, the interior joints for the full circumference shall be sealed and packed with mortar and finished smooth and even with the adjacent section of pipe. If steel pipe is used for the encasement pipe, the joints shall be welded sealed for the full circumference.

9. MEASUREMENT & PAYMENT

Unless indicated otherwise in the proposal, Jacking, Boring, and tunneling shall not be measured for pay but shall be subsidiary to the casing pipe or the liner plate.

SECTION 023040
TUNNEL LINER PLATE (S-65A)

1. DESCRIPTION

This specification shall govern all necessary work for furnishing tunnel liner plate required to complete the project.

2. MATERIALS

Tunnel liner plate shall be designed in accordance with AASHTO "Design Specification for Tunnel Liner Plate". It shall be capable of withstanding a unit pressure of 1,400 lb. per square foot at top of liner based on safety factors of 3, 2, and 3 for seam strength, buckling and stiffness, respectively.

Liner plate shall be fabricated from structural quality, hot-rolled carbon-steel sheets or plates conforming to ASTM Specification A-569. Plates shall be accurately curved to suit the tunnel cross section and shall be of uniform fabrication to allow plates of similar curvature to be interchanged.

All plates shall be punched for bolting on both longitudinal and circumferential seams and shall be so fabricated as to permit complete erection from the inside of the tunnel. The longitudinal seam shall be of the lap type, with an offset equal to gauge of metal for the full width of late to allow the cross section of the plate to be continuously through the seam. Circumferential hole spacing will be a multiple of plate length to allow staggering of the longitudinal seam.

Material shall be galvanized and zinc coated in accordance with ASTM Specification A 123, except that the zinc shall be applied at the rate of two (2) ounces per square foot total for both sides.

Material shall be bituminous coated and conform to AASHTO Designation M190.

Bolts and nuts shall be of the diameter and length as recommended by the manufacturer. Galvanized bolts and nuts are required with galvanized plate and shall conform to ASTM Specification A 153.

Liner plate shall be assembled in accordance with manufacturer's instructions.

Longitudinal seams shall be staggered between rings. Liner plate shall be a nominal diameter of 48" after assembly and have a minimum thickness of .1046" or 12 gauge.

3. MEASUREMENT & PAYMENT

Unless indicated otherwise in the Proposal, Tunnel liner plate shall be measured and paid for by the linear foot.

SECTION 023080
TIMBER FOUNDATION PILING (S-95)

1. DESCRIPTION

This specification shall govern all work necessary for furnishing and installing timber piles required to complete the project.

2. EQUIPMENT

Equipment used shall be of current design, safe, and of the required capacity and condition necessary to complete the project.

The driving equipment shall meet the energy requirements set forth as follows:

Average Pile Diameter (Inches)	Minimum Energy Requirements (foot-pounds)
8 and less	7,000
8 to 18	15,000
Over 18	22,000

3. MATERIALS

Piles shall be southern yellow pine of size and length indicated on the drawings, Piles shall be branded in accordance with A.W.P.A. Standard ML. Piles shall comply with physical requirements of ASTM D25 "Standard Specification for Round Piles".

Foundation piles shall be treated in accordance with A.W.P.A. Standards C1-82 and C3-81 (or latest revision) to a minimum final retention of 12 pounds per cubic foot with creosote conforming to A.W.P.A. Standard P1-78 (or latest revision).

4. CONSTRUCTION METHODS

It is the intent of this specification that all proposed piles be driven to the capacity indicated in the drawing while also achieving maximum penetration. The determination of the optimum amounts of jetting and driving shall be done by the Engineer during the pile driving operation. The Engineer will establish jetting and driving lengths that will result in minimal pile splicing. Each pile shall initially jetted to an elevation or depth indicated by the Engineer. The pile shall then be driven until it achieves the capacity indicated in the drawing. The bearing capacity, R (tons), of the pile shall be determined by the "Engineer News" formula given as follows:

$R = 2(WxH)/(S+1)$ For Drop Hammer

$R = 2(WxH)/(S+.1)$ For Single-Action Steam Hammer

$R = 2E/(S+.1)$ For Double-Action Steam Hammer

where: W = weight of hammer (tons)
H = length of drop (feet)
R = pile bearing capacity (tons)
S = final driving penetration (inches per blow)

If the pile is driven to the cut-off elevation and has achieved at least 80% of the specified capacity at the cut-off elevation, the pile shall be immediately spliced and driving continued until capacity is achieved. Splices shall not be allowed.

Final trim shall be treated in accordance with A.W.P.A. M4-80.

All piles (batter piles excluded) shall be driven vertically. Before beginning of the driving operation, lead shall be checked for plum. At cut-off, the piles shall not be over 3 inches from the position indicated on the drawing.

It shall be the responsibility of the contractor to select appropriate hammer, pile caps, tips, etc., as required to place the pile. All piles damaged during handling or placement shall be replaced by the contractor at no additional cost to the City.

The contractor shall cooperate with the Engineer during driving operation. No piling shall be driven in the absence of the Engineer. The contractor shall keep an accurate record of the pile driving operation. The records shall be kept on the jobsite by the contractor for the Engineer to review and shall be submitted to the Engineer, upon completion of the project.

5. CERTIFICATION & TESTING

Piles shall be branded in accordance with A.W.P.A. Standard M6 (latest revision). Compliance with specifications regarding physical characteristics and preservative retention shall be verified by lab reports from an independent testing lab. The reports shall be delivered with the material shipment. Failure to comply with these specifications will be cause to reject the shipment. The City reserves the right to have additional lab testing performed prior to acceptance of materials.

6. MEASUREMENT & PAYMENT

Unless indicated otherwise in the Proposal, piles will be measured by the linear foot along the centerline from he point at which the pile cut-off to the point of maximum penetration. Any length above cut-off elevation will not be measured for pay. Payment shall include, but not be limited to, transporting, storing, cutting, splicing, and placement of piles.

SECTION 024020
RAILROAD TRACKS (S-130)

1. SCOPE - This section covers furnishing all labor, materials, tools, equipment and services required for the rehabilitation of the railroad tracks as specified herein and called for on the plans, including placing ballast, setting ties, laying and aligning track to grade required to complete the project.

2. GENERAL - All construction and installation not noted herein or on the drawings shall conform to American Railway Engineering Association (AREA) specifications or Union Pacific Technical Specifications for Industrial Track.

3. MATERIALS

Top Ballast shall be hard rock crushed to suitable size; crushed blast furnace or properly processed open-hearth slag; or crushed gravel with sufficient angular physical properties to prevent rolling. The top ballast shall meet the following gradation requirements:

Sieve Opening	Passing
12 Inch	100%
1 Inch	90 - 100%
3/4 Inch	40 - 75%
1/2 Inch	15 - 35%
3/8 Inch	0 - 15%
No. 4	0 - 5%

Ties shall be new creosote-treated oak ties, sawed top, bottom and sides, and minimum size 7" thick x 9" wide x 8'-6" long. These cross ties shall be in accordance with AREA specifications for Cross ties, latest revision. The treatment shall be empty-cell process with eight pounds per cubic foot retention, in accordance with AREA specifications for Treatment, latest revision. Creosote shall be 40-60 creosote-coal tar solution in accordance with AREA specifications for Preservatives. No substitutes unless approved by the Engineer.

Switch Ties shall be new creosote-treated oak ties in accordance with AREA specifications for Switch Ties, latest revision. Treatment shall be same as above for Cross Ties. Dimensions shall be in accordance with AREA Plan 912-58. No substitutes unless approved by Engineer.

Guard Rails shall be 5" x 5" hardwood or yellow pine; treatment shall be same as above for Cross-Ties.

Tie Plugs shall be in accordance with AREA specification for Tie Plugs, latest revision.

Tie Plates shall be standard, single or double-shoulder, properly sized to fit the rail section used. Tie plates may be either new or used; if new they shall be AREA standard; if used, they shall be in good condition, free from excessive corrosion. Use double tie plates for guard rails.

Spikes shall be new spikes 5/8" square x 6" long in accordance with AREA specifications for High-Carbon Steel Track Spikes, latest revision.

Rails shall be new 90# ARA-A relay rails. Relay rail shall be in good condition, free from bends, broken flanges, flow, flat spots, end batter, and wheel burns. Cut off battered or defective ends, square and re-drill bolt holes as required. Rails, if necessary, will be cut with a saw during installation and repair or track. No oxygen-acetylene cutting of rails will be permitted.

Angle Bars will be four-hole new or used. Angle bars shall fit the rail section used and shall be in good condition, straight, and free from excessive corrosion.

Track Bolts shall be new 1" heat-treated carbon-steel track bolts and nuts in accordance with AREA specifications for heat-treated carbon-steel and alloy-steel track bolts, and carbon-steel nuts, latest revision.

Spring Washers shall be steel in accordance with AREA specifications for Spring Washers, latest edition.

Rail Anchors shall be new steel rail anchors, "Improved Fair," or approved equal.

Turnouts - Frogs, if required, shall be sized to match or as shown on drawings and shall be bolted-rigid frogs conforming to AREA Plan 323-55. Frogs shall be complete, including a full set of twin hook tie plates. Switches shall be 16'-16" long split-switch, conforming to AREA Plan 112-55. Switches shall be complete, including full set of slide and heel plates, heel blocks, and switch rods.

Two 11' guard rails shall be used at each frog. Guard rails shall conform to AREA Plan 504-55, except shall be furnished complete with guard rail plates and adjustable guard rail clamps.

All turnout dimensions shall conform to AREA Plan 910-41 unless noted otherwise on the drawing.

Switch-stands shall be automatic safety switch stands, Ramapo No. 20-C, or an approved equal.

Bumping Post - Buda Bumping Post #20 or approved equal.

Rail Clips - Rail clips used to anchor the rails through the buildings shall be L.B. Foster #106.

Gauge Rods shall be 1¾" diameter adjustable gauge rods, either new or used. If used, they shall be straight, the threads good, and free from excessive corrosion.

4. CONSTRUCTION - Cross ties shall be laid on 21" centers at right angles to the rail with one end lined uniformly. Ties must be laid with the heart side down. The bottom of the rail, the tie plate, and the bearing surface of the tie shall be cleaned before rail is laid. Switch ties shall be spaced and sized in accordance with AREA Plan 912-58.

Track shall be fully tie-plated. Tie plates must be applied in a workmanlike manner, at the time the rail is laid, with the shoulder in contact with the field side of the rail base for the entire length of the shoulder.

Metal, fiber, or wood shims must be used to provide the proper opening between the rails, and thermometer used to determine the thickness of shims to be used in accordance with the standards of the AREA. All shims must be removed to within 12 rail lengths of the laying; after completion, all shims must be removed.

Necessary gauging at joints, centers, and quarters must be done at the time rail is laid to maintain gauge recommended by the AREA. Do not remove gauge until spikes are driven home.

All joints shall be fully bolted and rail drilled where necessary. Spring washers shall be used on all bolts. Burning of bolt holes will not be allowed. All bolts must be tight.

All rail joints must be staggered and shorter rail lengths used to maintain the proper stagger or curves. On tangent track, or on curves less than three degrees, rail shall be spiked with not less than two spikes per tie plate. On curves three degrees and over, four spikes shall be used per tie plate.

All spikes shall be started and driven vertically and square with the rail and so driven as to allow 1/8" to 3/16" space between the underside of the head of the spike and the top of the base of the rail. In no case shall the spike be over driven, or straightened while being driven. No spikes shall be driven against the ends of joint bars.

Tie plugs shall be used to fill all spike holes.

Rail anchors shall be applied at the rate of eight anchors per 39' rail length. The anchors shall be placed approximately uniformly along the rail length and boxed around the same tie on opposite rails to resist movement in both directions.

Gauge rods shall be applied at the rate of five per 39' rail on all curves of ten degrees or over.

Switches must be left in proper adjustment and oiled, special care being given to the bending of the stock rail.

The preliminary surfacing gang shall follow the unloading of ballast as closely as practical. In using jacks, they must be placed close enough together to prevent undue bending of the rail or strain on the joints. Both rails must be raised at one time and as nearly uniformly as possible. The track shall be so lifted that after a period of not less than three days after the last lift, it will be necessary to give it a final lift of not less than one inch nor more than two inches to bring it to the grade of the stakes. All ties that are pulled loose shall be replaced in proper position. Ballast shall be well packed and tamped from a point 15" inside of each rail on both sides of the tie to the ends of the ties.

When the track has been raised to within one or two inches of the final grade and properly compacted by traffic, a finishing lift shall be made and the track brought to a true surface.

All track shall have a minimum of 12" of top ballast below the bottom of the ties.

The Contractor is to understand that any work not specifically mentioned in this specification, but which is necessary for the proper carrying out of the intent thereof, shall be required and applied.

5. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Track Resurfacing and Track Reconstruction shall be measured by the linear foot of tracks, measured along the centerline of the tracks. Measurement shall include, but not be limited to, all labor, materials, equipment, and incidentals required to restore the track to the required section, with the exception of those items specifically itemized in the proposal.

SECTION 024060
MARINE TIMBER (S-93)

1. DESCRIPTION

This specification shall govern all work necessary for furnishings and installing timber required to complete the project. The lengths and dimensions of timbers shall be as shown on the plans or as determined in the field by the Engineer.

2. MATERIALS

Unless specified otherwise, all timber members shall be new Southern Yellow Pine, pressure treated in accordance with A.W.P.A. Standard C1-78, C2-80 and C18-77 (or latest revisions). All timber shall be treated with chromated copper arsenate (CCA) conforming To A.W.P.A. Standard P5-78 (or latest revision) to a minimum final retention of .6 p.c.f. by assay (.4 p.c.f. by assay may be used where specifically indicated on the Plans or Special Provisions). The grade of lumber shall be as specified on the Plans or Special Provisions.

All timber shall be S4S milled to applicable size and tolerance, unless noted otherwise in the drawings and all materials shall be new and shall not have been previously used unless otherwise noted.

3. CONSTRUCTION METHODS

Field and handling procedures shall comply with A.W.P.A. Standard M4-80 (or latest revision). All timber shall be treated to comply with A.W.P.A Standard M4-80.

Nailing of members shall be sufficient to ensure adequate joining of members. Nails shall be hot-dipped USS common domestic manufacturer. USS box end nails will not be allowed. Nails shall be of a size as indicated on the drawings. Where sizes are not indicated, they shall be in accordance with standard acceptable practice.

Lag bolts shall have lead holes for the shank bored the same diameter as the shank and the same depth as the length of the unthreaded shank. The lead holes for the threaded portion shall have a diameter of 60 to 75 percent of the shank diameter and a length equal to at least the length of the threaded portion. Lead holes shall be not be bored completely through the piles. If this is done, the exit hole shall be plugged. The threaded portion of the screw shall be inserted into the lead hole by turning with a wrench and not by driving with a hammer. Epoxy shall be used as a lubricant on the lag bolt and lead hole to facilitate insertion and prevent damage to the bolt and galvanized finish.

Through bolted joints shall have lead holes bored from 1/32 to 1/16 inch larger than the bolts. Tight fit requiring forcible driving is not recommended.

4. CERTIFICATION & TESTING

Timber shall be marked with the identification of the treating company. Compliance with specifications regarding physical characteristics and preservation retention shall be verified by lab reports from an independent testing lab. The reports shall be delivered with the material shipment. Failure to comply with these specifications will be cause to reject the shipment. The City reserves the right to have additional lab testing performed prior to acceptance of materials. If the materials do not meet specified

requirements, the Contractor shall pay for the lab testing.

5. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Marine timber shall not be measured for pay, but shall be subsidiary to the appropriate bid item.

SECTION 024080
TIMBER PILING FOR PIER CONSTRUCTION (S-94)

1. DESCRIPTION

This specification shall govern shall work necessary for furnishing and installing timber piles required to complete the project.

2. MATERIALS

All piles shall be Souther Yellow Pine, complying with ASTM Standard D25-73 (or latest revision). Piles shall be pressure treated in accordance with A.W.P.A. Standard C1-78 and C18-77 (or latest revisions) with chromated copper arsenate (CCA) conforming to A.W.P.A. Standard P5-78 (or latest revision) to minimum final retention of 2.5 p.c.f. by assay.

3. CONSTRUCTION METHODS

Equipment used for the installation of piles shall be of current design, safe, and of the required capacity and condition necessary to complete the project. The Contractor shall be responsible for safe storage and handling of all piles furnished to or by him and shall use every precaution to avoid damage to the treated piling.

The embedment depth shall be measured from the top of the firm, hard virgin material (not shoal deposits) to the maximum penetration of the pile. All piles (battered piles excluded) shall be driven vertically. Before beginning the driving operation, lead shall be checked for plumb. At the cut-off point, the pile shall not be over three (3) inches from the position indicated on the plans. It shall be the responsibility of the contractor to select the appropriate hammer, pile caps, tips, etc., as required to place the piles. All piles damaged during handling or placement shall be replaced by the Contractor at no additional cost to the City.

After final trim, all piles shall be sealed at the top in compliance with A.W.P.A. Standard M4-80.

An accurate record of pile location, length and embedment depth shall be kept by the Contractor for each pile driven. The record shall be kept on the job site for the Engineer's review and shall be submitted to the Engineer upon completion of the pile driving operation.

4. CERTIFICATION AND TESTING

Piles shall be branded in accordance with A.W.P.A. Standard M6 (latest revision). Compliance with specifications regarding physical characteristics and preservative retention shall be verified by lab reports from an independent testing lab. The reports shall be delivered with the material shipment. Failure to comply with these specifications will be cause to reject the shipment. The City reserves the right to have additional lab testing performed prior to acceptance of materials. If the materials do not meet specified requirements, the Contractor shall pay for the lab testing.

5. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, piles will be measured by the linear foot along the centerline from the point at which the Contractor cuts off the pile to the depth of minimum embedment. The City will allow payment for one (1) additional foot of embedment should the Contractor elect to drive

the pile deeper than the minimum embedment depth. Any length above the top cut-off will not be measured for pay. Payment shall include, but not be limited to transporting, storing, cutting, drilling and placement of the piles.

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:

	Percent
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.

Square Sieve Size	Percent Retained By Weight
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)

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 form 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 OAR. 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 OAR 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 OAR. The OAR 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", 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, spread, and shaped into a uniform layer 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 as indicated in the drawings, not to exceed 10" loose lifts or 8" compacted lifts. Moisture and density requirements for each layer 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 ± 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 ±1% deviation from specified moisture or density requirements.

Correct or replace segregated areas as directed by the OAR at no additional cost. Maintain moisture and density until the compacted base is protected by the subsequent pavement layer. Do not allow standing water to collect and pond for an extended period on exposed unprotected base material.

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 prior to 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" in cross-section and in lengths of 16’ 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 shall 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 1⅜ 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 ½ 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 the 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 year 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 that 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^5. Rejuvenator shall be applied without dilution, unless authorized otherwise by the Engineer.

VIBRATORY SCREEDING of recycled HMAC 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 HMAC shall be placed over the Recycled HMAC while the temperature of the Recycled HMAC is still above 235 F. Unless specified otherwise on the drawings, the new HMAC 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:

Sieve Size	Percent Passing
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 60º F and falling, but it may be applied when the air temperature is above 50º 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 60ºF and falling, but may be applied when the air temperature is above 50ºF 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.

	Gallons of Asphalt Per Square Yard		Aggregate Cu.Yd. to Sq.Yd.	
	Min.	Max.	Min.	Max.
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 – 2nd course (top) Grade 3 – 1st course (bottom)
Three-Course:	Grade 4 – 3rd course (top) Grade 3 – 2nd course (middle) Grade 3 – 1st 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 60º F and is falling, but it may be applied when the air temperature is above 50º 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:

	1st Course	2nd Course	3rd Course
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:

Sieve Size	Percent Passing
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 025422
COLD MIX LIMESTONE ROCK ASPHALT PAVEMENT (Class A) (S-33)

1. MATERIAL

This specification shall consist of a surface course, a leveling-up course, or a combination of these courses as shown on plans, composed of a compacted layer of natural limestone rock asphalt, cold mixed with prescribed flux and shall be constructed on the completed and approved base course, existing pavement or floor slab, all in accordance with these specifications and in conformity with lines, grades, quantities and typical cross section shown on plans. The mixture when designed and tested in accordance with these specifications shall have a laboratory stability of not less than 30 percent unless otherwise shown on the plans.

2. MATERIALS

(1) Rock Asphalt. This material shall be composed of natural limestone rock asphalt. This material shall contain not more than 1 percent by weight of organic matter (other than native bitumen), clays, loam or pebbles coated therewith and shall contain not more then 5 percent by weight of any one of or combination of slate, shale, schist, soft particles or other undesirable materials when tested in accordance with Test Method Tex-217-F.

The rock asphalt mixture shall be uniform and well graded and shall contain natural limestone rock asphalt aggregate with an average bitumen content of 5 to 9 percent by weight of naturally impregnated asphalt as determined by Test Method Tex-215-F, and shall contain not more than 2 percent by weight of any one of or combination of iron pyrites, or other objectionable matter, as determined by Test Method Tex-217-F.

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

The portion of the material passing the No. 10 sieve shall have by weight not more than 8.5 percent or less than 5 percent of naturally impregnated asphalt.

Except for Type 'D' Paving Mixture, the portion of the material retained on the No. 4 sieve shall contain by weight from 20 percent to 35 percent of material with a naturally impregnated asphalt content of less than 1 percent. The portion of the material retained on the No. 4 sieve for Type 'D' Paving Mixture shall contain by weight from 15 percent to 35 percent of the material with a naturally impregnated asphalt content of less than 1 percent. This percentage shall be adjusted within the grading limits to obtain an acceptable mixture.

The percent of wear on limestone rock asphalt aggregate shall be no more than 40 as determined by Test Method Tex-410-A and shall be made on that portion of the material retained on the No. 4 sieve having a naturally impregnated asphalt content of less than 1 percent. Rock Asphalt shall have a minimum polish value of 35, unless otherwise specified, when tested in accordance with Test Method Tex-438-A.

No material shall be used before the source has been approved and the material has been sampled, tested and approved by the Engineer. The Contractor shall notify the Engineer in advance if change in source of any material is desired, and both the new source and material shall be

approved by the Engineer prior to use.

(2) Flux. The fluxing material shall meet the Flux Oil requirements of the specification, Section 025404 "Asphalts, Oils and Emulsions".

Tack Coat. The asphalt material for tack coat shall meet the requirements for emulsified asphalt, EA-11M, or cut-back asphalt, RC-2. If RC-2 cut-back asphalt is used it may, upon instruction from the Engineer, be diluted by the addition of an approved grade of gasoline and/or kerosene, not to exceed 15 percent by volume. Asphaltic materials shall meet the requirements of the specification, Section 025404 "Asphalts, Oils and Emulsions".

3. PAVING MIXTURES

(1) Types. The paving mixture shall consist of a uniform mixture of crushed limestone rock asphalt aggregate, flux and water if needed. The grading shall be such as to produce, when properly proportioned, a mixture which, when tested in accordance with Test Method Tex-200-F, will conform to the limitations for grading given below for the type specified prior to the aggregate. The grading to be used in these mixtures, within the limits specified, shall be approximately as designed by the Engineer, and the mixture produced shall be uniform.

	Percent by Weight
Type "A"	
Retained on 1" sieve	0
Retained on 7/8" sieve	0 to 2
Retained on 5/8" sieve	5 to 15
Retained on 3/8" sieve	25 to 35
Retained on No. 4 sieve	50 to 60
Retained on No. 10 sieve	25 to 35
Type "B"	
Retained on 5/8" sieve	0
Retained on 1/2" sieve	0 to 2
Retained on 3/8" sieve	5 to 15
Retained on No. 4 sieve	45 to 60
Passing No. 10 sieve	25 to 35
Type "C"	
Retained on 1/2" sieve	0
Retained on 3/8" sieve	0 to 2
Retained on No. 4 sieve	40 to 55
Passing No. 10 sieve	20 to 35
Type "CC"	
Retained on 1/2" sieve	0
Retained on 3/8" sieve	0 to 2
Retained on No. 4 sieve	40 to 55
Passing No. 10 sieve	35 to 50
Type "D"	
Retained on 3/8" sieve	0

Retained on 1/4" sieve	0 to 2
Retained on No. 4 sieve	5 to 15
Passing No. 10 sieve	35 to 50

(2) Sampling and Testing. The mixture shall be tested in accordance with Texas Test Methods to determine whether it complies with the governing specification requirements.

Stability is a control requirement. If the stability of the mixture produced has a value 10 percent lower then that specified, corrective measures shall be taken to bring the mixture within the specified requirements.

(3) Tolerances. The designated grading and fluxing material content shall be such that when the tolerances listed below are allowed, the grading and the fluxing material content will be within the grading limits specified. The respective tolerances, based on the percent by weight of the mixture, are listed as follows:

	Percent by Weight
Retained on 7/8" sieve	plus or minus 4
Retained on 5/8" sieve	plus or minus 4
Retained on 1/2" sieve	plus or minus 4
Retained on 3/8" sieve	plus or minus 4
Retained on 1/4" sieve	plus or minus 4
Retained on No. 4 sieve	plus or minus 4
Total Retained on No. 10 sieve	plus or minus 3
Fluxing Material	plus or minus 0.2

(4) Material Produced for Maintenance Requisition. The limestone rock asphalt aggregate grading and flux content of the mixture shall be within the limits specified. The designated grading and flux content shall be selected from the first shipment for material on each shipment or partial shipment where requested by the Engineer, and the mixture produced shall conform to this designated grading and flux context throughout each shipment or partial shipment, respectively, within the tolerances specified above.

(5) Water Content. If the rock asphalt mixture is prepared at some central point and shipped to the work, water may be added to prevent setting-up in transit. If water is added, the total water so added shall not exceed 4 percent by weight and shall be administered to the mixture through an approved spray bar. If the rock asphalt mixture is prepared on or adjacent to the project, the addition of water will not be permitted unless authorized by the Engineer. The amount of water that may be added shall be as designated by the Engineer but shall not exceed 4 percent by weight. In order to insure uniformity of the rock asphalt mixture a suitable measuring devise, subject to approval of the Engineer, shall be used to accurately measure the amount of water to be incorporated into each batch. All water in the mixture on the truck scales shall be deducted in determining the tonnage of mixture for payment. The method of determining the water content of the mixture shall be in accordance with Test Method Tex-212-F. The water content shall be measured on representative samples, each representing approximately 200 tons. Not less than one sample shall be taken on each day's run.

(6) Physical Properties of the Mixture. The material may be mixed on the job or at some central mixing plant and shipped ready to use. Mixtures that do not remain workable a sufficient period of time to permit unloading by

normal means, proper spreading, blading and rolling, will not be acceptable.

The type and amount of the mixture used shall be as specified on the plans.

4. EQUIPMENT

(1) Mixing Plants. Mixing plants that will not continuously produce a mixture meeting all of the above requirements will be condemned.

Mixing plants may be either the weight-batching type or the continuous mixing type. Both types of plant shall be equipped with satisfactory conveyors, power units, aggregate handling equipment, aggregate screens and bins and shall consist of the following essential pieces of equipment:

(a) Weight-Batching Type.

Cold Aggregate Bin and Proportioning Device. The cold aggregate bins or aggregate stockpiles shall be of sufficient number and shall be of sufficient size to supply the amount of aggregate required to keep the plant in continuous operation. The proportioning device shall be such as will provide a uniform and continuous flow of aggregate in the desired proportion to the plant.

Screening and Proportioning. The screening capacity and size of the bins shall be sufficient to screen and store the amount of aggregate required to properly operate the plant and keep the plant in continuous operation at full capacity. Proper provisions shall be made to enable inspection forces to have easy and safe access to the proper location on the mixing plant where accurate representative samples of aggregate may be taken from the bins for testing. The aggregate shall be separated into at least four bins when producing Type "A" mixtures, at least three bins when producing Type "B" and at lease two bins when producing Types "C" and "D".

Type "A":

Bin No. 1 - will contain aggregates of which 85 to 100 percent by weight will pass the No. 10 sieve.

Bin No. 2 - will contain aggregates of which at least 85 percent by weight will be of such size as to pass the 3/8 inch sieve and be retained on the No. 10 sieve.

Bin No. 3 - will contain aggregates of which at least 85 percent by weight will be of such size as to pass the 1/2 inch sieve and be retained on the 1/4 inch sieve.

Bin No. 4 - will contain aggregates of which at least 85 percent by weight will be of such size as to pass the 7/8 inch sieve and be retained on the 3/8 inch sieve.

Type "B":

Bin No. 1 - will contain aggregates of which 85 to 100 percent by weight will pass the No. 10 sieve.

Bin No. 2 - will contain aggregates of which at least 85 percent by weight will be of such size as to pass the 3/8 inch sieve and be retained on the No. 10 sieve.

Bin No. 3 - will contain aggregates of which at least 85 percent by weight will be of such size as to pass the 1/2 inch sieve and be retained on the 1/4 inch sieve.

Type "C", Type "CC" and Type "D":

Bin No. 1 - will contain aggregates of which 85 to 100 percent by weight will pass the No. 10 sieve.

Bin No. 2 - will contain aggregates of which at least 85 percent by weight will be of such size as to pass the 3/8 inch sieve and be retained on the No. 10 sieve.

Aggregate Weigh Box and Batching Scales. The aggregate weigh box and batching scales shall be of sufficient capacity to hold and weigh a complete batch of aggregate.

Flux Oil Bucket and Scales. The flux oil bucket and scales shall be of sufficient capacity to hold and weigh the necessary material for one batch.

Mixer. The mixer shall be of the pug mill type and shall have a capacity of not less than 3,000 pounds in a single batch. The number of blades and the position of same shall be such as to give a uniform and complete circulation of the batch in the mixer. The mixer shall be equipped with an approved spray bar that will distribute the fluxing material quickly and uniformly throughout the mixer. If, in the opinion of the Engineer, any mixer has a tendency to segregate the mineral aggregate or fails to secure a thorough and uniform mixing with the fluxing material, it shall not be used. All mixers shall be provided with an automatic time lock that will lock the discharge doors and the shaft seals of the mixer shall be tight enough to prevent the spilling of aggregate or mixture from the pug mill.

(b) Continuous Mixing Type

Cold Aggregate Bin and Proportioning Device. Same as for weight-batching type of plant.

Screening and Proportioning. Same requirements as specified under weight-batching plants. These requirements shall also apply to materials that are stockpiled and that are proposed for direct use by a continuous mixing plant without the use of plant bins.

Fluxing Material Spray Bar. The fluxing material spray bar shall be so designe

Mixer. The mixer shall be of the pug mill continuous type and shall have a thorough and uniform mixing of the aggregate with the fluxing material, it shall not be used.

(2) Spreading and Finishing Machine. The spreading and finishing machine, when permitted, shall be a type approved by the Engineer and shall be capable of producing a surface that will meet the requirement of the typical cross section and the surface test.

(3) Motor Grader. The motor grader shall be a self-propelled power-

grader; it shall be equipped with smooth tread pneumatic tired wheels; shall have a blade length of not less than 12 feet; shall have a wheel base of not less than 16 feet; and shall be tight and in good operating condition and approved by the Engineer.

(4) Pneumatic Tire Rollers. The rollers shall consist of not less than seven pneumatic tired wheels, running on axles in such manner that the rear group of tires will cover the entire gap between adjacent tires of the forward group, and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading. The front axle shall be attached to the frame in such manner that the roller may be turned within a minimum circle. The pneumatic tire roller under working conditions shall have an effective rolling width of approximately 84 inches and shall be so designed that be ballast loading the total load may be varied uniformly from 23,500 pounds or less to 50,000 pounds or more. The roller shall be equipped with tires that will afford ground contact pressures to 90 pounds per square inch or more. The operating load and tire air pressure shall be within the range of the manufacturer's chart as directed by the Engineer. The Contractor shall furnish the Engineer with charts and tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished.

The pneumatic tire roller shall be drawn by a suitable crawler type tractor, a pneumatic tired tractor, or a truck of adequate tractive effort, or may be of the self-propelled type, and the roller, when drawn or propelled by either type of equipment, shall be considered a medium pneumatic tire roller unit. The power unit shall have adequate tractive effort to properly move the operating roller at variable uniform speeds up to approximately 5 miles per hour.

The tire pressure of each tire shall be adjusted as directed by the Engineer and this pressure shall not vary by more than 5 pounds per square inch.

(5) Two Axle Tandem Roller. This roller shall be an acceptable power drive tandem roller weighing not less than 8 tons.

(6) Three Wheel Roller. This roller shall be an acceptable power driven three wheel roller, weighing not less than 10 tons.

(7) Three Axle Tandem Roller. This roller shall be an acceptable driven three axle roller weighing not less than 10 tons.

(8) Straightedges and Templates. The Contractor shall provide acceptable 10-foot straightedges for surface testing. Satisfactory templates shall be provided as required by the Engineer.

(9) Trunk Scales. A set of standard platform truck scales, shall be placed at a location approved by the Engineer.

(10) All Equipment. Shall be maintained in good repair and operating condition and shall be approved by the Engineer.

(11) Alternate Equipment. When permitted by the Engineer in writing, equipment other than that specified which will consistently produce satisfactory results may be used.

5. STORAGE, PROPORTIONS AND MIXING

(1) Storage of Rock Asphalt

Central Mixing Plants. Sufficient material shall be stored, stockpiled or produced to permit continuous operation throughout any working period without shutdowns due to material shortages. If the natural limestone rock asphalt aggregates are stored or stockpiled, they shall be handled in such a manner as to prevent segregation, the mixing of various materials or sizes and the contamination with foreign materials.

Storage of the crushed limestone rock asphalt mixture upon the ground will not be permitted at the plant site. Material that comes in contact with earth or other objectionable foreign matter shall be rejected. Mixtures that do not remain workable a sufficient period of time to permit proper spreading, blading and rolling will not be acceptable. Storage, handling or loading of the rock asphalt mixture shall be in such manner as to prevent undue segregation.

(2) Storage and Heating of Flux. The flux storage shall be ample to meet the requirements of the plant. The flux may be heated by steam coil or direct fire to a temperature not to exceed 250EF. Agitation by steam or air will not be permitted. If direct fire heating is used, the heating equipment shall be such that it will insure positive circulation of the flux while being heated and shall be approved by the Engineer. Care shall be taken not to injure the flux by subjecting it to undue continuous heat. The heating apparatus shall be equipped with a recording thermometer with a 24 hour chart that will record the temperature of the fluxing material where it is at the highest temperature.

(3) Proportioning. The proportioning of the various materials entering into the mixture shall be in accordance with this specification. Aggregate shall be proportioned by weight using the weigh box and batching scales when the weight-batch type of plant us used and by volume using the aggregate proportioning device when the continuous mixer type of plant is used. The fluxing material shall be proportioned by weight or by volume based on weight using the specified equipment. The proportions of each constituent by weight of the paving mixture shall be within the following limits.

Crushed Limestone Rock Asphalts, 96 to 97.5 percent by weight.

Flux Material, 2.5 to 4 percent by weight.

(4) Mixing. In introducing the batch into the mixer, the sequence of

addition of aggregate and flux oil and the amount of mixing shall be done in a manner to minimize formation of "flux balls" and produce optimum conditions for a homogeneous mix. The mixer shall be equipped with an approved spray bar that will distribute the flux oil quickly and uniformly throughout the mixer. Any mixer that has a tendency to segregate the rock asphalt aggregate or fails to secure a thorough and uniform mixing with the flux oil shall not be used.

Mixtures produced when the limestone rock asphalt aggregates contain moisture in excess of saturated surface dry condition will not be accepted. Excess moisture will be evidenced by visual surface moisture on the aggregates or any unusual quantities of fines clinging to the coarse aggregate.

In order to observe plant operations and the rock asphalt mixtures, adequate lighting shall be provided or mixing shall be confined to the daylight hours.

All limestone rock asphalt mixtures shipped on any one particular requisition or project shall be produced out of the same mixing plan, unless if in the opinion of the Engineer there is no difference in the quality of the rock asphalt mixture when produced by two difference mixing plants. Materials produced by a weight-batching plant shall not be mixed material produced from a continuous mixing plant.

6. CONSTRUCTION METHODS

The rock asphalt mixture, tack coat or prime coat shall not be placed when the air temperature is below 60EF and is falling, but it may be placed when the air temperature is above 50EF and is rising, the temperature being taken in the shade away from artificial heat, with the further provision that asphaltic mixture or tack coat shall only be placed when the humidity and general weather conditions, in the opinion of the Engineer, are suitable.

(1) Prime Coat. If a prime coat is required, it will be applied and paid for as a separate item. The tack coat or rock asphalt mixture shall not be applied on a previously primed flexible base until the primed base has completely cured to the satisfaction of the Engineer.

(2) Tack Coat. Before the rock asphalt mixture is laid, the surface upon which the tack coat is to placed shall be cleaned thoroughly to the satisfaction of the Engineer. The surface shall be given a uniform application of tack coat meeting the requirements for tack coat under asphaltic materials of this specification. This tack coat shall be applied, as directed by the Engineer, with an approved sprayer at a rate not to exceed 0.05 gallon per square yard of surface. Where the mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer. The tack coat shall be rolled with a pneumatic tire roller as directed by the Engineer.

(3) Placing. If the mixtures are shipped to the job, the railroad cars shall first be cleaned of all foreign matter, and the material shall be loaded in such a manner as to prevent segregation. The rock asphalt mixture, prepared as specified, shall be hauled to the work in tight vehicles previously cleaned

of all foreign materials. The dispatching of the vehicles shall be so that all material delivered may be placed and shall have received its initial rolling in daylight. The mixture shall be laid only on an approved base course or pavement which has been tack-coated as previously specified and shall be free of all foreign materials. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform coating cut-back or emulsified asphalt as required for tack-coating the base. The mixture shall be thoroughly aerated and then spread into place with a motor grader, in a uniform layer of such depth that after receiving ultimate compaction by rolling, the requirements of the typical cross sections will have been fulfilled. Hand spreading will be permitted where the mixture is placed on narrow stripes or small irregular areas.

Adjacent to flush curbs, gutters, liners and structures, the surface mixture shall be finished uniformly high so that when compacted it will be slightly above the edge of the curb or flush structure. During the application of asphaltic material, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures.

Where more than one course of pavement is to be placed, no succeeding course shall be placed until the preceding course has cured to the satisfaction of the Engineer, but shall contain not more than a maximum if 3 percent moisture and 0.2 percent hydrocarbon volatile content of the mixture by weight as determined by Test Method Tex-212-F and 213-F or test methods included in THD Bulletin C-14

Alternate Method of Placing. When indicated on the plans or directed by the Engineer in writing, the mixture may be spread with the specified spreading and finishing machine. In placing the material with a spreading and finishing machine, rolling shall be deferred for a period of time, as directed by the Engineer, to allow for volatilization. Where more than one course of pavement is to be placed, no succeeding course shall be placed until the preceding course has cured to the satisfaction of the Engineer, but shall contain not more than a maximum of 3 percent moisture and 0.2 percent hydrocarbon volatile content of the mixture by weight as determined by Test Method Tex-212-F and 213-F

(4) Compacting

(a) The pavement shall be compressed thoroughly and uniformly with the specified rollers and/or other approved rollers.

(b) Rolling with the three wheel and tandem rollers shall start longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the rear wheels. Alternate trips of the roller shall be slightly different in length. On super-elevated curves, rolling shall begin at the low side and progress toward the right side. Rolling with pneumatic tire roller shall be done as directed by the Engineer. Rolling shall be continued until no further compression can be obtained and all roller marks are eliminated. One tandem roller, one pneumatic tire roller and at least one three wheel roller as specified above shall be provided for each job. If the Contractor elects he may substitute the three axle tandem roller for the two axle tandem roller and/or the three wheel roller; but in no case shall less than three rollers be in use on each job. Additional rollers shall be provided if needed. The motion of the roller shall be slow enough at all times to avoid displacement of the mixture. If any displacement occurs, it shall be corrected at once by the use of rakes and of fresh mixture where required. The roller shall not be allowed to stand on pavement which has not been fully compacted. To prevent adhesion of the surface mixture to the roller, the wheels shall be kept thoroughly moistened with water, but an excess of water will not be permitted. All rollers must be in good mechanical condition. Necessary precautions shall be taken to prevent the dropping of gasoline, oil, grease or other foreign matter on the pavement, either when the rollers are in operation or when standing. When permitted by the Engineer in writing, equipment other than that specified which will consistently produce satisfactory results may be used.

(c) Pavement Compaction. When a pavement compaction requirement is specified, it is the intent of this specification that the material be placed and compacted such that the actual specific gravity of the pavement after compaction is equal to or greater than the minimum percent, indicated on the plans, of the laboratory actual specific gravity. The method of determining the in-place actual specific gravity shall be as designated by the Engineer, each method correlated satisfactorily with results obtained from standard tests as described in Test Method Tex-207-F. In-place percent compaction tests are intended for compaction control. If the in-place percent compaction is lower than that specified, work may proceed with changes in the construction operations, rolling procedure and/or, rolling sequence until the in-place percent compaction equals or exceeds that specified.

(d) Handling Tamping. The edges of the pavement along curbs, headers and similar structures, and pavement mixtures at all places not accessible to the roller, or in such positions as will not allow through compaction with the roller, shall be thoroughly compacted with lightly oiled tamps.

(5) Surface Test. The surface of the pavement, after compression, shall be smooth and true to the established line, grade and cross section, and when tested with a 10-foot straightedge placed parallel to the centerline of the roadway, it shall have no deviation in excess of 1/16 inch per foot from the nearest point of contact. The maximum ordinate measured from the face of the

straightedge shall not exceed 1/4 inch at any point. Any point in the surface not meeting these requirements shall be immediately corrected.

(6) Opening to Traffic. The pavement shall be opened to traffic when directed by the Engineer. All construction traffic allowed on the pavement shall comply with the State laws governing traffic on highways.

7. MEASUREMENT & PAYMENT

Unless indicated otherwise in the Proposal, Cold MIX Limestone Rock Asphalt Pavement shall measured be as described below.

(a) Measured by the square yard of the type and thickness of "Cold Mix Limestone Rock Asphalt Pavement" specified in Section 025422.

(b) Measured by the total weight of "Cold Mix Limestone Rock Asphalt Pavement" in Section 025422, of the type specified delivered to the jobsite.

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 or furnishing all material; for all heating, mixing, hauling, cleaning base course, tack coat, placing rock asphalt mixture; all blading, rolling and finishing; and for all labor, tools, equipment and incidentals necessary to complete the work except prime coat when required.

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:

Sieve Size	Percent Passing by Weight
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:

Sieve Size	Minimum Percent Passing by Weight
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:

APPLICATION	ASPHALT GRADE
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:

Item:	Tolerances Percent by Weight or Volume
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 ravels, 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 with the details shown on the drawings.

New curb and gutter returns at public street intersections shall be designed by a licensed PE and sized to accommodate the type of vehicles anticipated at the intersection in accordance with AASHTO guidelines for vehicular turning movement. In the absence of an AASHTO design by a licensed PE, the minimum back of curb return radius at 90 degree intersections shall meet the following:

15’ Residential-Residential
20’ Collector-Residential
25’ Arterial-Residential
30’ Arterial-Collector or Collector-Collector
35’ Arterial-Arterial

At locations where this is not achievable due to an existing significant obstruction, a recommendation on the maximum achievable radius along with the basis of variance must be submitted to the City Traffic Engineer for approval prior to placing the curb.

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". Flexible base shall conform to the requirements in the City’s Standard Specification Section 025223 “Crushed Limestone Flexible Base”.

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. Flexible base shall be placed to moisture and compaction requirements to a point at least 1-foot behind the back of the proposed curb in a uniform and monolithic placement with the roadway base.

Outside forms shall be of wood or metal, of a section satisfactory to the OAR, 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. Align concrete roadway joints with adjacent curb joints when possible. Driveway gutter shall be placed integrally with the driveway as shown on the City Standard Details, aligning adjacent joints when possible.

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 OAR. 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, compacted, and sloped as directed as soon as possible and no later than 48 hours after the removal of forms and prior to inclement weather. Backfill shall be placed to the full height of the curb, or as otherwise specified. When topsoil and sod, or adjacent structure such as tied sidewalk is to be placed at the back of curb, the initial backfill and compaction behind the back of curb shall be to at least the base of the adjacent feature, and no less than 6” from the top of curb. Do not allow water to collect and stand within the exposed area along the back of curb. Make temporary provisions as necessary to ensure adequate drainage of the area behind the curb until the finished surface is complete.

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 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.

When the curb and gutter is related to isolated repair or 'remove and replace', the cost of providing and preparing subgrade and base related to the repair (or removal and replacement) shall be subsidiary to the cost of the curb and gutter repair or replacement. The cost of related pavement repair shall be subsidiary to the cost of curb and gutter repair or replacement unless otherwise indicated in the Bid Form.

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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 with 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 OAR, 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 OAR, 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 of the sidewalk. Align joints with joints in adjacent features such as sidewalks, driveways, and curb and gutter when possible.

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 **o**r #4 steel reinforcing bars spaced at 12” 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 and within 0 to +3% of optimum moisture.

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”, 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 . . . . . $S \leq 1:50$
Driveways abutting tied sidewalks $S \leq 1:10$

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

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

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 such that the ramp is fully contained within the crosswalk. 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 and ramp-related header curbs 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.

For any concrete pavement repair under this specification, the Contractor shall replace the entire panel affected by the repair, to include re-establishing appropriate moisture and density of the subgrade and base sections below the panel. In addition, it is a requirement that the Contractor shall dowel-in reinforcement or load-transfer bars to adjacent panels or curbs to ensure a monolithic pavement structure is re-established upon completion of the repair.

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 OAR 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 OAR.

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 specified by the Engineer or required by the OAR, 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 OAR. Complete concrete design data shall be submitted to the OAR 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 OAR 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

Construction Method	Desired Slump	Minimum Slump	Maximum Slump
Concrete Pavement (slipformed)	1.5”	1”	3”
Concrete Pavement (formed)	4”	2.5”	6.5”

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 OAR 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

Class of Concrete	Minimum Flexural (Beam) Strength	Minimum Compressive Strength	Maximum Water-Cement Ratio	Coarse Aggregate
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. Finished surface grades shall conform to testing criteria in Specification Section 038000 “Concrete Structures” and Section 13 below.

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. 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 OAR, the Contractor shall perform sufficient checks with a long handled 10' straightedge on the plastic concrete to insure that the final surface will be within the tolerances specified below. The 10' straightedge shall be furnished by the Contractor. 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 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", approximately 3/16" deep, with a minimum depth of 1/8", and approximately 1/12" 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 OAR be not less than 0.035" with a minimum texture depth of 0.030" 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' 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 1/8", making proper allowances for camber, vertical curvature and surface texture. Occasional variations, not exceeding 3/16" will be acceptable, if in the opinion of the Engineer it will not affect the riding qualities.

When directed by the OAR, 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. MEASUREMENT AND PAYMENT

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

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.

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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.

Temporary asphalt required for a smooth driving surface on existing pavements, temporary pavements, or tie-ins from new work to existing pavements during construction shall conform to the City's Standard Specification Sections 025424 "Hot Mix Asphaltic Concrete Pavement".

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.

The Contractor shall monitor and maintain a reasonably smooth riding surface on any existing or temporary pavement that is used for interim travel lanes during all phases of construction, to include timely pothole repair such that the road is maintained as needed for all weather access. The Contractor shall use HMAC for all temporary pavement repairs, pothole repairs, or tie-ins from new construction to existing pavements.

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, engineering of the traffic control system, 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 to the satisfaction of the OAR and in coordination with and approval by the City Traffic Engineer.

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.

If delays occur during construction, the Contractor is responsible for any additional Traffic Control related costs unless additional Traffic Control costs are specifically authorized by a Change Order.

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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:

Condition	Spacing	Length of Stripe
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 OAR.

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 before Type I markings are applied and as a sealer and/or to apply glass beads after a Type I marking is applied. 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 OAR.

3.2 Equipment - All equipment for the work shall be approved by the OAR 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% Na_3PO_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 OAR 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 OAR.

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 OAR.

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 OAR 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 OAR. 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. Before application of Type I pavement markings on new or existing concrete surfaces or on old HMAC, the pavement shall be sealed with acrylic or epoxy primer-sealer or Type II pavement marking material. After application, Type I pavement markings shall also be sealed on top with acrylic or epoxy primer-sealer or a Type II pavement marking material. If called for in the plans, drop-on glass beads will be applied to the top sealer. Primer-sealer is considered subsidiary to the bid item for pavement markings. Glass beads are considered subsidiary to the bid item for pavement markings.

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 OAR, 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. Primer-sealer will be considered subsidiary to the pay items for pavement markings.

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.

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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:

TYPE	DESCRIPTION
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[4]
Flow, 5 hr., 70°C (158°F), mm			5		5[4]
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: 45 µm (No. 325) 75 µm (No. 200) 150 µm (No. 100)	 75 95 100	 -- -- --	ASTM C 430, as modified in Section 6130.4.

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 ± 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 ± 3°C (160 ± 5°F) to remove solvent. Weigh the dried filler. Filter the decanted solvent through a filter paper with a 20–25 µm 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 75µm (No. 200) and 150 µm (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 µm (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 90º 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

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

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 plys 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:

Diameter (inches)	**Pressure Class** (psi)	**Wall Thickness** (inches)	**Range of Maximum Allowable Depth Cover** (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 Pressure Pipe for Municipal Water Mains and
Wastewater Force Mains)

1. DESCRIPTION

This specification shall govern all work necessary for furnishing all AWWA C900 PVC pipe 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 D1784 with an established hydrostatic-design-basis of 4000 psi for water at 73.4 degrees F.

2.1. DIMENSIONS

Pipe shall be manufactured to ductile iron pipe equivalent outside diameters.

2.2. JOINTS

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.

2.3. GASKETS

Gaskets for jointing pipe shall be in accordance with ASTM F477 (High Head).

2.4. PIPE PRESSURE CLASS AND DIMENSION RATIO

Unless indicated otherwise on the drawings, AWWA C900 pipe shall have a dimension ratio (DR) of 18.

2.5. CAUSE FOR REJECTION

Pipe shall be clearly marked in accordance with AWWA Requirements. Unmarked or scratched pipe shall be rejected.

2.6. CERTIFICATION

The Contractor shall furnish in duplicate to the OAR a copy of the manufacturer's affidavit of compliance with this specification, to include gaskets. Certification shall accompany each delivery of materials.

3. CONSTRUCTION METHODS

Comply with requirements of Section 026402 “Waterlines.”

4. MEASUREMENT AND PAYMENT

Unless otherwise specified in the Bid Form, AWWA C900 PVC pipe 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 AWWA C900 PVC pipe, together with all incidentals necessary to install the pipe complete in place, per linear foot.

SECTION 026212
MOLECULARLY ORIENTED
POLYVINYL CHLORIDE PIPE (MOP)
(AWWA C909 Pressure Pipe for Municipal Water Mains and
Sanitary Sewer Force Mains)

1. DESCRIPTION

This specification shall govern all work necessary for furnishing all MOP pipe (AWWA C909) required to complete the project.

2. MATERIAL

MOP pipe shall be made of Class 12454-A or Class 1245-B virgin compounds, as defined in ASTM D1784 with an established hydrostatic-design-basis of 7100 psi for water at 73.4 F.

3. DIMENSIONS

Pipe shall be manufactured to cast 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

Unless indicated otherwise on the drawings pipe shall be Class 150.

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 indicated otherwise in the Proposal, MOP pipe (AWWA C909) shall not be measured for pay but shall be subsidiary to the appropriate bid item, waterline, sanitary force main, etc.

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 pipe 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 20’ 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 18” clearance from the new water main pipe OD in all directions (typical) per City Water Standard Details. Maintain a minimum of 18” (2’ typical) vertical clearance between outsides of pipes where a new waterline crosses over a new wastewater line and center the wastewater pipe joint and the water pipe joint on the crossing. Do not cross a new waterline under a new wastewater line without following all current TCEQ water/wastewater minimum separation and encasement requirements. TCEQ minimum allowable separation for new waterline crossing above a new wastewater line, is 6” when the new wastewater line below is constructed of PVC or Ductile Iron and has a pressure rating of 150 psi or greater.

At gravity wastewater line crossings, the proposed PVC waterline shall be encased in a 20’ joint of ductile iron or PVC 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 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 on the gravity wastewater line as indicated on the drawings, and both ends of the casing shall be sealed with cement grout or manufactured seal. Follow all current TCEQ minimum separation distance requirements.

b) Deviation from Drawings: No deviation from the line and grade shown on the plans may be made without the written consent of the OAR.

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.

d) Separation Distance from Structures: Waterlines shall be placed no closer than 15' to any habitable structure.

(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" 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' 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 OAR 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 8" of sand on the bottom and sides of waterlines smaller than 16" in diameter, and 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 12" of sand encasement all around the pipe for 16" 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 OAR.

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 8" of sand between the excavation

and the pipe (twelve inches for 16” 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 OAR 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 OAR 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.

Permanent thrust blocks shall only be used on transmission mains, as determined and designed by the Engineer. When used on transmission mains, the thrust blocks shall be placed such that the pipe and fittings are accessible for repair.

(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 OAR, 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 OAR 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 1-½" & 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 1-½" 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 026406
Private Water Service Lines (S-112)

1. Scope:

This section governs the furnishing of all labor, equipment, tools and materials necessary for the construction of private water service lines as shown on the plans, as outlined herein and as necessary to complete the project. Private water service lines are defined as those lines from the customer side of the water meter to the structure.

2. Materials:

Materials for the construction of private water service lines shall comply with the provisions of the Standard Plumbing Code as published by the Southern Building Code Congress and as adopted, with local amendments, by the City of Corpus Christi, unless otherwise noted herein or on the plans.

3. Permits:

Normal plumbing permit application and fee requirements of the Standard Plumbing Code as adopted by City Code shall apply for this project. A plumbing permit for each lot will be issued to the Contractor by the Building Inspections Department of the City of Corpus Christi. The Contractor shall make application for permits upon award of the contract.

4. General Obligations:

(a) Contractor: The Contractor shall construct private water line services in accordance with the plans and these specifications in a neat and workmanlike manner. The route of the proposed water service shall be determined by the Contractor subject to approval of the Owner and the Engineer. All work on private service lines shall be supervised and inspected by a licensed plumber. Good relationships with the public are essential to the success of this project. The Contractor shall make all the required notifications and notices to the owner/occupants in the area. The work shall be accomplished with minimal inconvenience to the public and owner/occupants. The Contractor shall cooperate with all City employees involved in the execution of this contract. The removal of the existing meter from the old location and placement in the new location shall be done by the Contractor under City supervision. Contractor will be held responsible for restoring the water service level better than or equal to before. Compensation will be addressed on an as needed basis upon approval by the Engineer.

(b) City: The Engineer will review work proposed by the Contractor and the City Plumbing Inspector shall inspect the installation.

5. Sequence of Work and Construction Methods:

(a) City will mail out general letter to property owner describing the project with Form WS-1 (See Appendix) for execution.

(b) Contractor shall acquire authorization for site inspections, using Form WS-1 in Appendix from those owners not responding to general letter.

(c) Contractor shall perform site inspection, fill-out required forms

and submit copy of APrivate Water Service Inspection Report & Routing Recommendation≅ and Site Plan Showing Route to Engineer.(see From W-2 and Sample Site Plan in Appendix). Contractor is encouraged to take photographs of before and after conditions on each lot.

(d) Typically, the proposed service line will be connected at the existing riser serving the main structure, usually at the rear. In special cases, where existing surface improvements preclude trench excavation, the connection of the proposed line to the existing line may be allowed at an alternate location. Any alternate tie in locations must be authorized by the Engineer; and there must be evidence that equivalent water pressure of the standard connection will result using the information gathered during the site inspection.

(e) Contractor notifies owner/occupant of proposed construction and acquires approval for proposed construction with City assistance using Form W-2.

(f) Construct private service lines from structure to proposed meters.

(1) Materials shall be installed in accordance with manufacturer's requirements and as set forth in the plumbing code.

(2) The Contractor shall be responsible for laying the line along the pre-approved Site Plan Route. All lines shall be a minimum depth of 18 inches except at the riser and near water meter. Portions of the lines that are exposed shall be protected from frost action.

(3) Separate trenches (one for water and one for sewer) separated by undisturbed or compacted earth shall be excavated. The trenches shall be excavated in such a manner which will minimize damage to surface vegetation. After installation of the line, the excavated material shall be tamped into the trench and the surface restored to a condition acceptable to the Engineer. Lines shall be bored, jetted or jacked under sidewalks, driveways or other such improved surfaces--unless authorized by the Engineer.

(4) When authorized, the proposed line may be hung under pier and beam structures. In such cases, new line shall be insulated and supported with hangar straps at intervals not to exceed four (4) feet spacing.

(5) Where required by the building code, electrical ground wires shall be installed to assure any appliances grounded to the plumbing system remain grounded.

(6) Boring and casing shall be required adjacent to foundations (Foundation Protection Exhibit in Appendix).

(g) Clean, flush, and pressure test new service lines. Make final connection to riser. The service line shall remain under pressure to the angle water check valve.

(h) Construct the water service lines to the angle meter stop for meter setting. Clean, flush, and put into service.

(1) The proposed meter location shall be placed as follows:

(a) for separated curb and sidewalk; 1.5 feet from curb edge of sidewalk;

(b) for sidewalk tied to curb; 1.5 feet behind sidewalk;

(c) where no sidewalk exists; 4.5 feet behind the curb;

(2) The City shall furnish the Contractor a water meter housing so that a proper alignment of the angle meter stop and meter coupling is assured.

(i) Set meter box. Existing meter boxes shall be re-used on this project. Any meter boxes which are cracked, broken, or have missing lids shall be replaced with new meter boxes provided by Water Department as deemed necessary by the City Water Inspector.

(j) The Contractor shall remove the old meter and set the same meter at the new location. Concurrently, the Contractor shall plug the existing service line and backfill the old meter box pit with clean excavated material.

6. Interruptions of Water Service:

The Contractor shall advise the building occupants a minimum of twenty-four (24) hours in advance of the interruption of water service. After the water service has been interrupted, the Contractor shall expeditiously continue work until service has been restored. In no case shall water service be interrupted for more than four (4) hours.

7. Measurement and Payment:

Private water service lines shall be measured per each service for the appropriate size of meter setting installed. Payment shall be full compensation for furnishing and installing all lines, valves, fittings, hangar straps, meter boxes and incidentals, trenching, trench safety, boring, jetting or jacking, flushing, testing, service restoration and all other work or materials required to provide water service lines from the meter location to the existing riser.

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 026413
BUTTERFLY VALVES FOR WATERLINES (S-85B)

1. DESCRIPTION

This specification shall govern all work necessary for furnishing and installing butterfly valves with boxes required to complete the project.

2. MATERIALS

BUTTERFLY VALVES

General:

All butterfly valves shall be tight-closing, rubber-seat type conforming to AWWA C504 and the following. Acceptable suppliers shall have a minimum of 5 years experience in the manufacturer of butterfly valves of the type specified herein. Unless indicated otherwise on the drawing, valves shall be Class 150B.

Body end connections:

Mechanical Joint ends conforming to AWWA C111 shall be required for all butterfly valves, unless indicated otherwise on the Drawing.

When flanged ends are indicated on the Drawings, valves shall have short body and flanged ends with flanges dimensioned in accordance with ANSI B16.1, class 125 cast-iron flanges.

Shaft: Shaft shall be type 304 or 316 stainless steel.

Disc: Valve disc shall be constructed of aluminum bronze ASTM A148-952 or ductile iron ASTM A536 with 316 stainless steel or Monel disc edge, or ductile iron with removable seal.

Valve Seat: The seat shall be field replaceable, and body or ring mounted and shall be adjustable for seats over 30" in diameter. Adjustment shall not require special tools.

Bearings: Bearings shall be reinforced Teflon.

Actuator: Unless indicated otherwise on drawings. The valve actuator shall be integrally mounted on the valve-mounting flange. The housing, cover and shaft shall be sealed to prevent water entry under 25' submergence. Actuator shall be designed for buried service and furnished with 2" AWWA operating nut.

When Automatic Actuator is required - electric motor

Electric motor modulating valve actuator shall comply with AWWA C540 and the following:

Rotation - 90 degree reversible
Torque rating - for 125 p.s.i. differential
Cycle time - less than 100 seconds
Duty - 15 minutes continuous
Manual operation - integral with declutching device
Hand switch - integral 5 positions to permit local operation
Mechanical stops - internal to prevent over travel
Gearing - for 30 to 60 second opening/closing
Auxiliary limit switches - 4 SPDT: 2 full open, 2 full closed

Heater - 8 watt minimum
Control wiring - 120 VAC, 1 phase, 60 Hz
Equipment actuator with zero and span adjustments
Provide actuator with a field set choice of valve position on loss of signal
Submersible design required

Electrical Characteristics:
Power: 120 VAC. 1 phase, 60 Hz
Rating: NEMA 4

Local Control:
Push button station equipped with:
Remote/local switch
Position indication lights
Reversible, intermittent contact
Close - stop - open switch
Contact closure for remote/local indication where indicated in schedule
Enclosure - NEMA 4
Mounting – at inflow and outflow valves adjacent to tank

Manual Operation:

Type: Hand wheel, lever, or (operating nut required below ground unless specified otherwise).

General:
Comply with AWWA C504
Maximum torque at 80 lb. input
Worm gear for hand wheel operation
Totally enclosed worm gear

Field Service: The equipment manufacturer shall furnish the services of a qualified factory field service engineer at the site to inspect the installation and instruct the City's Water personnel of the operation and maintenance of the unit.

O&M Manual: The manufacturer shall furnish the Engineer with 4 sets of complete operation and maintenance manuals (including wiring diagrams).

CAST IRON VALVE BOX

Valves boxes shall be provided and installed with all butterfly valves, unless indicated otherwise on the drawings. The word "Water" shall be cast in the top cover. The boots shall be hemispherical in shape and shall fit the particular valve size box, lid and boot shall be hot tar dipped. The extension pipe for the valve box assembly shall be 8" PVC with SDR of 35 or thicker. Valve box and accessories shall be designed for roadway application.

3. CERTIFICATIONS & TESTS

The valve manufacturer shall furnish an affidavit stating that valves comply with AWWA C504 and this specification with exceptions noted in affidavit. Said exceptions are subject to approval of the Engineer. The manufacturer shall furnish test records as per sections 2.3, 3.8.5.8, 3.8.5.9, 5.2.1, 5.2.2, 5.2.3, and 5.2.4 of AWWA C504.

4. SHOP DRAWINGS

The manufacturer shall submit certified shop drawings as per sections 1.4 and 1.5 of AWWA C504.

5. CONSTRUCTION METHODS

Valves shall be installed in a workman like manor and wrapped with two plies of 8-mil polyethylene.

Valve boxes in street ROW shall be set flush with pavement or surrounding ground. In cultivated areas the top of box shall be set 12" below natural ground and long enough to be raised to natural ground at a future date.

6. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Butterfly Valves with box shall be measured as a unit for each size of valve and box assembly. Payment shall include but not be limited to furnishing and installing the valve and box complete with polyethylene wrap, concrete collar, box assembly, and all labor, materials, incidentals, etc., required for the proper 1installation.

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 (5-¼") 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" to 60".

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 PIaster

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.

0. 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 00 72 00 Article 25 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 portable flash drive 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 non-shrink 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, Non-shrink 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 11 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 and OAR. 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 AWWA C3OI.

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” 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 macro-etching tests for complete penetration production welds on normal production weld tests. Complete joint penetration welds are defined in ANSI/AWS A3.O. Verify complete joint penetration by means of macro-etch 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' 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 OAR 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. The Contractor shall arrange for Manufacturer to 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 modi1y 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 022020 "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% of minimum yield point at rated working pressure and 67% 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% 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% 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: hw = 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". 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% tricalciuni aluminate and pipe shall be placed with 6" cover of cement stabilized sand 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% for average value, and 11% 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' in length unless indicated on Drawings or approved by the OAR.

6. Butt Straps for Closure Piece: Provide at locations indicated on Drawings or authorized by the OAR. Minimum 12" 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" welded outlet for inspecting each closure section, unless access manway is within 40' 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. Harnessed 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’ and maximum length as indicated on shop Drawings and approved by the OAR. Gasketed joints are allowed on standard lengths of pipe. Non-standard pipe lengths must be approved by the OAR 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” in diameter and larger with stulls. Remove stulls after completion of backfill.

P. Provide radius of curve as indicated on Drawings unless approved by the OAR. 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/I 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 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 OAR. 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, Non-Shrink 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 OAR. 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 11072500 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 Carborunduin 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” for 33” diameter and smaller; minimum width of 12” for diameters greater than 33” hemmed at edge to allow threading with minimum 5/8” wide steel strap. Provide minimum 6” wide Ethafoam strip sized, positioned, and sewn such that two circumferential edges of Ethafoam are 12” 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 OAR 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 OAR 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 OAR wish to see specific pipes during manufacturing process, manufacturer shall provide the OAR with minimum of 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 OAR. Subsequent backfilling thereof shall not be considered as authorized additional excavation and backfill. Backfill bell holes and spaces to satisfaction of the OAR.

6. Remove blocking after placing sufficient backfill to hold pipe in position.

G. Follow non-shrink grout manufacturer’s specifications for non-shrink 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” from grade and 3” 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 OAR, in-place survey data for pipe laid each day and submit copy of data to the OAR 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 OAR 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 OAR 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 OAR.

B. Pipe manufacturer's representative and the OAR to entirely witness closures and approved pipe modification efforts.

C. Provide minimum lap of 4" between member being joined and edge of butt strap. Weld on both interior and exterior, unless otherwise approved by the OAR.

D. Provide full circumferential welds on joints required to be welded. Employ independent. certified testing laboratory, approved by the OAR, 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” of pipe ends.

B. Repair interior lining cracks that exceed 1/16” (0.0625 inches) wide.

C. Reject pipe with exterior coating cracks that exceed 0.01” 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 non-shrink 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 non-shrink grout, securely bonded to existing coating or lining. Finish junctures between patches and existing concrete as inconspicuous as possible. Strike off non-shrink 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” 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

A. As indicated on the plans

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.

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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 0º F to 170º 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 026604
AIR RELEASE VALVES (S-96)
(WASTEWATER APPLICATION)

1. Description

This specification shall govern all work necessary to furnish and install all air release valves and accessories required to complete the work as shown on the drawing.

2. Air Release Valve

The automatic sewage air release valve shall be designed to operate under pressure to allow entrapped air to escape from a sewage force main line, sewage pump, or wastewater system. After the air escapes out of the air release valve, the valve shall shut off until more air accumulates in it and the opening cycle will repeat automatically.

The sewage air release valve must have a compound internal linkage of precision molded delrin. All other internals must be stainless steel to positively prevent galvanic action. The float rod shall be 20" long to provide an air gap between the linkage and waste level inside the valve to retard the waste solids from clogging the linkage. Each valve shall be complete with hose and blow-off valves to permit back flushing without dismantling valve.

Body and Cover Cast Iron	ASTM A48, Class 30
Internal Delrin Linkage	ASTM D2133
Stainless Float	ASTM A240
Buna-N	ASTM SB800
Exterior Paint Red Lead	TTP 86 B, Type IV

Valve Height 17½ " - with back flushing attachments – 23½ "
Inlet Size = 2" I.P.T.
Orface Size = 5/16 "
Minimum Capacity = 20 CFM @ 15 PSIG
Operating Pressure Range = 10 to 25 PSIG
Type: APCO 400 SARV or approved equal

Accessories

Service Saddle: Ford Brass Saddle Style 202 BS Double Stainless Band
2″ IPT tap and C900 or C905 PVC pipe application
Two – 2″ I.P.T. Short Nipples
One – 2″ I.P.T. Shut-Off Valve (Gate Valve)
One – 1″ I.P.T. Short Nipple
One – 1″ I.P.T. Blow-Off Valve (Gate Valve)
One – ½ ″ I.P.T. 90˚ Elbow
One – ½ ″ I.P.T. Nipple
One – ½ ″ I.P.T. Shut-Off Valve (Gate Valve)
Two – ½ ″ I.P.T. Quick Connect Valve Couplings
One - Rubber Hose (10' Minimum Length) with Two Quick Connect Couplings for In Place Back Flushing

3. Operation & Maintenance Manual and Field Service

The Contractor shall submit five (5) sets of detailed drawing and specifications with installation instructions and maintenance procedures for the Engineer's review prior to installation. The manufacturer's field representative shall check installation and make any required adjustments prior

to operation of system.

4. Measurement and Payment

Unless indicated otherwise in the Proposal, Air Release Valves and accessories shall be measured as units and shall include but not be limited to valve, accessories and vault. Payment shall include all material, labor, and incidentals required to complete the work.

SECTION 026608
SMOOTH WALL HIGH DENSITY POLYETHYLENE PIPE FOR
SLIPLINING (S-59A)

(Force Main Sewers)

1. SCOPE

This specification shall govern all work necessary for furnishing and installing smooth wall, high density polyethylene pipe required to complete the sliplining of existing sanitary sewer lines.

2. MATERIALS

2.1 Polyethylene: The material used for the liner and for the service taps shall be the same materials as designated below.

ASTM Designation: D-3350 with a cell classification of PE345434C. 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, D1248. This material shall also conform to the design criteria as specified in Plastic Pipe Institute (PPI) Designation: PE34C8.

If requested by the owner, the pipe and fitting manufacturer shall provide certified copies of the quality control data taken during product manufacture.

Pipe and fittings shall be produced by the same manufacturer from identical materials meeting the requirements of these specifications.

Pipe and fittings shall be pressure rated to meet the service pressure requirements specified by the Design Engineer. Whether molded or fabricated, fittings shall be fully pressure rated to at least the same service pressure rating as the pipe to which joining is intended.

Molded fittings shall meet the requirements of ASTM D-3261 and this specification. At the point of fusion, the outside diameter and minimum wall thickness of fitting butt fusion outlets shall meet the outside diameter and minimum wall thickness specifications of ASTM F-714 for the same size of pipe. Fitting markings shall include a production code from which the location and date of manufacture can be determined. Upon request, the manufacturer shall provide an explanation of his production code.

Fitting shall be manufactured in production facilities designed for that purpose. Field fabricated fittings are not allowed.

Pipe shall be manufactured in accordance with ASTM F-714, ASTM D-3035, or the applicable dedicated service specification. Identification markings shall include a production code from which the location and date of manufacture can be identified. Upon request, the manufacturer shall provide an explanation of his production code.

2.2 Pipe Rating: The pipe shall have a manufacturer's recommended hydrostatic design stress rating of at least 8OO p.s.i. based on a material with a 1600 p.s.i. design basis determined in accordance with ASTM D 2837-69, Standard Method for Obtaining Hydrostatic Basis for Thermoplastic Pipe Materials.

2.3 Dimensions:

Sewer Line I.D.Inches	Nominal O.D. of Liner (Inches)	Min.Wall Thickness Liner (Inches
24 (CIOD)	22.00	1.95

2.4 Liner Diameter: The inside diameter of the liner pipe at any point shall not vary from the nominal inside diameter by more than one percent or one quarter inch, whichever is greater.

2.5 Wall Thickness: The polyethylene lining to be used shall have a wall thickness that yields an SDR (Standard Dimension Ratio) of 11 or less. The SDR shall be calculated by dividing the outside diameter of the pipe by its minimum wall thickness. The average wall thickness of the liner pipe shall not be less than the nominal wall thickness published in the manufacturer's literature current at the time of purchase and the wall thickness at any point shall not vary from the nominal by more than 10 percent. The manufacturer shall provide sufficient data to demonstrate that the pipe supplied provides a 50 year service life with a maximum external hydrostatic pressure of 10 feet of water above the pipe center line.

All pipes 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 Cleaning: All lines to be relined shall be cleaned prior to installation of liner. The Contractor shall select the method of cleaning. All materials resulting from the cleaning operations shall be removed at the downstream manhole of the section being cleaned.

Television Inspection - Upon completion of the cleaning operation and prior to insertion of the liner material, a closed circuit television camera will be pulled through each line. The interior of the main shall be carefully inspected to determine the location and extent of any condition which may prevent proper installation of lining materials.

A television report log and video tape shall be furnished on each line inspected. The observations are to be recorded on a television inspection form. This log shall indicate the internal condition of the sewer segment, the deviations in line and grade, abnormal conditions of the pipe barrel and joints, and the location and quantity of each source of infiltration and inflow. The distance from the beginning manhole shall be noted for each observation made on the report form. Photographs of each defect shall be made from the television monitor for further study and justification for rehabilitation.

All observed obstructions shall be removed by the Contractor before initiating liner insertion. All excavation and backfilling for removal of obstructions, liner insertions, manhole rehabilitation and side sewer connection, if any, shall conform to requirements set out in this specification.

3.2 Bypass Sewage: It shall be the responsibility of the Contractor to bypass the sewage, if necessary, around the section or sections of line that are to be sliplined. Under no circumstances will dumping of raw sewage on private or City property be allowed. Bypass shall be made by pumping the sewage into a downstream manhole or adjacent system, or other methods as

may be approved by the Owner and the Engineer. The pump and bypass line shall be of adequate capacity to handle the flow. If bypass pumping is not a continuous operation, flow through the sewer line shall be restored at the end of a work day. Complete plugging of the existing line will not be permitted unless adequate bypass capacity for anticipated flows is provided or other means of handling the flows is approved by the Engineer.

3.3 Pipe Jointing: Sections of the Polyethylene (PE) liner pipe shall be joined into continuous lengths on the job site above ground. Joining shall be accomplished by the butt-fusion method and performed in strict conformance with the pipe manufacturer's recommendations using approved equipment. Except where flange connections or mechanical connections are specified, pipe and fittings as determined by the Engineer shall be butt-fusion joined in accordance with the manufacturer's recommended procedure. Before construction begins, the Contractor shall furnish to the Engineer for his review and approval, four copies of all details of the butt-fusion jointing procedure proposed for use. 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.

3.4 Insertion: After completing the access shaft excavation, the top half of the existing sewer down to the spring line shall be broken or cut and removed for the full length of the access shaft. A power winch cable shall then be connected to the end of the liner by use of fabricated or flexible pulling head so that the liner can be pulled into the existing sewer. Precautions shall be taken not to damage the liner by scoring on a ragged edge of the old sewer line during sliplining. Whenever possible, liner shall be pulled through manholes and liner sections shall be joined in pits other than in manholes. The purpose of this requirement is to (1) provide a smooth invert without grouting and a uniform condition for manhole rehabilitation and (2) minimize the number of insertion pits. Details for joining of liner section in manholes shall be submitted to the Engineer for approval prior to construction. Sufficient time (minimum 12 hours) shall be allowed after pulling the pipe for the pipe to recover to its original length since polyethylene liner will elongate due to stress during pulling, and allow for stabilization of length due to temperature. During the installation of the liner, should the liner break or separate, the excavation required to rejoin the pipe and all other work necessary to complete such repair shall be done for no separate pay.

3.5 Service Connections: After the liner has been pulled into place, allowed to recover, and secured to the manhole walls, each side sewer service shall be connected to the new liner. Service laterals shall be connected by the use of an approved remote tapping system or a prefabricated saddle. If the prefabricated saddle is used, a neoprene gasket shall be 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. Inspection of this line did not reveal any connections to the sewer except at manholes. Laterals connecting to existing manholes shall be reconnected to the rehabilitated manhole as shown on the drawings and to the satisfaction of the Engineer.

3.6 Backfill: At all points where the liner pipe has been exposed, as in access shafts, outside of manholes, service connections, etc., the Contractor shall remove all debris and create a void along each side of the pipe at the spring line to undisturbed soil. Width of the void shall not exceed existing pipe 0.D. plus four feet. Suitable spacers shall be

used to center the liner within the existing pipe, or hold the liner at the top of the existing pipe. The space between the liner and the pipe shall be filled with cement grout which shall contain a minimum of seven sacks of cement per cubic yard of sand and enough water (but no more) to provide a mixture that will flow around the pipe. As the bottom portion of this grout begins to set up, a drier mix shall be placed on top of the liner until a cover over the liner approximately the 0.D. of the existing pipe is formed. In the voids along each side of the existing pipe, the Contractor shall place cement stabilized sand consisting of 3 sacks of Portland Cement per cubic yard of fine aggregate for concrete, mixed dry and placed in six inch lifts for the full width and length of the excavation and shall also be placed over the above described grout until a depth of twelve inches over the top of the original pipe is achieved. Each lift shall be hand tamped and utmost care shall be exercised to avoid damaging the inserted liner pipe and its encasement of the existing pipe. After the stabilized sand is in place and accepted by the Engineer, backfilling to finished grade may be completed using material from the excavation, select material or cement stabilized sand, all at the Contractor's option and as approved by the Engineer.

3.7 Sealing Manholes: The annular space between the polyethylene liner and the existing sewer line shall be sealed where the sewer link enters or exits each manhole. 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.

3.8 Grouting Annular Space: The annular space between the polyethylene liner and the existing pipe shall be filled with a grout having good flow characteristics, minimum shrinkage, and permanence of support. One suggested mix design per cubic yard is: 500 lbs. of 3/8" washed river gravel (rounded), 2,100 lbs. ∀ of sand, 7 sacks of Portland Cement and 21 ounces (3 ounces per sack of cement) of Pozzolith 300R as manufactured by Master Builders, or Sikamix 100 as manufactured by Sika Chemical Corporation, or equal. The gravel may be omitted if proven to be of no benefit. Another suggested mix design per cubic yard is: 1,150 lbs. of sand, 400 lbs. of fly ash, 658 lbs. of cement and 83 gal. of water. If neither of these mix designs is used, the Contractor shall submit a mix design to the Engineer for approval prior to beginning the grouting process. It is intended that the annular space be 100% filled, but particular attention must be paid to those areas just downstream of manholes to avoid air traps. Equipment for placement of grout shall be used so as to prevent segregation of the grout components and to cause the grout to flow around the liner and completely fill the voids in the annular space. Under no circumstances shall grout be dropped down the shafts onto the polyethylene liner. Grout shall not be permitted to rise in the vertical shafts more than two feet above the top of the existing pipe. The Contractor shall have operable vibrators on the job to aid the flow of the grout. The Contractor shall have operable pumps on the job site to remove water from the vertical shafts as it is displaced by grout to prevent an excessive hydrostatic head on the polyethylene liner. Grouting method details shall be submitted for approval.

3.9 New Manholes: In those places where the main access shaft is excavated at an existing manhole, the manhole will be replaced with a new manhole. The new manhole shall essentially be equal to the rehabilitated manhole shown on the drawings except that a concrete vault will not have to be constructed at the bottom. Details of such construction shall be subject to review and approval by the Engineer before construction. All materials shall be new and the best quality and workmanship shall be that of skilled craftsmen. New manholes constructed under this section shall not be reason for extra compensation. All materials not used in the backfilling operation shall be disposed of off site by the Contractor and all areas must be restored to their original conditions.

4. CLEANUP

After all installation work has been completed, the Contractor shall clean up the area around the work area and return the ground cover to a like or better condition as existed prior to construction. All pavement shall be repaired as specified. All broken pipe, and other material not a part of the ground cover shall be hauled off and properly disposed of by the Contractor.

5. MEASUREMENT AND PAYMENT

5.1 Measurement: Unless specified otherwise in the Special Provisions, Sanitary Sewer Sliplining will be measured by the linear foot for each size installed.

5.2 Payment: Unless specified otherwise in the Special Provisions, Sanitary Sewer Sliplining shall be paid by the linear foot for each size installed, complete in place.

SECTION 026610
REINFORCED PLASTIC MORTAR (RPM) LINER PIPE FOR SLIPLINING (S-67)

1. SCOPE

1.1 This specification covers constant outside diameter reinforced plastic mortar (RPM) pipe intended for use as a liner to rehabilitate existing sewer pipelines conveying sanitary sewage, storm water and those industrial wastes and corrosive fluids for which the pipe is determined to be suitable.

1.2 The RPM pipe furnished under this specification shall be a composite structure manufactured from thermosetting resin, glass fiber reinforcement and aggregate. The RP shall have a chemical resistant resin inner surface liner meeting ASTM specification D3262. This liner shall be capable for conveying sewage flows with a pH range lower than 3 and higher than 11.

1.3 Liner pipe furnished under this specification shall be furnished in classes designated as GRAVITY, intended to operate at up to 25 feet of water head (10 psig) external pressure, and 115 feet of water head (50 psig) internal pressure.

2. MATERIALS

2.1 The structure of the pipe shall be composite consisting of a resin binder, an aggregate filler and fiberglass reinforcement.

Resin - The resin shall be catalyzed isophthalic polyester resin.

Aggregate - The aggregate shall be a siliceous sand conforming to the requirements of the current specifications for concrete aggregate (ASTM C-33), except that the requirements for gradation shall not apply.

Fiberglass - The fiberglass reinforcement shall be a borosilicate "E" type glass roving with a polyester compatible finish.

Liner - The chemical resistant resin liner shall be a reinforced thermosetting resin without aggregate filler.

2.2 The gaskets used with this pipe shall have a round cross section and shall conform to the requirements of ASTM F-477, "Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe". Gasket material shall be chemically resistant to the fluids described in Section 026610.1.2.

3. PHYSICAL REQUIREMENTS

3.1 Axial Compressive Strength - Each length of liner pipe shall have sufficient strength to withstand, without structural damage, the axial compressive proof load specified below:

Nominal Size (Inches)	Axial Compressive Proof Load (1 lbs.)
36	90,000
42	110,000

when tested in accordance with the following:

The axial compression proof load shall be uniformly applied to the bearing faces of the liner pipe section for a period of not less than 30 seconds. There shall be no structural damage to the liner pipe wall. The pipe shall pass the hydrostatic soundness test after withstanding the axial compressive proof load.

3.2 Hydrostatic Soundness - Liner pipe shall be capable of withstanding, without leakage, the hydrostatic proof pressure below:

HYDROSTATIC PROOF PRESSURE

Rated Operating Pressure psi	(feet of water)	Hydrostatic Proof Pressure psi	(feet of head)
Gravity	(25)	25	(60)
50	(115)	100	(230)

when tested in accordance with the following:

Place the liner pipe in a hydrostatic pressure testing machine which seals the ends and exerts no end loads. Then fill the liner pipe with water, expelling all air, and apply internal pressure at a uniform rate until the specified test pressure is reached. The pressure shall be maintained for one minute to assure hydrostatic soundness.

3.3 **Joints** - Inverted bell and spigot joints shall be furnished. The outside diameter of the liner pipe shall be constant over its entire length and shall be sealed with a solid, uniform cross section gasket conforming to Section 026610.2.2. The gasket shall be contained in a groove and shall not support the weight of the pipe when two sections are joined. The joint assemblies shall be so formed that when pipe sections are drawn together, the pipe shall form a continuous watertight conduit, and shall provide for slight movements of any pipe in the pipeline due to contraction, settlement, or lateral displacement.

3.4 **Stiffness Factor** - The fitness factor shall be as follows when tested in accordance with the method of ASTM D-3262.

STIFFNESS FACTOR REQUIREMENTS

Nominal Size (Inches)	Minimum Stiffness Factor (lbs.-in.2/in.)
36	8,690
42	13,799

3.5 **Beam Strength** - The beam strength of liner pipe shall be as follows when tested in accordance with ASTM D-3262. This is a design qualification requirement and a copy of the manufacturer's test report shall be the basis of acceptance.

MINIMUM BEAM STRENGTH

Nominal Size (inc.)	Beam Load, P (lbg)	Alternative Axial Flexure Strength Requirements Min. Longitudinal Tensile Strength (lbf/inch circum.)	Min. Longitudinal Compressive Strength (lbs/inch circum.)
36	----	700	700
42	----	800	800

4. DIMENSIONS AND PERMISSIBLE VARIATIONS

4.1 **Inside Diameter** - The diameter of the liner pipe, except at the joints, shall not be less than the nominal by more than one and one-half percent or one quarter inch, whichever is greater.

4.2 **Laying Lengths** - The laying length of each line pipe section shall be as follows:

Inverted Bell and Spigot - 20 feet, 3 inches ∀ 1 inch

4.3 **Wall Thickness** - The minimum wall thickness of the liner pipe barrel shall be as follows:

Nominal Size, Inches	Minimum Wall Thickness, Inc.
36	0.28
42	0.32

5. WORKMANSHIP, FINISH AND APPEARANCE

5.1 The inside surface of each liner pipe shall conform to the requirements of ASTM D-3262 and shall be free of bulges, dents, ridges, or other defects that result in a variation of inside diameter of more than one-eighth inch from that obtained on adjacent unaffected portions of the surface.

5.2 Joint sealing surfaces shall be free of dents and gouges that will affect the integrity of the joints.

5.3 No glass fiber reinforcement shall penetrate the interior surface of the pipe wall.

6. CONSTRUCTION

6.1 General

a. **Insertion Pits** - The Contractor shall provide all necessary pits to completely reline the sewers. The location of any access pits shall be subject to the approval of the Engineer. The number of access pits shall be minimized.

b. **Access Pits and Lateral Connection Excavations** - Access pits shall be constructed to the minimum size necessary for insertion of liner pipe. All pits shall be constructed with properly applied vertical side support. At access pits, lateral service connections and at all points where liner pipe is exposed, the Contractor shall encase liner and fittings as detailed in the plans.

c. **Pipe Stockpiling and Handling** - Pipe and fittings shall be stockpiled in a safe manner at each contractor staging area or liner pit location. The stockpiling shall be arranged to cause a minimum of interference to pedestrian and vehicular traffic. No stockpiling will be permitted on the opposite side of the street from construction without prior approval of the Engineer. When handling liner pipe, the Contractor shall take all precautions necessary to avoid damage to the pipe. Dragging of the pipe over sharp objects shall be avoided. Pipe with deep cuts, scratches or gouges shall be rejected and replaced.

6.2 Liner Pipe Installation

a. **General** - Liner pipe grade shall be maintained equal to the grade of the sewer being relined. As the work progresses, the interior of the pipe shall be cleared of all dirt and debris. At times when work is not in progress for whatever reason, open ends of pipe or fittings shall be protected.

Pipe shall not be installed if the condition of the existing sewer line is unsuitable, or if the weather is such that anticipated sewer flows will be in excess of those flows maintained during insertion.

The Contractor shall make all necessary arrangements and provide all necessary equipment to maintain sewage flows at all times. This shall be accomplished by allowing flows to pass around and through the liner pipes or by other means acceptable to the Engineer.

b. **RPM Liner Pipe Installation** - Within the insertion pit, the top half of the exposed existing pipe is to be removed to the springline. The bottom half is to be left in place where it shall serve as a cradle for the liner pipe. The liner pipe shall be either jacked into the existing pipe or pushed as determined by the Contractor. An aqueous solution of Bentonite may be used as a lubricant to minimize jacking loads. A tapered guide shall be attached to the leading end of each section to be installed to help pipe clear small obstructions. A jacking ring shall be used to distribute load as per manufacturer's recommendations for installation of the liner pipe. For each section to be lied, insertion shall be one continuous operation until the planned termination point is reached. Closure in the insertion pit after jacking may be accomplished using a long bell closure kit or other methods, as approved by the Engineer.

Pipe jointing shall be carried out in strict accordance with the manufacturer's recommendation. Total jacking loads shall not exceed the values recommended by the manufacturer. The Contractor shall provide a suitable means for measuring jacking loads, and shall monitor the load as the liner pipe is being installed. If at any time the load appears to rise non-uniformly, indicating possible obstruction of the pipe, jacking operations shall be terminated and the obstruction removed before continuing.

c. **Manhole Replacement** - In those places where the entrance pit is excavated at an existing manhole, the manhole shall be repaired or it shall be replaced with a new manhole conforming to the section on manhole construction and, further, in accordance with Standard Details included in the drawings.

6.3 **Manholes** - Pipe at manholes shall be grouted one pipe diameter back from inside edge of manholes. The liner pipe shall be cut out at manholes as detailed after insertion and grouting. The method of cutting shall be such as to leave a smooth clean straight plastic edge. Where detailed or required mild steel ties shall be provided as required to tie the liner to the manhole benching. The liner pipe shall be suitably strutted or blocked during grout and concrete placement so that no bowing or other deviation from a parallel sided channel occurs.

6.4 Pipe grade shall be maintained within the limit shown on the drawing. The Contractor shall be responsible for and take all necessary precautions to ensure that no liner pipe flotation, adverse pipe grades, or pipe rotation about the vertical axis results, or collapse of the liner pipe occurs during grouting operations. Multiple low pressure application grout lifts are recommended. Grouting shall be in accordance with Section 027610.3.7.

6.5 **Measurement and Payment** - Unless indicated otherwise in the Proposal, Reinforced Plastic Mortar Pipe for Sliplining shall be measured and paid for by the linear foot, complete in place.

SECTION 026612
GLASS FIBER REINFORCED LINER PIPE FOR SLIPLINING (S-67A)

1. SCOPE

1.1 This specification covers glass fiber reinforced plastic mortar pipe intended for use as a liner to rehabilitate existing pressurized pipelines conveying sanitary sewage, storm water and those industrial wastes and corrosive fluids for which the pipe is determined to be suitable.

1.2 The pipe furnished under this specification shall be a composite structure manufactured from thermosetting resin, glass fiber reinforcement and aggregate. The pipe shall have a chemical resistant resin inner surface liner meeting ASTM specification D-3754. This liner shall be capable of conveying sewage flows with a pH range lower than 3 and higher than 11.

1.3 Liner pipe furnished under this specification shall be furnished in classes designated as C150, intended to operate at up to 150 psig internal pressure.

2. MATERIALS

2.1 The structure of the pipe shall be a composite of resin binder, an aggregate filler and fiberglass reinforcement.

Resin - The resin shall be a thermosetting polyester or epoxy resin.

Aggregate - The aggregate shall be siliceous and conform to the requirements of the current specifications for concrete aggregate (ASTM C-33), except that the requirements for gradation shall not apply.

Fiberglass - The fiberglass reinforcement shall be a borosilicate "E" type glass roving with a polyester compatible finish.

Liner - The chemical resistant resin liner shall be a reinforced thermosetting resin without aggregate filler.

2.2 The gaskets used with this pipe shall conform to the requirements of ASTM F-477, "Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe." Gasket material shall be chemically resistant to the fluids described in Section 026612.1.2.

3. PHYSICAL REQUIREMENTS

3.1 Axial Compressive Strength - Each length of liner pipe shall have sufficient strength to withstand, without structural damage, an axial compressive proof load of 110% of the minimum longitudinal compressive strength shown in the beam strength requirements of ASTM D-3754. The pipe shall pass the hydrostatic soundness test after withstanding the axial compressive proof load.

3.2 Hydrostatic soundness - Liner pipe shall meet the requirements of ASTM D-3754.

3.3 Joints - The liner pipe shall be sealed with a solid, uniform cross section gasket conforming to Section 026612.2.2. The gasket shall be contained in a groove and shall not support the weight of the pipe when

two sections are joined. The joint assemblies shall be so formed that when pipe sections are drawn together, the pipe shall form a continuous watertight conduit, and shall provide for slight movements of any pipe in the pipeline due to contraction, settlement or lateral displacement.

3.4 Stiffness Factor - Liner pipe shall meet the requirements of ASTM D-3754.

3.5 Beam Strength - The beam strength of the liner pipe shall meet the requirements of ASTM D-3754. This is a design qualification requirement and a copy of the manufacturer's test report shall be the basis of acceptance.

4. DIMENSIONS AND PERMISSIBLE VARIATIONS

4.1 The nominal size of liner pipe furnished for this project will be 18 inch cast iron pipe equivalent diameter.

4.2 The inside diameter of the liner pipe at any point shall not vary from the nominal inside diameter by more than one percent or one quarter inch, whichever is greater.

4.3 The typical laying length of each liner pipe sections shall be 20 feet, plus or minus 2 inches. Other laying lengths will require the approval of the Engineer.

4.4 The average wall thickness of the pipe shall not be less than the nominal wall thickness published in the manufacturer's literature current at the time of purchase, and the wall thickness at any point shall not vary from the nominal by more than 10 percent.

5. WORKMANSHIP, FINISH AND APPEARANCE

5.1 The inside surface of each liner pipe shall conform to the requirements of ASTM D-3754 and shall be free of bulges, dents, ridges, or other defects that result in a variation of inside diameter of more than one-eighth inch from that obtained on adjacent unaffected portions of the surface.

5.2 Joint sealing surfaces shall be free of dents and gouges that will affect the integrity of the joints.

5.3 No glass fiber reinforcement shall penetrate the interior surface of the pipe wall.

6. CONSTRUCTION

6.1 General

The Contractor shall provide all necessary pits to completely reline the sewers. The location of any access pits shall be subject to the approval of the Engineer. The number of access pits shall be kept to a minimum.

Access pits shall be constructed to the minimum size necessary for insertion of liner pipe. All pits shall be constructed with properly applied vertical side support. At access pits, lateral service connections, and at all points where liner pipe is exposed, the Contractor shall encase liner and fittings as detailed in the plans.

Pipe and fittings shall be stockpiled in a safe manner at each Contractor

staging area or liner pit location. The stockpiling shall be arranged to cause a minimum of interference to pedestrian and vehicular traffic. No stockpiling will be permitted on the opposite side of the street from construction with prior approval of the Engineer. When handling liner pipe, the Contractor shall take all precautions necessary to avoid damage to the pipe. Dragging of the pipe over sharp objects shall be avoided. Pipe with deep cuts, scratches or gouges shall be rejected and replaced.

6.2 Liner Pipe Installation

Liner pipe grade shall be maintained equal to the grade of the sewer being relined. At times when work is not in progress for whatever reason, open ends of pipe or fittings shall be protected.

Pipe shall not be installed if the condition of the existing sewer line is unsuitable or if the weather is such that anticipated sewer flows will be in excess of those flows maintained during insertion.

The Contractor shall make all necessary arrangements and provide all necessary equipment to maintain sewage flows at all times. This shall be accomplished by allowing flows to pass around and through the liner pipes or by other means acceptable to the Engineer. The Contractor will be responsible for any necessary bypassing of sewage around the section of sections or line to be sliplined. Under no circumstances will dumping of raw sewage on private or City property be allowed. Bypass shall be made by pumping the sewage into a downstream manhole or adjacent system, or other methods as may be approved by the Owner and the Engineer. The pump and bypass line shall be of adequate capacity to handle the flow. If bypass pumping is not a continuous operation, flow through the sewer line shall be restored at the end of each work day. Complete plugging of the existing line will not be permitted unless adequate bypass capacity for anticipated flows is provided or other means of handling the flows is approved by the Engineer.

Cleaning - All lines to be rehabilitated shall be cleaned prior to the installation of the liner. The Contractor shall select the method of cleaning. The Contractor shall take such precautions as necessary to protect the line from further damage during the cleaning process and shall be responsible for repairing any such damages. All materials resulting from the cleaning operations shall be removed at the downstream manhole of the section being cleaned.

Television Inspection - Upon completion of the cleaning operation and prior to insertion of the liner material, a closed circuit television camera will be pulled through each line. The interior of the main shall be carefully inspected to determine the location and extent of any condition which may prevent proper installation of lining materials.

A television report log and video tape shall be furnished on each line inspected. The observations are to be recorded on a television inspection form. This log shall indicate the internal condition of the sewer segment, the deviations in line and grade, abnormal conditions of the pipe barrel and joints, and the location and quantity of each source of infiltration and inflow. The distance from the beginning manhole shall be noted for each observation made on the report form. Photographs of each defect shall be made from the television monitor for further study and justification for rehabilitation.

Liner Pipe Installation - Within the insertion pit, the top half of the exposed existing pipe is to be removed to the springline. The bottom half is to be left in place where it shall serve as a cradle for the liner pipe. The liner pipe shall be either jacked into the existing pipe or

pushed as determined by the Contractor. An aqueous solution of bentonite may be used as a lubricant to minimize jacking loads. A tapered guide shall be attached to the leading end of each section to be installed to help pipe clear small obstructions. A jacking ring shall be used to distribute load as per manufacturer's recommendations for installation of the liner pipe. For each section to be lined, insertion shall be one continuous operation until the planned termination point is reached. Closure in the insertion pit after jacking may be accomplished using a long bell closure kit or other methods, as approved by the Engineer.

Pipe jointing shall be carried out in strict accordance with the manufacturer's recommendations. Total jacking loads shall not exceed the values recommended by the manufacturer. The Contractor shall provide a suitable means for measuring jacking loads, and shall monitor the load as the liner pipe is being installed. If at any time the load appears to rise non-uniformly, indicating possible obstruction of the pipe, jacking operations shall be terminated and the obstruction removed before continuing.

Manhole Replacement - In those places where the entrance pit is excavated at an existing manhole, the manhole shall be repaired or it shall be replaced with a new manhole conforming to the section of manhole construction and, further, in accordance with Standard Details included in the drawings.

6.3 Manholes - Pipe at manholes shall be grouted one pipe diameter back from inside edge of manholes. The liner pipe shall be cut out at manholes as detailed after insertion and grouting. The method of cutting shall be such as to leave a smooth clean straight plastic edge. Where detailed or required, mild steel ties shall be provided to tie the liner to the manhole benching. The liner pipe shall be suitably strutted or blocked during grout and concrete placement so that no bowing or other deviation from a parallel sided channel occurs.

6.4 Pipe grade shall be maintained within the limits shown on the drawings. The Contractor shall be responsible for and take all necessary precautions to ensure that no liner pipe flotation, adverse pipe grades, or pipe rotation about the vertical axis results, or collapse o the liner pipe occurs during grouting operations. Multiple low pressure application grout lifts are recommended. Grouting shall be in accordance with Section 026608.3.8.

6.5 Measurement and Payment - Unless indicated otherwise in the Proposal, Glass Fiber Reinforced Liner Pipe for Sliplining shall be measured and paid for by the linear foot, complete in place.

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 OAR 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 OAR a minimum of 7 days prior to mobilizing to site. The OAR reviews the bypass plan and coordinates approval with Engineering Services and the Operating Department. OAR 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 OAR if they meet all requirements in this specification, but Contractor shall provide submittal package for OAR'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 OAR, 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, OAR 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 OAR and Wastewater Department for the startup of bypass operations once the completed bypass plan has been approved by the OAR. 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 OAR, 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. OAR 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 OAR/Utilities 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 OAR 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 OAR, 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 OAR's 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 OAR.

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 be measured as a Lump Sum pay item, to include all material, labor, equipment and supervision necessary to complete the bypass design, planning, coordination, installation, operation, maintenance and removal. When not listed in the Bid Form, Temporary Bypass Pumping shall not be measured for pay but will be considered subsidiary to the applicable pay item.

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 Surcharge Depth Allowed: _____
Bypass Forcemain 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	
☐	☐	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.
☐	☐	Has traffic control plan been appropriately modified to facilitate the bypass pumping equipment?
☐	☐	Pumps: Self-priming & Critically Silenced. Provide pump curve with Bypass plan. (Requirement).
☐	☐	Contractor shall coordinate with Supplier for appropriate instruction and training on pump operation.
☐	☐	Have emergency and/or backup provisions been made for quick pump change out in the case of system failure?
☐	☐	Contractor has confirmed no rain (less than ½-in) in the forecast?

Prepared by: Reviewed by:

_____ _____
Contractor Representative Date Wastewater Representative Date

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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 otherwise established by the OAR.

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 1 part Portland cement to 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 (frames) for streets shall be East Jordan Iron Works, Inc. product V1420, all wastewater manhole covers shall be V1430 (standard) or V1480 (tall), 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 4’ 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 OAR. Shoring shall remain in place at least 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 OAR prior to placing concrete. Forms shall remain in place for minimum of 24 hours and shall be removed within a maximum time of 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" of the corbel shall be brick to facilitate subsequent grade adjustment. Either concentric or eccentric cones may be required. Where not specified, concentric cones shall be used. Manhole designs shall be submitted for approval to the OAR and Engineer. The Contractor shall perform preliminary exploratory excavations as needed to verify all tie-ins, sizes, connections, and related utility adjustments prior to ordering precast structures.

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 existing 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 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% of loss will be permitted for each additional 2' head over a basic 2' 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 OAR. "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 6’ 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 OAR. "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.

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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)

Depth	Diameter (inches)				
(feet)	42	48	54	60	72
	Time (seconds)				
8	17	20	23	26	33
10	21	25	29	33	41
12	25	30	35	39	49
14	30	35	41	46	57
16	34	40	46	52	67
18	38	45	52	59	73
20	42	50	53	65	81
22	46	55	64	72	89
24	51	59	64	78	97
26	55	64	75	85	105
28	59	69	81	91	113
30	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 027207
REHABILITATION OF MANHOLES AND WET WELLS
WITH SHOTCRETE AND WATERPROOFING (S-74)

1. SCOPE - SHOTCRETING

The work covered by these specifications consists of furnishing all labor, equipment, materials, and performing all operations in connection with the rehabilitation of manholes with shotcrete and waterproofing, complete in strict accordance with these specifications and the applicable drawings and subject to the terms and conditions of the contract.

1.1 Shotcrete:

1.1.1 Shotcreting shall conform to all requirements of "Specifications for Materials, Proportioning, and Application of Shotcrete (ACI-506.2-77)" published by the American Concrete Institute, Detroit, Michigan, except as modified by these specifications.

1.1.2 Steel reinforcement shall be incorporated in the shotcrete as required and shall be furnished, bent, set and placed in accordance with the provisions of these specifications.

1.1.3 The purpose of this specification is to obtain a dense and durable concrete having the specified strength.

1.2 Composition:

1.2.1 Shotcrete shall be composed of Portland Cement, aggregate and water so proportioned as to produce a concrete suitable for pneumatic application.

1.3 Strength Requirements:

1.3.1 Concrete ingredients shall be selected, proportioned in such a manner as will produce concrete which will be extremely strong, dense and resistant to weathering and abrasion. Concrete shall have a minimum 28-day strength of 4,000 psi.

1.4 Materials:

1.4.1 Portland Cement

1.4.1.1 Cement shall be Portland Cement conforming to all of the requirements of the American Society for Testing Materials Standard Specifications, Latest Serial Designation C150 for Portland Cement, Type I.

1.4.1.2 When weighed in the conventional manner, Portland Cement shall weigh not less than 94 pounds per cubic foot.

1.4.2 Fine Aggregate

1.4.2.1 Fine aggregate shall be natural siliceous sand consisting of hard, clean, strong, durable and uncoated particles, conforming to the requirements of American Society for Testing Materials Standard Specifications, Latest Serial Designation C33 for Concrete Aggregates.

1.4.2.2 Fine aggregate shall not contain less than 3% nor more than 6% of moisture.

1.4.2.3 Fine aggregate shall be evenly graded from fine to coarse and shall be within the following limits:

Passing No.	3/8 sieve -	100%
Passing No.	4 sieve -	95% to 100%
Passing Go.	8 sieve -	80% to 100%
Passing No.	16 sieve -	50% to 85%
Passing No.	30 sieve -	25% to 60%
Passing No.	50 sieve -	10% to 30%
Passing No.	100 sieve -	2% to 10%

1.4.3 Water

1.4.3.1 Water used in mixing at the nozzle shall be fresh, clean, and free from injurious amounts of oil, acid, alkali, vegetable, sewage and/or organic matter. Water shall be considered as weighing 8.33 pounds per gallon.

1.4.4 Reinforcement

1.4.4.1 Reinforcement bars shall conform to the latest requirements of ASTM Standard Specifications, Serial Designation A 615 for Deformed Billet Steel Bars for Concrete

Reinforcement. Unless shown otherwise on the plans, all bars shall be Grade 40.

1.4.4.2 Steel mesh reinforcement shall be electrically welded, cold drawn, mild steel fabric conforming to the latest requirements of ASTM Standard Specifications, Serial Designation A 185 for Welded Steel Wire Fabric for Concrete Reinforcement. Mesh can be fabricated from cold-drawn steel wire conforming to the requirements of the latest ASTM Standard Specifications, Serial Designation A 82. Unless otherwise shown on the plans, mesh shall be 2 x 2 - WO.9 x WO.9 galvanized welded wire fabric.

1.4.5 Storage of Materials

1.4.5.1 Cement shall be stored with adequate provisions for the prevention of absorption of moisture. It shall be stored in a manner that will permit easy access for inspection and identification of each shipment.

1.4.5.2 Aggregate shall be stockpiled at points selected to provide maximum drainage and to prevent the inclusion of any foreign material during rehandling.

1.4.5.3 On delivery to the site of the work, the steel reinforcement shall be carefully bundled, tagged and stored so the bars for any position in the work may be readily identified. All reinforcing steel shall be stored on approved material above the ground.

1.5 Sampling and Testing Cement and Aggregate

1.5.1 The Contractor shall determine the source, kind and quality of the cement and aggregates to be used in the work well in advance of the time scheduled for starting the work and, when so directed, shall submit such information for approval before starting shotcrete operations.

1.5.2 The cost of testing cement and aggregates shall be borne by the City. Certified test reports and certificates, when so directed, shall be submitted in duplicate to the Engineer and to such other agencies or persons as he may designate.

1.5.3 Where cement and aggregate suppliers maintain regular recognized testing services, certified copies of such tests shall be submitted to the Engineer. However, in any case of doubt as to the accuracy and/or adequacy of such tests, the Owner may require that cement and aggregates be tested by a recognized commercial testing laboratory which has been selected by the Contractor and approved by the Owner. The testing laboratory shall then test the cement and aggregates and prepare written reports showing the results of such tests on each shipment. The laboratory shall also certify that the materials covered by the report comply in all respects with these specifications.

1.5.4 No cement or aggregate which fails to meet the requirements of these specifications shall be incorporated into the work.

1.6 Surface Preparation

1.6.1 Unsound materials of construction and all coated, scaly, or unsound material shall be removed by chipping with pneumatic hammers and chisels to sound surface; all cracks and cavities shall be chipped to such formation that their sides form approximately a 45-degree angle to the exposed surface for at least one (1) inch in depth. All areas to receive pneumatic concrete shall be cleaned by flushing or scouring with water and compressed air jets to assure removal of all loose particles. All areas of existing surfaces shall be given a wet sandblasting with the shotcrete equipment and the air pressure at the cement gun shall not be less than 50 psi or hydroblast @ min. 6000 psi.

A caustic wash comprised of sodium hydroxide solution at a ratio of one quart of 50% Sodium Hydroxide Solution to 100 gallons of water shall be applied to all surfaces. The mixing, application, and removal of the solution shall be done with caution to avoid contact with body and in a workmanlike manner. The solution shall remain on the surface for at least 15 minutes. Once the solution has been washed completely off, the surface shall be allowed to dry before application of replacement materials.

1.6.2 To insure perfect bond, the newly chipped, sandblasted, and washed surface shall be thoroughly moistened with water prior to application of shotcrete. In no instance shall shotcrete be applied in an area where free running water exists.

1.7 Proportioning

1.7.1 Prior to start of shotcreting, the Contractor shall submit to the Engineer the recommended mix as a ratio of cement to aggregate. Recommended mix shall be on the basis of test data from prior experience and capable of producing the required 4,000 psi compressive strength. Provided data submitted is adequate, no further testing of recommended mix will be required.

1.7.2 The Contractor shall provide all equipment necessary to control the actual amounts of all materials entering into the concrete. The types of equipment and methods used for measuring materials shall be subject to approval.

1.8 Mixing

1.8.1 Shotcrete shall be thoroughly mixed by machine and then passed through a sieve to remove all large particles before placing in hopper of the cement gun. The mixture shall not be permitted to become damp. Each batch should be entirely discharged before recharging is begun. The mixer shall be cleaned thoroughly enough to remove all adherent materials from the mixing vanes and from the drum at regular intervals.

1.8.2 Water shall not be added to the mix before it enters the cement gun. Quantities of water shall be controlled by a valve at the nozzle of the gun. Water content shall be adjusted as required for proper placement, but shall in no case exceed four gallons of water per sack of cement, including the water contained in the aggregate.

1.8.3 Remixing or tempering shall not be permitted. Mixed material that has stood 45 minutes without being used shall be discarded. Rebound materials shall not be reused.

1.9 Application

1.9.1 Shotcrete shall not be placed on a frozen surface nor during freezing weather. Shotcrete shall not be placed when it is anticipated that the temperature during the following 24 hours will drop below 32 degrees Fahrenheit.

1.9.2 Sequence of application may be from bottom to top or vice versa if rebound is properly removed.

1.9.3 Corners shall be filled first. "Shooting" shall be from an angle as near perpendicular to the surface as practicable, with the nozzle held approximately 3 feet from the work (except in confined control). If the flow of material at the nozzle is not uniform and slugs, sand spots, or wet sloughs result, the nozzleman shall direct the nozzle away from the work until the faulty conditions are corrected. Such defects shall be replaced as the work progresses.

1.9.4 Shotcreting shall be suspended if:

(1) Air velocity separates the cement from the sand at the nozzle.
(2) Temperature approaches freezing and the newly placed shotcrete cannot be protected.

1.9.5 Shotcrete shall be applied in one or more layers to such total thickness as required to restore the area as detailed over the original lines of the adjoining surface, unless otherwise specified. All cavities, depressions, washouts, and similar failures shall be rebuilt to original lines by use of shotcrete reinforced with wire mesh; where the cavity exceeds 4 inches in depth, a layer of mesh shall be used for each 3 inches of depth of shotcrete. However, in no case shall wire mesh be placed behind existing reinforcement.

1.9.6 The time interval between successive layers in sloping, vertical or overhanging work must be sufficient to allow initial but not final set to develop. At the time the initial set is developing, the surface shall be cleaned to remove the thin film of laitance in order to provide a perfect bond with succeeding applications.

1.10 Construction Joints

1.10.1 Construction joints or day's work joints shall be sloped off to a thin, clean, regular edge, preferably at a 45-degree slope. Before placing the adjoining work, the slope portion and adjacent shotcrete shall be thoroughly cleaned as necessary, then moistened and scoured with an air jet.

1.11 Surface Finish

1.11.1 Nozzleman shall bring the shotcrete to an even plane and to well-formed corners by working up to ground wires or other guides, using somewhat lower placing velocity than normal.

1.11.2 After the body coat has been placed, the surface shall be trued with a thin-edge screed to remove high areas and expose low areas. Low areas shall be properly filled with concrete to insure a true, flat surface.

1.11.3 After the concrete surface has been trued, the entire surface shall be given a flashcoat finish unless a special type finish is specified on the drawings.

1.11.4 Thicknesses: The minimum thickness of the shotcrete shall be 1-inch over all surfaces.

1.12 Curing

1.12.1 Curing shall be in accordance with either paragraph 3.7.l(d) or paragraph 3.7.5 of ACI 506.2-77 depending upon atmospheric condition.

1.13 Adjacent Surface Protection

1.13.1 During progress of the work, where appearance is important, adjacent areas or grounds which may be permanently discolored, stained, or otherwise damaged by dust and rebound, shall be adequately protected and, if contacted, shall be cleaned by early scraping, brushing or washing as the surroundings permit.

1.14 Inspection

1.14.1 Because of the importance of workmanship affecting the quality of the shotcrete, shotcrete continual inspection during placing shall be maintained. Any imperfections discovered shall be cut out and replaced with sound material.

1.15 Equipment

1.15.1 Cement Gun

1.15.1.1 The mixing and delivering equipment shall be either the vertical double chamber type or rotary type. The upper chamber of the double chamber type shall receive and pressurize the dry mix and deliver it to the lower chamber. The lower chamber shall force the pressurized mix into the delivery hose by means of a feed wheel. The type of feeder utilized should be of sufficient capacity that the lower chamber may continuously furnish all required material to the delivery hose while the upper chamber receives the recharge. The rotary type cement gun shall have an enlarged hopper to feed material into a rotating-multiported cylinder. Material shall fall by gravity into a port which shall then be rotated to a position in which the material is expelled by air into a moving stream of air. All equipment must be kept in good

repair. The interior of drums, feed gearing and valves shall be cleaned as often as necessary (at least once every 8-hour shift) to prevent material from caking on critical parts.

15.2 Nozzle

1.15.2.1 Nozzle shall be the premixing type with perforated water feed ring inside the nozzle. The maximum length of material hose for the application of shotcrete shall be approximately 150 feet although it shall be permissible to use as much as 800 feet of material hose if the supply air pressure measured at the cement gun is increased to maintain proper velocity. The following table gives requirements for compressor size, hose size, and air pressure using 150 feet of material hose:

TABLE I

Comp.Cap cfm	Max. Hose Dia. In.	Max. Size Nozzle In.	Min Air Press. psi
365	1-5/8	1-5/8	60
600	2	2	80
750	2-1/2	1-1/2	90

For each 25 feet of material hose used in excess of 150 feet, the required air pressure shall be increased by 5 psi.

1.15.3 Air Compressor

1.15.3.1 Any standard type of compressor shall be satisfactory if it is of sufficient capacity to provide, without interruption, the pressures and volume of air necessary for the longest hose delivery. The air compressor capacity determinations shall include allowances made for the air consumed in blowing rebound, cleaning, reinforcing, and for incidental uses. Compressor equipment shall be of such capacity so as to insure air pressures at the special mixer capable of producing the required material velocities.

1.15.4 Water Supply

1.15.4.1 The water pressure at the discharge nozzle should be sufficiently greater than the operating air pressure to assure the water is intimately mixed with the other materials. If the line water pressure is inadequate, a water pump or pressurized tank shall be introduced into the line. The water pressure shall be uniformly steady (nonpulsating).

1.16 Qualifications

1.16.1 Foremen, Nozzlemen, Gunmen, Reboundmen

1.16.1.1 Before employment on the project, above workmen must satisfy the Engineer that each has done satisfactory work in similar capacities elsewhere for a sufficient period of time to be fully qualified to properly perform the work in accordance with the requirements of the related specifications.

1.16.2 Foremen

1.16.2.1 Foreman shall have had at least 4 years experience on similar work.

1.16.3 Nozzlemen

1.16.3.1 Nozzlemen shall be qualified workmen, having had at least 2 years experience in similar work, and it shall be his responsibility to:

1. Insure all surfaces to be shot and clean and free of laitance or loose material,using air and air-and-water blast from the nozzle as required.
2. Insure the operating air pressure is uniform and provides proper nozzle velocity for good compaction.
3. Regulates the water content so the mix will be plastic enough to five good compaction and a low percentage of rebound but still enough not to sag.
4. Hold the nozzle at the proper distance and as nearly normal to the surface as the type work will permit, to secure maximum compaction with minimum rebound.
5. Follow a sequence routine that will fill corners with sound shotcrete and encase reinforcement without porous material behind the steel, using the maximum practicable layer thickness.
6. Determine necessary operating procedures for placement in close quarters, extended distances or around unusual obstructions where placement velocities and mix consistency must be adjusted.
7. Direct the crew when to start and stop the flow of materials, and stop the work when material is not arriving uniformly at the nozzle.
8. Insure sand or slough pockets are cut out for replacement.
9. Bring the shotcrete to finished lines in a neat and workmanlike manner.

1.16.4 Gunman

1.16.4.1 Gunman shall operate the special pneumatic mixer and direct the work of the mixer crew. Utilizing his experience, he shall maintain proper pressure on the cement gun to insure the necessary nozzle velocity. He shall further see that the material fed to the nozzle is uniform.

2. WATERPROOFING

When indicated on drawings and upon completion of the shotcreting operations, two coats of Drycon (Grey and white), as manufactured by IPA Systems of Philadelphia, PA, shall be applied to the interior surfaces of the manholes. Minimum thickness of each coat shall be 1/16 inch. Alternate waterproofing materials shall be submitted to the Engineer for approval prior to commencing manhole rehabilitation work.

3. MEASUREMENT AND PAYMENT

Unless included in the proposal as a bid item, manhole and wetwell rehabilitation shall not be measured and paid but shall be subsidiary to other work.

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 OAR 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 OAR 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 OAR, a proper joint is not secured.

Pipe Size	Primer Per 100 Jts.	Cut Lengths Per Joint
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 OAR.

d. Geotextile for wrapping pipe joints shall be Class 2 geotextile for subsurface drainage with an average opening size of 0.22mm and 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 OAR. 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 OAR, 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” in diameter, the Contractor may drill two holes not larger than 2” 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 OAR.

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 OAR. 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 OAR. 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 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 OAR, no heavy earth moving equipment will be permitted to haul over the structure until a minimum of 4’ 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.

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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 HL93 loading per ASHTO 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 2 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 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 OAR. 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 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” in diameter or 2” 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” of uniformly moistened and mixed cement-stabilized sand containing a minimum of 1.5 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 2’ wide and centered on the joints.

Minimum clearance between parallel RCBs is 6”, and the space between the boxes shall be filled with uniformly moistened and mixed cement stabilized backfill.

Lifting holes shall be filled with mortar or concrete and cured to the satisfaction of the OAR.

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.”

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.

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SECTION 027414
CULVERT REHABILITATION FLEXIBLE LINING PROCESS

1. SCOPE

This specification shall govern all work necessary to rehabilitate gravity storm sewer lines using a flexible liner process. Lining and method of installation shall be similar or equivalent to the Insituform® or Inliner Lining Process where a flexible tube saturated with thermosetting resins is inserted into the line using water pressure.

2. MATERIALS

The lining material shall be a polyester fiberfelt tubing, lined on one side with polyurethane and fully impregnated with a liquid thermal setting resin. The resin shall bond to concrete. The tubing shall be properly sized for the diameter and length of sewer pipe to be lined. The proposed lining material thickness shall be as follows:

Existing Sewer Line I.D. (Inches)	Minimum Liner Thickness (Inches)
24"	.50"

The liner material shall conform to the structural standards listed below:

Tensil Strength at yield 73%	ASTM D-638 3000 psi
Flexural Strength	ASTM D-790 3000 psi
Modulus of Elasticity	ASTM D-638 300,000 psi
Flexural Modulus	ASTM D-790 300,000 psi
Impact Strength	ASTM D-256 2.5 FT-lb/In
Shear Strength	ASTM D-732 7400 psi

Prior to the use of the lining material, the contractor shall submit, for approval, satisfactory certification from an approved testing laboratory, that the material meets or exceeds the above criteria.

After placement, test for modulus of elasticity shall be conducted by an Independent Laboratory. Two field liner specimens shall be required.

In addition, satisfactory evidence shall be provided that the liner materials will withstand the corrosive effects of effluent, liquids and gases normally found in a municipal storm sewer system.

3. CONSTRUCTION METHODS

A. Cleaning: All lines to be rehabilitated shall be clean and dry during the installation of the liner. The contractor shall select the method of cleaning. It is anticipated that a high velocity jet nozzle ewer cleaner will be used. However, the contractor shall utilize such other equipment as necessary to clean the line. The contractor shall take such precautions as necessary to protect the line from further damage during the cleaning process and shall be responsible for repairing any such damages. All materials resulting from the cleaning operations shall be removed at the downstream manhole of the section being cleaned. Disposal of this material shall be as provided in the Special Provisions.

B. Inspection: Upon completion of the cleaning operation and prior to insertion of the liner material, an inspection shall be performed. The interior of the main shall be carefully inspected to determine the location and extent of any condition which may prevent proper installation of lining materials or bonding of materials to the pipeline shall be noted so that these conditions can be corrected.

C. Repairs: Any obstacles or conditions detrimental to liner installation shall be corrected by making an excavation at that point and effecting the necessary repairs. The method and extent of the repairs shall be approved by the Engineer.

D. Maintain Flows: Storm water flows, that may intermittently occur, shall not be restricted during project.

E. Liner Installation: Rehabilitation of the sewer pipe shall be accomplished by the installation of flexible liner by an inversion process wherein the flexible tube is saturated with resin turned inside out and forced in the existing line using water pressure. The contractor shall begin this phase of the work until there are sufficient materials on hand to complete the job.

The fiberfelt tube shall be vacuum impregnated with sufficient resin and catalyst system to achieve the liner thickness specified. Once impregnated, the tube shall be inserted through an existing manhole by means of an inversion process and the application of a hydrostatic head sufficient to fully extend it to the next designated access point. The hydrostatic head shall be sufficient to hold the liner tight to the existing pipe wall, produce ☐dimples ☐at side connections and flared ends at the entrance and exit access points.

After inversion is completed the contractor shall supply a suitable heat source and water recirculation equipment. The equipment shall be capable of delivering hot water to the far end of the pipe section through a hose, which has been perforated per manufacturer ☐s recommen
raise the water temperature in the line section above the temperature to effect a cure of the resin.

The heat source shall be fitted with suitable monitor to gauge the temperature of the incoming and outgoing heat exchange circulating water. Thermocouple shall be placed between the impregnated tube and the invert at the far access point to determine the temperature and time of exotherm. Water temperature in the pipeline during the cure period shall not be less than 150 F as measured at the heat exchanger return line.

Initial cure shall be deemed to be completed when inspection of the exposed portions of the liner appear to be hard and sound and the thermocouple indicate that an exotherm has occurred. The cure period shall be of a duration recommend by the resin manufacturer modified for the lining process during which time the recirculation of the water and cycling of the heat exchanger to maintain the temperature continuously.

The contractor shall cool the finished liner to a temperature below 100 F before relieving the static head in the inversion stand pipe. Cool-down may be accomplished by the introduction of cool water into the inversion stand pipe to replace water being drained from the downstream

end. Care shall be taken in the release of the static head such that a vacuum will not be developed that could damage the newly installed liner.

F. Branch of Service Connections: After liner has been cured, the contractor shall reconnect the existing active branch lines as designed by the Engineer. This shall generally be done without excavation and in the case of non-man entry pipes from the interior of the pipeline by means of a television camera and a cutting device that re-establishes them to not less than 90 percent capacity.

G. Inspection of Completed Work: A final inspection will be required upon completion of rehabilitation operations. It is the intent of the plans and specifications that the entire length of the completed rehabilitation be inspected.

H. Clean Up: After all installation work has been completed the contractor shall clean the area around the work site and return the ground cover to a like or better condition as existed prior to construction. All pavement disturbed shall be repaired as specified elsewhere in these specifications.

4. MEASUREMENT AND PAYMENT

Unless specified otherwise in the Proposal, Sanitary Sewer Rehabilitation - Flexible Lining Process shall be measured and paid by the linear foot for each size installed, complete in place.

SECTION 027418
POLYPROPYLENE STORM WATER PIPE

1. DESCRIPTION

This specification shall govern all work necessary for furnishing and placing all polypropylene (PP) pipe (ASTM F2881 and AASHTO M330) for gravity-flow storm drainage as required to complete the project.

2. MATERIALS

2.1 PP pipe shall be made of impact modified copolymer meeting the material requirements of ASTM F2881, Section 5 and AASHTO M330, Section 6.1. PP pipe shall have a smooth interior and annular exterior corrugations and meet or exceed ASTM F2881 and AASHTO M330.

2.2 DIMENSIONS
Pipe size shall be as indicated in the drawings, minimum 18" to maximum 36" unless otherwise authorized by the OAR.

2.3 JOINTS
Pipe shall be joined with a gasketed integral bell and spigot joint meeting the requirements of ASTM F2881. The joint shall be watertight according to the requirements of ASTM D3212. Bell shall overlap a minimum of 2 corrugations of spigot end when fully engaged. Spigots shall have gaskets meeting the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removeable protective wrap to ensure the gasket is free from debris. A joint lubricant which has no detrimental effect on gasket or on pipe in accordance with the manufacturer's recommendations shall be used on the gasket and bell during joint assembly.

2.4 FITTINGS
Fittings shall conform to ASTM F2881 and AASHTO M330. Bell and spigot connections shall utilize a welded or integral bell and spigot and gaskets meeting ASTM F477. The bell and spigot fittings joint shall meet the watertight joint performance requirements of ASTM D3212.

3. INSTALLATION

Installation shall be installed open trench and in accordance with ASTM D2321, manufacturer recommendations and guidelines, and construction methods prescribed in 027402 "RCP Culverts", including CCTV inspection. Geotextile wrap of the watertight joints is not required. Pipe installation shall begin at the downstream end working upstream. The Contractor shall make such temporary provisions as necessary to ensure adequate drainage of the trench and bedding during the construction operation.

Minimum cover for 18" – 36" diameter pipe is 2'. No heavy earth moving equipment is allowed

over the pipe until a minimum of 2’ of compacted fill (permanent or temporary) has been placed over the top of the pipe. Do not exceed manufacture’s guidelines for loading during construction.

Evidence of local or unequal deformation caused by improper construction methods at any point during construction shall be cause for corrective measures as directed by the OAR.

Use of PP pipe is not allowed beneath the pavement footprint or within 1’ clearance from the back of curb.

If any portion of the trench falls within 1’ of the back of curb, backfill shall be as if the pipe is beneath the pavement, including cement stabilizing the top 3’ of trench backfill.

Joints shall be properly aligned. Misaligned joints are not acceptable.

Deflections at joints shall be designed such that they not exceed 75% of the manufacturer’s recommended maximum allowable joint deflection.

4. MEASUREMENT AND PAYMENT

Unless otherwise specified in the Bid Form, PP pipe 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, or up to the interior wall of connecting inlets, headwalls, catch basins, manholes, junction boxes, or other structures, but not include the interior dimension of the structure. For multiple pipes, the measured length will be the sum of the lengths of each barrel measured as prescribed above.

Payment shall be full compensation for furnishing, transporting, and installing the PP pipe, for bedding materials and bed preparation including compaction, for excavation and backfill, for all connections to existing and new structures (except as otherwise specified in the Bid Form), CCTV, and for all labor, materials, tools, equipment and incidentals required to complete the work as shown on the drawings and 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 20' 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' vertical clearance between outsides of pipes where a new waterline crosses over a new non-pressurized wastewater line. Maintain a minimum of 6" 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' of horizontal offset exists from each water joint to the wastewater carrier pipe. In all instances where the water and wastewater pipe offsets cannot meet TCEQ minimum separation distances, the wastewater pipe shall be SDR 26 ASTM pressure-rated pipe from manhole to manhole when improvements span between mahnoles.

Alternatively, at waterline crossings, the PVC gravity wastewater pipe may be encased in a 20’ 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 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” 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

Depth of Cut	Required Bedding
Less than 20’	Gravel or Crushed Stone
Over 20’	Crushed Stone

BOTTOM OF TRENCH NOT IN GROUND WATER

Depth of Cut	Required Bedding
Less than 15’	Sand, Gravel, or Crushed Stone
Less than 20’	Gravel or Crushed Stone
Over 20’	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 OAR.

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:

$T = 0.00237D^2L$ [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 5 psi. The time required for a 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:

Nominal Size (inches)	Mandrel O.D. (inches)
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 OAR 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 50', 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 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, jetted 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 027608
PRIVATE SEWER SERVICES (S-39)
(FOR RESIDENTIAL AND COMMERCIAL APPLICATION)

1. Scope:

This section governs the furnishing of all labor, equipment, tools and materials necessary for the construction of private sewers services as shown on the plans, as outlined herein and as necessary to complete the project. Private sewer services lines (aka Building Sewers) are defined as the sewer piping extending from the customers structure to the clean-out at the property line.

2. General:

Construction of private sewer services shall comply with the provisions of the Standard Plumbing Code as published by the Southern Building Code Congress and as adopted, with local amendments, by the City of Corpus Christi, in addition to the plans and specs. In case of conflict, between the code and the plans the more stringent prevails.

3. Materials:

PVC pipe and fittings for sewers shall be in accordance with ASTM D2665 and ASTM D 3311. Solvent cement for PVC shall meet ASTM D2564. Asbestos cement pipe, concrete pipe and cast iron pipe shall not be used as sewer pipe. There shall be no co-mingling of different materials except through proper adaptors. Section (504.4.2) of the Standard Plumbing Code. Rejected materials shall be marked and removed from the job site.

4. Permits:

Normal plumbing permit application and fee requirements of the Standard Plumbing Code as adopted by City Code shall apply to this project. A plumbing permit for each lot will be issued to the Contractor by the Building Inspections Department of the City of Corpus Christi. The contractor shall make application for permits upon award of the contract.

5. General Obligations:

(a) Contractor: The contractor shall construct private sewer services in accordance with the plans and these specifications in a neat and workmanlike manner. The route of the proposed private service shall be determined by the Contractor subject to approval of the Owner and the Engineer. All work on private services shall be supervised and inspected by a licensed plumber. Good relationships with the public are essential to the success of this project. The contractor shall make all the required notifications and notices to the owner/occupants in the area. The work shall be accomplished with minimal inconvenience to the public and owner/occupants. The contractor shall cooperate with all City employees involved in the execution of this contract.

(b) City: The Engineer will review work proposed by the Contractor and the City Plumbing Inspector shall inspect the installation.

6. Sequence of Work:

(a) City will mail out general letter to property owners describing the project with Form WS-1 (See Appendix) for execution.

(b) Contractor to acquire authorizations from owners for site inspections using Form WS-1 in Appendix from those property owners not responding to general letter. The contractor is encouraged to take photographs of before and after conditions on each lot.

(c) Contractor performs site inspection and fills out required form and submits copy of inspection report and Site Plan Showing Route to Engineer. (Private Sanitary Sewer Service Inspection Report & Routing Recommendations Form S-2 and Sample Site Plan in Appendix).

(d) Form S-2 reviewed by Engineer and property owner. This should be completed prior to installing main sewer.

(e) Contractor notifies owner/occupant of proposed construction and acquires authority for proposed construction on Form S-2 and Site Plan in Appendix.

7. Construction Methods:

(a) Clean outs - A two-way, 4-inch double riser clean out shall be installed at the connection of proposed private sewer and building sewer and also a single wye riser at the property line. Clean outs shall be placed at change in direction and at a maximum spacing of 75 feet. All clean outs shall be brought to finish grade.

(b) Bends - Change in direction in drainage piping shall be made by the appropriate use of 45° wyes, long sweep quarter bends, one-sixth, one-eighth, or one-sixteenth bends or by a combination of these, or equivalent fittings.

(c) Disconnection from Old Main - Abandoned service lines shall be plugged below ground surface with concrete.

(d) Fittings prohibited - A straight tee shall not be used. Saddle type fitting or running threads shall not be used. Pipe shall not be drilled or tapped unless approved by the Engineer. A fitting having a hub in the direction opposite to flow shall not be used, unless the pipe is cut by a saw or snap cutter, which will assure clean, smooth cuts of the pipe. Adaptors for connecting new pipes to existing piping shall be of the non-shear type. Adaptors with internally fitted fiberglass support ring as manufactured by DFW/HPI or Adaptors with externally fitted stainless steel shear rings and hardware as manufactured by Fernco or approved equal shall be required for matching pipe with the same nominal dimensions such as 4" clay to 4" plastic. Other types of adaptors that do not have this feature shall not be used.

(e) Protection of foundations - Trenches shall not be excavated within 3 feet of foundations. (See Foundation Protection Exhibit in Appendix) Where trenching is not allowed because of insufficient clearance from foundation, the private service shall be installed in a bored or jacked casing. The ends of each casing shall be wrapped with Class AA≅ subsurface Geotextile per AASHTO M288. This steel casing will only be measured for pay when it falls within the areas where open trenching is not allowed because of it being excessively close to existing foundations. Boring under surface improvements such as existing driveways, sidewalks, etc. shall not require casing.

(f) Pipe size - Minimum pipe size for private services shall be 4" diameter for residential and 6" diameter for commercial.

(g) Slope/velocity - Minimum slope of services shall be not less than 0.01 or 1/8 inch per foot.

(h) Installation - Materials shall be installed in accordance with manufacturer requirements.

(I) Alignment/grade - The contractor shall be responsible for establishing alignment and grade for proposed services. (See paragraph (g) above.)

(j) Surface Restoration - Separate trenches (one for water and one for sewer) separated by undisturbed or compacted earth shall be excavated. Trenches shall be excavated in such a manner which will minimize damage to surface vegetation. After installation, the excavated material shall be tamped into the trench and the surface restored to like or better condition acceptable to the Engineer. Lines shall be bored, jetted or jacked under sidewalks, driveways or other such improved surfaces; unless authorized by the Engineer.

(k) Electrical ground - Where required by the building code, electrical ground wires shall be installed to assure any appliances grounded to the plumbing system remain grounded.

(l) Maintenance of service - Sanitary services shall be installed with a minimum of inconvenience to the occupant of the house. The contractor shall provide continuous service of all utilities during construction, where practical. In the event of damage to existing utility, restoration is the responsibility of the contractor.

(m) Interruption of service - In the event that an unavoidable interruption of service is anticipated, the contractor shall advise the building occupant (s) a minimum of 24 hours in advance of the interruption. After the service has been interrupted, the contractor shall expeditiously continue work until service has been restored. In no case shall sewer service be interrupted for more than four (4) hours.

(n) Testing - The Private sewer shall be tested for leaks prior to connecting with the clean-out at the property line. The private sewer service shall be plugged at the down stream end and a ten foot test riser placed at the up stream end(s). The line shall be filled with water and no measurable leaks shall be allowed. The Air Test [417.2.2] may be used at the option of the Contractor. Test equipment shall be provided by the Contractor.

8. - Measurement and Payment:

Unless indicated otherwise in the Proposal, Private Sewer Services shall be measured per each service installed. Some services may require more than one connection on the owner's pipe. For example, house with garage apartment. All connections of this nature made to common lot owner shall be considered one service. Rental house of a common owner shall be measured as separate unit for each house. Payment shall be at the contract unit bid prices and shall constitute full compensation for furnishing and installing all pipes, fittings and incidentals, trenching, trench safety, boring, jetting or jacking, flushing, surface restoration and all other work or material required to provide sewer service from the structure(s) to the sanitary clean-out at the property line.

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 ±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.

SAMPLE TELEVISED INSPECTION REPORT FORM

CITY OF CORPUS CHRISTI
TELEVISED INSPECTION REPORT DATA REQUIREMENTS
[On screen at start of each set-up and on Inspection Report]

City's Project Name _____

City's Project Number _____ Contractor/Operator _____

Date /Time Televised _____ DVD Number _____

Upstream MH Location _____ Downstream MH Location _____

Upstream MH Number _____ Downstream MH Number _____

Upstream MH Depth _____ Downstream MH Depth _____

Pipe Size _____ Pre-Rehab TV Y N Evaluation TV Y N

Post-Rehab TV Y N Reverse Set-up Y N

Pipe Material _____

DISTANCE FROM ENTRY POINT	OBSERVATIONS/COMMENTS

DVD LABELING REQUIREMENTS [On each DVD]

City Project Name _____ Upstream Manhole No. _____

City Project No. _____ Downstream Manhole No. _____

Street Name _____ Pre Post Other

DVD No. _____ Date/Time Made _____

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) DR, Dimension Ratio, D/T
T = Wall Thickness of CIPP (in) 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 027616
PROFILED WALL HIGH DENSITY POLYETHYLENE PIPE FOR SLIPLINING (S-73)
(Gravity Sewers)

1. SCOPE

This specification shall govern for all work necessary for furnishing and installing profiled wall, high density polyethylene pipe required to complete the sliplining of existing sanitary sewer lines.

2. MATERIALS

2.1 This profiled wall pipe shall be Spirolite Core Wall as manufactured by Spiral Engineered Systems, a Division of Gulf Plastic Fabricated Products Company, or approved equal.

Polyethylene: The material used for the liner and for the service taps shall be the same materials as designated below.

ASTM Designation: D 3350 with a cell classification of PE345434C. 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, D1248. This material shall also conform to the design criteria as specified in Plastic Pipe Institute (PPI) Designation: PE3408.

If requested by the owner, the pipe and fitting manufacturer shall provide certified copies of the quality control data taken during product manufacture.

Pipe and fittings shall be produced by the same manufacturer from identical materials meeting the requirements of this specification.

Pipe and fittings shall be rated to meet the service requirements specified by the Design Engineer. Whether molded or fabricated, fittings shall be fully rated to at least the same service rating as the pipe to which joining is intended.

Fitting shall be manufactured in production facilities designed for that purpose. Field fabricated fittings are not allowed.

Pipe and fittings shall be manufactured in accordance with ASTM F894, or the applicable dedicated service specification. Printline markings shall include a production code from which the location and date of manufacture can be identified. Upon request, the manufacturer shall provide an explanation of his production code.

Gaskets shall meet the requirements of ASTM F477.

The Corewall pipe shall have a ring stiffness class of 160.

2.2 Pipe Rating: The pipe shall have a manufacturer's recommended hydrostatic design stress rating of at least 800 psi based on a material with a 1600 psi design basis determined in accordance with ASTM D2837-69, Standard Method for Obtaining Hydrostatic Basis for Thermoplastic Pipe Materials.

2.3 Dimensions:

Sewer Line I.D. (Inches)	Nominal O.D. of Liner (Inches)	Min. Wall Thickness Liner (Inches)
60	58.56	2.280
54	52.30	2.150
48	46.05	2.025

Laying length of joints shall be 20' feet plus or minus 2 inches.

The Contractor shall specifically note the relatively small size of the annular space between the liner pipes proposed under this material option. By submitting a bid based on this material option, the Contractor is indicating that sliplining under these conditions is entirely feasible, and assumes all responsibility for any difficulties encountered resulting from these conditions.

2.4 Liner Diameter: The inside diameter of the liner pipe at any point shall not vary from the normal inside diameter by more than one percent or one quarter inch, whichever is greater.

2.5 Wall Thickness: The average wall thickness of the liner pipe shall not be less than the nominal wall thickness published in the manufacturer's literature current at the time of purchase and the wall thickness at any point shall not vary from the nominal by more than 10 percent. The manufacturer shall provide sufficient data to demonstrate that the pipe supplied provides a 50 year service life with a maximum external hydrostatic pressure of 10 feet of water above the pipe center line.

All pipes 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 of said materials.

3. CONSTRUCTION METHODS

3.1 Cleaning: All lines to be relined shall be cleaned prior to installation of liner. The Contractor shall select the method of cleaning. All materials resulting from the cleaning operations shall be removed at the downstream manhole of the section being cleaned.

Television Inspection: Upon completion of the cleaning operation and prior to insertion of the liner material, and closed circuit television inspection will be performed in accordance with Standard Specification S-125.2.2.

All observed obstructions shall be removed by the Contractor before initiating liner insertion. All excavation and backfilling for removal of obstructions, liner insertions, manhole rehabilitation and side sewer connection, if any, shall conform to requirements set out in this specification.

3.2 Bypass sewage: It shall be the responsibility of the Contractor to bypass the sewage, if necessary, around the section or sections of line that are to be sliplined. Under no circumstances will dumping

of raw sewage of private or City property be allowed. Bypass shall be made by pumping the sewage into a downstream manhole or adjacent system, or other methods as may be approved by the Owner and the Engineer. The pump and bypass line shall be of adequate capacity to handle the flow. If bypass pumping is not a continuous operation, flow through the sewer line shall be restored at the end of a work day. Complete plugging of the existing line will not be permitted unless adequate bypass capacity for anticipated flows is provided or other means of handling the flows is approved by the Engineer.

3.3 Pipe jointing: All jointing of pipe sections is to be done in strict conformance with the manufacturer's recommendations.

3.4 Insertion: After completing the access shaft excavation, the half of the existing sewer down to the spring line shall be broken or cut and removed for the full length of the access shaft. Precautions shall be taken not to damage the liner by scoring on a ragged edge of the old sewer line during sliplining. Wherever possible, liner shall be pushed, jacked, or pulled through manholes and liner sections shall be joined in pits other than in manholes. The purpose of this requirement is to: 1) provide a smooth invert without grouting and a uniform condition for manhole rehabilitation; and, 2) minimize the number of insertion pits. Details for joining of liner section in manholes shall be submitted to the Engineer for approval prior to construction. Sufficient time (minimum 12 hours) shall be allowed after pushing, jacking, or pulling the pipe for the pipe to recover to its original length, and allow for stabilization of length due to temperature. During the installation of the liner, should the liner break or separate, the excavation required to rejoin the pipe and all other work necessary to complete such repair shall be done for no separate pay.

3.5 Service Connections: After the liner has been pushed, jacked, or pulled into place, allowed to recover, and secured to the manhole walls, each side sewer service shall be connected to the new liner, Service laterals shall be connected by the use of an approved remote tapping system or a prefabricated saddle. If the prefabricated saddle is use, a neoprene gasket shall be installed between the saddle and the liner pipe so that a complete water seal is accomplished when the two piece saddle is place around the polyethylene pipe and pulled together with stainless steel bands. Inspection of this line did not reveal any connections to the sewer except at manholes. Laterals connecting to existing manholes shall be reconnected to the satisfaction of the Engineer.

3.6 Backfill: At all pints where the liner pipe has been exposed, as in access shafts, outside of manholes, service connections, etc., the Contractor shall remove all debris and create a void along each side of the pipe at the spring line to undisturbed soil. Width of the void shall not exceed existing pipe O.D. plus four feet. Suitable spacers shall be used to center the liner within the existing pipe, or hold the liner at the top of the existing pipe. The space between the liner and the pipe shall be filled with cement grout which shall contain a minimum of seven sacks of cement per cubic yard of sand and enough water (but no more) to provide a mixture that will flow around the pipe. As the bottom portion of this grout begins to set up, a drier mix shall be placed on top of the liner until a cover over the liner approximately the O.D. of

the existing pipe is formed. In the voids along each side of the existing pipe, the Contractor shall place cement stabilized sand consisting of 3 sacks of Portland Cement per cubic yard of fine aggregate for concrete, mixed dry and placed in six inch lifts for the full width and length of the excavation and also be placed over the above described grout until a depth of twelve inches over the top of the original pipe is achieved. Each lift shall be hand tamped and utmost care shall be exercised to avoid damaging the stabilized sand is in place and accepted by the Engineer, backfilling to finished grade may be completed using material from the excavation, select material or cement stabilized sand, all at the Contractor's option and as approved by the Engineer.

3.7 Sealing Manholes: The annular space between the polyethylene liner and the existing sewer line shall be sealed where the sewer line enter or exits each manhole. The annular space may be sealed with a mechanical device, chemical seal, or quick setting concrete. The method chosen shall bee approved by the Engineer prior to construction.

3.8 Grouting Annular Space: The annular space between the polyethylene liner and the existing pipe shall be filled with a grout having good flow characteristics, minimum shrinkage, and permanence of support. The grout mix used shall have a minimum 24 hour compressive strength of 25 psi and a minimum 28 day compressive strength of 200 psi. Exact grout mix designs and details of proposed grouting methods shall be submitted to the Engineer for approval prior to use on the project. It is intended that the annular space be 100% filled, but particular attention must be paid to those areas just downstream of manholes to avoid air traps. Equipment for placement of grout shall be used as to prevent segregation of the grout components and to cause the grout to flow around the liner and completely fill the voids in the annular space. Under no circumstances shall grout be dropped down the shafts onto the polyethylene liner. Grouting pressures shall not exceed the limits established by the liner pipe manufacturer. Such limits shall be adjusted to allow for higher temperatures caused by hydration of the grout mix. The Contractor shall have operable pumps on the job site to remove water for the vertical shafts as it is displaced by grout to prevent an excessive hydrostatic head on the polyethylene liner.

3.9 New Manholes: In those places where the main access shaft is excavated at an existing manhole, the manhole will be replaced with a new manhole. The new manhole shall essentially be equal to the rehabilitated manhole shown on the drawings except that a concrete vault will not have to be constructed at the bottom. Details of such construction shall be subject to review and approval by the Engineer before construction. All materials shall be new and the best quality and workmanship shall be that of skilled craftsmen. New manholes constructed under this section shall not be reason for extra compensation. All materials not used in the backfilling operation shall be disposed of off site by the Contractor and all areas must be restored to their original conditions.

3.10 Inspection of Completed Work: A final closed circuit television inspection in accordance with Standard Specification S-125.2.3 will be required upon completion of trunk line and manhole rehabilitation operations. It is the intent of the plans and specifications that the entire length of the completed trunk line

rehabilitation be inspected, however, the Contractor shall have the option of performing final inspection of sections of the trunk line as completed. The time, location, and length of final inspections shall be as approved by the Engineer.

4. CLEANUP

After all installation work has been completed, the Contractor shall cleanup the area around the work area and return the ground cover to a like or better condition as existed prior to construction. All pavements shall be repaired as specified. All broken pipe, and other material not a part of the ground cover shall be hauled off and properly disposed of the Contractor.

5. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Sanitary Sewer Sliplining will be measured by the linear foot for each size installed.

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.

		LB/ACRE OF PURE LIVE SEED FOR MIXTURES		
COMMON NAME	SCIENTIFIC NAME	A	B	C
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 OAR.

Wood Cellulose Fiber Type mulch shall have no growth inhibiting ingredients and shall be dried with a moisture content less that 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" 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" 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" by use of a heavy, dulled disk harrow, set nearly straight. Disks shall be set approximately 9" 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". 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 1 plant per square inch with no bare spots larger than 3 square inches. The Contractor shall re-establish grass growth as directed by the OAR 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 in two portions with 25% of pay (less retainage) due after seeding, and 75% of pay (less retainage) due 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 that 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", or live St. Augustine with thickly matted roots throughout the soil with a minimum thickness of 1". 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 Contractor 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" shall be planted in rows on 15" 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" 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 OAR 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 OAR, slopes may cause displacement, areas to be block sodded shall be indicated on the drawings or as directed by the OAR 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" or more than 10", 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 OAR. 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" to 6" deep along horizontal slope lines at 2' vertical intervals. Excavated material from the furrows shall not protrude more than 3" 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 OAR 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:

Pipe Size (O.D. Nominal)	Square (Tubular)	Gate Length
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.

Use and Section	O. D. or Dimensions, Nominal Round	Square
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:

Type of Post	Fabric Height	Hole Diameter	Hole Depth	Post Embedment
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". Top edge of fabric shall be twisted and barbed selvage on 6' height fencing and shall be knuckled selvage on 4' height 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" intervals. Ties shall be furnished to fasten the fabric to bottom tension wire at 24" intervals. The fabric shall be tied to line posts at 15" intervals.

Line Posts shall be provided at a maximum spacing of 10' and be of the following sizes:

Fabric Height	Pipe Size	H-Beam Section		Embedment	
		Size	Wt./Ft.	Size	Length
4'	1.90" O.D.	2.72#	1.875" x 1.625"	2.70#	24"
6'	2.375" O.D.	3.65#	2.25" x 1.95"	4.10#	30"

Corner Posts and End Post shall be of the following sizes:

Fabric Height	Pipe Section Size	Embedment Length Wt./Ft.	
4'	2.375" O.D.	3.65#	30"
6'	2.875" O.D.	5.79#	42"

Gate Posts shall be of the following sizes:

Gate Leaf	Pipe Section Size	Embedment Length Wt./Ft.	
Up to 6'	2.875" O.D.	5.79#	36"
6' to 13'.	4.0 " O.D.	9.10#	42"
13' to 18'	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" skirt for rigidity.

Top rail, where called for, shall be 1.625" O.D. steel pipe weighing 2.27#/foot. Top rail shall be furnished in random lengths not less than 18' per section and shall be joined with outside sleeve, steel couplings not less than 6" long and having a wall thickness of not less than 0.70". 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" O.D. pipe as specified for top rail material. Tension members shall be 3/8" diameter steel rods with turnbuckles.

For 6' fences with top tension wire, braced panels shall consist of horizontal pipe brace, located approximately 4" 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' 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" 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" diameter truss rods with turnbuckles, two to each

gate frame. Vehicle gates shall have vertical 1.90” 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” into a 12” diameter by 24” deep concrete footing.

A malleable iron center rest, designed to receive the plunger rod, to be anchored at least 12” into a 12” diameter by 24” 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” greater in overall height than the adjacent fencing so as to extend to within 2” of pavement between 6” curbs, if curbs are designated on the plans.

Barbed wire, where specified, shall be 12-gauge with barbs spaced approximately 5” 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" by 3/4" flat steel and not more than 2” 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” x 1/8” flat steel bands with 3/8” carriage bolts at intervals not exceeding 15”.

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 OAR 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 OAR will approve the staked 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’ apart and at each change in direction exceeding 20 degrees, both horizontally and vertically. Runs of fencing over 500’ but less than 1,000’ 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

Type Post	Fabric Height	Min.Hole Diameter	Min.Hole Depth	Post Embedment
Line	4'	9"	30"	24"
Line	6"	10"	36"	30"
End	4'	12"	36"	30"
End	6'	12"	48"	42"

Holes for Gate Posts

Gate Post Size	Min. Hole Diameter	Min. Hole Depth	Post Embedment
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", and end, corner, gate and pull posts a minimum of 18" 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 "Portland Cement Concrete", unless otherwise specified on plans. All concrete footings shall be cast up to finish grade and crowned 2" 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". Fence fabric shall generally follow the finished contour of the site with the bottom edge of fabric located 2" above the grade. In uneven areas, the ground shall be graded so that the maximum distance between bottom of fabric and ground in limited to 6".

Electric grounds. Grounding rods shall be at least 5/8" diameter by 8' long "copperweld" rods driven or drilled into the soil so that the top of the rod is approximately 6" 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' 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 028360
CHAIN LINK SECURITY FENCE (S-71A)

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 6 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 7 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:

Fabric Height	Pipe Size		H-Beam Section		Embedment Length
	Size	Wt./Ft.	Size	Wt./Ft.	
7 Ft.	2.375" O.D.	3.65#	2.25" x 1.95"	4.10#	32"

Corner Post & End Post shall be of the following sizes:

Fabric Height	Pipe Section		Embedment Length
	Size	Wt./Ft.	
7 Ft.	2.875" O.D.	5.79#	42"

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 post 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 gate post. 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 7-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 7-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.

Barbed wire, where specified, shall be 12-1/2 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" x 3/4" 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 material 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 not more than six inches and not less than two inches to the ground.

Post Spacing: Maximum spacing for line post shall be 10'-0". 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 not 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

Type Post	Fabric Height	Min. Hole Diameter	Minimum Hole Depth	Post Embedment
Line	7'	12"	36"	32"
End	7'	12"	48"	42"

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 material 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 sell 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 gate posts 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 enclosure. A ground shall be provided directly under the point where a power line passes over the fence.

4. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Chain Link Security Fence shall be measured by the linear foot. Measurement shall include but not be limited to all fence materials, gates, caps, concrete, ground wires, and cleanup. Payment shall cover all materials required, labor, tools, equipment and all other

incidentals required to complete the work.

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 grades 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 028380
SANITARY LANDFILL FENCE (S-76)

(18' high perimeter containment)

1. DESCRIPTION

This specification shall govern all materials and work required to complete the perimeter containment fence.

2. MATERIALS

WOOD POLES shall be 25' long, southern yellow pine, class 6, poles in accordance with ANSI's "American National Standard Specifications and Dimensions for Wood Poles". Poles shall be treated in accordance with C-4 of the American Wood Preservers Association Standards with Creosote conforming to P-1 of said standards, to a minimum retention of 10 pounds per cubic foot.

WIRE FABRIC shall be 2" by 4", 14 gage, 72" wide, and galvanized.

ZINC-COATED (GALVANIZED) STEEL WIRE STRAND shall be in accordance with ASTM A 475 and shall be 3" 7 strand EHS grade with a minimum breaking strength of 6,650 lb and with Class B coating.

EYEBOLT shall be of 2" steel rod with a minimum shank length of 9.75" (or 1" larger than the pole diameter) and an eye diameter of 1.25". The eyebolt along with the required bolt and washer shall be galvanized. The bolt shall restrain a 1,500 pound load.

STEEL SHACKLE shall be galvanized steel, load rated at a minimum of 2 tons, weldless with screw pin, and shall secure the wire, the wire fabric and wire strands to the eyebolts.

PREFORMED GRIP shall be constructed of helically formed galvanized steel, when applied, encircles the steel wire strand. Two types shall be required; splice grip and terminal grip. The splice grips shall consist of a set of gripping legs at each end for splicing which is used for splicing. The guy grip shall have one looped end as a terminal and the other end with gripping legs for connection to the steel strand. Load capacity of grips shall exceed wire strand capacity.

3. CONSTRUCTION METHODS

The largest end of the pole goes into the ground!

Poles shall be spaced at 25' centers. Embedment of poles shall be between 6.5' and 7'. Maximum allowable horizontal tolerance from true alignment shall be 4".

Backfill around pole shall be cement stabilized sand mixed at a ratio of 1 sack Portland cement per cubic yard of sand. The backfill shall be well compacted around pole after proper alignment has been achieved.

Corner and end bracing shall be placed at all openings and corners.

Wire Fabric shall be spliced such that the capacity of splice is not less than 90% of that of the unspliced section.

4. FENCE OPERATION

The fence is designed to be lowered when the wind speed is anticipated to exceed 60 MPH. This is done by disconnecting the upper two rows of wire fabric and folding them onto the lower row, resulting in a 3 ply fence 6' high.

When indicated on the plans, after the fence has been completely installed, the Contractor will be required to completely lower the fence to the 6' position. The fence shall then be corrected of any operational deficiencies, and restored to its normal position by the Contractor. This shall be considered subsidiary work.

Sequence of lowering shall generally be as follows:

1. Remove tie wires connecting the fabric to the top wire strand within 30' of end or corner connection.

2. Disconnect top row of shackles beginning at end or corner connection.

3. Use shackles from top row to connect the lowered top strand with the lower intermediate strand.

4. Retention the lowered top strand and connect at end or corner connection.

5. Retie wire fabric within 30' of end or corner section along the lowered top wire strand.

6. Remove tie wire connecting the fabric to the upper intermediate wire strand within 30' of end or corner connection.

7. Disconnect upper intermediate row of shackles beginning at end or corner connection.

8. Use shackles from the upper intermediate row to connect the lowered upper intermediate strand with the bottom strand.

9. Retention the lowered upper intermediate strand at end or corner connection

10. Retie wire fabric within 30' of end or corner section along the lowered upper intermediate strand.

5. EXTRA MATERIALS

The Contractor shall provide the Sanitation Department with the following materials:

ITEM	QUANTITY
Galvanized Steel Wire Strand	1,000 Ft. Roll
Galvanized Shackles	50
Preformed Splices Grip	25
Preformed End Grip	25
Wire Fabric	100 Ft. Roll

The extra materials shall be furnished to the Sanitation Department storage yard at the landfill and shall be considered subsidiary to the project.

6. MEASUREMENT & PAYMENT

Unless indicated otherwise in the Proposal, Sanitary Landfill Fence shall be by the linear foot along the center line of the fence and shall include but not be limited to post, wire, connections, splices, sand backfill, corner and end sections, etc.

Payment shall fully compensate the Contractor for all materials, labor, equipment, and other incidentals required to install the fence.

SECTION 028810
RECREATIONAL EQUIPMENT (S-99)

1. DESCRIPTION

This specification governs all labor, materials, equipment required for proper installation of recreational equipment, and related items.

2. MATERIALS

All materials shall be as manufactured by Gametime Equipment or an approved equal. All equipment and related items are listed in the Appendix of the Special Provisions and Specifications.

3. INSTALLATION

All equipment and related items shall be installed as per manufacturers recommendations unless otherwise indicated on the plans.

4. MEASUREMENT AND PAYMENT

Recreational equipment shall be measured and paid for by lump sum. Such payment shall constitute full compensation for all labor, materials, equipment and incidentals necessary to complete the installation as specified.

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								
Aggregate Grade No.	Nominal Size	2-½ In.	2 In.	1-½ In.	1 In.	3/4 In.	1/2 In.	3/8 In.	No. 4	No. 8
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	3/8 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

	Percent Retained on Each Sieve							
Aggregate Grade No.	3/8 In.	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
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

Concrete Designation	Desired Slump	Max. Slump
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'c) 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
P	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. Re-tamping 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.

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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:

Bar Size Number	Nominal Diameter, In.	Nominal Area, Sq. In.	Weight per Linear Foot, Pounds
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:

Gauge Number	Equivalent Diameter, Inches	Gauge Number	Equivalent Diameter, Inches
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:

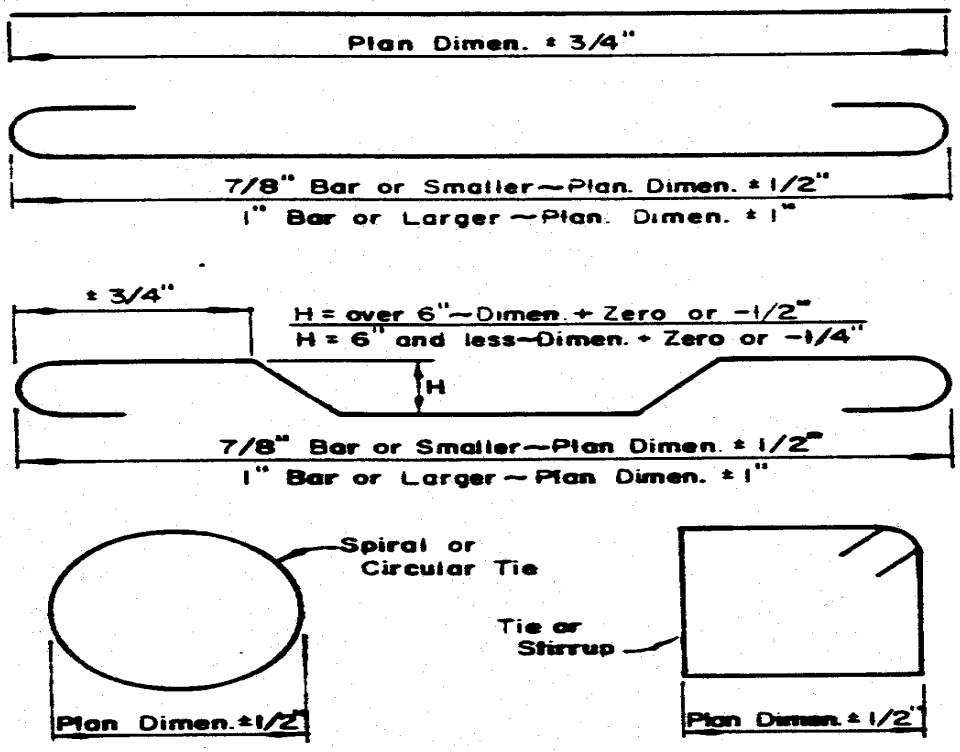
	Grade 60
#3, #4, #5	4d
#6, #7, #8	5d

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

	Grade 60	Grade 75
#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.

Splices will not be permitted in main reinforcement at points of maximum stress. When permitted in main bars, splices in adjacent bars shall be staggered a minimum of two splice lengths.

TABLE 1
Minimum Lap Requirements

Lap		Uncoated	Coated
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 036020
STUCCO AND PLASTER (S-123)

1. GENERAL

This work includes lath, furring and stucco including all accessories conforming to details.

This Applicator shall show evidence of experience and competency in accomplishing plaster work of the highest workmanship, which is the requirement herein. All improper workmanship shall be removed and be replaced with proper workmanship at any stage of the work.

All manufactured materials shall be delivered in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name.

All cementitious material must be kept dry until ready for use, and must be kept off the ground, under cover, and away from any sweating walls or other damp surfaces.

2. LATHING MATERIALS

All lath for exterior stucco shall be galvanized, self-furring diamond lath weighing not less than 2.5 lbs. per square yard.

Tie wires shall be No. 16 gauge galvanized wire.

Apply lath over continuous 6 mil. polyethylene vapor barrier film.

3. ACCESSORIES

Accessories shall be zinc, and equal, in total value, to U.S.G. No. 1-A expanded corner bead; No. 60 or 66 expanded square casing bead; No. 10-A expanded bull nose corner bead; No. 15 and other expansion joints and other accessories as necessary for stopping plaster at all changes of plane or backup material. Use 1/2" beads on masonry; 3/4" beads on metal lath.

4. STUCCO MATERIALS

Stucco shall be applied in 3 coats, 3/4" thick on metal lath.

5. PORTLAND CEMENT EXTERIOR PLASTER

Portland cement exterior plaster (where stucco is called for) shall be a 3 coat system, buff colored. Submit samples to Engineer's satisfaction. Approximate color sample may be seen at Engineer's office by interested parties. Submit sample to match.

6. SCRATCH COAT

Scratch Coat - one sack Portland cement, two sacks equal to U.S.G. Bondcrete lime, 72 cubic feet sand and 2 lbs. fiber. Scratch surface and damp cure for 48 hours minimum.

7. BROWN COAT

Brown Coat - same proportions and materials as scratch coat except use 9 cu.ft. sand finish. Damp cure 48 hours minimum.

8. FINISH COAT

Finish Coat - 1/8" thick, equal, in total value, to U.S.G. Exterior Stucco, with color added, receiving sand finish.

9. PATCHING AND POINTING

Upon completion of the building and when directed, all loose, cracked, damaged, or defective plastering shall be cut out and replastered in a satisfactory and approved manner. All pointing and patching of plastered surfaces, and where plastering abuts or adjoins any other finished work, shall be done in a neat and workmanlike manner. Plaster droppings or spatterings shall be removed from all surfaces. Exposed plastered surfaces shall be left in clean, unblemished condition ready to receive paint or other finish. Protective covering shall be removed from floors and other surfaces, and all rubbish and debris shall be removed from the building.

Finish coat of all plaster work shall be properly damp cured according to directions of the manufacturer of the materials used.

The repairing of damage to plaster work caused by other trades shall be done by this Applicator and shall be paid for by the trade responsible for the damage.

Do not apply plaster below 55E F. temperature.

10. CLEANING AND PATCHING

Clean floors of droppings immediately after each coat is applied. At any exterior locations, remove droppings or splashes from all concrete, masonry or other finish surfaces.

Patch after all other work except painting has been completed. Cut out damaged or broken plaster to straight lines with clean, sharp edges. Cut out cracks to width of at least 1-inch. Fill areas to be patched with vase materials, then give a finish coat of same material as adjoining plaster. Patched areas shall match adjoining work in finish and texture. Joinings shall be flush and smooth so joints between patch and existing plaster are imperceptible.

SECTION 037040
EPOXY COMPOUNDS

1. DESCRIPTION

This specification shall govern all work necessary to provide and apply epoxy compounds.

2. MATERIALS

2.1 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 "Sikadur 32 Hi-Mod" as manufactured by Sika Chemical Corporation of Lyndhurst, New Jersey or approved equal.

2.2 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 SikaTop-123 Plus as manufactured by Sika Chemical Corporation or approved equal.

3. CONSTRUCTION METHODS

3.1 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 manufacturer's 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 "Portland Cement Concrete." 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 Elapsed Time from Mixing Epoxy Until Placing Concrete Overlay
90^{O}F	40 min.
80^{O}F	1 hr.
70^{O}F	2 hrs.
60^{O}F	3 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.

3.2 Epoxy Grout for patch to non-horizontal surfaces to concrete:

a) Surface Preparation: The surface shall be prepared as described in 3.1.

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 ASTM 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.

3.3 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.

4. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Bid Form, Epoxy Compounds shall be considered subsidiary to the bid item for the applicable feature.

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 ± 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 ± 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, 77º F.:	
150 gm. cone, 5 sec., max., cm.....	0.90
Bond and Extension 75%, Oº F, 5 cycles:	
Dry Concrete Blocks.....	Pass
Wet Concrete Blocks.....	Pass
Steel Blocks...(Primed if specified by manuf.).	Pass
Flow at 200º F.....	None
Water Content % by weight, max.....	5.0
Resilience:	
Original sample min. % (cured).....	50
Oven aged at 158º 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" 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 1" in 3.5".

(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:

PROPERTY	METHOD	REQUIREMENT
Color	ASTM D1752, Type 1	Black
Density	ASTM D1752, Type 1	40 lb./ft^3 Min.
Recovery	ASTM D1752, Type 1	90% Min.
Compression	ASTM D1752, Type 1	50 to 500 psi
Extrusion	ASTM D1752, Type 1	0.25” Max.
Tensile Strength	ASTM D1752, Type 1	20 psi Min.
Elongation		75% Min.

The manufacturers shall furnish the OAR with certified test results as to compliance with the above requirements and a 12” x 12” x 1” 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%
72 hours after application.....4%

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 OAR.

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 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 OAR, 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 OAR.

Forming plans shall be submitted to the OAR 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% of the allowable stresses used by the TxDOT 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 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 OAR.

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. No work shall be accepted and no payment shall be made for concrete work showing signs of bulging or other lack of vertical or horizontal control of forms.

(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’ 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 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 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 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 proved 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:

Air or Concrete Temperature	**Maximum Time**
Non-Agitated Concrete:	
Above 80 degrees F	15 minutes
Up to 80 degrees F	30 minutes
Agitated Concrete:	
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 OAR fully of the construction methods he proposes to use, the adequacy of which shall be subject to the approval of the OAR.

The Contractor shall give the OAR 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 OAR. 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” in thickness, unless otherwise directed by the OAR.

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" 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 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 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 1 hour after the concrete is placed. This shall not be construed to be 1 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 3 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 OAR 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 OAR. 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 1/2 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’ in clear height, an interval of not less than 1 nor more than 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 OAR 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 OAR, 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 directed by the OAR. Other surfaces shall be wood float finished and striped with a fine brush leaving a fine-grained texture.

Roadway slab finishing is found in Section 025620 “Portland Cement Concrete Pavement.’

13. CURING CONCRETE

The Contractor shall inform the OAR 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 OAR to stop all construction on the job until remedial action is taken. All concrete shall be cured for a period of 4 curing days except as noted herein.

EXCEPTIONS TO 4-DAY CURING

Description	Required Curing
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

	STRUCTURE UNIT DESCRIPTION	REQUIRED		PERMITTED	
		WATER FOR CURING	MEMBRANE FOR INTERIM CURING	WATER FOR CURING	MEMBRANE FOR INTERIM CURING
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 OAR, 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 ensure proper coverage, the OAR 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.

14. 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 1/2 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.

15. 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 OAR, large defective areas shall be corrected using concrete or other material approved by the OAR.

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 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.

16. 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.

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SECTION 041020
STRUCTURAL CLAY TILE FLOOR AND SIDEWALK (S-22)

1. DESCRIPTION

This specification shall govern all work and materials necessary for placement of clay tile required to complete the project.

2. MATERIALS

Clay Tile shall meet the requirements of Grade FT2 of ASTM C-57.

Mortar shall be in accordance with ASTM C-270 and shall be Grade M, unless indicated otherwise in the drawings.

3. CONSTRUCTION METHODS

Tile shall be set in a full bed of mortar not exceeding 2 inch in thickness. Tile shall be placed in a workmanlike manner. The exposed face of the tile shall be cleaned upon completion. In extreme cases, a 5% solution of muratic acid may be used for cleaning tile. If acid is used, it shall be preceded and followed by a generous bath of fresh clean water.

4. MEASUREMENT & PAYMENT

Unless indicated otherwise in the Proposal, Structural Clay Tile Floor and Sidewalk shall not be measured and shall be considered subsidiary to other work.

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 road 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 20º 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 0º 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 @ 0ºF- 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

TYPE OF STEEL	MAIN MEMBERS Groove & Fillet Welds		SECONDARY MEMBERS Groove & Fillet Welds		
Steel Piling, A53 Pipe, A500, A501, Armor Joints	E6010 E6011 E7016 E7018	E60T-8 E70S-1B E70S-2 E70S-3 E70S-6 E-70S-7	E60XX E70XX E70S-1B E70S-2 E70S-3 E70S-6 E70U-1	E60T-8 E7XT-1 E7XT-5 E7XT-6 E7XT-8	E70S-2 E70S-3 E70S-6 E70S-7
A36, A441, A572-Grade 50 A588, A242 Deck Plates API Pipe	E7016 E7018 E7XT-1 E7XT-5 E7XT-6 E7XT-8	E70S-2 E70S-3 E70S-6 E70S-7	E7016 E7018 E7XT-1 E7XT-5 E7XT-6 E7XT-8	E70S-2 E70S-3 E70S-6 E70S-7	
A514 2½" Thick or Less	E11018M E110T	E110S	E11018M E110T	E110S	
A514 Over 2½" Thick	E10018M E100T	E100S	E10018M E100T	E100S	
A588, A242, A618 Weathering Steel	E8018, C-3 E80T(3)	E80S(3)	E8018, C-3 E80T(3) E80S(3)		
Reinforcing Steel	E7016	E7018			
A572 Grades 60 and 65 for Light Towers	E8016 E8018	E80T E80S			

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 -40º 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 400º F for thickness up to 1½ inches and 450º 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 With Low Hydrogen Electrodes	
	ASTM A36; A242; A441 A572 Grades 42, 45 and 50; A588	ASTM A514
To 3/4, inclusive	50º F	50º F
Over 3/4 to 1½, inclusive	70º F	125º F
Over 1½ to 2½, inclusive	150º F	175º F
Over 2½	225º F	225º 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 400º 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 32º F, preheat to at least 70º 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 200º 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 1200º 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 1100º 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.

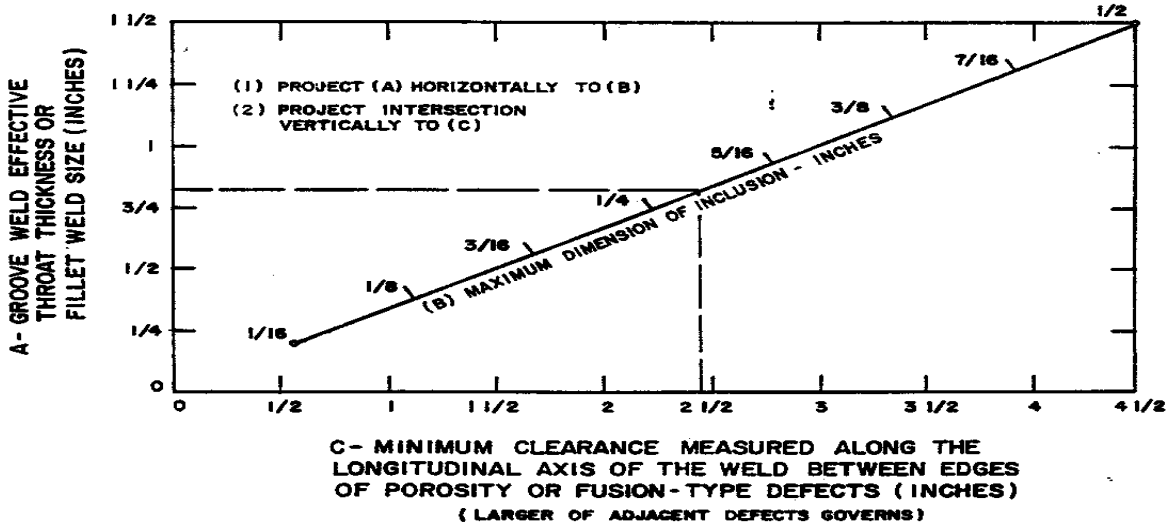
1. Sections of welds shown to have any cracking, regardless of length or location, incomplete fusion, overlapping, or inadequate penetration shall be judged unacceptable.

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 1½ inches, the minimum allowable dimension and spacing of inclusions shall be the same as for 1½-inch joints.

(4) Values of (B) obtained by projecting horizontally from (A) are maximum values. Any value of (B) smaller than the maximum is satifactory.

(5) Values of (C) obtained by projecting vertically from (B) are minimum values. Any value of (C) larger than the minimum is satifactory.

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

CARBON RANGE	NO. 7 & SMALLER	NO. 8 & LARGER
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.

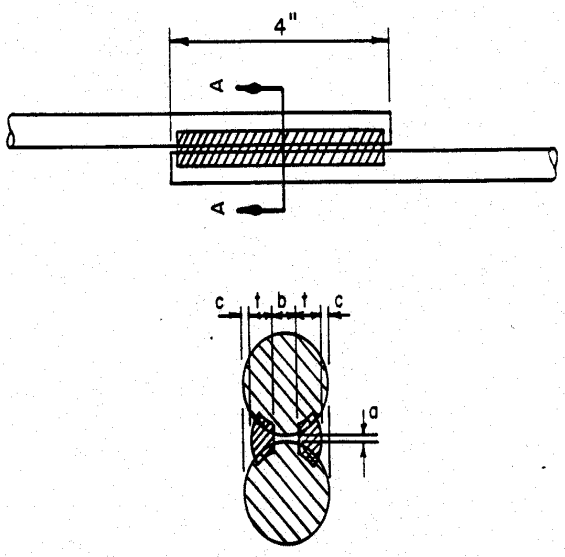
Fillet welds in lap splices shall be a minimum of 4 inches in length and shall be welded on each side of the lap joint. For bars No. 5 and smaller, welding from one side of the lap will be permitted by the Engineer when it is impractical to weld from both sides of the joint, and the weld shall be a minimum 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

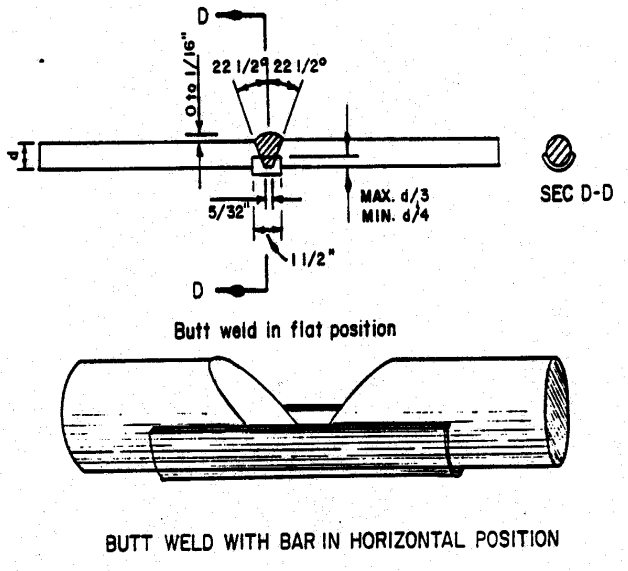
BAR SIZE	"a"	"b" (Max.)	"t" (Min.)	"c" (Max.)	ELECTRODE SIZE
No. 4	0.04 in.	1/8 in.	1/8 in.	1/16 in.	1/8 in
No. 5	0.05 in.	1/8 in.	3/16 in.	1/16 in.	5/32 in.
No. 6	0.06 in.	1/8 in.	1/4 in.	1/16 in.	5/32 in.
No. 7	0.07 in.	3/16 in.	5/16 in.	1/16 in.	5/32 in.



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

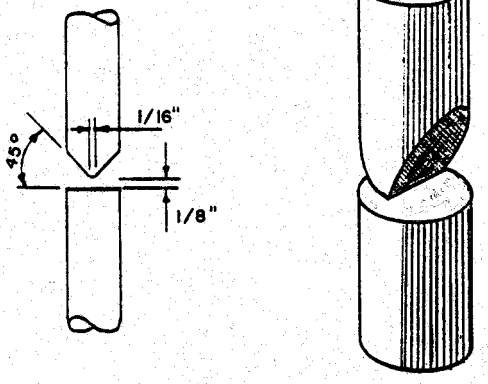


FIGURE 3

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 053700
LANDFILL VEHICLE WEIGHT SCALE SYSTEM (S-119)

1. DESCRIPTION

This specification shall govern all work and materials necessary to furnish, construct, install, and calibrate, and place scales into operation scales, data base system and remote terminal required to complete the project.

2. GENERAL

2.1 Requirement:

The Contractor shall furnish and install two vehicle weight scale systems complete with computer terminals and a remote office terminal. The weight scales will be used for weighing vehicles, consisting mostly of garbage packer trucks, entering in the City's landfills. The City has two landfills, the Elliott Landfill at 7002 Greenwood and the Westside Landfill located at 3702 Carbon Plant Road. The complete weight scale and data base system shall fully document vehicle weighing operations; also upon request provide various detailed reports, monthly customer invoices, and provide a complete accounting system of accounts receivable and revenues as described in the following specifications.

Computer terminals shall be installed at each landfill location along with scales and remote terminal shall be installed at the Solid Waste Services Office. Computer terminal for the Westside Landfill shall be portable.

2.2 Warranty:

The Contractor shall provide the City with a manufacturer's warranty covering all materials, labor, and freight. The warranty period shall begin upon acceptance of the completed project by the City. The warranty period shall be as follows:

Scale	3 Years
All Other	2 Years

The Contractor shall be responsible for all system maintenance for the first year of the warranty period.

3. MATERIALS

3.1 Scale:

Two (2) required, one for the Elliott Landfill and one for the Westside Landfill.

Minimum Dimensions:	10 feet width x 60 feet long
Weight Capacity:	60 ton (minimum)
Section Capacity:	40 tons
Scale Type:	Pitless low profile - fully electronic or electronic mechanical.
Weightbridge Design:	Shall meet American Railroad Engineering Association (AREA) specifications for bridge deflection with 40,000 lb. tandem axle load placed in the center of any module.
Deck Type:	Steel

Platform Checking: Checking of platform shall be by bumper bolts.

Scale Side Rails: Side rails shall be a minimum of 6" high, either integral or bolt-on structural steel, radiused to prevent damage to hubs and tires.

Paint Specifications: All metal surfaces shall be sandblasted to white metal (SP-5; before coating with 2 part catalyzed Epoxy). Any portion of the finish which is damaged by field installation shall be reblasted and recoated.

3.2 Data Base System:

Three (3) required. Systems shall be installed at the scale locations, one at Elliott, one at Westside Landfills and one system at the Solid Waste Services Office. The system for the Elliott Landfill and the Solid Waste Services Office shall be linked by telephone data circuit line for daily down loading of daily transactions from Elliott Landfill to the office. The system for the Westside Landfill shall be portable type and down load daily transactions onto a diskette for up loading transactions onto office computer.

HARDWARE:

Computer: Elliott Landfill and Solid Waste Services Office

Processor - Shall have a 80286 CPU
Shall have a minimum clock speed at 10 mhz
Shall have a functional 80287 math co-processor

Memory - Shall be 640K RAM capacity
Shall have 1 mb on the system board expandable to 2mb
Shall be able to expand to l6mb using cards

Security - Shall include a security key lock
Shall include a security lock down device

Clock/
Calendar - Shall include an internal battery powered system clock/calendar

Storage - Shall have one internal 5 1/4" disk drive capable of reading/writing .36 or 1.2mb 5 1/4" diskettes
Shall have one (1) 2Omb fixed disk or larger with (40 ms) access time or faster at each landfill 6Omb fixed disk at Solid Waste Services Office

Ports - Must include the serial port, one parallel port, and one mouse port

Mode - Shall be internal with a 2400 baud

Westside Landfill

Same as above except security, modem and mouse port will not be required.

Keyboard - Elliott and Solid Waste Services Office

E Keyboard must include an IBM enhanced 101 keyboard or equivalent

Westside Landfill

E Shall be minimum of 84 key keyboard, detachable

Display Monitor - Elliott and Solid Waste Services Office

E Shall be a 14" color display
E Shall support all VGA Modes
E Shall include a tilt and swivel base
E Shall address at least 640 x 480 pixels (graphic mode)
E Shall have provisions to connect with existing PC/AT and PS/2 class machines through direct connections or by use of adapter

Westside Landfill

E Shall be integral to computer unit
E Shall be 6" display minimum
E Shall support all CGA modes
E Shall be Gas Plasma Display

Printer - Solid Waste Services Office

E Shall be Okidata Microline 321 or equivalent
E Shall support high resolution APA Graphics
E Shall print 300 cps or faster in draft mode
E Shall print 63 cps or faster in NLQ mode
E Shall have front panel controls wide carriage
E Shall attach via parallel printer cable
E Shall support continuous - forms feed, single sheet feed (manual) and envelope feed (manual)
E Shall include ribbon, parallel printer cable, adapters and documentation necessary to make operational in addition to printer drive
E Shall support 3" to 16.5" paper width for cut sheets
E Shall support 3" to 15" paper width for continuous forms
E Shall support word processing software

Elliott and Westside Landfills

E Shall be EPSON FX S50 or equivalent
E Must print 264 cps or faster in draft form
E Must print 54 cps or faster in NLQ form
E Shall have front panel controls
E Shall attach via parallel printer cable
E Shall support 80 column paper

Scale Indicator - Elliott Landfill and Westside Landfills (only)

E Shall be housed in a dust tight metal enclosure designed for desk-top mounting

- E Shall be programmed and calibrated through keyboard data entry only
- E Shall provide Serial ASCll data output of gross weights in 2OMA current loop, R232C and RS422 modes
- E Shall provide selectable on demand or continuous data output, with band rate selections from 300 to 9600
- E Shall provide adjustable low pass digital filters to dampen scale vibration on motion while maintaining a responsive display and fast settling time

- E Shall have selectable automatic zero maintenance to compensate for weight vibrations
- E Shall have selectable motion detection to inhibit zero and print functions while scale display is changing
- E Shall have a minimum of six digit display

SOFTWARE: The software system shall be capable of printing weight tickets, general management reports, accounting reports, monthly invoices and performing accounting procedures as described herein. Software shall have several security levels to prevent unauthorized access. Weight and cash tickets are the only thing to be printed at landfill location, all other reports, invoices, and accounting capabilities shall be handled in the Solid Waste Services Office. Complete documentation and support shall be provided with software. Software **shall not be copy protected** and shall be easily installed on hard disk.

The system shall have the capacity to handle the following:

- E Cash Accounts - 1,000 daily transactions and separate receipt numbers from other accounts
- E City Garbage Collection Accounts with 75 vehicle capacity and is not to be included in monthly revenues accounting program, but information accessible by management report programs
- E 300 commercial monthly billed accounts of which 25 accounts shall have 50 vehicle capacity and 275 accounts shall have 10 vehicle capacity
- E 50 material categories with different rates ($) per category
- E Ability to enter manually (at Solid Waste Services Office only) information on customers activities while scales were inoperable and hand written tickets were given out with estimates of trash volume (cubic yards)
- E Grid System information to identify placement of waste within landfill
- E Shall distinguish accounts for each landfill by a code number
- E Ability to keep count of anything driving onto the scale which weighs more than 2000 lb. whether a weight ticket was printed or not

Weight Tickets - The system shall print weight tickets as vehicles are weighed. Printed tickets shall include the following information:

- E Landfill name and code number
- E Ticket number
- E Customer name, account number, address, zip, and phone number
- E Vehicle ID number

- E Vehicle license number
- E Vehicle gross weight
- E Vehicle tare weight
- E Vehicle net weight
- E Material category
- E Time and day vehicle was weighed
- E Total charge ($)

A place for the attendant to initial and for the vehicle driver to sign

Cash Tickets - The system shall print cash receipt tickets for vehicles not being weighed. Printed tickets shall include the following information:

- E Landfill name and code number
- E Ticket number
- E Vehicle license number
- E Estimate of volume in cubic yards
- E Material category
- E Time and day of transaction
- E Attendants initials
- E Total charge ($)

Management Reports - System shall be able to print reports for any specified time period and shall sort by landfill, customer, and material category the following information and provide cumulative summary of specified items:

- E Customer account number, name, address. zip, and phone number
- E Landfill name
- E Optional customer vehicle information (printed only when requested)

Vehicle ID number
Vehicle license number
Material category
Grid ID where material was placed
Total weight per material category

- E Total weight for customers vehicles (by material category)
- E Total number of vehicles per customer
- E Rate for material category ($/ton or $/cubic yard)
- E Total charge ($) per customer
- E A summary of the cumulative totals of revenue generated ($) number of vehicles, tons by material category, cubic yards by material category

ACCOUNTING CAPABILITIES The system shall provide the capability to perform daily and monthly accounting procedures used to verify daily bank deposits and track monthly accounts receivable and payments as follows.

Daily Cash Accounts - Daily cash transactions shall be kept separate from entries for monthly invoices. Each cash entry/transaction shall be

identified by consecutive receipt number. A cash total for each daily work shift (2 minimum) and an end of day total shall be required and printed upon request.

Monthly Accounts - The system shall have the capability to store accounts receivable by account number order and charges to each customer for each calendar month.

An itemized list of account receivable (debits) for all customer accounts being invoiced shall be printed at the end of the month showing monthly totals and grand totals.

As payments (credits) are received for an individual account, the system shall have the ability to recall the debit accounts receivable balance, to which the payment entry would allow zeroing of the owed amount if account was paid in full or applying partial payment (as the case may be), leaving an unpaid balance (arrears) for that month.

All payments entered within the month shall be stored until the end of the month at which time an itemized list of payments shall be printed.

Unpaid balances shall be stored and shall be shown as an arrears amount on the next month's invoices.

Unpaid accounts receivables shall be stored for one year to coincide with a fiscal audit.

Monthly Invoices - System shall be able to print monthly invoices for customers and segregate customers activity by landfill. Invoices shall include the following information:

- Customer account number, name, address, zip, and phone number
- Payment due date with optional message space
- Arrears amount ($)
- Landfill name and code number
- Customer vehicle information
  - Vehicle ID number
  - Vehicle License plate number
  - Vehicle gross weight
  - Vehicle tare weight
  - Vehicle net weight and/or cubic yards
  - Time and date vehicle was weighed
  - Material category
  - Rate charge
  - Total charge ($) per vehicle
  - Total charge per customer

4. SCALE AND DATA BASE SYSTEM INSTALLATION:

E Contractor shall furnish all labor and materials to install, calibrate and place into satisfactory operation two vehicle weight scales with computer terminal systems, one each at the Elliott Landfill and at the Westside Landfill and a remote scale computer terminal at the City's Solid Waste Services Office located at 2525 Hygeia. The Contractor shall have a qualified software analyst and programmer available on the jobsite to supervise set-up and system start-up. This work shall include earth excavation for scale foundation, foundation form work, pouring concrete foundation, backfilling and compacting solid around foundation, offloading scale from haulers truck, scale installation on foundation, installation of computer terminal with scale indicator and printer and associated wiring, scale calibration and systems start up and trouble shooting.

E Each scale and data base system installation shall be completed and operating within 15 working days from start of installation. Foundation installation shall be scheduled to start as close as possible to scale delivery date to minimize interrupting standard operations at the Westside Landfill. Contractor shall have the option to install scales and data base system simultaneously or consecutively with the Westside being first.

E Installation of scales and Data Base Systems shall be limited to office working hours (8 a.m. - 5:00 p.m. Monday thru Friday) and landfill hours (7:00 a.m. - 7:00 p.m. Monday thru Friday).

E Scale shall be installed in accordance with the National Bureau of Standards Handbook 44 Specifications and Recommendations.

E Scale shall be installed at a distance no greater than 10 feet from the scale building at each landfill site.

E All wiring from scale to building shall be in sealed rigid conduit a minimum of 12" below ground surface and rigid conduit shall extend up to location where wire enters building.

E Reinforced concrete foundation designed for a soilbearing pressure of 1,500 pounds per square foot for scales shall be installed as specified on certified foundation drawing furnished by the scale manufacturer.

E Concrete foundations design and installation shall conform to standard specifications Section 030020, Section 038000 and Section 032020 as attached in part S of these specifications.

E Concrete shall have a minimum of 3000 pounds per square inch compressive strength.

E Load bearing portions of the foundation shall extend across the entire width of the foundation.

E For the Elliott Landfill (only) non-load bearing portion in between load bearing portions of the foundation shall be concrete, a minimum of 4" deep reinforced with Welded Wire Mesh (6x6x6).

E The entrance and exit ramps of the scale shall be concrete, with minimum thickness of 6".

E The entrance and exit ramps of the scale shall have a 10 feet level section and an additional ramp with a slope of not more than 1 inch vertical to 1 foot horizontal.

5. SUBMITTALS

The Contractor shall furnish the Engineer with four (4) sets of complete operation and maintenance manuals. The manuals shall be bound in a three ring binder and shall include the following information:

1. Detailed shop drawings of scale and foundation
2. Detailed specifications of all components
3. Wiring diagrams
4. Software with documentation
5. Name, address, phone number of manufacturers supplying components of system
6. List of manufacturer's recommended replacements/spare parts with prices

6. TECHNICAL SUPPORT

The contractor shall have a qualified software and programmer analyst on site to supervise set-up and system start-up.

The software manufacturer shall conduct a two day operator training course.

The software manufacturer shall provide free technical support of software by phone during normal business hours.

7. MEASUREMENT AND PAYMENT

Vehicular scales and data base systems shall be described in the proposal and shall include furnishing, constructing, and installing all materials and equipment; providing all labor, equipment, and incidentals required to complete the job complete, in place.

SECTION 053820
PRE-FABRICATED STEEL BRIDGE

1.0 GENERAL

1.1 Scope

These specifications are for a fully engineered clear span bridge of steel construction and shall be regarded as minimum standards for design and construction. These specifications are based on products designed and manufactured by Continental Bridge, 8301 State Highway 29 North, Alexandria, MN 56308, or an approved equal.
Phone: 1-800-328-2047 or (320) 852-7500 Fax: 320-852-7067
E-mail: conbridg@continentalbridge.com

1.2 Qualified Suppliers

Each bidder is required to identify their intended bridge supplier as part of the bid submittal. Qualified suppliers must have at least 5 years experience fabricating these type structures.

Pre-approved Manufacturers:
Continental Bridge
8301 State Highway 29 North
Alexandria, Minnesota 56308
1-800-328-2047

Suppliers other than those listed above may be used provided the engineer or owner's agent evaluates the proposed supplier and approves the supplier 5 days prior to bid.

The contractor must provide the following documentation, for any proposed supplier who is not pre-approved, at least 10 days prior to bid:

* Product Literature

* All documentation to insure the proposed substitution will be in compliance with these specifications. This shall include:

  - Representative design calculations
  - Representative drawings
  - Splicing and erection procedures
  - Warranty information
  - Inspection and Maintenance procedures
  - AISC Shop Certification
  - Welder Qualifications

* Proposed suppliers must have at least five (5) years experience designing and fabricating these type structures and a minimum of five (5) successful bridge projects, of similar construction, each of which has been in service at least three (3) years. List the location, bridge size, owner, and a contact for reference for each project.

  The engineer will evaluate and verify the accuracy of the submittal prior to bid. If the engineer determines that the qualifying criteria have not been met, the contractor's proposed supplier shall be rejected. The engineer's ruling shall be final.

2.0 GENERAL FEATURES OF DESIGN

2.1 Span

Bridge span shall be 75'-0" (straight line dimension) and shall be as measured from each end of the bridge structure.

2.2 Width

Bridge width shall be 6'-0" and shall be as measured from the inside face of structural elements at deck level.

2.3 Truss Type

Bridge shall be designed as a half-through "Pratt" truss with one (1) diagonal per panel and square end vertical members. All end vertical members, unless specified otherwise, shall be plumb. Interior vertical members shall be perpendicular to the chord faces.

2.3.1 Bridge shall be designed utilizing an underhung floor beam (top of floor beam welded to the bottom of the bottom chord).

2.3.2 The distance from the top of the deck to the top and bottom truss members shall be determined by the bridge manufacturer based upon structural and/or shipping requirements.

2.3.3 The top of the top chord shall not be less than 42 inches above the deck (measured from the high point of the deck) on bridges used for pedestrian traffic.

2.4 Member Components

All members of the vertical trusses (top and bottom chords, verticals, and diagonals) shall be fabricated from square and/or rectangular structural steel tubing. Other structural members and bracing shall be fabricated from structural steel shapes or square and rectangular structural steel tubing.

To provide lateral support for the top flange of open shape stringers (w-shapes or channels), a minimum of one stiffener shall be provided in each stringer at every floor beam location.

2.5 Attachments

2.5.1 Safety Rails

Horizontal safety rails shall be placed on the structure up to a minimum height of 3′-6″ above the deck surface. Safety rails shall be placed so as to prevent a 4″ sphere from passing through the truss. Safety rails shall be round, square or rectangular tubing welded to the inside or outside of the structure at the bridge fabricators option. Tubular safety rails shall have their ends capped and ground smooth so as to produce no sharp edges.

The safety rail system shall be designed for an infill loading of 200 pounds, applied horizontally at right angles, to a one square foot area at any point in the system.

2.6 Camber

The bridge shall have a vertical camber dimension at midspan equal to 100% of the full dead load deflection plus 2% of the full length of the bridge.

2.7 Elevation Difference

The bridge abutments shall be constructed at the same elevation on both ends of the bridge.

3.0. ENGINEERING

Structural design of the bridge structure(s) shall be performed by or under the direct supervision of a licensed professional engineer and done in accordance with recognized engineering practices and principles. The engineer shall be licensed to practice in Texas.

3.1 Design Loads

In considering design and fabrication issues, this structure shall be assumed to be statically loaded. No dynamic analysis shall be required nor shall fabrication issues typically considered for dynamically loaded structures be considered for this bridge.

3.1.1 Dead Load

The bridge structure shall be designed considering its own dead load (superstructure and original decking) only. No additional dead loading need be considered.

3.1.2 Uniform Live Load

3.1.2.1 Pedestrian Live Load

Main Members: Main supporting members, including girders, trusses and arches shall be designed for a pedestrian live load of 100 pounds per square foot of bridge walkway area. The pedestrian live load shall be applied to those areas of the walkway so as to produce maximum stress in the member being designed.

Secondary Members: Bridge decks and supporting floor systems, including secondary stringers, floor beams and their connections to main supporting members shall be designed for a live load of 100 pounds per square foot, with no reduction allowed.

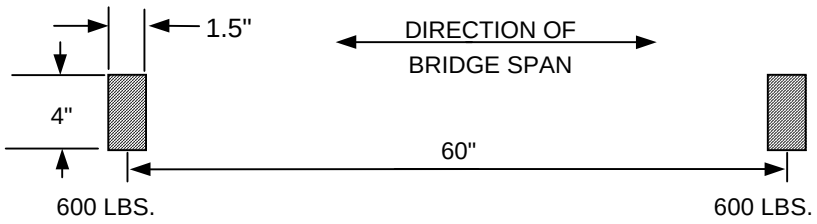
3.1.3 Vehicle Loads

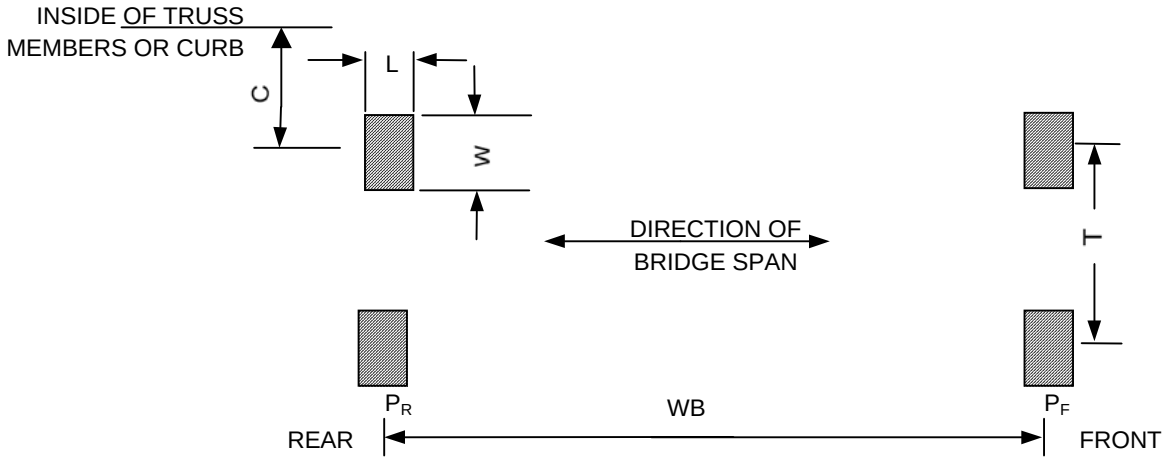
The bridge superstructure, floor system and decking shall be designed for each of the following point load conditions:

3.1.3.1 A concentrated load of 1000 pounds placed on any area 2.5 ft x 2.5 ft square.

3.1.3.2 A 1200 pound two wheel vehicle with a wheelbase and tire print area as shown in the following diagram:

3.1.3.3 A 6,000 pound four wheeled vehicle with the appropriate wheelbase, tire track and tire print area as shown in the following diagram: (See Table I for the values corresponding to the selected vehicle.)





Vehicle	Axle and Wheel Spacings		Front Wheels			Rear Wheels			
Weight	WB	T	P_F	L	W	P_R	L	W	C*
4,000 #	48"	32"	1,000 #	2.0"	5.0"	1,000 #	2.0"	5.0"	9"
6,000 #	66"	48"	1,500 #	2.5"	6.0"	1,500 #	2.5"	6.0"	12"

(*C is the minimum dimension from center of wheel to the inside face of truss or curb.)

TABLE I

All of the concentrated or wheel loads shall be placed so as to produce the maximum stress in each member being analyzed. Critical stresses need be calculated assuming there is only one vehicle on the bridge at any given time. Assumptions that vehicles only travel down the center of the bridge or that the vehicle load is a uniform line load will not be allowed.

Each four wheeled vehicle load listed in Table I, up to and including the maximum weight vehicle selected, must be used in determining critical deck stresses. The wheel distribution for deck design shall be as specified in Section 4.3.1. Stringers shall be designed for the applied wheel loads assuming no lateral load distribution to adjacent stringers.

A vehicle impact allowance is not required.

3.1.4 Wind Load

3.1.4.1 Horizontal Forces

The bridge(s) shall be designed for a wind load of 35 pounds per square foot on the full vertical projected area of the bridge as if enclosed. The wind load shall be applied horizontally at right angles to the longitudinal axis of the structure.

The wind loading shall be considered both in the design of the lateral load bracing system and in the design of the truss vertical members, floor beams and their connections.

3.1.4.2 Overturning Forces

The effect of forces tending to overturn structures shall be calculated assuming that the wind direction is at right angles to the longitudinal axis of the structure. In addition, an upward force shall be applied at the windward quarter point of the transverse superstructure width. This force shall be 20 pounds per square foot of deck.

3.1.7 Top Chord Railing Loads

The top chord, truss verticals, and floor beams shall be designed for lateral wind loads (per section 3.1.4.1) and for any loads required to provide top chord stability as outlined in Section 3.3.6; however, in no case shall the load be less than 50 pounds per lineal foot or a 200 pound point load, whichever produces greater stresses, applied in any direction at any point along the top chord.

3.1.9 Load Combinations

The loads listed herein shall be considered to act in the following combinations, whichever produce the most unfavorable effects on the bridge superstructure or structural member concerned.
[DL=Dead Load; LL = Live Load; WL = Wind Load; VEH = Vehicle Load]

DL + LL
DL + VEH
DL+WL
DL+LL+WL
DL+VEH+.3WL

NOTE: Allowable stresses may be increased 1/3 above the values otherwise provided when produced by wind loading, acting alone or in combination with the design dead and live loads.

It shall be the responsibility of the foundation engineer to determine any additional loads (i.e. earth pressure, stream force on abutments, wind loads other than those applied perpendicular to the long axis of the bridge, etc.) and load combinations required for design of the abutments.

3.2 Design Limitations

3.2.1 Deflection

3.2.1.1 Vertical Deflection

The vertical deflection of the main trusses due to service pedestrian live load shall not exceed 1/400 of the span.

The vertical deflection of cantilever spans of the structure due to service pedestrian live load shall not exceed 1/300 of the cantilever arm length.

The deflection of the floor system members (floor beams and stringers) due to service pedestrian live load shall not exceed 1/360 of their respective spans.

The service pedestrian live load shall be 100 PSF for deflection checks.

Deflection limits due to occasional vehicular traffic shall not be considered.

3.2.1.2 Horizontal Deflection

The horizontal deflection of the structure due to lateral wind loads shall not exceed 1/500 of the span under 35 PSF wind load.

3.2.2 Minimum Thickness of Metal

The minimum thickness of all structural steel members shall be 3/16" nominal and be in accordance with the AISC Manual of Steel Constructions' "Standard Mill Practice Guidelines". For ASTM A500 and ASTM A847 tubing, the section properties used for design shall be per the Steel Tube Institute of North America's Hollow Structural Sections "Dimensions and Section Properties".

3.3 Governing Design Codes / References

Structural members shall be designed in accordance with recognized engineering practices and principles as follows:

3.3.1 Structural Steel Allowable Stresses

American Institute of Steel Construction (AISC).

Structural steel design shall be in accordance with those sections of the "Manual of
Steel Construction: Allowable Stress Design" related to design requirements and allowable stresses.

3.3.2 Welded Tubular Connections

American National Standards Institute / American Welding Society (ANSI/AWS) and the
Canadian Institute of Steel Construction (CISC).

All welded tubular connections shall be checked, when within applicable limits, for the limiting failure modes outlined in the ANSI/AWS D1.1 Structural Welding Code or in accordance with the "Design Guide for Hollow Structural Section Connections" as published by the Canadian Institute of Steel Construction (CISC).
When outside the “validity range” defined in these design guidelines, the following limit states
or failure modes must be checked:

* Chord face plastification
* Punching shear (through main member face)
* Material failure
  - Tension failure of the web member
  - Local buckling of a compression web member
* Weld failure
  - Allowable stress based on “effective lengths”
  - “Ultimate” capacity
* Local buckling of a main member face

* Main member failure:
  - Web or sidewall yielding
  - Web or sidewall crippling
  - Web or sidewall buckling
  - Overall shear failure

All tubular joints shall be plain unstiffened joints (made without the use of reinforcing plates) except as follows:

* Floor beams hung beneath the lower chord of the structure may be constructed with or without stiffener (or gusset) plates, as required by design.

* Floor beams which frame directly into the truss verticals (H-Section bridges) may be designed with or without end stiffening plates as required by design.

* Where chords, end floor beams and in high profiles the top end struts weld to the end verticals, the end verticals (or connections) may require stiffening to transfer the forces from these members into the end vertical.

* Truss vertical to chord connections.

NOTE: The effects of fabrication tolerances shall be accounted for in the design of the structure. Special attention shall be given to the actual fit-up gap at welded truss joints.

NOTE: Open ends of tubes on painted structures shall be capped and seal welded.

3.3.3 Bolted Splices

American Institute of Steel Construction (AISC) and the Research Council on Structural
Connections of the Engineering Foundation (RCSC).

Bolted splice design shall be in accordance with Section J3 of the “Manual of Steel Construction: Allowable Stress Design”. Splices shall be designed for the actual load in the member but in no case for less than 50% of the effective strength of the member.

Bolted field splices shall be located on the bridge so as to produce a structure which can be economically shipped and erected. Splices along the length of the bridge (in chords and diagonals) shall be placed at the approximate mid point of a bay (between two panel points). Splices across the width of the bridge (in floor beams and wind braces) may be used, when necessary, to keep the overall structure width within reasonable limits for shipping.

3.3.6 Top Chord Stability

Structural Stability Research Council (SSRC), formerly Column Research Council.

The top chord of a half-through truss shall be considered as a column with elastic lateral supports at the panel points. The critical buckling force of the column, so determined, shall exceed the maximum force from dead load and live load (uniform or vehicular) in any panel of
the top chord by not less than 50 percent for parallel chord truss bridges or 100 percent for tied
arch bridges. The design approach to prevent top chord buckling shall be as outlined by E.C.
Holt's research work in conjunction with the Column Research Council on the

stability of the top chord of a half-through truss. See Appendix A for the calculation of the spring constant C and the determination of an appropriate K factor for out-of-plane buckling.

In addition, for the dead load plus vehicle load combination, the spring constant “C” furnished by the transverse “U-Frames” shall not be less than “C” required as defined by:

$$C\ required = \frac{1.46\ P_c}{L}$$

where P_c is the maximum top chord compression due to dead load plus the vehicle load times the appropriate safety factor (1.5 for parallel chord truss bridges or 2.0 for tied arch truss bridges) and L is the length in inches of one truss panel or bay.

For uniformly loaded bridges, the vertical truss members, the floor beams and their connections (transverse frames) in half-through truss spans shall be proportioned to resist a lateral force of not less than 1/100k times the top chord compressive load, but not less than .004 times that top chord load, applied at the top chord panel points of each truss. The top chord load is determined by using the larger top chord axial force in the members on either side of the "U-frame" being analyzed. For end frames, the same concept applies except the transverse force is 1% of the axial load in the end post member.

For bridges with vehicle loads, the lateral force applied at the top chord elevation for design of the transverse frames shall not be less than 1% of the top chord compression due to dead load plus any vehicle loading.

The bending forces in the transverse frames, as determined above, act in conjunction with all forces produced by the actual bridge loads as determined by an appropriate analysis which assumes that the floor beams are “fixed” to the trusses at each end.

NOTE: The effects of three dimensional loading (including “U-frame” requirements) shall be considered in the design of the structure. The “U-frame” forces in half-through spans shall be added to the forces derived from a three dimensional analysis of the bridge.

4.0 MATERIALS

4.1 Steel

4.1.1 Painted Steel

Bridges which are to be painted shall be fabricated using ASTM A500 grade C cold-formed welded square and rectangular tubing (Fy = 50,000 psi) and/or high strength, low allow, atmospheric corrosion resistant ASTM A847 cold-formed welded square and rectangular tubing (Fy = 50,000 psi) and/or ASTM A588, ASTM A242, ASTM A572, ASTM A 606 (Fy = 50,000 psi) and/or ASTM A36 (Fy = 36,000 psi) plate and structural steel shapes. Splice plates, if required, shall be ASTM A588.

4.2 Bolts

Field splices shall be fully bolted with ASTM A325 type 3 high strength bolts in accordance with the “Specifications for Structural Joints Using ASTM A325 or A490 Bolts”.

4.3 Decking

4.3.1 Grate decking

This bridge shall be provided with a steel grate deck.

The grate decking shall utilize bearing bars spaced 1-3/16″ on center with welded crossbars at 4″ centers. The grating shall be designed to carry the imposed deck loads at the stringer or floor beam spacings used in the bridge as determined by the bridge designer.

Grate decking shall be designed for concentrated loads as specified in Section 3.1.3. Grate decking shall be designed using only the bars engaged by the "tire print area" unless cross bars suitable for transverse load distribution are utilized. Grating shall be galvanized in accordance with ASTM A123 with smooth bearing bars.

5.0 WELDING

5.1 Welding

Welding and weld procedure qualification tests shall conform to the provisions of ANSI/AWS D1.1 "Structural Welding Code", 1996 Edition. Filler metal shall be in accordance with the applicable AWS Filler Metal Specification (i.e. AWS A 5.28 for the GMAW Process). For exposed, bare, unpainted applications of corrosion resistant steels (i.e. ASTM A588 and A847), the filler metal shall be in accordance with AWS D1.1, Section 3.7.3.

5.2 Welders

Welders shall be properly accredited operators, each of whom shall submit certification of satisfactorily passing AWS standard qualification tests for all positions with unlimited thickness of base metal, have a minimum of 6 months experience in welding tubular structures and have demonstrated the ability to make uniform sound welds of the type required.

6.0 SUBMITTALS

6.1 Submittal Drawings

Schematic drawings and diagrams shall be submitted to the customer for their review after receipt of order. Submittal drawings shall be unique drawings, prepared to illustrate the specific portion of the work to be done. All relative design information such as member sizes, bridge reactions, and general notes shall be clearly specified on the drawings. Drawings shall have cross referenced details and sheet numbers. All drawings shall be signed and sealed by a Professional Engineer who is licensed in accordance with Section 3.0.

6.2 Structural Calculations

Structural calculations for the bridge superstructure shall be submitted by the bridge manufacturer and reviewed by the approving engineer. All calculations shall be signed and sealed by a Professional Engineer who is licensed in accordance with Section 3.0. The calculations shall include all design information necessary to determine the structural adequacy of the bridge. The calculations shall include the following:

* All AISC allowable stress checks for axial, bending and shear forces in the critical member of each truss member type (i.e. top chord, bottom chord, floor beam, vertical, etc.).

* Checks for the critical connection failure modes for each truss member type (i.e. vertical, diagonal, floor beam, etc.). Special attention shall be given to all welded tube on tube connections (see section 3.3.2 for design check

requirements).

* All bolted splice connections.

* Main truss deflection checks.

* U-Frame stiffness checks (used to determine K factors for out-of-plane buckling of the top chord) for all half through or "pony" truss bridges.

* Deck design.

NOTE: The analysis and design of triangulated truss bridges shall account for moments induced in members due to joint fixity where applicable. Moments due to both truss deflection and joint eccentricity must be considered.

6.3 Welder certifications in compliance with AWS standard qualification tests.

6.4 Welding procedures in compliance with Section 5.1.

7.0 FABRICATION

7.1 General Requirements

7.1.1 Drain Holes

When the collection of water inside a structural tube is a possibility, either during construction or during service, the tube shall be provided with a drain hole at its lowest point to let water out.

7.1.2 Welds

Special attention shall be given to developing sufficient weld throats on tubular members. Fillet weld details shall be in accordance with AWS D1.1, Section 3.9 (See AWS Figure 3.2). Unless determined otherwise by testing, the loss factor “Z” for heel welds shall be in accordance with AWS Table 2.8. Fillet welds which run onto the radius of a tube shall be built up to obtain the full throat thickness (See Figure 7.1). The maximum root openings of fillet welds shall not exceed 3/16” in conformance with AWS D1.1, Section 5.22. Weld size or effective throat dimensions shall be increased in accordance with this same section when applicable (i.e. fit-up gaps> 1/16”).

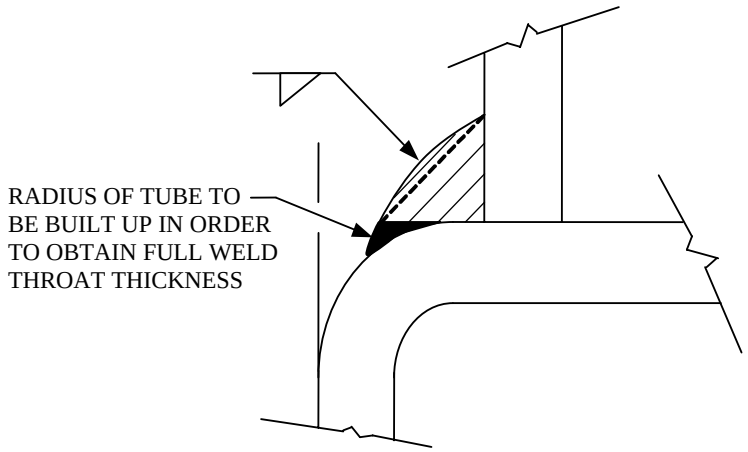


FIGURE 7.1
BUILD UP RADIUS WELD

The fabricator shall have verified that the throat thickness of partial joint penetration groove welds (primarily matched edge welds or the flare-bevel-groove welds on underhung floor beams) shall be obtainable with their fit-up and weld procedures. Matched edge welds shall be “flushed” out when required to obtain the full throat or branch member wall thickness.

For full penetration butt welds of tubular members, the backing material shall be fabricated prior to installation in the tube so as to be continuous around the full tube perimeter, including corners. Backing may be of four types:

* A “box” welded up from four (4) plates.

* Two “channel” sections, bent to fit the inside radius of the tube, welded together with full penetration welds.

* A smaller tube section which slides inside the spliced tube.

* A solid plate cut to fit the inside radius of the tube.

Corners of the “box” backing, made from four plates, shall be welded and ground to match the inside corner radii of the chords. The solid plate option shall require a weep hole either in the chord wall above the “high side” of the plate or in the plate itself. In all types of backing, the minimum fit-up tolerances for backing must be maintained at the corners of the tubes as well as across the “flats”.

7.1.3 Sealing and Caulking

To prevent rust runs on painted structures, open ends of all tubes shall be capped and seal welded. Wherever practical, member end connections and steel on steel contact surfaces, such as stringer to floor beam connections, shall be welded all around. Long seams between members or any seam which cannot be practically welded shall be caulked.

7.1.4 Paint Clearance

To provide adequate clearance for initial painting and future recoating, a minimum of a 1-1/2″ gap shall be provided between any two opposing painted surfaces. If this gap cannot be maintained, member sizes shall be increased or filler plates added to bring the opposing surfaces in contact for seal welding.

7.2 Quality Certification

Bridge(s) shall be fabricated by a fabricator who is currently certified by the American Institute of Steel Construction to have the personnel, organization, experience, capability, and commitment to produce fabricated structural steel for the category “Simple Steel Bridges” as set forth in the AISC Certification Program. Quality control shall be in accordance with procedures outlined for AISC certification.

8.0 FINISHING

8.1 Blast Cleaning

8.1.1 Painted Steel

All exposed surfaces of steel to be painted shall be blast cleaned in accordance with the appropriate section of the Steel Structures Painting Council Surface Preparation Specifications as recommended by the paint manufacturer.

8.2 Painting

All exposed steel surfaces shall receive shop applied primer and finish coats. The paint system shall consist of one of the following:

* Primer: Carboline 893 Epoxy Primer
  Top Coat: Carbothane 133 HB Polyurethane
  As manufactured by The Carboline Company, 350 Hanley Industrial Court, St. Louis, MO 63144-1599 314-644-1000.

* Primer: Pitt Guard All Weather DTR Expoxy Primer
  Top Coat: Pitthane Acrylic-Aliphatic Urethane Enamal
  As manufactured by PPG Architectural Finishes, Inc., One PPG Place, Pittsburgh, PA 15272 800-441-9695.

* Primer: Epoxide 52 Epoxy Primer
  Top Coat: Acrolon 218 HS Acrylic Polyurethane
  As manufactured by Sherwin Williams, PO Box 7570, Highlands Ranch, CO 80126-9170 800-336-1110.

Each system shall consist of a minimum of one primer and one top coat applied in accordance with and to the minimum dry film thickness listed in the paint manufacturer's recommendations. The top coat paint color shall be ***(specifier to input color choice here)***.

NOTE: Unless specified otherwise, connection faying surfaces and the interior surfaces of all structural tubing shall not be coated.

8.2.3 Touch-up Paint

A nominal quantity of touch-up paint will be provided to repair marred surfaces. Touch-up painting includes any and all painting required after the structure reaches the site, and is the responsibility of others. This painting shall include, but not be limited to, the following areas:

1. Any areas damaged due to shipping, handling, and erection of the bridge and components.

2. Bolt heads and exposed area of bolts and nuts as applicable.

3. Non-galvanized attachments or anchor bolts if not made of corrosion resistant steel.

4. If applicable, small areas (0″ to 2″ each side) around bolted field splices, designed as "slip critical", where one or all paint coats may be required to be left off the faying surfaces.

8.2.4 Painter Qualifications

All painters shall be certified by the appropriate paint manufacturer for proper handling, mixing, thinning (if required) and application of the paint system in accordance with the manufacturer's instructions. The painters shall also be certified by the Department of Transportation in the state in which the bridge is manufactured.

9.0 DELIVERY AND ERECTION

Delivery is made to a location nearest the site which is easily accessible to normal over-the-road tractor/trailer equipment. All trucks delivering bridge materials will need to be unloaded at the time of arrival.

The manufacturer will provide detailed, written instruction in the proper lifting procedures and splicing procedures (if required). The method and sequence of erection shall be the responsibility of Contractor.

The bridge manufacturer shall provide written inspection and maintenance procedures to be followed by the bridge owner.

10.0 BEARINGS

10.1 Bearing Devices

Bridge bearings shall consist of a steel setting or slide plate placed on the abutment or grout pad. The bridge bearing plate which is welded to the bridge structure shall bear on this setting plate. One end of the bridge will be fixed by fully tightening the nuts on the anchor bolts at that end. The opposite end will have finger tight only nuts to allow movement under thermal expansion or contraction.

The bridge bearings shall sit in a recessed pocket on the concrete abutment. Minimum 28-day strength for the abutment concrete shall be 3000 PSI. The bearing seat shall be a minimum of 16" wide. The step height (from bottom of bearing to top-of-deck) shall be determined by the bridge manufacturer.

Bridges in excess of 100 feet in length or bridges with dead load reactions of 15,000 pounds or more (at each bearing location) shall have teflon on teflon or stainless steel on teflon slide bearings placed between the bridge bearing plate and the setting plate. The top slide plate shall be large enough to cover the lower teflon slide surface at both temperature extremes.

11.0 FOUNDATIONS

Unless specified otherwise, the bridge manufacturer shall determine the number, diameter, minimum grade and finish of all anchor bolts. The anchor bolts shall be designed to resist all horizontal and uplift forces to be transferred by the superstructure to the supporting foundations. Engineering design of the bridge supporting foundations (abutment, pier, bracket and/or footings), including design of anchor bolt embedments, shall be the responsibility of the foundation engineer. The contractor shall provide all materials for (including anchor bolts) and construction of the bridge supporting foundations. The contractor shall install the anchor bolts in accordance with the manufacturer's anchor bolt spacing dimensions.

Information as to bridge support reactions and anchor bolt locations will be furnished by the bridge manufacturer after receipt of order and after the bridge design is complete.

12.0 PAYMENT

A partial payment or "deposit" for the prefabricated bridge shall be made upon order and storage as required by the terms of the manufacturer.

13.0 WARRANTY

The bridge manufacturer shall warrant their steel truss structure(s) to be free of design, material and workmanship defects for a period of fifteen years from the date of delivery. This warranty does not include decking, railing attachments, on any other items not part of the steel truss structure.

This warranty shall not cover defects in the bridge caused by abuse, misuse, overloading, accident, improper maintenance, alteration or any other cause not the result of defective materials or workmanship. This warranty shall be void unless owner’s records, which will indicate compliance with the minimum guidelines

specified in the Inspection and Maintenance Procedures, can be supplied.

Repair or replacements shall be the exclusive remedy for defects under this warranty. The bridge manufacturer shall not be liable for any consequential or incidental damages for breach of any express or implied warranty on their structures.

14.0 APPROVAL CHECKLIST

The following checklist will be used in the evaluation of all submittals to assure compliance with the Special Specifications for Prefabricated Bridge. This checklist is considered the minimum acceptable requirements for compliance with these specifications. Any deviations from this checklist shall be considered grounds for rejection of the submittal. Any costs associated with delays caused by the rejection of the submittal, due to non-compliance with this checklist, shall be fully borne by the contractor and bridge supplier.

SUBMITTAL DRAWINGS

Data Required to be Shown:

- ρ Bridge Elevation
- ρ Bridge Cross Section
- ρ All Member Sizes
- ρ All Vertical Truss Members are Square or Rectangular Tubing
- ρ Bridge Reactions
- ρ General Notes Indicating
- ρ AISC Stress Conformance
- ρ Material Specifications to be Followed
- ρ Design Live Load
- ρ Design Vehicle Load (If Applicable)
- ρ Design Wind Load
- ρ Other Specified Design Loads
- ρ Welding Process
- ρ Blast Cleaning
- ρ Paint System to be Used (If Applicable)
- ρ Paint Color Chart (If Applicable)
- ρ Detailed Bolted Splices (If Applicable)
- ρ Bolted Splice Location (If applicable)
- ρ Signature and Seal of Professional Engineer, licensed in Accordance with Section 3.0

DESIGN CALCULATIONS

Data Required to be Shown:

- ρ Data Input for 3-D Analysis of Bridge
- ρ Joint Coordinates & Member Incidences
- ρ Joint and Member Loads
- ρ Member Properties
- ρ Load Combinations
- ρ AISC Member Stress Checks for Each Member Type
- ρ Critical Connection Failure Mode Checks For Each Member Type
- ρ Chord Face Plastification Checks
- ρ Punching Shear Checks
- ρ Material Failure Checks (Truss Webs)
- ρ Weld Failure Checks (Effective Length)
- ρ Weld Failure Checks (Ultimate)
- ρ Local Buckling of the Main Member Face Checks
- ρ Main Member Yielding Failure Checks
- ρ Main Member Crippling Failure Checks
- ρ Main Member Buckling Failure Checks
- ρ Main Member Shear Failure Checks
- ρ All Bolted Splice Checks (if applicable)
- ρ Main Truss Deflection Checks
- ρ Decking Material Checks
- ρ “U-Frame” Stiffness Checks (if “Pony” Truss)
- ρ nterior and End Portal Design Checks(if “Box” Truss)
- ρ eterminatioN of Top Chord K Factor Based on“U-Frame” Stiffness (if “Pony” Truss)
- ρ Consideration of Individual Member Moments Due to truss Deflection, Joint Fixity and Joint Eccentricity

FABRICATION SUBMITTALS

Data Required to be Shown:

- ρ** Written Installation Instructions
- ρ** Written Splicing Instructions
- ρ** Written Maintenance & Inspection Instructions
- ρ** Welder Certifications
- ρ** Welding Procedures
- ρ Material Certifications (if applicable)
- ρ Structural Steel (if applicable)
- ρ Decking (if applicable)
- ρ Structural Bolts (if applicable)
- ρ** Quality Control Section of AISC Certification Manual (if applicable)
- ρ** Painter Certifications (if applicable)
- ρ Weld Testing Reports (if applicable)

** NOTE: These items are required to be submitted along with Submittal Drawings and Design Calculations. Those Fabrication Submittal Items not marked are to be submitted prior to shipment of the bridge.

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.

SECTION 055440
ALUMINUM GRATING (S-110)

1. DESCRIPTION

This specification shall govern all work necessary to provide and install all aluminum grating required for this project.

2. GENERAL REQUIREMENTS

After installation, the grating shall be capable of withstanding a uniformly distributed load of 200 PSF or a concentrated load of 600 pounds with a maximum deflection of 3 inch. Grating shall meet federal specification RR-G-661-C and standards set by OSHA of 1975.

Prior to installation, the Contractor shall submit four sets of detailed shop drawings for the Engineer's review and approval.

3. MATERIAL

Corrosion Resistance. All materials incorporated into the grating system shall be of an aluminum alloy which is corrosion resistant and recommended for use in an environment to include chlorine treated wastewater.

Walking surface. Walking surface shall have a non-skid surface.

Fasteners, Anchor Bolts and Supports. All fasteners, additional structural supports shall be provided by the manufacturer or in accordance with his recommendations.

4. CONSTRUCTION METHODS

All fabrication shall be done in a workmanlike manner, to provide a structurally sound product. All connections, supports, clips, etc. shall be properly aligned and installed.

5. MEASUREMENT AND PAYMENT

Unless indicated otherwise in Proposal, aluminum grating shall be measured by the square foot of aluminum grating installed. Measurement shall include but not be limited to furnishing and installing all grating, supports, clips and connections.

SECTION 057220
ALUMINUM HANDRAILS (S-98)

1. SCOPE OF THE WORK: The work includes the furnishings of all labor, materials, equipment an services necessary and reasonable incidental for installing all aluminum handrails including all fittings and attachments required for the completion of the project.

2. MATERIALS: All handrails, posts, fittings, brackets, anchors, etc., required for the installation of all handrails shown on the drawings shall be fabricated of aluminum. The railing system has been designed around ReynoRail II Aluminum Pipe Railing System as supplied by the Architectural and Building Products Division of Reynolds Metals Company. The Connectorial System by Julius Blum and Company, Inc., or any other approved equal will be acceptable.

   A. Rail, Posts and Formed Elbows: Shall be formed from extruded ReynoRail II 6063 or 6061 aluminum pipe of 1-2 schedule 40 pipe size.

   B. Other Components: All other aluminum parts shall be fabricated from 6063 or 6061 extruded aluminum. All fittings, except cast bases, shall be a one piece extrusion machined to final shape. Blind rivets and self-tapping screws shall be a furnished by Reynolds Metals Company. No fasteners other than 305 stainless steel shall be used with the ReynoRail II pipe railing system.

3. FINISH: All aluminum railing components shall be clear satin anodized finish on all exposed surfaces. All cast aluminum components shall be 0.4 mil anodized and all extruded components shall be 0.7 mil anodized. All pipe-shaped components shall have a light curcumferentially-brushed finish before anodizing. All aluminum pipe and elbows shall be packed and shipped in individual plastic film to protect the anodized finish.

4. INSTALLATION: All handrails shall be installed as recommended by the manufacturer.

5. PROTECTION OF FINISH: The Contractor shall use all precautions necessary to protect the finish from scratches, nicks, gouges, dents, etc., during storage, assembly and installation. Insofar as possible, the plastic film shall be left intact on the pipe until inspection and acceptance by the Owner and/or Engineer.

6. WORKMANSHIP: All pipe cuts shall be square and accurate for minimum joint-gap. Cuts shall be clean and straight, free of "chanafer" from deburring, burrs and nicks. All holes shall be drilled and countersunk the proper size, as required for a tight flush fit of rivets.

7. SHOP DRAWINGS: Complete shop drawings of all handrail installations shall be submitted to the Engineer for approval before any fabrication is commenced. All fittings, connections, splices, anchors, brackets, etc., shall be shown.

8. MEASUREMENT AND PAYMENT: Unless indicated otherwise in the Proposal, Aluminum handrails shall subsidiary and not measured for pay.

SECTION 061810
SHELTER CONSTRUCTION (S-102)

1. DESCRIPTION

This specification shall govern all work necessary for furnishing and constructing the shelter as required to complete the project.

2. MATERIALS

Reinforced Concrete: All concrete shall be Class A as described in Specification Section 030020. Rebar shall be Grade 40 as described in Specification Section 032020.

Laminated Beam: Laminated beams shall be of a size as indicated on the construction drawings. The beams shall be capable of supporting a 120 lb/linear foot dead load and a 240 lb/linear foot live load when connected as indicated in the construction drawings. Laminating lumber shall be kiln-dried southern pine, stress graded to meet the requirements of Standard Specifications for Structural Glued Laminated Timber AITC 117. The beams shall be manufactured in accordance with The American Institute of Timber construction Standards AITC 100, and Standard Specification of Structural Glue Laminated Timber, AITC 117. Adhesives shall be waterproof conforming to ASTM D2559-70. Quality control shall be provided in accordance with PS-56-73 Voluntary Products Standard for Structural Glued Laminated Timber and The American Institute of Timber Construction Manual, AITC 200. A certificate of conformance to these requirements shall be furnished and the AITC quality marks shall appear on all beams.

Decking: Shall be 2 x 6 or 2 x 8, nominal, single tongue and groove with V joint bottom. Lumber shall be #2 Grade of better kiln dried southern pine.

Facer & Drip Cap: Facer and drip cap shall be 1 inch (nominal) #1 Grade southern pine and shall be treated with PENTA or CCA to a minimum retention of .6 lbs. per cubic foot.

Roof: The roof shall consist of a minimum 235 lb. per square asphalt shingle with a U.L. rating of Class C or better. One layer of 15 lbs. per square felt conforming to ASTM D226 shall be placed under shingles.

Nails, Fasteners and Metal Connectors: All nails, fasteners, metal connectors and flashing shall be galvanized or corrosion resistant.

3. CONSTRUCTION METHODS

General: The Contractor shall provide all temporary bracers, supports, etc., as required during construction. The Contractor shall obtain all the necessary permits and pay all fees required for construction. Contractor shall meet requirements set forth in the southern building code as adopted by the City with amendments, unless indicated otherwise on the drawings.

Wood Treatment: All exposed ends of decking at overhangs, ends of beams, and ends of facers and drip cap shall be treated with a brushed-on PENTA wood preservative after ends are cut.

Reinforced Concrete: Concrete shall be placed in accordance with Section

038000. Concrete columns shall be allowed to cure a minimum of 3 days prior to placement in the foundation; and 7 days prior to connecting the timber beam. Placement of deck and roof shall not begin until the concrete column has cured for a minimum of 14 days. No heavy equipment shall be allowed on the concrete slab.

Laminated Beam: The laminated beams shall be protected by the Contractor. If temporary storage is required, the beams shall be blocked off ground and separated with spacers. Non-marring slings shall be used when handling. The holes for the column connection shall be made with the beam resting in place on top of column with treated wood spacers set.

Decking: Decking shall be placed with all joints at alternate beams as indicated in plans. The deck shall be secured to beam with 16d nails. 2 x 6 decking shall require 2 nails at each beam. 2 x 8 decking shall require 3 nails at beams without joint (or at center) and 2 nails at each end or at the joints.

Roof: Saturated felt shall be applied shingle fashion parallel to and starting from the eave and lapped six inches, fastened only as necessary to hold in place. Asphalt shingles shall be installed in accordance with manufacturer's require- ments. Nails shall not extend through the bottom of decking.

Facer and Drip Cap: Facer, drip cap and flashing shall be placed around the structurer. Flashing and nails for flashing shall be of like metals. Facer shall be secured to beams with three 8d mails at each beam.

4. CERTIFICATION OF QUALITY

The Contractor shall provide the Engineer with the evidence of tests conducted which verify that the materials meet the require- ments set forth under Section 061810.2.

5. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the proposal, Shelter Construction shall be subsidiary and not measured for pay.

SECTION 066000
FIBERGLASS V-NOTCHED WEIR PLATE (S-111)

1. DESCRIPTION

This specification shall govern all work required to fabricate and install all fiberglass V-notched weir plates required to complete the project.

2. MATERIALS AND FABRICATION

Plate shall be constructed for a 90E V-notched weir unless otherwise indicated on the drawings. Plate shall be of fiberglass reinforced polyester molded to a minimum thickness of 3" with matched die method to produce a uniform surface. Plate shall be resin rich, free of voids and unreinforced areas. The plate shall be provided with 2" diameter mounting holes spaced at 9" C-C. See contract drawings for plate dimensions.

Anchor Bolts shall be 2" x 4" stainless steel.

Washers shall be 5" in diameter and 3" thick fiberglass with a hole for a 2" bolt.

3. INSTALLATION

The weir plate shall be secured into position with 2" stainless steel anchor bolts and fiberglass washers. Bolts shall be set into concrete on 9" centers as shown in the drawings. The plate shall be fine adjusted for proper elevation and symmetry. The weir plate shall be caulked with non-hardening caulk.

4. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Fiberglass V-Notched Weir Plates will not be measured and are considered subsidiary to the appropriate bid item.

SECTION 070020
ASBESTOS REMOVAL (S-1)

SCOPE: This specification shall govern all work required for the removal and disposal of asbestos required to complete the project. See Lab Report in Appendix for asbestos that has been identified.

APPLICABLE DOCUMENTS AND SAFETY COMPLIANCE: The removal and disposal of asbestos shall be done in strict accordance with all Federal, State and Local requirements as applicable during the time of construction. Requirements to be observed include, but are not limited to, the following:

a. Title 29, code of Federal Regulations, Sections 1910.1001, 1923.58 and 1910.1101 OSHA, U.S. Department of Labor.

b. Title 40, Code of Federal Regulations, Part 61, Subpart M, National Emissions Standards for Hazardous Air Pollutants, EPA.

c. Copies of the EPA Guidelines "Guidance for Controlling Asbestos Containing Materials in Buildings", June, 1985, shall be available at all times on the job site.

RESPONSIBILITY FOR DAMAGE CLAIMS:

The Contractor shall provide insurance in accordance with B-6-11 of the General Provisions of these contract documents. Said insurance shall be non-exclusive to asbestos.

QUALIFICATIONS OF CONTRACTOR:

All bidders shall submit a resume. The resume may include as much evidence as deemed necessary to establish qualifications for asbestos related work. The resume shall be submitted with this proposal. Non-submission of resume with proposal shall be considered grounds for rejection of bid.

DEFINITIONS:

Amended Water: Water containing a wetting agent or surfactant.

Asbestos: The term asbestos includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

Asbestos Control Area: An area where asbestos removal operations are performed which is isolated by physical boundaries to prevent the spread of asbestos dust, fibers or debris.

Asbestos Fibers: This expression refers to asbestos fibers having an aspect ratio of 3:1 and longer than 5 micrometers.

Ceiling Concentration: An exposure of airborne concentrations of asbestos fibers at any time in excess of 10 fibers, longer than 5 micrometers, per cubic centimeter of air.

Competent Person: One who is capable of identifying existing asbestos, tremolite, anthophyllite, of antinolite hazards in the workplace and who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f). The duties of the competent person include at least the following: establishing the negative-pressure enclosure, ensuring its integrity, and controlling entry to and exit from the enclosure; supervising any employee exposure monitoring required by the standard; ensuring that all employees working within such an enclosure wear the appropriate

personal protective equipment, are trained in the use of appropriate methods exposure control, and use the hygiene facilities and decontamination procedures specified in the standard; and ensuring that engineering controls in use are in proper operating condition and are functioning properly.

Area Monitoring: Sampling of asbestos fiber concentrations within the asbestos control area and outside the asbestos control area which is representative of the airborne concentrations of asbestos fibers which may reach the breathing zone.

Friable Asbestos Material: Material that contains more than one percent asbestos by weight and that can be crumbled, pulverized or reduced to power by hand pressure when dry.

HEPA Filter Equipment: High efficiency particulate absolute filtered vacuuming equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall be of 99.97 percent efficiency for retaining fibers of 0.3 microns or larger.

Nonfriable Asbestos Material: Material that contains asbestos in which the fibers have been locked in by a bonding agent, coating, binder, or other material so that the asbestos is well bound and will not release fibers in excess of the asbestos control limit during any appropriate use, handling, demolition, storage, transportation, processing or disposal.

Personal Monitoring: Sampling of asbestos fiber concentrations within the breathing zone of an employee.

Time Weighted Average (TWA): Three samples are required to establish the 8-hour time weighted average. The TWA is an 8-hour time weighted average airborne concentration of fibers, longer than 5 micrometers, per cubic centimeter of air.

Asbestos Permissible Exposure Limit: 0.2 fibers (longer than 5 micrometers) per cubic centimeter as an 8-hour time weighted average.

TITLE TO MATERIALS: All materials resulting from demolition work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified herein.

MEDICAL REQUIREMENTS: 29 CFR 1910.1001.

Medical Examinations: Before exposure to airborne asbestos fibers, provide workers with a comprehensive medical examination as required by 29 CFR 1910.1001. This examination is not required if adequate records show the employee has been examined as required by 29 CFR 1910.1001 requirements with in the past year. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos fibers and within 30 calendar days before of after the termination of employment in such occupation. Specifically identify x-ray films of asbestos workers to the consulting radiologist and mark medical record jackets with the word "ASBESTOS".

Medical Records: Maintain complete and accurate records of employees' medical examinations for a period of 40 years after termination of employment and make records of the required medical examinations available for inspection and copying to: The Assistant Secretary of Labor for Occupational Safety and Health, the Director of The National Institute for Occupational Safety and Health (NIOSH), authorized representatives of them, and an employee's physician upon the request of the employee or former employee.

RESPIRATOR PROGRAM: Establish a respirator program as required by ANSI Z88.2

AND 29 CFR 1910.134.

INDUSTRIAL HYGIENIST: Conduct monitoring and training under the direction of an industrial hygienist certified by the American Board of Industrial Hygiene.

POST BID SUBMITTALS: Prior to issuance of work order, the contractor shall provide the following submittals. These submittals shall be reviewed at the pre-construction conference and shall include the following:

Notification to Public Agencies: The contractor shall send written notice of the proposed asbestos related work to all applicable public agencies with a copy to the Engineer. The notice shall advise said agencies of the date of the pre-construction conference in addition to other relevant information. The pre-construction conference will be scheduled by the Construction Engineer (880-3058) of the City. Agencies to be notified include the following:

Environmental Protection Agency
1201 Elm Street
Dallas, TX 75270

Texas Air Pollution Control
5602 Old Brownsville Road
Corpus Christi, TX 78415

City-County Health Department
1702 Horne Road
Corpus Christi, TX 78416

Building Official
City of Corpus Christi
P.O. Box 9277
Corpus Christi, TX 78469

Permits and Arrangements: The Contractor shall submit proof that all required permits, disposal sites, transport and other necessary arrangements for the hazardous waste have been procured.

Education of Workers: The Contractor shall submit documentation (certificates signed by each employee) indicating that each employee to be associated with the asbestos related work has had current instructions on the hazards of asbestos and that each demonstrated proficiency in all aspects of work procedures and protective measures.

Medical Records: The Contractor shall submit documentation that each employee has had a current physical examination including name, address, and phone number of the physician conducting said examination.

Certification of Equipment: The Contractor shall submit manufacturer's certification that vacuums, ventilation equipment and other equipment required to contain airborne asbestos fibers conform to ANSI Z9.2

Envirinmental Protection Plan: The Contractor shall submit a detailed plan of work procedures to be used in the removal and demolition of materials containing asbestos. The plan shall be prepared, signed and sealed, including certification number and date, by the certified industrial hygienist or consulting professional engineer. Such a plan shall include location of asbestos control areas, change rooms, layout of change room, inter face of trades, involved in the demolition, sequencing of asbestos related work, disposal plan, type of wetting agent and asbestos sealer to be used, air monitoring and a detailed description of

the method to be employed in order to control pollution and provide a safe work area. This plan shall be reviewed prior the start of any asbestos work.

Testing Laboratory: The Contractor shall submit the name, address and telephone number of the testing laboratory selected for the monitoring, testing, and reporting of airborne concentrations of asbestos fibers along with certification that persons counting the samples have been judged proficient by successful participation within the last year in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) Program.

Industrial Hygienist or Consulting Engineer: Submit the name, address and telephone number of the industrial hygienist selected to prepare asbestos plan, direct monitoring and training, and a certification that the Industrial Hygienist is certified by the American Board of Industrial Hygiene, or State Board of Registration for Professional Engineers, including certification number and date.

SUBMITTALS FOR ENVIRONMENTAL MONITORING:

Monitoring Results: Fiber counting shall be completed and results reviewed by the industrial hygienist within 16 hours. The industrial hygienist shall notify the Contractor and the Engineer immediately of any exposures to asbestos fibers in excess of the acceptable limits. Submit monitoring results to the Engineer within three working days, signed by the testing laboratory employee performing air monitoring, and employee that tested, and the certified industrial hygienist.

Monitoring of Nonfriable Materials: A copy of all monitoring reports of nonfriable asbestos, including a description of the work procedure at the time of air monitoring, shall be submitted to the Engineer prior to completion of the project.

Notification: Notify the Engineer three working days prior to the start of asbestos work.

Disposal Manifest: The Contractor shall submit written evidence that the landfill for disposal is approved for asbestos disposal by the ESEPA and state or local regulatory agency(s). Submit detailed delivery tickets, prepared, signed and dated by an agent of the landfill, certifying the amount of asbestos materials delivered to the landfill, within three working days after delivery.

Local Exhaust System: The local exhaust system shall be operated continuously 24 hours a day until the enclosure of the asbestos control area is removed. Pressure differential recording for each work day shall be reviewed by the industrial hygienist and submitted to the Engineer within 24 hours from the end of each work day. The industrial hygienist shall notify the Contractor and the Engineer immediately of any pressure differential which is less than .02 inches of water.

EXECUTION

Equipment: Make available to the Engineer two complete sets of personal protective equipment and instructions for their use as required herein for entry to the asbestos control area at all times for inspection of the asbestos control area.

Competent Person: The Contractor shall have a "Competent Person" on the job site during work.

Protective Clothing: Provide personnel exposed to airborne concentrations of asbestos fibers with fire retardant disposable protective whole body clothing, headcovering, gloves, and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber gloves for comfort but shall not be used alone. Make sleeves secure at the wrists and make coverings secure at the ankles by the use of tape.

Caution Signs and Labels: Provide bilingual caution signs at all approaches to asbestos control areas containing concentrations of airborne asbestos fibers. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to all asbestos materials, scrap, waste, debris and other products contaminated with asbestos.

Tools and Local Exhaust System: Provide a local exhaust system in the asbestos control area. The local exhaust system shall be in accordance with ANSI Z9.2 Equip exhaust with absolute (HEPA) filters. Local exhaust equipment must be sufficient to maintain a minimum pressure differential of minus 0.02 inch of water column relative to adjacent, unsealed areas. Provide continuous 24-hour per day monitoring of the pressure differential with an automatic recording instrument. In no case shall the building ventilation system be used as the local exhaust system for the asbestos control area. Filters on vacuum and exhaust equipment shall conform to ANSI Z9.2.

Work Procedures: Perform asbestos related work in accordance with 29 CFR 1910.1001 and as specified herein. Use wet removal procedures. Personnel shall wear and utilize protective clothing and equipment as specified herein. Eating, smoking and drinking shall not be permitted in the asbestos control area. Personnel of other trades not engaged in the removal and demolition of asbestos shall not be exposed at any time to airborne concentrations of asbestos unless all the personnel protection provisions of this specification are complied with by the trade personnel. Shut down the building, heating, ventilation and air conditioning systems. Disconnect electrical service when wet removal is performed and provide temporary electrical service.

Furnishings: Uncontaminated furnishings shall be removed prior to asbestos removal as applicable.

Asbestos Control Area Requirements: Seal openings in areas where the release of airborne asbestos fibers is expected. Establish an asbestos control area with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of asbestos fibers from the contaminated asbestos control area.

Asbestos Handling Procedures: Sufficiently wet asbestos material with a fine spray of amended water during removal, cutting or other handling so as to reduce the emission of airborne fibers. Remove material and immediately place in plastic disposal bags. Where unusual circumstances prohibit the use of plastic bags, submit an alternate proposal for containment of asbestos fibers to the Engineer for approval. For example, in the case where both piping and insulation are to be removed, the Contractor may elect to wet the insulation and wrap the pipes and insulation in plastic and remove the pipe by sections.

Sealing and Removal of Asbestos-Contaminated Items: Remove contaminated architectural mechanical and electrical appurtenances such as venetian blinds, full-height partitions, carpeting, duct work, pipes and fittings, radiators, light fixtures, conduit, panels, and other contaminated for removal by completely coating the items with an asbestos sealer at the demolition site before removing the items from the asbestos control area. Remaining asbestos residue shall not be of such size so as to allow dislodging by means other than vacuuming. These items need not be vacuumed. The asbestos sealer shall be

tinted a contrasting color. It shall be spray-applied by airless method. Thoroughness of sealing operation shall be visually gauged by the extent of colored coating on exposed surfaces. Sealers shall be equal to the following products:

"Asbestite 2000" manufactured by Arpin Products, Inc., P.O. Box 262, Oak Hurst, NJ 07755, Phone (201)531-0674. (Application rate as recommended by manufacturer.)

"Wedbestos Sealer" distributed by Webco Products, Stinnes Western Chemical, 3270 East Washington Blvd., Los Angeles, CA 90023, Phone (213) 269-0191. (Application rate as recommended by manufacturer.)

"Dust-Set" Manufactured by Mateson Chemical Corporation, 1025 E. Montgomery Avenue, Phila., PA 19125,Phone (215)423-3200. (Application rate as recommended by manufacturer.)

Monitoring: Monitoring of airborne concentrations of asbestos fibers shall be in accordance with 29 CFR 1910.1001 and as specified herein.

Monitoring Prior to Asbestos Work: Provide area monitoring and establish the reference TWA one day prior to the masking and sealing operations for each demolition site.

Monitoring During Asbestos Work: Provide personal and area monitoring and establish the TWA during the first exposure to airborne concentrations of asbestos. Thereafter, provided the same type of work is being performed, provide area monitoring once every four hours during the work shift inside the asbestos control area, outside the entrance to the asbestos control area, and at the exhaust opening of the local exhaust system. If monitoring outside the asbestos control area shows airborne concentrations have reached the specified TWA, stop all work, correct the condition(s) causing the increase, and notify the Engineer immediately.

Site Inspection: While performing asbestos removal work, the Contractor shall be subject to onsite inspection by the Engineer who may be assisted by safety or health personnel. If the work is found to be in violation of this specification, the Engineer will issue a stop work order to be in effect immediately and until the violation is resolved. Standby time required to resolve the violation shall be at the Contractor's expense.

Clean-up and Disposal: Essential parts of asbestos dust control are housekeeping and clean-up procedures. Maintain surfaces of the asbestos control area free of accumulations of asbestos fibers. Give meticulous attention to restricting the spread of dust and debris; keep waste from being distributed over the general area. Do not blow down the space with compressed air. When asbestos removal is complete, all asbestos debris is removed from the worksite, the final clean-up is completed, certify the area as safe before the signs are removed. After final clean-up, remove all filters on the building HVAC system and provide new filters. Dispose of filters as asbestos-contaminated materials. Reestablish HVAC, mechanical, and electrical systems in proper working order. The Engineer will visually inspect the affected surfaces for residual asbestos material and accumulated dust and the Contractor shall re-clean all areas showing dust or residual asbestos materials. If re-cleaning is required, monitor the asbestos airborne concentration after re-cleaning. Notify the Engineer before unrestricted entry is permitted. The City shall have the option to perform monitoring to certify the areas are safe before entry is permitted.

Procedure for Disposal: Collect asbestos waste, scrap, debris, bags,

containers, equipment, and asbestos-contaminated clothing which may produce airborne concentrations of asbestos fibers and place in sealed impermeable bags. Affix a caution label to each bag. Dispose of waste asbestos material at an Environmental Protection Agency (EPA) or state-approved sanitary landfill. For temporary storage, store sealed impermeable bags in asbestos waste drums. Procedure for hauling and disposal shall comply with 40 CFR 61 (Subpart B), state, regional and local standards. Sealed plastic bags may be dumped from drums into the burial site unless the bags have been broken or damaged. Damaged bags shall remain in the drum and the entire contaminated drum shall be buried. Uncontaminated drums may be recycled. Workers unloading the sealed drums shall wear appropriate respirators and personal protective equipment when handling asbestos materials at the disposal site.

MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Asbestos Removal shall not be measured for direct payment and will be subsidiary to the project.

SECTION 070120
ROUGH AND FINISH CARPENTRY (S-120)

1. GENERAL

Scope: Furnish all labor, equipment, and materials to properly execute all rough and finish carpentry.

Delivery and Storage: Lumber delivered to the site shall be carefully piled off the ground in such a manner as to insure proper drainage, ventilation and protection from the weather.

2. MATERIALS

Grade marking: Each piece of framing and board lumber shall bear the official trademark and grademark of the manufacturer's association or the authorized inspection bureau under rules of which the lumber is manufactured, graded and purchased.

Sizes, patterns and moisture content: Lumber shall be surfaced four sides. Lumber to be incorporated in the structure shall conform to the moisture-content requirement of the latest official grading rules of nationally recognized associations representing the lumber industry. Lumber treated with water-borne preservatives shall be dried to a moisture content not exceeding 19 percent after treatment.

Plywood shall bear the mark of a recognized association of independent inspection agency that maintains continuing control over the quality of the plywood. The mark shall identify the plywood as to species, glue type and grade.

Species and grades of lumber for the various uses shall, at the option of the contractor, be any one of the species listed for the purpose of and of the grade specified for the species used.

Framing, bucks, sleepers, nailing strips and nailers:
Cypress; eastern hemlock; southern pine - No. 2
Balsam fir; eastern white pine, Norway pine; eastern spruce - No. 1
Cedar; coast region Douglas fir, inland Douglas fir, white fir, west coast hemlock; western larch; Idaho white pine, lodgepole pine, ponderosa pine - Standard.
Redwood - sap common.

Nails and Bolts shall be galvanized.

3. EXECUTION

Framing shall be closely fitted, accurately set to required lines and levels and rigidly secured in place.

Nailing strips, unless otherwise shown, shall be continuous, cut with square ends in as long lengths as practicable, and rigidly secured in place.

Interior finish shall be machine sanded at the mill and sand-papered smooth at the building when installed. Interior trim shall be standard stock moldings and members conforming to the following requirements, and of approved design and type. Interior trim shall be run with hollow backs. Joints shall be made in approved manner to

conceal shrinkage and shall be tight. Trim shall be secured with fine finishing nails and with screws and glued as required. Nails shall be set for putty stopping. Wood finish shall be set straight, plumb or level, in perfect alignment, and shall be closely fitted. Moldings shall be mitered at exterior corners and coped at interior angles. Trim shall be drawn tight against finished surfaces.

SECTION 074320
CEDAR SHINGLE ROOFING (S-4)

1. DESCRIPTION

This specification shall govern for all work necessary for furnishing and installing a cedar shingle roof on the project.

2. MATERIALS

Cedar shingles shall be Red Tagged Exterior Fire-X, Class B, as manufactured by American Wood Treater, Inc., or approved equal.

3. CONSTRUCTION METHODS

A. Roof Pitch and Exposures

On roof slopes of 4" rise in 12" horizontal run (pitch - 1/6) and steeper, the standard exposures shall be:

1. 5.0" for 16-inch shingles
2. 5.5" for 18-inch shingles
3. 7.5" for 24-inch shingles

On roof slopes of less than 4" rise in 12" horizontal run, the standard exposures shall be:

1. 4.0" for 16-inch shingles
2. 4.5" for 18-inch shingles
3. 6.0" for 24-inch shingles

B. Roof Application

Shingles shall be applied in straight, single courses and shall be tripled at all eaves. Butts of first-course shingles shall project 12" beyond the first sheathing board. Spacing between adjacent shingles (joints) shall be one-quarter inch. Joints in any one course shall be separated not less than 12" from joints in adjacent courses, and joints in alternate courses shall not be in direct alignment.

C. Underlayment

Underlayment shall be Type 30-lb. felt. When used with spaced sheathing, the horizontal felt overlap shall extend over a wood lath and the vertical joint must be lapped a minimum of 4 inches to insure proper waterproofing.

D. Valleys, Hips and Ridges

Roof valley flashing shall be No. 18 galvanized sheet gauge metal applied over an underlayment of Type 30-lb. felt. The metal shall extend a minimum of 10 inches from the centerline each way.

Hips and ridges shall be constructed of shingles that are uniform from 3" to 5" in width. Adjacent courses shall have alternate overlap. Shingles shall be placed on an underlayment of Type 30-lb. felt.

E. Nails

Each shingle shall be applied with two (only) hot-dipped zinc or aluminum nails. Each nail shall be placed not more than 3/4" from the side edge of the shingle and not more than 1" above the exposure line. Nails shall be 3d (1$\frac{3}{4}$") for 16" and 18" shingles and 4d (1$\frac{2}{4}$") for 24" shingles. In all cases, nails shall be long enough to penetrate at least 3/4" or through the sheathing. Drive nails flush, but not so that the head crushes the wood.

4. WARRANTY

Upon completion of the project, the Contractor shall supply a 20-year manufacturer's warranty for the cedar shingles. The project will not be accepted and final payment will not be made until the warranty is supplied. If warranty registration with the manufacturer is required, the Contractor shall make said registration on behalf of the City. Any signatures required on the registration shall be done by the Engineer or his authorized representative. The Contractor shall furnish proof, satisfactory to the Engineer, that the warranty is registered with the manufacturer.

5. MEASUREMENT AND PAYMENT

The cedar shingle roof shall be measured for payment at the unit specified in the proposal. This unit shall include all underlayment, sheet metal and other incidentals required to provide the complete roofing system in place. Payment at the unit specified shall be full compensation for furnishing all materials, tools, equipment, labor and incidentals necessary to complete the work.

SECTION 075220
BUILT-UP ASPHALT ROOF SYSTEM (S-108)

1. DESCRIPTION

This specification shall govern all work for furnishing materials and constructing built-up asphalt roof required to complete the project.

2. MATERIALS

Materials: Obtain primary roofing materials from only one manufacturer, to the greatest extent possible. Secondary materials (and materials not available from the primary roofing materials manufacturer) shall be those built-up roofing materials recommended by the manufacturer of the primary materials. Materials shall comply with the following A.S.T.M. standards or shall be of equal or superior quality to the listed product:

Asphalt Primer - ASTM D-41
Steep Asphalt - Type III or IV - ASTM D-312
Polyurethane Foam Board Insulation - Johns-Manville - Fesco Foam Roof Insulation
Perlitic Board Roof Insulation - ASTM C209/E84
Asphalt Saturated Fiberglass Plies - ASTM D-2178 Type IV
Wood Fiberboard Cant Strip - (cut from 1 1/2" thick wood fiberglass roof insulation) - ASTM C-208
Plastic Cement -
Inner Ply: Gulf States No. 304 Plastic Cement
Outer Ply: J. M. Asbestile Flashing Cement
Fibrated Aluminum Roof Coating - ASTM D-2824-69

3. MATERIAL STORAGE AND HANDLING

During storage and handling, insulation should be protected from the elements. It should be protected from moisture to prevent moisture absorption.

Roll roofing materials should be stacked vertically and protected from the elements. If the base ply is left exposed on the roof overnight, it is recommended that the laps be sealed either with hot asphalt or mastic, and any uncoated base sheet should be glaze coated with hot asphalt to temporarily seal the surface at the end of each day's work.

Care should be exercised in the handling and application of insulation to prevent cracking, breaking off or spalling of the edges.

4. CONSTRUCTION METHODS

A. Preparation of Deck - Remove existing built-up roof system. Prior to the installation of any roofing materials, the deck surface must be clean, smooth, free from moisture, loose particles, grease, oil and other foreign matter. Solid prime the deck and necessary portions of parapet walls with asphalt primer and allow to dry completely. Contractor shall be held responsible for any damage to the inside of the building.

B. Insulation - Perlitic tapered board roof insulation shall be applied to provide a slope of a minimum of 1/8 inch per foot of roof toward roof

edge. The contractor shall submit a plan showing the drainage pattern for approval prior to commencing work. The contractor is cautioned that there are a number of low areas on this roof to be corrected. Installation shall be as per manufacturer's recommendations. The foam board shall be laid in a solid mopping of hot asphalt applied at a rate of 25 lb. per square and heated in accordance with Equiviscous Temperature Standards. Equiviscous Temperature Range (E.V.T.) is the temperature range, plus or minus 25EF., at which a viscosity of 125 centistokes is attained. E.V.T. information can be obtained from the manufacturer.

The installation of the roofing system during two or more separate time intervals, or phase application, is not recommended. All plies of a given specification should be applied at one time.

Only install as much insulation as can be completely covered with roof membrane and exposed edges of insulation boards should be protected with water cut offs at the end of each working day. The water cut offs should be removed or cut before starting the next day's work.

When two or more layers of insulation are installed, the joints shall be staggered vertically and offset where possible. The edges of insulation board shall be straight and flush. End joints between adjacent boards should be staggered.

C. Membrane: A solid mopping of asphalt shall be applied over insulation followed by four plies of asphalt saturated fiberglass meeting ASTM D-2178 Type IV. Each of the four plies of fiberglass shall be applied into a fluid, continuous application of asphalt. The plies should be lapped 27 1/2" leaving an exposure of 8 1/2". The asphalt shall be applied such that in no place will adjacent plies touch each other. All plies shall be broomed or squeegeed into place as they are applied. The asphalt shall be heated in accordance with E.V.T. standards and applied at a rate of 30 lbs. per square. A flood coat of asphalt applied at a rate of 20 lbs. per square shall be placed on the last layer of fiberglass followed by a coat of fibrated aluminum roof coating.

Felts should be laid in a straight line to assure adequate lap.

During the application of roofing materials, moisture should be prevented from becoming entrapped between the felts. If precipitation occurs prior to the completion of roof membrane application, all surfaces should be allowed to dry prior to resuming work.

Care should be taken to ensure a thin, continuous uniform interplay mopping of asphalt is applied within the E.V.T. temperature range to attain maximum adhesion of the plies.

5. ACCEPTANCE CRITERIA

All areas which fail drainage specification requirements with respect to slope, materials quality, etc., shall be repaired or replaced at the expense of the contractor. The maximum ponding area acceptable shall be 10 square feet and/or 1/4 inch deep.

6. GUARANTEE

The Contractor shall submit two copies of a five-year guarantee for the roofing and associated work, agreeing to repair or replace any work which leaks water, deteriorates excessively, or otherwise fails to perform as required due to failures of materials or workmanship. Guarantee shall be signed by the

Contractor.

At the end of the five-year period (two years from substantial completion), representatives of the Contractor and the City shall inspect the roof for any deficiencies due to wear and tear or faulty construction. All deficiencies shall be Contractor's at no expense to the City.

7. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the proposal, built-up asphalt roof shall not be measured for pay but shall be considered subsidiary to the project.

SECTION 078220
CONCRETE TILE ROOFING (S-122)

1. PRODUCTS DELIVERY, STORAGE, AND HANDLING

Delivery:

a. Clearly identify manufacturer, tradename, style and color of palletized material.

b. Deliver materials in original containers with manufacturer's labels intact and legible.

Storage:

a. Store cementitious materials in weather-tight spaces; keep free from moisture.

b. Aggregate - Store in well drained area to minimize change in moisture content; prevent contamination by other materials.

c. Protection - Cover stored materials with tarpaulin or other suitable covering to prevent soiling or exposure to weather. Fasten coverings to prevent removal by wind.

Handling: Do not stack tiles on roof in quantities exceeding six tiles high on 12 in. (300 mm) centers at every third course on slope.

2. SUBMITTALS

Samples: Submit 2 samples of full size standard tile.

Shop Drawings: Submit shop drawings detailing shop fabricated custom shapes.

3. JOB CONDITIONS

1. Do not set tiles in mortar when the ambient temperature is less than 40E F. (4.4E C) or when such temperature is expected within 24 hours.

2. Do not start setting tiles until other trades have completed work requiring traffic on or across roof surfaces.

4. GUARANTEE

Guarantee materials and workmanship to be free from defects and leaks for a period of 2 years from date of acceptance.

5. CONCRETE ROOFING TILES

1. Monray, Villa Field Type manufactured by Monier Rooftile (trade name).

2. Espana Mission Tile manufactured by Lifetile.

3. Color shall be selected from the manufacturer's standard color samples.

4. Fittings: Furnish all fittings as needed for complete installation in accordance with manufacturer's recommended

and approved samples.

6. FELT UNDERLAYMENT

Coal-tar saturated roofing felt, ASTM D227, 30 lbs. x 36 width.

7. FASTENERS

Underlayment - Fasteners shall be specified for built-up roof.

Tile - Fasteners shall be as recommended by the tile manufacturer.

8. ROOF CEMENT AND SEALANT

Roof cement and sealant shall be as recommended by the tile manufacturer.

9. MORTAR

1. ASTM C270 - Type O.

2. Color to be selected to match tile color alkali and sun resistant mineral oxide.

10. METAL TRIM AND FLASHING

Metal trim and flashing to be as recommended by manufacturer.

11. WOOD NAILER STRIPS

Pine or Fir, Grade 2, Wolmanized. (Species)

12. LAYING ROOFING TILES

Layout and install tiles in accordance with manufacturer's specifications using closures trim at ridge, hip and coping manufactured for the purpose.

13. Cleaning

1. Remove any mortar or asphalt splatter from adjacent surfaces.

2. Upon completion of work, remove excess materials and broken tiles from the premises.

SECTION 097020
EXPOSED AGGREGATE FINISH FOR CONCRETE SIDEWALKS (S-51)

1. DESCRIPTION

This specification shall consist of exposed aggregate finish, also called "Pea Gravel" or "Pebble Concrete," for sidewalks composed of Portland cement concrete, constructed as herein specified, in conformity with plans.

2. MATERIALS

Materials used shall be the same as specified in Section 025612, Concrete Sidewalks and Driveways". Exposed aggregate shall be from 1/2" minimum to 3/4" maximum in size free from flat pieces, cleaned prior to use.

3. CONSTRUCTION METHODS

Wet over which topping is to be poured, pour concrete, screed and darby. Aggregate to be exposed shall be evenly distributed by hand (approximately 4.25 lbs. per sq. ft.) so the entire surface is completely covered with a single layer (special care shall be taken in covering edges uniformly). Work aggregate into concrete with darby and as soon as surface will support the weight of the mechanic on knee-boards, hand float thoroughly so that all aggregate is completely embedded just below the surface with no holes or openings left in the surface, after which an approved retarder may be applied at the Contractor's option. At the proper time, aggregate shall be exposed by spraying the surface with a garden hose equipped with sprinkler attachment and brushing and flushing the water from the surface without overexposing or dislodging the aggregate. Care shall be exercised in moving over surface during spray and brushing to avoid breaking the aggregate bond.

When completed, the Contractor shall cure the slabs with a clear, non-staining curing compound. See Section 038000, "Concrete Structures" Section 14 for curing specifications.

Just prior to completion of the project, the slabs shall be thoroughly cleaned with water and light muratic acid solution, thoroughly rinsed and completely and evenly covered with "Sono Glaze" as manufactured by Sonneborn Building Products, Inc., or an approved equal glaze.

4. MEASUREMENT & PAYMENT

Unless indicated otherwise in the Proposal, Work and accepted material as prescribed for this specification will be measured by the square foot of surface area of completed. The work will be paid for at the unit bid price under the bid item "Exposed Aggregate" or ACurb Ramp≅, which price shall be full compensation for preparing the subgrade; for furnishing and placing all materials, including all reinforcing steel, and expansion joint materials; and all manipulation, labor, tools, equipment, and incidentals necessary to complete the work.

SECTION 099020
PAINTING (S-56)

1. DESCRIPTION

This specification shall govern for all work necessary to provide all painting required to complete the project.

2. INTENT

All ferrous metal or unfinished material furnished on this project shall be furnished with a protective coating, but stainless steel, aluminum, bronze, copper, lead, and galvanized surfaces are not to be painted. Any factory painted item that is damaged or shows any sign of corrosion prior to the date of substantial completion shall be repainted by the Contractor. Concrete or concrete block is to be painted only when shown on the drawings to be painted.

COLORS

All colors shall be selected by the Engineer and/or Owner. The Contractor shall prepare samples of colors for approval by the Engineer and/or Owner.

SAMPLES

The Contractor shall submit for approval samples of paint materials proposed for use, in three displays of each kind of color of paint to be applied. The Contractor shall make panels used for displays, representative of respective types of surfaces to which several kinds and colors are to be applied in actual work. The Contractor shall not order paint materials until color selections have been made and samples approved.

3. PREPARATION OF SURFACES

3.1 General: All surfaces shall be clean when paint is applied.

3.2 Concrete and Masonry: The Contractor shall clean all concrete surfaces with mechanical abrasion (brushing) and water blast. The last step in the cleaning of surfaces other than sanitary sewer wet wells shall be to wash the surface to be painted with a 20% solution of muriatic acid and then rinse with potable water. In cleaning sanitary wet wells, all corroded concrete shall be removed as indicated above and the surface shall be washed with a solution of potable water and sodium hydroxide and then rinsed with potable water. The surface shall be thoroughly dry when paint is applied.

3.3 Metal:

a. General: All metal surface to be painted shall be cleaned by sandblasting, except items that are shop coated. Cleaning shall be to "Near White Metal" SP-10 or NACE #2, or "Commercial Grade" SSPC-6 or NACE #3. One of these two methods will be specified where blast cleaning is required. NOTE: All submerged surfaces will require a "Near White Metal" (SP-10 or NACE #2 blast), without exception.

b. "Near White Metal": Sandblast cleaning SP-10 or NACE #2. Definition and procedure as follows: "Near White Metal" is a method of preparing the metal surfaces for the application of

protective coatings by removing mill scale, rust, oil paint, and any foreign matter by propelling sand through a nozzle with compressed air. This is defined as a surface, gray white in appearance, being almost a completely uniform metallic color, with very light shadows allowed over less than 10% of the surface area.

Procedure:

(1) Before blasting, grind smooth any rough welds and sharp edges.
(2) Remove heavy deposits of oil and grease by detergent cleaning using one pound Sodium Meta Silicate per five gallons of water.
(3) The sand used shall be 16-35 mesh, or 20-60 (unless otherwise specified) sharp angular grained silica sand that is fresh water washed, dried, properly graded and delivered to the job site in moisture proof bags (bulk sand of equal quality and size is acceptable). Sand shall not be re-used.
(4) Compressed air shall be delivered at a minimum nozzle pressure of 90 p.s.i. not to exceed 110 p.s.i. This shall be free of detrimental amounts of condensed water and oil.
(5) All blast products shall be swept or blown from the surface before priming commences.
(6) Blast cleaning will not be conducted on surfaces that may become wet after blasting and before priming is complete, or when surfaces are less than 5E above dew point, or when relative humidity is above 85%.
(7) The blasted surface shall be primed within 8 hours.

c. "Commercial" Blast Cleaning (SP-6 of NACE #3) Definition and Procedure: Commercial blast cleaning is a method of preparing metal surfaces for painting by removing mill scale, rust, rust scale, paint or foreign matter by the use of abrasive propelled through nozzles or by centrifugal wheels. Heavy deposits of grease or oils shall be removed by No. 1 "Solvent Cleaning" prior to blasting. "Commercial" blast cleaning entails the removal of practically all rust, mill scale and other detrimental matter from the surface. The surface will not necessarily be uniform in color, nor will all surfaces uniformly clean since the original condition of the surface will affect the final result. (If surface, prior to cleaning, is in such bad condition that the cleaning, when done according to this specification, results in a surface unsatisfactory to the Owner or suitable for very severe service, the No. 10 Blast Cleaning to "Near White Metal" shall be specified.) Less than 30% light shadow shall be visible.

Procedure:

(1) Remove heavy deposits of grease or oil by detergent cleaning.
(2) The sand shall be 20-40 mesh, unless otherwise specified, fresh water washed, dried, properly graded and delivered to the job site in vapor proof bags, or bulk. Sand shall not be re-used.
(3) Compressed air shall be delivered at a minimum nozzle pressure of 90E p.s.i., not to exceed 100 p.s.i. This shall be free of condensed water and oil (use moisture traps).
(4) Blow or sweep off the excess blast products from the surface.
(5) Prime the blasted surface within 8 hours.

(6) Blasting shall not be conducted when relative humidity is in excess of 85% or surfaces are less than 5E above the dew point, unless approved by the Engineer.

d. Removal of Oil and Grease: Remove oil and grease with approved solvents such as Naptha, or by steam combined with approved detergent. USE OF GASOLINE OR KEROSENE NOT PERMITTED.

e. Scraping, Grinding and Chipping: Scrapers or other suitable grinding and chipping tools may be used for removal of existing paint coating prior to repainting, or for cleaning before application of secondary coats only when approved by the Engineer.

f. Sandblasting: Clean such surfaces by "Near White" or "Commercial" sandblasting and leave clean, dry, and ready to receive prime coat. River sand must be graded and washed to insure removal of clayey material. Remove all dust and sand from surfaces before painting. Take care to remove all sand and grit around and between joints of connecting members. Schedule operations to avoid settling of dust or grit on freshly painted surfaces and adequately protect machinery or other equipment in vicinity of sandblasting work.

4. STORING AND MIXING OF PAINT: The Contractor shall use one convenient location for storing and mixing of paint materials, and keep and approved type fire extinguisher available in this area. The Contractor shall protect areas where paint is stored or painting is done and he shall remove all oily rags and waste from building at close of each day.

5. WEATHER AND SITE CONDITIONS:

5.1 Temperature: Painting shall not be accomplished when either the surface or ambient temperatures are less than 50E or when temperature drop of 20EF, or below 50E Fahrenheit, is forecast.

NOTE: Material shall be stored in area where the extreme cold or heat will not greatly affect viscosity. Coatings apply much better when product temperature is held within 60E - 90E F range (77E F is optimum).

5.2 Humidity: Painting shall not be accomplished during misty or rainy weather, or on surfaces that have any frost or moisture. Painting shall not be permitted at temperatures less than 5EF above the dew point.

5.3 Wind and Dust: Painting shall not be accomplished in dusty rooms or on the exterior during excessive wind. The Engineer shall be the sole judge as to what constitutes excessive wind.

6. APPLICATION PROCEDURES:

6.1 General: Paint shall be applied by skilled workmen. Paint may be applied with brush or spray equipment. Paint shall be applied in even and thorough coats, without runs, sags or other blemishes. Contractor shall properly sand paint surfaces between coats of enamel, paint or shellac when applied to any surface other than masonry. Apply paints in accordance with manufacturer's

recommendations. Do not apply finish field painting to machinery, equipment, or piping until operational testing has been completed.

6.2 Driving Time: Allow thorough drying time of each coat before succeeding coat is applied, except when manufacturer recommends otherwise, or as specified herein.

6.3 Coverage: Shall be as recommended by manufacturer.

6.4 Delivery of Paint: Contractor shall deliver paint to the site in original, unbroken, sealed containers, with manufacturer's label attached.

6.5 Thinners and Solvents: Contractor shall use only those thinners and solvents specified in paint formulas of paint being used and mix in proportions as recommended by paint manufacturer.

6.6 Brush Application: Contractor shall apply paint in uniform thickness consistent with specified coverage and with sufficient cross brushing to insure filling of surface irregularities. He shall exercise particular care in painting around rivet heads, bolt heads and nuts, in corners, restricted spaces, and on irregular concrete surfaces.

6.7 Spray Application: Contractor shall apply paint with adjustable air gun equipped with suitable water trap to remove moisture from compressed air, and with paint pot having hand or air driven agitator. Application of paint by suitable airless spray equipment is acceptable. Paint shall be applied with the width of spray not less than 6 inches nor more than 18 inches, and with suitable pressure for particular type of paint being used. Contractor shall make frequent checks to insure correct spreading rate and coating, and apply without sags, runs or "orange peel" effect. Correct all such imperfection. The Contractor shall take special care to cover edges, corners, and rivet head without bridging over of paint film.

6.8 Application of Protective Coating: When applying coats designed to prevent corrosion due to liquids and gases, the coating must be complete and absolutely free of the slightest pinhole, air pocket or other defect which would allow the entrance of either liquid or gas.

6.9 Painting Shop Coated Metal Surfaces:

a. Prior to Installation: After delivery to site of work, and prior to installation, keep all shop coated metal work clean and free from corrosion. When directed, clean and re-touch damaged areas with additional primer.

b. After Installation: After erection or installation of shop coated metal work, clean, and re-touch all rust spots, all places where paint has been rubbed or scraped off, and all field rivet boat head nuts. After previously applied paint has hardened, and when surfaces to receive succeeding coats of paint have been perfectly cleaned and dried, apply paint as set out elsewhere in these specifications. Allow interval of not less than 48 hours, or as recommended by manufacturer, between coats, and if surface is to be submerged in water, allow 5 days or more for hardening of final coat before

placing in water.

c. Machinery and Electrical Equipment: After installation of machinery and electrical equipment, check base coats carefully and retouch all damaged surfaces. Do not paint nameplates, serial number bases, chrome or bronze trim, or any rotating parts. Clean off any excess paint that impairs convenient removal of covers or gauges, instrumentation or other equipment fitted with doors or covers.

d. Bolted and Imbedded Surfaces: All surfaces to be blotted together, to concrete or to be imbedded in concrete or grouted, to have prime and complete finish coats applied and dried before erecting in place.

6.10 CLEANING: Upon completion of painting operations, the Contractor shall clean off all paint spots, oil, and stain from all surfaces and leave entire project in perfect condition as far as painting work is concerned. Remove from premises all containers and debris resulting from painting operations.

7. PAINTING EQUIPMENT, MACHINERY AND METAL WORK

7.1 INTERIOR METAL DOORS, FRAMES, AND WINDOWS, AND OTHER MISCELLANEOUS ARCHITECTURAL METAL WORK:

Prime Coat: (Surface Prep - SP-6, or PT-4 "Hot Phosphate Treat")

a. 1 coat - Briners #4805 Versatile Red Primer - Minimum 2.5 D.M.T.*, or
b. 1 coat - Koppers 654 Epoxy Primer - Minimum 2.5 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Red Inhibitive Primer #97-48/98 - Minimum 2.5 D.M.T., or
d. an approved equal.

*Dry Mils Thick

Intermediate Coat

a. 1 coat - Briners #4800 Series Polyamide-Epoxy (Versatile) - Minimum 2 D.M.T., or
b. 1 coat - Koppers Glamorglaze 200 Epoxy - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Polyamide-Epoxy Finish- Minimum 2 D.M.T., or
d. an approved equal.

Top Coat:

a. 1 coat - Briners #4800 Series Polyamide-Epoxy (Versatile) - Minimum 2 D.M.T., or
b. 1 coat - Koppers Glamorglaze 200 Epoxy - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Polyamide Epoxy Finish - Minimum 2 D.M.T., or
d. an approved equal.

7.2 EXTERIOR METAL DOORS, FRAMES, AND WINDOWS, AND OTHER

MISCELLANEOUS ARCHITECTURAL METAL WORK:

Prime Coat: (Surface Prep-SP-6)

a. 1 coat - Briners #4805 Versatile Red Primer - Minimum 2.5 D.M.T., or
b. 1 coat - Koppers 654 Epoxy Primer - Minimum 2.5 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Red Inhibitive Primer #97-48/98- - Minimum 2.5 D.M.T., or
d. an approved equal.

Intermediate Coat:

a. 1 coat - Briners #4817 Versatile Tan Primer - Minimum 2.5 D.M.T., or
b. 1 coat - Koppers Glamorglaze 200 Epoxy - Minimum 2.5 D.M.T. or
c. 1 coat - Pittsburgh Aquapon Polyamide Epoxy Finish - Minimum 2.5 D.M.T., or
d. an approved equal.

Top Coat:

a. 1 coat - Briners ACRA-CLAD (Acrylic Urethane) - Minimum 2.5 D.M.T., or
b. 1 coat - Koppers Polyurethane - Minimum 2.5 D.M.T., or
c. 1 coat - Pittsburgh Pitthane (Polyurethane) - Minimum 2.5 D.M.T. or
d. an approved equal.

7.3 INTERIOR-STRUCTURAL STEEL, HANDRAILS, WALKWAYS, AND OTHER MISCELLANEOUS METAL WORK: (Sandblast "Near-White Metal", SP-10 or NACE #2)

Prime Coat:

a. 1 coat - Briners #4805 Versatile Red Primer - Minimum 3 D.M.T., or
b. 1 coat - Koppers #654 Epoxy Primer - Minimum 2.5 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Red Primer #97-48/49 - Minimum 2.5 D.M.T., or
d. an approved equal.

Intermediate Coat:

a. 1 coat - Briners #4817 Versatile Tan Primer - Minimum 3. D.M.T., or
b. 1 coat - Koppers 200 H.B. Epoxy - Minimum 3 D.M.T., or
c. 1 coat - Pittsburgh Light Gray Aquapon #97-3/98, Minimum 3 D.M.T., or
d. an approved equal.

Top Coat:

a. 1 coat - Briners #4800 Series Versatile Polyamide Epoxy Finish - Minimum 2.5 D.M.T., or
b. 1 coat - Koppers Glamorglaze 200 Epoxy - Minimum 3 D.M.T. or
c. 1 coat - Pittsburgh Aquapon Polyamide Epoxy Finish #97-51/51 - Minimum 3 D.M.T., or
d. an approved equal.

7.4 EXTERIOR-STRUCTURAL STEEL, HANDRAILS, WALKWAYS, AND OTHER MISCELLANEOUS METAL WORK: (Sandblast "Near White Metal", SP-10 or NACE #2)

Prime Coat:

a. 1 coat - Briners #4805 Versatile Red Primer - Minimum 3 D.M.T., or
b. 1 coat - Koppers #654 Epoxy Primer - 2.5 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Red Inhibitive Primer #97-48/98 - Minimum 2.5 D.M.T., or
d. an approved equal.

Intermediate Coat:

a. 1 coat - Briners #4817 Versatile Tan Primer - Minimum 3 D.M.T., or
b. 1 coat - Koppers 200 H.B. Epoxy - Minimum 3 D.M.T., or
c. 1 coat - Pittsburgh Light Gray Aquapon #97-3/98 - Minimum 3 D.M.T., or
d. an approved equal.

Top Coat:

a. 1 coat - Briners ACRA-CLAD (Acrylic Urethane) - Minimum 2.5 D.M.T., or
b. 1 coat - Koppers Polyrethane - Minimum 2.5 D.M.T., or
c. 1 coat - Pittsburgh Pitthane (Polyurethane) - Minimum 2.5 D.M.T., or
d. an approved equal.

7.5 STRUCTURAL STEEL AND OTHER MISCELLANEOUS METAL SUBMERGED IN WASTEWATER: (Sandblast "Near White Metal", SP-10 NACE #2)

Prime Coat:

a. 1 coat - Briners U#4817 Versatile Tan Primer - Minimum 2.5 D.M.T., or
b. 1 coat - Koppers 654 Epoxy, Minimum 2.5 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Green Inhibitive Primer - #97-49/98 - Minimum 2.5 D.M.T., or
d. an approved equal.

Intermediate Coat: (Shall be applied in not less than four (4) hours and not more than fifteen (15) hours after applying the previous coat.)

a. 1 coat - Briners #791 Coal Tar Epoxy - Minimum 8 D.M.T., or
b. 1 coat - Koppers Bitumastic 300-M Coal Tar Epoxy - Minimum 8 D.M.T., or
c. 1 coat - Pittsburgh Coal Tar Epoxy - Coal Cat #97-640/641 Epoxy-Minimum 8 D.M.T., or
d. an approved equal.

Top Coat: (Shall be applied in not less than four (4) hours and not more than fifteen (15) hours after applying the previous coat.)

a. 1 coat - Briners #791 Coal Tar Epoxy - Minimum 8 D.M.T., or
b. 1 coat - Koppers 300-M Coal Tar Epoxy - Minimum 8 D.M.T., or

c. 1 coat - Pittsburgh Coal Tar Epoxy - Coal Cat #97-640/641 Epoxy-Minimum 8 D.M.T., or
d. an approved equal.

7.6 STRUCTURAL STEEL AND OTHER MISCELLANEOUS METAL SUBMERGED IN POTABLE WATER: (Sandblast "Near White Metal", SP-1 or NACE #2)

Prime Coat:

a. 1 coat - Briners #796 Non-Toxic Primer, 2 - 2.5 D.M.T., or
b. 1 coat - Koppers #294 Epoxy Primer - Minimum 3 D.M.T., or
c. Pittsburgh (No system available), or
d. 1 coat - Tnemec 20-1255 "Beige" Pota-Pox Primer - Minimum 3 D.M.T., or
e. an approved equal.

Intermediate Coat: (Shall be applied in not less than four (4) hours and not more than fifteen (15) hours after applying the previous coat.)

a. 1 coat - Briners #797 Super Versatile Non-Toxic White - Minimum 5 D.M.T., or
b. 1 coat - Koppers 200 H.B. Epoxy - Minimum 6 D.M.T., or
c. Pittsburgh (No system available), or
d. 1 coat - Tnemec 20-2000 "White" Pota-Pox - Minimum 4 D.M.T., or
e. an approved equal.

Top Coat: (Shall be applied in not less than (4) hours and not more than fifteen (15) hours after applying the previous coat.

a. 1 coat - Briners #797 Super Versatile Non-Toxic White - Minimum 5 D.M.T., or
b. 1 coat - Koppers 200 H.B. Epoxy - Minimum 6 D.M.T., or
c. Pittsburgh (No system available), or
d. 1 coat - Tnemec 20-2000 "White" Pota-Pox - Minimum 4 D.M.T., or
e. an approved equal.

7.7 INTERIOR - SHOP PAINTED PUMPS, MACHINERY AND MOTORS:

Prime Coat:

a. 1 coat - Briners #2810 Durapon Red Primer - Minimum 2 D.M.T., or
b. 1 coat - Koppers 621 Rust Inhibitive Primer - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Multi-Prime #97-684 Minimum 2 D.M.T., or
d. 1 coat - Tnemec Series 37K-77 Chem-Prime-Minimum 2 D.M.T., or
e. an approved equal.

Intermediate Coat:

a. 1 coat - Briners #2800 Series Durapon Enamel Epoxy - Minimum 2 D.M.T., or
b. 1 coat - Koppers Ponkote 300 Enamel - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Polyamide Epoxy finish - Minimum 2 D.M.T., or

d. 1 coat - Tnemec Series 2H Hi-Build Tnemec-Glass - Minimum 2 D.M.T., or
e. an approved equal.

Top Coat:

a. 1 coat - Briners #2800 Series Durapon Enamel Epoxy - Minimum 2 D.M.T., or
b. 1 coat - Koppers Ponkote 300 Enamel - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Polyamide Epoxy Finish - Minimum 2 D.M.T., or
d. 1 coat - Tnemec Series 2H Hi-Build Tnemec-Glass - Minimum 2 D.M.T., or
e. an approved equal.

7.8 EXTERIOR - SHOP PAINTED PUMPS, MACHINERY, AND MOTORS:

Prime Coat:

a. 1 coat - Briners #4805 Versatile Red Prime - 2.5 - 3 D.M.T., or
b. 1 coat - Koppers 654 Epoxy Primer 2.5 - 3 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Red Inhibitive Primer #97-48/98 2.5 - 3 D.M.T., or
d. an approved equal.

Intermediate Coat:

a. 1 coat - Briners #4817 Versatile Tan Primer - Minimum 3 D.M.T., or
b. 1 coat - Koppers Glamorglaze 200 Epoxy - Minimum 3 D.M.T., or
c. 1 coat - Pittsburgh Polyamide Epoxy Gray High Solids #97-151/159 - Minimum 5 D.M.T., or
d. an approved equal.

Top Coat:

a. 1 coat - Briners ACRA-CLAD (Acrylic Urethane) - Minimum 2.5 D.M.T., or
b. 1 coat - Koppers Polyrethane - Minimum 2.5 D.M.T., or
c. 1 coat - Pittsburgh Pitthane (Polyurethane) - Minimum 2.5 D.M.T., or
d. an approved equal.

7.9 ELECTRICAL CONTROL EQUIPMENT:

Prime Coat:

a. 1 coat - Briners #2810 Durapon Red Primer - Minimum 2.5 D.M.T., or
b. 1 coat - Koppers 621 Rust-Inhibitive Primer - Minimum 2.5 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Red Inhibitive Primer #97-48/98 - Minimum 2.5 D.M.T., or
d. 1 coat - Tnemec Series 37-77 Chem-Prime - Minimum 2 D.M.T., or
e. an approved equal.

Intermediate Coat:

a. 1 coat - Briners #2816 Durapon Intermediate Primer (Epoxy) - Minimum 2 D.M.T., or
b. 1 coat - Koppers 300 Enamel - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Polyamide Epoxy Finish - Minimum 2 D.M.T., or
d. an approved equal.

Top coat:

a. 1 coat - Briners #2800 Series Durapon Enamel Epoxy - Minimum 2 D.M.T., or
b. 1 coat - Koppers 300 Enamel - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Polyamide Epoxy Finish - Minimum 2 D.M.T., or
d. 1 coat - Tnemec Series 2H High-Build - Minimum 2 D.M.T., or
e. an approved equal.

8. PAINTING EXPOSED AND SUBMERGED METAL PIPING

8.1 EXPOSED VALVES, FITTINGS, AND PIPES: (Sandblast "Commercial Grade" SP-6 or NACE #3)

Prime Coat:

a. 1 coat - Briners #4805 Versatuke Red Primer - Minimum 3 D.M.T., or
b. 1 coat - Koppers 654 Primer - Minimum 2.5 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Red Inhibitive Primer #97-48/98 - Minimum 2.5 D.M.T., or
d. an approved equal.

Intermediate Coat:

a. 1 coat - Briners #4817 Versatile Tan Primer - Minimum 3 D.M.T., or
b. 1 coat - Koppers H.B. Epoxy - Minimum 6 D.M.T., or
c. 1 coat - Pittsburgh Polyamide Epoxy Gray High Solids #97/151/159 - Minimum 5 D.M.T., or
d. an approved equal.

Top Coat:

a. 1 coat - Briners ACRA-CLAD (Acrylic Urethane) - Minimum 2.5 D.M.T., or
b. 1 coat - Koppers Polyurethane - Minimum 2.5 D.M.T., or
c. 1 coat - Pittsburgh Pitthane (Polyrethane) - Minimum 2.5 D.M.T., or
d. an approved equal.

Color Coding: Piping shall be color coded as shown on the drawings. When coding is not shown on the drawings, the following shall apply:

Sludge Line	Brown
Gas Line	Red
Potable Water Line	Blue
Non-Potable	White-stenciled "Unsafe Water"
Chlorine Line	Yellow

Sewage Line	Gray
Compressed Air Line	Green
Heating Water Lines for Digesters or Building	Blue with 6" red bands spaced 30" apart

*Dry Mils Thick

8.2 VALVES, FITTINGS, AND PIPES SUBMERGED IN WASTEWATER: (Sandblast "Near White Metal" SP-10 or NACE #2)

Prime Coat: (Applied at the rate recommended by the manufacturer)

a. 1 coat - Briners U #4817 Versatile Tan Primer, 2.5 - 3 D.M.T., or
b. 1 coat - Knoppers 654 Epoxy Prier, 2.5 - 3 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Green Inhibitive Primer #97-49/98, 2.5 - 3 D.M.T., or
d. an approved equal.

Intermediate Coat: (Shall be applied in not less than four (4) hours and not more than fifteen (15) hours after applying the previous coat.)

a. 1 coat - Briners #791 Coal Tar Epoxy - Minimum 8 D.M.T., or
b. 1 coat - Knoppers Bitumastic 300 Coal Tar Epoxy - Minimum 8 D.M.T., or
c. 1 coat - Pittsburgh Coal Tar Epoxy - Coal Cat #97-640/641 Epoxy - Minimum 8 D.M.T., or
d. an approved equal.

Top Coat: (Shall be applied not less than four (4) hours and not more than fifteen (15) hours after applying the previous coat.)

a. 1 coat - Briners #791 Coal Tar Epoxy - Minimum 8 D.M.T., or
b. 1 coat - Koppers Bitumastic 300 Coal Tar Epoxy - Minimum 8 D.M.T., or
c. 1 coat - Pittsburgh Coal Tar Epoxy - Coal Cat 640-641 Epoxy - Minimum 8 D.M.T., or
d. an approved equal.

8.3 VALVES, FITTINGS, AND PIPES SUBMERGED IN POTABLE WATER: (Sandblast "Near White Metal" SP-10 or NACE #2)

Prime Coat:

a. 1 coat - Briners #796 Non-Toxic Primer, Minimum D.M.T., or
b. Koppers - No Primer Required, or
c. Pittsburgh (No system available), or
d. 1 coat - Tnemec 20-1255 "Beige" Pota-Pox Primer - Minimum 3 D.M.T., or
c. an approved equal.

Intermediate Coat:

a. 1 coat - Briners #797 Super Versatile Non-Toxic White - Minimum 4 D.M.T., or
b. 1 coat - Koppers 200 Epoxy - Minimum 6 D.M.T., or
c. Pittsburgh (No system available), or
d. 1 coat - Tnemec 20-1000 "Pota-Pox" - Minimum 4 D.M.T., or
e. an approved equal.

Top Coat: (Should be applied within 48 hours of Intermediate (Coat)

a. 1 coat - Briners #797 Super Versatile Non-Toxic White - Minimum 4 D.M.T., or
b. 1 coat - Koppers 200 HP Epoxy - Minimum 6 D.M.T., or
c. Pittsburgh (No system available), or
d. 1 coat - Tnemec 20-2000 "White" Pota-Pox - Minimum 4 D.M.T., or
e. an approved equal.

9.PAINTING CONCRETE AND MASONRY

9.1 INTERIOR OF CONCRETE WASTEWATER WET WELLS:

Prime Coat: (Applied at the rate recommended by manufacturer)

a. 1 coat - Briners #791 Coal Tar Epoxy - Minimum 8 D.M.T., or
b. 1 coat - Koppers Bitumastic 300-M - Minimum 8 D.M.T., or
c. 1 coat - Pittsburgh Coal Tax Epoxy - Coal Cat #97-640/641 Epoxy - Minimum 8 D.M.T., or
d. Tnemec - No Prime Coat Required, or
e. an approved equal.

Top Coat: (Shall be applied in not less than four (4) hours and not more than fifteen (15) hours after applying the previous coat).

a. 1 coat - Briners #791 Coal Tar Epoxy - Minimum 10 D.M.T., or
b. 1 coat - Koppers Bitumastic 300-M - Minimum 10 D.M.T., or
c. 1 coat - Pittsburgh Coal Tar Epoxy - Coal Cat #97-640/641 Epoxy - Minimum 10 D.M.T., or
d. 1 coat Tnemec 46H413 Hi-Build Tnemec-Tar - Minimum 18 D.M.T., or
e. an approved equal.

The interior epoxy coating of concrete wastewater wet wells must be absolutely free of the slightest pinhole, air pocket, and other imperfections which allow entry of corrosive gasses. The Contractor shall provide all equipment, labor, and materials for testing and repair of pinholes and imperfections. Holiday detection shall be done with a D.E. Stearns Model 14/20 holiday detector.

9.2 INTERIOR - CONCRETE AND CONCRETE BLOCK:

Prime Coat: (Applied as necessary to fill surface to the satisfaction of the Engineer)

a. 1 coat - Briners #4849 Block Sealer, or
b. 1 coat - Koppers Block Sealer, or
c. 1 coat - Pittsburgh Polyamide Epoxy Filler #97-685/686, or
d. 1 coat - Tnemec 54-562 Modified Epoxy Masonry Filler, or
e. an approved equal.

Intermediate Coat:

a. 1 coat - Briners #4800 Series Versatile Polyamide Epoxy - Minimum 2 D.M.T., or
b. 1 coat - Koppers Glamorglaze 200 Epoxy - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Pitt-Glaze Hi Solids Epoxy - Minimum 2 D.M.T., or

d. 1 coat - Tnemec Series 66 Hi-Build Epoxoline - Minimum 2 D.M.T., or
e. an approved equal.

Top Coat:

a. 1 coat - Briners #4800 Series Versatile Polyamide Epoxy - Minimum 2 D.M.T., or
b. 1 coat - Koppers Glamorglaze 200 Epoxy - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Pitt-Glaze Hi Solids Epoxy - Minimum 2 D.M.T., or
d. 1 coat - Tnemec Series 66 Hi-Build Epoxoline - Minimum 2 D.M.T., or
e. an approved equal.

9.3 EXTERIOR - CONCRETE AND CONCRETE BLOCK:

Prime Coat: (Applied as necessary to fill surface to the satisfaction of the Engineer.)

a. 1 coat - Briners #4849 Block Sealer, or
b. 1 coat - Koppers Block Sealer, or
c. 1 coat - Pittsburgh Polyamide Epoxy Block Filler #97-685/686, or
d. 1 coat - Tnemec Series 54-562 Modified Epoxy Masonry Filler, or
e. an approved equal.

Intermediate Coat:

a. 1 coat - Briners #4800 Series Versatile Polyamide Epoxy - Minimum 2 D.M.T., or
b. 1 coat - Koppers Glamorglaze 200 Epoxy - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Polyamide Epoxy Finish - Minimum 2 D.M.T., or
d. 1 coat - Tnemec Series 66 Hi-Build Epoxoline - Minimum 2 D.M.T., or
e. an approved equal.

Top Coat:

a. 1 coat - Briners #4800 Series Versatile Polyamide Epoxy - Minimum 3 D.M.T., or
b. 1 coat - Kopper Glamorglaze 200 Epoxy - Minimum 3 D.M.T., or
c. 1 coat - Pittsburgh Aquapon Polyamide Epoxy Finish - Minimum 3 D.M.T., or
d. 1 coat - Tnemec Series 66 Hi-Build Epoxoline - Minimum 2 D.M.T., or
e. an approved equal.

10. PAINT WOOD SURFACES

10.1 INTERIOR WOODWORK:

Prime Coat:

a. 1 coat - Briners #1600 Enamel Undercoater - Minimum 2 D.M.T., or
b. 1 coat - Koppers 625 Undercoater - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Enamel Undercoat 6-6 - Minimum 2 D.M.T.,

or
d. 1 coat - Tnemec Series 36-603 Undercoater - Minimum 2 D.M.T., or
e. an approved equal.

Intermediate Coat:

a. 1 coat - Briners Duranemal - Minimum 2 D.M.T., or
b. 1 coat - Koppers Ponkote 300 Enamel - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Speedhide 6-252 Series Enamel - Minimum 2 D.M.T., or
d. 1 coat - Tnemec Series 2H Hi-Build - Minimum 2 D.M.T., or
e. an approved equal.

Top Coat

a. 1 coat - Briners Duranemal - Minimum 2 D.M.T., or
b. 1 coat - Koppers Ponkote 300 Enamel - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Speedhigh 6-252 Series Enamel - Minimum 2 D.M.T., or
d. 2 coats - Tnemec Series 2 H Hi-Build - Minimum 2 D.M.T., or
e. an approved equal.

10.2 EXTERIOR WOODWORK:

Prime Coat:

a. 1 coat - Briners Exterior Wood Primer - Minimum 2 D.M.T., or
b. 1 coat Koppers 625 Undercoater - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Speedhide 6-809 Exterior Wood Primer (Mildew Resistant) - Minimum 2 D.M.T., or
d. 1 coat - Tnemec Series 36-603 Undercoater - Minimum 2 D.M.T., or
e. an approved equal.

Intermediate Coat:

a. 1 coat - Briners Acraflex - Minimum 2 D.M.T., or
b. 1 coat - Koppers Rustarmor - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Speedhide 6-800 Series or Speedhike 1-900 Series (Mildew Resistant) - Minimum 2 D.M.T., or
d. 1 coat - Tnemec Series 23 Enduratone - Minimum 2 D.M.T., or
e. an approved equal.

Top Coat

a. 1 coat - Briners Acraflex - Minimum 2 D.M.T., or
b. 1 coat - Koppers Rustarmor - Minimum 2 D.M.t., or
c. 1 coat - Pittsburgh Speedhike 6-800 Series or Speedhike N-900 Series (Mildew Resistant) - Minimum 2 D.M.T., or
d. 2 coats - Tnemec Series 23 Enduratone - Minimum 2 D.M.T., or
e. an approved equal.

11. PAINTING GYPSUM BOARD

11.1 GENERAL INTERIOR - GYPSUM BOARD

Prime Coat:

a. 1 coat - Briners #3400 Acra-Kote - Minimum 2 D.M.T., or

b. 1 coat - Koppers 600 Acrylic Emulsion - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Speedhike 6-2 Latex Sealer - Minimum 2 D.M.T., or
d. 1 coat - Tnemec 51-792 PVA Sealer - Minimum 2

D.M.T., or
e. an approved equal.

Top Coat:

a. 1 coat - Briners #3400 Acra-Kote - Minimum 2 D.M.T., or
b. 1 coat - Koppers 600 Acrylic Emulsion - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Speedhide 6-2 Latex Sealer - Minimum 2 D.M.T., or
d. 1 coat - Tnemec Series 6 Tnemec Cryl - Minimum 2 D.M.T., or
e. an approved equal.

11.2 WASHROOM, SHOWER ROOM, LOCKER ROOM INTERIOR GYPSUM BOARD:

Prime Coat:

a. 1 coat - Briners #4800 Series Versatile Polyamide Epoxy - Minimum 2 D.M.T., or
b. 1 coat - Koppers Glamorglaze Wallboard Primer - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Multiprime 97-684 - Minimum 2 D.M.T., or
d. 1 coat - Tnemec Series 51-792 PVA Sealer - Minimum 21 D.M.T., or
e. an approved equal.

Intermediate Coat:

a. 1 coat - Briners #4800 Series Versatile Polyamide Epoxy - Minimum 2 D.M.T., or
b. 1 coat - Koppers Glamorglaze 200 Epoxy - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Aquapon #97-3/98 - Minimum 2 D.M.T., or
d. 1 coat - Tnemec Series 66 Hi-Build - Minimum 2 D.M.T., or
e. an approved equal.

Top Coat:

a. 1 coat - Briners #4800 Series Versatile Polyamide Epoxy - Minimum 2 D.M.T., or
b. 1 coat - Koppers Glamorglaze 200 Epoxy - Minimum 2 D.M.T., or
c. 1 coat - Pittsburgh Aquapon 97-51/51 - Minimum 2 D.M.T., or

d. 1 coat - Tnemec Series 66 Hi-Build - Minimum 2 D.M.T., or
e. an approved equal.

12. RESPONSIBILITY FOR PAINT SYSTEMS

12.1 The intent of this specification is to provide the Contractor with several manufacturers' paint systems on which to base his bid. The Contractor is responsible for verifying with the paint manufacturer before he purchases any material, that the paint system is suitable for use on this project and that application rates, etc., are in compliance with the manufacturer's recommendations.

13. Measurement and Payment

Painting shall not be measured for pay and shall be subsidiary to other work.

SECTION 113100
FIBERGLASS REINFORCED PLASTIC WETWELL (S-64)

1. DESCRIPTION

This specification shall govern all work necessary for the furnishing of all plant, labor, equipment, supplies, and materials and for performing all operations required to complete the wetwell. The Fiberglass Reinforced Plastic wetwell shall be a one-piece unit of one class, fabricated in a composite laminate to conform to the requirements as set forth in this specification.

2. GENERAL

A. Dimensions: The wetwell shall be a ribbed, circular cylinder of minimum internal diameter as shown in the plans.

(1) Wall component elements: isophthalic polyester resin, fiberglass chopped strand & continuous reinforcements.

(2) Rib component elements: isophthalic polyester resin, Fiberglass chopped strand and woven roving reinforcements.

B. Class: The wetwell shall be manufactured in one class of load rating. This class shall be H-20 wheel load (16,000 pounds dynamio wheel load).

C. Governing Standards: Plastic laminate must meet the conditions of ASTM C582, and the chemical resistance test ASTM C581. Previous tests are acceptable provided laminates are representative.

3. MATERIALS:

A. Resin: Unsaturated isophthalic polyester resins shall be used and they must meet the requirements listed below.

Property	Test Method	Requirements
1.Acid Number	ASTM D 465-59	Maximum = 15
2.Hydroxyl Number		Maximum = 30
3.Solids Content	ASTM D1259-61	Maximum = 50%

The following requirements are determined when testing the resin without any reinforcing material included.

Property	Test Method	Requirements
4. Flexural Strength	ASTM D 790-70	Min. 10,000 psi
5. Flexural E-modulus	ASTM D 790-70	Min.400,000 psi
6. Elongation at rupture	ASTM D 790-70	Min. 22%
7. Heat distortion temp.	ASTM D 648-61	Min. 167EF
8. Weight change after 28 days storing in distilled water	ASTM D 570-63	Max. 150 mg/sample
9. Surface hardness (Barcol)	ASTM D2583-67	Minimum 80% of resin's normal

B. Reinforcement: Reinforcement shall be fiberglass mat, continuous roving, chopped roving and/or roving fabric. The fiberglass shall be type "E" and a finish compatible with the resin used.

The interior surface shall be reinforced layer 0.25 mm to 0.50 mm (10 to 20 mils). Reinforcement materials shall be:

1. Chemically resistant
2. Organic Surfacing veil
3. Asbestos

and they must have a coupling agent which will provide a suitable bond between the reinforcement and the resin.

C. Fillers: Fillers, when used, must not degrade the resin chemical resistant properties as defined in Section 3.A of this specification.

D. Additives: Additives, such as thixotropic agents, catalyst and promoters may be added as required by the specific manufacturing processes used to meet this standard.

E. Laminate: (Cured composite including glass fiber reinforcement.) Cured laminate must meet the following conditions:

	Property	Test Method	Requirements
1.	Glass Content (9% by weight)	ASTM D2584-68	20 + 70 %
2.	Compressive Strength	D 695-69	Min. 12,000 psi
3.	Flexural Strength	D 790-70	Min. 12,000 psi
4.	Flexural E-modulus	ASTM D790-70	Min.700,000 psi
5.	Surface Hardness	ASTM D2583-67	Min. 90% of resin's normal

4. REQUIREMENTS

A. Manufacturer Submitted: The manufacturer shall file with the Engineer the following prior to approval for installation.

1. Detailed design calculation for all structural components of the wetwell.

2. Detailed prototype test procedures and test results to include:

   a. Static Load test for H-20 (16,000 pounds dynamic wheel load incorporating 1.5 impact factor, 1.33 factor of safety with a long term strength retention of 80%.

   b. Deflection test.

   c. Stiffness test.

   d. Soundness test.

   e. Barcol Harness Cure test.

   f. Thickness test.

   g. Chemical Resistance test.

3. Detailed quality control to demonstrate conformance to design values and likeness to prototype wetwell features.

B. Rejection of Wetwells: Wetwells are subject to rejection on account of any of the following visual defects.

1. Fuzz: Glass fibers loosely adhering to manhole which are not wet out with resin.
2. Protruding Fibers: Glass fibers sticking out form pipe surface that are not wet out with resin.
3. Resin Runs: Runs of resin and sand on surface of manhole.
4. Dry Areas: Areas in laminate with glass not wet out with resin.
5. Delamination: Separation in the laminate.
6. Blisters: Light (straw) colored areas resulting form too hot a cure.
7. Craze: Crack usually star shaped; caused by sharp impact.
8. Surface Pits or Voids: Small air pockets on the surface or directly), beneath the surface mat.
9. Wrinkles: Smooth irregularities on the surface.
10. Torn Edges, End Delaminations and End Gouges: Tears and rips in the edge of cuts.
11. Ground Areas: Areas around lap-up which have been abraded and not covered by lay-up.
12. Hand Layup Ragged Edges: Areas at the edge of hand layup that are not rolled down properly and rough.

5. CONSTRUCTION METHODS

A. General: The wetwell installation should follow the manufacturer's recommended installation procedures.

B. Excavation: The Contractor shall do all necessary excavation for the wetwell. Such excavations shall be of sufficient size as to permit the proper installation of the base. All such excavating shall conform to the size and dimensions as shown on the drawings, plus a minimum of three (3> feet to permit working room. Care shall be taken to insure that the excavation is not carried to a greater depth than required. If it becomes necessary to shore the walls of the excavated area, such shoring shall be of two (2) inch material. Shoring shall be braced in such a manner as to insure support of the walls and also permit the installation of the wetwell itself without necessitating the removal of any shoring until such time as the entire manhole is completed. No shoring shall be left or backfilled around, unless authorized by the Engineer. Shoring shall remain in place for at least 24 hours after the masonry or concrete work has been completed.

C. Backfilling: The backfilling around the outside of wetwell shall commence as soon as practical but not until approval is given by the Engineer. All forms, sheeting, shoring, bracing etc., shall be removed as backfilling is accomplished. Such backfill shall be placed in layers of not more than 6 inches and mechanically tamped to a minimum 95% standard proctor density.

6. MEASUREMENT AND PAYMENT

Work provided for by this item shall be measured by each individual structure built, and paid for at the unit price bid per each, of the size, type specified, complete in place, and meeting the approval of the Engineer. "Complete in

place" shall mean all labor, materials, equipment necessary to furnish and install the wetwell.

SECTION 113120
WET WELL VENTILATION SYSTEM (S-113)

1. Description

This specification shall govern all materials and work necessary for wet well ventilation system required to complete the project.

2. Materials

1. Duct: PVC Pipe ASTM D3034, DR 35 or 41, solvent joint

2. Fasteners: 316 Stainless steel

3. Exhaust Fan: 550 CFM at .25 inches of water

The exhaust fan shall be sidewall mounting, centrifugal belt driven type. The fan shall be designed for use in a corrosive environment of hydrogen sulfide and be constructed of fiberglass, stainless steel and other such materials required for the application. The fan wheel and inlet cone shall be of the centrifugal blower type. The fan wheel shall be of non-overloading, backward inclined type, statically and dynamically balanced. Blades, find, inlet cones and back plates shall be securely fastened together for rigid assembly. Fan wheels and shaft seals shall be rated non-sparking in accordance with standards of the Air Movement and Control Association.

Motors and drives shall be isolated from the exhaust airstream. Electric motors, wiring, controls, and monitors shall meet NEC requirements for Class 1, Division 1, Group D hazardous areas. Motors shall be of heavy duty type with permanently lubricated, sealed ball bearings. Air for cooling the motor shall be taken into the motor compartment by means of an air tube from a location free of discharge contaminants. The entire drive assembly and wheel, as a unit, shall be removable thru the support structure without dismantling the fan housing. The wheel shaft shall be mounted in heavy duty, permanently lubricated, sealed ball bearing pillow blocks. Drives shall be sized for 165% of driven horsepower. Pulleys shall be keyed securely to the fan and motor shafts. Motor pulleys shall be of the adjustable type to allow for final balancing.

3. Submittals:

The contractor shall submit 5 sets of detailed drawings and specifications and parts lists for the engineer's review and approval.

4. Measurement and Payment:

Unless specifically included in the proposal, work and materials for the ventilation system shall not be measured for pay but shall be subsidiary to other pay items.

SECTION 113130
CHLORINATION SYSTEM (S-19)

1. DESCRIPTION

This specification shall govern all work required to furnish and install the chlorination system as required to complete the project.

2. GENERAL

This specification describes an "Advance gas feeder manufactured by Capital Controls Company of Colmar, Pennsylvania. The gas feeder shall be the Model 203 ADVANCE Gas Feeder and shall be of the vacuum operated, solution feed type. The gas feeder shall have a maximum capacity of 500 pounds per day of chlorine gas feed and shall be equipped with two remote mounted gas flowmeters of 300 pounds of gas feed per day. The gas feeders shall mount directly on the gas manifold valve by means of a positive yoke type, gasket connection and shall be provided with a gas valve direction indicator.

3. DESIGN

The gas feeder design shall provide for conveying the gas under vacuum from the vacuum regulator to the ejector-check valve assembly to insure complete system safety. The gas feeder design shall permit the entire system to be vacuum checked in the field without using special tools or manometers. The gas feeder shall be constructed of materials specially selected for wet or dry gas services. All springs used in the gas feeder shall be of a tantalum alloy for chlorine. The rate valve and seat shall be constructed of fine silver. A double thickness diaphragm shall be provided for vacuum regulation.

The rate of gas feed shall be set manually and shall remain constant until manually changed. A differential pressure regulator shall not be required for gas flow control.

The gas feeder shall be convertible to automatic control by insertion of a motorized control valve in the vacuum line to receive a signal from appropriate control equipment.

4. COMPONENTS

Feeder

The gas feeder shall be comprised of the following: vacuum regulator or indicating meter, panel mounted dual gas flow meters with two manual rate valve, pressure relief valve, two ejector-diffuser assemblies, gas supply indicator, (manifold).

Vacuum regulator

The vacuum regulator shall mount directly on the gas valve by means of a positive yoke type, gasket connection. Vacuum shall be controlled by a spring opposed diaphragm regulator which shall close tight upon loss of vacuum. The regulator shall be equipped with a gravity actuated, loss of gas indicator, and gas flowmeter.

Gas Flowmeters and Rate Valves

The gas flowmeters with solid silver rate valves and solid silver seats for chlorine shall be mounted on a chemical resistant panel for wall mounting. The gas flowmeter(s) shall indicate the flow of gas to a minimum of 1/20 maximum feed.

Relief Valve
Pressure will be prevented from building up in the system by means of a spring loaded, diaphragm actuated pressure relief valve located at the vacuum regulator. The gas shall vent at the vacuum regulator.

Ejector-Diffusers
Two ejector-diffuser assemblies shall receive all gas and ejector water nd discharge the resulting solution to the points of application. the ejector shall be equipped with a check valve which will prevent water from backing up into the vacuum regulators. A loss of water supply shall automatically shut-off the gas flow. Ejector shall have 1" inlet and outlet.

Supply Indicator
The gas feeder shall be equipped with a gravity actuated device, directly connected to the main control diaphragm, to indicate when gas supply is exhausted.

Valve Direction Indicator
A gas valve direction indicator shall be provided with each gas feeder.

Manifold (For Eight Cylinders)
The manifold shall be (horizontally) oriented and constructed of 3/4" schedule 80 Grade A, types, seamless carbon steel pipe per ASTM A-106 and forged steel 3000 lb. CWP fitting per ASTM A-105, and shall include a drip leg with heater, header valve for mounting the gas feeder, and flexible connectors for connection to eight gas cylinders.

Electrical
Power supply to the drip leg heater shall be (120 VAC, 60 Hz) single phase.

Electrical conduit and wire shall extend from the proposed chlorine building to the power source in the adjacent sludge pump building. Wire shall be size 12 TWR minimum.

Portable Building
A 6' x 6' x 7' portable chlorine building with cabinet shall be furnished and installed at location indicated in plan.

Mask
A chlorine gas mask shall be furnished.

Chlorine cylinders
Eight 100 lb. cylinders of chlorine shall be furnished by the City and installed by the Contractor.

Miscellaneous components
Gate valves, gages, Y-type strainers and connections shall be corrosion resistant and designed for exterior use. PVC pipe shall be schedule 80 unless indicated otherwise in drawings.

5. OPERATION MANUAL

The chlorinator supplier or manufacturer shall provide five copies of an operation manual to the City. Each manual shall include but not be limited to the following items.

a. Schematic diagram of entire chlorinator system.

b. Parts and assemble diagram with parts numbers for ordering.
c. Operations and maintenance procedures and schedule.

6. WARRANTY

The City shall be supplied with a written one year warranty against defective chlorination equipment from the manufacturer and supplier.

7. MEASUREMENT AND PAYMENT

Measurement of the chlorination system shall be made as a lump sum. Measurement shall include but not be limited to, all chlorination equipment, filter water supply lines, diffuser lines, fitting, chlorine building, mask, four chlorine cylinders, mounting brackets, valves, gages, and strainers.

Payment shall be made at the unit price bid and shall fully compensate the contractor for all equipment, labor, materials and other incidental required for furnishing and installing the chlorination system.

SECTION 132010
Ground Storage Tank for Water
(Bolted Steel)

1. DESCRIPTION

This specification shall govern all work necessary for furnishing and installing the factory-coated (galvanized) bolted steel tank for water storage required to complete the project.

2. GENERAL

The project shall consist of furnishing and erecting a 750,000-gallon potable water storage tank on concrete foundation. The tank shall have a nominal diameter of 73 feet with a 24’ height. The tank shall have a minimum of 1:12 outward draining coned roof and a steel bottom. The tank shall be complete with all pipe connections, access openings, nozzles, taps, drains, ladders, vent. The Contractor to provide designs for tank and concrete foundation. All foundation design work shall performed by a registered professional engineer, licensed to practice in the state of Texas. The tank design shall be accompanied by a certification attested by the manufacturers design engineer that the design meets all TNRCC, AWWA, and NSF requirements.

3. MATERIALS

The tank shall meet all requirements of AWWA D103-97, NSF 61, and Title 30 Texas Administrative Code, Chapter 290.43. All metal components, hardware and accessories shall be galvanized. Zinc metal suitable for immersion in drinking water shall be applied to the parts after fabrication in accordance with the recommended practices of the American Hot Dip Galvanizers Association in compliance with ASTM 123 and ASTM 153.

4. DESIGN DATA

The following information shall be used as a basis for design and erection of the tank and appurtenances.

TANK CAPACITY – 750,000 gallons
DIAMETER – about 73 feet
HEIGHT – about 24 feet
OVERFLOW HEIGHT – 23’ 6” or match existing overflow height
SEISMIC ZONE – 0
CONTENTS – potable water
WIND LOAD – 125 mph
OVERFLOW – 7,000 gpm
DRAWDOWN – 10,000 gpm for vent

5. ACCESSORIES

Shell manway shall be near bottom of shell ring, and be shown in the shop drawings submitted by the Contractor.

Provide inlet connection, outlet connection and overflow and drain outlet and show in submittal drawings.

Provide a 1-inch NPT tank connection for sampling and show in submittal drawings.

Overflow pipe shall be internal and external with internal weir with a minimum capacity of 7,000 gpm and shown on drawings.

Ladder shall be galvanized steel and be provided with a backguard safety cage and a lockable anti-climb assembly.

Steel handrail (top catwalk) shall be provided between exterior ladder and manways thru the roof, and between ladder and the screened vent. The handrail shall enclose a 100 square foot landing area at the manway. The handrail shall be capable of supporting 100 lb/ft lateral loading.

A 24″ pressure-vacuum screened vent shall be provided on the roof. The vent shall have openings that facilitate removal of screen. The screen shall be 316 stainless steel with a minimum size of 24″ x 24″ x .018 wire mesh insect screen.

A separate pressure-vacuum relief valve/mechanism shall be provided which will operate in the event screens become clogged over with foreign material, and designed for 10,000 gpm draw-down.

The tank roof shall have two curbed; upward opening 30″ square-opening lockable hatch located near the ladder and over the overflow weir. The curb shall extend 4″ above the tank and have a 2″ overlap with cover and gasket.

A pressure gage shall be mounted on the tank shell about 3″ from the bottom. The gage shall be calibrated in feet of water and have a full-scale reading between 25 and 30 feet.

Gaskets and sealant shall meet AWWA, FDA, NSF61, AND EPA standards for potable water. Bolted connections shall incorporate a prefabricated gasket. Neoprene backed washers or approved equal shall be at all bolts/nuts in contact with the stored water.

6. SUBMITALS

Shop drawings (6 sets) shall be submitted for review and approval of the City of Corpus Christi prior to fabrication. The shop drawings shall be submitted on 24″ x 36″ drawings and include sufficient data to show that the tank and accessories conform to the requirements of the specifications. A professional engineer licensed in the state of Texas shall prepare and design the foundation, and associated appurtenances. The shop drawings shall include all erection drawings, accessories and foundation.

Submit mill test on steel plate and structural members demonstrating that the physical and chemical requirements of the specifications have been met.

7. CONSTRUCTION

Erection of the tank shall done in accordance with the manufacturer’s recommendation. Particular care shall be exercised in handling and

bolting the tank plates, supports, and members to avoid abrasion or scratching the coating. Prior to placing water in the tank, a coating inspection of the entire tank will be performed. Touch-up coating in accordance with the manufacturer's recommendations shall be done where needed. The tank manufacturer's rep shall certify in writing to the City that the tank installation meets all manufacturers' requirements for installation.

8. CLEANING, DISINFECTION, INSPECTION & TESTING

Piping shall be pressure tested per 026202 the standard specs and disinfected per 026402 of the standard prior to testing tank.

The City shall provide water for initial test.

Cleaning and disinfection of interior surfaces shall be performed by the Contractor in accordance with AWWA C652. Disinfection shall be done with sodium hypochlorite (15% available chlorine) by Chlorination Method 3. After removal of all foreign material, all interior surfaces shall be thoroughly cleaned using a high-pressure water jet. All water dirt and foreign material accumulated in the cleaning operation shall be discharged from the tank. Approximately 1 foot (30,000 gallons) of potable water shall be added to the cleaned tank after which sodium hypochlorite shall be added to the water in the tank such that a chlorine concentration in water would be 50 mg/l when the tank is filled to 5% of the total storage volume (37,500 gallons). Approximately 13 gallons of sodium hypochlorite solution (15% available chlorine) shall be added to the 30,000 gallons of water in the tank. Add an additional 7,500 gallons of water in the tank to achieve 5% of the volume of the tank or a depth of 1.2 feet. This solution shall held in the tank for not less than 6 hours. The tank shall then be filled to the overflow level by adding potable water to the concentrated solution. The tank shall be held full for not less than 24 hours. The water shall then be tested for coliform organisms by the Water Department.

If no leaks are observed at the end of the 24 hour holding period and satisfactory bacteriological testing and aesthetic quality water quality are achieved, the water in the tank may be incorporated into the distribution system, provided that the free chlorine residual is between 2 and 4 mg/l.

The City shall provide water for initial test. If the water is contaminated such that it can not be reincorporated into the distribution system, the Contractor shall be responsible for properly disposing of it and pay for the additional water.

9. MEASUREMENT & PAYMENT

Unless indicated otherwise in the proposal, Factory-Coated (Galvanized) Bolted Steel Tanks for water shall be measured as individual units. Payment shall include furnishing, erecting, testing, disinfecting, the completed tank, complete with foundation, piping and valving, and site preparation and shall compensate for all materials, labor, equipment, and incidentals required to complete the work.

SECTION 150620
PLUMBING (S-90)

1. DESCRIPTION

This specification shall govern all work necessary for the installation of plumbing required to complete the project.

2. MATERIALS

Pipe shall be hot-dipped galvanized steel water pipe schedule 40.

Fittings shall be threaded type using galvanized malleable iron fittings. All joints shall be coated with an appropriate epoxy and up to 3 inches of the adjoining pipe, after installation.

Pipe Supports shall rigidly support pipe to concrete bulkhead. Clamps shall be galvanized steel with an epoxy coating applied both before and after installation. Perforated strap hangers will not be permitted.

Water Faucet shall be 3/4" hose connection, rough brass, T-handle and of good quality.

3. PERMITS AND BUILDING CODES

The Contractor shall be responsible for obtaining plumbing permit and work shall comply with applicable requirements of the City.

4. CONSTRUCTION METHODS

(1) Handling Materials

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. The interior of all pipes shall be kept free from dirt and foreign matter. All materials found during the progress of work to have defects will be rejected, and the Contractor shall remove such defective material from the site.

(2) Sterilization

Fittings: Valves and fittings shall be kept clean. Where soil or other substances come in contact with the water surface of the fittings, the interior shall be washed and sterilized with 2% solution of calcium hypochlorite.

Pipe: As each joint of pipe is placed the contractor, unless specified otherwise by the Engineer, shall throw powered calcium hypochlorite (70%) through the length of the joint. (One pound for each 1680 gallons of water to give 50 mg./1.) After the line is assembled, it shall be slowly filled with water and allowed to stand for 48 hours. After sterilization is completed, lines shall be flushed. The Engineer will take a sample test 2 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 with and 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 fee of $100 paid by the Contractor to the City for each retest that is required.

(3) Hydrostatic Testing Water System

See Section 026202 Hydrostatic Testing of Pressure System.

5. MEASUREMENT

Unless specified otherwise in the special provisions, measurement shall be made as follows:

Pipe will be measured by the linear foot along the centerline for each size of pipe installed. Measurement shall be up to but not include the fittings.

Fittings will be measured as individual units for each type and size installed.

6. PAYMENT

Payment shall include but not limited to all materials, labor, equipment, support clamps, testing, sterilization, and all other incidentals necessary to complete the job.

SECTION 151010
GATE VALUES (S-103)

1. DESCRIPTION

This specification shall govern all work required to furnish gate values required to complete the project.

2. GENERAL

All values comply with AWWA C-500 or C-905. Values shall be designed for a minimum 150 psi working pressure service with gate open. Valves shall have an unobstructed waterway of a diameter of not less than the full nominal diameter of the valve. Valves shall be of vertical mount, conventually packed stem, non-rising stem with spur gear and grease case, iron body, bronze mounted, double disk, parallel seat or resilient type gate valves furnished with 125 lb. flanged ends, valve position indicator, and clockwise close. Prior to shipping, the contractor shall submit five sets of detailed drawings and specifications and maintenance instructions for the Engineer's review and approval.

3. PAINTING

Valves shall be painted in accordance with Section 099020.

4. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Gate Valves shall not be measured and are considered subsidiary to the appropriate bid item.

SECTION 151020
CHECK VALVES (LEVER & WEIGHT OPERATION) (S-104)

1. DESCRIPTION

This specification shall govern all work necessary to furnish the check valves required to complete the project.

2. GENERAL

The check valves shall be in accordance with AWWA C508 and prevent the return of fluid through the valve upon pump shut-off. It shall be Muller Type A-2600-6-01 or approved equal. It shall have a heavy cast, iron body with bronze clapper disc seated by a bronze clapper arm against a bronze seat ring. The clapper shall be secured to a stainless steel shaft which turns in bronze bushings. The valve shall have 125 lb. flanged ends. The valve shall be of lever and weight operation. Prior to shipping, the contractor shall submit five sets of detailed drawings, specifications, installation instructions and maintenance instructions for the Engineer's review and approval.

3. FIELD SERVICE

The manufacturer's field representative shall check the instal- lation, adjust valves and be on-hand for initial start-up of the system.

4. PAINTING

See Section 099020.

5. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, check valves shall not be measured and will be considered subsidiary to the appropriate bid item.

SECTION 151030
ECCENTRIC PLUG VALVES & ELECTRIC MOTOR ACTUATORS (S-105)

1. DESCRIPTION

This specification shall govern all work required for furnishing eccentric plug valves & electric actuators required to complete the job.

2. MATERIALS

Plug valves shall be of the tight closing resilient faced, non-lubricated variety and shall be of eccentric design such that the plug rises off the seat contact area during shaft rotation while opening and closing valve. In the closed position the plug shall press firmly into the seat for a dead-tight shutoff. Valves shall be drip-tight rated at pressures up to 175 p.s.i. through 12" and 150 p.s.i. for larger. The valve closing member should rotate approximately 90 degrees from open to closed position.

Valve body - cast iron ASTM A 126, Class B
End style - flanged
Seat - 304 stainless steel or nickel
Bearings - stainless steel
Plug - cast iron
Resilient facing - Buna N or Fluorinated Hydrocarbon
Packing - Buna Vee
Actuator - electric motor

Electric motor modulating valve actuator shall comply with AWWA C540 and the following:

Rotation - 90 degree reversible
Torque rating - for 125 p.s.i. differential
Cycle time - less than 100 seconds
Duty - 15 minutes continuous
Manual operation - integral with declutching device
Hand switch - integral 5 position to permit local operation
Mechanical stops - internal to prevent over travel
Gearing - for 30 to 60 second opening/closing
Auxiliary limit switches - 4 SPDT: 2 full open, 2 full closed
Heater - 8 watt minimum
Control wiring - 120 VAC, 1 phase, 60 Hz
Equipment actuator with zero and span adjustments
Provide actuator with a field set choice of valve position on loss of signal
Submersible design required

Electrical Characteristics:
Power: 120 VAC. 1 phase, 60 Hz
Rating: NEMA 4

Local Control:
Push button station equipped with:
Remote/local switch
Position indication lights
Reversible, intermittent contact
Close - stop - open switch
Contact closure for remote/local indication where indicated in schedule
Enclosure - NEMA 4
Mounting – at inflow and outflow valves adjacent to tank

Manual Operation:

Type: Handwheel, lever, or (operating nut required below ground unless specified otherwise).

General:
Comply with AWWA C504
Maximum torque at 80 lb. input
Worm gear for handwheel operation
Totally enclosed worm gear

3. SUBMITTALS

The Contractor shall submit 5 sets of detailed drawings and specifications and maintenance instruction for the Engineer's review and approval, prior to construction.

4. SUPPORT FROM MANUFACTURER

Field Service: The equipment manufacturer shall furnish the services of a qualified factory field service engineer at the site to inspect the installation and instruct the City's Wastewater personnel of the operation and maintenance of the unit.

O&M Manual: The manufacturer shall furnish the Engineer with 4 sets of complete operation and maintenance manuals (including wiring diagrams).

5. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the proposal, plug valves shall not be measured for pay but shall be subsidiary to other work.

SECTION 151040
SURGE RELIEF VALVES (S-106)

1. DESCRIPTION

This specification shall govern all work necessary for providing surge relief valves required to complete the project.

2. MATERIALS

Valves shall be full metal body, mechanical pinch type with flange joint ends on both the body and flexible sleeve. Port areas shall be 100% of the full pipe area at the valves' ends. The valve area shall be 100% of the full pipe area through the entire length of the valve.

Integral flanges shall be drilled and tapped to ANSI B16.1 Class 125 standard.

The pinch valve shall be one piece construction with integral flanges drilled to be retained by the flange bolts. The pinch tube shall be reinforced with nylon. The pinch tube shall be connected to the pinch bar by rubber tabs embedded in the tube reinforcing ply. All internal valve metal parts are to be isolated from the wastewater by the flexible elastomer pinch tube.

The steel mechanism shall be double-acting, closing the pinch tube, sleeve, from both the bottom and the top. The mechanism shall be supported in the valve body. The pinch mechanism shall be adjustable on line. The mechanism shall be connected to the cylinder actuator by a stainless steel stem.

A cylinder housing shall fully enclose the spring. The cylinder assembly shall be mounted on the valve body by means of an open yoke. The spring shall be externally adjustable for set pressure.

The yoke shall be used to limit swishes, stem position indicator, and accessories.

The valve shall normally be closed. The valve will be factory set at and easily adjusted in the field. Valve shall meet the following:

Valve Size: 2"
Factory set cracking pressure: 40 PSI

3. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the Proposal, Surge relief valves shall not be measured for pay, but shall be considered subsidiary to other work.

SECTION 151050
SHEAR GATE (S-107)

1. DESCRIPTION

This specification shall govern all work required to furnish shear gates required to complete the project.

2. GENERAL

Shear gates shall be full opening, circular port, iron body, with a bronze seat (both body ring and gate ring) and furnished with a spigot end unless indicated otherwise on the plans. The body, gate and wedges shall be cast iron conforming to ASTM A-126 Class B. The valve shall be furnished with 2 wedges bolted to the body which may be replaced due to wear. The gate shall pivot on a bronze hinge pin. The bronze gate seat ring shall be machined to a smooth finish. The body seat ring shall be bronze, threaded and screwed into place and be machined to a smooth finish. The shear gate shall be furnished with an adjustable stop on wedge to prevent jamming gate to seat. Shear gates shall be furnished and installed with lifting handles as indicated on the plans.

3. PAINTING

Valves and lifting handles shall be painted in accordance with Section 099020.

4. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the proposal, Shear Gates shall not be measured and are considered subsidiary to the appropriate bid item.

SECTION 151060
FLAP GATE (DRAINAGE) (S-76A)

1. Description

This specification shall govern all materials and work required for furnishing and installing flap gates required to complete project.

2. Materials

Frame Ring and Slide Cover

The frame ring and slide cover shall be cast iron with machined seating faces. A cast iron flap (cover) shall be domed construction and have machined seating faces, or have a resilient rubber seal permanently bonded in a groove and be flush with the surrounding cast iron seat face. The flap cover shall be attached to the slide cover in such a manner as to allow full opening of the cover and prevent jamming of the cover in the open waterway. Flap seat shall be inclined from the vertical a minimum of 2 2E. Flap cover hinge linkage shall be galvanized steel structural. Pivot points in flap cover shall be bronze bushed. Hinge bolts shall be stainless steel. Assembly hardware and structural steel shall be galvanized. Flap gates shall be Waterman Drainage, Model FC-10 or approved equal.

Frame Ring, Flap Cover
Cast Iron - ASTM A-126, Class B

Structural Steel - ASTM A-36 - Galvanized per ASTM A-123

Assembly Hardware and Fasteners
Steel - ASTM A-307 - Galvanized per ASTM A-153 & ASTM A-123

Paint
Manufacturer's Standard

3. Construction

The frame shall be secured to the concrete with four (4) 3/4" x 6" Type 304 stainless steel bolts and nuts.

A 3" Schedule 40 Galvanized Steel Pipe & Assembly shall be provided and installed for each gate a required to secure the gate in a normally open position. The 3"pipe shall be grouted into the 4" sleeve with a lean sand cement grout. The galvanized steel hooking device shall be secured to the gate. The assembly shall be adjusted as necessary.

4. Measurement & Payment

Unless indicated otherwise in the Proposal, Flap Gates shall not be measured for pay, but shall be considered subsidiary to other work.

SECTION 151502
ULTRASONIC DOPPLER FLOWMETER AND RECORDER (S-118)

1. DESCRIPTION

This specification shall govern all work necessary for furnishing and installing ultrasonic doppler flowmeters and recorders required to complete the project.

2. GENERAL

The flowmeter shall be ultrasonic of the doppler type for measuring flow rate in full pipes, and shall display instantaneous flow rate and shall have a totalizer and shall be capable of transmitting a signal to a Z-fold chart recorder. Flowmeter shall be POLYSONICS Model UFM84 with options specified below, or approved equal.

3. QUALIFICATIONS

The manufacturer shall have instruments of the Doppler type and configuration measuring flow in domestic wastewater for a minimum of eight years. The Contractor shall submit a suitability certification signed by both the manufacturer and the Contractor stating that the manufacturer has reviewed the plans and specifications and the equipment to be supplied will comply with the specifications and will function properly after installed.

4. EQUIPMENT

TRANSDUCERS: The electronic flow sensing device shall be mounted to the outside of the carrier pipe and be capable of removal without interruption of flow. Electrodes in contact with the liquid are not acceptable. The transducers shall be of the crystal type--one to transmit, the other to receive. The transducers shall be designed to operate in temperatures up to 320E F. The dual-head transducers shall be self-aligning with mount strap to be provided by the manufacturer.

CALIBRATION: The flowmeter calibration shall be capable of being changed to different flow ranges on 1" through 72" pipe without replacement of any components or flow sensing assembly.

ARMORED ASSEMBLY: The sensing element shall be supplied as a armored assembly with a jacketed flexible cable of sufficient length and shall be interchangeable between without recalibration of metering system.

SOLID-STATE: The sensing element shall be solid-state and the transformer isolated and designed to meet special requirements. The receiver circuit shall be double high-Q staged. The transmit circuit shall be cable length adjustable to permit transmit power to flow sensor cables up to 100 feet long.

RESPONSE: The flowmeter shall respond to flow rates as low as .2 feet per second when flow stream is nearly clean or contains particles and/or bubbles.

ENCLOSURE: The transmitter-indicator shall be housed in a NEMA 4X enclosure with gasketted shatterproof windows for meter viewing. The housing shall be front hinged for easy access for controls and be suitable for wall mounting.

FLOWMETER ELECTRONICS: The flowmeter electronics shall be designed to operate at temperatures between -10E and 140E F. All electronic

circuits shall be interchangeable with other flowmeters of the same model number. All electronic circuits shall be coated with an anti-fungus compound. The transmitter circuit and calibration frequency standard shall be crystal controlled. The transmitter shall be powered by 120 VAC at 50/60 Hz requiring less than 10 watts. Circuitry shall have automatic bleeds for lightning protection.

FILTER: An AC power line noise filter and voltage surge protector shall be provided.

SIGNAL LOSS PROTECTION: A signal strength meter and/or loss of signal indicator shall be provided. Output shall be driven to zero upon loss of signal.

DAMPING: The transmitter circuitry shall employ dual stage damping to detect flow variations and automatically change time constants to track the actual flow change for steady chart readings and smooth flow control.

ADJUSTMENTS: The transmitter shall include adjustments for range calibration, mA span, mA zero, output signal damping and AGC sensitivity.

CALIBRATION PANEL: The transmitter shall contain a calibration panel with switch and vernier dial directly calibrated in velocity units over a range of 0-1 Ft/Sec through 0-40 Ft/Sec. Dial resolution shall be in increments of .01 Ft/Sec.

CALIBRATION CHECKING DEVICE: A built-in calibration checking device shall be provided. This internal frequency standard shall consist of an on-board frequency device and separate reference frequencies. The manufacturer shall supply a multi-point flow calibration curve.

CURRENT OUTPUT: The 4-20 mA output shall be proportional to flow and isolated. The maximum resistive load shall be 600 ohms. Output current limiting circuitry shall be provided.

DIGITAL DISPLAY OF FLOWMETER: The transmitter shall contain a digital display of flow rate. The digital display shall be calibrated in gallons per minute.

CROSSTALK: The transmitter shall contain electronic means to allow crosstalk from other in-service sonic flowmeters of the same manufacturer.

RECORDER-TOTALIZER: The recorder shall be Z-fold 4" chart recorder with 3 continuous writing pins. The recorder-totalizer shall be a digital type to receive the 4-20 ma signal from two independent transponor assemblies. The signal from the two sources shall be integrated to display the total flow from the lift station by the third pen. The digital display will only display the instantaneous flows.

5. OPERATING CONDITIONS

GENERAL REQUIREMENT: The job will require that flow be measured at two locations by two separate transponder assemblies. The instantaneous flow at each location shall be independently displayed. The recorder-totalizer shall display the combined flow from the two locations.

10" PIPE CONNECTION AT LAGUNA SHORES:

Liquid to be measured: domestic sewage
Flow range: 0-1,200 GPM
Pipe: 10" ductile iron class 50 with
40 mil polyethylene lining
Diameter: OD=11.10".44" ID=10.44"
Transducer cable length: 55 feet

16" PIPE CONNECTION AT LAGUNA SHORES:
Liquid to be measured: domestic sewage
Flow range: 0-3,800 GPM
Pipe: 16" ductile iron class 50 with
40 mil polyethylene lining
Diameter: OD=17.40" ID=16.64"
Transducer cable length: 65 feet

6. INSTALLATION

STORAGE OF MATERIALS: The Contractor shall be responsible for the proper storage of equipment and materials.

PLACEMENT: The transducers shall be mounted to the pipes in the fiberglass manholes. The flowmeter and recorder-totalizer units shall be mounted on the wall of the control room of the lift station. Cables shall be installed in 1" PVC conduit along side the pipe for underground installation and in 1" aluminum conduit mounted to the exterior wall of the valve vault and interior wall of the existing structure for above-ground installation.

CALIBRATION AND INITIAL OPERATION: The equipment supplier shall provide the services of a qualified field representative to calibrate and set up equipment as required for proper operation. After the system is functioning properly, the equipment supplier shall prepare a final report to be submitted by the contractor to the engineer. The final report shall address any revisions or modifications which are not consistent with the original submittals for the equipment. Four copies of the report shall be submitted as part of the 0&M Manual.

7. MEASUREMENT AND PAYMENT

Unless indicated otherwise in the proposal as bid item, providing and installing of ultrasonic doppler flowmeter and recorder shall not be measured for pay but shall be considered subsidiary to other work.

SECTION 151620
SUBMERSIBLE PUMPS FOR WASTEWATER (S-114)

1. DESCRIPTION

This specification shall govern all work necessary for furnishing, installing, and placing into operation the submersible pumps with accessories required to complete the project.

2. GENERAL

Pumps shall be designed and constructed to pump raw unscreened sanitary sewage and capable of passing 3" diameter spheres. Design of mounting system shall facilitate removal and inspection of pumps. There shall be no need for personnel to enter wet well for inspection and maintenance of pumps. Lifting chain, guide rails and mounting system shall be provided and installed for each pump. Pumps shall be designed, built and installed in accordance with best available technology and practice, and shall operate satisfactorily when installed.

3. WARRANTY

The pump manufacturer shall furnish the City with a written guarantee to warrant pumps and components against failure due to defective materials and workmanship for a period of 5 years after full operation and acceptance by the City. The warranty shall include 100% coverage of manufacturer's shop labor and parts for the first year, then 50% coverage through the 5th year. Pumps repaired under warranty shall be returned to the City's Wastewater Department with freight prepaid.

4. QUALIFICATIONS OF BIDDER

4.1 Manufacturer & Supplier: The submersible pumps and accessories, with the possible exception of the discharge connection assembly which shall be Flygt or compatible, for each lift station shall be furnished by a single manufacturer/supplier who is fully experienced, reputable and qualified in the manufacturer of the pumps to be furnished.

4.2 Prebid Submittals: General The Contractor shall obtain tentative approval of the submersible pumps prior to bidding the project. Tentative approval does not relieve the Contractor of the responsibility of providing and installing pumps that will comply with all sections of these specifications and that will function properly. To obtain tentative approval for bidding, the Contractor shall submit the following pre-bid submittals at least 3 weeks prior to the bid opening. Failure to obtain tentative approval shall be considered grounds for rejection of bid.

Suitability Certification

The Contractor shall submit a certification stating that the manufacturer's authorized representative for the pumps has studied the Contract Documents (plans and specs), evaluated conditions affecting these pumps, and certifies that they should be suitable for the application and should required no more than normal maintenance if not damaged or abused. The certification shall state that the proposed pumps are suitable for the application and will function as intended and will comply with all requirements of this specification, with the exception of those listed in the certification. The certification shall be

signed by the Contractor and the Manufacturer's authorized representative. If the equipment is approved for use on the project and is found at any time to have unlisted exceptions, the Engineer shall have the right to reject the equipment or require the Contractor to bring the equipment into compliance at no cost to the City.

Pump Data

The Contractor shall furnish certified pump curves showing the results of test pumping units of identical design, size, and horsepower as those to be furnished. Catalog curves are not acceptable. Graphs shall include:

1. Pump Curve - Q in GPM, H in FEET
2. Power Input Curve - KILOWATT
3. Efficiency Curve (including motor) wire to water
4. N.P.S.H. Curve
5. Model, Impeller size, serial number
6. Motor rated HP, Voltage
7. Date and place of test
8. Customer for whom test was conducted
9. Data in English units (gallons, feet, etc.)

5. MATERIALS

5.1 Pump Construction:

General

Major parts, including lifting cover, stator casting, volute, and impeller, shall be ASTM 48, Class 30 gray cast iron. All nuts, bolts, washers, and fastenings shall be of 316 stainless steel. Ferrous metal surfaces coming into contact with wastewater shall be protected with a coating of rubber-asphalt paint.

Power Cable

The motor power cable shall consist of well insulated cable with a double jacketed system, Hypolon outside, synthetic rubber inside, exceeding industry standards for oil, gas, and sewage resistance and shall be permanently marked with the indicated code. Sizing shall conform to NEC specifications for pump motors and shall be of adequate size to allow motor voltage conversion without replacing the cable. Each pump shall be installed with a sufficiently long power cable to suit the installation as shown on the drawings without splicing.

Power Cable Entry

The cable entry seal shall insure a watertight and submersible seal. The cable entry shall be comprised of a single cylindrical elastomer grommet flanked by a stainless steel washer, all having close tolerance fit against the cable and compressed by the entire body containing a strain relief function, separate from the function of sealing. A separate junction chamber shall provide for connection of the cable to the stator power leads. The junction chamber shall be separated from the motor stator housing by a terminal board which is bolted to a machined surface using an o-ring seal. Stator leads shall also be sealed to prevent moisture from entering the motor interior.

Impeller

The impeller shall be of non-clog design, capable of handling solids fibrous

material, sludge, etc. with long thoroughfare having no acute angles and shall be dynamically balanced. The impeller shall be class 30 gray cast iron, coated with a ceramic coating to provide wear resistance to particle erosion caused by sands and silts typically found in sewage. The coating shall have a minimum thickness of .05". The fit between the shaft and impeller shall be a sliding fit with one key. Fastening of the impeller to the shaft shall be by a locking assembly which is sealed from the liquid by a protective rubber cap and a bolt threaded to the shaft end.

Volute

The volute shall be single piece gray cast iron and shall have a replaceable wear ring.

Wear Rings

Stainless steel wear rings shall be fitted to the volute and the impeller.

Discharge Connection

Each pump shall be supplied with a coupling, ANSI 125 cast iron, which bolts to the discharge flange, if other than Flygt. The floor mounted discharge elbow shall be compatible with the Flygt model specified as follows:

At Laguna Shores	CP 3201
At Riviera	N/A use existing

No part of the pump shall bear directly of the sump floor and no rotating motion of the pump shall be required for sealing. Sealing at the discharge shall be effected by metal to metal contact of the pump discharge flange and the mating discharge connection either with or without a replaceable rubber seal form fitted to the machine discharge coupling to insure a positive leak proof system and for ease of removal of the pump.

Bearings

Pumps shall be equipped with three lubricated bearings, one upper and two lower. The upper shall restrain radial thrust and be of the single row roller type. The two lower shall consist of one roller for radial thrust and one angular contact for axial thrust. Bearings shall have a minimum design life of 40,000 hours.

Lower Bearing Temperature Sensor

Pumps with motors larger than 60 HP shall have a lower bearing temperature sensor to monitor the lower bearing temperature, unless the bearings are lubricated with circulating force fed oil.

Shaft

The shaft shall be of large one piece design and extend through the pump and motor. The shaft shall be constructed of stainless steel, unless the entire shaft is not exposed to the pumped liquid, in which case the shaft may be C1034 carbon steel.

Shaft Seals

Shaft seals shall have lapped tungsten carbide faces. The seal system shall

allow continuous pump operations with the exterior completely dry. The seal assemblies shall not require adjustments, shall be easily inspected, shall be easily replaceable and shall not require operating pressure differential for sealing.

Guide Brackets

A guide bracket shall be Flygt compatible and shall allow raising and lowering of the pump in the wet well without binding with the guide rails. No special adjustment shall be necessary to assure proper alignment. Guide brackets shall be cast iron or stainless steel.

Motor

The pump motor shall be integral to the pump for submersible or dry well operation. The motor shall be squirrel cage induction type with class F insulation, NEMA B design, class H slot liners with a service factor of 1.15 or above. The dual voltage copper wound stator, which will allow field change-ability of voltage, shall be triple dipped in epoxy enamel or varnish to withstand a heat rise of 155E C as defined in NEMA Standard MG-1. The NEMA starting code shall be F or less. The motor shall be statically and dynamically balanced. The motor shall be designed for continuous operation at 400E C ambient air and be capable of up to 10 starts per hour.

Stator Temperature Sensor

Stator temperature sensors switch shall be embedded in the stator windings and shall be used to stop the motor when the stator temperature exceeds 155E C. The motor shall resume operation when the stator cools to 150E C.

Cooling System

Motors shall have a forced convection type of cooling system.

5.2 Accessories:

General

Pump, accessories, controls, rails, hardware, etc. shall be furnished by the pump manufacturer. The pump manufacturer shall be responsible for the coordination and compatibility of accessories. The accessories shall be warranted against defects and corrosion by the manufacturer for five years after final acceptance of the project.

Lifting Chain

A lifting chain assembly shall be provided and installed for each pump. The chain and shackle shall be of 316 stainless steel and have a minimum working load of two times the pump weight. The chain shall be secured to the pump with the shackle and to the access cover with a hook. A five foot length of excess chain shall be suspended at the hook to facilitate the lifting of the pump.

Access Covers

Access covers and frames shall be of aluminum. The door panels shall be 1/4" thick diamond plate designed to withstand a live load of 150 lbs, per square foot. The door shall be provided with stainless steel hinges with tamper-proof fasteners. All hardware shall be stainless steel. The door shall open to 90E

and automatically lock in that position with a stainless steel positive locking arm and release handle. The door shall close flush with the top of the frame.

Guide Rails

Guide rails shall be schedule 40 type 316 stainless steel pipe of suitable diameter. The rail shall be held in position with upper, intermediate (if bar exceeds 20' in length) and lower guide bar brackets. The upper guide bracket shall be stainless steel and designed to allow simple removal and replacement of guide bar without entering the wet well. The intermediate bracket shall be of stainless steel and be installed about midway between the upper and lower bracket.

Float Cable Rack (not applicable for doppler controls)

A stainless steel cable rack shall be provided and attached to the upper frame. The rack shall support the level control float cable.

Power Cable Supports

Stainless steel power cable supports, Kellum type, shall he used for power cables to all motors. The supports shall be attached to eyebolts bolted into the concrete on the side of the access opening.

Hardware

All nuts, bolts, fasteners, fabricated metal, etc. shall be Type 316 stainless steel.

5.3 Electrical Controls:

The pump supplier and the Contractor shall provide for proper control operation and protection. The electrical control panels for the pumps shall be supplied to the Contractor by the pump supplier to assure component compatibility. See drawings for electrical equipment to be supplied.

5.4 Preconstruction Submittals

Pump Data (same as prebid submittal)

The Contractor shall furnish certified pump curves showing the results of test pumping units of identical design, size, horsepower as those to be furnished. Catalog curves are not acceptable. Graphs shall include:

1. Pump Curve - Q in GPM, H in Feet
2. Power Input Curve - KILOWATT
3. Efficiency Curve (including motor) wire to water
4. N.P.S.H. Curve
5. Model, Impeller size, serial number
6. Motor rated HP, Voltage
7. Date and place of test
8. Customer for whom test was conducted
9. Data in English units (gallons, feet, etc.)

Parts List and Specifications

A comprehensive list of all station accessories and pump components, listing

material type shall be submitted for the Engineer's review and approval.

Shop Drawings

Shop drawings of station accessories and pump components and connections shall be submitted for the Engineer's review and approval.

Supplemental Construction Details

The construction drawings depict the approximate locations of pumps and access covers. Supplemental drawings depicting the precise locations of anchor bolts, pump mounting system, access covers, guide rails, etc. will be required for the type of pump to be used. These supplemental drawings shall be prepared by the pump supplier and submitted by the Contractor to the Engineer for documentation of the project. The supplier shall be responsible for completeness and accuracy of shop drawings and any applicable revisions, as required to successfully complete the construction.

Wiring Diagrams

See construction Drawings for wiring diagrams.

6. OPERATING CONDITIONS

Pump Sequences

0 & 1 pump alternating:

#1 0 #2 0 #3 0 #4 0 #1 0 #2 0

----one----cycle----

1 & 2 pumps alternating:

#2 #3 #4 #1 #2

#1 #2 #2 #3 #3 #4 #4 #1 #1 #2

----one----cycle----

2 & 3 pumps alternating:

#3 #4 #1 #2 #3

#2 #3 #3 #4 #4 #1 #1 #2 #2 #3

#1 #2 #3 #3 #3 #4 #4 #1 #1 #2

----one----cycle----

Control Settings

Elev.	Rising	Descending
-5.80	Alarm On	
-6.05	P_1 + P_2 + P_3 on	

-6.15 P_1 + P_2 on P off

-6.40 P_1 + on P off

-6.75 Min. W.S. P off

-8.25 Bottom of Sump

Pump Operating Conditions

Pump Discharge Size: 8"
Max. Head Condition:
1220 GPM @ 105' TDH, Minimum Total Efficiency 57%
* 1185 GPM @ 105' TDH, Minimum Total Efficiency 57%
1173 GPM @ 105' TDH, Minimum Total Efficiency 57%
Mid. Head Condition
1824 GPM @ 85' TDH, Minimum Total Efficiency 60%
* 1771 GPM @ 85' TDH, Minimum Total Efficiency 60%
1753 GPM @ 85' TDH, Minimum Total Efficiency 60%
Min. Head Condition
2226 GPM @ 69' TDH, Minimum Total Efficiency 57%
2162 GPM @ 69' TDH, Minimum Total Efficiency 57%
2140 GPM @ 69' TDH, Minimum Total Efficiency 57%
Total Efficiency = combined pump and motor
Max. RPM: 1750

6.2 Riviera Lift Station: (three pumps required)

Pump Sequences

0 & 1 pump alternating:

#1 0 #2 0 #3 0 #1 0 #2 0

----one----cycle----

#2 #3 #1 #1

#1 #2 #2 #3 #3 #1 #1 #2

----one----cycle----

Control Settings

Elev.	Rising	Descending
-5.80	P_1 + P_2 + P_3 on + Alarm	
-6.00	P_1 + P_2 + on	P_3 off
-8.25	P_1 on	P_2 off
-10.00	Min. W.S. P_2 off	
-12.25	Bottom of Sump	P_1 off

Pump Operating Conditions

Pump discharge Size: 6"
Max. Head Condition: 613 GPM @ 67' TDH, Tot. Eff. 45%
Mid. Head Condition: 989 GPM @ 51' TDH, Tot. Eff. 54%
Min. Head Condition: 1100 GPM @ 46' TDH, Tot. Eff. 53%
Total Efficiency = Wire to Water Efficiency
MAX. RPM: 1750

Discharge Connection

The three discharge connections that are currently in place are designed to accept Flygt Model CP3152 Pump Impeller 432 with 8" discharge.

7. CONSTRUCTION METHODS

7.1 Delivery and Storage of Materials:

Parts and equipment shall be properly protected so that no damage or deterioration will occur during transport and during storage. Factory assembled components shall not be dismantled, unless done so under the supervision of the authorized pump manufacturer.

7.2 Installation:

General

Installation of the pumps shall be in strict accordance with the manufacturer's instructions and recommendations.

Placement of Pumps and Accessories

The location of the discharge piping is shown on the construction drawings. The location of the pumps, access covers, and discharge connection are approximate. The precise placement and alignment of anchor bolts, discharge assembly guide rails, access cover and associated connections shall be in accordance with supplemental construction details provided by the pump manufacturer. The manufacturer shall check alignment during start up field testing. Improper alignment shall be corrected prior to continuation of testing.

7.3 Start-up Inspection

Installation Inspection

After the pumps have been completely installed and wired, the Contractor shall remove the pumps to the deck of the wet well and the pump manufacturer shall:

a. Megger stator and power cables
b. Check seal lubrication
c. Verify proper rotation
c. Check power supply voltage
e. Measure motor no load current

Operating Check

After initial inspection, the Contractor shall lower pumps into pumping position and confirm proper alignment and connection. The service representative shall then perform an initial operation check of each pump including:

a. Motor current with discharge valve closed
b. Motor current with discharge valve open
c. Power supply voltage with 1, 2, 3, ... pumps running
d. Vibration
c. Check level control and sequence

8. FINAL SUBMITTALS

8.1 Inspection Report: (four copies required)

The results of the Installation Inspection and Operating Check shall be submitted as a written report of findings and data determined with regard to the pumps, motors, level control, sequence, accessories, electrical, etc. The report shall be prepared and signed by a Registered Professional Engineer employed or retained by the pump manufacturer.

8.2 Manual: (included with Inspection Report)

The Operation and Maintenance Manual shall be included with the Inspection Report with one manual for each of the four copies of the report. The O&M Manual shall include a minimum of the following:

1. Service Location & phone
2. Fact Sheet (pump data)
   - Serial No.
   - Pump Curve
3. Maintenance instructions & schedule
4. A shop service manual
5. An assembly manual showing all parts by their catalog number for ordering

8.3 Spare Parts:

Unless it can be demonstrated that local parts and service have been available through the same financially sound firm on a continuing basis for at least 10 years, the spare parts listed below must be furnished with the pumps at no additional costs to the City.

Spare Parts: (For each type of pump)

Impeller		Service Tools
Upper mechanical seal		Wear ring
Lower mechanical seal		Cable entry assembly
Complete set of o-rings and gaskets	Power Cable	
	Set of bearings	

9. MAINTENANCE TRAINING WORKSHOP

The equipment manufacturer shall conduct an 8 hour training workshop under the direction of a qualified factory field service representative. The workshop shall be conducted both at the job site and at a training room provided by the Wastewater Department.

10. MEASUREMENT AND PAYMENT

Pumps and accessories shall not be measured for pay but shall be subsidiary to the appropriated bid item.

SECTION 151630
PROPELLER PUMPS (S-38)

1. DESCRIPTION

This specification shall govern all work required for furnishing, installing and placing into operation the propeller pumps required to complete the project.

2. GENERAL

Pumps shall be designed for handling pre-treated domestic wastewater and suitable for high volume and low head operation. Pumps shall be single stage, 12", vertical, water lubricated, propeller type. Each pump shall include a bowl assembly, column, open line shaft, and above ground discharge head. Pumps shall be Fairbanks Morse 12" Model 8211, 1770 RPM, with B-1369.5 vane or approved equal. Three pumps shall be required.

3. PUMP CONSTRUCTION

Bowl Assembly

Pumps bowls shall be flanged, and free from sand and blow holes. The suction bell shall have a flared inlet with a grease packed lower bearing. It shall be fitted with guide vanes to minimize entrance losses. A sand cap shall be provided to prevent entrance of sand into the suction bell bearing. Suction bowls shall be provided without a strainer.

The discharge bowl shall be provided with a bearing immediately above the propeller and a connector bearing above the diffuser vanes. A discharge bowl bearing by-pass shall be provided in the bearing cavity for drainage and pressure relief.

Propellers shall be statically and dynamically balanced.

Pump shaft shall be 1.44" diameter. Propeller shall be attached to the pump shaft by longitudinal key ways and annular keyways fitted with snap rings to prevent axial movement.

Column and Bearing Retainer

Column shall be threaded, size 12" diameter, with butt joint connections weighing 43.77 lbs./ft. A 6 1/8" long sleeve type column coupling, with an O.D. of 13 7/8" shall be used to connect the column pieces. Non-revolvable lineshaft bearings pressed into stationary bearing retainers and clamped between column butt joint connections shall be provided.

Line Shaft (Open)

Line shaft shall be a minimum diameter of 1" size per ANSI - B 58.1 and shall provide satisfactory operation without excessive vibration or distortion and furnished in sections of uniform length not exceeding 10 feet. Bearings shall be lubricated with pump fluid. The lineshaft shall be coupled with threaded steel shaft couplings machined from solid bar stock. A replaceable lineshaft sleeve having a maximum diameter of 1 1/8" shall be provided at each lineshaft bearing journal.

Discharge and Packing Box

The discharge elbow shall be of the above ground configuration and shall

terminate in a 125 lb. ANSI cast iron flange with tapped holes. The pump mounting plate shall be 33 3/4" x 33 3/4" to cover an opening which will permit the withdrawal of the complete pump unit. Thickness shall be 1" and designed to adequately support the entire pump and assembly during operation. The discharge assembly shall have a 162" BD and be designed to provide a mounting surface for the electric motor as provided in "Electrical Equipment" of the standard specification. The assembly shall have adequate space for the maintenance of the shaft sealing arrangement. An open lineshaft packing box rated for a minimum working pressure of 175 PSI shall be provided. A packing box bushing, arranged for grease lubrication of the packing shall be provided. A packing gland shall be provided to compress packing. A shaft slinger shall be provided to prevent pumped fluid from traveling up the shaft into the driver.

4. PUMP MATERIALS

All materials designated are ASTM unless otherwise noted and are for description of chemistry.

Bowl Assembly

DESCRIPTION	MATERIAL	SPECIFICATION
Snap Ring	Stainless Steel	A564-(632)
Column Pipe	Steel	A120
Shaft Coupling	Steel	AISI-C1215
Pump Shaft	416 Stainless Steel	A582-416
Discharge Bowl	Cast Iron	A48-CLASS 30
Discharge Bowl Bearing	Bronze	B505-(932)
Intermediate Bowl Bearing	Bronze	B505-(932)
Intermediate Bowl	Cast Iron	A48-CLASS 30
Cap Screw	Steel	SAE Bolt Steel
Nut	Steel	SAE Bolt Steel
Propeller	Bronze	B145-(836)
Suction Bell	Cast Iron	A48-CLASS 30
Suction Bell Bearing	Bronze	B505-(932)
Companion Flange	Cast Iron	A48-CLASS 30
Capscrew	Steel	SAE Bolt Steel
Nut	Steel	SAE Bolt Steel
Connector Bearing	Bronze	B505-(932)

Column and Lineshaft

DESCRIPTION	MATERIAL	SPECIFICATION

Lineshaft	Steel	AISI-1045
Column	Steel	A120
Bearing Retainer	Bearing	B145-(836)
Lineshaft Bearing	Rubber	Neoprene
Snap Ring	Cadmiumm Plated Steel	SAE 1060-1090
Column Pipe	Steel	A 120
Lineshaft Sleeve	Stainless Steel	AISI-304
Tapered Bottom Column Pipe	Steel	A283-Grade D
Shaft Coupling	Steel	AISI-C1215
Pump Shaft	Stainless Steel	A582-416
Connector Bearing	Bronze	B505-(932)

Discharge and Packing Box

DESCRIPTION	MATERIAL	SPECIFICATION
Adjusting Nut	Steel	A108-12L14
Water Slinger	Rubber	Neoprene
Above Ground Discharge Head	Cast Iron	A48-CLASS 30
Pipe Plug	Cast Iron	A48-CLASS 30
Gland Stud	Brass	Common Bolt Brass
Gland Nut	Brass	Common Bolt Brass
Packing Box Gland	Bronze	B145-(836)
Packing Box Gasket	Tag Board	D1170-G3111
Top Shaft Sleeve	Stainless Steel	AISI-304
Packing	Graphite Filled Asbestos	
Column Flange Gasket	Tag Board	D1170-G3111
Packing Box	Cast Iron	A48-CLASS 30
Packing Box Bushing	Bronze	B505-(932)
Top Column Flange	Cast Iron	A48-CLASS 30
Top Shaft	Steel	AISI-1045
Top Column	Steel	A120
Top Enclosing Tube Bearing	Bronze	B145-(836)
Top Enclosing Tube	Steel	A120

Underground Elbow	Steel	A283-Grade D, A120
Enclosing Tube Adapter	Cast Iron	A48-CLASS 30
Pedestral	Steel	A283-Grade D, A120
Enclosing Tube Tension Nut	Bronze	B145-(836)
Base Plate	Steel	A283-Grade D
Motor Adapter Plate	Steel	A283-Grade D

5. OPERATING CONDITIONS

At Wet Well Water Surface Elevation of 14.0

4100 GPM @ 11.0' TDH* with 65% efficiency

At wet well water surface elevation 8.0
3750 GPM @ 16.0' TDH* with 74% efficiency

*TDH does not include losses for

(1) 10 feet of column pipe
(2) Discharge elbow
(3) Mechanical friction of 10' of lineshaft

6. OPERATION OF PUMPS

General

Control panel and liquid level sensors shall be in accordance with "Electrical Materials" in the standard specification.

Pump Sequence

Water Surface Elevation	Pumping Status
7.0	All Pumps off
9.0	Submersible on
12.0	Submersible off and lead on
14.0	Lag on and alarm on

7. - WARRANTY

The pump manufacturer shall provide the City with a written one year warranty against defective pump and assembly.

8. - MANUAL

The pump supplier or manufacturer shall provide five copies of an operations manual for the pumps. Each manual shall include but not be limited to the following items:

a. Certified pump curve for each pump
b. Parts and assembly diagram with part numbers for ordering
c. Maintenance schedule and procedures
d. General operations

9. - MEASUREMENT AND PAYMENT

Measurement for propeller pumps shall be made as a lump sum and shall include but not be limited to all three propeller pumps and assembly complete in place.

Payment shall be made at the unit price bid and shall fully compensate the Contractor for all equipment, labor, materials, and incidentals required for furnishing and installing pumps and assembly.

SECTION 151640
SUBMERSIBLE GRINDER PUMPS FOR WASTEWATER
(LESS THAN 10 HORSEPOWER)

1. DESCRIPTION

This specification shall govern all work necessary for furnishing, installing, and placing into operation, heavy duty submersible grinder pumps capable of grinding sewage into a finely ground slurry for ease in pumping.

2. GENERAL

Pumps shall be designed and constructed to grind and pump raw unscreened sanitary sewage without clogging. Design of wetwell systems shall facilitate removal and inspection of pumps. Lifting cables shall be provided and installed for each pump. Pumps shall be designed, built and installed in accordance with best available technology and practice, and shall operate satisfactorily when installed. Each pump unit, with its appurtenances, shall be capable of continuous duty underwater without loss of watertight integrity to a depth of 65 feet.

3. WARRANTY

The pump manufacturer shall furnish the City with a written guarantee to warrant pumps and components against failure due to defective materials and workmanship for a period of 5 years after full operation and acceptance by the City. The warranty shall include 100% coverage of manufacturers shop labor and parts for the first year then 50% coverage through the 5th year. Pumps repaired under warranty shall be returned to the City's Wastewater Department with freight prepaid.

4. QUALIFICATIONS OF BIDDERS

The submersible pumps and accessories, shall be furnished by a single manufacturer/supplier who is fully experienced, reputable and qualified in the manufacture of the pumps to be furnished. The manufacturer/supplier shall also maintain provisions for providing parts and/or service within 48 hours of notification by the owner.

5. MATERIALS

A. General:
Major parts including lifting cover, stator casting, volute, and impeller shall be ASTM 48, Class 30 gray cast iron. All nuts, bolts, washers, and fastenings shall be of 316 stainless steel. All metal surfaces other than stainless steel or brass coming into contact with wastewater shall be protected with a coating of rubber-asphalt paint, or other water proof coating approved by the Engineer.

B. Power Cable:
The motor power cable shall consist of well insulated cable with a double jacketed system, Hypolon outside, synthetic rubber inside, exceeding industry standards for oil, gas, and sewage resistance, and shall be permanently marked with the indicated code. Sizing shall conform to NEC and ICEA specifications for pump motors. Each pump shall be installed with a sufficiently long power cable to suit the installation as shown on the drawings without splicing.

C. Power Cable Entry:

The cable entry seal shall insure a watertight and submersible seal. The cable entry shall be comprised of a single cylindrical elastomer grommet flanked by a stainless steel washer, all having close tolerance fit against the cable and compressed by the entire body, containing a strain relief function, separate from the function of sealing. A separate junction chamber shall provide for connection of the cable to the stator power leads. The junction chamber shall be separated from the motor stator housing by a terminal board which is bolted to a machined surface using an O-ring seal. Stator leads shall also be sealed to prevent moisture from entering the motor interior. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

D. Impeller and Grinding System:
The grinding system shall consist of a rotating cutter of chrome alloyed cast iron and a stationary cutter of 316 "L" hardened stainless steel. Cutting systems with plastic components or coatings shall be unacceptable. The impeller shall be of the multi-vane, semi-open type of cast iron ASTM A 48-76 Class 30B, and shall be fastened to the pump-motor shaft by a tapered collet and locking screw. All mating surfaces of the pump and motor housings shall be machined and fitted with nitrile o-rings where watertight sealing is required. Machining and fitting shall be such that sealing is accomplished by controlled compression of the o-rings without the requirement of specific torque limits to achieve compression. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered adequate nor equal.

E. Bearings:
Pumps shall be equipped with two permanently lubricated bearings, one upper and one lower. The upper shall restrain radial thrust and be of the single row ball type. The lower shall consist of a two row angular contact ball bearing. Bearings shall have a minimum design life of 40,000 hours.

F. Shaft:
The shaft shall be of one piece design and extend through the pump and motor. The shaft shall be constructed of stainless steel.

G. Shaft Seals:
Each pump shall be provided with a tandem mechanical shaft seal system. The upper of the tandem set of seals shall operate in an oil chamber. The upper seal shall contain one stationary carbon ring and one positively rotating ceramic ring. The lower of the tandem set of seals shall consist of a stationary ring and a positively driven rotating ring. Both rings shall be constructed of ceramic on pumps smaller than 3.0 horsepower. On pumps of 3.0 horsepower and larger, the stationary ring shall be constructed of ceramic and the rotating ring constructed of tungsten carbide.

H. Motor:
The pump motor shall be integral to the pump for submersible or dry well operation. The motor shall be a squirrel cage induction type with class F insulation, NEMA B design, with Class H slot liners and a service factor of 1.15 or above. The stator shall be triple dipped in epoxy enamel or varnish to withstand a heat rise of 155° C as defined in NEMA standard MG-1. The NEMA starting code shall be F or less. The motor shall be statically and dynamically balanced. The motor shall be designed for continuous operation at 40° C ambient air temperature and be capable of up to 10 starts per hour. The pump motor(s) shall be furnished for operation with 230 volts, 1 phase, 60 hertz power supply.

I. Motor Overload Protection:
Motors shall have a forced convection type of cooling system. In addition, thermal radiators (cooling fins), integral to the stator housing, shall be adequate to provide the cooling required by the motor at the maximum rated power of this unit. A minimum of two thermal sensors shall be imbedded in the stator winding and coils. The thermal sensors shall be wired to the control panel and wired in series so that the opening of either sensor will cause the motor to shut down. Thermal sensors and controls which average the temperature across the phases of the winding and coils will not be acceptable. Stator temperature sensor switches shall stop the motor when the stator temperature exceeds 155° C. The motor shall resume operation when the stator cools down to 150° C.

J. General Accessories:
Pump accessories, controls, hardware, etc. shall be furnished by the pump manufacturer. The pump manufacturer shall be responsible for the coordination and compatibility of all accessories. The accessories shall be warranted against defects and corrosion by the manufacturer for five years after final acceptance of the project.

K. Lifting Cable:
A lifting cable assembly shall be provided and installed for each pump. The cable and shackle shall be of 304 stainless steel and have a minimum working load of twice the pump weight. The cable shall be secured to the pump with the shackle and to the access cover with a hook. A four foot length of excess cable shall be suspended at the hook to facilitate the lifting of the pump.

L. Access Covers:
Access covers and frames shall be of aluminum. The door panels shall be diamond plate finish and designed to withstand a live load of 300 lbs per square foot. The door shall be provided with stainless steel hinges with tamperproof fasteners. All hardware shall be stainless steel. The door shall close flush with the top of the frame and shall have lockable hardware installed.

M. Float Cable Rack:
A cable rack fabricated of type 304 stainless steel shall be provided and attached to the access cover frame. The rack shall have provisions for holding in place and supporting the level control float cables.

N. Power Cable Supports:
Stainless steel power cable supports (Kellums Grip) shall be used for all power cables. The supports shall be attached to eye bolts bolted into the side of the access opening, or other support approved by the Engineer. Supporting the power cables on the cable rack will not be acceptable.

O. Hardware:
All nuts, bolts, anchor bolts, wedge anchors, and other hardware (including nuts and bolts for pipe fittings) shall be minimum grade type 304 stainless steel.

P. Electrical Pump Controls:
The electrical control panels for the pump(s) shall be supplied to the Contractor by the pump supplier to assure component compatibility. The pump supplier and Contractor shall provide for proper control operation and protection. The control panel shall be factory wired and tested prior to shipment. The control panel shall include but is not limited to the following:

1. Incoming power, neutral, and ground lug connections

2. Thermal magnetic circuit breakers for motor and control circuits

3. Magnetic starters with overload protection for each motor phase with manual reset

4. Magnetic starter shall meet NEMA requirements and shall be sized as required for the motor horsepower

5. 115 volt control power

6. Hand-off-automatic (HOA) selector switches with red running lights

7. High level alarm light, weatherproof, vaportight, with red globe, 100 watt

8. Run time meter for each pump

9. Space heater with thermostat and on/off switch

10. Terminal blocks as required for connection of pump and level sensor cables

Q. Enclosure:
All components shall be housed in a NEMA 3R fiberglass enclosure. The enclosure shall have a minimum of two stainless steel latches. A stainless steel piano hinge shall extend the full length of one side of the enclosure door. The enclosure shall be provided with pad-locking capability. Enclosures shall be mounted as shown in the plans or as called for elsewhere in the specifications.

R. Float Switches:
Float switches installed for the grinder pump systems shall consist of epoxy encapsulated, single pole, heavy duty, mercury tilt switches housed in a non-corrosive PVC float body. The float switches shall be internally weighted and wired directly into the pump control panel. They shall also be UL listed and CSA certified.

6. PRECONSTRUCTION SUBMITTALS

A. Pump Data:
The Contractor shall furnish certified pump curves showing the results of test pumping units of identical design, size, and horsepower as those to be furnished. Catalog curves are not acceptable. Graphs shall include:

1. Pump Curve with Q in GPM and H in feet

2. Power input curve in kilowatts

3. Efficiency curve (including motor), wire to water

4. N.P.S.H. curve

5. Pump model, impeller/grinder model, serial numbers

6. Motor rated horsepower and voltage

7. Date and location of test

8. Customer for whom test was performed

9. Data in English units

10. NEC Code letter

B. Parts List and Specifications:
A comprehensive list of all station accessories and pump components, listing material type shall be submitted for the Engineer's review and approval.

C. Shop Drawings:
Shop drawings of station accessories and pump components and connections shall be submitted for the Engineer's review and approval.

D. Supplemental Construction Details:
The construction drawings depict the approximate locations of pumps and access covers. Supplemental drawings depicting the precise locations of anchor bolts, pump mounting systems, access covers, etc. will be required for the type of pump to be used. These supplemental drawings shall be prepared by the pump supplier and submitted by the Contractor to the Engineer for documentation of the project. The supplier shall be responsible for completeness and accuracy of shop drawings and any applicable revisions, as required to successfully complete the construction.

E. Wiring Diagrams:
Wiring diagrams shall also be prepared and submitted by the Contractor/Supplier to the Engineer for review and project documentation.

7. PUMP OPERATING CONDITIONS

The proposed pump installation shall be designed to operate at approximately 40 GPM and 73 feet of head, and approximate the characteristics of the Flygt model M-3085 pump with 23 horsepower motor in 1 phase, 230 volt operation, and No. 257 (high head) impeller.

8. CONSTRUCTION METHODS

A. Delivery and Storage of Materials:
Parts and equipment shall be properly protected so that no damage or deterioration will occur during transport or storage. Factory assembled components shall not be dismantled, unless done so under the supervision of an authorized pump manufacturer representative.

B. Installation:
Installation of the pumps shall be in strict accordance with the manufacturer's instructions and recommendations. The location of the discharge piping is shown on the construction drawings. The location of the pumps, access covers, and discharge connection are approximate. The precise placement and alignment of anchor bolts, discharge assemblies, access covers, etc., shall be in accordance with supplemental construction details provided by the pump manufacturer.

C. Installation Inspection:
Prior to completing installation (but after wiring of the pump(s)), the Contractor shall:

1. Megger pump motor stator and power cables

2. Check seal lubrication

3. Verify proper pump rotation

4. Check power supply voltage

5. Measure pump motor no load current

D. Operating Check:
After initial inspection the Contractor shall lower the pump(s) into pumping position and confirm proper alignment and connection. The Contractor shall then perform an initial operation check of each pump including:

1. Motor current with discharge valve closed

2. Motor current with discharge valve open
3. Power supply voltage with pump(s) running

4. Vibration

5. Check level control and sequence

9. FINAL SUBMITTALS

A. Inspection Report:
The results of the Installation Inspection and Operating Check shall be submitted as a written report of findings and data determined with regard to the pumps, motors, level controls, sequences, accessories, electrical, etc. The report shall be prepared by the Contractor/Supplier and three copies submitted to the Engineer for review and approval.

B. Operation and Maintenance Manual:
The Operation and Maintenance Manual shall be included with the Inspection Report with one manual for each of the three copies of the report. The O & M manual shall include a minimum of the following:

1. Service location & phone number

2. Fact sheet with pump data such as serial number and pump curves

3. Maintenance instructions and schedule

4. Shop service manual

5. Assembly manual showing all parts by catalog number

10. MEASUREMENT AND PAYMENT

Submersible Grinder Pumps and accessories shall not be measured and paid for directly, but shall be considered subsidiary to the various other bid items unless indicated otherwise in the Contract Documents or Plan Details.

SECTION 161001
ELECTRICAL MATERIALS (S-18)

1. DESCRIPTION

This specification shall govern all work required for furnishing and installing electrical equipment required to complete the project.

2. GENERAL

The contractor shall install electrical equipment in accordance with the National Electric Code Requirements.

The contractor may incorporate existing electrical control panel, conduit and other electrical materials into the project provided that it is in compliance with the drawings and approved by the Engineer.

The contractor may substitute materials of equal or superior quality provided that they are approved by the Engineer.

Motors

Each of the three pumps shall be driven by a vertical hollow shaft 25 HP, 1800 RPM Motor of squirrel cage, induction, normal starting torque, low starting current type of NEMA Design B. Each shall be of the weatherproof type with Class A-1 insulation and provided with non-reverse ratchets. Each motor shall be provided with strip heaters suitable for 120 volt single phase current. All name plates shall be of stainless steel. The motor shall be designed for operation on three phase, sixty hertz, 480 volt power. Motor shall be totally enclosed, fan cooled.

3. MEASUREMENT AND PAYMENT

Measurement shall be made as a lump sum for all electrical equipment furnished and installed by the contractor.

Payment shall fully compensate the contractor for all materials supplied and incidental storage and handling.