

Section 02630**STORM SEWERS****1.0 GENERAL****1.01 SECTION INCLUDES**

- A. Storm sewers and appurtenances.
- B. References to Technical Specifications:
 - 1. Section 01200 – Measurement and Payment Procedures
 - 2. Section 01350 – Submittals
 - 3. Section 01450 – Testing Laboratory Services
 - 4. Section 03300 – Cast-in-Place Concrete
 - 5. Section 02255 – Bedding, Backfill, and Embankment Materials
 - 6. Section 02318 – Excavation and Backfill for Utilities
 - 7. Section 02415 – Augering Pipe or Casing for Sewers
 - 8. Section 01140 – Contractor’s Use of Premises
 - 9. Section 02629 - Safety End Treatments
- C. Referenced Standards:
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM C 76, “Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - b. ASTM C 443, “Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets”
 - c. ASTM C 506, “Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe”
 - d. ASTM C 877, “Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections”
 - e. ASTM C 507, “Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe”
 - f. ASTM C 655, “Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe”
 - g. ASTM D 3350, “Standard Specification for Polyethylene Plastic Pipe and Fittings Materials”
 - h. ASTM C 1433, “Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers”
 - i. ASTM B 633, “Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel”
 - j. ASTM A 760, “Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains”

2. American Association of State Highway and Transportation Officials (AASHTO)

1.02 MEASUREMENT AND PAYMENT

- A. Measurement for storm sewers is on a linear foot basis taken along the center line of the pipe from center line to center line of manholes or from end to end of culverts, measured and complete in place. Separate measurement will be made for each type and size of pipe installed.
- B. Payment for storm sewer includes pipe, earthwork, connections to existing manholes and pipe, accessories, equipment and execution required are incidental to storm sewer work.
- C. Refer to Section 01200 – Measurement and Payment Procedures.

1.03 SUBMITTALS

- A. Make Submittals required by this Section under the provisions of Section 01350 – Submittals.
- B. Submit manufacturer's literature for product specifications and installation instructions.
- C. Submit product quality, material sources, and field quality information in accordance with this Section.

1.04 TESTING

- A. Testing and analysis of product quality, material sources, or field quality shall be performed by an independent testing laboratory provided by the Owner under the provisions of Section 01450 – Testing Laboratory Services and as specified in this Section.

1.05 QUALITY ASSURANCE

- A. The condition for acceptance will be a storm sewer that is watertight both in pipe-to-pipe, box-to-box joints and in pipe-to-manhole connections and in box connections.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's recommendations.
- B. Handle pipe, fittings, and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks or trailers. Materials cracked, gouged, chipped, dented, or otherwise damaged will not be approved for installation.
- C. Store pipe and fittings on heavy timbers or platforms to avoid contact with the ground.
- D. Unload pipe, fittings, and specials as close as practical to the location of installation to avoid unnecessary handling.
- E. Keep interiors of pipe and fittings completely free of dirt and foreign matter.

2.0 PRODUCTS**2.01 MATERIAL**

- A. Materials for storm sewers shall be of the sizes and types indicated on the Plans.
- B. Materials for pipe and fittings, other than those specified or referenced, may be considered for use in storm sewers.
- C. For consideration of other materials, submit complete manufacturer's data including materials, sizes, flow carrying capacity, installation procedures, and history of similar installations to Engineer for pre-bid evaluations, if allowed, or as a substitution.

2.02 REINFORCED CONCRETE PIPE

- A. Circular reinforced concrete pipe shall conform to requirements of ASTM C 76, for Class III wall thickness. Joints shall be rubber gasketed conforming to ASTM C 443.
- B. Reinforced concrete arch pipe shall conform to the requirements of ASTM C 506 for Class A-III. Joints shall conform to ASTM C 877.
- C. Reinforced concrete elliptical pipe, either vertical or horizontal, shall conform to the requirements of ASTM C 507 for Class VE-III for vertical or Class HE-III for horizontal. Joints shall be rubber gaskets conforming to ASTM C 877.
- D. Reinforced concrete D-load pipe shall conform to the requirements of ASTM C 655.

2.03 PRECAST AND CAST-IN-PLACE REINFORCED CONCRETE BOX SEWERS

- A. All box sewer sections shall conform to ASTM C1433.
- B. All pipe and boxes shall be machine-made or cast by a process which will provide for uniform placement of concrete in the forms and compaction by mechanical devices which will assure a dense concrete.
- C. Concrete shall conform to requirements of Section 03300 – Cast-in-Place Concrete with minimum compressive strength of 4000 psi.
- D. Concrete shall be mixed in a central batch plant or other batching facility from which the quality and uniformity of the concrete can be assured. Transit-mixed concrete is not acceptable.
- E. Make test specimens in test cylinders at the same time and in the same manner as the box sections they represent. Make a minimum of 4 test cylinders for each day's production run and each mix design. Cure test cylinders in the same manner and for the same times as the boxes they represent. The producer must furnish all equipment required for testing concrete for boxes produced in a precasting plant.
- F. For precast boxes, provide no more than 4 lifting holes in each section. Lifting holes may be cast, cut into fresh concrete after form removal, or drilled. Provide lifting holes of sufficient size for adequate lifting devices based on the size and weight of the box section. Do not use lifting holes larger than 3 in. in diameter. Do not cut more than 1 longitudinal.
- G. Rubber gasketed joints for precast reinforced concrete box culverts and sewers may be selected in lieu of boxes with preformed, flexible, mastic gasket material. When rubber gasket joints are selected, they shall meet the requirements of ASTM C 1677 for design of the joints, performance and joint tolerances. When selecting the rubber gasket joint for box, neither filter fabric nor external joint wrap shall be required.

2.04 CORRUGATED METAL PIPE AND FITTINGS

- A. Corrugated metal pipe may be galvanized steel, aluminized steel, aluminum or precoated galvanized steel as indicated on Plans and conforming to the following:

Galvanized Steel	AASHTO M218
Aluminized Steel	AASHTO M274
Aluminum	AASHTO M197
Precoated Galvanized Steel	AASHTO M246

- 1. Reference to gauge of metal is to U.S. Standard Gauge for uncoated sheets. Tables in AASHTO M218 and AASHTO M274 list thicknesses for coated sheets in inches. The tables in AASHTO M197 list thicknesses in inches for clad aluminum sheets.

- B. Coupling bands and other hardware for galvanized or aluminized steel pipe shall conform to requirements of AASHTO M36 for steel pipe and AASHTO M196 for aluminum pipe.
1. Coupling bands shall be not more than 3 nominal sheet thicknesses lighter than thickness of pipe to be connected and in no case lighter than 0.052 inch for steel or 0.048 inch for aluminum.
 2. Coupling bands shall be made of same base metal and coating (metallic or otherwise) as pipe.
 3. Minimum width of corrugated locking bands shall be as shown below for corrugations which correspond to end circumferential corrugations on pipes being joined:
 - a. 10 ½ inches wide for 2 ⅔ inch x 1/2-inch corrugations.
 - b. 12 inches wide for 3 inch x 1 inch corrugations.
 4. Helical pipe without circumferential end corrugations will be permitted only when it is necessary to join a new pipe to an existing pipe which was installed with no circumferential end corrugations. In this event pipe furnished with helical corrugations at ends shall be field jointed with either helically corrugated bands or with bands with projections (dimples). The minimum width of helical corrugated bands shall conform to the following:
 - a. 12 inches wide for 1/2 inch-deep helical end corrugations.
 - b. 14 inches wide for one inch-deep helical end corrugations.
 5. Bands with projections shall have circumferential rows of projections with one projection for each corrugation. Width of bands with projections shall be not less than the following:
 - a. 12 inches wide for pipe diameters up to and including 72 inches. Bands shall have two circumferential rows of projections.
 - b. 16 ¼ inches wide for pipe diameters of 78 inches and greater. Bands shall have four circumferential rows of projections.
 6. Bolts for coupling bands shall be 1/2 inch diameter. Bands 12 inches wide or less will have a minimum of 2 bolts per end at each connection, and bands greater than 12 inches wide shall have a minimum of 3 bolts at each connection.
 7. Galvanized bolts may be hot dip galvanized in accordance with requirements of AASHTO M 232, mechanically galvanized to provide same requirements as AASHTO M 232, or electro-galvanized per ASTM B 633, Type RS.

- C. Bituminous coated pipe or pipe arch shall be coated inside and out with a bituminous coating which shall meet these performance requirements and requirements of AASHTO M190.
1. Pipe shall be uniformly coated inside and out to a minimum thickness of 0.05 inch, measured on crests of corrugations.
 2. Bituminous coating shall adhere to the metal so that it will not chip, crack, or peel during handling and placement; and shall protect pipe from corrosion and deterioration.
 3. Where a paved invert is shown on Plans, pipe or pipe arch, in addition to fully-coated treatment described above, shall receive additional bituminous material, same as specified above, applied to the bottom quarter of circumference to form a smooth pavement. Maintain a minimum thickness of 1/8 inch above crests of corrugations.
- D. Furnish all fittings and specials required for bends, end sections, branches, access manholes, and connections to other fittings. Design fittings and specials in accordance with Plans and ASTM A 760. Fittings and specials are subject to same internal and external loads as straight pipe.

2.05 PIPE FABRICATION

- A. Steel Pipe:
1. Galvanized or aluminized steel pipe shall be full circle or arch pipe conforming to AASHTO M 36, Type I, Type IA, or Type II, as indicated on the Plans.
 2. Fabrication with circumferential corrugations, lap joint construction with riveted or spot-welded seams, helical corrugations with continuous helical lock seam, or ultra-high frequency resistance butt-welded seams is acceptable.
- B. Aluminum Pipe:
1. Pipe shall conform to the requirements of AASHTO M 196, Type I, Type IA, circular pipe, or Type II, pipe arch as indicated on the Plans.
 2. Fabrication with circumferential corrugations, lap joint construction with riveted or spot-welded seams, or helical corrugations with a continuous helical lock seam.
 3. Portions of aluminum pipe that will be in contact with concrete or metal other than aluminum, shall be insulated from these materials with a coating of bituminous material meeting requirements of AASHTO M 190. Extend coating a minimum distance of one foot beyond area of contact.

- C. Precoated Galvanized Steel Pipe:
 - 1. Pipe shall be full circle or arch pipe conforming to AASHTO M 245, Type I, Type IA or Type II as indicated on the Plans.
 - 2. Fabrication with circumferential corrugations, lap joint construction with riveted seams, or helical lock seams is acceptable.
 - 3. Inside and outside coating shall be a minimum of 10 mils.

2.06 SOURCE QUALITY CONTROL

- A. Tolerances: Allowable casting tolerances for concrete units are plus or minus 1/4 inch from dimensions shown on the Plans. Concrete thickness in excess of that required will not constitute cause for rejection provided that such excess thickness does not interfere with proper jointing operations.
- B. Precast Unit Identification: Mark date of manufacture and name or trademark of manufacturer clearly on the inside of inlet, headwall or wingwall.
- C. Rejection: Precast units may be rejected for non-conformity with these specifications and for any of the following reasons:
 - 1. Fractures or cracks passing through the shell, except for a single end crack that do not exceed the depth of the joint.
 - 2. Surface defects indicating honeycombed or open texture.
 - 3. Damaged or misshaped ends, where such damage would prevent making a satisfactory joint.
- D. Replacement: Immediately remove rejected units from the work site and replace with acceptable units.
- E. Repairs: Occasional imperfections resulting from manufacture or accidental damage may be repaired if, in the opinion of the Engineer, repaired units conform to requirements of these specifications.

2.07 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

- A. Bedding and Backfill Material: Conform to Plans and requirements of Sections 02255 – Bedding, Backfill, and Embankment Materials.

3.0 EXECUTION

3.01 PREPARATION

- A. Conform to requirements of Section 02318 – Excavation and Backfill for Utilities, 3.02 “Preparation”.

3.02 EARTHWORK

- A. Excavate in accordance with requirements of Section 02318 – Excavation and Backfill for Utilities, except where tunneling or jacking methods are shown on the Plans. When pipes are 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 backfill and bedding material under and around pipe.
- B. Bed pipe in accordance with Plans and Specifications. When requested by Engineer, furnish a simple template for each size and shape of pipe for use in checking shaping of bedding. Template shall consist of a thin plate or board cut to match lower half of cross section.
- C. Where rock in either ledge or boulder form exists below pipe, remove the rock below grade and replace with suitable materials so that a slightly yielding compacted earth cushion is provided below pipe a minimum of 12 inches thick.
- D. Where soil encountered at established grade is quicksand, muck or similar unstable materials, such unstable soil shall be removed and replaced in accordance with requirements of Section 02318 – Excavation and Backfill for Utilities. Do not allow cement stabilized materials for backfill to come into contact with any uncoated aluminum or aluminized pipe surface.
- E. After metal pipe structure has been completely assembled on proper line and grade and headwalls constructed when required by the drawing details, place selected material from excavation or borrow along both sides of the completed structures equally, in uniform layers not exceeding 6 inches in depth (loose measurement), wetted if required and thoroughly compacted between adjacent structures and between structure and sides of trench, or for a distance each side of structure equal to diameter of pipe. Backfill material shall be compacted to the same density requirements as specified for adjoining sections of embankment in accordance with specifications. Above three-fourths point of structure, place uniformly on each side of pipe in layers not to exceed 12 inches.
- F. Only hand operated tamping equipment will be allowed within vertical planes 2 feet beyond horizontal projection of outside surface of structure for backfilling, until a minimum cover of 12 inches is obtained. Remove and replace damaged pipe.
- G. Do not permit heavy earth moving equipment to haul over structure until a minimum of 4 feet of permanent or temporary compacted fill has been placed.

- H. During backfilling, obtain uniform backfill material and uniform compacted density throughout length of structure so that unequal pressure will be avoided. Provide proper backfill under structure.
- I. Prior to adding each new layer of loose backfill material, an inspection will be made of inside periphery of structure for local or unequal deformation caused by improper construction methods. Evidence of deformation will be reason for such corrective measures as may be directed by Engineer.

3.03 CORRUGATED METAL PIPE INSTALLATION

- A. Place pipes on prepared foundation starting at outlet end. Join sections firmly together, with side laps or circumferential joints pointing upstream and with longitudinal laps on sides.
- B. Metal in joints which is not protected by galvanizing or aluminizing shall be coated with an approved asphaltum paint.
- C. Provide proper equipment for hoisting and lowering sections of pipe into trench without damaging pipe or disturbing prepared foundation and sides of trench. Pipe which is not in alignment or which shows undue settlement after laying, or is damaged, shall be taken up and relaid.
- D. Multiple installations of corrugated metal pipe and pipe arches shall be laid with the center lines of individual barrels parallel. Unless otherwise indicated on the Plans, maintain the following clear distances between outer surfaces of adjacent pipes:

DIAMETER OF PIPE	CLEAR DISTANCE BETWEEN PIPES FULL CIRCLE AND PIPE ARCH	PIPE ARCH DESIGN NO.
18"	1' 2"	2
24"	1' 5"	3
30"	1' 8"	4
36"	1' 11"	5
42"	2' 2"	6
48"	2' 5"	7
54"	2' 10"	8
60" – 84"	3' 2"	9
90" – 120"	3' 5"	10 & Over

- E. Where extensions are attached to existing structures, install a proper connection between structure and existing as indicated on Plans, coat the connection with bituminous material when required.
- F. When existing headwalls and aprons are indicated for reuse on the Plans, sever portion to be reused from the existing culvert, and relocate to prepared position. Damaged

headwalls, aprons or pipes attached to the headwall, shall be restored to their original condition.

3.04 JOINTING

- A. Field joints shall maintain pipe alignment during construction and prevent infiltration of side material.
- B. Coupling bands shall lap equally on pipes being connected to form a tightly-closed joint.
- C. Use corrugated locking bands to field join pipes furnished with circumferential corrugations including pipe with helical corrugations having reformed circumferential corrugations on ends. Fit locking bands into a minimum of one full circumferential corrugation of pipe ends being coupled.

3.05 CONCRETE PIPE INSTALLATION

- A. Install in accordance with the Plans and pipe manufacturer's recommendations and as specified in this Section.
- B. Install pipe only after excavation is completed, the bottom of the trench shaped, bedding material is installed, and the trench has been approved by the Engineer.
- C. Install pipe to the line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in the trench so the interior surfaces of the pipe follow the grades and alignments indicated.
- D. Install pipe with the spigot ends toward the direction of flow.
- E. Form a concentric joint with each section of adjoining pipe so as to prevent offsets.
- F. Place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Engineer.
- G. Keep the interior of pipe clean as the installation progresses. Where cleaning after laying the pipe is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull it forward past each joint immediately after the joint has been completed.
- H. Keep excavations free of water during construction and until final inspection.
- I. When work is not in progress, cover the exposed ends of pipes with an approved plug to prevent foreign material from entering the pipe.

3.06 PRECAST AND CAST-IN-PLACE CONCRETE BOX SEWERS INSTALLATION

- A. Placement of Boxes: when precast boxes are used to form multiple barrel structures, place the box sections in conformance with the plans or as directed. Place material to be used between barrels as shown on the plans or as directed. Unless otherwise authorized, start the laying of boxes on the bedding at the outlet end and proceed toward the inlet end with the abutting sections properly matched. Fit, match, and lay the boxes to form a smooth, uniform conduit true to the established lines and grades. For trench installations, lower the box sections into the trench without damaging the box or disturbing the bedding and the sides of the trench. Carefully clean the ends of the box before it is placed. Prevent the earth or bedding material from entering the box as it is laid. Remove and re-lay, without extra compensation, boxes that are not in alignments or that show excessive settlement after laying. Form and place cast-in-place boxes in accordance with Section 03300 - Cast-in-Place Concrete.
- B. Connections and Stub Ends: Make connections of boxes to existing boxes, pipes, storm drains, or storm drain appurtenances as shown on the plans. Mortar or concrete the bottom of existing structures if necessary to eliminate any drainage pockets created by the connections. Connect boxes to any required headwalls, wingwalls, safety end treatments or riprap, or other structures as shown on the plans or as directed. Repair any damage to the existing structure resulting from making the connections. Finish stub ends for connections to future work not shown on the plans by installing watertight plugs into the free end of the box.
- C. For precast boxes, fill lifting holes with mortar or concrete and cure. Precast concrete or mortar plugs may be used.

3.07 INSTALLATION OTHER THAN OPEN CUT

- A. For installation of pipe by augering, boring, or jacking pipe, conform to requirements of Section 02415 - Augering Pipe or Casing for Sewers.
- B. Design pipe and box sewers for jacking, boring or tunneling considering the specific installation conditions such as the soil conditions, installation methods, anticipated deflection angles and jacking pressures. When requested, provide design notes and drawings signed by a Texas licensed professional engineer.

3.08 CONNECTIONS

- A. Connect inlet leads to the inlets as shown on the Plans. Use non-shrink grout jointing material as shown on the Plans Drawing or as approved. Make connections water tight.

3.09 FINISHES

- A. Cut off inlet leads neatly at the inside face of inlet wall. Point up with mortar or field galvanizing.
- B. When the box section of the inlet has been completed, shape the floor of the inlet with mortar to conform to the detailed Plans.
- C. Finish concrete surfaces in accordance with requirements of Section 03300 – Cast-in-Place Concrete.

3.10 BACKFILL

- A. Backfill the trench only after pipe and box sewer installation is approved by the Engineer.
- B. Bed pipes with materials conforming to requirements of Section 02318 – Excavation and Backfill for Utilities and as indicated on Plans.
- C. Backfill and compact soil in accordance with Section 02318 – Excavation and Backfill for Utilities.

3.11 INSPECTION

- A. Remove and replace all nonconforming work at no additional cost to City.

3.12 SAFETY END TREATMENTS (SET)

- A. Install safety end treatments in accordance with Section 02629 and as indicated on the plans. Use only approved pre-cast SET's with cross bars.

3.13 CLEAN-UP AND RESTORATION

- A. Perform clean-up and restoration in and around construction zone in accordance with Section 01140 – Contractor's Use of Premises.
- B. In unpaved areas, grade surface as a uniform slope to natural grade as indicated on the Plans.

END OF SECTION