



DENVER

THE MILE HIGH CITY

CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS | ENGINEERING DIVISION

Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

10.3 Precast Reinforced Box Conduits

10.3.1 General

The work of this section includes furnishing and installing all precast reinforced concrete box conduits for storm drainage systems. This shall include all associated special pieces, except inlets and manholes.

10.3.2 Related Sections

Section 4.0, Trenching and Excavation for Pipework (Capital Project Management Standard Specifications).

10.3.3 Referenced Standards

This section references American Society for Testing and Materials (ASTM) Specifications, which are made a part hereof by such references, and shall be the latest edition and revision thereof. All material, manufacturing, operations, testing, inspection and production of precast reinforced box conduits shall conform to the following standards.

ASTM C150	Standard Specification for Portland Cement
ASTM C497	Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
ASTM C822	Terminology Relating to Concrete Pipe and Products

ASTM C1433	Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

10.3.4 Submittals

10.3.4.1 Supplier Certification

A letter from the supplier to the Project Construction Engineer shall be submitted certifying that all Precast Reinforced Box Conduits are manufactured in accordance with ASTM C1433.

10.3.4.2 Design Calculations

All designs shall be per the tables of ASTM C1433 except where box sizes and or special load conditions are not covered by these tables. All special designs and load conditions shall require the submittal of design calculations through the Project Construction Engineer for City and County of Denver approval.

10.3.4.3 Shop Drawings

Shop drawings showing laying diagram and location of all closure pieces shall be submitted. Drawings shall include: proposed lifting anchors, lugs and any other features pertinent to the manufacture of special sections.

10.3.4.4 Gasket Deformation

Calculations showing the gasket deformation(s) shall be submitted to the Project Construction Engineer.

10.3.4.5 Lifting Anchors

The lifting mechanisms proposed for handling and placement of box conduit shall be submitted to the Project Construction Engineer for approval.

10.3.4.6 Maximum Allowable Joint Gap

The manufacturer shall provide the Project Construction Engineer with the maximum allowable joint gaps on all box conduit sizes for the project. The maximum allowable joint gap is determined as that point where the bevel of the bell and the shoulder of the spigot are vertically aligned and the rubber gasket has achieved the minimum compression necessary to ensure a water tight seal per these Detail and Technical Specifications.

10.3.5 Materials

10.3.5.1 Box Conduits

All precast reinforced concrete box conduits shall be manufactured in accordance with ASTM C1433.

The Project Construction Engineer shall be provided a schedule at least three working days in advance of when the various types of box conduit will be cast so the casting operation may be inspected and appropriate specimens may be selected for testing in accordance with the Contract Documents.

10.3.5.2 Box Joints

Box joints for reinforced concrete box conduits shall be formed using either o-ring or profile rubber gaskets that provide a watertight seal. The gasket shall be properly placed on the spigot using an adhesive, as necessary along the joint perimeter, to maintain the correct position of the gasket. Joints for box conduits shall comply with the requirements set forth in ASTM C443, with the following revisions.

1. Gasket Deformation

The joints shall be of such design that they will withstand the forces caused by the compression of the gasket when the joint is in the assembled and homed position, as well as when the box joint is fully off-centered and the maximum dimensional tolerances are applied.

2. Hydrostatic Testing and Requirements

One box joint per size, for each project, shall be hydrostatically tested at the place of manufacture to verify watertightness and joint integrity. Hydrostatic pressure tests on joints shall be made on an assembly of two sections of box, properly connected in accordance with the joint design. Suitable means shall be provided that allows pressure to be applied to the joint, either external or internal of the two joined box sections. When infiltration is a concern, the joint shall be tested using external pressure only.

Assembled joints shall pass the following performance tests without leakage at the joints. Moisture or beads of water appearing on the surface of the joint will not be considered as leakage.

Box in straight alignment

Concrete box conduit shall be subjected to a hydrostatic pressure of 5psi (11.5 ft of pressure head) for 10 minutes in straight alignment. If leakage of joints should initially occur, the manufacturer shall have the option to extend the test period up to 24 hours.

Box in maximum deflected position

Upon completion of the test for box in straight alignment, the test section shall be deflected to create a position ½ inch wider than the assembled position on one side of the outside perimeter of each joint and shall be subjected to a hydrostatic pressure of 3psi (6.9 ft of pressure head) for 10 minutes.

3. Joint Gap

If the end face joint gap is greater than or equal to 65% of the maximum allowable joint gap, as submitted by the manufacturer for each specific box size and less any factors of safety, the gap shall be grouted with an approved non-shrink grout product around the entire internal joint perimeter.

10.3.5.3 Closure Pieces

All pieces required for closure between precast and cast-in-place elements shall be fabricated with protruding dowels or exposed reinforcing steel, as shown in the Contract Documents, and as approved by the Project Construction Engineer. All dowels and/or exposed reinforcing shall be fully developed.

10.3.5.4 Special Pieces

Special pieces shall be fabricated as shown on the Contract Documents and shall be approved by the Project Construction Engineer prior to fabrication.

10.3.5.5 Lifting Anchors

Lifting anchors shall be used on all box conduits. Lifting holes will not be allowed.

10.3.6 Acceptance

In addition to deficiencies covered by applicable ASTM specifications, individual precast reinforced concrete box conduits shall be subject to rejection due to any of the following:

1. Surface defects indicating honeycombed or open texture that would adversely affect the function of box sections. Onsite repairs may be made, if approved by the Project Construction Engineer.
2. Damaged ends, where such damage would prevent making a satisfactory joint.
3. Conduit which has been excessively patched or repaired. The manufacturer may request that the Project Construction Engineer perform an inspection at the plant, prior to delivery, to assess patching and/or repair work on conduits. Conduit damaged during shipment or construction may be repaired with the approval of the Project Construction Engineer.
4. Exposure of the reinforcement. The exposure of the ends of longitudinals, stirrups and spacers used to position reinforcement shall not be cause for rejection.
5. Box conduit that has been delivered to the jobsite prior to being at least 5 days (120 hours) old.

Acceptance of the conduit shall not relieve the General Contractor of full responsibility for defects in material or workmanship on the completed boxlines.

10.3.7 Marking

The following information shall be legibly marked on each box section by indentation, waterproof paint or other approved means:

1. ASTM specification designation
2. Date of manufacture
3. Name or trademark of manufacturer

10.3.8 Testing

The Project Construction Engineer or other identified representatives shall be permitted to visit the manufacturing facility of the General Contractor's supplier to observe compliance with all applicable testing provisions. These visits may be scheduled or random.

10.3.9 Shipping and Handling Box Conduit and Fittings

All conduits, fittings, and specials shall be hauled, unloaded, stockpiled, distributed, handled and installed as recommended by the manufacturer and in such a manner as to prevent damage to the product.

10.3.10 Installation

Box conduit lines shall be constructed continuously, from downstream to upstream, except when otherwise approved by the Project Construction Engineer. The General Contractor is responsible for matching line and grade as shown within the Contract Documents. Bedding material shall be placed in accordance with the Contract Documents and applicable Standard Details to provide uniform and continuous support.

Box conduits shall be placed with the grove end upstream. Each conduit section shall be set into position and checked for line and grade prior to continuing placement. The manufacturers' recommendations shall be closely followed during installation.

The General Contractor shall ensure that all reinforced concrete box conduits are kept clean and free from gravel, dirt and debris during and after installation. Precautions shall be taken by the General Contractor to eliminate soil and debris from being washed into the sewer prior to completion of the entire system and its appurtenances. The General Contractor shall incur all costs associated with street failures, cave-ins, system washouts and settlements, and conduit cleaning as a result of carelessness during this timeframe.