



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

10.1 Precast Concrete Pipe

10.1.1 General

This section covers material requirements, inspection, marking, delivery, installation, field performance and acceptance of reinforced concrete pipe for storm drainage systems. This shall include circular, elliptical and arch pipe along with all associated special pipe sections.

10.1.2 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 concrete pipe shall conform to the following Referenced Standards:

ASTM C14	Concrete Sewer, Storm Drain and Culvert Pipe
ASTM C33	Specification for Concrete Aggregates
ASTM C76	Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
ASTM C150	Standard Specification for Portland Cement
ASTM C361	Reinforced Concrete Low-Head Pressure Pipe
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C497	Standard Test Methods for Concrete Pipe, Manhole Sections or Tile

ASTM C506	Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe
ASTM C507	Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
ASTM C655	Standard Specification for Reinforced Concrete D-Load culvert, Storm Drain and Sewer pipe
ASTM C822	Standard Terminology Relating to Concrete Pipe and Related Products
ASTM C985	Standard Specification for Non-reinforced concrete Specified Strength Culvert, Storm Drain and Sewer pipe
ASTM C1417	Standard Specification for Manufacture of Reinforced Concrete Sewer, Storm drain and Culvert pipe for Direct Design

10.1.3 Diameter of Pipe

The diameter indicated on the Contract Documents shall mean the inside diameter of the pipe.

10.1.4 Wall Thickness and Class of Pipe

The wall thickness and reinforcing steel shall comply with the appropriate ASTM Specification and the designated class of pipe as indicated in the Contract Documents. All jacking pipe shall be specifically designed by the pipe manufacturer to withstand all forces that the pipe may be subjected to during jacking operations.

10.1.5 Submittals

10.1.5.1 Supplier Certification

A letter from the supplier to the Project Construction Engineer shall be submitted certifying that all Precast Reinforced Concrete Pipe is manufactured in accordance with the applicable ASTM specification.

10.1.5.2 Design Calculations

All designs shall be per the applicable ASTM designation, except where pipe sizes and or special load conditions are not covered in the specifications. All special designs and load conditions shall require the submittal of design calculations through the Project Construction Engineer for approval.

10.1.5.3 Shop Drawings

Shop drawings showing a laying diagram and the 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.

10.1.5.4 Gasket Deformation

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

10.1.5.5 Lifting Anchors

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

10.1.5.6 Maximum Allowable Joint Gap

The manufacturer shall provide the Project Construction Engineer with the maximum allowable joint gaps on all 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.

10.1.6 Materials

All precast reinforced concrete pipe shall be manufactured in accordance with the applicable ASTM designation or as specified in the Contract Documents.

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

10.1.6.1 Cement

Unless otherwise specified by the Project Construction Engineer, or within the Contract Documents, Type II Portland Cement complying with the requirements of ASTM C150 will be used in the production of concrete pipe.

10.1.6.2 Lifting Anchors

Lifting anchors shall be used on all precast concrete pipe. Lifting holes are not allowed.

10.1.6.3 Fittings and Specials

Details of all fittings and specials shall be submitted for approval to the Project Construction Engineer prior to construction. Fittings and specials shall be made up of pipe segments having the same structural qualities as the adjoining pipe and shall have the interior treated the same as the pipe.

10.1.6.4 Joints and Gaskets

Pipe joints for all reinforced concrete pipes shall be formed using rubber gaskets that provide a watertight seal, in accordance with ASTM C443. The joints shall be of such design that they will withstand the forces caused by the compression of the gasket when joined.

The joint design of concrete pipe shall be a bell and spigot or a tongue and groove style joint. The spigot or tongue shall be grooved to properly contain and seat the rubber gasket. The joint assemblies shall be accurately formed so that when each pipe section is forced together in the trench the assembled pipe shall form a continuous watertight conduit with a smooth and uniform interior surface, and shall provide for slight movement of any piece of the pipeline due to expansion, contraction, settlement or lateral displacement. The gasket shall be

the sole element of the joint providing watertightness. The ends of the pipe shall be perpendicular (90° angle) to the longitudinal centerline of the pipe, except where bevel-end pipe is required. The ends shall be finished so that they are uniform and smooth.

Rubber gaskets for bell and spigot pipe shall consist of an o-ring rubber gasket, rubber profile gasket, or another gasket specifically approved, in writing, by the Project Construction Engineer.

Gaskets may be either natural rubber or neoprene conforming to ASTM C443. All gaskets shall be stored in a cool place, preferably at a temperature of less than 70 degrees Fahrenheit (F), and in no case shall the gaskets be stored in the open, or exposed to direct sunlight. No gaskets which show signs of deterioration, such as surface cracking or checking, shall be installed in a pipe joint. When the air temperature is 10 degrees F or lower, the gaskets shall be warmed to temperature of 60 degrees Fahrenheit for a period of 30 minutes before being placed on the pipe.

10.1.6.5 Joint Gap

For reinforced concrete pipe 30-inches (or equivalent diameter for arch and elliptical pipes) and larger, 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 pipe 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. If the end face joint gap is greater than the maximum allowable joint gap submitted by the manufacturer, at any point around the internal joint perimeter, the adjoining pipe sections will be rejected and no payment will be made.

10.1.6.6 Jacking Pipe

All other Requirements set forth in this specification shall apply to reinforced concrete pipe being jacked, with the following additions: Pipe shall be Class V unless specified otherwise in the Contract Documents; grouting nipples shall be spaced no more than 8 feet apart on the installed pipeline, pipe shall include steel joint rings (bell and spigot) conforming to ASTM C361 and as shown on Standard Detail S-401, Joint type R-Z.

10.1.7 Acceptance

In addition to any deficiencies not covered by the applicable ASTM specifications, individual concrete pipe sections 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 pipe 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. Pipe 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. Pipe 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 and may be repaired with the approval of the project Construction Engineer, in writing.
5. Concrete pipe that has been delivered to the jobsite prior to being at least 5 days (120 hours) old
6. Broken Bells or spigots on installed pipeline
7. Joint gaps greater than maximum allowable submitted by manufacturer

Acceptance of the pipe at point of delivery will not relieve the Contractor of full responsibility for any defects in materials due to workmanship.

10.1.8 Marking

The following shall be clearly marked on both the interior and exterior surface of the pipe:

1. ASTM specification designation
2. Class and size
3. Date of manufacture
4. Name or trademark of manufacturer

10.1.9 Protective Coatings

Whenever adverse corrosive conditions warrant additional interior protection, those pipe segments noted in the Contract Documents shall be lined as specified elsewhere in these Detail and Technical Specifications.

10.1.10 Installation

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

Pipe shall be placed with the grove or bell 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 pipe is 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.