

ARTICLE 12

STORM SEWERS

12.1 GENERAL

12.1.1 DESCRIPTION

The work covered by this specification consists of furnishing all labor, equipment, tools, materials necessary to install storm sewer pipe and appurtenances as shown on the plans and as specified herein. The term "Storm Sewer" as used in these specifications also applies to "Culverts" and all provisions apply unless noted otherwise.

12.1.2 PLANS AND DATA

Profiles of the ground are shown on the plans for the work. The Contractor must satisfy himself regarding the character of the material to be excavated and the work to be done.

12.2 MATERIALS

12.2.1 PIPE MATERIALS

For 36-inch diameter and smaller pipe sizes, the storm sewer may be constructed of either Reinforced Concrete Pipe (RCP), High Density Polyethylene (HDPE) with smooth interior, Corrugated Polypropylene Pipe (CPP) or Polyvinyl Chloride (PVC). Where designated as "RCP" on the drawings, **only the type of pipe designated will be allowed.**

For pipe sizes larger than 36 inches, only RCP and CPP will be allowed. For pipes sizes larger than 60 inches in diameter, **only RCP will be allowed.**

When plastic pipe with end sections is to be installed, the end section shall be steel or reinforced concrete pipe (RCP) approved by the Engineer. Concrete collars will be required to join the end section to the plastic pipe. Plastic flared end sections are not acceptable.

12.2.2 REINFORCED CONCRETE PIPE (RCP)

Concrete pipe shall be made using Type I/II cement or a 7-sack mix design and shall be a minimum of Class III unless shown otherwise on the drawings, and shall conform to the following AASHTO / ASTM designation:

	AASHTO	ASTM
Storm Drain and Sewer Pipe (NRCP)	M 86	C 14
Storm Drain and Sewer Pipe (RCP)	M 170	C76
Precast Manhole Sections	M 199	C 478
Arch Pipe	M 206	C 506
Elliptical Pipe	M 207	C 507
Joints, Using Rubber Gaskets	M 315	C 473
Precast Reinforced Concrete Box Sections	M 259	C 1577 or C 1433
Joints, Using Rubber Gaskets (Box Culverts)		C 1677
Joints, Using Mastic Gaskets		C 1990

Prior to pipe laying operations, the Contractor shall submit a letter from the pipe manufacturer certifying that the minimum areas of steel (RCP) and concrete strengths are in compliance with the applicable AASHTO specification and strength classification. The pipe manufacturer's facility shall be certified annually by the American Concrete Pipe Association. Representatives from the City shall be allowed full access to the facility to observe all phases of the pipe manufacturing process and to review all records pertaining to pipe testing. The City reserves the right to reject pipe based upon visual observations of apparent defects or departures from the tolerance standards.

Joints for storm drains or manholes shall be either bell and spigot or tongue and groove. Jointing material for concrete pipe shall be a preformed, flexible plastic sealing compound which conforms to Federal Specification SS-S-00210 (GSA-FS6) "Sealing Compound Preformed Plastic for Expansion Joints and Pipe Joints". The sealant shall be made of top-grade vulcanized butyl rubber which is compressible and has a tacky surface for adherence to the joint. The material shall be capable of being installed in the temperature range from zero to one-hundred degrees Fahrenheit (0 - 100°F).

12.2.3 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

High density polyethylene pipe shall have a smooth interior wall (Type S) and shall conform to AASHTO M 294. Joints shall be a gasketed bell and spigot fitting. Acceptable products are "N-12 WT IB" as manufactured by Advanced Drainage Systems, Inc. or an approved equal. The joining of pipe shall be in strict conformance with the manufacturer's recommendations or the Contract Documents, whichever is more stringent. Only pipe diameters 15" through 36" will be allowed. Installation of High-Density Polyethylene pipe (HDPE) must meet the following conditions described below:

- (a) Contractors installing HDPE pipe must provide the City with a letter from the pipe manufacturer certifying that they have been trained in proper installation procedures of their product.
- (b) Where there are discrepancies between HDPE pipe installation specifications and City of Pueblo Standard Specifications, the more stringent specifications will apply.
- (c) Where HDPE pipe enters a manhole, flowable fill must be used to ensure proper support beneath the pipe. Flowable fill must be installed to the spring line of the highest HDPE pipe and within the area of manhole excavation.
- (d) Upon completion of installation and backfill, the contractor must demonstrate that the pipe has not deflected more than 5% of the pipe diameter, including manufacturing tolerances.
- (e) HDPE pipe may not be used in or adjacent to a street that has classification as a Collector or higher designation.
- (f) The maximum allowable height of backfill as measured from the top of pipe to finished grade shall be limited to ten feet (10').

12.2.4 CORRUGATED POLYPROPYLENE PIPE (CPP)

Twelve through 60-inch pipe shall be polypropylene or pre-approved equal. Pipe supplied shall be smooth interior and annular exterior corrugated polypropylene (CPP) pipe meeting the requirements of ASTM F2881 for respective diameters.

Pipe shall be joined using bell & spigot joints, meeting the requirements of ASTM F2881. The joint shall be watertight according to the requirements of ASTM 3212. Gaskets shall meet the requirements of ASTM F477.

Fittings shall conform to ASTM F2881. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM 3212. Gaskets shall meet the requirements of ASTM F477.

All corrugated polypropylene storm sewer shall be installed in accordance with ASTM D2321. Please refer to the CPP Storm Trench Installation Detail for all other installation requirements.

12.2.5 - POLYVINYL CHLORIDE (PVC)

Polyvinyl chloride pipe shall have a diameter to wall thickness ratio of not less than 35 (SDR 35) and shall conform to ASTM D3034 (for 15 inch diameter pipe and smaller) or ASTM F679 (for pipe diameters between 18 to 27 inches).

Where Polyvinyl Chloride pipe enters a manhole, flowable fill must be used to ensure proper support beneath the pipe. Flowable fill must be installed to the spring line of the highest PVC pipe and within the area of manhole excavation.

12.2.6 PIPE BEDDING

Bedding for storm sewer pipe shall be Class "B" as defined in ARTICLE 11 - SANITARY SEWERS, Section 11.2.11 Class "B" Bedding Material. Limits for bedding around the pipe shall be as shown on the Standard Details.

12.2.7 CONCRETE MANHOLES

The requirements for storm sewer manholes shall be the same as those for sanitary sewers as defined in ARTICLE 11 – SANITARY SEWERS, Section 11.2.5, except:

- (a) Special manholes may be required for larger diameter pipes as noted on the Contract Drawings or in the Standard Details.
- (b) The wrapping of joints outside of the manhole with a butyl adhesive tape sealant is not required.

12.2.8 INLETS

Inlets (Catch Basins) shall be constructed of cast-in-place concrete in accordance with the standard detail of the type and size shown on the drawings. Precast concrete inlets may be used when approved by the Engineer with the added requirements shown on the "Pre-Cast Inlet Detail". Shop drawings for all precast inlets must be submitted to the Engineer for approval prior to installation. If differing site conditions require modifications to the precast inlet, the cost to modify or replace the inlet will be borne solely by the contractor. Inlets fabricated prior to the completion of the inlet piping will be at the contractor's risk.

12.2.9 BRICK

Brick may only be used for modifications to existing brick structures. Brick to be used in the construction of manholes shall conform to the requirements of AASHTO M 91, Grade MM "Specifications for Sewer and Manhole Brick".

12.2.10 CONCRETE GRADE RINGS

Reinforced concrete grade rings may be used in the adjustment of manhole castings. Grade rings shall have a minimum thickness of two inches (2") and a maximum thickness of six inches (6"). Total adjustment height shall not exceed the tolerances as shown on the Standard Details.

12.2.11 MORTAR

The requirements for mortar to be used in storm sewer construction shall be the same as those for sanitary sewers as defined in ARTICLE 12 – SANITARY SEWERS, Section 12.2.8.

12.2.12 CASTINGS AND MANHOLE RING & COVERS

The requirements for iron castings to be used in storm sewer manhole construction shall be the same as those for sanitary sewers as defined in ARTICLE 12 - SANITARY SEWERS, Section 12.2.9 with the following exception: The informational logo "No Dumping / Drains to River" shall be cast on the covers. Other castings shall be as shown on the Standard Details.

12.2.13 RIPRAP

Riprap shall consist of hard, dense, sound, rough fractured stone as nearly cubical as practicable. Thin slab type stones and flaking rock shall not be used. The stone shall have a specific gravity of at least 2.5. Concrete rubble is not acceptable for use as rip rap unless approved by the Engineer.

Stones shall be well graded in order that the voids can be filled. At least fifty percent (50%) of the mass shall be stones equal to or larger than the stone size called for on the plans. Stone size shall not be larger than the thickness of the riprap layer.

Riprap shall be placed to conform to the plan details. The larger size stones composing the riprap material shall be placed first and roughly arranged in close contact. The spaces between the larger stones shall then be filled with smaller stone of suitable size, so placed as to leave the surface evenly stepped, conforming to the contour required. The material may be machine placed with sufficient hand work to accomplish requirements of this specification.

Excavation for riprap shall be made to a neat line. Allowance will not be made for work outside of the neat line.

12.2.14 FILTER MATERIAL

Class A filter material shall consist of free draining sand, gravel, slag, or crushed stone. The material shall be uniformly graded from coarse to fine and shall meet the following gradation requirements:

SIEVE SIZE	PERCENT PASSING
3"	100
3/4"	20-90
No. 4	0-20
No. 200	0-3

12.2.15 FILTER FABRIC

Filter fabric shall be a nonwoven polypropylene material conforming to the minimum performance specifications outlined below and designed for use under riprap. Acceptable products are Supac 4NP manufactured by Phillips 66, 0401T manufactured by Advanced Drainage Systems, Inc., or an approved equal.

Min. Thickness (mils) ASTM D1777	40
Min. Grab Strength (md/cd, %) ASTM D4632	50
Min. Grab Elongation (md/cd, %) ASTM D4632	50
Min. Burst Strength (psi) ASTM D3786	155
Min. Puncture Strength (lbf) ASTM D4833	55
Min. Permeability (cm/sec) ASTM D4491	0.2
Max. A.O.S. (Std. Sieve) ASTM D4751	35

12.2.16 TRACER WIRE

All provisions of Section 11.2.14 are applicable.

12.3 CONSTRUCTION REQUIREMENTS

Many portions of ARTICLE 11 - SANITARY SEWERS, Section 11.3 - CONSTRUCTION REQUIREMENTS are applicable to storm sewer construction; however, there are numerous exceptions and discrepancies. It is the intent of this section to include Section 11.3 – CONSTRUCTION REQUIREMENTS by reference and all provisions are applicable as though they were listed herein, unless specifically excepted or modified.

12.3.1 STORM SEWER CROSSINGS

Section 11.3.1 does not apply to storm sewer construction.

12.3.2 WATER LINE CROSSINGS

All provisions of Section 11.3.2 are applicable.

12.3.3 RAILROAD AND HIGHWAY CROSSINGS

All provisions of Section 11.3.3 are applicable.

12.3.4 EXCAVATION - GENERAL

All provisions of Section 11.3.4 are applicable.

12.3.5 TRENCH EXCAVATION - WIDTH AND DEPTH

All provisions of Section 11.3.5 are applicable.

12.3.6 HANDLING EXCAVATED MATERIAL

All provisions of Section 11.3.6 are applicable.

12.3.7 UNSTABLE SUBGRADE

All provisions of Section 11.3.7 are applicable.

12.3.8 TRENCHES IN ROCK

All provisions of Section 11.3.8 are applicable.

12.3.9 QUICKSAND AND GROUNDWATER INFILTRATION

All provisions of Section 11.3.9 are applicable except that the following sentence be added; "Drainage of ground water during construction through any storm sewer pipeline will be allowed."

12.3.10 EXCAVATION FOR STRUCTURES

All provisions of Section 11.3.10 are applicable.

12.3.11 PIPE BEDDING LIMITS

All provisions of Section 11.3.11 are applicable except that the following sentence shall be added to the CLASS "A" - CONCRETE CRADLE BEDDING and CLASS "B" BEDDING subsections; "For reinforced concrete pipe (RCP), the bedding may be terminated at the springline (mid-depth) of the pipe."

12.3.12 PIPE LAYING

All provisions of Section 11.3.12 are applicable except the fourth paragraph pertaining to service wyes.

(a) ALIGNMENT

All provisions are applicable with the following modifications: delete the last sentence and replace with the following - At the City's request, deflection testing for PVC and HDPE storm sewer pipe by use of a mandrel shall be completed by the contractor or independent agency and paid for by the contractor or owner/developer. Deflection testing shall be done prior to paving and not less than thirty days after installation. The maximum allowable deflection shall not exceed five percent (5%) during the testing. Pipes larger than 36" in diameter may be entered and deflection levels measured directly."

(b) VERTICAL TOLERANCES

All provisions are applicable.

(c) JOINTING PIPE

All provisions are applicable.

12.3.13 BACKFILLING

All provisions of Section 11.3.13 are applicable except that Class “B” bedding is not required above the springline of reinforced concrete pipe. Also, add the following sentence to the sixth paragraph after the last sentence; “An additional compaction test is required for each inlet pipe run and may be taken along the pipe or at the inlet at the discretion of the Engineer.”

12.3.14 MANHOLE CONSTRUCTION AND ADJUSTMENT

All provisions of Section 11.3.14 are applicable except that drop manholes are not required unless specified on the drawings.

12.3.15 SANITARY SEWER SERVICE LINE INSTALLATIONS

Section 12.3.15 does not apply to storm sewer construction.

12.3.16 TESTING AND INSPECTION

Replace section 11.3.16 - TESTING AND INSPECTION with the following:

Prior to acceptance or payment, the Contractor must provide compaction test results to the City for the backfill compaction tests required in Section 11.3.13 - BACKFILLING. At the City’s request, deflection testing by use of a mandrel shall be completed for PVC and HDPE storm sewer pipe by the contractor or independent agency and paid for by the contractor or owner/developer. Deflection testing shall be done prior to paving and not less than thirty days after installation. The maximum allowable deflection shall not exceed five percent (5%) during the testing. Pipes larger than 36” in diameter may be entered and deflection levels measured directly.

Pipe shall be removed, replaced and retested if maximum deflection exceeds five percent of the pipe’s internal diameter. Pipe shall be retested for deflection by the City of Pueblo prior to the end of the two-year warranty period. Any pipe showing a deflection in excess of five percent shall be removed and replaced by the Contractor, at his expense.

All storm sewers will be inspected by closed-circuit television, by the City, after other utility installations and acceptance of all testing, but prior to construction of surface improvements over the new sewer unless otherwise authorized by the City. The Contractor shall thoroughly clean all sewers prior to televising by the City. The City requires five (5) working days advance notice for scheduling the televising and will be allowed five (5) working days to complete the television inspection.

Acceptance of the pipe will be granted by the Engineer only after all defects such as poor alignment, mislaid pipe, and broken or damaged pipe have been remedied, and the prescribed testing has been satisfactorily completed. Acceptance of the pipe does not relieve the Contractor of the responsibilities imposed by all other sections of these specifications.

12.3.17 CLEANING SEWERS AND APPURTENANCES

All provisions of Section 11.3.17 are applicable.

12.3.18 REPLACING SIDEWALKS, CURB AND GUTTER, BASE COURSE, PAVING, ETC.

All provisions of Section 11.3.18 are applicable.

STORM SEWER REHABILITATION SPECIFICATIONS

If any part of a stormwater main or lateral is removed or damaged to facilitate a private utility main installation or replacement, then the stormwater main or lateral must be replaced from the point of damage to the nearest inlet or manhole. Deviations from this requirement must be approved in writing by the Director of Stormwater and the Director of Public Works. In no instance will a patch of the break or a repair sleeve in the stormwater pipe be allowed. The stormwater pipe must be installed at the same grade it was found prior to being disturbed. The Stormwater Utility Department must approve the pipe size and material and perform inspections during installation of the damaged stormwater pipe.

Compaction testing shall be performed in accordance with Section 12.3.13 of the City of Pueblo Standard Construction Specifications and Standard Details and testing shall be included for the bedding material.

12.4 METHOD OF MEASUREMENT

Method of measurement for storm sewer construction shall be as follows:

- (a) Inlets and Manholes - Each inlet or manhole constructed will be counted for payment by the contract unit.
- (b) Storm Sewer Pipe - The length of storm sewer pipe of various sizes and types shall be measured in feet along the centerline of acceptably laid storm sewer from inside of wall to inside of wall of manholes and/or inlets, or to end of pipe (excluding flared end sections).
- (c) Riprap - Shall be measured by the ton as evidenced by weight tickets or by the cubic yard as measured in the field. Method shall be determined by the bid schedule.
- (d) Flared End Section - Flared end sections shall be counted and paid for as each unit installed.

12.5 BASIS OF PAYMENT

Basis of payment for storm sewer construction shall be as follows:

- (a) Inlets and Manholes - Payment for inlets and manholes shall be full compensation to construct the complete unit in accordance with these specifications and the Standard Details. It shall include the ring and cover castings, concrete adjustment rings or brick, and all items incidental to the manhole or inlet.
- (b) Storm sewer pipe - Storm sewer pipe will be paid for at the contract unit price for the various sizes and types, installed complete in place. Said price shall include all joint materials, plugs, and other materials to construct in accordance with these specifications, and the standard details. It shall include but not be limited to all costs associated with excavation, shoring, bedding, pipe placement, backfill, compaction, water for compaction, clean-up, landscape restoration, etc. No payment will be made for pipe until backfilling, compaction tests, deflection (go-nogo) test have been accepted by the Engineer.

- (c) Riprap - Payment for this item shall be full compensation for all labor and material to furnish and install the riprap, including filter fabric and filter material, and excavation, in accordance with these specifications. Class A filter material shall be included in the bid price for riprap and not paid for separately.
- (d) Flared End Section - Payment for this item shall be full compensation for all labor and materials to furnish and install the flared end section, including excavation, backfill, coupling adapters and necessary grading to match to a channel or ditch flowline.