



City of Estevan

Construction Specifications

SECTION 1300
SEWER MAINS AND APPURTENANCES

1.0 GENERAL

1.1 Scope:

This specification governs the supply and installation of sanitary or storm sewer mains, special applications, manholes, catchbasins, leads and appurtenances.

1.2 Scheduling of Work:

Schedule and co-ordinate all work to minimize disruption to existing services.

Submit a proposed work schedule as may be stipulated in the Special Provisions of these specifications.

Comply with any special service interruption or other scheduling requirements stipulated within the Special Provisions and City of Estevan bylaws including notifications to customers, Engineering Services Division and Fire Department.

2.0 MATERIAL

2.1 Pipe:

.1) Reinforced Concrete Pipe:

Shall conform to ASTM C76. Non-reinforced concrete pipe shall conform to ASTM C14.

All concrete pipe shall be manufactured with sulphate resistant, Type 50 Portland Cement conforming to CSA CAN 3-A5.

.2) Polyvinyl Chloride (PVC) Pipe:

PVC gravity sewer pipe and fittings (150 mm to 375 mm diameter) shall conform to CSA B182.1-M92 and B182.2-M90, standard dimension ratio (SDR) 35 and minimum pipe stiffness of 320 kPa and ASTM D3034-89.

PVC gravity sewer pipe and fittings (450 mm to 675 mm) shall conform to CSA B182.2-M90, minimum pipe stiffness of 320 kPa and ASTM F679-89. For sizes 750 mm to 900 mm, third party independent test verification shall accompany each shipment of pipe. These sizes (750 mm to 900 mm) must also have minimum pipe stiffness of 320 kPa.

PVC profiled gravity sewer pipe and fittings (150 mm to 900 mm diameter) shall conform to CSA B182.4-M90 and shall have a minimum pipe stiffness of 320 kPa and conform to ASTM F794-93a.

SECTION 1300
SEWER MAINS AND APPURTENANCES

The PVC pipe referred to in this specification may be used for sanitary and storm sewers up to and including 900 mm diameter.

All PVC gravity sewer pipe shall be manufactured with integral wall-thickened bell ends complete with factory installed gaskets and spigot ends for push-on joints conforming to ASTM F477.

PVC sewer pipe shall be permanently colour-coded green.
Do not use PVC pipe that is more than 24 months old.

.3) Polyethylene Pipe:

Polyethylene pipe shall only be used for sewer forcemain and shall conform to CSA B173.1, Type PE Series, as shown on the drawings.

.4) Corrugated steel pipe and fittings

Corrugated steel pipe and fittings shall only be used for underground detention systems, high live load and/or cover deficient installations, water retaining embankments, storm sewer outfalls and other similar special applications where the use and details are specified on engineering drawings approved by the Engineering Services Division. Corrugated steel pipe and coatings shall conform to Section 1700 Culverts. Corrugated steel pipe through water retaining embankments shall be fitted with puddle flanges or approved cut-off collars.

2.2 Joints:

All joints shall conform to manufacturer's recommendations.

.1) Sanitary Sewers:

Concrete pipe joints shall be rubber gasketed conforming to ASTM C443. Lift holes in concrete pipe shall be made water tight with mortar from the inside and outside.

Polyvinyl chloride (PVC) pipe joints shall be locked-in elastomeric gaskets conforming to ASTM C443/F477.

Polyethylene to polyethylene joints shall be thermal butt fusion welded according to manufacturer's instructions. Polyethylene to flanged fittings or pipe shall be made by a slip-on flange assembly. The flanged assembly shall consist of a polyethylene stub end, and metal slip on flange. The polyethylene stub end shall be butt fused to the end of the pipe and will be made of the same resin and of the same series as the remainder of polyethylene pipe. The slip-on metal flange shall be ductile iron, conforming with AWWA C203. It shall be faced and drilled to ANSI B16.1, 860 kPa, coated with coal tar enamel and over wrapped with Denso wrap.

SECTION 1300
SEWER MAINS AND APPURTENANCES

.2) Storm Sewers:

Concrete pipe joints shall be rubber gasketed conforming to ASTM C443 and installed as recommended by the manufacturer.

Lift holes in concrete pipe shall be made water tight with mortar from the inside and outside.

Polyvinyl chloride (PVC) pipe joints shall be locked-in elastomeric gaskets and conforming to ASTM F477.

.3) Concrete for pipe, mortar, anchors and underground structure concrete shall conform to CAN3-A23.1.

Cement shall be sulphate resistant, Type 50 conforming to CSA CAN3-A5.

Air entraining admixtures shall conform to CAN/CSA A23.2.

Minimum design strength shall be 25 MPa at 28 days for cast-in-place concrete and 27.6 Mpa for precast concrete.

.4) Corrugated Steel Pipe

Corrugated steel pipe joints shall conform to Section 1700 Culverts.

3.0 INSTALLATION

3.1 Excavation and Backfill:

.1) Keep the interior of pipes and fittings free of dirt and foreign matter. Cement shall be stored properly to prevent dampness.

.2) Do no lay pipe in water or on frozen trench bottom or when in the opinion of the Engineering Services Division the trench conditions or the weather conditions are unsuitable for such work.

.3) Carry out excavation and backfill in full conformance with the relevant sections of these specifications.

.4) Comply with all requirements of:

- City of Estevan bylaws;
- Occupational Health and Safety Regulations

.5) Maintain trench excavation and bedding preparation a sufficient distance ahead of pipe installation to avoid interference.

.6) Pipe bedding shall be Class B unless specified otherwise on the drawings.

SECTION 1300
SEWER MAINS AND APPURTENANCES

3.2 Pipe Installation:

.1) Concrete or Polyvinyl Chloride:

Commence laying at lower end of line, lay pipes and specials true to line and grade, bell ends up grade – spigot ends down grade, joints close and evenly butted all around pipe. Take special care to prevent sagging of spigot end in hub and provide true, even invert surface throughout entire length of sewer without settlement. Excavate at end of each pipe to provide rest for socket, sufficient to permit proper jointing.

Set each pipe with measuring rod and sight rails set at equal height from grade line. Adjust pipe until sight rails and top of rod are exactly in line while rod is held plumb and to invert of pipe. Set pipe true to line by plumbing down from a taut cord fastened to sight rails or reference line. Provide at least three sight rails during construction of any section of sewer. Do not lay pipe until all sight rails line through correctly. Fabricate sight rails of substantial material and pin to prevent any variation from preset grades. Other methods of establishing lines and grades may be used subject to the approval of the Engineering Services Division. Before leaving work at anytime, close end of sewer with plug to prevent entry of water and foreign matter. Do not backfill until the pipe installation has been approved by the Engineering Services Division.

.2) Polyethylene Pipe:

Install polyethylene pipe in accordance with manufacturer's instructions. Provide copies of manufacturer's directions on site for reference. Obtain technical assistance from manufacturer or representative during jointing of pipe by thermal butt-fusion process.

Inspect all pipe and specials prior to jointing and remove all foreign materials from the inside.

After jointing, lower or snake the pipe into the trench, laying in the uphill direction unless otherwise approved by the Engineering Services Division. Open sufficient trench ahead of the pipe to avoid excessive stresses in the pipe during lowering in.

Take measures in accordance with the manufacturer's instructions to avoid excessive temperature differentials which may result in expansion or contraction between pipe during jointing, laying in and final operating conditions. Install pipe so that it will accommodate future expansion and contraction after backfilling.

SECTION 1300
SEWER MAINS AND APPURTENANCES

.3) Corrugated Steel Pipe
Corrugated Steel Pipe shall be installed in accordance with the manufacturer's recommendations and conform to the provisions of Section 1700 Culverts.

.4) Junctions and Risers:

Install junctions and risers where required in sewer mains using prefabricated "T" branches or "Y" branches. Strap-on saddles are not acceptable. Place vertical wooden 50 mm by 50 mm markers opposite the risers and extending from the bottom of the trench to approximately 300 mm above ground surface.

3.3 Connection to Existing Sewers and Appurtenances:

Make connections to existing pipes, manholes and structures as indicated on the drawings without causing damage to the structure. Perform all excavation, backfilling, pipe cutting, jointing, demolition, repair and other work required. After making connections fill all openings completely with grout.

Openings for pipes shall not exceed pipe diameter by more than 50 mm in any direction. Restore and reconstruct benching.

3.4 Augered, Bored or Tunnelled Pipe

Install in conformance with Section 1600 Augered, Bored, or Tunnelled Mains.

4.0 TESTING

4.1 General:

Carry out the following tests after completion of backfilling, witnessed by the Engineering Services Division. Assist the Engineering Services Division in preparing a log documenting all tests completed. The log shall be the property of the City and kept for record purposes. One copy shall be turned over to the Contractor for his records. All repairs and replacements necessary within the maintenance period shall be the responsibility of the Contractor.

4.2 Procedure:

.1) Maximum Acceptable Deviation From Line:

Sewers shall be laid to the grade and alignment shown on the drawings and/or staked in the field by the Engineering Services Division.

Lasers, batter boards and boning rod or survey techniques must be used to transfer the grade and alignment to the pipe.

SECTION 1300
SEWER MAINS AND APPURTENANCES

Check each pipe length by the above methods during construction.

Acceptable deviations from these lines for any manhole to manhole section shall be:

<u>Pipe Size</u>	<u>Allowable Vertical Deviation</u>	<u>Allowable Horizontal Deviation</u>
Up to and including 300 mm	15 mm	50% of pipe dimension
375 mm - 525 mm	25 mm	50% of pipe dimension
600 mm - 1200 mm	50 mm	50% of pipe dimension
1350 mm and greater	75 mm	50% of pipe dimension

In all cases, variation from vertical alignment resulting in a reverse sloping invert is unacceptable.

Correct misalignment beyond these limits by re-excavation and re-laying the pipe.

.2) Obstruction:

Test sewer mains for obstructions using a ball test. The sewer main shall be deemed unobstructed if a wood or metal ball having a diameter of 50 mm less than the inside diameter of the pipe can be readily pulled through the sewer main.

.3) Deflection Test:

The Engineering Services Division may require the Contractor to perform random deflection tests of pipe before final acceptance. Where closed circuit television inspection indicates excessive deflections, the Engineering Services Division shall require the Contractor to perform a deflection test in that section of pipe. All locations with excessive deflection shall be excavated and repaired by rebedding or replacement of pipe. All deflection testing shall be in accordance with CSA Standard B182.11-95. To ensure accurate testing, the lines must be clean.

.4) Exfiltration:

.1) Ten (10%) percent of all sanitary sewer mains may be tested for exfiltration. The exfiltration test and records shall be conducted in accordance with the City's procedure for Leakage Testing of Gravity Sewers.

.2) The maximum allowable exfiltration for 200 mm to 600 mm diameter pipe is 4.6 liters/day/mm/km per CSA Standard B182.11.

SECTION 1300
SEWER MAINS AND APPURTENANCES

For larger than 600 mm pipe, the maximum allowable exfiltration rate is 55 liters/day/mm/km. A tested section of sanitary sewer exceeding this limit shall not be accepted. Sections on either side of the failed section shall be immediately tested. The test failed section of the sewer line shall be rectified and retested.

- .3) Ten (10%) percent of all sanitary sewer manholes may be tested for exfiltration potential in terms of their integrity of installed materials and construction procedures. The test procedure shall be as per ASTM 1244M-93 or the City's Hydrostatic Water Leakage Test procedure.

If the manhole leakage rate is excessive, the Engineering Services Division shall require the manhole to be repaired or reconstructed. Retesting shall proceed until a satisfactory test is obtained.

- .5) Visual Inspection and T.V. Inspection:

This test conducted by the City shall consist of the following:

- (i) Inspection of all in-place sewers, for installation/material defects;
- (ii) Inspection by closed circuit T.V. camera for pipes 750 mm diameter and smaller. Pipes 900 mm diameter and larger shall be toured and viewed directly;
- (iii) The Contractor may obtain documentation of all particulars, including service connections upon making a request and payment of costs.

- .6) Cleaning Sewer Mains:

Upon completion, flush all sewer mains, appurtenances and service connections, until all deposits of earth and/or debris are removed. Whenever practicable, flush mains in sections not in excess of 250 m in length. If the new work connects to an existing system, plug the out-going line of the last manhole of the new work and remove dirt and debris there. Do not permit debris from new construction to enter the existing system. During flushing check all manholes for depth of flow and if any flow is greater than the anticipated flow, check for obstructions in pipe line. Repair all defects in construction.

SECTION 1300
SEWER MAINS AND APPURTENANCES

5. MANHOLES AND CATCHBASINS

5.1 MATERIALS

- .1) Precast Manhole or Catchbasin Sections (bases, barrels and grade rings):

Designed and constructed to the requirements of ASTM C478 with dimensions shown on the drawings and/or as designated by the Engineering Services Division in the field. Cement shall be Type 50 Sulphate Resistant Portland Cement meeting CAN/CSA-A5/A8/A362-M89.

Precast concrete box bottom sections shall conform to the requirements of ASTM C789 for the live load and earth cover specified on the drawings and/or the schedule of Unit Prices.

- .2) Sewer Manholes:

All sewer manhole sections shall have single offset or grooved "O" ring rubber gasket joints manufactured in accordance with the provisions of ASTM C443. A rubber gasket shall be provided with each manhole section which is supplied. The use of other joints sealants such as "Ram Nek" will require prior written authorization of the Engineering Services Division.

- .3) Frames and Covers:

- (a) Close-grained grey cast iron meeting ASTM A48, Class 20 or cast steel conforming to ASTM A27, Grade 70-36.

All frames and covers shall be true in form and dimension, free from faults, sponginess, cracks, blow holes, and other defects. Bearing surfaces shall be machined to prevent rocking.

Frames and covers shall be hot dipped in asphaltic varnish.

- (b) Types of Frames and Covers:

- (i) Manholes: Norwood Foundry F-39.
(ii) Catchbasins: Norwood Foundry F39, F51, F60, F51 C/W stormback Tyton Foundry: Type K, Type K2.

- (c) Manhole Steps:

Safety type conforming to CSA G30.12-M billet steel deformed bars, 19 mm in diameter, hot dip galvanized, after fabrication, conforming to CSA G164.

SECTION 1300
SEWER MAINS AND APPURTENANCES

- (d) Concrete (Cast-In Place):

Concrete shall conform to the following:

<u>Type of Cement</u>	<u>Type 50 Sulphate Resistant Portland Cement</u>
Specified strength	25 MPa
Air	$6.5 \pm 1\%$
Maximum water/ cementing materials ratio	0.50
Specified slump	$70 \text{ mm} \pm 10 \text{ mm}$

- (e) Mortar:

One (1) part Type 50 Sulphate Resistant Portland Cement to three (3) parts clean sharp sand, mixed dry. Sufficient water shall be added after mixing to give optimum consistency for placement. No additives shall be used.

- (e) Reinforcement:

Details for reinforcing to be used in cast-in-place concrete shall be submitted and approved by the Engineering Services Division prior to construction.

Reinforcing steel shall be intermediate grade deformed bars ($f_y = 300 \text{ MPa}$) conforming to CSA G130-12M.

- (f) PVC Pipe/Manhole Adaptor Ring for connecting PVC pipe to manholes or catchbasins as supplied by pipe manufacturer.
- (h) Sealing compound shall be preformed plastic "Ram-Nek" or approved equal to seal joints between pre-cast concrete sections.

- .4) Catchbasin Lead Pipe:

Minimum catchbasin lead size to be 250mm diameter

5.2 INSTALLATION

- .1) Install all manholes and catchbasins in accordance with the standard drawings, of the type and diameter specified. The exact location of manholes and catchbasins shall be indicated by the Engineering Services Division in the field.
- .2) Where no road grades exist for the location at which the sewer is being constructed, the elevation of rims will be indicated on the design plans and/or grade sheet. Construct manholes or catchbasins such that the rim elevation conforms accurately to the elevation specified. Set manhole and

SECTION 1300
SEWER MAINS AND APPURTENANCES

catchbasin frames within ± 6 mm of correct grade and to match proposed roadway cross slopes as directed.

- .3) Support pipes at manholes and catchbasins to prevent shearing or settlement. Where not detailed, use concrete fill, concrete or temporary timber beam, suitable compacted gravel or site material as approved by the Engineering Services Division. During construction, plug pipes at manholes and catchbasins to prevent entry of concrete or mortar. Remove plugs immediately after construction is completed.
- .4) Construct manholes and catchbasins to details shown on standard drawings.
- .5) Lay half sewer pipe through manhole upon precast base. Use an adaptor ring at all pipe entrances into manholes and catchbasins. Channel or bench manhole invert with mortar to provide for uninterrupted flow. Use mortar to construct benching to conform to details on standard drawings. Benching for pipes in excess of 600mm diameter need only be constructed from pipe invert sloped up to manhole walls at 10%.
- .6) Use only precast concrete grade rings to raise manholes or catchbasins covers to the finished grade.
- .7) Seal all sections of catchbasins and manholes with O-Ring gaskets or "Ram-Nek" (if pre-approved) and use mortar to bond sections and fill all spaces and joints. Ensure that manholes and catchbasin assemblies are watertight. Firmly embed rungs in the manhole and catchbasin structure 400mm on center vertically. Set perpendicular to flow and as shown on standard drawings.

6.0 MEASUREMENT AND PAYMENT

- 6.1 The following work items in this section shall be paid in accordance with the Contract Unit Prices, which shall be deemed full compensation for all labour, materials, equipment, supplies, superintendence, overhead and profit for all work incidental to the supply, installation, completion and maintenance during warranty period of the respective items.
 - (i) Sewer pipe shall be paid on the basis of lineal meters of pipe of various diameters in place, measured from manhole centerlines between T-riser manholes or from the exterior wall surfaces of the bottom manhole barrel or box between other manholes, or a combination thereof between standard and T-riser manholes, at installed depth ranges. Depth ranges shall be computed as an average of depths at the same interval as layout survey states marked on grade sheets surveyed by the Engineering Services Division, and supplied to the Contractor, between manholes or

SECTION 1300
SEWER MAINS AND APPURTENANCES

between manholes and stub ends. The depths shall be measured from ground surface just prior to construction to the final pipe invert.

The Contract Unit Price shall be deemed to include trench excavation and backfill, pipe, specially cast or fabricated fittings, connections, testing, flushing, restoration of surface and all work incidental to a complete installation, but excluding pipe where the pipe is supplied by the owner.

(ii) Manholes shall be paid on the basis of lineal vertical meters of manhole depth measured from:

- the underside of the manhole frame to the invert of the lowest pipe in the manhole except T-riser manholes. No payment will be made for pipes within manholes and/or used to form benching; and
- measured from the underside of the manhole frame to the obvert of the main outgoing sewer pipe for T-riser manholes. Payment for the pipe portion of T-riser manholes is included with the quantity of pipe measured for pipe installation; or
- as a lump sum quantity per manhole of the type and size of bottom barrel or box in accordance with the Contract Unit Prices.

The Contract Unit Price shall be deemed to include trench excavation and backfill, manhole concrete sections (bases, risers and grade rings), adaptor rings, connections, benching, adjustments, specially cast or fabricated fittings, unshrinkable fill, testing, flushing, restoration of surface and all work incidental to a complete installation.

(iii) Catchbasins shall be paid on the basis of type, barrel diameters, number and single or twin assemblies.

The Contract Unit Price shall be deemed to include trench excavation and backfill, catchbasin concrete sections (bases, risers and grade rings), adaptor rings, connections, unshrinkable fill, adjustments, twin assembly interconnecting pipe, flushing, restoration of surface and all work incidental to a complete installation.

(iv) Frame and cover assemblies shall be paid on the basis of type, number and single or twin catchbasin assemblies. The Contract Unit Price shall be deemed to include costs of all work incidental to a complete installation.

(v) Connection to existing manhole, catchbasin or sewer main shall be paid on the basis of the type, diameters and number. The Contract Unit Price shall be deemed to include break-out existing structure or plug, removal of necessary portions, making the connection, reconstruction as necessary, benching, regrouting, adaptor rings, adjustments, patching, unshrinkable

SECTION 1300
SEWER MAINS AND APPURTENANCES

fill, flushing, surface restoration and all work incidental to a complete installation.

- 6.2 All remaining work items described in this section shall be deemed incidental to the items in Article 6.1 of this section.