

DIVISION 8 - WATER & SEWER		
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08000-1 **SCOPE**

This Section includes the procedures for obtaining Product Approval and describes certain general materials which have been approved for use in the construction of water and sewage mains in the City of Saskatoon. This Section shall be read in conjunction with Sections 08001, Construction Materials - Water Mains and 08002, Construction Materials - Sewage Mains. Materials which have not been approved for use in any of these three Sections, may only be used with the written approval of the General Manager, Infrastructure Services.

08000-2 **NEW MATERIAL**

All material supplied under this Contract shall be newly manufactured and free from all defects. Salvaged materials from prior use will not be accepted. Materials which have been in storage may not be accepted unless the Supplier can demonstrate that the materials have not been damaged in any way during storage.

08000-3 **PRODUCT APPROVAL**

Suppliers wishing to have a product approved for use in the City of Saskatoon shall submit the following items:

1. A description of the product including detailed drawings and specifications.
2. A sample of the product.
3. Test results indicating compliance with the industry standard specifications such as AWWA, ASTM or CSA. Tests shall be certified by a Professional Engineer from an independent testing firm.

4. A list of users who may be contacted with respect to the product's performance.

At least 8 weeks will be required to evaluate the product. Approval for use in the City of Saskatoon shall be at the discretion of the General Manager, Infrastructure Services.

08000-4 CORROSION PROTECTION

4.1 Asphaltic Coatings

Ferrous metal products for buried installation shall be coated with asphaltic varnish in accordance with Section 10-8.1 of AWWA C110-82.

4.2 Field Coatings

Field coatings shall be Denso paste and tape as supplied by DENSO of Canada Ltd., POLYKEN 927 primer and POLYKEN 932 tape, or approved equal.

4.3 Bolts

Bolts which will be used as a fastening device on any material which will be buried underground shall be type A-304 stainless steel as per ASTM A276.

4.4 Anodes

Galvanic Zinc anodes shall generally be comprised of an insulated electrical copper lead wire, Type II zinc casting, a cardboard tube, and low resistivity backfill. References to the weight of the zinc anode shall be understood to mean the weight of the zinc in the package anode.

The anode lead wire shall be a minimum 3.0 meters of No. 10 American Wire Gauge (AWG) Standard (7 Strand) Copper wire with white TWU minus 40 Degree Centigrade insulation conforming to CSA C22.2 No 75.

Galvanic Zinc anodes shall be made of zinc conforming to ASTM B418-09 Type II. The Anode shall have the following composition:

Aluminium	0.0005% Maximum
Cadmium	0.0003% Maximum
Iron	0.0014% Maximum
Lead	0.003% Maximum
Copper	0.002% Maximum
Zinc	Remainder

Anode composition shall be determined by an independent testing laboratory and test results verifying compliance with these specification shall be provided. Sampling and methods of zinc anode chemical analysis shall be on accordance with ASTM B418-09.

The zinc shall be cast directly around a minimum of 3.17 mm diameter galvanised steel core. The lead wire shall be connected to the steel core with silver solder and the connections shall be insulated by filling the recess and any voids in the lead wire connection with an electrical potting compound.

The anode shall be packaged in a rugged water permeable cardboard tube with a minim wall thickness of 2.3 mm. The diameter and length of the cardboard tube shall suit the dimensions of the zinc casting and backfill material so that a minimum 25 mm of backfill is provided between the anode and the tube.

Plastic spacers shall be used to centre the anode. The tube ends shall be sealed with plastic caps.

Anode backfill shall be low resistivity (45 ohm-cm Max) gypsum/bentonite backfill to the following:

Ground Hydrated Gypsum	75-77%
Powdered Wyoming Bentonite	15-20%
Anhydrous Sodium Sulphate	5-8%

The backfill shall have a grain size so that 100% is capable of passing through a 20 mesh screen and 50% will be retained by a 100 mesh screen. The backfill shall be firmly packaged around the anode by means of adequate vibration. Back fill material shall be sufficient quantity to cover all zinc anodes surfaces.

The anode shall be marked with the manufacturer's name, location, type of anode (Type II to ASTM B418-09 zinc), Zinc weight, date of manufacture and lot number.

08000-5 INSULATION

Insulation shall be closed-cell, rigid sheets manufactured from polystyrene foam or approved equal suitable for buried installation. The material shall conform to the following specifications:

Thermal Resistance 1.74 °C/m²/50 mm as per ASTM C177 and C518.

Compressive Strength 275 kPa (min.) as per ASTM D1621.

Shear Strength 200 kPa (avg.) as per ASTM D1621.

Water Absorption 0.7% by volume (max.) as per ASTM D2842.

08000-6 **GEOTEXTILE**

The Geotextile which may be used in trenches to separate aggregates shall be a 100% polyester, non-woven, needle punched engineering fabric with a minimum thickness of 1.90 mm. .

08000-7 **GRANULAR MATERIALS**

Granular materials shall consist of fragments of durable rock and shall be free from undesirable quantities of soft or flaky particles of shale, loam, organic or other deleterious material.

7.1 **Pipe Bedding**

Specifications for pipe bedding aggregate are contained in the Aggregates Specifications 03001-3.2.7 “Pipe Bedding Aggregate”.

7.2 **Street Surface & Base Gravel**

Specifications for gravel to be used for pavement base and street surfacing are contained in the Aggregates Specifications 03001-3.2.2 “Base Aggregate”.

7.3 Crushed Rock

Specifications for crushed rock to be used for the stabilization of the trench bottom or otherwise as directed by the Engineer are contained in the Aggregates Specifications 03001-3.2.8 “Crushed Rock”.

7.4 Plaster Sand

Specifications for sand to be used in the production of plaster or mortar are contained in the Aggregates Specifications 03001-3.2.6 “Plaster Sand”.

08000-8 NON SHRINK / UNSHRINKABLE FILL

Specifications for unshrinkable fill are contained in the Aggregates Specifications 03001-3.2.10 “Unshrinkable Fill”.

08000-9 CONCRETE

Type 50 sulphate resistant cement shall be used in the manufacture of ready mixed concrete and all other concrete products used.

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08001-1 **SCOPE**

This Section describes materials which have been approved for use in the construction of 150 mm to 300 mm diameter water mains in the City of Saskatoon. The material shall be suitable for use in a potable water system.

08001-2 **PIPE**

2.1 **Polyvinyl Chloride (PVC)**

PVC pipe shall be designed for a working pressure of 1035 kPa and may be used for all sizes from 150 mm to 300 mm diameter. The joint shall be bell and spigot type. The pipe shall be supplied with factory installed elastomeric gasket in the bell end. The pipe shall conform to AWWA C900-81.

2.2 **Polyethylene**

Polyethylene pipe may be used in special cases when approved by the General Manager, Infrastructure Services. Polyethylene pipe shall conform to the most current Canadian Government Specification No. 41-GP-25m. Joints shall be butt fused in accordance with the manufacturer's recommendations. Mechanical joints will only be allowed at valves and other locations approved by the Engineer.

08001-3 VALVES

3.1 Gate Valves

Gate valves shall be designed for a working pressure of 1035 kPa and shall be suitable for buried service on horizontal mains.

The valve body shall be grey cast iron according to ASTM A126-04 class B. The valve shall have a non rising stem and "O"-ring stem seals.

Valves shall be supplied with all rubber gaskets required for installation in compliance with ANSI/AWWA C111/A21.11.

External bolts shall be Type 304 stainless steel.

The valve shall be operated by a 50 mm square operating nut which shall turn counter clockwise to open.

3.1.1 Double Disc Valves

In addition to the above specifications, double disk valves shall conform to AWWA C500-80 and all current revisions. The valves shall be bronze mounted with a bronze gate. The manufacturer shall supply information in compliance with Section 1.4 of AWWA C500-80. At the time of delivery, the manufacturer shall supply information in compliance with Section 2.2 and 5.2 of AWWA C509-87.

3.1.2 Resilient-seated Valves

In addition to the above specifications, resilient-seated valves shall conform to AWWA C509-87. The manufacturer shall supply information in compliance with Section 1.4, 1.5 and 6.2 of AWWA C509-87. At the time of delivery, the manufacturer shall supply information in compliance with Section 6.3 of AWWA C509-87.

3.2 Butterfly Valves

Butterfly valves which are suitable for buried installation and operation on horizontal mains may be used for 300 mm water mains and shall conform to AWWA C504-80 for Class 150 B valves.

Valves shall be supplied with all gaskets and bolts required for installation.

The valves shall be iron body with stainless steel shaft and "O"-ring stem seals. The disk shall be cast iron with rubber or stainless steel seating edge. External bolts shall be Type 304 stainless steel.

The valve shall have a manual operator with non rising stem and 50 mm square operating nut which shall turn counter clockwise to open.

3.3 Valve Boxes

Valve boxes shall be the sliding type with cast iron top section and boot. The middle section may be either cast iron or steel. The minimum wall thickness shall be 4.6 mm and the box shall extend from 2440 mm to 3280 mm. The boot shall have a minimum inside diameter of 190.5 mm for 150 mm to 200 mm valves and 215.0 mm for 250 mm to 300 mm valves. The valve box shall be supplied with a cast iron cover.

The operating rod shall be solid steel, 32 mm square, with a 50 mm square operating nut and socket. The operating nut shall be connected to the top of the rod with a brass cotter key. The socket at the bottom shall be connected with a 9 mm stainless steel bolt and nut. For water mains and connections at 3 metre depth, the total length of the rod including nut and socket shall be 2130 mm. For water mains and connections at depths more than 3 metres, the top of the extension rod shall not be more than 600 mm or less than 300 mm below the top of the valve box. The rod shall be supplied with stone and centring disks.

All castings shall be clean and sound. A 15 mil (minimum) fusion bonded epoxy coating shall be applied to the top, bottom and mid-sections as follows:

The fusion bonded epoxy coating and its application shall conform to AWWA Standard C213-96 and all current revisions. The coating shall be a 100% solid, thermosetting, fusion bonded, dry powder epoxy resin, approved for contact with potable water by the National Sanitation Foundation (NSF). Powders shall be one of the following products or an approved equal:

Valspar, D 1003 LD

Valspar, G 1003 RB

Nap-Gard Mark X 7-2500

3M, Scotchkote 134

Surface Preparation shall conform to Sec. 3.2 of AWWA Standard C213-96 and all current revisions. Coatings shall be applied to a preheated surface by the fluidized bed method or the electrostatic powder spray gun method. The coating thickness shall be 0.50mm (15 mil) minimum, 0.64mm (20 mil) maximum.

08001-4 HYDRANTS

Hydrants shall conform to AWWA C502-80 and shall have a compression type main valve of 127 mm nominal diameter which closes with water pressure. The stem and ground line flange shall be designed to break on impact. The operating nut shall be rotated counter clockwise to open the hydrant.

The hydrant shall have two 65 mm nozzles and one 114 mm pumper nozzle. The nozzle threads shall be to City standard, 6 threads per inch for 65 mm nozzles and 8 threads per inch for 114 mm nozzles. The operating nut on the top of the hydrant and on the nozzle caps shall be triangular and shall match the City of Saskatoon standard. Nozzle caps shall be fitted with chains or cables and shall be secured to the hydrant.

The inlet elbow (boot) shall be supplied with rubber gasket and shall be suitable for connection to 150 mm pipe. Hydrant Base Slabs Shall be 450 mm x 450 mm x 100 mm.

The length of bury, from the ground line flange to the bottom of the boot, shall be 2900 mm. The hydrant barrel, and stem shall be capable of extension at the ground line flange.

The hydrant shall be painted with two coats of highway yellow enamel. Bolts and/or studs and nuts below ground shall be A304 stainless steel.

08001-5 FITTINGS

The following fittings may be used on distribution mains up to 300 mm diameter:

5.1 Cast Iron

Cast iron fittings shall conform to AWWA C110-82 and shall be suitable for working pressure of 1035 kPa.

The fittings shall be cast from grey iron only with rubber gasket joints conforming to AWWA C111-80. Gaskets shall be supplied with the fitting. The fittings shall be coated with asphaltic varnish.

5.2 Polyvinyl Chloride

Polyvinyl Chloride fittings shall be HARCO Class 150 as manufactured by the Harrington Corporation, or approved equal.

5.3 Fabricated Fittings

Fabricated fittings, manufactured in accordance with the requirements of AWWA C900-97, may be used on distribution mains from 150mm to 300mm diameter. Such fittings shall meet the testing requirements of CSA specification B137.3. Upon request from the Engineer, proof of compliance with testing requirements shall be provided.

Fabricated fittings, manufactured in accordance with the requirements of AWWA C905-97, may be used on distribution mains from 400mm to 1200mm diameter on a project to project basis as determined by the Engineer. Such fittings shall meet the testing requirements of CSA specification B137.3. Upon request from the Engineer, proof of compliance with testing requirements shall be provided.

08001-6 **PIPE COUPLINGS**

Pipe couplings shall be manufactured in compliance with AWWA 219-91 or the most current specification. The Coupling shall be supplied with a center ring and end plates produced from either Ductile iron conforming to ASTM A536-84, Carbon steel conforming to ASTM A512 and A53 with a yield strength of 30,000 psi or Cast Iron Conforming to ASTM A97 Grade 32510 or 35018. The center ring shall be clearly and permanently marked with the manufacturers name and OD range. Gaskets shall be made of virgin rubber for water service and have a good shelf life with antioxidant and antiozonant properties. Gaskets shall be clearly and permanently marked with the nominal size, pipe OD working range, and the manufacturers' name. The Gaskets shall conform to ASTM D2000 compound, AWWA C111 SBR Buna S and EPDM Gasket Grade E.

Couplings shall have the following overall lengths and bolt numbers:

Nominal Size <u>mm (inches)</u>	Minimum Overall Length <u>mm (inches)</u>	Minimum No. of bolts <u>16 mm (5/8")</u>
100 (4)	140 (5.6)	4
150 (6)	178 (7)	4
200 (8)	175 (6.9)	5
250 (10)	175 (6.9)	6
300 (12)	175 (6.9)	8
350 (14)	180 (7.1)	9
400 (16)	180 (7.1)	10

All couplings shall be supplied complete with cap anodes for each bolt on the coupling. The Anodes shall be Zinc complying with ASTM B418-09 Type II and shall be a minimum of 300 grams.

Bolts shall be a minimum of 16 mm (5/8") diameter track head type. Bolts and nuts shall be made of high strength, low alloy steel with NC thread and heavy hex nuts conforming with the AWWA C111-85 standard. The bolt length shall be sufficient to allow for the installation of anodes following installation of the coupling.

The center ring, end plates and bolts shall be factory coated with either fusion bonded epoxy or nylon coating. The requirements for each option are as follows:

Fusion bond epoxy coating shall conform to the AWWA C213-85 standard. The coating thickness shall be 0.30 mm (0.012") minimum and 0.50 mm (0.020")

maximum. Electrical conductivity must be provided between bolts and end plates and between end plates by removing a small portion of the coating from under the nut bearing area. Each end plate shall be provided with one 6 mm (1/4") NC cadmium plated set screw for electrical conductivity between the end plate and the center ring.

Or

Nylon coating shall conform to Rilsan Nylon 11 in compliance with Wis 4-53-02 Part 1 shall be used to coat the body, end plates and bolts of the coupling.

Couplings shall be packaged and delivered as a complete unit (i.e.: center ring, gaskets, and end plates, nuts, bolts and anodes shall be packaged as a single unit). Couplings shall be available for all nominal pipe sizes between 100 mm and 400 mm (4 to 16 inches) to accommodate cast iron, PVC, rough barrel and machined end asbestos cement class 150 and standard steel pipe.

08001-7 **REPAIR COUPLINGS**

Repair couplings shall be Robar 5600 or approved equal.

The material of the repair coupling shall be fully passivated all Stainless Steel construction. Gaskets shall be full wrap-around SBR (Buna S) rubber gaskets. Fasteners shall be T304 Stainless Steel material.

Repair couplings shall have a minimum length to diameter ratio of 1.5:1.

END OF SPECIFICATION 08001

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08002-1 **SCOPE**

This Section describes materials which have been approved for use in the construction of gravity, sanitary and storm sewage mains in the City of Saskatoon. Sewage force mains shall be constructed using pressure pipe, as described in Section 08001, Construction Materials - Water Mains.

08002-2 **CONCRETE**

Notwithstanding the provisions of any other specification, Type 50 sulphate resistant cement shall be used in the manufacture of concrete sewer pipe, manhole barrels and other concrete products described herein.

08002-3 **SEWER PIPE**

The minimum size of pipe which shall be used for the construction of sanitary sewage mains, catch basin lead and storm sewage mains shall be 200 mm, 250 mm and 300 mm respectively.

3.1 **Polyvinyl Chloride (PVC)**

PVC pipe shall conform to ASTM D3034-08. The SDR shall not be greater than 35. The pipe shall be supplied with factory installed rubber gaskets.

3.2 **Reinforced Concrete**

Reinforced concrete pipe shall be manufactured according to the 5 classes in ASTM C76M-08a or for a specific D-load in ASTM C655M-09.

Pipe larger than 1200 mm shall have a tapered lift hole. A tapered plug shall be supplied to seal the hole. No portion of the plug shall extend into the pipe.

The laying length of standard pipe sections shall not be less than 1.8 m. Bevelled pipe for laying on curves shall be either standard length or one-half standard length. The tolerance on the bevel shall not exceed ± 0.001 of the pipe diameter.

3.2.1 Joints

Joints shall be the rubber gasket type.

For pipe installed with less than 6 m of cover, the joints shall conform to either ASTM C443M-07 or ASTM C361M-08.

For pipe installed with 6 m of cover or more, the joints shall be confined in a spigot groove in accordance with Section 8.4 of ASTM C361M-08.

3.2.2 Basis of Acceptance

Unless otherwise specified acceptance shall be based on tests described in either ASTM C76M-08a or ASTM C655M-09.

All tests shall be certified by an independent testing firm.

3.3 Polyethylene Pipe

Polyethylene pipe may be used in special cases when approved by the General Manager, Infrastructure Services.

Polyethylene pipe shall conform to the current Canadian Government Specification No. 41-GP-25m. Joints shall be butt fused in accordance with the manufacturer's recommendations.

08002-4 STANDARD 1200mm MANHOLES

Precast reinforced concrete manhole barrels, top sections, bases and grade rings shall be manufactured in accordance with the requirements of ASTM Specification C478M-09 and all current revisions.

Twenty (20) mm diameter ribbed, extruded aluminium step rungs, equal to Model 350 Climbing Step as manufactured by MSU Mississauga or an equivalent as approved by the General Manager, Infrastructure Services, shall be installed in all manhole barrels.

Step rungs shall be uniformly spaced with centres not more than **305** mm apart.

A minimum clearance of 150mm shall be maintained between the rungs and the manhole barrel.

Notwithstanding the provisions of ASTM C478M-09, the barrels, bases, top slabs and grade rings shall be manufactured in accordance with the dimensions and details shown on current City of Saskatoon Standard Drawings as posted on the City's Internet web site.

Inserts, approved by the General Manager, Infrastructure Services, shall be installed in all manhole barrels for the purpose of lifting and installing the barrels. Manhole sections and catch basins shall NOT be equipped with lift holes.

Further to the requirements of article 17 of ASTM C478M-09, the specification designation, the name or trade mark of the manufacturer and the date of manufacture shall be clearly marked, with waterproof paint, on the inside surface of each manhole and catch basin section.

Manhole Safety Platforms, where required, shall be manufactured in accordance with the detailed drawing supplied with these specifications.

4.1 1050 mm Manholes

Notwithstanding the provisions of ASTM Specification C478M-09, all 1050 mm diameter manhole barrel sections shall be manufactured with a minimum wall thickness of 89 mm (ASTM Class "A" Wall). The top section shall be concentric reducing from 1050 mm to 600 mm. Steps shall be spaced at **406** mm and staggered on opposite sides of the barrel.

4.2 1200 mm Manholes

Notwithstanding the provisions of ASTM Specification C478M-09, all 1200 mm diameter manhole barrel sections shall be manufactured with a minimum wall thickness of 127 mm (ASTM Class "B" Wall). The top section shall be eccentric reducing from 1200 mm to 600 mm. Steps shall be spaced at 305 mm, in line, along one side of the barrel.

All 1200 mm manhole barrel sections shall have single offset or grooved O-ring rubber gasket joints manufactured in accordance with the provisions of ASTM Specification C443M-07 and all current revisions. The offset or O-ring rubber gasket shall be approved by the General Manager, Infrastructure Services prior to manufacture and acceptance of the manhole barrels. A rubber gasket shall be provided with each manhole section which is supplied.

4.3 Cast Iron Frame and Cover/Grate

Castings shall be grey cast iron and shall be clean, sound and coated with asphaltic varnish.

4.3.1 Manhole Frame and Cover

1. The manhole frame and cover shall be manufactured in accordance with the dimensions shown on current City of Saskatoon Standard Drawings as posted on the City's Internet web site.
2. Castings shall conform to all requirements of ASTM designation A48M-00 class 20B.
3. Castings shall be produced to the dimensions and within the tolerances noted.

4. Castings shall be marked with the proper identification markings which will include:
 - Foundry identification markings and year of casting
 - Markings shall be so located in such a manner and of such size that they are easily identifiable after installation
5. All castings shall be free of defects, be true to pattern and be free from cracks, gas holes, flaws and excessive shrinkage. Surfaces of castings shall be free from burnt- on sand and shall be reasonably smooth.
6. Castings shall not rock when installed. The manufacturer shall trial fit the castings against a standard frame.

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08003-1 WATER SERVICE

1.1 Pipe

This Section applies to materials used in the construction of service connections to City water mains. Connections larger than 50 mm shall conform to Section 08001.

Pipe used for water service shall be either copper tubing, minimum size 19 mm, or polyethylene tubing, minimum size 25 mm.

1.1.1 **Copper**

Copper tubing shall conform to ASTM B88 for Type K soft copper.

1.1.2 **Polyethylene**

Polyethylene tubing shall conform to ASTM D2737-03 for materials designated PE2306, PE3306, or PE3406. The SDR for the tubing shall be 9.

1.2 Valves and Fittings

Main stops, curb stops and unions shall conform to AWWA C800-84 and shall be made of brass. Connections shall be the compression type suitable for use with either Type K copper or polyethylene tubing. Compression couplings shall be MUELLER 110, EMCO "Successor", FORD "Pack Joint" or approved equal.

1.2.1 Main Stops

Main stops shall have a standard AWWA inlet thread and a compression coupling on the outlet.

1.2.2 Curb Stops

Curb stops shall be either the ball valve type or plug type with "O"-ring seals and shall be non-draining. FORD Type B44, EMCO "Century", MUELLER "Oriseal" or approved equal shall be used.

1.2.3 Curb Boxes

All castings shall be clean and sound.

Curb boxes shall be the sliding type with steel pipe top and bottom sections. The top section shall be 32 mm diameter, schedule 40, type 304 stainless steel and the bottom section shall be 25 mm diameter, schedule 40, type 304 stainless steel. The sliding sections shall have a 3/8" stainless steel set screw. The box shall extend from 2460 to 2900 mm.

The curb box shall have a cast iron cover complete with 15mil (minimum) asphaltic varnish coating. The cover shall have a 25 mm threaded hole fitted with a five sided brass plug through which the curb box key may be inserted when the plug is removed. The connection between the cover and top section shall be threaded.

The boot shall be cast iron complete with 15mil (minimum) epoxy coating throughout. Refer to current City of Saskatoon Standard Drawing as posted on the City's Internet web site for epoxy specifications. It shall be designed to rest on a base level with the bottom of the curb stop without touching the stop and service tubing. All castings shall be clean and sound. All parts shall be coated as specified.

For all new installations, the operating rod shall be a 2134mm (7ft) long stainless steel rod conforming to ASTM 304. For rehabilitation work, the operating rod shall be 2134mm (7 ft), 2438mm (8 ft) or 2743mm (9 ft) long stainless steel rod conforming to ASTM 304. At the top of the rod the sides shall be flattened to fit the curb box key.

The rod shall be 15mm in diameter for water service diameters up to and including 50mm.

The clevis shall be stainless steel conforming to ASTM 304. The clevis shall be machined or cast with a 17mm wide by 30mm deep by 30mm long slot to accept the curb stop. A hole shall be drilled in the clevis such that a 5/32" brass cotter key can be inserted to make a mechanical connection to the curb stop. The connection between the rod and clevis shall be made by forging a 1/2" wide square by 1/2" long end on the rod and inserting it into the mating hole in the clevis. The rod shall be held in the clevis by means of a 3/8" brass rivet.

1.2.4 Inserts

Inserts are required for polyethylene tubing at all compression couplings.

The inserts shall be polyethylene with SDR of 13 and length of 38 mm. One end shall be bevelled and the other end flanged. The flange shall be 9.6 mm wide and 1.6 mm thick.

1.2.5 Service Saddles

Service saddles shall be ROBAR 2606 or approved equal for PVC pipe. ROBAR 2786 isolating saddles or approved equal shall be used for iron and steel pipe.

1.2.6 Tapping Sleeve and Valve

Tapping sleeves shall be MUELLER H-615 or approved equal. Tapping valves shall be MUELLER H-667 or approved equal.

1.2.7 Curb Box Marker

Curb box markers shall be installed on new service connections in new subdivisions. Replacement curb boxes will not require installation of the curb box marker. The curb box marker shall be 25mm polyethelene tubing with a minimum length of 0.6 meters above ground. It shall be securely fastened to the curb box spindle using tape or zip ties, as shown in the Service Connection Standard Drawing posted on the City's Internet web site. The Contractor shall supply the markers and fastening materials unless otherwise directed by the Engineer.

08003-2 SEWER SERVICE

This Section applies to materials used in the construction of service connections to City sanitary and storm sewer mains. The minimum size of connection shall be 100 mm for sanitary and 150 mm for storm. Connections 200 mm or larger shall conform to Section 08002.

2.1 Pipe

2.1.1 Acrylonitrile Butadiene Styrene (ABS)

ABS pipe shall conform to CSA B181.1-73. The minimum SDR shall be 19. The pipe shall be supplied with rubber gaskets.

2.1.2 Asbestos Cement (AC)

This pipe material is not approved for use in new construction or reconstruction.

2.1.3 Polyvinyl Chloride (PVC)

PVC pipe shall conform to ASTM D3034-08. The SDR shall be 28 for all sizes less than 200 mm. The pipe shall be supplied with rubber gaskets.

2.1.4 Vitrified Clay Tile (VCT)

This pipe material is not approved for use in new construction or reconstruction.

2.2 Fittings

All bends shall be long radius PVC.

For connection of PVC, pipe couplings shall be PVC supplied with rubber gaskets. PVC to ABS connections shall be made with glued ABS coupling. "Fernco" couplings shall be used for connection of other sewer pipe materials.

2.3 Saddles

Saddles shall be supplied with seat and joint gaskets. When installed the saddle shall extend to the inner surface of the pipe wall but shall not protrude into the pipe.

2.3.1 PVC

Saddles shall conform to ASTM D3034-08 and the SDR shall be 28. The saddle shall be attached with two stainless steel straps tightened with a stainless steel screw assembly. Quick release mechanisms shall not be permitted.

2.4 Manholes and Catch Basins

Where required on service connections, manholes and catch basins shall conform to Section 08002 of these Specifications.

END OF SPECIFICATION 08003

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08010-1 **SCOPE**

The General Conditions, Specific Conditions and Material Specifications form an integral part of these Specifications and shall be read in conjunction herewith.

This Section shall include Sewer Connections Construction not regulated by Section 08025 wherein sewer service connections are greater than 150mm in diameter.

The Contractor shall supply all material, labour, equipment, plant and tools necessary to construct the gravity storm and sanitary sewers within and/or under the jurisdiction of the City of Saskatoon as required under its Contracts.

1.1 **Existing Infrastructure - Requirements and Fees**

Certain fees for inspection, tapping mains, pavement and concrete repair, detouring services and public liability insurance shall be charged by the City to the Contractor on completion of the work.

The contractor shall obtain the conditions of work and fee rates by contacting the City Construction Services Department at 975-2461 before estimating or commencing any particular project. The Construction Services Department will outline the requirements and fees so that the Contractor shall know in advance and the safety of the water and sewer system remains intact.

Before any work within the City Right-of-Way is performed, the Contractor shall have an approved permit "Use of Right-of-Way Permit". This permit shall be obtained by contacting the Infrastructure Services Connections Desk at 975-2460. There may be restrictions on times and dates that portions of Right-of-Way may be available and this will be outlined in the Use of Right-of-Way permit.

08010-2 **EXISTING UTILITIES AND STRUCTURES**

The location and elevation of existing underground utilities is compiled from records but is not guaranteed. Notwithstanding any other provision, the Contractor shall be responsible for determining at his expense the actual location and elevation of all

sewer, water and gas lines, power, telephone or telecommunications conduits, or other such structures or utilities whether or not shown on the plans. The Contractor shall be responsible for notifying the respective utility at least 48 hours in advance of his intention to carry out operations in the vicinity of the said utility and if required shall pay for any services supplied for locating these utilities.

When in the course of the work, existing utilities must, for reasonable cause, be temporarily disconnected, the Contractor shall be wholly responsible for notifying all persons affected, at least 48 hours in advance of the outage. The Contractor shall contact the utility owner who may disconnect the utility himself or supervise the Contractor during disconnection. In no case shall the Contractor operate any utility without the approval of the owner.

When a utility is exposed during construction, the Contractor shall immediately inform the owner of the utility, who may inspect the utility prior to backfilling.

Any accidental damage such as severing a cable, scraping the coating on an underground pipe or rupturing the pipe must be reported immediately through the appropriate emergency number.

Where existing utilities or other street improvements are found to be within the lines of the work the Engineer shall be notified. The Contractor shall then proceed as directed by the Engineer or the respective utility corporation.

All costs incurred for the disruption of service and for the repair of surface and/or underground utilities damaged by the Contractor's operation shall be the Contractor's responsibility.

Existing sidewalks and curbs, mains, service connections, catch basin leads and structures removed or damaged by the Contractor shall be repaired or replaced by the Contractor at his own expense.

Maintenance of existing utilities and structures which were disturbed or repaired by the Contractor, shall be the responsibility of the Contractor for the duration of the maintenance period.

08010-3 **EXCAVATION**

3.1 **General**

Excavation shall be taken to mean the removal from the trench of all material of whatever kind encountered, for the construction therein of all sewers and manholes. All excavations shall be made to the lines and grades as shown on the plans or as established in the field by the Engineer.

3.2 **Trenching**

The trench shall be excavated only so far in advance of pipe laying as permitted by the Engineer. The walls of the trench shall be sloped or shored up to prevent caving, in accordance with the requirements of the Occupational Health and Safety Regulations. All water encountered in the trench shall be pumped out before saturation of the pipe bedding material occurs. The discharge from the trench dewatering pumps shall be conducted away from the site of the work and into natural drainage channels, drains or storm sewers.

The trench shall be excavated so as to provide a uniform and continuous support for the pipe and fittings on solid undisturbed ground. Any over-excavation by the Contractor below the required grade shall be backfilled at his expense with compacted bedding material.

The earth taken from the trench shall be neatly deposited at the sides, in such manner as to obstruct the street or lane as little as possible. Where it is impracticable in the opinion of the Engineer to place the earth at the side of the trench, it shall be removed and deposited as designated by the Engineer. The Contractor shall repair all walls, crib work, culverts, drains, ditches and embankments which it may be necessary to remove or to pass through in laying the pipes.

The Contractor shall provide for all surface water courses and drainage

systems interrupted during the progress of the work, and replace them in as good condition as originally encountered.

The Contractor shall remove all pavement from the surface of any area to be excavated prior to starting the excavation.

The edges of the areas to be removed shall be precut in straight lines for the full depth of the pavement. The Contractor shall then remove the pavement and transport it to the storage site designated by the Engineer.

3.3 **Trench Width**

The minimum trench width below the crown of the pipe shall be the outside diameter of the pipe plus 450 mm.

The maximum trench width below the crown of the pipe shall be as follows:

<u>Nominal Pipe Diameter</u>	<u>Maximum Trench Width Below Crown of Pipe</u>
Less than 450 mm	1050 mm
450 mm to 900 mm	Pipe O.D. + 600 mm
1050 mm to 1350 mm	Pipe O.D. + 750 mm
1500 mm and larger	Pipe O.D. + 900 mm

3.4 **Rock Excavation**

Rock excavation is defined as boulders, pieces of concrete, or masonry equal to or exceeding 1 cm in volume.

The use of EXPLOSIVES within the limits of the City of Saskatoon is strictly prohibited. The Contractor shall, where required, use other methods such as drilling and wedging to split very large boulders prior to removing them from the trench.

Where the excavation is made in rock or in another material which cannot provide an even, uniform surface, all of the projections of such material shall be removed to provide a clear space around the pipe and fittings. The minimum dimension for this clear space shall be 150 mm for pipe having an outside diameter less than or equal to 600 mm and 225 mm for pipe having an outside diameter greater than 600 mm.

The subgrade shall then be made by backfilling with bedding material compacted in 150 mm layers to provide a uniform and continuous support for the pipe.

3.5 Unstable Subgrade

Where, in the opinion of the Engineer, the bottom of the trench at the subgrade below the pipe bedding is found to be unstable or to contain organic or other deleterious material which would not provide a sound foundation for the pipe, the Contractor shall remove such material to the width and depth ordered by the Engineer and shall replace it with Crushed Rock, compacted in 150 mm layers. The entire upper surface of the Crushed Rock shall be covered with a single layer of geotextile fabric before any bedding sand is placed.

Where, in the opinion of the Engineer, additional support is required for the pipe, the Contractor shall supply all materials and shall construct such additional support in accordance with the plans and specifications which will be provided to him by the Engineer.

08010-4 TEMPORARY PROTECTIVE STRUCTURES

The Contractor shall protect excavations, trenches, shafts and tunnels from cave-ins, collapse, sliding or rolling materials by cutting back the walls and/or supplying and installing Temporary Protective Structures as required by the Occupational Health and Safety Regulations and as may be necessary to protect adjacent property and the work.

The Contractor shall install Temporary Protective Structures to prevent movement in the sides of the excavations. All material required, as well as the labour required for the installation, shall be furnished by the Contractor as part of this Contract.

The Contractor shall ensure that, where required by the Occupational Health and Safety Regulations, a professional engineer certifies that the Temporary Protective Structure, if constructed as drawn, and installed and used as instructed, will provide adequate protection to any worker constructing, installing or using the Temporary Protective Structure. The Contractor shall, prior to commencing construction, provide the Engineer with a copy of this certification for each Temporary Protective Structure which will be used on the project.

The right of the Engineer to order sheeting, bracing, underpinning or any other form of brace or support shall not be construed as creating any obligation on his part to issue such orders and his failure to exercise his right to do so shall not relieve the Contractor from his responsibility for damages to persons or property arising from or upon the work of construction occasioned by negligence or otherwise growing out of a failure on the part of the Contractor to leave in place in the trench sufficient sheeting and bracing to prevent any caving or moving of the ground adjacent to the sides of the trench, or for failure to construct and maintain proper support of all kinds whatsoever in the first instance.

Sheeting and bracing ordered left in place must be cut off and removed for a depth of 900 mm below the established street grade or the existing surface of the street, whichever is lower.

08010-5 PREPARATION OF TRENCH BOTTOM

The Contractor shall remove any water which has accumulated in the excavation by pumping before any bedding is placed. The previously installed pipe shall not be used to drain the trench. Loose material shall be removed from the surface and the subgrade shall be thoroughly compacted.

08010-6 PIPE BEDDING

6.1 General

The type of bedding to be used with each size and class of pipe shall be as shown on the Tender Form and in the Specific Conditions. The following various classes of bedding are detailed on the current City of Saskatoon Standard Drawing as posted on the City's Internet web site.

6.2 Class A Bedding

The pipe shall be bedded on a continuous cradle constructed of 17.25 MPa concrete shaped to fit the lowest part of the pipe exterior. The concrete shall be made using Type 50 sulphate resistant cement. The required minimum concrete cradle thickness under the pipe shall be as outlined on the current City of Saskatoon Standard Drawing as posted on the City's Internet web site for various pipe diameters and shall extend up the sides of the pipe to a height equal to 1/4 of the outside diameter of the pipe. The concrete cradle shall extend over the whole width of the trench and shall be constructed monolithically without horizontal construction joints.

6.3 Class B Bedding

The pipe shall be bedded on a layer of approved fine granular material as defined in Section 08000-7.1 shaped to fit the lowest part of the pipe exterior. The required minimum depth of the granular material under the pipe shall be as outlined on the current City of Saskatoon Standard Drawing as posted on the City's Internet web site for various pipe diameters and shall extend up the sides of the pipe to a height equal to 1/2 of the outside diameter of the pipe. Care shall be taken to completely fill all voids under the pipe. The bedding material shall be placed in 150 mm layers and shall be compacted to 98% of its Standard Proctor Density using mechanical compaction equipment.

08010-7 PIPE LAYING AND JOINTING

7.1 General

The pipe shall be protected against impact shocks and free fall during handling and shall be kept clean at all times.

Each pipe shall be carefully inspected prior to being lowered into the trench and those not meeting specifications shall be rejected and shall be removed from the site of the work. Pipe laying shall commence at the lowest point of the sewer. The individual pipe lengths shall be laid in an uphill direction with spigots pointing downgrade and bell ends in the upgrade direction. The Contractor shall excavate the trench deeper at the location of each joint to facilitate making the joint and so that the pipe will not rest on the bell when it is installed. Each pipe shall be installed so that the bedding material will support it evenly throughout its entire length. The interior of the pipe and the bell must be cleared of all foreign material before the joint is made. The sections of pipe shall be fitted together to form a smooth and uniform invert.

The Contractor shall supply a watertight cap or plug which shall be installed on the end of the pipe while excavation is in progress and when the Contractor leaves the site of the work.

7.2 Alignment and Grade

Gravity sewers shall be installed according to the lines and grades shown on the plans or as staked in the field by the Engineer. The Contractor shall transfer line and grade to the sewer by means of an approved batter board and boning rod system, laser beam system, or other system approved by the Engineer.

Variance from grade shall not exceed 0.03 mm per mm of pipe diameter or 10 mm whichever is greater. Provided in all cases that such variation does not result in a reverse sloping invert.

Variance from alignment shall not exceed 2 times the variance allowed for grade.

7.3 Polyvinyl Chloride (PVC) Pipe

Polyvinyl Chloride (PVC) pipe shall be jointed as follows. The bell, spigot and rubber gasket shall be cleaned with a clean cloth, removing all traces of dirt, grit or plastic cuttings. A thin film of a lubricant manufactured for this purpose shall be applied uniformly to the SPIGOT end ONLY. With the assistance of a lever pressing on a wooden cushion block which has been placed against the bell end of the pipe, a uniform force shall be applied until the pipe has been inserted to the reference mark.

The Contractor shall use a fine tooth hand saw or a power cut-off saw to cut the pipe where this is required. The ends shall be cut square and shall be bevelled at 15° through 1/2 of the wall thickness using a grinding disc or a flat file. The jointing reference mark shall be re-established using a factory marked pipe of the same size as a guide.

7.4 Concrete Pipe

The sealing surfaces of the pipe shall be carefully checked to ensure that they are smooth, concentric and free from any imperfections which might impair the sealing efficiency of the rubber gasket. Both the tongue and the groove shall be cleaned and the gasket shall be installed on the tongue in accordance with the manufacturer's instructions.

All sliding surfaces shall be well lubricated and the pipes immediately coupled. The proper equipment shall be used to pull the pipes together to ensure that the joints are properly engaged.

7.5 Polyethylene Pipe

Polyethylene pipe which is being used for sewer construction shall be joined by butt fusing the ends of the pipes. The Contractor shall use the specially designed joining machines complete with alignment jigs, trimmers and heating plate which can be obtained from the pipe manufacturer. The Contractor shall provide personnel who have been trained to perform this procedure and shall ensure that the joints are made in accordance with the manufacturer's specifications.

08010-8 **MANHOLES**

The Contractor shall construct manholes on gravity sewers at the locations and grades shown on the plans or as staked in the field by the Engineer.

1200 mm diameter manholes on sewers with a diameter less than or equal to 600 mm shall be constructed in accordance with the current City of Saskatoon Standard Drawing as posted on the City's Internet web site.

Manholes on sewers with a diameter greater than 600 mm but less than or equal to 900 mm shall be constructed in accordance with the current City of Saskatoon Standard Drawing as posted on the City's Internet web site.

Manholes on sewers with a diameter greater than 900 mm shall be constructed in accordance with the current City of Saskatoon Standard Drawing as posted on the City's Internet web site.

Cement mortar shall not be used on the rubber gasket joints of manholes constructed with 1200 mm diameter precast sections.

Manholes shall be constructed to final grade by installing one or more grade rings between the tapered precast manhole section and the cast iron frame. The minimum and maximum depth of grade rings permitted shall be 50 mm and 300 mm respectively or as directed by the Engineer.

The joint between the grade rings and the top of the tapered precast manhole section, the joint between the grade rings and the cast iron frame and the joints between individual grade rings shall be glued using Tytan MP1 100% Silicone Sealant manufactured by Selena, or equivalent. The sealant shall be applied in a continuous bead around the above noted components approximately 25 mm from the inner and outer edges. The sealant must be sufficiently placed between all grade rings (rubber and concrete) and frames so that when the components are placed together the total areas touching are covered and sealant is squeezed out around the entire inner and

outer circumference. A finished bead of sealant shall be placed on the inside and finished smooth. The supply and application of the sealant shall be the responsibility of the Contractor.

The Contractor shall install stub pipes for future connections at the alignment and grades shown on the plans or as established in the field by the Engineer. The stubs shall be sealed with suitable plugs which will not admit earth or water into the manhole.

The Contractor shall construct a standard City of Saskatoon exterior drop structure at the manhole on any sanitary sewer line where the incoming sewer **crown** is 750 mm or more above the lowest **crown of outlet pipe in the manhole**.

08010-9 BACKFILL

9.1 Initial Backfill in Pipe Zone

The Contractor shall hand place select excavated material which is free from lumps and stones in 150 mm lifts above the granular bedding on both sides of the pipe and to a point 300 mm above the crown of the pipe over the full width of the trench. The Contractor shall compact each lift to 98% of its Standard Proctor Density using mechanical compaction equipment.

9.2 Backfill Above Pipe Zone

9.2.1 Class I Backfill

Approved granular material with a maximum aggregate size of 75 mm, shall be placed in 300 mm lifts over the whole width of the trench. Each lift shall be compacted to 98% of Standard Proctor Density, using mechanical compaction equipment.

9.2.2 Class II Backfill

Approved excavated material shall be placed in 300 mm lifts over the whole width of the trench. Each lift shall be compacted to 98% of Standard Proctor Density, using mechanical compaction equipment.

This backfill may contain coarse materials but shall be free from brush, frozen or other objectionable material that would prevent proper consolidation or that might cause subsequent settlement.

Rocks or stones not exceeding 10 kg in weight may be placed in this portion of the backfill but must be placed by hand.

The Contractor shall be responsible for controlling the moisture content of the backfill material so that the moisture content will be close to the optimum percentage for compaction. The Contractor shall add water to the material if the moisture content is too low or if the moisture content is too high, the Contractor shall move the material to an approved stockpile area, dry the material and then move the material back to the site of the work.

9.2.3 Class III Backfill

Class III backfill shall consist of approved excavated material free from brush and rocks or stones over 10 kilograms and other objectionable material. Backfill material shall be pushed down a ramp or slope of existing backfill and not directly onto the newly bedded pipe.

The backfill material shall be placed in 750 mm lifts over the whole width of the trench. Each lift shall be compacted to a density which is equal to the density of the adjacent soil.

9.2.4 Backfill Around Manholes

The Contractor shall carefully select, place and compact backfill material in 150 mm lifts for a distance of 600 mm around each manhole. The contractor shall compact each lift to a minimum of 98% of the Standard Proctor Density.

9.3 Street Surfaces

9.3.1 General

The Contractor shall use a rubber tired motor grader to spread surface granular materials during compaction and to level earth streets after the backfilling has been completed.

The Contractor shall be responsible for filling trench settlements and repairing street surfaces which settle along the lines of his work during the maintenance period.

9.3.2 Paved Streets

Where excavation has been carried out on a paved street or on a street which has been based and is ready for pavement, the Contractor shall backfill the excavation up to 300 mm below the

level of the original street surface. The Contractor shall then place 300 mm of base gravel to the gradation as specified in Section 08000-7.2 flush with the original street surface and shall compact it to 100% of Standard Proctor Density. Prices tendered for laying pipe, shall include the supply and placing of this gravel unless specified otherwise.

9.3.3 Gravel Streets

Where the excavation has been carried out on a gravel street, the Contractor shall backfill the excavation up to 100 mm below the level of the original street surface.

The Contractor shall then place 100 mm of base gravel to the gradation as specified in Section 08000-7.2 flush with the original street surface and shall compact it to 100% of Standard Proctor Density. Prices tendered for laying pipe, shall include the supply and placing of this gravel unless specified otherwise.

9.3.4 Earth Streets

Where excavation has been carried out on a graded earth street, the Contractor shall backfill the excavation up to the level of the original street surface.

Where the surface of the street has not previously been cut to grade, the Contractor shall spread and level any surplus excavated material over the top of the excavation.

9.3.5 Surplus Excavated Material

Where excavation has been carried out on a paved street, gravelled street or graded earth street all of the excavated material may not be required for backfilling. The Contractor shall load and haul this surplus excavated material to the nearest earth dumping site or to the location as specified in the Specific Conditions. The costs of disposing of this material shall be included in the Contractor's unit prices for constructing sewers.

08010-10 TESTING

10.1 General

The Engineer will designate those sections on which testing is to be conducted and whether the tests should be for infiltration or exfiltration.

Infiltration and exfiltration tests will not be required for storm sewers unless specified on the Tender Form or in the Specific Conditions.

The Contractor shall supply all of the labour and equipment necessary to perform these tests. The costs of testing shall be included in the Contractor's unit prices for constructing sewers.

10.2 Infiltration Testing

The pipe at the highest point on the infiltration test section shall be sealed with a water tight plug. The amount of water infiltrating into the test section shall be measured at the low end of the test section by means of an approved weir or meter.

The duration of the test shall not be less than 4 hours and the length of the test section will be as determined by the Engineer.

10.3 Exfiltration Testing

The pipe section to be tested shall be sealed at its lower extremity with a water tight plug and filled with water so that a hydrostatic head of 600 mm is formed above the crown of the pipe at the upper end of the test section.

In no case shall the pressure head on any part of the test section be in excess of 3 m of water.

The 600 mm head of water shall be maintained by the addition of water for 1 hour prior to commencing the test to allow for normal absorption.

The length of the test period shall not be less than 6 hours. The Contractor shall continue to add water as required throughout the test period in order to maintain the 600 mm head of water on the test section. The water added during this time shall be considered to be equal to that lost due to exfiltration.

10.4 Allowable Leakage

The maximum allowable leakage of gravity sewers and appurtenances subjected to exfiltration or infiltration testing shall not exceed 1.85 litres per 24 hours per millimetre of diameter per 100 m of sewer pipe.

The Contractor shall, where the actual leakage on a section of sewer exceeded the allowable, repair and/or replace the section and then retest the section until the actual leakage no longer exceeds the allowable.

08010-11 CLEAN UP

The Contractor shall clean up the site as the work progresses.

The Contractor shall remove all of his equipment, plant, tools and surplus material from the site of the finished work and shall repair and restore all drainage facilities which have been blocked or damaged as a result of the Contractor's operations.

END OF SPECIFICATION 08010

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08015-1 **SCOPE**

The Contractor shall furnish all material, labour, equipment, plant and tools necessary to perform the work required under the Contract. The Contractor shall remove any road surface as stipulated at shaft locations, excavate for shafts and tunnel to the required dimensions, sheet, brace and support the tunnel section during construction, handle all drainage of ground water, provide barricades, guards and warning lights, backfill and consolidate shafts, repair or replace all structures removed or damaged during the course of the fulfilment of the Contract, remove surplus excavated material and cleanup the site of the work.

08015-2 **DRAWINGS**

The drawings and the specifications are intended to supplement each other. The Contractor shall examine both carefully. Any discrepancies shall be brought to the attention of the Engineer as outlined in the General Conditions.

08015-3 **MATERIALS**

The Contractor shall supply all materials required for the fulfilment of the Contract except those specifically listed elsewhere in the specification as being supplied by the Owner. The Contractor is solely responsible for delivery to site from point of origin, handling and safe storage of all materials until such time as they are incorporated in the work and it is accepted by the Engineer. The Contractor is further responsible for any surplus material supplied by the Owner until he has returned such surplus to the Owner's storage yard.

08015-4 TUNNEL EXCAVATION

4.1 General

The method of tunnelling may vary in accordance with requirements of the particular materials being excavated.

The method of tunnelling shall be subject to prior approval by the Engineer but full responsibility for safety and quality of the work shall be borne by the Contractor. The use of primary tunnel lining will not decrease the specified requirements for tunnel pipe.

4.2 Tunnel Excavation and Material Removal

Excavation shall mean the removal of all material of whatever kind from the shafts and tunnel for the laying or construction therein of all liner and for the construction of manholes. The tunnel shall be excavated to lines and grades shown on the plans and established by the Engineer. Excavation for the tunnel shall be to the sizes and shapes specified or shown and such as will allow placing of tunnel liner or the full concrete section specified. Excavated material shall be promptly removed from the tunnel and tunnel exit as soon as it is taken out of the heading and disposed of at a site designated by the Engineer. Where the haul to the dump site is greater than 1.6 kilometres from the exit, the Contractor shall be paid for overhaul at the rate set out in the Specific Conditions section. Excavation shall be carried out in accordance with the best rules and methods of tunnel construction with safety to life and property and with a minimum of inconvenience to the public.

4.3 Support of Tunnel

The right of the Engineer to order sheeting, bracing, underpinning or any other form of brace or support shall not be construed as creating any obligation on his part to issue such orders and his failure to exercise his right, shall not relieve the Contractor from his responsibility for damages to persons, or property arising from or upon the work of construction occasioned by negligence or otherwise growing out of a failure on the part of the Contractor to leave in place in the tunnel sufficient sheeting and bracing to prevent any caving or moving of the ground adjacent to the sides of the tunnel, or for failure to construct and maintain proper support of all kinds whatsoever in the first instance.

4.4 Tunnel Headings

Tunnel headings shall not be farther than 7.6 metres from the concrete or tunnel liner section except with the written permission of the Engineer. All mining operations shall cease until this provision is fulfilled and the general procedure of the work indicates that this provision will be maintained. Whenever two headings or a heading and a shaft are to meet underground the final 6.0 metres shall be driven without the use of explosives approximately 1.0 metres smaller in diameter except in the case of soft ground or forepoled tunnels so that adjustment to line or grade may be made. The entire cost of enlarging this connecting tunnel to the specified size and dimensions shall be included in the price bid for that section by the Contractor and no additional payment will be made.

4.5 Rock Excavation

Excavation in rock shall be carried out in such a way as to not damage structures above or adjacent to the work. Boulders one quarter of a cubic metre or over within the line of the tunnel will be classified as rock.

4.6 Explosives

The use of explosives shall be permitted only when the Contractor has demonstrated his ability to undertake subsurface blasting with absolutely no damage resulting to structures in the vicinity of the blasts. Only a minimum of nuisance from blasting operations can be tolerated.

The Contractor shall comply with the "Explosives Act" 1927 Revised Statutes of Canada, Chapter 63 and Amendment, and with all regulations made thereafter, plus any local regulations.

4.7 Water Removal

All water shall be removed by the Contractor from the tunnel by pumping or other means and the tunnel must be kept free from water until the structures to be built therein are completed. No concrete shall be placed in water nor shall water be allowed to rise over, drip on or flow over freshly placed concrete until the concrete or mortar has hardened sufficiently to prevent damage. The disposal of water after removal from the tunnel shall be to the satisfaction of the Engineer.

4.8 Drainage

Such drains or outlets as are built as part of this Contract may be used for removal of water under conditions approved by the Engineer but such drains or outlets shall be left in a clean and satisfactory condition at the completion of this Contract.

08015-5 SHAFTS, MANHOLES AND ALIGNMENT HOLES

5.1 Shafts

Construction shafts shall be located to coincide with manholes unless otherwise shown on plans. Additional shafts desired by the Contractor shall be located on streets or easements. Plans of location and proposed type of construction of all shafts shall be submitted by the Contractor for approval of the Engineer before commencement of excavation. Such approval shall not relieve the Contractor from any responsibility or liability under the Contract or from any expenses incurred or delay by reason of encountering any underground objects.

Shafts shall be sized to provide ample space for hoisting operations and for safety ladders, which ladders must be installed in each shaft. Shafts may be of concrete, corrugated steel or timber construction. It is the responsibility of the Contractor to design and construct the shafts to be suitable and safe for the depth and soil conditions.

At all tunnel shafts concrete tunnel liner shall be increased to a minimum thickness of 500 mm at the spring lines. That external portion of the concrete

shell below and above the spring lines shall be carried vertically downward to the floor of the shaft to form a flat monolithic concrete base. The concrete shall also be carried vertically upward from the spring line to a height which produces a minimum concrete thickness of 500 mm at the crown of the sewer. In no case shall the shaft rest on any portion of the sewer pipe.

In the event that steel tunnel liner is being used at a shaft location, such tunnel liner shall be strutted in accordance with the tunnel liner manufacturer's recommendations. The tunnel liner at the shaft locations shall be boxed in with concrete as outlined in the preceding paragraph.

5.2 Manholes

Manholes shall be constructed at the points designated on the plans. The manholes will be constructed according to current City of Saskatoon Standard Drawings as posted on the City's Internet web site.

Where manholes are required at shaft locations, the Contractor shall cap the shaft with a 300 mm thick reinforced concrete slab containing 19 mm diameter reinforcing steel bars at 100 mm on center each way. The slab shall be capped at an elevation below the ground surface as directed by the Engineer. Standard 1050 mm diameter manhole pipe shall be constructed from the top of the slab to the surface elevation where the manhole will be equipped with a standard manhole frame and cover. All steps and manhole pipe shall be so arranged so as to allow easy access to the sewer pipe. Only shafts constructed of precast or poured-in-place concrete shall be capped in this manner.

5.3 Alignment Holes

The Contractor shall drill alignment holes where required to ensure proper alignment of the pipe. Alignment holes shall be located within 15.25 metres of each end of each bend with at least one hole in each straight section between bends. The exact location of alignment holes shall be arranged at the time of construction or where required to ensure proper alignment of the pipe. The alignment holes may be used for ventilation purposes and for concreting operations at the option of the Contractor. Alignment holes shall consist of 250 mm diameter steel casing driven in a drilled hole over the centre of the tunnel. The casing shall be vertical so a plumb bob will hang free inside it. The top of the hole shall be covered with a substantial steel plate securely fastened but removable. The lower end of the casing shall pass through the tunnel wall and shall be watertight. After the tunnel section is completed, the casing shall be removed, the opening in the tunnel wall filled with concrete and the hole filled with sand.

5.4 Backfilling Shafts and Around Manholes

When the project is completed, the Contractor shall backfill the construction shafts and around manholes. The top of the shaft shall be removed to a point not less than 1.5 metres below finished grade. Backfill shall be imported granular material where the structure is located on a travelled roadway or surplus excavated material if not located on a travelled roadway. Where surplus excavated material is to be used, the Contractor shall first place imported granular material to a point at least 300 mm above the top of the sewer.

Every attempt shall be made to consolidate the shaft backfilling to the end that no more than 150 mm of settlement shall take place in one year.

The ground surface shall be evenly and smoothly graded to its original condition. The heaping of earth over the shaft excavation will not be permitted. A minimum of 300 mm of gravel shall be placed over all shaft excavations located on any City roadways.

08015-6 TUNNEL LINING

6.1 General

The tunnel lining shall completely fill the bore of the tunnel. Where overbreak has occurred, the void shall be completely filled with concrete or with sand-cement grout as determined by the Engineer, and the expense shall be completely borne by the Contractor. The tunnel lining shall be monolithic concrete unless otherwise specified.

6.2 Alignment and Grade

Survey line and grade control markers will be provided by the Engineer in a manner consistent with accepted practices. The Contractor shall establish his own reference and control from this information using a laser beam system or other system approved by the Engineer. The Contractor shall constantly check line and grade and in the event that they do not meet that specified, the work shall be immediately stopped, the Engineer notified, and the cause remedied before proceeding with the work.

The completed sewer shall conform to the prescribed line and grade.

Variance from grade shall not exceed the larger of 12.7 mm or 0.03 mm per millimetre of pipe diameter. Provided in all cases that such variation does not result in a reverse sloping of invert.

Variance from alignment shall not exceed two (2) times the variance allowed for grade.

6.3 Monolithic Concrete Sewer

Diameter, wall thickness, type and strength shall be as stated on drawings or elsewhere in the specifications. All concrete work shall conform to City of Saskatoon specification 06020 entitled "Plain and Reinforced Concrete".

The lower third of the sewer circumference shall be formed using rolled steel forms. Each form shall be accurately manufactured to fit the specified radius and shall be continuous throughout the length to be poured. The balance of the forms may be of wood or steel provided they are adequate for strength and quality of finish.

When the forms are removed, all protrusions shall be chipped from the walls of the tunnel and any rough sections shall be mortared. The completed tunnel shall have smooth walls which accurately match the specified radius.

At construction shaft locations, bends and manhole locations, the Contractor shall construct the special sections of tunnel as shown on the plans. The Contractor shall include all the extra cost for additional excavation, labour, concrete and reinforcing steel in his unit price for the standard tunnel construction. No additional payment will be made for these special sections.

6.4 Galvanized Steel Tunnel Liner

Galvanized steel tunnel liner shall be stated on drawings or elsewhere in the specifications. Installation shall be in strict accordance with manufacturers' recommendations and instructions of the Engineer. The Contractor shall cut and reweld tunnel liner as required to make specified bends and deflections. All such reworked metal shall be given two (2) coats of an approved asphalt prior to installation. The Contractor shall include all cost for such special work in his unit price for standard tunnel construction. No additional payment will be made for these special sections.

Where monolithic concrete has been specified but adverse soil conditions make it impossible to construct same, steel tunnel liner may be substituted upon written permission of the Engineer. The steel tunnel liner shall be not less than one standard size or 150 mm diameter, whichever is greater, larger than the specified inside diameter for monolithic concrete liner. The steel liner shall be hot dip bituminous coated prior to installation.

The Contractor will be paid for supplying and installing the steel liner at the same unit price as was tendered for installing monolithic concrete liner.

08015-7 TUNNEL SAFETY AND ACCESSORIES

7.1 General

The Contractor shall comply with all regulations of the Saskatchewan Workmen's Compensation Board and the Saskatchewan Department of Labour respecting the protection of persons working in tunnels and/or in compressed air.

All power machinery and tools within the tunnel heading and shaft shall be operated by electricity, compressed air or other approved power. The use of internal combustion engines in the tunnel or shafts is forbidden.

The Contractor shall keep adequate first aid kits at the site of the works at all times.

All reasonable precaution against fire shall be taken and adequate fire protection shall be provided in such a manner as may be approved by the Engineer. Head frames built of combustible material shall be open framework. Waste material and rubbish of any kind shall not be allowed to accumulate underground. Only material which may be used within the next 24 hour period may be stored in the tunnel at any time and the tunnel shall be kept free and clear of all material not actually in use. Smoking or the use of unprotected lights shall be prohibited in the head houses, shafts and tunnel and notice shall be posted to this effect. Adequate approved fire extinguishers full and ready for use shall be provided in all surface buildings, head frames and underground workings or where danger of fire seems likely to exist.

7.2 Ventilation

A supply of fresh air to the working chambers shall be sufficient at all times to permit work to be done without damage or discomfort.

Suitable provision shall be made by the best available means to keep the temperature in the working chamber at comfortable levels.

A ventilating plant with a capacity of at least 2.83 cubic metres of air per man per minute shall be installed and used while work is going on, and so much of the other time as is required to produce the conditions herein before specified.

Ventilating pipes shall be of approved size, well supported, strong enough to resist collapse and maintained airtight. Unless otherwise permitted, vent pipes shall be maintained within 45.7 metres of the face of the heading in tunnel. In tunnels 45.7 metres or less in total length, the Contractor may, subject to prior approval of the Engineer, modify this requirement through the assistance of natural ventilation.

7.3 Electric Wiring and Lighting

All electrical wiring and facilities shall be in accordance with Provincial regulations and shall be maintained in first class conditions. All wiring and conduits in shafts and the tunnel shall be removed on or before completion of the Contract.

The shafts and tunnel shall be lighted with electric lights in sufficient number to insure proper work and inspection. At headings and at places where pipe lining or concrete is being placed or grouting done, and at other points where work is going on or inspection is being made, adequate special illumination shall be provided.

7.4 Hoisting

Bucket cables shall be equipped with an approved safety hook attached directly to the cable and all buckets shall be equipped with approved safety dogs on the bail. No men shall be allowed to ride on loaded buckets and all men shall be required to ride in the bucket and not on the rim or bail. Full safety precautions shall be taken to insure safety of buckets. Cages shall be provided with strong protective roofs.

Safety precautions shall include frequent inspection of hoisting cables, safety catches, hooks and dogs and landing dogs at all landings, and effective devices for the prevention of overwinding shall be provided. All hooks and dogs shall be of the best design. Effective and reliable means shall be provided for indicating at all times to the hoisting engine man, the position of buckets or cages. The efficiency of all safety devices shall be established by satisfactory tests before the hoists are put in service, and at approved intervals thereafter.

In addition to a telephone system, effective and reliable signalling devices shall be maintained at all times to give instant communications from the foot of the shaft and the shaft head to the hoist room.

08015-8 TUNNELLING UNDER COMPRESSION AIR

If the soil is found to be unstable and of such high water content that operations cannot be carried on satisfactorily with tunnel liners, the soil shall be dewatered. The Contractor shall submit for approval to the Engineer, his proposed method of working with compressed air and proposed air pressures prior to starting this working method. The Contractor shall comply with any orders issued by the Workmen's Compensation Board in this connection.

The Contractor shall supply complete compressing equipment, locks, etc. required to supply and control air pressure as required in the tunnels. The compressors both for high pressure air for mining, etc. and low pressure air for ventilation and water control shall be electrically driven with standby diesel or gas engine driven equipment and operated so as to cause a minimum of inconvenience to adjacent residences. Standby equipment for low pressure air shall be arranged for immediate starting in case of failure of electric power. The compressing machinery shall be installed in a

weatherproof structure adjacent to the operating shaft. The building shall be tight all around, including at the ground level, eaves, etc. and shall be insulated against sound transmission. Compressors shall be equipped with silencers and receivers on the intake and exhaust lines and engines shall have super quiet exhaust silencers as required to effectively reduce the noise to prevent annoyance to adjacent owners.

Air shall be admitted to the compressors through the roof by steel or cast iron pipes. Compressors shall not be operated after 10 o'clock at night without permission of the Engineer.

Air for ventilation and water control shall be supplied by compressors separate from compressors supplying high pressure air. Low pressure air compressors shall have ample standby units so one compressor can be out of service without reducing the amount of air supplied. Accurate gauges and controls shall be operated to carefully control the air pressure. A recording gauge shall provide a continuous record of the air pressure in each heading and be mounted outside the air lock. Gauges shall be enclosed in locked waterproof cases and shall be kept in continuous operation.

A lock attendant shall be on duty and shall control operation of the air lock and locking out time, whenever air pressure in the tunnel exceeds 103.4 kPa and shall keep a complete record of personnel entering and leaving the tunnel with time of entry and leaving and rate of decompression. Decompression time for all personnel passing through the lock shall be strictly controlled according to the Department of Labour regulations.

The Contractor shall advise all employees working under compressed air or in other hazardous conditions, of the dangers which might be encountered and of precautions to be taken to assure their safety in cases of emergency.

The Contractor shall provide competent medical attendance and such other medical facilities as may be required by current regulations of the Department of Labour.

The Contractor shall keep complete full records of medical examinations of his personnel working under compressed air and such records shall be available to the Engineer. Any cases of compressed air sickness shall be reported and treated at once. Records of such cases shall be kept on the job and shall be readily accessible. All persons working in compressed air shall undergo regular physical examinations.

08015-8 CLEANUP

The tunnel shall be cleaned of construction material, waste and debris as each section is completed. Surface work site areas including shaft and alignment hole locations shall be cleaned up and restored to original condition except where otherwise permitted in writing by the Engineer. Excavated material hauled to dumping sites shall be trimmed and levelled thereon.

END OF SPECIFICATION 08015

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08020-1 GENERAL DESCRIPTION OF WORK

The work to be done under this specification consists of providing all labour, plant, tools and equipment and supplying certain materials necessary for the construction of catch basins and leads and other related work, all in accordance with these specifications, the accompanying plans and all City Bylaws.

08020-2 MATERIALS FOR CATCHBASINS, RISER RINGS & GRADE RINGS

Materials used for catch basins shall be in accordance with the current ASTM Specification C478M-09, and as per drawings.

Rubber adjustment riser rings shall be Infra-Riser or approved equal; have a 615 mm I.D. and 806 mm O.D.; and be flat type or a 25 mm to 50 mm taper.

Concrete grade rings shall be constructed using Type 50 cement. Concrete compressive strength shall be 32 MPa, with a minimum of 5 to 7 percent air entrainment. Reinforcement shall be 75 x 75 x 6.25 mm wire, single layer on centre. Outside diameter shall be 800 mm and inside diameter shall be 600 mm with varying height. .

The Contractor shall supply all poured in place concrete grout, pipe bedding materials, sealant for rubber adjustment riser rings and any other materials necessary to complete the work.

08020-3 CONSTRUCTION

3.1 Catch Basin Lead

All catch basin leads shall be connected to storm sewer manholes or other catch basin barrels. The connection of leads directly to the mains will not be

permitted. Catch basin leads shall be laid in a straight line and at a constant and uniform grade of not less than 2%.

1. **Excavation**

The minimum width of trench below the crown of the pipe shall be 600 mm. Upon excavation of the trench to the required depth, a layer of bedding sand shall be placed and compacted to 98% of Standard Proctor Density to a minimum depth of 75 mm. Any over-excavation by the Contractor below the required grade shall be backfilled at his expense with an approved compacted sand or gravel. Where leads are required to cross an area with unstable soil conditions, the Contractor shall over-excavate to a depth as directed by the Engineer. The over-excavated area shall then be filled with base gravel to the bottom of the pipe. The gravel will be paid for at the price tendered for base gravel in place.

2. **Pipe Laying and Jointing**

The Contractor shall establish and maintain line and grade control using a batterboard and boning rod system, laser beam system or other system approved by the Engineer.

The Contractor shall constantly check line and grade and in the event they do not meet that specified, the work shall be immediately stopped, the Engineer notified, and the cause remedied before proceeding with the work.

All pipe shall be installed with the spigots in a downgrade position. Bell holes shall be hand excavated at the end of each pipe for catch basin lead pipe with enlarged socket ends. An even bearing must be given to each

pipe as it is installed and all adjustments for line and grade shall be made by hand shovel removal or filling in with compacted bedding sand under the body of the pipe and not by wedging or blocking.

There shall be a maximum of two couplers allowed per single catch basin lead. All joints shall be made under the inspection of the Engineer with joints close and evenly abutting all around the pipes, special care being taken so that there will be no sagging of the spigot end in the hub, and that a true, even surface is given to the invert throughout the entire length of the sewer. The interior of the pipes and sockets must be cleared of earth, sand, stones, water and all foreign material before any jointing is done. The installation and jointing of the pipe shall be performed in a workmanlike manner in accordance with manufacturer's recommendations and accepted procedures for the particular material or product being used.

Pipe bedding sand shall be placed and mechanically compacted to 98% of Standard Proctor Density up to the spring line of the catch basin lead. All sand used for bedding and backfill purposes shall conform to the specifications for bedding sand contained in Aggregates Specifications Section 03001-3.2.11.

3. **Backfill**

Backfilling trenches before a thorough inspection by the Engineer or his representative will not be permitted.

The use of Fillcrete (Unshrinkable Fill – See Section 03001-3.2.10) is preferred when backfilling trenches. If Fillcrete is not used, the following methodology will be used for backfill:

Initial backfill in the pipe zone from the spring line of the pipe to 300 mm above the crown of the pipe shall consist of select approved backfill hand placed and mechanically tamped to 98% of Standard Proctor Density. Approved excavated material shall then be placed in 150 mm lifts over the whole width of the trench. Each lift shall be compacted to 98% of Standard Proctor Density using mechanical compaction equipment.

Granular backfill may be used in lieu of earth backfill. The granular material shall be placed and compacted in even layers to a minimum of 98% of Standard Proctor Density.

Periodical density tests will be performed by the City to make certain that the backfill is compacted to the specified density. Should the backfill not meet the specified density, the Contractor shall undertake to recompact the backfill. Another density test will be performed at the cost of the Contractor.

The cost of supplying, placing and compacting Fillcrete (Unshrinkable Fill – See Section 03001-3.2.10) or granular backfill shall be borne by the Contractor.

3.2 Catch Basin Units & Storm Sewer Manhole Connections

Before installing precast catch basin barrels the area under the barrel shall be compacted to a minimum 98% of Standard Proctor density.

Precast concrete catch basin units shall be installed to grade on 75 mm of crushed rock (25 mm max. size) at the base. Manholes shall be cored and rubber gaskets used for lead installation. Debris resulting from the connection inside manholes shall be removed from the site. Manhole rungs are not to be removed or loosened in any way. If, however this does

happen, the method of repair shall be determined by the Engineer and all costs borne by the Contractor.

All catch basin leads protruding into the manhole barrel shall be sloped according to the current City of Saskatoon Standard Drawing.

3.3 Catch Basin Frame Adjustment

Catch basin barrels will be left 225 mm low to accept grade rings below the catch basin frame.

The rubber adjustment riser rings are to be bonded to the concrete barrel, other rubber adjustment riser rings, and catch basin frame using Tytan MP1 100% Silicone Sealant manufactured by Selena, or equivalent. The sealant shall be applied in a continuous bead around the above noted components approximately 25 mm from the inner and outer edges. The sealant must be sufficiently placed between all grade rings (rubber and concrete) and frames so that when the components are placed together the total areas touching are covered and sealant is squeezed out around the entire inner and outer circumference. A finished bead of sealant shall be placed on the inside and finished smooth. The supply and application of the sealant shall be the responsibility of the Contractor.

In most cases a 25 mm rubber adjustment riser will be placed between the catch basin barrel and 150 mm concrete grade ring. Between the 150 mm concrete grade ring and the catch basin frame will be placed two 25 mm - 50 mm rubber adjustment rings.

3.4 Existing Utilities

Prior to the installation of the catch basin unit and lead in the vicinity of existing underground utilities, the Contractor shall contact the Owner of the utility and undertake all precautions as directed. Any damage caused to the

utility shall be repaired at the expense of the Contractor. If hand excavation is required to clear the utilities, such shall be carried out by the Contractor at no additional cost.

On curb returns, the catch basin unit shall be constructed after the straight section of the sidewalk or curb is completed. The catch basin frame shall be set to proper grade and alignment and the sidewalk or curb poured monolithically to the frame. In locations where the curb alignment is straight, the catch basin may be installed after the alignment and grade of the curb or sidewalk has been staked for construction. Separate staking for catch basin construction will not be carried out.

Where an existing catch basin lead is not required, it shall be plugged by suitably concreting the lead at the manhole and at the catch basin barrel. If the catch basin barrel is not removed, it shall be backfilled with compacted granular material.

08020-4 PAYMENT

- 4.1** Catch basin will be paid for at the unit price tendered per catch basin unit. No payment will be made for incomplete units.

- 4.2** Payment for catch basin leads will be at the price per lineal metre tendered and based upon measured length from the outside edge of the catch basin grate to the nearest edge of the manhole rim.

This covers the complete work of installing the lead, including excavation to a maximum depth of 2.0 metres, pipe laying and jointing, sealing, and backfilling with Fillcrete (Unshrinkable Fill – See Section 03001-3.2.10) or backfilling with approved material to the specified density.

Where depth of trench excavation exceeds 2.0 metres, the cost of excavation in excess of 2.0 metres will be paid at the unit price for extra excavation.

- 4.3** Payment for raising and lowering existing catch basins will be paid at the unit price per vertical metre as measured by the Engineer. Payment will include all labour and material required, including bricks and mortar. No payment will be made for adjusting an existing catch basin horizontally if no vertical adjustment is required.
- 4.4** Payment for exchanging old catch basins or manhole frames and covers will be paid at the unit price which will include all labour and hauling to and from Central Stores.
- 4.5** Payment for removing and salvaging existing catch basin units will include all labour and equipment including filling with Fillcrete (Unshrinkable Fill – See Section 03001-3.2.10) or backfilling with approved material and compacting the hole to 98% Standard Proctor and returning salvaged material to Central Stores. Unsalvageable material such as brick is classified as ordinary excavation and shall be removed from the site.
- 4.6** Payment for Fillcrete (Unshrinkable Fill – See Section 03001-3.2.10) or compacted granular material, when required at a manhole or trench, will be made at the contract unit price per cubic metre and will include all labour and material required to place and compact to a minimum of 98% Standard Proctor Density.
- 4.7** Payment for extra compaction of trench to increase from specified 98% to a minimum of 100% Standard Proctor Density will be made at the contract unit price and will include all labour, material and equipment required to obtain this additional compaction.

- 4.8** Payment for blocking off existing catch basin leads will be made at the contract unit price for each lead blocked off, and will be full compensation for all labour and material required.

END OF SPECIFICATION 08020

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08025-1 **SCOPE**

These specifications shall cover the supply of all material, labour, equipment, plant and tools necessary for the construction and cut-off of water, sanitary sewer and storm sewer service connections within Saskatoon's City Limits.

These specifications regulate the construction of service connections including: water services up to 50 mm in diameter and sewer services up to 150 mm in diameter. The construction of larger service connections is regulated by these specifications together with Water Main Construction, Section 08030 and Gravity Storm and Sanitary Main Construction, Section 08010.

08025-2 **PERMITS AND FEES**

The Contractor shall construct all service connections as per the drawings submitted with the "Building Application - Water and Sewer Section" form.

Before any work within the City Right-of-Way is performed, the Contractor shall have an approved permit "Use of Right-of-Way Permit". This permit shall be obtained by contacting the Infrastructure Services Connections Desk at 975-2460. There may be restrictions on times and dates that portions of Right-of-Way may be available and this will be outlined in the Use of Right-of-Way permit.

2.1 **Existing Infrastructure - Requirements and Fees**

Certain fees for inspection, tapping mains, pavement and concrete repair, detouring services and public liability insurance shall be charged by the City to the Contractor on completion of the work.

The contractor shall obtain the conditions of work and fee rates by contacting the City Construction Services Department at 975-2461 before estimating or commencing any particular project. The Construction Services Department will outline the requirements and fees so that the Contractor shall know in advance and the safety of the water and sewer system remains intact.

08025-3 **MATERIALS**

3.1 Water and Sewer Materials

Materials for use in the construction of water, sanitary sewer and storm sewer service connections shall conform to Section 08000 and 08003.

3.2 Concrete

All concrete shall be sulphate resistant and have a minimum compressive strength of 20 MPa at 28 days.

3.3 Granular Backfill

Granular backfill shall consist of a graded mixture of sand, gravel, and stone of which no portion shall be greater than 75 mm in diameter, nor shall the material contain more than 10% by volume passing 0.420 mm (No. 100) sieve.

3.4 Street Surface and Base Gravel

Street gravel shall be composed of durable rock, free from undesirable quantities of soft or flaky particles, loam, organic or other deleterious material. Street gravel shall conform to the gradation as per Section 08000-7.2.

3.5 Pipe Bedding Sand

Bedding sand shall conform to the gradation as per Section 08000-7.1.

3.6 Unshrinkable Fill

This material shall conform to the specifications as per Section 08000-8.

3.7 Crushed Rock

Crushed rock is fragments of durable rock, free from undesirable quantities of soft or flaky particles, shale, loam and other harmful material.

Where crushed rock is required the material shall conform to the specifications as per Section 08000-7.3.

3.8 Schedule for Use of Service Clamps

Size and Type of Pipe	Size of Main Stop			
	<u>19 mm</u>	<u>25 mm</u>	<u>38 mm</u>	<u>50 mm</u>
150 mm Cast Iron	D	D	D	D
200 mm Cast Iron	D	D	D	D
250 mm Cast Iron	D	D	D	D
150 mm Class 200 A.C.	None	None	D	D
150 mm Class 150 A.C.	D	D	D	D
200 mm Class 150 A.C.	None	None	D	D
250 mm and larger Class 150 A.C.	None	None	D	D
Steel Pipe	D	D	D	D
Ductile Iron, 8 mm wall or less	D	D	D	D
150 mm and larger Class 150 PVC	None	None	D	D

NOTE: D - Double Strap Bronze Service Clamp or approved equal

All service clamps shall be solid bronze of continuous and uniform manufacturing complete with stainless steel straps, washers and nuts.

08025-4 EXISTING UTILITIES AND STRUCTURES

4.1 General

Before starting any excavation, and at his own expense, the Contractor is responsible for determining the actual location and elevation of all sewer, water and gas mains or lines, electric light, power, telephone or telecommunications conduits, or other such structures or utilities which may exist in the area of the proposed work.

The Contractor is responsible for notifying the respective utility at least 48 hours before his intention to carry out operations near the said utility and if required shall pay for any services supplied for locating these utilities.

4.2 Conflicting Utilities

Where existing utilities conflict with the proposed work, the Contractor shall immediately notify the Engineer and the Owner of the utility. The Contractor shall proceed as directed by the Engineer or utility owner.

If the proposed work can be altered to avoid the conflict with the existing utility and the Engineer so orders, the Contractor shall supply all labour and material required to change his work to conform to the new alignment.

When traversing beneath existing utilities, they must be supported with timber shoring approved by the Engineer. Before backfilling the trench, the suspended utility must be supported from below with well-tamped backfill according to Section 08025-12.3.1 Class I Backfill. When the level of compaction required for Class I Backfill is not attainable directly below the duct, the Contractor shall pour non-shrink concrete in compliance with Section 08025-3.6. The Contractor shall supply and install this material at his cost.

Where the existing utility must be relocated to avoid conflict with the new work, the Contractor may be ordered to relocate the utility under the direction of the utility owner or the utility owner may relocate the utility himself. In either case, the Contractor shall be responsible for all the costs incurred.

4.3 Disruption of Service

When in the course of the work, existing utilities must, for reasonable cause, be temporarily disconnected, the Contractor shall give all persons affected 48 hours written notice.

The Contractor shall contact the utility owner who may disconnect the utility himself or supervise the Contractor during disconnection.

In no case shall the Contractor operate any utility without the approval of the owner.

All costs incurred during the disruption of service from any utility shall be borne by the Contractor.

4.4 Existing Sidewalks and Curbs

The Contractor shall take precautions to protect existing sidewalks and curbs from damage as a result of his operations. Where it is necessary for equipment to work on or cross existing sidewalks, the Contractor shall carefully place planks or mats on the sidewalks.

4.5 Signing

The Contractor shall sign and demark all excavations to the standard as set out by the Traffic Control Manual (1982). The Contractor shall supply and install all signs, signals, snow fence and barricades necessary for public safety. The Contractor shall securely fence all excavations during unsupervised periods.

Where the work will require the detouring of traffic around the site, the Contractor shall contact the City of Saskatoon Infrastructure Services Department and arrange for all necessary detours.

The Contractor shall be responsible for maintaining access to all private property during construction.

4.6 Damage to Existing Utilities and Structures

When a utility is exposed during construction, the Contractor shall immediately inform the owner of the utility, who may inspect the utility before backfilling.

Any damage to the existing utility shall be repaired at the Contractor's expense.

No sidewalk or curb shall be removed by the Contractor without the approval of the Engineer. The Infrastructure Services Department shall repair sidewalks and curbs damaged or removed by the Contractor without prior approval. Unless otherwise specified, the Contractor shall pay for this work. The Contractor may repair the damage with its own forces, at no charge to the City, only if prior approval was granted by the Engineer. All work must be restored to as-built conditions and conform to current specifications.

All culverts, drains, removed; and ditches, embankments damaged during the work shall be replaced or repaired by the Contractor at his expense to the current specifications enforced by the City. Mains and service connections damaged by the Contractor shall be repaired by the Contractor at his expense subject to the Engineer's approval and inspection.

08025-5 **EXCAVATION**

5.1 **General**

The Contractor shall schedule and conduct the work to cause the least interruption to traffic. The Contractor shall refer to Section 00700-45 (Traffic Operations) of the General Conditions and be governed by the regulations stated therein.

The Contractor shall provide for the free passage of surface water and shall not obstruct the gutters of any street.

The Contractor shall protect all trees, shrubbery, fences, poles, survey pins and all other property from damage during the work and shall repair or replace any items removed or damaged at his expense.

5.2 **Classes of Excavation**

5.2.1 **Common Excavation**

Common excavation shall be taken to mean the removal of all materials, except rock, from the trench to the lines and levels shown on the plans or specified herein for the construction of service connections.

5.2.2 Rock Excavation

The word "Rock" wherever used as the name of an excavated material, shall mean boulders and pieces of concrete or masonry exceeding 0.25 m³ in volume or solid ledge rock and masonry which, in the opinion of the Engineer, requires for its removal, drilling and blasting.

The Contractor shall note that asphalt or concrete pavements, sidewalks, drains, sewers, manholes, conduits, tanks, soft or disintegrated rock which can be removed with a hand pick or power operated excavator or shovel; loose, shaken or previously blasted rock or broken stone in rock fillings or elsewhere, and rock exterior to the maximum limits of the trench width shall not be considered "rock excavation". Rock shall be disposed of at a site designated by the Engineer.

5.2.3 Blasting

No explosives shall be stored on the site nor shall any blasting be done without the prior approval of the City Manager. Such approval shall not relieve the Contractor of his sole responsibility for any damage or accident to adjoining utilities, properties and structures or other persons as a result of his operations.

The supplying, hauling, handling and storing of all explosives and accessories shall be done according to the rules and regulations of the Explosives Division, Department of Mines, Ottawa and the Mining Act.

5.2.4 Unstable Subgrade

Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, any type of refuse, organic material or large pieces of inorganic material which in the opinion of the Engineer should be removed, the Contractor shall excavate and remove such unsuitable material to the width and depth ordered by the Engineer. The subgrade shall be made by backfilling with an approved granular material in 75 mm lifts. Each lift shall be thoroughly compacted to a density approved by the Engineer.

Where the bottom of the trench at subgrade is found to consist of material unstable to such degree that, in the opinion of the Engineer, it cannot be corrected by methods specified above, the Contractor shall construct a foundation for the pipe in accordance with plans prepared by the Engineer.

5.3 Trenching

5.3.1 General

The line of the trench shall be straight from the water and sewer mains to the building or to the point on the lot where the service connection is to terminate.

Where possible the line of the trench shall be perpendicular to the water and sewer mains.

Deviation from this procedure shall only be permitted with the written consent of the Engineer.

The connection may not be laid so as to encroach onto an adjoining Property.

The earth taken from the trench shall be neatly deposited at the sides of the trench to obstruct the street or lane as little as possible. Where it is impractical in the opinion of the Engineer to place the earth at the side of the trench, it shall be removed and deposited to a location designated by the Engineer.

5.3.2 Trench Width and Depth

All trenches shall be sufficient width to permit proper jointing of the pipes but in all cases the width shall be at least 750 mm for a single set of services and at least 1000 mm wide for a double set of services.

Excavation for the service shall be carried out to provide 2850 mm cover at the property line and 2250 mm at the building. The slope of the sewer line shall not be less than 20 mm per metre.

5.3.3 Trenching on Paved Streets

Paved streets shall include all soil cement and macadamized road surfaces in addition to those paved with asphalt and/or concrete.

Where a service connection is to be constructed on a paved street, only that portion of the street directly above the water and sewer mains shall be open cut. The remainder of the street shall be tunnelled or augured. Additional open cut shafts may be approved by the Engineer to ensure that the correct line and grade are being maintained.

The Contractor is responsible for controlling the removal of the asphalt to ensure that the resulting asphalt cut is rectangular in shape and the walls are vertical. Where soil conditions disrupt the integrity of the initial cut, the contractor shall ensure that the resulting cut meets the specifications listed previously.

5.3.4 Tunnelling or Auguring

Where the line of the proposed service connection crosses a street designated arterial or proposed arterial; crosses a sidewalk or the location of a proposed sidewalk; crosses under another buried utility, the Contractor shall excavate by tunnelling or auguring methods.

The Contractor shall maintain the correct line and grade on the utility throughout the tunnelled or augured section and shall provide for the protection of the workers according to the regulations of the Saskatchewan Department of Labour.

The maximum size of the tunnelled or augured section shall be the largest outside diameter of the pipe measured at the joint plus 50 mm.

The minimum length of the tunnelled or augured section under an existing or proposed sidewalk shall be 3000 mm.

5.3.5 Trenching in Winter Conditions

If thawing of the ground is required, the method shall first be approved by the Engineer.

All excavated material that is frozen or which subsequently becomes frozen shall be removed from the site of the work and shall be disposed of to a site designated by the Engineer.

5.3.6 Excavations for Tappings and Tee Installation

The minimum excavation size required for tapping water mains is 1000 mm perpendicular to the main by 900 mm along the main-

For water connections larger than 50 mm the minimum dimensions of the excavation are 1500 mm perpendicular to the main by 1500 mm along the main.

08025-6 SHORING

Open cut trenches and shafts shall be sheeted and braced as required by the Occupational Health and Safety Regulations of the Saskatchewan Department of Labour and as may be necessary to protect life, property and the work.

All necessary shoring and bracing required for the prevention of movement surrounding the excavation shall be provided for and installed by the Contractor.

The right of the Engineer to order sheeting, bracing, underpinning or any other form of brace or support shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from his responsibility for damages to persons or property arising from or upon the work of construction occasioned by negligence or otherwise growing out of a failure on the part of the Contractor to leave in place in the trench sufficient sheeting and bracing to prevent any caving or moving of the ground adjacent to the sides of the trench, or for failure to construct and maintain proper support of all kinds whatsoever in the first instance.

Sheeting and bracing left in place must be cut off and removed for a depth of 900 mm below the established street grade or the existing surface of the street, whichever is lower.

All materials and labour required for shoring shall be furnished by the Contractor.

08025-7 **PREPARATION OF TRENCH BOTTOM**

The Contractor shall remove by pumping or other means approved by the Engineer any water accumulated in the excavation. Trenches shall be free of water before the pipe is laid. Previously laid pipe shall not be used to drain the trench bottom. The disposal of water after removal from the trench shall be to the satisfaction of the Engineer.

The trench bottom shall be shaped in such a way that the body of the pipe rests on solid ground throughout its length, and so that when in final position the pipe is true to line and grade. Bell holes shall be hand excavated below the bottom of the trench and be of sufficient size to allow ample room for making complete and proper pipe joints.

Where the pipe zone contains rock or boulders that may damage the pipe, the bottom of the trench shall be over excavated to a depth of one-fourth (1/4) the diameter of the pipe, but in no case less than 150 mm below the bottom of the pipe. Where over excavation of the trench bottom has occurred, the Contractor shall replace the excavated material with approved granular backfill to the invert of the pipe and compact it to 98% of Standard Proctor Density.

08025-8 CONNECTION TO EXISTING FACILITIES

The Contractor shall supply all materials when making the connection including but not limited to the following: main stops or valves, water pipe, tees, anodes, welded tee (steel pipe), pipe coatings, saddles, pipe hub ends for storm sewer connections and cement mortar.

8.1 Tapping Water Mains

City employees shall perform all tapping of water services up to 50 mm in diameter. When a tapping is required, the Contractor shall give the City 48 hours notice and shall have the mains properly exposed and ensure that the trench is safe and properly shored.

The Contractor shall indicate the location on the main where the tapping is to be made.

The Contractor shall supply and install a service clamp or sleeve, when required, on the water main at the required location. See Section 8025-3.8 for required service clamp.

Copper water tubing requires a smooth even "Gooseneck" curve at the main stop. 19 mm copper connections shall have a gooseneck 300 mm above the water main crown. Larger copper connections shall have a gooseneck 400 mm above the water main crown. For copper services the main is tapped at 30 to 45 degrees above the horizontal plane.

Polyethylene connections shall have a horizontal gooseneck extending in two curves a distance of 400 mm on each side of the centre line of the connection. The tapping shall be horizontal and perpendicular to the water main

Tappings shall not be made closer than 450 mm from a joint or a main stop.

8.2 Water Services Greater than 50 mm

The Contractor shall supply and install all materials for water services greater than 50 mm.

Water services shall be installed at the City water main by excavating, removing a portion of the water main and installing a water main tee, short length of PVC pipe (each a minimum of 300 mm long), and pipe coupling to the existing water mains and a valve on the water service.

The Water Service shall connect horizontally and perpendicular to the water main.

Water services greater than 50 mm up to 150 mm in diameter, require a 150 mm tee, 150 mm valve and reducer.

The Contractor shall protect each valve with a 24 pound Anode as specified in Section 08000-4.4. The tee, pipe coupling and all other metal water main fittings shall be connected each with a 12 pound Anode as specified in Section 08000-4.4. The anode shall be attached using a "Cadweld" in compliance with the manufacturers recommended installation procedures. The Contractor shall supply and install sacrificial zinc anodes to provide cathodic protection for all valves, hydrants and cast iron fittings installed under this Contract.

The Contractor shall connect a 24 lb. anode to each hydrant and each valve. Where the anode is connected to a valve, the anode wire shall also be connected to the valve box.

The Contractor shall connect a 12 lb. anode to each cast iron fitting, each robar coupling and to each copper water service line where the existing service lines are being reconnected into the new water main.

The Contractor shall install the anodes one metre away from the fitting/valve at water main depth and shall connect the anode wire to the cast iron using the "Cadweld" method. The Contractor shall provide experienced personnel who shall make these connections in accordance with the manufacturer's recommendations.

Following welding, the Contractor shall remove all slag from the weld, file off all sharp edges and coat all exposed cast iron surfaces, steel surfaces and "Cadweld" locations with "Denso" tape and paste.

When the installation is complete, the Contractor shall pour 10 litres of water over the anode and backfill uniformly around the anode. The exposed metal surfaces on all metal fittings shall then be field coated in compliance with 08000-4.2.

Where a water service will be made to an existing steel water main it shall be a Reinforced branch conforming to section 13.3 "Reinforcement of Fittings, Steel Pipe - A Guide for design and installation, American Water Works Association M11 Manual". The Branch shall come complete with a flange end suitable for attaching a flanged valve.

8.3 Tapping of Sewer Mains

Sewer and storm sewer mains shall be tapped above the springline of the pipe at 45 degrees to the vertical plane. A 45° Long Radius shall connect to the saddle to allow for connection of the graded service. Where the main pipe is clay tile or concrete only one tapping shall be made into a one length of pipe. Tappings shall not be made closer than 450 mm from a joint or another tapping. The method of tapping used shall ensure a smooth edged hole suitable for accommodating the service saddle. No sharp or raised surfaces shall exist within the area covered by the saddle gasket, and the opening shall be sized small enough to allow the entire area of the saddle gasket to make contact with the outside of the pipe.

Where the pipe diameter is too large for existing saddle sizes, the bell end of a pipe may be used for connection to the main. The diameter of the opening shall be no larger than $1 \frac{1}{4}$ the diameter of the connecting service; the bell shall not protrude past the inner wall of the main greater than 25 mm, and 0.3 m³ of concrete shall be placed under the connection at the main.

The Contractor shall satisfy himself as to the relative position of the water and sewer leads at the house in order to properly plan his work so that when the mains are tapped the service pipes can be laid parallel to each other and at the correct grade and alignment.

8.4 Connections into Manholes

8.4.1 Existing Manholes

Wherever it is practicable, sanitary and storm sewer connections shall be made directly into existing manholes.

The Contractor shall supply all material, labour and equipment, required to tap into the manhole and complete the connection. The Contractor shall mortar the service pipe firmly into place, supply grout and reshape the channelling in the manhole if required; trim off the service pipe leaving no more or less than 100 mm extending into the inside of the manhole; supply and install an interior drop structure if required and remove any dirt or concrete rubble which has entered the manhole or main sewer as a result of his operations.

8.4.2 Constructing New Manholes

The Contractor shall supply all materials, labour and equipment required to construct the new manhole and complete the connection according to Section 8010-8.

Where the size of a sanitary service exceeds 150 mm and the connection cannot be made into an existing manhole, the Contractor shall construct a new standard 1200 mm manhole at the point of entry.

Where the size of the storm sewer service exceeds one-half the diameter of the storm sewer main, the Contractor shall construct a new 1200 mm manhole at the point of entry.

Where the connection is to be made to a large storm or sanitary sewer main, the Engineer may, on request, approve a special connection directly into the main.

08025-9 **LAYING AND JOINTING PIPE**

9.1 **Sewer Service Pipe**

9.1.1 **General**

The pipe shall be protected against impact shocks and free falling during the handling. Pipe shall be kept clean at all times.

Each pipe shall be inspected for defects before being lowered into the trench. Those not conforming to specifications will be rejected, and shall be removed from the site of the work. All sewers shall be laid in an upgrade direction with the bells laid upgrade. The sections of pipe shall be fitted together to form a smooth and uniform invert.

In making joints, care must be taken not to disturb or break joints already made, otherwise the pipes shall be uncovered, and the joints remade.

The interior of pipes shall progressively be freed from all dirt or other superfluous material.

Before leaving the work at any time, all open ends of pipe in place shall be closed with a watertight cap or plug.

Where the point of termination is at the property line, the Contractor shall install a watertight plug.

9.1.2 Bedding

The pipe shall be bedded in a natural solid soil foundation shaped to fit the lowest part of the pipe exterior.

The foundation supporting the pipe shall have a minimum width equal to 60% of the outside diameter of the pipe and shall be carefully hand trimmed and levelled to provide even bearing throughout the whole length of the pipe. The remainder of the pipe shall be surrounded by approved excavated material placed and compacted by hand to fill completely all spaces adjacent to the pipe. If the pipe cannot be laid on a solid soil foundation, bedding sand shall be used. All pipe shall be sand bedded on City of Saskatoon property. All pipe bedding shall be properly compacted with approved tamping machines.

9.1.3 Alignment and Grade

Sewer service lines shall be straight, perpendicular to the main sewer and shall terminate at a point designated by the Engineer.

Sewer service lines shall be installed with a minimum 2% grade, unless specific grades are supplied in the field by the Engineer, in which case these grades shall be adhered to.

9.1.3.1 Use of Bends

Long sweep 22-1/2 degree bends and long sweep 45 degree bends may be used on the horizontal. Short 45 and 22 degree bends shall not be used unless approved by the Engineer. Long sweep bends on the horizontal greater than 45 degrees shall require a cleanout.

9.1.4 Jointing

9.1.4.1 Slip-Seal Joint

This material is not approved for new installations.

9.1.4.2 Plain End Pipe

This material is not approved for new installations.

9.1.4.3 Vitra-Mate or Vitra Flex

This material is not approved for new installations.

9.1.4.4 A.C. Sewer Pipe

This material is not approved for new installations.

9.1.4.5 P.V.C. Sewer Pipe

The spigot and bell ends and/or the coupling as well as the pipe interior shall be carefully cleaned and inspected for damage. The neoprene gaskets shall be properly placed in the bell or coupling groove and the pipe sliding surfaces well lubricated with the approved lubricant.

The spigot end of the pipe shall then be inserted into the bell end or coupling until it is firmly in place according to the manufacturer's instructions. Extreme care shall be exercised in this procedure to ensure that the neoprene gaskets are not dislodged or damaged during the assembly.

9.1.5 Cleanouts

The Contractor shall supply and install a sewer cleanout at the following locations according to the current City of Saskaton Standard Drawing as posted on the City's Internet web site:

- at each horizontal deflection in excess of 45 degrees in the line of the sewer service pipe.
- at points on a long sewer service that will provide access for cleaning at intervals not greater than 25 m.

9.1.6 Pipe Laying in Tunnels

The Contractor shall use P.V.C. pipe for that portion of the sewer service connection that is to be constructed in a tunnel.

The Contractor shall ensure that all joints are made as specified prior to installation into tunnel.

9.1.7 Vertical Risers

On some streets where the sanitary sewer is at great depths, the City of Saskatoon has constructed a sanitary sewer stand pipe (riser) to facilitate the construction of the sewer connections. The Contractor may be permitted to excavate down to the main sewer in preference to locating and connecting into the stand pipe. The riser shall be constructed to current specifications.

The City shall endeavour to supply the Contractor with information leading to the location of sewer service risers on deep sewers. In the event that the risers cannot be found, or when found, it proves to be damaged or unusable, the Contractor shall construct a riser according to the current specifications.

9.2 Water Service Pipe

9.2.1 General

The pipe and fittings shall be protected against damage during

handling, and shall be kept clean and free from dirt. Copper pipe shall not exhibit any signs of crimping or flattening. The Contractor shall use only new material and shall not use short cut-off lengths of pipe less than 2150 mm long. Unions shall not be installed between the main stop and the curb stop.

The minimum water service pipe diameter shall be 19 mm copper or 25 mm polyethylene.

Water service connections with a length greater than 23 m shall be a minimum of 25 mm diameter copper and 38 mm diameter polyethylene.

Water Services greater than 50 mm shall be installed to the requirements of Section 08030 Water Main Construction.

9.2.2 Jointing

All joints at main stops, curb stops, unions or other fittings shall be compression type. Compression joints shall be made according to the manufacturer's recommended procedure.

9.2.3 Curb Stops and Boxes

The non-draining curb stop shall be installed within the City Right-of-Way at a distance of 300 mm from the property line unless otherwise directed. A 305 mm x 152 mm x 50 mm concrete bearing block shall be placed under each curb stop.

The Contractor shall fasten the stainless steel spindle to the curb stop with a brass cotter key.

Curb boxes shall be placed vertically plumb and the Water and Sewer Contractor shall leave all curb boxes at 300mm below the future back of sidewalk grade. It is the responsibility of the Roadways Contractor to locate and raise all curb boxes to 150mm below finished back of sidewalk grade.

Should the existing curb box be located in the street or sidewalk, the Contractor shall cut through the sidewalk or pavement to place the box flush with its surroundings, and also restore the sidewalk or pavement flush with the existing surrounding elevations.

Connections to vacant lots require a curb box marker. The curb box marker shall be installed a minimum length of 0.6 meters above ground and shall be 25mm polyethelene tubing. It shall be securely fastened to the spindle using tape or zip ties, as shown in the Service Connection Standard Drawing.

08025-10 INSPECTION

When the work is completed and before any backfilling, the Contractor shall allow an inspection of the work and shall provide all reasonable assistance during the inspection. If backfilling is completed prior to an inspection, the Engineer may require exposure of the connection for inspection purposes. All related costs of this procedure shall be at the expense of the Contractor.

When connecting to the watermain, the Contractor shall turn on the main stop and all joints shall be inspected for leakage.

When the inspection has been completed and all defects have been corrected, the Contractor shall backfill the excavation as specified.

08025-11 BACKFILL

The Contractor shall start backfilling immediately after the work has been inspected and all defects have been corrected, and shall complete the backfilling on the same date that the inspection was made.

11.1 Initial Backfill in the Pipe Zone

Initial backfill material in the pipe zone shall consist of selected excavated material or imported granular material, free from frozen lumps, rock, large stones, boulders or other unsuitable material. The initial lift shall be hand placed in the trench uniformly on both sides of the pipe up to the spring line and hand tamped with an appropriate hand tamper to attain a density of 98% of Standard Proctor Density at the optimum field moisture content. Special care shall be taken to thoroughly compact the backfill around and next to the mains at the points where the mains were tapped.

Additional 150 mm lifts of selected excavated material or imported granular material, as previously described herein, shall be hand placed in the trench uniformly with each 150 mm lift compacted using hand operated mechanical compaction equipment to attain a minimum density of 98% of Standard Proctor Density at the optimum moisture content up to a uniform minimum level 300 mm above the crown of the highest pipe in the trench.

11.2 Backfill Above the Pipe Zone

After the initial backfill has been placed and compacted, the remainder of the trench shall be backfilled according to one of the following methods. All backfill shall be tested according to the City of Saskatoon's decision.

11.2.1 Class I Backfill

Class I backfill as follows shall be used on all open cut portions on existing paved streets and boulevards.

The Contractor shall supply and place granular material in 300 mm lifts, over the whole width of the trench and shall compact each lift to 98% of Standard Proctor Density at optimum moisture content, using mechanical compaction equipment. The compacted granular material shall be brought up to 300 mm below the original street level. The Contractor shall supply and place 300 mm of street gravel flush with the original street level and compact it to 100% of Standard Proctor Density at optimum moisture content.

Under existing sidewalks, the Contractor shall place unshrinkable fill to an elevation 0.3 m below existing grade, unless otherwise directed by the Engineer.

11.2.2 Class II Backfill

Class II backfill, as follows, shall be used on prepaid service connections to backfill open cuts and on cash connections on all portions, other than cuts as per Section 11.2.1 Class I Backfill.

Class II backfill shall be placed uniformly along the trench in maximum 300 mm lifts with each lift compacted using mechanical compaction equipment to attain 98% of Standard Proctor Density at the optimum moisture content up to the top of the trench. If the Contractor does not consistently attain the specified compaction, the lift thickness, compactive effort or compaction equipment shall be modified until the specified densities are attained consistently.

This backfill may contain coarse materials but shall be free from brush or other objectionable material that would prevent proper consolidation or that might cause subsequent settlement. Rocks or stones not exceeding 10 kg may be placed in this portion of the backfill but must be placed by hand.

Where the excavation is carried out on an earth street, the compacted excavated material shall be brought up to the original street level.

Where the excavation was carried out on a gravel street, the compacted excavated material shall be brought up to 100 mm below the original street level. The Contractor shall then supply and place 100 mm of street gravel flush with the original street level and compact it to 100% of Standard Proctor Density at existing field moisture content.

Where the excavation was carried out on a paved street, or a street that has been prepared for paving, the compacted excavated material shall be brought up to 300 mm below the top of the pavement. The Contractor shall supply and place 300 mm of street gravel flush with the original street level and compact it to 100% of Standard Proctor Density at existing field moisture conditions.

11.2.3 Class III Backfill

Class III backfill shall consist of approved excavated material free from brush and rocks or stones over 10 kg and other objectionable material. Backfill material shall be pushed down a ramp or slope of existing backfill and not directly onto the newly bedded pipe. The trench shall be compacted to the surface in lifts of 300 mm maximum depth. The minimum compacted effort required shall be that to obtain in-situ density of the adjacent soil type. The backfill shall not be placed at less than 92% Standard Proctor at the optimum moisture content.

11.3 Backfilling Tunnels

Where the excavation is carried out by tunnelling or boring, all voids left in the excavation after the pipe has been installed shall be filled with compacted excavated material or granular material.

Where the Contractor has augured under an existing or future sidewalk he shall carefully plug all voids around the pipe at the end of the augured section closest to the street with concrete mortar. The remainder of the augured section may be filled with excavated material.

11.4 Backfilling in Winter Conditions

The Contractor shall remove from the site of the work any backfill material that is frozen or unacceptable to the Engineer and shall dispose of it as directed by the Engineer. The Contractor shall, at his expense, supply imported unfrozen granular material to complete the backfilling.

08025-12 CONNECTION CUT OFFS

When a water connection is no longer required or is serving a building which is being demolished, it shall be cut off. The owner of the property served by the connection is responsible for retaining a Licensed Water and Sewer Contractor to perform the cut off. The Contractor shall perform the cut off in compliance with the following:

12.1 Domestic Water Connection (50 mm or less):

1. Remove the main stop.
2. Remove all loose material from pipe and finish to a smooth surface.
3. Install a stainless steel repair sleeve (minimum of 300 mm in length) as per manufactures specifications.
4. Removed the top section of the curb box and spindle at a depth of 1000 mm below existing ground.

**12.2 Commercial, Industrial and Multi-unit Water Connection
(Up to 50 mm)**

Where a connection has been made with more than one main stop (e.g. a 50 mm water service connection to the water main using 4 - 25 mm main stops), the following shall apply:

1. Remove the section of pipe from the main including all the main stops to be cut-off.
2. Replace section of water main with approved PVC pipe.

3. Use PVC couplings, where practical, to connect the PVC pipe to the existing pipe.
4. Excavate and remove a portion of each curb box top by cutting the curb boxes and spindles at a depth of 1000 mm below existing ground.

12.3 Commercial, Industrial and Multi-unit Water Connections **(100 mm or greater)**

1. Remove the tee or tapping sleeve, the valve, valve box, valve spindle and section of main to be removed. In the case of a three way valve connection, remove two or three valves at the Engineer's discretion.
2. Replace section of water main with approved PVC pipe.
3. Use PVC couplings, where practical, to connect the PVC pipe to the existing pipe.

12.4 Reuse of an Existing Main Stop

1. The reuse of an existing mainstop is not permitted.
2. Where a main stop has been removed and a stainless steel repair sleeve installed, the stainless steel sleeve may be replaced with a repair sleeve complete with a tapping provided that the tapping will be at the correct angle for the new connection material.
3. Where the Contractor chooses to remove an existing repair sleeve and it is found that the sleeve was used in a repair, the Contractor shall install a new repair sleeve and a new tapping shall be made a minimum of 1.0 m from the repair sleeve.

12.5 Sanitary Sewer

Sanitary sewer connections shall be cut-off at the main at the existing saddle location using the following methods:

PVC main - the existing saddle shall be plugged with a PVC plug

Clay Tile main - the existing saddle shall be removed and either replaced with a PVC saddle complete with stainless steel straps, and plugged with a PVC plug; or replaced with a stainless steel repair sleeve. In both cases, the rubber gasket shall form a seal around the opening of the main. The Engineer may approve the use of a PVC plug inserted into the saddle and covered with concrete, where the removal of the saddle may damage the main.

Clay Tile main - the existing in line wye shall be plugged with a PVC plug and concreted.

08025-13 RESTORATION AND CLEANUP

The Contractor shall remove all construction planks, equipment, appliances, barricades and surplus materials and shall remove excavated material from natural drainage courses, sidewalks, crossings and do such other work as may be necessary to leave the work on any premises occupied by him in a neat, workmanlike condition. This work shall be done with a minimum of inconvenience to the public. All clean up costs shall be borne by the Contractor.

The Contractor shall restore or replace all sidewalks, curbing, gutters, shrubbery, turf, fences, irrigation systems, poles and/or other property and surface structures damaged or removed during the work to a condition meeting current specifications, furnishing all labour and materials incidental thereto.

All excavated material that is not to be used as backfill shall be hauled from the site to a location designated by the Engineer.

Where the Excavation or excavations are on an earth street the Contractor shall level the roadway portion as near as possible to the condition it was originally found as determined by the Engineer.

Where appurtenances such as valves and manholes exist, the road grades shall be brought level with the tops of these structures to avoid them being buried or left protruding from the roadway.

END OF SPECIFICATION 08025

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08030-1 **SCOPE**

The General Conditions, Specific Conditions and Material Specifications form an integral part of these Specifications and shall be read in conjunction herewith.

This Section shall include Water Connections Construction not regulated by Section 08025 wherein water service connections are greater than 50mm in diameter.

The Contractor shall supply all material, labour, equipment, plant and tools necessary to construct the water mains complete with hydrants, valves and fittings within and/or under the jurisdiction of the City of Saskatoon as required under this Contract.

1.1 **Existing Infrastructure - Requirements and Fees**

Certain fees for inspection, tapping mains, pavement and concrete repair, detouring services and public liability insurance shall be charged by the City to the Contractor on completion of the work.

The contractor shall obtain the conditions of work and fee rates by contacting the City Construction Services Department at 975-2461 before estimating or commencing any particular project. The Construction Services Department will outline the requirements and fees so that the Contractor shall know in advance and the safety of the water and sewer system remains intact.

Before any work within the City Right-of-Way is performed, the Contractor shall have an approved permit "Use of Right-of-Way Permit". This permit shall be obtained by contacting the Infrastructure Services Connections Desk at 975-2460. There may be restrictions on times and dates that portions of Right-of-Way may be available and this will be outlined in the Use of Right-of-Way permit.

08030-2 **EXISTING UTILITIES AND STRUCTURES**

The location and elevation of existing underground utilities is compiled from records

but is not guaranteed. Notwithstanding any other provision, the Contractor shall be responsible for determining at his expense the actual location and elevation of all sewer, water and gas lines, power, telephone or telecommunications conduits, or other such structures or utilities whether or not shown on the plans. The Contractor shall be responsible for notifying the respective utility at least 48 hours in advance of his intention to carry out operations in the vicinity of the said utility and if required shall pay for any services supplied for locating these utilities.

When in the course of the work, existing utilities must, for reasonable cause, be temporarily disconnected, the Contractor shall be wholly responsible for notifying all persons affected, at least 48 hours in advance of the outage. The Contractor shall contact the utility owner who may disconnect the utility himself or supervise the Contractor during disconnection. In no case shall the Contractor operate any utility without the approval of the owner.

When a utility is exposed during construction, the Contractor shall immediately inform the owner of the utility, who may inspect the utility prior to backfilling.

Any accidental damage such as severing a cable, scraping the coating on an underground pipe or rupturing the pipe must be reported immediately through the appropriate emergency number.

Where existing utilities or other street improvements are found to be within the lines of the work the Engineer shall be notified. The Contractor shall then proceed as directed by the Engineer or the respective utility corporation.

All costs incurred for the disruption of service and for the repair of surface and/or underground utilities damaged by the Contractor's operation shall be the Contractor's responsibility.

Existing sidewalks and curbs, mains, service connections, catch basin leads and structures removed or damaged by the Contractor shall be repaired or replaced by the Contractor at his own expense.

Maintenance of existing utilities and structures which were disturbed or repaired by the Contractor, shall be the responsibility of the Contractor for the duration of the maintenance period.

08030-3 EXCAVATION

3.1 General

Excavation shall be taken to mean the removal from the trench of all material of whatever kind encountered, for the construction therein of all water mains and appurtenances. All excavations shall be made to the lines and grades as shown on the plans or as established in the field by the Engineer.

3.2 Trenching

The trench shall be excavated only so far in advance of pipe laying as permitted by the Engineer. The walls of the trench shall be sloped or shored up to prevent caving, in accordance with the requirements of the Occupational Health and Safety Regulations. All water encountered in the trench shall be pumped out before saturation of the pipe bedding material occurs. The discharge from the trench dewatering pumps shall be conducted away from the site of the work and into natural drainage channels, drains or storm sewers.

The trench shall be excavated so as to provide a uniform and continuous support for the pipe and fittings on solid undisturbed ground. Any over-excavation by the Contractor below the required grade shall be backfilled at his expense with compacted bedding material.

The earth taken from the trench shall be neatly deposited at the sides, in

such manner as to obstruct the street or lane as little as possible. Where it is impracticable in the opinion of the Engineer to place the earth at the side of the trench, it shall be removed and deposited as designated by the Engineer.

The Contractor shall repair all walls, crib work, culverts, drains, ditches and embankments which it may be necessary to remove or to pass through in laying the pipes.

The Contractor shall provide for all surface water courses and drainage systems interrupted during the progress of the work, and replace them in as good condition as originally encountered.

The Contractor shall remove all pavement from the surface of any area to be excavated prior to starting the excavation.

The edges of the areas to be removed shall be precut in straight lines for the full depth of the pavement.

The Contractor shall then remove the pavement and transport it to the storage site designated by the Engineer.

3.3 Trench Width

The minimum trench width below the crown of the pipe shall be the outside diameter of the pipe plus 450 mm.

The maximum trench width below the crown of the pipe, for pipes with a nominal diameter of 300 mm or less, shall be 1050 mm.

3.4 Rock Excavation

Rock excavation is defined as boulders, pieces of concrete, or masonry equal to or exceeding 1 cubic metre in volume.

The use of EXPLOSIVES within the limits of the City of Saskatoon is strictly prohibited. The Contractor shall, where required, use other methods such as drilling and wedging to split very large boulders prior to removing them from the trench.

Where the excavation is made in rock or in another material which cannot provide an even, uniform surface, all of the projections of such material shall be removed to provide a clear space around the pipe and fittings. The minimum dimension for this clear space shall be 150 mm for pipe having an outside diameter less than or equal to 600 mm and 225 mm for pipe having an outside diameter greater than 600 mm.

The subgrade shall then be made by backfilling with bedding material compacted in 150 mm layers to provide a uniform and continuous support for the pipe.

3.5 Unstable Subgrade

Where, in the opinion of the Engineer, the bottom of the trench at the subgrade below the pipe bedding is found to be unstable or to contain organic or other deleterious material which would not provide a sound foundation for the pipe, the Contractor shall remove such materials to the width and depth ordered by the Engineer and shall replace it with Crushed Rock, compacted in 150 mm layers. The entire upper surface of the Crushed Rock shall be covered with a single layer of geotextile fabric before any bedding sand is placed.

Where, in the opinion of the Engineer, additional support is required for the pipe, the Contractor shall supply all materials and shall construct such additional support in accordance with the plans and specifications which will be provided to him by the Engineer.

08030-4 TEMPORARY PROTECTIVE STRUCTURES

The Contractor shall protect excavations, trenches, shafts and tunnels from cave-ins, collapse, sliding or rolling materials by cutting back the walls and/or supplying and installing Temporary Protective Structures as required by the Occupational Health and Safety Regulations and as may be necessary to protect adjacent property and the work.

The Contractor shall install Temporary Protective Structures to prevent movement in the sides of the excavations. All material required, as well as the labour required for the installation, shall be furnished by the Contractor as part of this Contract.

The Contractor shall ensure that, where required by the Occupational Health and Safety Regulations, a professional engineer certifies that the Temporary Protective Structure, if constructed as drawn, and installed and used as instructed, will provide adequate protection to any worker constructing, installing or using the Temporary Protective Structure. The Contractor shall, prior to commencing construction, provide the Engineer with a copy of this certification for each Temporary Protective Structure which will be used on the project.

The right of the Engineer to order sheeting, bracing, underpinning or any other form of brace or support shall not be construed as creating any obligation on his part to issue such orders and his failure to exercise his right to do so shall not relieve the Contractor from his responsibility for damages to persons or property arising from or upon the work of construction occasioned by negligence or otherwise growing out of a failure on the part of the Contractor to leave in place in the trench sufficient sheeting

and bracing to prevent any caving or moving of the ground adjacent to the sides of the trench, or for failure to construct and maintain proper support of all kinds whatsoever in the first instance.

Sheeting and bracing ordered left in place must be cut off and removed for a depth of 900 mm below the established street grade or the existing surface of the street, whichever is lower.

08030-5 PREPARATION OF TRENCH BOTTOM

The Contractor shall remove any water which has accumulated in the excavation by pumping before any bedding is placed. The previously installed pipe shall not be used to drain the trench. Loose material shall be removed from the surface and the subgrade shall be thoroughly compacted.

08030-6 PIPE BEDDING

6.1 General

The type of bedding to be used with each size and class of pipe shall be as shown on the Tender Form and in the Specific Conditions. The following various classes of bedding are detailed on the current City of Saskatoon Standard Drawing as posted on the City's Internet web site.

6.2 Class A Bedding

The pipe shall be bedded on a continuous cradle constructed of 17.25 MPa concrete shaped to fit the lowest part of the pipe exterior. The concrete shall be made using Type 50 sulphate resistant cement. The required minimum concrete cradle thickness under the pipe shall be as outlined on

the current City of Saskatoon Standard Drawing as posted on the City's Internet web site for various pipe diameters and shall extend up the sides of the pipe to a height equal to one-quarter (1/4) of the outside diameter of the pipe. The concrete cradle shall extend over the whole width of the trench and shall be constructed monolithically without horizontal construction joints.

6.3 Class B Bedding

The pipe shall be bedded on a layer of approved fine granular material as defined in Section 08000-7.1 shaped to fit the lowest part of the pipe exterior. The required minimum depth of the granular material under the pipe shall be as outlined on the current City of Saskatoon Standard Drawing as posted on the City's Internet web site for various pipe diameters and shall extend up the sides of the pipe to a height equal to one-half (1/2) of the outside diameter of the pipe. Care shall be taken to completely fill all voids under the pipe. The bedding material shall be placed in 150 mm layers and shall be compacted to 98% of Standard Proctor Density using mechanical compaction equipment.

08030-7 PIPE LAYING AND JOINTING

7.1 General

The pipe shall be protected against impact shocks and free fall during handling and shall be kept clean at all times. **All pipe to be used for water main distribution shall be sealed before leaving the production plant and shall remain sealed throughout transportation and storage onsite until installed.** Each pipe shall be carefully inspected prior to being lowered into the trench and those not meeting specifications shall be rejected and shall be removed from the site of the work. The individual

lengths of pipe shall be installed so that the spigot end can be inserted into the bell of the previously installed pipe. The Contractor shall excavate the trench deeper at the location of each joint to facilitate making the joint and so that the pipe will not rest on the bell when it is installed. Each pipe shall be installed so that the bedding material will support it evenly throughout its entire length. The interior of the pipe and the bell must be cleared of all foreign material before the joint is made.

The Contractor shall supply a watertight cap or plug which shall be installed on the end of the pipe while excavation is in progress and when the Contractor leaves the site of the work.

7.2 Alignment and Grade

Water mains shall be installed according to the lines and grades shown on the plans or as staked in the field by the Engineer. The Contractor shall transfer the line and grade to the water main by means of an approved batter board and boning rod system, laser beam system, or other system approved by the Engineer.

7.3 Polyvinyl Chloride (PVC) Pipe

Polyvinyl Chloride (PVC) pipe shall be jointed as follows. The bell, spigot and rubber gasket shall be cleaned with a clean cloth, removing all traces of dirt, grit or plastic cuttings. A thin film of an edible, vegetable based lubricant manufactured for this purpose shall be applied uniformly to the SPIGOT end ONLY. With the assistance of a lever pressing on a wooden cushion block which has been placed against the bell end of the pipe, a uniform force shall be applied until the pipe has been inserted to the reference mark.

The Contractor shall use a fine tooth hand saw or a power cut-off saw to cut the pipe where this is required. The ends shall be cut square and shall be bevelled at 15 degrees through one-half of the wall thickness using a grinding disc or a flat file. The jointing reference mark shall be re-established using a factory marked pipe of the same size as a guide.

7.4 Polyethylene Pipe

Polyethylene pipe which is being used for main construction shall be joined by butt fusing the ends of the pipes. The Contractor shall use the specially designed joining machines complete with alignment jigs, trimmers and heating plate which can be obtained from the pipe manufacturer. The Contractor shall provide personnel who have been trained to perform this procedure and shall ensure that the joints are made in accordance with the manufacturer's specifications.

Connections to valves and fittings shall be bolted and shall be made using flange assembly consisting of a polyethylene stub-end which must be butt-fused to the end of the pipe and a special metal slip-on flange.

08030-8 REACTION BLOCKING

Reaction blocking shall be constructed at all hydrants, tees, bends, reducers, caps and plugs. Detailed methods of anchoring and blocking the fittings are shown on the current City of Saskatoon Standard Drawing as posted on the City's Internet web site.

Concrete shall have a minimum strength of 20 MPa at 28 days. Blocking shall be placed between solid ground and the fittings to be anchored. The area of bearing on the ground in each instance shall be as shown on the current City of Saskatoon Standard Drawing as posted on the City's Internet web site. The blocking shall be so placed that the pipe and fitting joints will be accessible for repair. 6 Mil polyethylene sheeting shall be placed between the reaction blocking and the pipe or fittings.

Where metal harness tie rods or clamps form an integral part of the reaction blocking they shall be galvanized or rust proofed by methods approved by the Engineer.

08030-9 **VALVES**

Valves shall be set accurately at the positions shown on the plans and properly jointed into the main. The valve box shall be set plumb over the valve bonnet. The bottom nut of the extension rod shall be securely fitted on the valve operating nut. On paved streets, the top of the valve box on main and hydrant valves shall be set flush with the finished paved surface. On gravelled streets and lanes, the top of the valve box on main and hydrant valves shall be set 150 mm below the finished gravelled surface. The top of the extension rod shall not be more than 600 mm or less than 300 mm below the top of the valve box.

The Contractor shall mark the location of each valve with a 38 mm x 89 mm x 750 mm stake with letters M.V. painted in red on a white background.

08030-10 **HYDRANTS**

The Contractor shall install hydrants at the locations as shown on the plans or as directed by the Engineer.

All hydrants shall be installed in accordance with the current City of Saskatoon Standard Drawing as posted on the City's Internet web site.

The hydrant shall stand plumb. The hose nozzles shall be parallel with the curb and the pumper nozzle shall face the street.

The hydrant shall be set so that the ground flange is at an elevation of **100mm +/- 50 mm** above finished grade.

08030-11 CATHODIC PROTECTION

The Contractor shall supply and install sacrificial zinc anodes to provide cathodic protection for all valves, hydrants and cast iron fittings installed under this Contract.

The Contractor shall connect a 24 lb. anode to each hydrant and each valve. Where the anode is connected to a valve, the anode wire shall also be connected to the valve box.

The Contractor shall connect a 12 lb. anode to each cast iron fitting, each robar coupling and to each copper water service line where the existing service lines are being reconnected into the new water main.

The Contractor shall install the anodes one metre away from the fitting/valve at water main depth and shall connect the anode wire to the cast iron using the "Cadweld" method. The Contractor shall provide experienced personnel who shall make these connections in accordance with the manufacturer's recommendations.

Following welding, the Contractor shall remove all slag from the weld, file off all sharp edges and coat all exposed cast iron surfaces, steel surfaces and "Cadweld" locations with "Denso" tape and paste.

When the installation is complete, the Contractor shall pour 10 litres of water over the anode and backfill uniformly around the anode.

08030-12 BACKFILL

12.1 Initial Backfill in Pipe Zone

The Contractor shall hand place select excavated material which is free from lumps and stones in 150 mm lifts above the granular bedding on both sides of the pipe and to a point 300 mm above the crown of the pipe over the full width of the trench. The Contractor shall compact each lift to 98% of Standard Proctor Density using mechanical compaction equipment.

12.2 Backfill Above Pipe Zone

12.2.1 Class I Backfill

Approved granular material with a maximum aggregate size of 75 mm, shall be placed in 300 mm lifts over the whole width of the trench. Each lift shall be compacted to 98% of Standard Proctor Density, using mechanical compaction equipment.

12.2.2 Class II Backfill

Approved excavated material shall be placed in 300 mm lifts over the whole width of the trench. Each lift shall be compacted to 98% of Standard Proctor Density, using mechanical compaction equipment.

This backfill may contain coarse materials but shall be free from brush, frozen or other objectionable material that would prevent proper consolidation or that might cause subsequent settlement.

Rocks or stones not exceeding 10 kilograms in weight may be placed in this portion of the backfill but must be placed by hand.

The Contractor shall be responsible for controlling the moisture content of the backfill material so that the moisture content will be close to the optimum percentage for compaction. The Contractor shall add water to the material if the moisture content is too low or if the moisture content is too high, the Contractor shall move the material to an approved stockpile area, dry the material and then move the material back to the site of the work.

12.2.3 Class III Backfill

Class III backfill shall consist of approved excavated material free from brush and rocks or stones over 10 kilograms and other objectionable material. Backfill material shall be pushed down a ramp or slope of existing backfill and not directly onto the newly bedded pipe.

The backfill material shall be placed in 750 mm lifts over the whole width of the trench. Each lift shall be compacted to a density which is equal to the density of the adjacent soil.

12.2.4 Backfill Around Valves & Hydrants

The Contractor shall carefully select, place and compact backfill material in 150 mm lifts for a distance of 600 mm around each valve and hydrant. The contractor shall compact each lift to a minimum of 98% of the Standard Proctor Density.

12.3 Street Surfaces

12.3.1 General

The Contractor shall use a rubber tired motor grader to spread surface granular materials during compaction and to level earth streets after the backfilling has been completed.

The Contractor shall be responsible for filling trench settlements and repairing street surfaces which settle along the lines of his work during the maintenance period.

12.3.2 Paved Streets

Where excavation has been carried out on a paved street or on a street which has been based and is ready for pavement, the Contractor shall backfill the excavation up to 300 mm below the level of the original street surface. The Contractor shall then place 300 mm of base gravel to the gradation as specified in Section 08000-7.2 flush with the original street surface and shall compact it to 100% of Standard Proctor Density. Prices tendered for laying pipe, shall include the supply and placing of this gravel unless specified otherwise.

12.3.3 Gravel Streets

Where the excavation has been carried out on a gravel street, the Contractor shall backfill the excavation up to 100 mm below the level of the original street surface.

The Contractor shall then place 100 mm of base gravel to the gradation as specified in Section 08000-7.2 flush with the original street surface and shall compact it to 100% of Standard Proctor Density. Prices tendered for laying pipe, shall include the supply and placing of this gravel unless specified otherwise.

12.3.4 Earth Streets

Where excavation has been carried out on a graded earth street, the Contractor shall backfill the excavation up to the level of the original street surface.

Where the surface of the street has not previously been cut to grade, the Contractor shall spread and level any surplus excavated material over the top of the excavation.

12.3.5 Surplus Excavated Material

Where excavation has been carried out on a paved street, gravelled street or graded earth street all of the excavated material may not be required for backfilling. The Contractor shall load and haul this surplus excavated material to the nearest earth dumping site or to the location as specified in the Specific Conditions. The costs of disposing of this material shall be included in the Contractor's unit prices for constructing water main.

08030-13 CHLORINATION

The method to disinfect the water mains shall consist of liquid chlorine injection, conforming to AWWA C651, and result in chlorine residual of 50ppm after initial loading, 25ppm after twenty-four hours, and 1.5ppm after flushing and bacteria tests that meet City of Saskatoon standards.

Saskatchewan Environment requires that the pipes be flushed prior to chlorination. The chlorinated water must be disposed of in an environmentally safe manner, and in most circumstances this will mean the nearest sanitary sewer system.

Two consecutive sets of three samples along with turbidity and total chlorine residual for each sample will be required. Sampling will continue until two consecutive sets of all samples meet the regulatory requirements for total chlorine residual and turbidity and provide negative bacteriological results. The Contractor shall continue disinfection and flushing until these objectives are met.

The activation of the valve connecting the system or long lead to the City water main will not occur until these objectives are met.

Short connections and stubs (less than 40-60 feet) may still be chlorinated with granular H.T.H. disinfection powder, and flushed to the sanitary sewer system. The use of Chlorine Pool Pucks is never acceptable for any disinfection.

All of the Contractor's work to energize, disinfect and flush the water mains shall be carried out under the supervision of the Engineer. The Engineer shall approve the activities of the Contractor during the work required to energize, disinfect and flush the water mains. The Contractor shall not operate any valves of the existing City system unless the Engineer is present and has given his approval to do so.

08030-14 FIELD PRESSURE TESTING

All water mains installed under this Contract shall be subject to a hydrostatic pressure

test in the presence of the Engineer after backfilling has been completed and the mains have been chlorinated and flushed.

The Contractor shall furnish all labour and equipment necessary to make the tests including the costs of tapping the pipe if required. Water for the test shall be supplied to the Contractor without charge.

The Contractor shall subject each section of water main to a test pressure of 1034 KPa for a period of 1 hour. Additional water shall be added from a measured container as required to maintain this pressure during the test.

The test section will not be accepted if the leakage in litres measured by the above method exceeds the quantity determined by the following formula:

$$L_{PVC} = \frac{NxDx(P)^{0.5}}{130,400}$$

L_{PVC} = Allowable leakage in litres per hour.

N = Number of joints in the test section
(Including all associates appurtenances).

D = Nominal diameter of the pipe in millimetres.

P = Average Test Pressure in kilo pascals (kPa).

Note: Allowable leakage calculations for pipe types other than PVC shall be done in accordance with current AWWA standards.

If the leakage exceeds the allowable, the Contractor shall locate and repair leaks and defects and repeat the tests until the leakage does not exceed the allowable.

08030-15 BACTERIA AND TURBIDITY TESTING

The Contractor shall provide all labour and materials necessary to flush lines until the turbidity and bacteria test levels meet or exceed the levels set out by the City.

The City shall supply and perform bacteria and turbidity testing.

08030-16 CLEAN UP

The Contractor shall clean up the site as the work progresses.

The Contractor shall remove all of his equipment, plant, tools and surplus material from the site of the finished work and shall repair and restore all drainage facilities which have been blocked or damaged as a result of the Contractor's operations.

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08040-1 DESCRIPTION OF WORK

This Specification covers the installation of reinforced concrete, PVC, and corrugated metal pipe culverts and riprap. The Contractor shall supply all labour, tools, equipment and materials for the construction of culverts through roadways and embankments, unless otherwise noted.

08040-2 MATERIALS

The Contractor shall supply all culvert and storm sewer materials of the type and class approved by the City.

08040-3 CULVERT INSTALLATION

The Contractor shall install culverts at locations noted on drawings and to the elevations staked by the Engineer. Culverts shall be placed in a trench and the bottom of trench shall be shaped to uniformly support the lower quadrant of the culvert pipe. Unsuitable foundation material shall be removed to the depth, width, and length authorized by the Engineer and replaced with suitable material.

08040-4 BEDDING

All culverts installed under this Contract shall be laid on Class "B" granular bedding as shown on current City of Saskatoon Standard Drawings as posted on the City's Internet web site. Mechanical or pneumatic compaction equipment shall be used to compact bedding material around and up to the spring line of the pipe and for compacting the select backfill to 300 millimetres above the pipe. All bedding and backfill shall be compacted to 98% of Standard Proctor Density.

08040-5 CULVERT INLET AND OUTLET TREATMENT

Culvert inlet and outlet shall be constructed as per the Engineer's specifications. Riprap shall consist of durable field or quarry stone, hard, dense, resistant to weathering and to water action.

The riprap stones shall be 150 mm to 300 mm in diameter with stone sizes evenly distributed. The area to be riprapped shall be excavated and trimmed and 50 mm granular bedding sand installed prior to placing the stones.

08040-6 MEASUREMENT

Culverts will be measured in metres. Measurements will be taken parallel to the barrel for the entire length of the culvert.

Riprap will be measured in place, in cubic metres.

08040-7 PAYMENT

Payment for installing concrete, clay, tile or corrugated metal pipe culverts or storm sewers will be at the contract unit price per metre for the sizes specified in the Tender Form. The unit prices will be full compensation for supplying, unloading, storing, handling and hauling culvert materials, placing Class "B: bedding, excavating, assembling the culvert, backfilling and compacting the backfill material. Payment for riprap will be at the contract unit price per cubic metre. The unit price will be full compensation for excavating and preparing the bed, placing the 50 mm granular bedding, supplying, loading, hauling, unloading, and placing the stones.

Payment for removing unsuitable subgrade material, if directed by the Engineer will be paid for at the Contract Unit Price for unstable subgrade. Unstable subgrade excavated from the bottom of the trench will be measured in cubic metres calculated from the length, width and depth authorized for removal. The unit price shall include excavating and disposing of surplus material and backfilling with stabilized material.

Granular materials salvaged from existing roadways may be used as granular bedding and backfill material when installing culverts. The Contractor will be responsible for handling and transporting the material from the stockpile site to the trench area. The cost of handling granular backfill shall be included in the contract unit price for installing culverts.

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08045-1 **DESCRIPTION**

1.1 **Scope of Contractor's Work**

Work under this Contract shall include:

- a) Repairs to manhole rungs where necessary to access the storm sewer. This will include welding vertical strips of angle iron onto damaged rungs for reinforcement and welding in new steps where required.

Angle iron to be supplied and delivered by the Contractor.

- b) Supply and installation of hooks for stringing lighting and cable along the crown of the pipe.
- c) Remove damaged liner and use pop rivets to tack down loose liner. Pop rivets to be supplied by the City of Saskatoon.
- d) Installation of 10 gauge stainless steel straps using pop rivets to secure damaged ends. Pop rivets and stainless steel strapping to be supplied by the City of Saskatoon.

1.2 Scope of City of Saskatoon's Work

The City of Saskatoon will supply all labour and equipment for the ventilation, pumping and lighting. The City will also supply the labourers to assist the Contractor in the removal and tacking down of liner and installation of strapping.

08045-2 STAINLESS STEEL STRAPPING

Ten gauge 316 2B stainless steel strapping will be used to tack down loose ends where the liner has been removed or damaged. It will be installed on the inside circumference using pop rivets. Straps will be riveted to two corrugations. The length of the straps are 1/3 the circumference and are machine rolled to a radius of 28 inches.

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08125-1 GENERAL

1.1 Description

This section specifies the requirements for T.V. inspection of sewer mains which shall consist of cleaning the mains, pulling a closed circuit T.V. camera through the mains viewing down the service connection, and recording on videotape the condition of the inside periphery, providing traffic control around the work area and submission of videotapes and reports. The work shall be completed within the limits of the contract documents.

08125-2 EQUIPMENT

2.1 General

All tools, machinery, and equipment used in handling materials and executing any part of the work, shall be subject to the approval of the Engineer. All such equipment shall be maintained in efficient working order and where any of the machinery, or equipment is found to be unsatisfactory, it shall be improved or replaced by the Contractor to the satisfaction of the Engineer.

2.2 Video Equipment

Video equipment is to be capable of producing a High Quality (HQ) video cassette recording. Equipment is to consist of a closed circuit television system. The T.V. camera shall be colour as well as the monitor and a recorder in a mobile van with a data input system capable of continuously superimposing onto the videotape the following captions; street name, manhole numbers, date, and location of camera in metres from the point of entry.

These captions should be located to facilitate full viewing of the pipe periphery.

The video camera equipment is to allow for lateral inspection at the service connection by using remote control.

The television camera used for the inspection shall be one specifically designed and constructed for inspection purposes.

Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The Camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Engineer, and if unsatisfactory, the equipment shall be removed and no payment will be made for unsatisfactory inspection.

2.3 Sewer Flusher

Direct pulling and/or stringing shall be done using a high pressure sewer flusher.

The sewer flusher shall be of sufficient size, capacity, and condition to ensure continuous operation in 150 mm through 1200 mm diameter pipe.

2.4 Hazard Lights

The mobile van, sewer flusher and service vehicles shall be equipped with rotating amber lights of sufficient number and height for the amber lights to be visible from all directions of approach.

2.5 Heating System

A heating system or suitable alternative is required to prevent fogging of the lines during cold weather inspection.

2.6 Distance Meter

The meter shall record distance travelled by the camera to 0.1 m with an accuracy of plus or minus 0.2%.

It must be connected to the video equipment in such a manner that the distance is automatically imprinted onto the video cassette.

08125-3 EXECUTION

3.1 General

Camera inspection is to be performed on one sewer section at a time, pulling the camera through the pipe in the direction of flow. Pulling against the flow will be permitted where an obstruction requires a reverse set up. The distance meter is to be zeroed at the beginning of each section of main televised. A sewer section is defined as the length of pipe between adjacent manholes.

The view of the camera is to be transmitted to a suitably sized monitor located in the mobile van, allowing continuous monitoring and recording of the progress of the colour T.V. camera. During recording a log is to be kept identifying the location of all defects and lateral connections. Still recordings shall be made of defects in the sewer.

3.2 Cleaning

A high pressure sewer flusher and vacuum shall be used to clean the sewer. Accumulations of debris must be removed and hauled by the Contractor to the Water Pollution Control Plant for disposal. Cleaning shall be sufficient to produce a video record which is unobstructed by material in the sewer main.

3.3 Access to Hydrants

The Contractor shall use designated hydrants for filling his flusher. A hydrant key will be issued to the Contractor for this purpose. The person designated to operate the hydrant shall be knowledgeable in the proper operation of hydrants. Any damage resulting from improper operation of the hydrant shall be repaired by the City at the Contractor's expense.

3.4 Pulling Camera

A sewer flusher may be required for pulling the camera. It is mandatory that a flusher be used for pulling where there are; high flows, dips and flat grades that may accumulate material that will obscure the camera lens and where there is light debris in the line. The flusher shall be used to lower flow levels and to move minor deposits of sludge and debris and clean the camera lens to ensure total viewing of the inside periphery of the pipe.

Where the condition of the pipe permits, the method of pulling is optional and may be accomplished by directly pulling with a flusher or by prestringing the mains with a flusher and using a winch to pull the camera. The Engineer shall be advised of all mains which are prestrung, the string lines shall be taut and tied to manhole steps.

Communication between the person pulling the camera and the person monitoring its progress must be suitable to quickly stop the camera if necessary to prevent jamming of the camera or damage to the sewer. When pulling the camera the rate of progress shall not exceed 9 m per minute.

3.5 Recording defects in the sewer

The camera shall be stopped for 10 to 15 seconds to record defects. Defects shall include open and/or offset joints, cracked pipe, deflected or collapsed pipe, missing pipe segments, root infiltration, groundwater infiltration, pipe misalignment, corrosion and erosion.

3.6 Pipe Obstructions

If during the inspection operation, the television camera will not safely pass through the entire section, the Contractor may set up his equipment so that the inspection can be performed from the opposite manhole.

In the event that the T.V. camera encounters broken pipe and there is a possibility the camera could become stuck or result in pipe damage or collapse, either the Contractor or the on-site Inspector may elect to discontinue the inspection.

08125-4 REPORTING

4.1 General

A copy of videotape and inspection shall be submitted for all sewer sections televised. Payment to the contractor will be based on review of this material.

4.2 Inspection Report

The inspection report shall be typewritten and in log format. The format shall be approved by the Engineer. For each sewer section the street name, manhole numbers, pipe size and material, length of section, type of sewer, direction of flow, date of inspection and name of technician shall be recorded. The report shall include a reference so each sewer section can be readily located on the videotape.

The location, nature and extent of all defects in the sewer shall be recorded in the inspection report.

4.3 Videotapes

All sections of main televised are to be recorded on a High Quality (HQ) colour VHS videotape. Captions superimposed at the time of recording are to include street name, manhole numbers, date, and distance in metres from the starting manhole to 1/10 of a metre. Captions are to be continuous over each section and must be located on the screen in a location that does not affect the viewing of the periphery of the pipe.

08125-5 MEASUREMENT

Payment is based on length of sewer televised as per the tender documents. The Contractor shall notify the Engineer of any discrepancies between the distance specified in the tender and actual distances.

Payment will be based on metres of sewer televised. Payment shall not be made for lengths greater than 0.20% of the actual length of a sewer section as measured along the surface between manholes.

Deductions shall be made for televised lengths that are not clear or do not meet specifications. The deductions shall be equal to the contracted unit price times the distance affected as interpreted from the videotapes.

08125-6 PAYMENT

Payment for length of sewer televised and recorded will be at the contract unit price per metre. The unit price will be full compensation for all labour, equipment and materials necessary to produce the videotapes and reports that are submitted to the City for payment.

END OF SPECIFICATIONS 08125