



Part 1 General

1.1 DESCRIPTION OF WORK

- .1 The work described herein shall consist of the construction of mechanical works for pump houses, treatment plants, lift stations or wetwells as shown on the Plans, including the supply and installation of piping, pumps, feeders, mixers, valves, meters, fittings and related appurtenances including supports; the sandblasting, priming and painting of all uncoated, non-galvanized, non-stainless ferrous metal (iron and steel) products, the connection of the completed works to external water and sewer lines; and the testing of the completed works.

1.2 STANDARDS

The following organizations publish Standards which have been referred to in this Section:

- .1 CSA International
 178 Rexdale Boulevard
 Etobicoke, ON M9W 1R3
- .2 ASTM – American Society for Testing and Material
 100 Barr Harbor Drive
 West Conshohocken, PA 19428-2959 USA
- AWWA – American Water Works Association
 6666W. Quincy Avenue
 Denver, Colorado 8235 U.S.A.

The Standards referred to shall be the most recent edition.

1.3 QUALITY ASSURANCE

- .1 OPERATION - The Contractor shall test the operation of the completed works under the direct supervision of the Engineer.
- .2 WELDED JOINTS – The Contractor shall supply a procedure for welded joints to the Engineer. The Engineer may test welded joints by x-raying or other means. If the welds are deemed to be faulty the costs to fix the welds shall be the responsibility of

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the Contractor. Welders shall hold a valid "Welder's Licence" in the Province of Manitoba and be certified by Provincial Regulator.

- .3 GROOVED JOINTS – All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.4 STORAGE AND HANDLING

- .1 Pumps, feeders, mixers, valves, meters, pipe, fittings and other appurtenant products associated with the construction of the works shall be stored and handled in accordance with the recommendations of the Manufacturer or in a manner approved by the Engineer.

1.5 INSPECTION

- .1 Inspection of the work described in this Section shall be performed by the Engineer.

Part 2 Products

2.1 PRESSURE RATING

- .1 All products shall be suitable for 1000 kPa cold water service, unless otherwise specified.

2.2 VALVE OPENING DIRECTION

- .1 All valves with hand wheels shall open when turned in a counter clockwise direction. All valves with operating levers shall be open when the lever is parallel to the valve body, and shall be closed when the lever is perpendicular to the valve body.

2.3 CASTINGS

- .1 Cast iron shall conform to the current ASTM Standard A126, Standard for Gray Iron Castings. Ductile iron shall conform to the current ASTM Standard A536, Standard for Ductile Iron Castings for Valves, Flanges and Pipe Fittings. Bronze shall conform to the current ASTM Standard B62, Standard for Bronze Castings.

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2.4 JOINTS

- .1 FLANGED JOINTS - shall conform to the current AWWA Standards C110, Standard for Gray and Ductile Iron Fittings; C115, Standard for Flanged Cast and Ductile Iron Pipe; and C207, Standard for Steel Pipe Flanges. Gaskets shall be full faced and drilled, red rubber type or approved equal. Nuts, bolts, and washers shall be either Type 304 or 316 stainless steel with hexagonal heads.
- .2 MECHANICAL JOINT-TYPE ADAPTER FLANGE JOINTS - (subject to approval of the Engineer) used to connect plain-end steel or iron pipe to appurtenances with integral flanges shall be ductile iron, drilled in accordance with the current AWWA C110, Standard for Gray and Ductile Iron Fittings. Set screws shall be zinc-plated, heat treated steel with a minimum tensile strength of 28 MPa. The rubber gaskets shall conform to the current AWWA C111/A21.11-07, Standard for Rubber-Gasket Joints for Cast Iron and Ductile-Iron Pressure Pipe and Fittings. Nuts, bolts and washers shall be stainless steel with hexagonal heads.
- .3 GROOVED AND SHOULDERED JOINTS – (subject to approval of the Engineer) shall conform to the current AWWA C606, Standard for Grooved and Shouldered Joints.
 - .1 Ductile Iron Pipe: Grooved joint couplings for Class 53 (min) ductile iron pipe shall comply with AWWA Standard C606, consisting of two or more ductile iron housings to ASTM-A536, Zinc-electroplated carbon steel bolts, meeting ASTM A-449 and pressure responsive FlushSeal® gasket.
 - .2 Carbon Steel Pipe: Grooved joint couplings shall consist of two ductile iron housing segments, pressure responsive elastomer gasket, and ASTM A449 Zinc-electroplated steel bolts and nuts.
 - .1 Rigid: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9. Installation-Ready, for direct stab installation without field disassembly.
 - .2 Flexible: Use in locations where vibration attenuation and stress relief are required.
 - .3 AGS series two-segment couplings with lead-in chamfer on housing key and wide-width FlushSeal® gasket.
 - .3 For direct connection from AWWA / ductile iron pipe sizes to IPS / steel pipe sizes, grooved joint transition couplings may be used.

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- .4 THREADED JOINTS - (or screw type joints) shall be standard iron pipe size type. PVC male ends shall be coated with Teflon paste; and steel and iron male ends shall be coated with an approved anti-seize compound.
- .5 WELDED JOINTS - shall be used to connect adjacent plain-end steel pipe and fittings.
- .6 SOLVENT WELDED JOINTS - shall be used to join schedule type PVC pipe to PVC unions and fittings. Primer and solvent cement shall conform to the current ASTM Standard D2564, Standard for Solvent Cements for PVC Plastic Pipe and Fittings.
- .7 COMPRESSION JOINTS - (push-on or stab-in joints with compression type rubber gaskets) may be used on small diameter tubing with the Engineer's consent, and shall be used as shown on the plans on larger diameter piping where a non-rigid joint is required (AWWA C900 joint specification). Compression joints 50 mm and smaller shall have a compression nut to seat the rubber gasket.
- .8 SOLDERED JOINTS - shall be used to join copper pipe and fittings. Flux shall be non-corrosive type. The solder for connection shall be no-lead type.

2.5 PIPE AND FITTINGS

Pipe, tees, elbows, reducers, sleeves, nipples, unions, and related fittings shall be steel, iron, polyvinyl chloride (PVC) or copper, as shown on the Plans or as detailed in Section 01 00 10, Special Provisions.

- .1 STEEL - shall be seamless steel, Grade B, conforming to the current AWWA Standards C200, Standard for Steel Water Pipe, and C208, Standard for Dimensions for Steel Water Pipe Fittings.
- .2 STAINLESS STEEL - shall be seamless stainless steel conforming to the current AWWA Standards C220 Standard for Stainless-Steel Water Pipe 13 mm or Larger and C226, Standard for Stainless Steel Fittings for Waterworks Service (13 mm through to 1800 mm).
- .3 IRON - shall conform to the current AWWA Standards C110, Standard for Gray and Ductile Iron Fittings and C115, Standard for Flanged Cast and Ductile Iron Pipe.
- .4 PVC - shall conform to the following Standards:

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- .1 ASTM D1784 - Standard for Rigid PVC and CPVC Compounds
- .2 ASTM D1785 - Standards for Schedule 40, 80, 120 PVC Plastic Pipe
- .3 CSA B137.0 - Standard for Thermoplastic Pressure Piping
- .4 CSA B137.3 - Standard for Rigid PVC Pipe for Pressure Applications

PVC compound shall be Type I, Grade 1, Polyvinyl Chloride 1120. The pipe and fittings shall be Schedule 80 unless otherwise specified on the Plans or in Section 01 00 10, Special Provisions. Joints shall be solvent-welded type and/or threaded type, as shown on the Plans.

- .5 COPPER - shall conform to ASTM B88, Standard for Seamless Copper Water Tubing, and shall be rigid or flexible (as required) type "L" or "K", with soldered joints. Solder shall be 95% tin, 5% antimony (general use) and silver where used on carbon dioxide piping.

2.6 FLEXIBLE DISCHARGE HOSE

- .1 Discharge hose shall be heavy duty black rubber or heavy gauge fabric and rubber coated steel wire reinforcement capable of bending to five times the nominal inside diameter, in cold temperatures, suitable for 500 kPa working pressure and flexible for full vacuum.

2.7 CLAMPS

- .1 Clamps for flexible discharge hose connections shall be all stainless steel, with all stainless steel nuts and bolts.

2.8 UNDERGROUND PIPE

- .1 Pipe used to make connections between the structures and pipelines shall conform to Section 02 70 60, Pressure Pipelines.

2.9 REPAIR CLAMPS

- .1 Repair clamps used to make transition connections or repairs shall be wrap around "O" style. All metal parts and welds shall be Type 304 stainless steel which has been fully passivated. Bolt shanks shall be forged flat to resist bending. Bolt threads shall be rolled-type, lubricated by an anti-galling (i.e. Seal-On 500) compound. Nuts and washers shall be connected to turn independently without separating.

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- .2 The rubber gaskets shall have tapered ends, a gridded surface, and stainless steel armours. Gaskets shall be made of a synthetic equivalent to natural rubber. Virgin SBR to ASTM D2000.
- .3 Clamps for all pipe with a nom. i.d. of 250 mm and less shall have a minimum of one row of no less than three bolts. Clamps for 300 mm to 400 mm nom. i.d. pipe shall have a minimum of two rows of no less than three bolts. Clamps for 400 mm nom.i.d. pipe and larger shall have three rows of no less than four bolts. Clamp lengths shall be no less than two times the nominal inside diameter of the pipe on which the clamp is to be installed.

2.10 METAL BODY (FLEXIBLE) COUPLINGS

- .1 Metal body-type couplings used to make transition and flexible connections shall have the centre ring and end plates fabricated of ductile iron which shall conform to the current ASTM Standard A536, Standard for Ductile Iron Castings, and shall be finished with two coats of enamel for corrosion protection and epoxy coated when used for in-ground bury applications. The coupling length shall be a minimum two times the diameter of the pipe.
- .2 Gaskets shall conform to the current AWWA Standard C111, Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings.
- .3 Nuts, bolts and washers shall be stainless steel with plastic thread protector caps and zinc anode nuts unless otherwise specified in Section 01 00 10, Special Provisions.

2.11 BUTTERFLY VALVES

- .1 50 MM NOM.I.D. AND SMALLER - shall have a bronze body, stainless steel disc and stem, Buna-N rubber seal, a hand operating lever, and threaded or solder-type joints.
- .2 LARGER THAN 50 MM NOM.I.D. - shall be wafer-style or grooved end, with a cast ductile body, bronze disc or stainless steel alloy stem, EPDM seat (pressure responsive seat in sizes through NPS 12) and seals. Stem shall be offset from the disc centreline to provide complete 360-degree circumferential seating. Manually operated butterfly valves up to and including 150 mm nom.i.d. shall be complete with a lever type handle with notched position locks. Manually operated butterfly valves 200 mm and larger shall be complete with a heavy duty gear operator using NSF 61 approved gear box lubricant when submerged in potable water and with a hand wheel. Automatically operated (pneumatic) butterfly valves shall be complete with position

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indicators, integral positioner, spring or pneumatic "fail safe" devices (normally closed unless otherwise specified), solenoid operated pneumatic control and manual override. Extension spindles, as may be required shall be stainless steel.

- .3 Butterfly valve used for controlling flow regardless of size shall be operated with an actuated gear.

2.12 BALL VALVES

- .1 BRONZE BODY TYPE - shall have a bronze body, follower and bronze, brass, or chrome plated ball, Buna-N seal and seat, threaded, compression or solder-type joints, and a hand operating lever.
- .2 DUCTILE IRON BODY TYPE – shall have ASTM A536 ductile iron body, chrome-plated steel or fully stainless steel ball and stem, PTFE seats, grooved ends, and hand lever or gear operated.
- .3 PVC BODY TYPE - (for use with PVC pipe) shall have a PVC body conforming to the current ASTM Standard D1784, Standard for PVC Rigid PVC compound; ASTM D1785, Standard for PVC Plastic Pipe; ASTM D2467, Standard for PVC Pipe Fittings (Schedule 80); ASTM D2466 Standard for PVC Pipe Fittings (Schedule 40), and shall have an EPDM or Teflon seat, a hand operating lever and integral threaded union joints.

2.13 GATE VALVES

- .1 50 MM NOM.I.D. AND SMALLER - shall have a bronze body, rising stem, solid wedge disc (with fully guided disc travel), screwed bonnet, open rim multi-rib type hand wheel, and threaded or solder-type joints.
- .2 LARGER THAN 50 MM NOM.I.D. - shall have a cast iron body, bronze stem and seat, body guide ribs to control complete disc travel, rising stem, tapered seat, open rim hand wheel, and flanged joints.
- .3 200 MM NOM.I.D. AND GREATER – shall have gear actuated valve

2.14 KNIFE GATE VALVES

- .1 Knife gate valves shall be bonnetless, wafer-style body, with solid one piece cast grey or ductile iron body, type 18-8 stainless steel gate and stem, mild steel stuffing box and yoke, neoprene packing, bronze stem nut, open rim hand wheel, and all stainless

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or cadmium plated steel nuts and bolts. The valve body shall be drilled for flange connection. For submerged or buried or concrete encased service, nuts, bolts, and washers shall be all stainless steel Type 304.

2.15 GLOBE VALVES

- .1 Globe valves shall have a bronze body, renewable composition disc seating, screwed bonnet, open rim multi-rib type hand wheel, and threaded or solder-type joints.

2.16 CHECK VALVES

- .1 SWING CHECK - 50 MM NOM.I.D. AND SMALLER shall be bronze, Y-body, with 45° angle seating, two piece composition and all bronze rotating disc in threaded or compression joints.
- .2 SWING CHECK - LARGER THAN 50 MM NOM.I.D. shall conform to the current AWWA C508, Standard for Swing Check Valves, with an iron body and cap, and bronze trim, Nitrile or Buna N seal, bronze (B62) or stainless steel hinge pins trim, plated steel external operating lever and weight or lever and stainless steel spring, plugs and bushing sealed by "O" rings. Swing check flanged or grooved body 50 mm – 100 mm bronze disc and seat ring, 100 mm – 600 mm grey iron disc ASTM A126 all bronze disc and seat ring. Sewage collection valve shall consist of a rubber seat, otherwise bronze seat rings are acceptable.
- .3 WAFER STYLE SWING CHECK - shall have a cast iron body, Type 316 stainless steel or bronze disc, seat, hinge and related fittings, Buna-N rubber "O" ring, stainless steel or bronze spacer, cadmium plated steel external manual operating lever and related fittings.
- .4 GROOVED END CHECK VALVE - Check valves shall be silent type for 1575 kPa cold-water service suitable for use with grooved connections.
- .5 SILENT TYPE CHECK - shall have a cast iron body, bronze trim, stainless steel spring, and Buna-N rubber seals. The body shall be either wafer-style or globe-style, as specified in Section 01 00 10, Special Provisions, or as shown on the Plans.
- .6 PVC BODY TYPE - (for PVC pipe only) shall have PVC conforming to the current ASTM Standard D1784, Standard for Rigid PVC Compounds; ASTM D1785, Standard for PVC Plastic Pipe; ASTM D2466, Standard for PVC Pipe Fittings

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(Schedule 40); and ASTM D2467, Standard for PVC Pipe Fittings (Schedule 80), and shall be Y-body design with integral threaded union joints.

- .7 FOOT VALVES - shall have a flanged or threaded cast iron body, Buna-N rubber "O" ring, bronze seat, plug, bushing and bushing retainer, stainless steel seat retainer, nuts and bolts, screen and screen retainer.
- .8 BALL TYPE - shall be Flygt HDL or approved equal, with threaded (50 mm and smaller) or flanged (50 mm and larger) joints.

2.17 SELF REGULATED CONTROL VALVES

- .1 Self-regulating control valves shall be single chambered, hydraulically operated, controlled units with a cast iron globe-style body. If valve supplied is ductile then body shall be epoxy coated. Valves shall have threaded joints 50 mm nom.i.d. and smaller or flanged joints 50 mm nom.i.d. and larger. Larger valves shall have a replaceable stainless steel seat and stem, a reversible resilient polyurethane disc and a reinforced synthetic rubber or EPDM diaphragm. Such control valves shall be configured in pressure relief, pressure reducing, pressure sustaining, check, level regulating, surge suppression, valves, pump control or combination modes, as specified.

2.18 DIAPHRAGM VALVE

- .1 Diaphragm valves shall have a straight through pattern, cast iron with threaded joints 50 mm nom.i.d. and smaller or flanged joints (50 mm nom.i.d. and larger). The diaphragm liner shall be soft rubber. Manually operated (pneumatic) valves shall be complete with a single acting diaphragm operator, spring or pneumatic "fail safe" device, position indicator; integral positioner solenoid operated pneumatic control and manual override (hand wheel).

2.19 STRAINERS

- .1 Strainers shall be Y-body type design, with a cast iron body. Strainers with a nom.i.d. of 50 mm and less shall have a removable screen of monel metal or stainless steel, with openings of 0.75 mm diameter, and shall have threaded joints. Larger strainers shall be flanged with a heavy gauge brass sheet type screen, with openings of 1.5 mm diameter for strainers of 50 to 100 mm nom.i.d. or 3.0 mm diameter for strainers of nom.i.d. greater than 100 mm. The screen cover shall be complete with a threaded plugged blowoff outlet.

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2.20 WATER METERS

- .1 Water meters shall be installed as per Manufacturer's recommendations.
- .2 Meters 38 mm nom.i.d. and smaller shall have threaded joints, meters 50 mm nom.i.d. and larger shall have flanged joints. Meters shall read in cubic metres unless otherwise specified in Section 01 00 10 Special Provisions.
- .3 DISPLACEMENT TYPE METERS - shall conform to the current AWWA Standard C700, Standard for Cold Water Meters - Displacement Type.
- .4 TURBINE METERS - shall conform to the current AWWA Standard C701, Standard for Cold Water Meters - Turbine Type. All turbine meters (less than 150 mm nom.i.d.) shall be complete with proprietary strainers.
- .5 COMPOUND METERS - shall conform to the current AWWA C702, Standard for Cold Water Meters - Compound Type.
- .6 MAGNETIC METERS - shall conform to the current AWWA Standards C700 and C707 and CSA 22.2.

Magnetic meters shall be installed in a continuous flooded condition, which may require a trap configuration, within a straight pipe run length of minimum five times the pipe diameter before, and three times the pipe diameter after, the flow meter in flow direction (no elbows, bends, valves, etc. shall be within the straight pipe length). Ensure the flow tube is oriented in correct direction.

For testing/verification purposes, a sample tap shall be installed downstream from magnetic meter, at a suitable location beyond the required straight pipe length. The tap shall be located between one-third and one-half the pipe diameter from bottom of pipe, with a threaded hose connection and vacuum break.

Magnetic meter shall be grounded by installing two grounding rings directly adjacent to each tube end, separated only by a rubber seal. Each grounding ring shall be grounded directly to the grounding spot on the tube as required by the Manufacturer, near the display or the transmitter in case of a remote display. For the grounding conductor, use wire sizes ranging from #12AWG – #10AWG, or as otherwise directed by the Manufacturer. A split bolt shall be used on the building-ground side. If the system already incorporates a cathodic protection application, do not ground the flowmeter back to a building ground. In this case, please contact the Project

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Engineer prior to installation for further direction. Each magnetic meter shall be grounded individually back to the building ground.

Magnetic meter shall be programmed to show the NET or SUM counter (counting forward flow in flow direction and subtracting flow in reverse direction) on the main display screen. A MINUS or NEGATIVE (counting only flow in reverse from the intended flow direction) shall be used as an internal calculation.

2.21 AIR COMPRESSORS

- .1 Air Compressors shall be CSA approved self contained twin compressor units, complete with electric motors, V-belt drives, and pressure regulating equipment, mounted on a horizontal ASME receiver tank, complete with interconnecting piping between the compressor, receiver, and regulating equipment. Each of the two compressors shall be of the single-acting reciprocating type. Valves shall be readily accessible. Connecting rods shall be of the solid end, non-adjustable type. Inter-coolers on two stage units are to be finned, multi-tube copper construction to obtain maximum heat dissipation. The compressors shall be automatically unloaded every time the unit stops, regardless of the cause of shut down. The unloader mechanism shall operate as a function of speed, and shall be sealed in the crankcase. The design of the unit shall permit the operation of one compressor while the other is being serviced. The pressure regulation equipment shall automatically control the compressors such that the pressure in the receiver is regulated automatically. Each compressor shall operate on alternate cycles. A "hand-off-automatic" control shall be provided to override the alternator.
- .2 The compressor running gear lubrication shall be splash type. Lubrication dippers shall be integral with the connecting rod to prevent them from becoming loosened.
- .3 The receiver shall include a pressure gauge reading in kilopascals and pounds per square inch, a drain valve, service air line valve and safety relief valve.
- .4 The compressor units shall be complete with oil filtration system and air dryers compatible with the compressor output.
- .5 The motors shall be NEMA frame squirrel cage induction type with drip proof enclosure. Section 01 00 10, Special Provisions, shall specify the voltage, phase, cycles, compressor output (capacity and pressure) and receiver tank capacity.

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2.22 SOLENOID

- .1 Solenoid valves shall be two, three and four way, as required, general purpose, direct operated, with brass body, threaded joints, teflon seat, to open when energized by 1Ø /60 Hz/110-120 V current, to be CSA approved for air and water service to 1100 kPa.

2.23 PRESSURE GAUGES

- .1 Pressure gauges shall be liquid filled, have brass or bronze internal parts, threaded connections, and a steel case with an unbreakable crystal round face no less than 75 mm in diameter. The gauge shall be installed complete with a snubber where required and a shut off cock for gauge removal or replacement. Pressure gauges shall be supplied in the units of kPa and psi and the pressure range of 0 - 1035 kPa (0 - 150 psi), unless otherwise specified in Section 01 00 10 Special Provisions.

2.24 PIPE SUPPORTS

- .1 ADJUSTABLE CLEVIS - type pipe support, fabricated of carbon steel with black finish and with a black steel bolt to connect the clevis to an overhead beam, shall be used to suspend overhead piping. The clevis shall be Anvil International Fig. 260 or approved equal.
- .2 RISER CLAMPS - shall be used to support the pipes rising vertically through a sleeve. The clamp shall be Anvil International Fig. 261 or approved equal.
- .3 BEAM CLAMPS - shall be used to attach clevis pipe supports to structural I-beams. For beams up to 180 mm wide and 15 mm thick, the beam clamp shall have a malleable iron jaw and steel tie rod, nuts and washers, with black finish, and shall be Anvil International Fig. 218 or approved equal. For beams up to 380 mm wide and 27 mm thick, the beam clamp shall be forged steel, Anvil International Fig. 228 or approved equal.
- .4 CEILING FLANGES - shall be used to attach clevis pipe supports to ceilings, shall be malleable iron, and shall be Anvil International Fig. 153 or Fig. 128, or approved equal. The hardware to be used to attach the flange to the ceiling shall be: Hilti Kwik Bolts (for concrete); stainless steel bolts (steel); or stainless steel screws (wood).

SUPPORT RODS - shall be used to connect beam clamps and ceiling flanges to clevis pipe supports. The rods shall be carbon steel, threaded at both ends, and shall be Anvil

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International Fig. 140, or Fig. 253, or approved equal. Hanger rod sizing as a minimum shall be as follows:

TABLE 1

PIPE SIZE (Nominal, mm)	HANGER ROD DIAMETER (mm)
50	10
75	12
100	16
150	20
200	22
250	25
300	25
400	25
500	32
600	32

The metal framing system - using 16mm by 16mm galvanized channel shall be 'power strut' or 'unistrut' or approved equal or as otherwise detailed on the plans.

- .5 TURNBUCKLES - shall be used to connect two piece support rods, shall be black forged steel, and shall be Anvil International 230 or approved equal.
- .6 PIPE SADDLE SUPPORTS - shall be used to support pipes, shall be carbon steel or cast iron and shall be Anvil International 258 or approved equal.
- .7 PIPE STANCHION SADDLES - shall be cast iron with steel yoke and nuts, and shall be Anvil International Fig. 259 or approved equal.
- .8 SMALL DIAMETER PIPE (UNDER 75 ϕ) CLAMPS - shall be Anvil International 138 R extension split pipe clamps, connected to walls, floors and ceilings by threaded rods and one of either: Anvil International Fig. 117 expansion cases (drilled into

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concrete or masonry); or welded (onto structural steel); or to Fig. 128 R ceiling flanges (to wood, steel, etc.).

- .9 SUPPORT SPACING - The maximum pipe support spacing shall be as listed in the following table:

TABLE 2

MAXIMUM SUPPORT SPACING (m)			
PIPE SIZE (Nominal,mm)	PIPE MATERIAL		
	STEEL OR IRON	PVC	FRP
30 and under	2.1	1.4	1.5
30 to 40	2.7	1.5	1.8
40 to 50	3.0	1.5	2.1
60 to 75	3.6	1.5	2.4
100	4.2	1.8	2.7
150	5.2	2.4	3.0
200	5.8	3.0	3.3
250	6.7	3.5	3.5
300	7.0	3.5	3.5
400	7.0	-	-
500	7.0	-	-
600	7.0	-	-

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2.25 PNEUMATIC LINES AND FITTINGS

- .1 Pneumatic lines shall be type "L" or type "K" copper tubing, soft for under 13 mm nom. i.d., hard for 13 mm and up. Fittings shall be solder-joint type or "gyrolok" copper fittings. Manual valves shall be bronze body ball type, with Buna-N or TFE seal and seat, solder or "gyrolok" joints and a manual operating lever. As an alternative, for 13 mm and under tubing connecting to equipment, Rehau PE 130 polyethylene tubing or approved equal may be used.

2.26 BACKFLOW PREVENTER

- .1 **LOW HAZARD UNITS** - shall conform to the current AWWA C506, Standard for Backflow Prevention devices. Units 50 mm nom. i.d. and smaller shall incorporate gate and check valves with bronze body and trim, and check assemblies shall have guided centre stem travel. Units 62 mm nom. i.d. and larger shall incorporate cast iron bodies with bronze trim and internal epoxy coating. All gate valves shall be fully ported and shall have handwheels with non-rising stems. All units shall incorporate four bronze test cocks. All check valves shall incorporate stainless steel springs. The units shall be designed to permit servicing without removing the valves from the water line on which the unit is installed.
- .2 **HIGH HAZARD (REDUCED PRESSURE TYPE) UNITS** - shall conform to the above and AWWA C511, Standard for Reduced-Pressure Principle Backflow Prevention Assembly. Units shall also incorporate a differential pressure relief valve which shall open if the upstream and downstream pressure differential falls below 15 kPa, to maintain a proper differential of 35 kPa.

2.27 STAINLESS STEEL

- .1 Unless noted to the contrary, all stainless steel incorporated in the products described in this Section, shall be either type 304 or 316, in accordance with ASTM standards.

2.28 PUMPS, FEEDERS, AND MIXERS

- .1 Pumps, feeders, mixers and associated products shall conform to the requirement detailed elsewhere in these specifications or Section 01 00 10 Special Provisions or as shown on the Plans.

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2.29 RESTRAINT COLLARS

- 1 Restraint collars for positive limitation of movement on bell and spigot joints shall be Ford Meter Box Company 1350 or approved equal.

2.30 PIPE IDENTIFICATION

- 1 The Contractor shall identify all above-ground piping by colour bands with flow direction arrows and pipe identification name. Colour bands shall be in accordance with the following table:

TABLE 3

PROCESS FLUID	PRIMARY BAND ¹		SECONDARY BAND ²	
	COLOUR	REFERENCE ³	COLOUR	REFERENCE ³
Raw water	Spring green	71013		
Process water	Ocean blue	71027		
Treated water	Dark blue	71030		
Compressed air	Dark green	71016		
Vents	Grey	71050		
Desludge / filter backwash waste	Light tan	71021		
Low pressure sewer	Dark brown	71022		
CHEMICAL FEED PIPING;				
Fluoride	Light blue	71025	Red	71001
Chlorine	Yellow	71039	Pure black	
Carbon	Pure black			
Lime	Spring green	71013		
Soda ash	Signal green	71015		
Alum	Orange	71004		
Polymer	Light blue	71025		
Carbon dioxide	White	71043		

Note 1: Primary bands shall be 600 mm wide, at 2 m centres.

Note 2: Secondary bands shall be 150 mm wide, positioned in the centre of each primary band.

Note 3: Numbers refer to the International Chromoscan colour system.

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All letters, numbers and arrows shall be in solid colour, stencilled in style, colour and size as directed by the Engineer. Arrows / labels shall be provided on each side of all fittings, walls, equipment etc, on all pipes.

Part 3 Execution

3.1 GENERAL

- .1 All products shall be installed in proper alignment and with proper supports, to the satisfaction of the Engineer, in such a manner as not to cause any undue strain on any portion of the works. All installations shall conform to the recommendations of the respective product manufacturers.

3.2 JOINTS

- .1 **FLANGED JOINTS** - shall be bolted together with an appropriate sized bolt through each drilled hole in the flange face. An approved full-faced gasket shall be used between all flanges except where a flange faces on either wafer style valves or an adaptor flange with an integral gasket. Bolts shall be tightened evenly, as per manufactures recommended torque.
- .2 **MECHANICAL JOINT TYPE ADAPTOR FLANGES** - for plain end pipe being joined to appurtenances with integral flanges, the end of the pipe shall be cleaned and prepared as per Manufacturer's recommendations. The approved lubricant shall be applied to the end of the pipe and to the gasket. The adaptor flange and the gasket shall be slipped over the end of the pipe, and the adaptor flange shall be bolted to the flange of the appurtenance. The bolts shall be tightened evenly to the manufacturer's recommended torque, but in no case less than 95 Nm (70 ft./lbs).
- .3 **GROOVED AND SHOULDERED JOINTS** - shall be installed in accordance with the current AWWA Standard C606, Standard for Grooved and Shouldered Joints and the Manufacturer's latest published literature. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service. A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.

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- .4 THREADED JOINTS - shall be screwed together. Male ends of the PVC pipe, fittings and appurtenances shall be coated with Teflon paste prior to installation. Male ends on steel and iron pipe, fittings and appurtenances shall be coated with anti-seize compound.
- .5 WELDED JOINTS - welding shall be executed in accordance with the current AWWA Standards C206, Standard for Field Welding of Steel Water Pipe; and C207, Standard for Steel Pipe Flanges for Waterworks Service.
- .6 SOLVENT WELDED JOINTS - a PVC primer shall be used to clean the surfaces to be joined. The surfaces shall then be coated with solvent cement, and joined. Male ends shall be inserted to the fullest possible extent into the female ends. The joint shall be allowed to dry after excess cement is cleaned off the interface.
- .7 SOLDERED JOINTS - the end of the copper tubing shall be cleaned first with steel wool or emery cloth, and then with non-corrosive flux. The end shall be inserted into the fitting to which it is to be attached and rotated to evenly distribute the flux. A torch shall be used to heat the fitting and tubing until they are hot enough to melt solder. Solder wire shall be held at the edge of the fitting where capillary action will draw it in to seal the joint. Excess solder shall be wiped off with a clean cloth.
- .8 COMPRESSION JOINTS - shall be made to the recommendations of the product manufacturer.

3.3 CUTTING PIPE

- .1 Plain end steel, iron or PVC pipe shall be cut to the appropriate lengths in accordance with the manufacturer's recommendations. Copper and small diameter plastic pipe shall be cut with an appropriate tubing cutter.

3.4 THREADING PIPE

- .1 Pipe shall be threaded by means of a threading tool, appropriate for the type of pipe being threaded, and as manufactured by the Rigid Tool Company or approved equal. The appropriate lubricant shall be used when threading pipe.

3.5 DISCHARGE HOSE

- .1 The end of the hose shall be slipped over the end of the male adapter and a pair of clamps shall be installed and tightened to secure the hose on the adapter. The companion flange, complete with the male adaptor and discharge hose, shall then be

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bolted onto the required flanged pipe, fitting or appurtenance in accordance with flanged joints Clause 3.2.1.

3.6 REPAIR CLAMPS AND COUPLINGS

- .1 Repair clamps and metal body couplings shall be installed on or between pipes as shown on the Plans. Bolts shall be tightened evenly.

3.7 PNEUMATIC SYSTEM

- .1 Copper pipe and fittings and bronze valves shall be joined by soldering in accordance with the provisions of soldered joints Clause 3.2.7.

3.8 PIPE SUPPORTS

- .1 Supports shall be installed as shown on the Plans and in accordance with Table 1 and Table 2 of this Section and in accordance with manufacturers' recommendations. Small diameter piping "tube strapping" shall be mounted on wooden blocks prior to fastening to walls or ceilings.

3.9 TESTING

- .1 All completed works shall be pressure tested with water, at 1000 kPa for a duration of two hours. Any leakage shall be corrected and the test repeated until the works pass the test without leakage. All works shall be tested with water excepting pneumatic works, which shall be tested with air. The exterior of pneumatic works (particularly joints and fittings) shall be coated with a solution of soapy water prior to air testing to facilitate locating leakage. Subsequent to successful testing, this shall be washed off clean. Backflow preventers shall be tested and certified by a qualified backflow valve technician.

3.10 DISINFECTION OF PIPING WORKS IN WATER TREATMENT PLANTS AND PUMPING STATIONS

- .1 All completed works shall be flushed with clean water at a rate of not less than 0.75 m/sec. A 50 mg/L concentrated solution of calcium hypochlorite or sodium hypochlorite shall be applied, and retained in all piping and associated work (including pumps and valves) for a period of not less than 24 hours, during which time all valves shall be operated to ensure disinfection of all internal parts. After disinfection, the solution shall be flushed out with potable water. The Engineer will take a sample which shall be subject to bacteriological analysis. If satisfactory results

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are not obtained, the Contractor shall repeat the process until satisfactory results are obtained.

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