
IRRIGATION SYSTEM SPECIFICATIONS – MATERIALS

1.0 MATERIALS SPECIFICATIONS

1.1 DESIGN IRRIGATION SYSTEMS SPECIFICATIONS

- 1.1.1 All Irrigation systems shall comply with the City of Lethbridge – *Parks Planning and Development Irrigation Design Standard* (current edition)
- 1.1.2 All Product used in construction of the Irrigation system shall comply with the *City of Lethbridge Parks Irrigation Product List* (current edition)

1.2 SUBSTITUTIONS

- 1.2.1 Where materials are specified by brand name and model number, such specifications shall be deemed to facilitate a description of the materials and material quality, establishing a standard for performance and quality against which proposed substitutes will be evaluated.
- 1.2.2 Proposed substitutes must include sufficient descriptive literature and product samples to permit evaluation. If the substitute is not on the *City of Lethbridge Parks Irrigation Product List*, the City reserves the right to trial the substitute for one year, and at the Contractor expense, remove and replace with the originally specified product, if the substituted product is deemed not to be performing satisfactorily.
- 1.2.3 Proposed substitutions must be submitted to the Engineer at least two weeks prior to tender closing. Proposed substitutions submitted to the Engineer after the tender is awarded must allow two weeks for review prior to the proposed installation date.
- 1.2.4 Proposed alternate materials shall match the specified materials in, performance, flow, and pressure loss, so as not to compromise the irrigation system's design or the system's overall performance. Proposed alternate materials shall be applied according to their manufacturer's specifications.
- 1.2.5 Installation of materials that are not specified and have not been approved as an equal shall be removed and replaced with the specified material at the Contractors expense.

1.3 PIPING

- 1.3.1 HIGH DENSITY POLYETHYLENE (HDPE) PIPE
 - 1. High Density Polyethylene pipe shall be used on main lines and approved laterals, and the pipe must be Standard Dimension Ratio (SDR) 11 and must be listed by the Plastic Pipe Institute (PPI) as a PE 4710 resin with a hydrostatic design basis (HDB) of 1600 psi for water at 23°C. The material must comply with ASTM D1248 as a Type III Class C, Category 5, Grade P34 material and with ASTM D3350 – 08 as a 345434C cell material. The material must have a design factor of 0.63 for water service at 23°C. All HDPE pipe, tubing, and fittings furnished under this specification must conform to all applicable provisions and requirements of the latest revision of AWWA C901, C906, or CSA B137.1 and, by inclusion, all appropriate standards referenced therein.
 - 2. High Density Polyethylene Pipe connections shall be performed by certified personnel and made using butt-fusion or electro-fusion techniques according to manufacturer's specifications and CGSB 41-GP-25 M.

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3. HDPE pipe shall be used for all road crossings and shrub beds.

1.3.2 POLYVINYLCHLORIDE (PVC) PIPE

1. Pipe shall be manufactured of un-plasticized polyvinyl chloride resin and used for conveying fluids under pressure. The material shall be Type 1, Grade I with hydrostatic design stress of 2000 psi and designated as PVC 1120 in accordance with ASTM Specifications D1784 and DJ785. Pipe dimensions, pressure rating and wall thickness shall be those required for SDR 26 pipe as described in CSA Standards B137.3 or ASTM Specifications D2241. PVC pipe shall meet all the other requirements of CSA B137.3 or ASTM D2241, and shall have a water pressure rating of 160 psi and 23°C. 100 mm and larger pipe shall be of the bell and gasket joint type. 100mm pipe may be solvent welded if approved by the Engineer. 75 mm and smaller may be of solvent welded bell joint type.
2. All pipe and fitting diameters are nominal sizes and shall be clearly marked as nominal diameter and pipe class.
3. All pipe going into sleeves under a roadway must be HDPE. Please refer to section 07012 - 20.0 SLEEVES FOR CROSSINGS regarding sleeve details.
4. Thrust blocking product requirements outlined in *Standard Detail Drawing*.

1.3.3 LOW DENSITY POLYETHYLENE (LDPE) PIPE

1. Use of LDPE pipe must be approved by the Engineer.
2. Any piping under 38mm must be LDPE and approved by the Engineer.
3. Low pressure lateral polyethylene pipe sized 13 mm to 25 mm to be CSA certified.

1.4 FITTINGS

- 1.4.1 Threaded solvent weld PVC fitting shall be Schedule 40 dimensions and wall thickness. Solvent cement and cleaner/primer shall meet the requirements of CSA Standard B137.3 or ASTM specification D2564. Gasket (push-on bell and spigot) type PVC fittings shall be one (1) piece items wherever possible.
- 1.4.2 Fittings for swing connection shall be Schedule 40 tee with threaded connection of 90° elbow with a threaded connection.
- 1.4.3 Main line pipe, lateral pipe, tees and elbows shall be schedule 80 on all pressurized (pumped systems).
- 1.4.4 For PVC pipe repairs, Lasco or Spears compression couplers are acceptable.
- 1.4.5 For LDPE pipe, fittings shall be Schedule 80 PVC insert type complete with stainless steel Crimp rings. LDPE pipe over 25 mm (1") to use T-bolt style clamp.
- 1.4.6 For PVC pipe, only Cal-am saddle type fittings shall be used.
- 1.4.7 Fittings for HDPE pipe shall be butt-fusion type or electro-fusion type. Fittings shall be molded or fabricated by the pipe manufacturer. Fittings and flange adapters made by contractors or distributors are prohibited.
- 1.4.8 Saddles for HDPE pipe shall only be electro-fusion type.

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1.5 SWING JOINTS

- 1.5.1 Swing joints shall be prefabricated and sized to match the inlet diameter size of the sprinkler/quick coupler being used.
- 1.5.2 Swing joints shall be assembled with schedule 40 PVC street ells (male and female ended) and schedule 80 PVC nipples.
- 1.5.3 Swing joint assembly shall consist of two (2) street ells connected together on one (1) end connected to the sprinkler/quick coupler and the nipple piece and one (1) street ell at the other end of the nipple piece to connect into the lateral line.
- 1.5.4 The nipple piece may be required to suit the connection to the lateral line.
- 1.5.5 Teflon tape shall be used on threads.

1.6 SPRINKLER HEADS

1.6.1 GENERAL

- 1. Sprinkler mechanism, drive assembly, and any built in valve shall be removable with minimal site disturbance.
- 2. Sprinkler heads for separate project sites shall be from one manufacturer only, unless otherwise specified.
- 3. The use of pressure regulated sprinkler heads and nozzles are to be used instead of pressure reducing valves. Exceptions will have to be pre-approved by the City.
- 4. Nozzle sizes shall be based on flow rate (i.e. gallonage) and watering radius specified on plans.
- 5. In cases with non-potable sources of irrigation water, the sprinkler shall have a non-potable purple cover.
- 6. The Rotor shall have rubber covers and stainless steel covered nozzle turret and riser stem only, for curb lines and sports fields.
- 7. The sprinkler shall be warranted by the manufacturer for minimum 5 years.

1.6.2 SPRAYHEAD SPRINKLERS

- 1. A fixed spray type, capable of covering a 2 to 5.5m radius at 30psi (2.069 bars) with a full circle discharge rate of approximately 5gpm (18.9 l/s).
- 2. The sprinkler body, stem, nozzle and screen shall be constructed of heavy-duty UV resistant plastic. The sprinkler shall have a heavy-duty stainless steel retract spring for positive pop-down and a ratcheting riser for easy alignment of the pattern.
- 3. The optimum operating range of spray head sprinklers shall be 30psi (2.07 bars). The sprinkler shall regulate operating pressure to 30psi.
- 4. The sprinkler shall have a matched precipitation rate plastic nozzle with a fixed arc and an adjusting screw capable of regulating the radius and flow.
- 5. The sprinkler shall be sized as 100mm, 150mm, and 300mm pop-up.
- 6. The sprinkler shall have drain check valve, capable of holding minimum 2.13m (7 feet) of head, installed into the riser.
- 7. The sprinkler shall have a 12.5mm (1/2") diameter threaded bottom inlet.

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1.6.3 LARGE AREA TURF ROTARY SPRINKLERS

1. The sprinkler shall be a single stream (the single stream can be created by using one or multiple nozzles in the individual sprinkler head nozzle assembly), water-lubricated, gear drive type capable of covering a 24.4m (80-foot) radius, at a base pressure of 90 psi. The sprinkler shall have a standard rubber cover and strong stainless steel retract spring for positive pop-down.
2. The sprinkler shall not reverse direction during continuous operation in the full circle mode.
3. The sprinkler shall have a rotating nozzle turret independent of the riser stem. The portion of the riser stem that is in contact with the wiper seal shall be non-rotating.
4. The sprinkler shall have a non-strippable drive mechanism and permit manual rotation of the pop-up stem in any direction. Once the manual rotation is terminated, the sprinkler shall automatically return the water stream to its pre-set arc.
5. The sprinkler shall have a screen attached to the drive housing to filter inlet water.
6. The sprinkler shall have a 25.4mm (1") (26/34) female (NPT) bottom inlet.
7. The sprinkler shall have a front-load nozzle assembly which will allow the nozzle to be installed without a stator bushing change.
8. The sprinkler shall have a stainless steel nozzle retention screw.
9. The angle of trajectory shall be 25 degrees from horizontal.
10. The sprinkler shall have a standard check valve device capable of holding up to 2.74m (9 feet) of head.
11. Pop-up height shall be a minimum of 76.2mm (3"). The exposed diameter shall be a maximum of 88.9mm (3.5").

1.6.4 MEDIUM AREA TURF ROTARY SPRINKLERS

1. The sprinkler shall be a single stream (the single stream can be created by using one or multiple nozzles in the individual sprinkler head nozzle assembly), water-lubricated, gear drive type capable of covering 18m (59 foot) half circle radius, at a base pressure of 70 psi. The sprinkler shall have a standard rubber cover and strong stainless steel retract spring for positive pop-down.
2. The sprinkler shall not reverse direction during continuous operation in the full circle mode.
3. The sprinkler shall have a rotating nozzle turret independent of the riser stem. The portion of the riser stem that is in contact with the wiper seal shall be non-rotating.
4. The sprinkler shall have a screen attached to the drive housing to filter inlet water.
5. The sprinkler shall have a double wall construction 25.4mm (1") (26/34) female (NPT) bottom inlet.
6. The sprinkler shall have a front-load nozzle assembly which will allow the nozzle to be installed without a stator bushing change.
7. The sprinkler shall have a stainless steel adjusting screw capable of reducing the radius up to 25%.
8. The angle of trajectory shall be 25 degrees from horizontal.
9. The sprinkler shall have a standard check valve device capable of holding up to 3.1m (10 feet) of head.
10. Pop-up height shall be a minimum of 101.6mm (4"). The exposed diameter shall be a minimum of 44.5mm (1.75").

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1.6.5 SMALL AREA TURF ROTARY SPRINKLERS

1. The sprinkler shall be a single stream (the single stream can be created by using one or multiple nozzles in the individual sprinkler head nozzle assembly), water-lubricated, gear drive type capable of covering 7.62m (25 foot) half circle radius, at a base pressure of 45 psi with a discharge rate of 2.21 gallons per minute.
2. The sprinkler shall have a screen attached to the drive housing to filter inlet water.
3. The sprinkler shall have a 19.1mm (3/4") (26/34) female (NPT) bottom inlet.
4. The sprinkler shall have a standard rubber cover and strong stainless steel retract spring for positive pop-down.
5. The sprinkler shall have a stainless steel adjusting screw capable of reducing the radius up to 25%.
6. The angle of trajectory shall be 25 degrees from horizontal.
7. The sprinkler shall have a standard check valve device capable of holding up to 2.13m (7 feet) of head.
8. Pop-up height shall be a minimum of 101.6mm (4"). The exposed diameter shall be a minimum of 44.5mm (1.75").

1.7 QUICK COUPLING VALVES

- 1.7.1 Quick coupling valves shall be brass, one piece units, 19 mm size unless otherwise specified.
- 1.7.2 Quick coupling valves shall be installed on the main line and at the end of bubbler lines.
- 1.7.3 Quick coupling covers to be rubber covered and locking.
- 1.7.4 In cases with non-potable sources of irrigation water, the quick coupling valve shall have non-potable purple rubber covers.
- 1.7.5 Quick coupling valves to be installed in a 250 mm round valve box.

1.8 ISOLATION VALVES

- 1.8.1 Main line isolation valves 100 mm and larger shall be iron body bronze mounted units, which meet AWWA Specifications, solid wedge, resilient seat, gate valve with stainless steel bolts, with a working pressure rate for cold water of at least 150 psi.
- 1.8.2 The valves shall have "push-on" ends specifically designed for use with PVC pipe.
- 1.8.3 The valves shall have flanged ends for use with HDPE Pipe.
- 1.8.4 The valves shall be equipped with non-rising stems and 2" square cast iron operating nuts.
- 1.8.5 75 mm and smaller isolation valves and Manual Control Valves (if required) shall be screwed bonnet, brass or bronze, solid-wedge type gate valves with threaded ends, non-rising stems, and shall be rated for a normal operating pressure (cold water) of at least 150 psi.

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1.9 DRAIN VALVES

- 1.9.1 Drain valves shall be minimum 25 mm screwed bonnet gate type valves with threaded ends. The body and bonnet shall be brass or bronze.
- 1.9.2 Drain valves shall be installed on the main line at major low areas or where the Engineer deems necessary.

1.10 REACH WELLS, VALVE BOXES

- 1.10.1 Electric Control valve, isolation valve and drain valve boxes shall have a minimum size of 11" x 17" and 12" depth complete with a bolt down type lid.
- 1.10.2 Reach wells shall be a minimum size of 10" diameter and 10" depth complete with a bolt down type lid.

1.11 ELECTRIC CONTROL VALVES

- 1.11.1 Remote control valves shall be normally closed, electric solenoid controlled, diaphragm type valves, glob or angle pattern bodies with IPS threads and suitable for underground installation without protection.
- 1.11.2 Body and cover shall be of brass or plastic as per approved products list with stainless steel cover bolts
- 1.11.3 The valves shall be rated for at least 200 psi operating pressure.
- 1.11.4 Valve solenoids shall be moisture proof and non-corrosive and shall operate at nominal 24 VAC, 60 Hz, and shall be compatible with the controllers.
- 1.11.5 Valves shall be equipped with a flow control/manual shut-off stem, and a pressure bleed feature for manual operations.
- 1.11.6 Valves shall be serviceable without removal from the pipeline.
- 1.11.7 For systems where alternate low energy type controllers are used the control valve shall have a DC solenoid compatible with the controller used.
- 1.11.8 In cases with non-potable sources of irrigation water, the valve shall have a "Reclaimed Water" tag or purple valve handle. The diaphragm shall have secondary screening for debris.
- 1.11.9 Valve box separation shall be 1.5 m.
- 1.11.10 Pressure reducing valves are not to be used. Please refer to Sprinkler Heads 6.1.3 *Any exceptions shall be approved by the City representative.*

1.12 VALVE BOX FILTER FABRIC

- 1.12.1 Filter Fabric used in lining valve boxes shall be Armtex 200 non-woven filter cloth or approved equivalent.

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1.13 AUTOMATIC CONTROLLERS

1.13.1 CONTROLLERS CONNECTED TO CITY OF LETHBRIDGE CENTRAL CONTROL NETWORK.

1. All of the irrigation controllers made by Motorola are to be the IRRInet ACE3640, IRRInet-M, PIU (Piccolo Interface Unit), and Piccolo-XR Controllers, to be used on the Central Control Network. The controllers must be purchased from the City's approved vendor for Irrigation Control Systems.
2. All irrigation controllers need to operate with the City's current Irrigation Central Control System and be approved by the Engineer.
3. The City and the City's approved vendor for Irrigation Control Systems shall be consulted for configuration of products.
4. The City's approved vendor for Motorola Irrigation Control Systems shall install and commission all controllers or be approved by the vendor.
5. The irrigation controllers must be installed for completion of FAC. The contractor must supply a controller from CCC to FAC.

1.13.2 TWO-WIRE CONTROLLER

1. The controller shall be of a hybrid type that is microelectronic circuitry capable of fully automatic or manual operation.
2. The controller shall be a two-wire path decoder based control system.
 - a) The controller shall use the same decoder hardware as other specific controllers.
 - b) Output power for the decoders shall be adjustable from the controller
 - c) Inrush and holding current values shall be adjustable from the controller.
3. The two-wire controller shall be capable of flow and rain sensing. Controller operates standard electric control valves.
4. The controller shall have incorporated a base station capacity of 99 stations.
5. Station timing shall be from 0 minutes to 6 hours.
6. The controller shall have a seasonal adjustment feature.
7. The controller shall have 4 separate and independent programs which can have different start time, start day cycles and station run times.
8. The controller shall have the capability of having a normally open or closed master valve programmable by station.
9. The controller shall have a 365-day calendar with leap year intelligence. The leap year intelligence allows the use of "Odd" or "Even" day watering schedule without changing the date on leap years.
10. The controller shall incorporate a rain delay feature allowing the user to set the number of days the controller should remain off before automatically returning to the automatic operation mode.
11. The controller shall incorporate a flow manager feature that shall provide real-time flow, power, and station management.
12. The controller shall offer a flow sensor module option which adds flow sensing functionality.
13. The flow sensor module shall include a flow utility which learns the normal flow rates of each station.
14. Shall include non-volatile program memory to maintain the irrigation schedule indefinitely during a power outage.
15. Solenoid capacity: up to 8 solenoids max simultaneous (includes dual P/MV outputs).
16. The controller handheld radio shall be compatible to controller for field remote operations such as running programs and manually watering.

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1.13.3 CONTROLLER-to-DECODER-to-VALVE COMMUNICATIONS

1. The Field Decoder shall be compatible with the manufacture of the irrigation controller
2. The decoder addresses shall be pre-coded to eliminate confusion associated with user-defined decoder addressing.
3. Field Decoders shall have different field decoder options to allow the user to choose the precise amount of landscape irrigation control needed
4. The decoders shall be fully encapsulated creating a completely waterproof seal.
5. The line surge protector decoder specifications include but are not limited to:
 - a) The line surge protector decoder shall be grounded on a two-wire path every 500 feet (150 meters) or every 8 decoders, whichever is smaller.
 - b) The line surge protector decoder shall be placed on a two wire path with field decoder interfacing signal line and valves, field decoder interfacing signal line and valve or pair of valves, and field decoder interfacing signal line and 2 valves or 2 pair of valves.
 - c) The line surge protector decoder shall be used for surge protection only, and shall not have a decoder address.
 - d) The line surge protector decoder shall protect against 40V, 1.5kW
 - e) The line surge protector shall be grounded using a grounding plate.
6. Decoder to solenoid: standard pair 18 AWG/1 mm to 150 ft. (twisted improves surge resistance).

1.14 CONTROLLER ENCLOSURE

- 1.14.1 Controllers that are not installed in a building or pump station shall be mounted in a metal, weatherproof enclosure.
- 1.14.2 The controllers shall have a weatherproof, vandal proof metal cabinet housing; mounted on a metal pedestal type as shown on drawing.
- 1.14.3 The enclosure shall be a unit constructed in accordance with the specifications and standard drawing detail.
- 1.14.4 The cabinet shall be mounted on a 150 mm pipe pedestal with a flange base and bolted to a concrete base as per standard drawing.
- 1.14.5 The Variable Frequency Drive pump shall be installed in the large irrigation cabinet with electric fan and ventilation on each side of cabinet.

1.15 WIRE, SPLICE KITS

- 1.15.1 All single conductor wire shall be solid copper conductor.
- 1.15.2 Single Wire Conductor shall have CSA designated type TWU. PE insulated wire shall be UL listed, suitable for direct burial, and rated for operation up to 300 volts.
- 1.15.3 Control valves and the controller. The common wire shall be minimum No. 12 AWG.
- 1.15.4 Wire splices not associated with remote control valves, sprinkler wire shall be sized for the valves and controllers that are to be used in the system. The minimum size of the control valve wire shall be No. 14 AWG sized for a maximum 5 volt drop between heads or controllers shall be housed in a reach well.

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- 1.15.5 Decoder two-wire applications shall be PE jacketed cable, containing 2 single solid copper conductor PE insulated wire.
- 1.15.6 Two-wire cable shall meet the decoder and controller manufacturer specifications. The wire shall be CSA approved TWU or NMWU wire.
- 1.15.7 Splice kits shall be 3M DBR/Y-6 for 24-volt systems.

1.16 WATER SERVICE

- 1.16.1 Backflow Prevention Equipment: The double check valve assembly (DCVA) shall be sized minimum 50 mm or as specified and include 2 isolating gate/ball valves and 4 test cocks (compliant for cross connection control and testing). All shut off valves shall be resilient seated shut off valves and shall have full flow characteristics. All test cocks shall be resilient seated test cocks and shall have full flow characteristics. Any specified DCVA shall be as defined in the Lethbridge parks irrigation products list (current edition) or approved equal. DCVA shall have 300 mm of clearance in all directions (360o).
- 1.16.2 Flow meter/master control valve: Remote Control Hydrometer.
- 1.16.3 Fittings and Appurtenances: above ground fittings and appurtenances shall be schedule 40 galvanized steel or black steel ASTM A53 Grade B. Flanges for black steel piping shall be class 150 or AWWA C207. Black steel piping, fittings and flanges shall be welded by a certified welder. Piping below ground to be taped with Polyken tape. All exposed electrical wiring shall be installed in a flexible conduit.
- 1.16.4 The water service shall be installed in vault as specified on drawing. According to Standard detail drawings.

1.17 ELECTRICAL SERVICE

- 1.17.1 Wiring: Electrical wiring shall be in accordance with all governing codes and regulations for a 120/240 VAC, single phase power supply to the controller and/or booster pump station.
- 1.17.2 Enclosure: All electrical equipment inside the controller and/or pump station shall be installed in an EEMAC 12 enclosure. Ducting shall be installed (Minimum 50 mm I.D.) through the controller pad for the electrical wire. Long radius sweep shall only be used.
- 1.17.3 Miscellaneous: All panels, breakers, etc. shall be in accordance with all governing codes and regulations and shall be of adequate size for the installation.
- 1.17.4 Ground Rods: Shall be a 5/8" x 8' copperclad rod, connected with a 6 AWG copper conductor and a one-piece clamp connector.
- 1.17.5 All grounding must meet product and manufacturer's specifications.
- 1.17.6 An electrical meter base shall be provided in the controller enclosure for booster pump station only.

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1.18 BOOSTER PUMP STATION

1.18.1 GENERAL

1. In the booster pump station all electrical equipment must be CSA approved. The irrigation controller shall activate the pump start (stop with pump shutdown for low flow and low-pressure conditions monitored on the pump suction side. The pump shutdown relays shall be wired into the circuit with a 30 second time delay for both the low flow and low-pressure conditions. Actual set points for flow and pressure cut-off will be field set during commissioning.
2. Pump: Pump shall meet the specified design requirements and be rated for 150 psi operating pressure. Electric motor shall be open drip proof. The starter for the pump motor shall be a breaker type with a transformer properly sized for the motor.
3. Gate Valves: Gate valves shall be brass with non-rising stem meeting AWWA specifications and rated for at least a working pressure of 150 psi.
4. Piping & Fittings: Piping and fittings shall be 3" diameter schedule 40 galvanized steel or black steel ASTM A53 Grade B. Flanges for black steel piping shall be Class 150 or AWWA C207. Black steel pipe, fittings and flanges shall be welded by a certified welder. Minimum piping and fitting: as shown on the Booster Pump Station standard drawings. Piping above ground to be painted with one coat of Galvacon paint, grey in colour. Piping below ground to be taped with Polyken tape.
5. Pressure Gauges: Pressure gauges shall be Marsh liquid silicone/glycerin filled, with a 2.5" dial, 0 to 160 psi face and re-calibration feature and equipped with their own shut off valve.
6. Low Pressure Switch: Low-pressure switch shall have a dial range 0 to 160 psi, with psi differential at 20 psi.
7. Time Delay: Time delay relay shall be Potter and Brumfield 120 volt time delay on realize, 0 to 60 second adjustable or approved equal.
8. For pump station discharge piping, all pipe transitions shall use Schedule 80 fittings.

1.18.2 VARIABLE FREQUENCY DRIVE (VFD) PUMP

1. Variable frequency Drive (VFD) is required to automatically maintain a constant discharge pressure, regardless of varying flow demands within the system.
2. Pumping systems designed to start based on pressure demand shall use a pressure transducer.
3. The variable speed drive shall be a digital pulse width modulation VFD with an LCD display readout in English. The VFD LCD shall display the operating information (KWH, elapsed time, Hz, RPM, amps, voltage, etc.) and shall continuously scroll through the shutdown faults and operating data while the drive is running and stopped.
4. All control logic shall be handled by an industrial grade, Programmable Logic Controller (PLC) interfaced with a display and a built-in clock calendar. The PLC shall provide demand controlled sequential pump start-up and shutdown and safety features. The PLC shall have LED indicators for inputs, outputs, and diagnostic read-outs indication on/off status.
5. All logic for the system control, VFD speed control, and timing shall be controlled by the PLC.
6. The VFD shall have a direct communication with the PLC so that all readings and alarms can be displayed on the PLC interface.
7. The VFD shall be manufactured by ABB or approved equal.

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8. The PLC shall be manufactured by Panasonic or approved equal.
9. All VFD must be supplied and installed by prequalified Vendor.

1.18.3 PUMP ENCLOSURES

1. The steel enclosure shall be as shown on the standard drawings.
2. Louvers are to be punched and not drilled or alternately a section of steel plate may be punched with louvers and bolted in place on the sides of the enclosure with vandal resistant bolts.
3. All materials are to be new and of heavy duty construction.
4. The steel plate shall be rolled where ever possible to obtain the desired shape.
5. All welds shall be continuous and shall be ground smooth prior to coating.

1.18.4 PAINTING

1. All steel pipe, fittings, pedestals, and enclosures shall have one shop cot of primer to comply with CGSB I-GP-1 4 "Primer, Red Lead in Oil" or CGSB I - GP- 1 40, "Primer, Lead in Iron Oxide, Oil Alkyd Type" and one shop coat of Tremclad Rust paint applied prior to installation.
2. After installation all defects, chips, scrapes, etc., shall be field touched up with Tremclad paint.

1.18.5 CONCRETE PAD

1. Concrete pad shall be constructed on a compacted subgrade and 19 mm gravel base of 1.00 mm depth.
2. The concrete shall be Type 50 with 28 day strength of 25 MPa, air content between 5% to 7% and a maximum slump of 80 mm.
3. Steel reinforcement shall be 10 mm bars at 300 mm on center, "each way - each face" with 75 mm minimum cover.
4. Pipe sleeves are required for all pipes embedded in the concrete pad.
5. Water main valve and drain valve curb stand are to be set 2 meters off of concrete pad and not in the pad.

1.18.6 FILTRATION

1. Filtration of water is required for all systems that use non-potable water, including: stormwater; canal water; river water; and harvested rainwater.
2. The water shall be filtered to a quality that will prevent clogging of any emitter or sprinkler filter.