

# **PART E**

# **SPECIFICATIONS**

## **PART E - SPECIFICATIONS**

### **GENERAL**

#### **E1. GENERAL**

E1.1 These Specifications shall apply to the Work.

E1.2 The following Drawings, included in Appendix A, are applicable to the Work:

<u>Drawing No.</u>	<u>Drawing</u>
SK-01	Conceptual Yard Piping Valve Location Plan
SK-02	Typical Electrical Actuator Mounting

#### **E2. GOODS**

E2.1 The Contractor shall supply the following goods and support services:

- (a) Rubber seated butterfly valves conforming to the latest version of AWWA Standard C504, and as specified herein.
- (b) Manual actuators conforming to the latest version of AWWA Standard C504, and as specified herein.
- (c) Power Actuating Devices for valves in conformance to AWWA Standard C540, and as specified herein.
- (d) Test bulkheads and appurtenances for in-warehouse pressure testing of valves.
- (e) Inspection of installation in accordance with the requirements hereinafter specified.
- (f) Manuals for operation and maintenance of valves and actuators.
- (g) Training services accordance with the requirements hereinafter specified.

#### **E3. DELIVERY**

E3.1 All goods shall be delivered to City of Winnipeg warehouse at 1500 Plessis Road, Winnipeg, Manitoba, or at an alternate location within the City of Winnipeg, if directed by the Contract Administrator. Delivery shall be made between 8:00 a.m. and 2:00 p.m, Monday to Friday. Contact the Contract Administrator a minimum of 48 hours prior to delivery.

E3.2 All goods must be delivered to the above location by the Critical Stage set out in D10.1(a).

E3.3 The Contractor shall be responsible for off-loading of goods. The Contractor is advised that this location does not contain suitable lifting facilities for this purpose. The Contractor shall arrange and pay for suitable crane or forklift of sufficient capacity to off-load goods to floor of warehouse, in a position suitable for testing. The Contractor is responsible for providing stands, blocking and skids to secure valves in a vertical position for testing.

E3.4 Butterfly valves shall be delivered and off-loaded in accordance with AWWA Standard C504 Section 6 and Appendix A.

#### **E4. BUTTERFLY VALVES**

E4.1 Description

- (a) This specification shall cover the design and manufacture of butterfly valves to be supplied under this contract. This specification is supplementary to and shall be read together with the latest revision of AWWA Standard C504, "Rubber Seated Butterfly Valves".

- (b) All butterfly valves to be supplied under this contract shall be designed and manufactured by a company having at least five (5) years prior experience in manufacturing these types of products in the sizes and to the pressure ratings as those specified herein.

**E4.2 Design Requirements**

**(a) General**

- (i) Design, materials and construction of all valves shall conform to the latest version of AWWA Standard C504.
- (ii) Design, materials and construction of all valves larger than 1800 millimetre (72 inch) shall generally conform to AWWA Standard C504, except minimum design dimensions and parameters beyond those listed in AWWA Standard C504 shall be considered special designs. The manufacturer shall, at a minimum, provide design for body shell thickness and minimum shaft diameter.
- (iii) This product shall be certified as suitable for contact with drinking water by an accredited certification organization in accordance with ANSI/NSF 61 "Drinking Water System Components – Health Effects"

**(b) Design Parameters**

- (i) Service Potable Drinking Water
- (ii) Chemical Resistance 1 % Hypochlorite
- (iii) Installation Submerged Service
- (iv) Operating service -40°C to +70°C
- (v) Water Temperature Service 0°C to 20°C
- (vi) Normal System Operating Head 14 metres Static Head
- (vii) Normal System Operating Pressure 137 kPa ( 20 psi)
- (viii) Design System Flow Rate 600 Megalitres per day (MLd)
- (ix) Maximum Flow Rate ( closing) 1200 MLd
- (x) Valve Test Pressure ( 2 times Operating) 275 kPa ( 40 psi)
- (xi) Type of Body (All) Flanged Short Body
- (xii) Maximum Non-Shock Shut-Off Pressure (All) 150 Kilopascals (20 lb./in<sup>2</sup>)
- (xiii) Body (All) Cast Iron
- (xiv) Headloss Maximum K value 0.5
- (xv) Valve torques and safety factors shall be based upon the design pressure of Kilopascals (20 psi).

NOMINAL PIPE SIZE (MM)	QUANTITY	ACTUATOR TYPE	VALVE CLASS	PRIMARY SERVICE FUNCTION
2100	6	Manual	75B	Isolation (Open/Close)
2100	4	Electrical	75B	Control (Modulating)

**E4.3 Materials**

**(a) General**

- (i) Materials for butterfly valves shall meet or exceed the latest revision requirements of AWWA Standard C504 and shall meet or exceed the requirements of this Specification.

- (ii) Materials throughout shall be the best of their respective kinds. The equipment shall be designed for the very highest class of service, shall include the highest degree of strength, durability and reliability for continuous operation and for most convenient maintenance.
  - (iii) Liberal factors of safety (minimum of fifty percent (50%)) shall be used throughout especially for all parts subject to alternating stresses or shock.
  - (iv) All joints shall be machined and all castings shall be spot-faced for nuts. All rods shall be finished. All mating faces shall be drilled and tapped, peened, or finished as subsequently specified.
  - (v) The mechanical features of the equipment covered by these Specifications shall conform to the appropriate standards of the ASME.
  - (vi) Threads on all screws, bolts, studs, and nuts shall be American Standard. Tapped holes in flanges shall be standard unified national threads of the coarse-thread series.
- (b) Stainless Steel Components
- (i) All components specified in the latest revision of AWWA Standard C504 as stainless steel and the valve shaft, pins, clamps and retaining rings for the rubber seats shall be Type 304 stainless steel. No alternative materials will be accepted in this regard.
- (c) Workmanship
- (i) All foundry and machine work shall be in accordance with the best modern practice for the class of work involved.
  - (ii) All parts shall conform accurately to the required dimensions and shall be free from injurious defects. All machine parts shall be made to template or gauge.
  - (iii) No repairs to metal such as welding, plugging, peening or stitching will be permitted. Any valve or actuator exhibiting such repairs will be rejected.
  - (iv) All joints shall be faced true and shall be watertight where subject to water pressure.
  - (v) The bolt holes of all cast iron flanges and flanged fittings shall be spot faced to the specified thickness of flange with a plus tolerance of 3 millimetres (1/8 inch).
  - (vi) All iron parts receiving bronze mounting shall be finished to fit. Such hand work shall be done in finishing as is required to produce a neat, workmanlike, well fitting, and smooth operating job throughout.
  - (vii) All parts of the same size and same make shall be interchangeable.
- (d) Ferrous Castings
- (i) All castings shall be true to pattern, of workmanlike finish and of uniform fine grain quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks, or other injurious defects and shall be smooth and well cleaned before inspection. Castings shall be readily machinable. Castings shall not be repaired, plugged, or welded.
- (e) Valve Bodies
- (i) Valve bodies shall be short body and constructed of either cast iron conforming to ASTM Standard A126, Class B or ASTM A48, Class 40; of ductile iron conforming to ASTM A536, Grade 65-45-12; or of alloy cast iron conforming to ASTM A436, Type 1 and 2, or ASTM A439, Type D-2 with a maximum lead content of 0.003 percent.
- (f) Valve Ends
- (i) The ends of the valves shall be flanged and drilled to ANSI B16.1 standard for cast iron flanges (1034 Kilopascals (125 psi) standard).
- (g) Valve Discs
- (i) The design and materials of valve discs shall conform to the requirements of Section 4.5 of the latest revision of AWWA Standard C504.

- (ii) Discs shall be offset to provide an uninterrupted 360 degree seating edge and shall be cast iron per ASTM A48, Class 40 or ductile iron per ASTM A536 (65-45-12).
  - (iii) The disc seating edge shall be solid type 316 stainless steel.
  - (iv) The disc shall be securely attached to the valve shaft using type 304 stainless steel taper fasteners.
  - (v) Disc structures containing hollow cavities are not acceptable.
- (h) Valve Shaft
  - (i) Valve shaft shall be constructed of type 304 stainless steel.
- (i) Valve Seats
  - (i) Valve seats shall be reinforced natural or synthetic rubber reinforced with high resiliency fabric inserts. The mating seat shall be of type 304 stainless steel. Seats shall be of a design that permits adjustment, removal or replacement of the seat at the site of the installation without removal of the valve from the line. Seats that are clamped or mechanically secured are preferred over epoxy retained seats.
  - (ii) Valve seats shall be manufactured from a solid mass rather than layers of rubber bonded together.
  - (iii) Valves with a rubber seat mounted on the valve disc shall meet the following conditions:
    - a) The disc seats shall be offset from the centre line of the shafts so that the rubber seat forms a continuous uninterrupted ring.
    - b) An insert of stainless steel shall be provided in the body to provide a smooth seating surface for the rubber disc seat.
  - (iv) Mechanically retained rubber seats shall be held in position on the disc or body by a segmented retaining ring secured by type 316 stainless steel nuts and bolts which by tightening will slightly deform the rubber seat to maintain proper contact with the seat face throughout the entire circumference.
- (j) Bearings
  - (i) Bearings in the valve body for shaft ends shall be of the sleeve type made of self-lubricating material such as Teflon filled acetal or approved equal.
  - (ii) Each valve shall be equipped with one or two thrust bearings of corrosion resistant material on the shaft, outboard of the shaft seal or in the actuator housing.
- (k) Shaft Seals
  - (i) Shaft seals shall be designed for the use of standard split-V type packing, standard O-ring seals or pull down packing as described in Section 4.5.7 of the latest revision of AWWA Standard C504.
- (l) Painting and Coating
  - (i) Interior surfaces shall be coated with a protective system in accordance to AWWA Standard C550 – Protective Interior Coatings of Valves and Hydrants, which can be used in a potable water system.
  - (ii) Interior coatings shall comply with ANSI/NSF 61 “Drinking Water System Components – Health Effects”
  - (iii) Coating shall be two (2) or more layers (5 mils minimum each coat) Polyamide Epoxy, Amerlock 400, Tnemec Series 140F Pota-Pox Plus or approved equal. Application as per manufacturer’s recommendations.
  - (iv) Coatings shall be holiday free as defined in Section 5.2.3 of AWWA Standard C550.
  - (v) Exterior surfaces shall be painted consistent with interior surfaces.
  - (vi) Surfaces shall be prepared to NACE SSPC-SP10- Near-White Metal Blast Cleaning

- (vii) All machined surfaces shall be protected with an approved coating, prior to assembly to prevent rusting. Machined surfaces for valve seats shall have particular attention paid to, as this area if untreated, has proven to support "barnacle growth" which can prevent watertight closure of the valve.

(m) Acceptable Products

- (i) DeZurik
- (ii) K-Flo 47 Series
- (iii) Mueller
- (iv) Pratt
- (v) Rodney Hunt
- (vi) Val-Matic

E4.4 Submittals

(a) Shop Drawings

- (i) Submit Shop Drawings in accordance to D6.
- (ii) Shop Drawings shall state all performance and design criteria.
- (iii) Allow three (3) calendar weeks in delivery schedule for review of Shop Drawings, commencing at the date of receipt by the Contract Administrator.
- (iv) At the time of submission, the Contractor shall inform the Contract Administrator in writing of any deviation in the Shop Drawings from the requirements of the contract documents. The Shop Drawings shall include a copy of the Specifications attached in Part E and marked by the Contractor as either in "compliance" or "deviation" with comment.

(b) Affidavit of Compliance

- (i) Provide Affidavit of Compliance stating that valves meet requirements of the latest revision of ANSI/AWWA Standard C504 and terms of this specification.

(c) Testing

- (i) Provide all factory pressure test reports.
- (ii) Provide protective coating thickness measurements as specified in ANSI/AWWA Standard C550.
- (iii) Provide recent coating qualification testing results as specified in ANSI/AWWA Standard C550 Section 5.2.1.

E4.5 Valve Testing and Acceptance

E4.5.1 Factory Tests

(a) General

- (i) All acceptance testing shall be completed in the presence of the Contract Administrator or his appointed representative. Provide a minimum of two (2) weeks notice of testing schedule to the Contract Administrator.
- (ii) Testing of valves and actuators, including pressure tests, paint and coatings and electrical tests shall be coordinated to minimize number of plant visits.
- (iii) The Contract Administrator shall attend and witness testing in a maximum of two (2) separate factory visits, of five (5) days duration, at no cost to the Contractor. Additional plant revisits required due to failure of testing or non-conformance of products to specifications shall be borne by the Contractor.

(b) Butterfly Valves

- (i) All valves shall be tested with mated actuators mounted and adjusted.

- (ii) All valves shall be tested with valves mounted in the vertical operating orientation.
- (iii) Each valve shall be subjected to hydrostatic tests under a pressure (275 kPa for class 75B valves) by the manufacturer at their facilities prior to shipping. The tests shall be conducted in the following manner, in accordance with the latest revision of AWWA Standard C504.
- (iv) A hydrostatic pressure of (275 kPa for class 75B valves) shall be applied through bulkheads, alternately to the two sides of the closed disc with the opposite side open to inspection. Under this pressure, the valve seat shall be perfectly watertight.
- (v) A hydrostatic pressure of (1000 kPa for class 75B valves) shall be applied to the body of the valve with bulkheads closing both flanges and the disc open. Under this pressure there shall be no leakage through the metal or joints, no permanent deformation of the castings, and no other defects.
- (vi) The following information shall be supplied by the Contractor prior to delivery of the valves:
  - ◆ A certified copy of the chemical and physical analysis on all materials used in the manufacturer of the valve(s) or certification that the materials used are in strict accordance with this specification.
  - ◆ Copies of the test reports for Performance, Leakage and Hydrostatic Tests performed in accordance with AWWA Standard C504. Included in the report shall be the signature of the official who is responsible for the valve assembly and testing.

(c) Protective Coatings

- (i) Conduct non-destructive film thickness testing, in accordance to NACE SSPC PA 2, on both interior and exterior surfaces and provide comparison to qualification standard, as per AWWA Standard C550.
- (ii) Conduct low voltage holiday testing as specified in AWWA Standard C550 section 5.2.3. Completed coating shall be holiday-free.
- (iii) The Contract Administrator will conduct holiday testing to NACE RP01188-88.
- (iv) The Contract Administrator will conduct disbondment testing in accordance to ASTM D 4541. Tensile adhesion shall be acceptable if a minimum tensile adhesion rating of 3447 kPa (500 psi) is achieved.

E4.5.2 Field Tests

(a) Butterfly Valves

- (i) The Contractor shall provide the following materials to facilitate field tests:
  - ◆ AWWA Standard C207 Blind flange
    - ◆ AWWA Class B for Class 75 B Valves; or
    - ◆ AWWA Standard C207 Class B Steel ring flange with dished bulkhead, designed to ASME Boiler and Pressure Vessel CodeBlind flange shall contain two (2) 25 mm National Pipe Thread tapped ports and shutoff valves, located at dead centre and at centre top of the flange, suitable for test purposes.
  - ◆ 3 mm thick cloth inserted styrene-butadiene rubber (SBR) or neoprene gasket of sufficient number to complete testing.
  - ◆ One complete set of carbon steel bolts to ASTM Standard A307 Grade B conforming to AWWA Standard C207, of sufficient length to couple valve to blind flange.

- ◆ Valve stands, blocking, pipe supports and actuator stand sufficient to properly brace valves securely in an upright position.
- (ii) The Contractor shall perform a hydrostatic leak test, in the presence of the Contract Administrator, on all valves once they arrive at the City warehouse. The test shall be performed as follows:
  - ◆ The valve shall be orientated in the vertical position.
  - ◆ A gasketed, steel blind flange with a tapped fitting suitable for introduction of compressed water, shall be bolted in place.
  - ◆ The space between the blind flange and valve disc shall be filled through the center port, and air bled off through the top port. Once all air has been expelled, the top test port shall be closed.
  - ◆ A pressure of 275 kPa for class 75B valves shall be applied through the fitting and maintained for 10 minutes. Under this pressure the valve seat shall be perfectly watertight.
  - ◆ The test shall be repeated for the opposite side.

E4.5.3 The Contractor shall ensure a qualified representative of the valve manufacturer is present for the testing of the valves to correct any deficiencies found.

E4.5.4 Acceptance

- (a) Upon completion of delivery and testing specified, the Contractor shall give notice to the Contract Administrator so that arrangements for receipt and inspection can be made. The shipping lists of materials will be carefully checked by the Contractor in the presence of the Contract Administrator and the City.
- (b) Written acceptance of receipt, at delivery, by the Installation Contractor shall constitute "Delivery to Site" under this contract. A representative from each of the following groups will be in attendance at the time of delivery: The Contractor, Installation Contractor, and the Contract Administrator. A duly executed "Certificate of Equipment Delivery" (Form 200) shall be completed. A sample of this certificate is included in Part G. Any damage identified during the inspection shall be repaired as per the manufacturer's recommendations by the Contractor at no cost to the City.

E4.6 Measurement and Payment

- (a) Measurement and payment for "Supply and Delivery of Isolation Valve with Manual Valve Actuator" and "Supply and Delivery of Modulating Valve with Electric Valve Actuator" will be made at the Contract Unit Price for each size and type of valve listed in Form "B" Prices, and shall include valve, actuators, delivery and in-warehouse testing.
- (b) Measurement and payment of "Supply and Delivery of Testing Blind Flange" will be made at the Contract Unit Price for each size and type of flange listed in Form "B" Prices. The price shall include flange, bolts and gaskets.

**E5. ELECTRIC VALVE ACTUATORS**

E5.1 Description

- (a) This specification shall cover the design and manufacture of electric actuators for butterfly valves to be supplied under this Contract. This specification is supplementary to and shall be read together with the latest revision of AWWA Standard C540, "Power-Actuating Devices for Valves and Sluice Gates".
- (b) All electric actuators to be supplied under this Contract shall be designed and manufactured by a company having at least five (5) years prior experience in manufacturing these types of products in the size and to the pressure ratings as those specified herein.



- (c) All technologies and devices used in the actuator shall have a minimum of five (5) years' of commercial operating experience for that specific manufacturer. This is to include torque and position sensing, lubrication, and electrical compartment design.

**E5.2 Design Requirements**

**(a) Design Parameters**

- (i) Valve Size 2100 mm Class 75 B AWWA Standard C504 Butterfly Valve
- (ii) Service Throttling /Modulating, ASTM Standard C504 Class 4 (1200 starts / hour)
- (iii) Opening Quarter Turn, Counter Clockwise to open
- (iv) Electric Motor Nominal 575 Volts AC, 3 phase, 60 Hz power supply
- (v) Service Temperature -40°C to +70°C (-22°F to +158°F)
- (vi) Opening/ Closing Time 30 to 180 seconds
- (vii) Mounting Remote, floor stand mounted and coupler shaft
- (viii) It shall be possible to carry out the setting of the torque, turns, and configuration of the indication contacts without the necessity to remove any electrical compartment covers.

**(b) Actuator Sizing**

- (i) The electric actuators for the butterfly valves shall be sized to provide the torque required to close or open the valve for full bi-directional flow at a differential pressure equal to the AWWA numerical class designation of the valve. The maximum thrust output of the actuator shall not exceed the valve shaft torque capability as indicated in the latest revision of AWWA Standard C504.

**(c) Mounting**

- (i) Electric actuator shall be designed and constructed for remote mounting on a floor stand, coupled to the gear actuator with a connection shaft. Connection shafts shall be type 304 stainless steel. Floor stands shall be designed and constructed such that the centre of the handwheel is 900 millimetres above the operating floor. The length of the extension shafts shall be confirmed by field measurement prior to manufacture. Approximate lengths are provided below. Shaft length shall be based on the information provided below, plus or minus 600 millimetres;

Valve	Valve Size	Valve Invert (m)	Mounting Floor Elevation (m)
Cell 1 Treated Water	2100	227.49	236.20
Cell 3 Treated Water	2100	227.58	237.20
Raw Water Pump Station (2 required)	2100	229.80	236.50

- (ii) Connection shaft shall be designed to accommodate actuator torque for the various length of connection shaft required

**(d) Motor**

- (i) Motors shall be CSA approved, of the totally-enclosed, reversing, squirrel cage induction type with Class 'B' insulated windings and suitable for operation at 10% above and below normal 575 volt, 3 phase, 60 cycle power supply. Motor duty rating shall be sufficient for one complete operating cycle (open-close-open) without exceeding its temperature rating. Motor bearings shall be amply proportioned of the anti-friction type and permanently lubricated.

- (ii) The motor shall be of a design that allows for electrical and mechanical disconnection without disturbing the gear case or valve position. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gear case. Plugs and sockets shall not be acceptable as a means of electrical connection for the motor.
    - (iii) The actuator shall include circuitry to ensure the motor runs with the correct rotation for the required direction of operation with either phase sequence of the 3-phase power supply.
- (e) Motor Protection
  - (i) Protection shall be provided for the motor as follows:
    - a) The motor shall be de-energized in the event of a stall, when attempting to unseat a jammed valve.
    - b) Motor temperature shall be sensed by a thermostat to protect against overheating.
    - c) Single phasing protection.
    - d) Instantaneous reversal protection whereby an automatic time delay circuit limits the current surges when the actuator is signalled to instantaneously reverse direction.
- (f) Integral Starter and Transformer
  - (i) The reversing starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation built-up. For ON/Off service, the starter shall be an electromechanical type suitable for 60 starts per hour, and of rating appropriate to motor size. For modulating duty, the starter shall be a solid state type suitable for up to a maximum of 1,200 starts per hour with a duty in accordance with IEC34-1 to S4 50%. The controls supply transformer shall be fed from two of the incoming three phases. It shall have the necessary tapplings and be adequately rated to provide power for the following functions:
    - (a) 120V AC energization of the contactor coils
    - (b) 24V DC output where required for remote controls
    - (c) Supply for all the internal electrical circuits
  - (ii) The primary and secondary windings shall be protected by easily replaceable fuses.
  - (iii) The reversing motor controller shall consist of separate contactors for controlling valve movement in either the opening or closing direction. Each contactor shall be magnetic, full voltage across-the-line type, sized to suit the motor power rating. They shall also provide low voltage and thermal overload protection by means of three bi-metallic or melting alloy elements which shall be correctly related to the motor nameplate full load current and temperature rise of the motor. The contactors shall be of robust construction with double break contacts, requiring a minimum of maintenance and being easily replaceable. Mechanical and electrical interlocks shall be provided.
- (g) Gearing
  - (i) The actuator gearing shall be totally encased in an oil filled or sealed gear case complete with fill and drain taps, suitable for operation at any angle. All gearing shall be of hardened steel alloy and alloy bronze construction with machine cut teeth. Thrust bearings of the ball or roller type shall be provided at the base of the operator. The gear case shall be designed to be opened for inspection or repair without releasing the stem thrust or taking the valve out of service.
  - (ii) Standard SAE80EP gear oil shall be used to lubricate the gear case. Special or exotic lubricants shall not be used as they may be difficult to source.

(h) Manual Operation

- (i) Motorized actuators shall be provided with a handwheel, which shall not rotate during motor operation. The handwheel shall be made of cast iron or aluminum with the word "OPEN" and a directional arrow cast in relief on the rim. Spinners shall be provided on the handwheels. The handwheel operation shall be accomplished by a declutch lever, capable of lockout by padlock. The handwheel shall disengage automatically from the operating mechanism once the motor is capable of operation. The handwheel shall be located sufficiently away from the valve flanges, housings, etc. such that personnel will not hit their knuckles on any of these obstructions when using the handwheel.
- (ii) The handwheel shall be positioned on the operating floor as indicated in E5.2(c) above.
- (iii) The handwheel shall be sized to allow one man operation with a maximum rim pull of 356 Newtons (80 ft. lbs.) at maximum torque conditions.
- (iv) Clockwise operation of the handwheel shall give closing movement of the valve unless otherwise stated in this specification.

(i) Drive Bushing

- (i) The actuator shall be furnished with an easily detachable drive bushing for machining to suit the valve stem or gearbox input shaft. The drive bushing shall be positioned in the base of the actuator to facilitate the valve stem extensions.
- (ii) Thrust bearings, when housed in a separate thrust base, should be of the sealed-for-life type.

(j) Position Limit and Torque Limit Switches

- (i) Position limit switches shall be provided and set to stop the motion of the valve when it reaches the fully open and fully closed position. In addition, torque limiting switches shall be provided for open and close position as well to prevent damage to the operating mechanism in the case of torque overload. The torque switch shall be fitted with a mechanical interlock to prevent torque trip on valve opening. Provision shall be made for four extra limit switches, adjustable to any valve position.
- (ii) Switch design shall permit visual verification of switch position without disassembly.
- (iii) Switch contact rating on inductive circuits shall be 600 Volts AC power, per NEMA standard ICS 2-125 heavy duty.
- (iv) Torque protection reset shall not allow repeated starting in the same direction when control signal is maintained.
- (v) The manufacturer's representative shall field check the calibrations and settings of the limit and torque switches after installation, in the presence of the Contract Administrator.
- (vi) Torque and turns limitation to be adjustable as follows:
  - (a) Position setting range: 0.5 to 100,000 turns, with resolution to 15° of actuator output.
  - (b) Torque setting: 40% to 100% rated torque.
  - (c) Torque sensing shall be by purely electrically or electronically methods. Extrapolation of torque from mechanically measured motor speed will not be acceptable due to response time.
  - (d) "Latching" shall be provided for the torque sensing system to inhibit torque off during unseating or during starting in mid-travel against high inertia loads.

(k) Position Indication

- (i) The actuator shall incorporate an illuminated, mechanical dial indicator and digital readout to show continuous movement from fully open to fully closed in 1%

- increments. The digital display shall be maintained even when the power to the actuator is isolated.
- (ii) The local display shall be large enough to be viewed from a distance of 1.83 metres when the actuator is powered up.
  - (iii) Provision shall be made in the design for a contactless transmitter to give a 4-20mA analog signal corresponding to valve travel for remote indication.
- (l) Push Buttons and Selector Switches
- (i) Each actuator shall be complete with a local Open-Stop-Close push-button station with external Red-Open, Green-Closed indicating lights and a Local-Off-Remote selector switch padlockable in any one of the following three positions:
    - (a) Local Control Only
    - (b) Off (No Electrical Operation)
    - (c) Remote Control plus Local Stop Only
  - (ii) It shall be possible to select maintained or non-maintained local control.
  - (iii) The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.
- (m) Controls
- (i) The internal control and monitoring circuits shall operate at nominal 24 volts DC with interposing relays to energize the 120 volts AC contactor coil circuits (where employed). All necessary transformers shall be provided.
  - (ii) The necessary wiring and terminals shall be provided in the actuator for the following control functions:
    - (a) Additional geared limit switch closed when valve fully open.
    - (b) Additional geared limit switch closed when valve fully closed.
  - (iii) Removable links for substitution by external interlocks to inhibit valve opening and/or closing.
  - (iv) Provision of 4 to 20 milliamp R to I position transmitter suitable for any one or more of the following methods of control.
    - (a) Open, Close and Stop.
    - (b) Open and Close.
    - (c) Overriding Emergency Shutdown to Close (or Open) valve.
    - (d) Two-wire control, Energize to Close (or Open), De-energize to Open (or Close).
  - (v) Selection of maintained or push-to-run control for modes a) and b) above shall be provided by links.
  - (vi) The internal circuits associated with the control and monitoring functions shall be designed to withstand simulated lightning impulses of up to 1 kilovolt.
- (n) Monitoring Facilities
- (i) Facilities shall be provided for monitoring actuator operation and availability as follows:
    - (a) Motor (availability) relay, having one normally open contact, the relay being energized from the control transformer only when the Local/Off/Remote selector switch is in the remote position to indicate that the actuator is available for remote (control room) operation.
    - (b) Where required, it shall be possible to provide indication of thermostat trip and "Remote" selected as discreet signals.

- (c) Provision shall be made for the addition of diagnostic module which will store and enable download of historical actuator data to permit analysis of changes in actuator or valve performance.
  - (d) Diagnostic status screens shall be provided to show multiple functions simultaneously so troubleshooting can be affected rapidly and efficiently. All diagnostic information shall be contained on no more than seven or eight (7 or 8) screens so multiple functions can be checked simultaneously.
  - (e) One (1) copy of the actuator diagnostic/programming software, in a Microsoft Windows based portable computer format shall be included with "Supply and Delivery of Modulating Valve Complete With Electric Valve Actuator" in Form B: Prices. The actuator diagnostic/programming software shall be supplied with one data communications cable for connection between the portable computer and the electric actuator.
- (o) Wiring and Terminals
- (i) Internal wiring shall be of CSA approved insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end. Permanent heat shrunk labelling shall be used.
  - (ii) The terminals shall be embedded in terminal block of high tracking-resistance compound.
  - (iii) The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight 'O' ring seal.
  - (iv) The terminal compartment of the actuator shall be provided with a minimum of two (2) threaded cable entries.
  - (v) All wiring supplied as part of the actuator shall be contained within the main enclosure for physical and environmental protection. External conduit connections between components will not be acceptable.
  - (vi) Control logic circuit boards and relay boards shall be mounted on plastic mounts to comply with double insulated standards. No more than a single primary size fuse shall be provided to minimize the need to remove single covers for replacement.
  - (vii) A durable terminal identification card showing plan of terminals shall be attached to the inside of the terminal box cover indicating:
    - (a) Serial number
    - (b) External voltage values
    - (c) Wiring diagram number
    - (d) Terminal layout
  - (viii) The identification card shall be suitable to inscribe cable core identification alongside terminal numbers.
- (p) Enclosure
- (i) Actuators shall be O-ring sealed, watertight to NEMA 6/IP68 as well as have an inner watertight and dustproof O-ring seal between the terminal compartment and the internal electrical elements of the actuator, fully protecting the switch mechanism, motor and all other internal electrical elements of the actuator from ingress of moisture and dust when the terminal cover is removed on site for cabling.
  - (ii) Actuators shall be provided with an internal motor and compartment heater.
  - (iii) All external fasteners shall be of stainless steel.

### E5.3 Installation

- (a) The actuators will be installed by the Installation Contractor, in a weatherproof superstructure. The power supply and controls, however, will not be installed to the valve actuators until 2007. Heat will not be provided within the structure until that time. The

Contractor shall identify special handling procedures and/or protection requirements, if any, to safeguard actuators from damage during that period.

E5.4 Acceptable Products

- (a) Electric valve actuators shall be:
  - (i) Rotork
  - (ii) Limatorque

E5.5 Start-up Kit

- (a) Each actuator shall be supplied with a start-up kit comprising installation instruction, electrical wiring diagram and sufficient spare cover screws and seals to make good any site losses during the commissioning period.

E5.6 Protective Coatings

- (a) All external ferrous components including floor stands, adaptors and mounting plates, shall be painted and tested in accordance to Clause E4.3(l) Painting and Coating and Clause E4.5.1(c) of this specification.
- (b) Any touch-up paintwork required during installation shall be undertaken by the Installation Contractor. The touch-up paint shall be of the same colour and specifications used in the above clauses and shall be supplied by the Contractor. The Contractor shall provide a minimum of one (1) litre of paint product for this purpose.

E5.7 Testing

- (a) Each electric motorized actuator shall be performance tested by the manufacturer at their facilities prior to shipping. The test shall simulate a typical valve torque load from full-open to full-close and full-close to full-open. The following information shall be recorded:
  - (i) Torque at Maximum Torque Setting
  - (ii) Current at Maximum Torque Setting
  - (iii) Test Voltage and Frequency
  - (iv) Flash Test Voltage
  - (v) Actuator Output Speed and Operating Time for Full-Open to Full-Close
  - (vi) Amperage draw on motors at breakaway and normal operation.
- (b) Copies of the test reports for the above performance tests signed by the official who is responsible for the actuator assembly and testing shall be forwarded to the Contract Administrator as soon as completed.
- (c) In addition, the test reports shall include details of specification such as gear ratios for both manual and automatic drive, closing direction, wiring diagram code number, etc.
- (d) Actuators
  - (i) Electric actuators shall be tested in accordance with the latest revision of AWWA Standard C540.
  - (ii) In addition to factory inspection and the witness of tests by the Contract Administrator, the Contractor shall provide copies of the following test reports prior to delivery of the actuators: Note: The actuators are not being delivered separately from the valve
    - a) proof-of-design test, and
    - b) performance tests.

- (e) Electric Actuators
  - (i) The City shall perform voltage, current draw, cycle speed and whatever other tests are deemed appropriate, once valves and actuators have been delivered to the City of Winnipeg warehouse location.

#### E5.8 Measurement and Payment

- (a) Measurement and payment for electrical actuators will not be made. The cost of the actuators shall be included in the price for the butterfly valves as listed in Form "B" Prices.

### **E6. MANUAL VALVE ACTUATORS**

#### E6.1 Description

- (a) This specification shall cover the design and manufacture of manual actuators for butterfly valves to be supplied under this contract. This specification is supplementary to and shall be read together with the latest revision of AWWA Standard C504, "Rubber-Seated Butterfly Valves".
- (b) All manual actuators to be supplied under this contract shall be designed and manufactured by a company having at least five (5) years prior experience in manufacturing these types of products in the size and to the pressure ratings as those specified herein.

#### E6.2 General Design Requirements

- (a) Quarter turn, manual geared actuators shall be of worm gear drive type designed for one person operation and for a maximum pull on the handwheel rim, at maximum torque conditions of not more than 356 Newtons (80 ft pounds).

#### E6.3 Gearing and Enclosure

- (a) Actuators shall be manual geared with a ball bearing mounted worm gear drive, machine cut gear teeth, and be totally enclosed in a sealed housing sufficient to permit normal operation even when totally submerged in water. Travelling nut type of mechanisms will not be accepted. Gear lubricant shall be of the bulk grease type; synthetic lubricants will not be accepted.
- (b) Number of actuator turns to open or close the valve shall be kept to as few as possible to avoid overtorquing and damage to the actuator.
- (c) Submersible rating shall be adequate for 7.5 metres water submergence for forty-eight hours.
- (d) Accessible parts of the actuator requiring lubrication shall be provided with button-head alemite grease fittings.

#### E6.4 Input Limit Stops

- (a) Adjustable, external stop-limiting devices shall be provided on the actuators to prevent over-travel of the valve disc in the open and closed position.
- (b) Under circumstances where spur gear attachments are installed on the input side of the actuator to facilitate the maximum input operating torque of 356 Newtons (80 ft. pounds), input limit stops shall be installed on the input side of the spur gear attachment.
- (c) A shear pin or other torque regulating device shall be provided on the actuator or handwheel/operating nut as an extra precaution against actuators being over-torqued.

#### E6.5 Handwheel

- (a) Each actuator shall be equipped with a 450 millimetre (min.) to 600 millimetre (max.) diameter handwheel fitted with an operating nut secured in position by a lock nut, pin or

key. The operating nut shall be 49 millimetres square at the top, 51 millimetres square at the base and 45 millimetres high. The handwheel shall be made of cast iron or aluminum of the rimmed type with finger grips, an arrow, the word "OPEN" cast in relief on the rim and have an easy slide fit onto the mating shaft. Direction of opening shall be counter clockwise. Spinners shall be provided on all handwheels.

- (b) The handwheel shall be located sufficiently away from the valve flanges, housings, etc. such that personnel will not hit their knuckles on any of these obstructions when using the handwheel.

#### E6.6 Valve Position Indicator

- (a) A mechanical, valve position indicator shall be provided and mounted on the outside of each valve actuator. The dial or scale plate shall be 316 stainless steel and shall be clearly graduated and marked. A 316 stainless steel pointer shall be aligned to show the exact position of the valve disc in the valve body. The fastener for the indicator dial shall be made of 316SS stainless steel.
- (b) There shall also be a visible indication on the valve shaft end showing the position of the valve disc in relation to the shaft to ensure proper relation of the disc and indicating mechanism in the event an actuator has to be removed and replaced on a valve.
- (c) Open and closed limit switches (Form C, 120 Volts AC Rated) shall be provided as contacts for remote position indication. The limit switch enclosure shall be water tight to NEMA 6/IP68. Provide screw terminals and 3/4" NPT conduit hub for customer connection to the limit switch.

#### E6.7 Protective Coatings

- (a) All external ferrous components including adaptor and mounting plates, shall be painted and tested in accordance to Clause E4.3(l) Painting and Coating and Clause E4.5.1(c) of this specification.
- (b) Any touch-up paintwork required during installation shall be undertaken by the Installation Contractor. The touch-up paint shall be of the same colour and specifications used in the above clauses and shall be supplied by the Contractor. The Contractor shall provide a minimum of one (1) litre of paint product for this purpose.

#### E6.8 Measurement and Payment

- (a) Measurement and payment for manual actuators will not be made. The cost of the actuators shall be included in the price for the butterfly valves as listed in Form "B" Prices.

### **E7. INSPECTION OF INSTALLATION OF BUTTERFLY VALVES AND ACTUATORS**

#### E7.1 General

- (a) The butterfly valves and actuators will be installed by the Installation Contractor forces at a later date (Fall 2005) and the Contractor will be required to provide a qualified technical representative to:
  - (i) Be present at the field testing of valves and electric actuators.
  - (ii) Inspect each valve and actuator installation, provide any assistance necessary in setting up the actuators, instruct City personnel in the operation and maintenance of the actuators and provide a letter or certificate of satisfactory installation for each valve and actuator.

- E7.2 Unless otherwise specifically stated in the Specifications, the Contractor shall provide, and shall allow for in his Bid, a factory-trained representative who, in conjunction with the Contract Administrator, shall give instructions regarding the installation of the equipment. The Contractor's representative shall complete Form 201, attached in Part F, when he is satisfied



that the Installation Contractor has received adequate instruction in the installation of the Contractor's equipment. The completed Form 201 shall be submitted to the Contract Administrator prior to the commencement of equipment installation.

- E7.3 The Contractor's factory-trained representative shall visit the site as required to ensure that the installation work is being performed in a proper and workmanlike manner. The Contractor's representative shall complete Form 202, attached in Part F, following installation of the equipment. The completed Form 202 shall be submitted to the Contract Administrator prior to the commencement of functional testing. The Contractor shall allow for a minimum of one (1) full working day at the Deacon Booster Pumping Station for each valve to be installed. Additional days beyond time per valve noted above shall be approved by Contract Administrator.
- E7.4 The Contractor's representative shall be present to supervise the commissioning, initial operation and functional testing of the equipment. The Contractor shall be required to complete Form 203, stating that his qualified representative has checked the installed equipment and found the equipment to be satisfactorily installed and in specified working operation. The completed Form 203 shall be received by the Contract Administrator prior to commencement of the Warranty period. The scheduling of the Contractor's factory-trained representative's visits to the site shall be to the mutual satisfaction of the Contractor and the Installation Contractor, and shall be agreed upon before the work of installing the equipment begins. The Contractor shall allow for a minimum of two (2) full days at the Deacon Booster Pumping Station for the initial operation, functional testing and commissioning.
- As the system will not be capable of full operation until 2007, commissioning will consist of the following:
- (i) Dry operation of all valves through two (2) complete open and closed cycles in each operational configuration (both manual and electric for power actuated valves).
  - (ii) For three (3) raw water separation valves (manually actuated valves) capable of wet operation at the time of installation, operation of all valves through two (2) complete open and closed cycle in flow conditions.
  - (iii) Confirmation that valves are watertight under reservoir head for raw and treated water supply valves.
- E7.5 If the Contractor is requested by the Installation Contractor or the Contract Administrator to send a representative to the jobsite to investigate or rectify a suspected fault in the equipment furnished by the Contractor but it is found that the said equipment or Contractor is not at fault, the Contractor shall be entitled to be reimbursed for all reasonable costs and expenses incurred by him in sending his representative to the jobsite, at the per diem rate listed in Form B Prices. Additional time required for testing, installation inspection and commissioning required as a result of deficient work or materials attributed to supply and delivery of the valves shall be borne by the Contractor
- E7.6 Operating equipment and systems shall be performance tested by the Contractor in the presence of the Contract Administrator to demonstrate compliance with the specified operating requirements. Functional testing shall be conducted under the specified design operating conditions or under such simulated operating conditions as recommended or approved by the Contract Administrator.
- E7.7 The Contractor shall provide training to City staff in accordance with Clause E9. Form 203 shall not be issued until after training has been provided to the satisfaction of the City.
- E7.8 Immediately following issuance of Form 203, the City reserves the right to operate this equipment to suit system requirements.

**E7.9 Measurement and Payment**

- (a) Measurement and payment for inspection, installation, commissioning and testing shall be at the Contract Unit Price, per day for "Supply of Site Inspection and Commissioning Services". Payment shall be compensation in full for site time and expenses, including all travel and related expenses.

**E8. OPERATION AND MAINTENANCE MANUALS INCLUDING SPARE PARTS LISTS**

E8.1 For each type of equipment, twelve (12) sets of Operation and Maintenance Manuals shall be submitted to the Contract Administrator for review. The Contractor shall provide these manuals thirty (30) Calendar Days in advance before commencement of equipment startup and commissioning.

E8.2 All instructions in these manuals shall be in the English language to guide the City in the proper operation and maintenance of the equipment.

E8.3 Bind contents in a three-"D-Ring", hard-covered, plastic-jacketed binder with full cover and spine insert. Organize contents into applicable sections of work, parallel to Specifications breakdown.

E8.4 Provide all required data in electronic format. Text documents shall be Microsoft Word or Adobe format. Drawings, scanned documents, parts lists, test forms shall be in Adobe format. If possible, documents shall be an original electronic format. Documents that require scanning shall be high quality scans and fully legible. Documents shall be submitted on a high quality compact disk. Compact disk and case shall be labeled in type, with the following;

- (a) Bid opportunity number.
- (b) Job Title.
- (c) Description of Equipment.

E8.5 In addition to information called for in the Specifications, the following shall be included:

- (a) Title sheet, labelled "Operation and Maintenance Instructions," containing project name and date.
- (b) List of contents.
- (c) Reviewed shop drawings of all equipment.
- (d) Certified factory test results.
- (e) Full description of entire mechanical system, operation, and control. Provide "as programmed" parameter list for each electric valve actuator.
- (f) Names, addresses, and telephone numbers of all major sub-contractors and suppliers.
- (g) Detailed specification and operating and maintenance instructions for all items of equipment provided including a preventative maintenance program.
- (h) An itemized list of spare parts recommended for five years of service, particularly those components failure of which will render the equipment supplied inoperative. Any special tools or other ancillary items necessary for commissioning and/or proper operation and maintenance shall also be listed. These prices shall be available to the City at any time prior to the issuance of the Certificate of Acceptance.
- (i) Part books that illustrate and list all assemblies, sub-assemblies, and components.
- (j) Routine test procedures for all electronic and electrical circuits.
- (k) Troubleshooting chart covering the complete valve and controls/electrical power systems, showing description of trouble, probable cause, and suggested remedy.

E8.6 The Contractor shall modify and supplement the manual as required by the Contract Administrator. When accepted, six (6) additional copies, including electronic versions, shall be provided by the Contractor for distribution purposes. The City's staff shall be in receipt of these manuals prior to the date set out for Substantial Performance. The Contract shall not be considered complete, for the purpose of issuing a Certificate of Substantial Performance, until the above manuals have been completed and submitted to the satisfaction of the Contract Administrator.

E8.7 Measurement and Payment

- (a) Measurement and payment for operation and maintenance manuals shall be made lump sum basis for "Supply and Delivery of Operation and Maintenance Manuals" identified in - Form B: Prices. Payment shall only be made when all manuals are approved and received.

## **E9. TRAINING**

E9.1 The Contractor shall include costs for providing training to City staff by a factory-trained representative on the operation and maintenance of the equipment.

E9.2 Training for the equipment shall be conducted before the operation period as described in Form 203. The training seminar shall be conducted on site where practical. If necessary, instruction can be held in the City's office. The Contractor shall provide a qualified instructor as well as the necessary course materials.

E9.3 The Contractor shall be responsible for providing all course materials and presentation media. The City will provide suitable facilities in which to conduct training sessions. The Contractor shall allow for twenty (20 sets of training literature.)

E9.4 Training shall be provided in two sessions of one half day each (not more than four hours per day for each session). Two sessions for training shall be provided: one for operation staff, and one session for maintenance staff. The training shall cover operation and maintenance.

E9.5 Training shall be completed within 30 calendar days of the date set out for Substantial Performance. The Contract shall not be considered complete, for the purpose of issuing a Certificate of Total Performance, until the training has been provided and Form 204 has been signed.

E9.6 Measurement and Payment

- (a) Measurement and payment for training will be on a lump sum basis for "Supply of Training Services" identified in Form B: Prices, and shall include all supplier time and expenses including course materials and presentation media.