

## **1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 22 - Construction / Demolition Waste Management and Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 21 05 01 - Common Work Results - Mechanical.

### **1.2 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings stamped and signed by a Professional Engineer registered or licensed in the Province of Prince Edward Island, Canada.
- .3 Shop drawings to show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify current model production.
  - .5 Certification of compliance to applicable codes.
- .5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Operation and maintenance manual approved by, and final copies deposited with, consultant before final inspection.
  - .3 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
- .7 Maintenance data to include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .8 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .9 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Owner's Representative for approval 4 weeks prior to Substantial Completion. Submission of individual data will not be accepted unless directed by Consultant.

- .2 Make changes as required and re-submit as directed by Consultant.
- .10 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .11 Site records:
  - .1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour water proof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .12 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Owner's Representative for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .13 Submit copies of as-built drawings for inclusion in final TAB report.

### 1.3 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Testing and Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

### 1.4 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 22 - Construction/Demolition Waste Management and Disposal.

### 1.6 DEFICIENCY LIST

- .1 Lists of work deficiencies will be issued at anytime. Rectify immediately work to satisfaction of Consultant.
- .2 Submit requests for takeover inspection in writing.

## **1.7 SITE SERVICES**

- .1 Known Services:
  - .1 Drawings indicate known existing facilities.
  - .2 Locate all known services prior to initiating work.
  - .3 Consult with and follow Engineer's written instructions before commencing work.
  - .4 Once location has been set out, assume responsibility for all damage during installation. Bear cost of repairs and replacements made necessary.
- .2 Unknown Services:
  - .1 Locate all services whose exact location is not known.
  - .2 Avoid damaging or displacing existing services where exact position is not known. Should any damage occur, advise Engineer in writing for remedial instructions.

## **1.8 CO-ORDINATION**

- .1 Locate distribution systems, equipment and materials to provide minimum interference and maximum usable space.
- .2 Where interference occurs, Consultant shall approve location of equipment and materials regardless of installation sequence.

## **1.9 REGULATIONS**

- .1 Comply with most stringent requirements of NBC, Provincial and Municipal regulations and by-laws, specified standards, codes and these specifications and plans. Practices contained in these standards or standards suggested or recommended by referenced organizations, are to be taken as minimum requirements.
- .2 Furnish certificates confirming work installed conforms to requirements of authorities having jurisdiction.

## **1.10 DRAWINGS**

- .1 Drawings:
  - .1 Are not intended to show structural details or architectural features.
  - .2 Are not to be scaled.
  - .3 Except where dimensioned, the drawings indicate general mechanical layouts only.
- .2 Provide field drawings to indicate relative position of various services when required by Consultant. Obtain Consultant's approval before commencing work.
- .3 As-Built (Record) Drawings:
  - .1 Maintain as specified in Section 01 78 00 - Closeout Submittals.

## **1.11 EQUIPMENT LIST**

- .1 Submit list of manufacturers named within 7 days after award of the contract. Do not order equipment until list is approved.

## **1.12 BREAKDOWN OF COSTS**

- .1 Price will be broken down at tender time as required by depository instructions.
- .2 Immediately upon notice of contract award, further break down tender price as per Par. 1.34.

## **1.13 ACCEPTABLE PRODUCT**

- .1 Means that item named and specified by catalogue number meets specification in all respects regarding performance, quality of material and workmanship, and is acceptable to Consultant.
- .2 Equipment proposed shall meet same standards.
- .3 Owner and Consultant reserve the right to make final decision on proposed equipment usage, if different from that specified or accepted as an approved equal.

#### **1.14 AS INDICATED**

- .1 Means that the item or items specified are shown or noted on the drawings.

#### **1.15 EQUIPMENT REQUIREMENTS & INSTALLATION**

- .1 Permit equipment maintenance and disassembly by use of unions or flanges to minimize disturbance to connecting piping without interference from building structure or other equipment.
- .2 Provide accessible means for lubricating equipment including permanent lubricated "lifetime" bearings.
- .3 Mount base mounted equipment on chamfered edge housekeeping pads a minimum of 100mm high and 50mm larger than equipment dimension all around. Pads provided by this Contractor. Co-ordinate sizes with equipment provider.
- .4 Pipe drain lines to drains in a manner to avoid disruption of surrounding space.
- .5 Line-up equipment, rectangular cleanouts and similar items with building walls wherever possible.
- .6 Contractor to provide metal caps and counter flashing for all roof penetrations provided under this section. Installation by this Contractor. This Contractor responsible for all membrane flashing. All roofing work shall be completed by the licensed roofing Contractor as stipulated under this contract.

#### **1.16 ANCHOR BOLTS & TEMPLATES**

- .1 Supplied and installed by Contractor responsible.

#### **1.17 PROTECTION OF OPENINGS**

- .1 Protect equipment, system openings including rough-in plumbing from dirt, dust and other foreign materials with materials compatible to the system.

#### **1.18 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Electric equipment shall bear CSA label.
- .2 Conform to requirements of Canadian Electrical Code, Local Provincial and Municipal Authorities and specified standards.
- .3 Division 21, 22 and 23 responsible for their respective conduit, wiring and connections below 50 V which are related to control systems specified elsewhere and shown on mechanical drawings. Refer to Electrical section for quality of materials and workmanship for wiring and conduit. All material to be supplied and installed by this contractor.
- .4 Motors.
  - .1 Provide motors for mechanical equipment.
  - .2 If delivery of specified motor will delay delivery or installation of any equipment, install a motor for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .5 Motors under 372 W: Speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 115V or 208V, unless otherwise specified.
- .6 Motors 372 W and larger: EEMAC Class B, squirrel cage induction, continuous duty, drip proof, ball bearing, maximum temperature rise 40EC, three phase, 208V in building, unless otherwise specified. All material to be supplied and installed by this Contractor.
- .7 Provide motors, low voltage 50 V and less, wiring from transformers, and temperature pressure, humidity control devices.
- .8 Furnish composite wiring diagrams with remote interlocks for control systems, including performance and sequence of operation description of mechanical systems. Submit for approval by Consultant.

### 1.19 SLEEVES

- .1 Provide pipe sleeves at points where pipes pass through masonry or concrete walls or floors.
- .2 Provide acoustical pipe penetration seals where pipes pass through equipment room walls or floors.
  - .1 Seals to consist of two bolted pipe halves with minimum 19mm neoprene sponge bonded to inner face.
  - .2 Seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping.
- .3 Use cast iron or steel pipe sleeves with annular fin continuously welded at midpoint:
  - .1 Through foundation walls.
  - .2 Where sleeve extends above finished floor.
- .4 Sizes:
  - .1 Provide 6mm clearance all around, between sleeve and pipes or between sleeve and insulation.
  - .2 Where piping passes below footings, provide minimum clearance of 50mm between sleeve and pipe. Backfill up to underside of footing with concrete of same strength as footing.
- .5 Terminate sleeves flush with surface of concrete and masonry and 50mm above floors in mechanical or fan rooms or rooms susceptible to leaks. Not applicable to concrete floors on grade.
- .6 For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Provide flashing and counter flashing as necessary for installation by Division 21, 22 or 23 contractor responsible. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make water-tight durable joint.
- .7 Fill voids around pipes. Remove plastic sleeves.
  - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof pre-retardant non-hardening mastic.
  - .2 Where sleeves pass through walls or floors, caulk space between insulation and sleeve or between pipe and sleeve with waterproof fire retardant non-hardening mastic. Seal space at each end also with same.
  - .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
  - .4 Fill future-use sleeves with lime plaster.
  - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M + Amdt - Mar-78.
- .8 Temporarily plug all openings during construction.

### 1.20 ESCUTCHEONS AND PLATES

- .1 Provide on pipes passing through finished walls, partitions, floors and ceilings.
- .2 Use chrome or nickel plated brass, solid type, with set screws for ceiling or wall mounting. Use cast iron type in equipment room.
- .3 Inside diameter shall fit around finished pipe. Outside diameter shall cover opening or sleeve.
- .4 Where sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.
- .5 Secure to pipe or finished surface but not insulation.

### 1.21 TESTS

- .1 Provide the following supplementary requirements to tests specified:
  - .1 Give written 24 hours notice of date when tests will be made.
  - .2 Do not insulate or conceal work until tested and approved. Follow construction schedule and arrange for tests.
  - .3 Conduct tests in presence of Engineer.
  - .4 Bear costs including retesting and making good.
  - .5 Pipe pressure:
    - .1 Hydraulically test all water supply and steam supply systems at 1 1/2 times system operating pressure or minimum 860 kPa.

- .2 Maintain test pressures without loss for 4 hours unless otherwise specified.
- .3 Test drainage, waste and vent piping to code.
- .4 Prior to test isolate all equipment or other parts which are incomplete or not designed to withstand test pressures.
- .5 All piping of the drainage and venting systems shall be tested by means of filling the system with water after all outlets have been plugged. All joints shall be checked and the water level must hold without dropping for a period of one hour before the work is to be backfilled or otherwise built-in. Sections of the system may be tested separately provided they are at least 3000mm high and include at least 1500mm of the section below, where applicable. Any leaks observed must be corrected by additional caulking of joints or if necessary by removal of any section of pipe required.
- .6 Testing shall be done before pipe covering is installed. Leaks must be located, corrected and test reapplied before acceptance of building.
- .7 Provide test certification for all tests signed by Engineer or designated representative.

#### 1.22 PAINTING

- .1 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals as part of this contract. Coordinate with Division 9 on quality and standards.
- .2 Prime and touch up marred finished paintwork on mechanical equipment as supplied and/or installed under this contract. Paint to match original.

#### 1.23 DIELECTRIC COUPLINGS

- .1 Provide wherever pipes of dissimilar metals are jointed.
- .2 Provide insulating unions for pipe sizes NPS 2 and under and insulating flanges for pipe sizes over NPS 2.
- .3 Cast brass adapters may be used where approved by Engineer.
- .4 Provide felt or rubber gaskets to prevent dissimilar metals contact.

#### 1.24 DRAIN VALVES

- .1 Minimum NPS 19mm unless otherwise specified: straight pattern bronze with hose end male thread and complete with cap and chain.
- .2 Locate at all low points and section isolating valves unless otherwise specified.
- .3 Acceptable Product: Dahl

#### 1.25 INSTRUCTION OF OPERATING STAFF

- .1 Provide certified personnel to instruct operating staff on operation of mechanical equipment. Provide maintenance specialist personnel to instruct operating staff on maintenance and adjustment of mechanical equipment and any changes or modification in equipment made under terms of guarantee.
- .2 Provide instruction during regular work hours prior to acceptance and turn-over to operating staff for regular operation.
- .3 Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn one manual over to Owner and the balance to Engineer.
- .4 This Contractor to ensure mechanical systems are complete and fully operational as per the requirements of these documents and the applicable codes. Premature failure of any mechanical system(s) and/or related accessories deemed to be the result of poor workmanship shall be the financial responsibility of the Contractor responsible.

## **1.26 OPERATING AND MAINTENANCE MANUAL**

- .1 Provide operation and maintenance data for incorporation into manual specified in the Section 01 78 00 - Closeout Submittals.
- .2 Definition: detailed information and records of individual products provided by manufacturer of supplier as part of project requirements, and of systems, describing operation and maintenance of each item.
- .3 Operating data to include:
  - .1 Environmental and other control schematics for each system.
  - .2 Description of each system and its controls.
  - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
  - .4 Operating instruction for each system and each component.
  - .5 Description of actions to be taken in event of equipment failure.
  - .6 Valves schedule and flow diagram.
  - .7 Colour coding chart.
- .4 Maintenance data shall include:
  - .1 Servicing, maintenance, operating and trouble-shooting instructions for each item of equipment.
  - .2 Equipment manufacturer's performance data sheets.
  - .3 Equipment performance verification test results.
- .5 Approvals:
  - .1 Submit 1 draft of Operating and Maintenance Manual to Engineer for approval one month prior to estimated substantial completion date. Submission of individual data will not be accepted unless so directed by Engineer.
  - .2 Make any changes in submission as may be required and re-submit as directed.
  - .3 Failure to do so will result in delay of progress payment.
- .6 Provide two (2) bound final copies of operating and maintenance manuals to Owner and one (1) bound final copy to Engineer.

## **1.27 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures. Provide all shop drawings within 5 days after contract has been awarded. Failure to do so will delay progress payments. Photocopies of fax sheets or poor quality photocopies will not be acceptable for shop drawings.
- .2 Shop drawings and product data shall show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances, access door swing spaces.
  - .3 Internal wiring diagrams if applicable.
- .3 Shop drawings and product data shall be accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify as to current production.
  - .5 Certification of compliance to applicable codes.
- .4 Keep 1 copy of shop drawings and product data on site, available for reference purposes at all times.

## **1.28 CLEANING AND FINAL ADJUSTMENT**

- .1 Clean interior and exterior of all systems including strainers.
- .2 Clean and refurbish all equipment and leave in first class operating condition including replacement of all filters in all piping systems.
- .3 Balance and adjust all systems and each piece of equipment to operate efficiently.

## **1.29 AS-BUILT RECORD DRAWINGS BY CONTRACTOR**

- .1 General: to be read in conjunction with Section 01 78 00- Closeout Submittals.
- .2 Site records:
  - .1 Mark thereon all changes as work progresses and as changes occur.
  - .2 Transfer information to show all work as actually installed.
  - .3 Make these drawings available for reference purposes and to inspection at all times.
- .3 As-built drawings:
  - .1 Prior to start of testing, balancing and adjusting, finalize production of ACAD as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS". Signature of contractor and date to be included.
  - .3 Submit to Engineer for approval and make all corrections as directed.
  - .4 Testing, balancing and adjusting to be performed using as-built drawings.
  - .5 Hand over completed reproducible as-built drawings with Operating and Maintenance Manuals.

## **1.30 EXCAVATION, TRENCHING AND BACKFILLING**

- .1 All excavation, trenching, granular base or bedding and backfilling, both inside and outside the building, required for the work of Division 15 shall be the financial responsibility of, and carried out by the General Contractor under the direction of the Division 15 Sub-contractor.
  - .1 This work includes the breaking out of existing concrete where new lines are installed below existing concrete floors.

## **1.31 FIRESTOPPING AND SMOKE SEALS**

- .1 All firestopping and smoke seals required to properly accommodate the work of this Division shall be the financial responsibility of the respective Division 21, 22 or 23 and carried out by trades to the applicable Specifications provided in this document.
- .2 Work must be performed by a company with experience in the application of firestopping and smoke seals to ULC requirements.

## **1.32 CUTTING & PATCHING**

- .1 All cutting and patching required to properly accommodate the work of this Division shall be the financial responsibility of respective Division 21, 22 or 23 and carried out by The respective trades to the applicable Specifications provided in this document.

## **1.33 WASTE MANAGEMENT AND DISPOSAL**

- .1 Collect and separate waste material and place in on site bin in accordance with Waste Management Plan.

## **2 Products**

### **2.1 MATERIALS**

- .1 All materials used on this project shall be new and CSA approved unless noted otherwise.

## **3 Execution**

### **3.1 PAINTING, REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 00 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.



### **3.2 CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Testing and Quality Control and submit report as described in PART 1 - SUBMITTALS.
  - .1 Perform tests as specified in other sections of this specification.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

### **3.4 DEMONSTRATION**

- .1 Owner's Representative will use equipment and systems for test purposes prior to acceptance. Contractor to supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Owner's Representative may record these demonstrations on video tape for future reference.

### **3.5 PROTECTION**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system

End of Section

## **1 General**

### **1.1 SECTION INCLUDES**

- .1 Materials and installation for copper domestic water service used in the following:
  - .1 Copper incoming domestic water service, up to NPS 2 1/2.
  - .2 Hard drawn copper domestic hot and cold water services inside building.

### **1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 22 - Construction/Demolition Waste Management And Disposal.
- .3 Section 01 35 29 - Health and Safety Requirements.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 01 91 13 - General Commissioning Requirements.
- .6 Section 23 05 01 - Common Work Results - Mechanical.
- .7 Section 23 05 22 - Valves - Bronze.
- .8 Section 23 05 23 - Valves - Cast Iron.
- .9 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .10 Section 21 05 01 - Common Work Results for Mechanical.

### **1.3 REFERENCES**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
  - .1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.
  - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 ASTM B88M, Standard Specification for Seamless Copper Water Tube (Metric).
  - .3 ASTM F492, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.
- .3 American Water Works Association (AWWA).
  - .1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
  - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67, Butterfly Valves.
  - .2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .8 National Research Council (NRC)/Institute for Research in Construction.
  - .1 NRCC 38728, National Plumbing Code of Canada (NPC).
- .9 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

## 1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data for following: piping, fittings, valves.
- .3 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .4 Grooved product Manufacture to supply on site tool and products installation training.
- .5 All grooved products to be of one manufacture.
- .6 Grooved products to have current CRN Numbers.

## 2 Products

### 2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
  - .1 Above ground:
    - .1 Copper tube, hard drawn, type L: to ASTM B88M.
  - .2 Buried or embedded:
    - .1 Copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.
- .2 DI and RO laboratory grade water.
  - .1 Pipe: Type 1 HomoPolymer PolyPropylene to ASTM D4101.
  - .2 Standard of Acceptance: Orion Riontite
- .3 All fittings and valves shall be of the same system as piping designed for high purity water systems.

### 2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger: roll grooved to CSA B242.

### 2.3 JOINTS

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts hex head and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5 tin copper alloy.
- .4 Push-to-connect: EPDM gasket, UL classified in accordance with ANSI/NSF-61 for potable water service. Coordinate usage and locations with Owner.
- .5 Teflon tape: for threaded joints.
- .6 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.
- .7 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

### 2.4 GATE VALVES

- .1 NPS 3 and over, in mechanical rooms, flanged or Roll Grooved:
  - .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section 23 05 23 - Valves - Cast Iron
- .2 NPS 3 and over, other than mechanical rooms, flanged or Roll Grooved:
  - .1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet specified Section 23 05 23 - Valves - Cast Iron.

## 2.5 GLOBE VALVES

- .1 NPS2 and under, soldered:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 22 - Valves - Bronze
  - .2 Lockshield handles: as indicated.

## 2.6 SWING CHECK VALVES

- .1 NPS 2 and under, soldered: Primary method.
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 22 - Valves - Bronze.
- .2 NPS 2-1/2 and over, flanged or Roll Grooved:
  - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, regrind seat, bronze disc, bolted cap specified Section 23 05 23 - Valves - Cast Iron.
- .3 NPS 2 and under, push-to-connect, lift-disc type: Coordinate usage and location with Owner.
  - .1 To MSS-SP-80, 200 psig (1380 kPa) CWP, bronze body, stainless steel disc, spring, and shaft, suitable for installation in horizontal or vertical lines.

## 2.7 BALL VALVES

- .1 NPS 1/2 and under, soldered: Primary method.
  - .1 To ANSI/ASME B16.18, Class 150.
  - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adapters as specified Section 23 05 22 - Valves - Bronze.
- .2 NPS 1/2 and under, push-to-connect:
  - .1 200 psig CWP. Coordinate usage and location with Owner.
  - .2 Bronze body, full port chrome plated brass ball, TFE packing, reinforced TFE seat, steel Lever handle as specified.
- .3 NPS 3" or 4"
  - .1 To be used for isolation on Domestic Hot Water Heater.
  - .2 Body: 2 Piece full Port.
  - .3 End Connection: Butt weld, thickness to match pipe schedule.
  - .4 Pressure Rating: 800 PSI WOG.
  - .5 Body Material: ASTM A351 Grade CF8M (316) Cast stainless steel.
  - .6 Ball & Stem: ASTM A351 Grade CF8M (316) Cast stainless steel.
  - .7 Virgin TFE
  - .8 Seam Seal: Fluoroelastomer
  - .9 Body Bolt & Nuts; Thru body design, 18-8 stainless steel.
  - .10 Body Seal: Fluoroelastomer.
  - .11 Handle: Carbon Steel Enamel Paint.

## 2.8 BUTTERFLY VALVES

- .1 NPS 2-1/2 and over, wafer or lug:
  - .1 To MSS-SP-67, Class 200.
- .2 NPS 2-1/2 and over, grooved ends:
  - .1 Class 300.
- .3 NPS 2-1/2 and over, grooved ends:
  - .1 Class 300 psi CWP, bubble tight shut-off, cast bronze body. EPDM encapsulated ductile iron disc. (ANSI/NSF-61 approved). Copper-tube dimensioned grooved ends.
  - .2 Operator:
    - .1 NPS 4 and under: lever handle.
    - .2 NPS 6 and over: gear operated.
    - .3 Acceptable Material: Victaulic Series 608 or Approved Equal

### **3 Execution**

#### **3.1 INSTALLATION**

- .1 Install in accordance with NPC and local authority having jurisdiction.
- .2 Assemble piping using fittings manufactured to ANSI standards.
- .3 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .4 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .5 Grooved joint couplings and fittings shall be installed in accordance with the manufacturer's written installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.
- .6 Victaulic PermaLynx piping: Prepare copper tube and install in strict accordance with Victaulic installation instructions. Pipe ends shall be cleaned, free from indentations, projections, burrs and foreign matter. Use a tube preparation tool as supplied by NVent to clean and make installation mark. Push copper tube into fittings to installation depth mark, per manufacturers installation instructions. Keep fittings free of dirt and oil.

#### **3.2 VALVES**

- .1 Provide Isolation Ball Valves on all equipment, fixtures and branches. Above the ceiling near the tee.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

#### **3.3 PRESSURE TESTS**

- .1 Conform to requirements of Section 21 05 01 - Common Work Results - Mechanical
- .2 Test pressure: greater of 1.5 times maximum system operating pressure or 860 kPa.

#### **3.4 FLUSHING AND CLEANING**

- .1 The complete potable water system shall be treated immediately prior to occupancy with one of the methods
  - .1 Hyperchlorination shall be performed as follows:
    - .1 chlorine shall be introduced into the system;
    - .2 at least 25 ppm shall be measured at all outlets;
    - .3 the system shall not be used for 24h;
    - .4 based on pH adjusted to 7.5 to 8.0, the system shall have a stable residual chlorine concentration of >10 ppm;
    - .5 the system shall be monitored at 2h intervals for 24h;
    - .6 after 24h, the system shall be flushed until no more than 5 ppm is measured at all outlets and they are free of turbidity; and
    - .7 a minimum of 10 samples shall be taken at the most remote points of the system (including faucets, shower heads, and hot water tanks) and tested for growth of micro-organisms.
  - .2 Water shall be treated as follows:
    - .1 Water shall be superheated to a minimum temperature of 70°C for at least 30 min,

- during which time the system shall not be used;
  - .2 the system shall be brought back to normal operating temperatures;
  - .3 the system shall be flushed until it is free of turbidity.
- .2 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h. Submit to testing laboratory to verify that system is clean. Let system flush for additional 2 h, then draw off another sample for testing. System to be tested and flushed in sections as required by Project Manager to facilitate a staggered occupancy.
- .3 a minimum of 10 samples for each floor shall be taken at the most remote points of the system and tested for growth of micro organisms and chemicals.

### 3.5 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

### 3.6 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.
- .2 Upon completion, provide laboratory test reports on water quality for Consultant approval.

### 3.7 START-UP

- .1 Provide Start-up in sections as required by Project Manager, to facilitate a staggered occupancy.
- .2 Timing: Start up after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.
- .4 Start-up procedures:
  - .1 Establish circulation and ensure that air is eliminated.
  - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
  - .3 Bring HWS storage tank up to design temperature slowly.
  - .4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
  - .5 Check control, limit, safety devices for normal and safe operation.
- .5 Rectify start-up deficiencies.

### 3.8 PERFORMANCE VERIFICATION

- .1 Timing:
  - .1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.
- .2 Procedures:
  - .1 Verify that flow rate and pressure meet Design Criteria.
  - .2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
  - .4 Sterilize HWS and HWC systems for Legionella control.
  - .5 Verify performance of temperature controls.
  - .6 Verify compliance with safety and health requirements.
  - .7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds,

then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.8 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

.3 Reports:

.1 In accordance with Section 01 91 13 - General Commissioning Requirements: Reports, using report forms as specified.

End of Section

## **1 General**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM D2235, Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
  - .2 ASTM D2564, Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International).
  - .1 CSA-Series B1800, Plastic Nonpressure Pipe Compendium.
  - .2 CSA-B181.2, PVC Drain, Waste and Vent Pipe and Pipe Fittings.
  - .3 CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

### **1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 22 - Construction/Demolition Waste Management And Disposal.
- .2 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

### **1.3 REFERENCES**

- .1 Special Piping: Only Contractor's personnel who have received training in the installation of special piping materials and meet the manufacturer's qualifications shall assemble such material.

### **1.4 SUBMITTALS**

- .1 Product Data: Submit manufacturer's technical product data and installation instructions for process drainage systems materials and products.
- .2 Shop Drawings: Submit scaled layout drawings of drainage systems piping and fittings including, but not necessarily limited to, pipe and tube sizes, locations, elevations and slopes of horizontal runs wall and floor penetrations, cleanouts, expansion joints, adapters, floor drains, and connections. Show interface and spatial relationship between piping and approximate equipment. Drawings shall be stamped by a Professional Engineer registered or Licensed to practice in the province of Prince Edward Island.
- .3 Record Drawings: At project closeout, submit record drawings of installed systems products; in accordance with requirements.
- .4 Maintenance Data: Submit maintenance data and parts lists for drainage systems materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements.

## **2 Products**

### **2.1 PIPING AND FITTINGS**

- .1 For buried DWV piping to:
  - .1 CSA-B181.1.
  - .2 CSA-B181.2.
  - .3 CSA-B182.1.
- .2 For buried DWV Process Sanitary Piping and Venting:
  - .1 Polypropylene DWV piping and fittings which meet ASTM F-1412 for corrosive waste drainage systems with electric fusion resistant joints.



- .2 Piping shall be schedule 80.
- .3 For above ground DWV Process Sanitary piping:
  - .1 Polypropylene DWV piping and fittings which meet ASTM F 1412 for corrosive waste drainage systems with mechanical joints.
  - .2 Piping shall be schedule 40.

## 2.2 MATERIALS AND PRODUCTS

- .1 General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in drainage piping systems.
- .2 Provide combination of material and products as specified in PART 3 EXECUTION.

## 2.3 BASIC IDENTIFICATION

- .1 General: Provide identification complying with Section 23 05 54 - Mechanical Identification in accordance with the following listing:
- .2 Dialysis Drainage Piping Above Ground: Pipe markers.
- .3 Dialysis Drainage Piping Underground: Underground-type line markers.

## 2.4 BASIC PIPING SPECIALTIES:

- .1 General: Provide piping specialties complying with Section 22 42 01 - Plumbing Specialties and Accessories, in accordance with the following listing:
  - .1 Pipe escutcheons.
  - .2 Drip pans.
  - .3 Pipe sleeves.
  - .4 Sleeve seals.

## 2.5 BASIC SUPPORTS AND ANCHORS

- .1 All acid waste and vent piping systems shall be supported and anchored in strict accordance with the manufacturer's instructions.

## 2.6 DRAINAGE PRODUCTS

- .1 Traps and Tailpieces: Provide traps and tailpieces for each fixture inlet connection to drainage system, constructed of same material and weight as piping system. Trap assemblies shall be mechanical joint. Mechanical joints for fused polypropylene piping systems may not be used for any other purpose.

## 2.7 CLEANOUTS

- .1 Cleanout Plugs: Poly Propylene male ferrule with stainless steel screws and threaded stainless steel plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access Covers:
  - .1 Wall Access: face or wall type, stainless steel square or round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
  - .2 Floor Access: Poly Propylene body and frame with adjustable secured stainless steel top and:
    - .1 Plugs: Stainless steel with neoprene gasket.
    - .2 Cover for Unfinished Concrete Floors: stainless steel round, gasket, vandal-proof screws.

## **2.8 FLOOR DRAINS**

- .1 Floor Drains and Trench Drains: to CSA B79.
- .2 FD-1: Corrosion resistant; Poly Propylene round body, adjustable head, 125mm, 316 stainless steel strainer, integral seepage pan and trap primer connection. Removable / replaceable 316 stainless steel solid cover.
- .3 F.F.D: Combination funnel floor drain: Poly Propylene round body with integral seepage pan, trap primer connection and stainless steel adjustable head strainer with integral funnel.

## **3 Execution**

### **3.1 INSTALLATION**

- .1 Install in accordance with Canadian Plumbing Code and the local authority having jurisdiction.

### **3.2 TESTING**

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

### **3.3 PERFORMANCE VERIFICATION**

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and re-seal.
  - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).
- .5 Coordinate venting with roofing Trade Contractor.

### **3.4 INSPECTION**

- .1 General: Examine areas and conditions under which drainage systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

### **3.5 INSTALLATION OF PIPING**

- .1 Install in accordance with Canadian Plumbing Code and the local authority of having jurisdiction.
- .2 All acid waste and vent piping system installations (regardless of material type) shall have on site factory trained and authorized supervision made available to the Contractor on a regular basis throughout the installation process.
- .3 Each pipe and fitting system manufacturer shall conduct field inspections of the product installation of not less than once a week and provide a typed report to the Architect/Engineer confirming the product is being properly installed in accordance with manufacturer's requirements. Failure to provide reports to Architect/Engineer will be cause to hold all retainage from the Contractor.
- .4 Provide and install UL listed fire-stop and sealant systems for all piping penetrating fire rated walls, floors or roof systems.
- .5 All below grade buried acid waste and vent piping shall have trenching, backfill and compaction as specifically required by each manufacturer's written installation instructions.
- .6 The Contractor shall provide any and all necessary pipe fittings and/or offsets necessary for proper expansion control as recommended by the pipe material manufacturer.

### **3.6 INSTALLATION OF SUPPORTS AND ANCHORS**

- .1 Provide Supports and Anchors in accordance with piping manufacturer's recommendations.

**3.7 INSTALLATION OF PROCESS SANITARY DRAINAGE PIPING PRODUCTS:**

- .1 Cleanouts: Install in above ground piping and building drain piping as indicated, and:
  - .1 As required by plumbing code;
  - .2 At each change in direction of piping greater than 45 degrees below slab;
  - .3 At sinks;
  - .4 At each upper terminal;
  - .5 At egress of building (surface cleanout).
  - .6 Select cleanout locations and access for minimum disturbance of occupant functions and building systems operation during cleanout servicing. Ascertain that Architect and Owner agree with location and appearance. Avoid conflicts with shelves, mirrors and any other architectural obstructions.
  - .7 Install cleanouts above all sinks (42inches AFF or at least above flood level of lav.).
  - .8 Install cleanouts 6inches above highest trap on that floor on the main vent of each group of fixtures and in vent stacks for isolated fixtures on each floor.
  - .9 Install cleanouts of full size at top and base of each stack and at end of each horizontal run. Do not exceed 40 feet on horizontal runs.
  - .10 Provide cleanout plugs line-size up to 3inches, 4inches for line sizes 4inches and larger.
  - .11 Specify wall cleanouts where piping is concealed in wall or non-accessible chases, 42inches AFF.
  - .12 All vent piping to be provided in accordance with code.
- .2 Cleanouts Covers: Install floor and wall stainless steel plate cleanout covers for concealed piping, types as indicated in Section 22 42 01 and in accessible locations.
- .3 Flashing Flanges: Install flashing flange and clamping device with each cleanout passing through waterproof membrane.

End of Section

## **1 General**

### **1.1 REFERENCES**

- .1 ASME B16.11, Forged Fittings, Socket-Welding and Threaded.
- .2 ASTM A53/A53M, Specification for Pipe, Steel Black and Hot-dipped, Zinc-coated Welded and Seamless.
- .3 ASTM A181/181M, Specifications for Carbon Steel Forgings for General Purpose Piping.
- .4 CAN/CSA B51 Boiler, Pressure Vessel and Pressure Piping Code.

### **1.2 SHOP DRAWINGS**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 Submittal Procedures.

### **1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 35 43 - Environmental Procedures.
- .2 Fold up metal banding, flatten and place in designated area for recycling.
- .3 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with waste management plan

## **2 Products**

### **2.1 REFRIGERATED AIR DRYER (AIR COOLED)**

- .1 Refrigerated air dryer, air cooled condenser, 35 38 degrees F pressure dew point, indoor installation (ambient temperature 40 100 degrees F), automatic drain valve, and charged with R134a or R22 refrigerants.
- .2 Inlet and outlet connections to be factory insulated.

### **2.2 PIPING**

- .1 Copper Tubing and Fittings (up to 2 inches)
  - .1 Tubing: Copper, hard drawn or annealed, ASTM B88, Type L
  - .2 Fittings: Wrought copper, ASME B16.22
  - .3 Joints: Solder, ASTM B32, Alloy Sb5 tin-antimony
- .2 Steel Pipe and Fittings (over 2 inches)
  - .1 Pipe: Black steel, ASTM A53, Schedule 40
  - .2 Fittings: Steel, ASTM A234, Grade WPB, Schedule 40, butt-welding type, ASME B16.9
  - .3 Joints: Welded

### **2.3 VALVES**

- .1 Gate Valves: MSS SP-80 Class 150, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder or threaded ends to suit piping.
- .2 Ball Valves: MSS SP-110 Class 150, bronze, chrome-plated brass ball, full port, teflon seats and stuffing box ring, lever handle, solder or threaded ends to suit piping.
- .3 Globe Valve: MSS SP-80 Class 150, bronze body, bronze trim, solder or threaded ends to suit piping.
- .4 Swing Check Valve: MSS SP-80 Class 150, bronze body and cap, bronze swing disc with rubber seat, solder or threaded ends to suit piping.

### **3 Execution**

#### **3.1 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION**

- .1 Install shut-off valves at outlets, major branch lines and elsewhere as indicated.
- .2 Install quick-coupler chucks and pressure gauges on drop pipes as indicated on plans.
- .3 Install unions to permit removal or replacement of equipment.
- .4 Grade piping at minimum 1% slope.
- .5 Install compressed air trap and pressure equalizing pipe at moisture collecting points. Drain pipe to nearest floor drain.
- .6 Make branch connections from top of main.
- .7 Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.
- .8 Provide drain from refrigerated air dryer.
- .9 Testing: Pressure test for 4h minimum, to 1100 kPa, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 10 kPa.

#### **3.2 COMMISSIONING**

- .1 Commission system and demonstrate operation to satisfaction of Engineer.

End of Section

## **1 General**

### **1.1 RELATED SECTIONS**

- .1 Related Sections:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 22 - Construction/Demolition Waste Management And Disposal.
  - .3 Section 01 35 29 - Health And Safety Requirements
  - .4 Section 01 78 00 - Closeout Submittals.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CAN/CSA-B45 Series, Plumbing Fixtures.
  - .2 CAN/CSA-B125, Plumbing Fittings.
  - .3 CAN/CSA-B651, Barrier-Free Design.

### **1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets.
  - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Indicate, for all fixtures and trim:
      - .1 Dimensions, construction details, roughing-in dimensions.
- .3 Closeout Submittals:
  - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Include:
    - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
    - .2 Details of operation, servicing, maintenance.
    - .3 List of recommended spare parts.

### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse in accordance with Section 01 74 22 - Construction/Demolition Waste Management And Disposal.
  - .2 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .3 Fold up metal banding, flatten and place in designated area for recycling.

## **2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.
- .7 Stainless steel counter-top sinks.
  - .1 S-1: Double compartment c/w drain board (trim and supplies only):
    - .1 From 1.0 mm thick type 302 stainless steel, self-rimming, undercoated, clamps. Overall sizes: 410 x 460 x 200 mm.
    - .2 Trim: cast brass kitchen faucet with a 12" gooseneck with laminar flow, 13 mm male thread inlets, coupling nuts, chrome finish c/w wrist blade handles.
    - .3 Waste fitting: integral stainless steel basket strainer/stopper, tailpiece, cast brass P-trap with cleanout. Provide additional DI water faucet.
  - .2 V-1: Laboratory needle stop valves:
    - .1 Deck mount turret with single ball valve hose cock, complete with vandal resistant locking pins, shank, locknut, lockwasher, coupling nut and 1/4" IP tail piece.
- .8 Fixture piping:
  - .1 Hot and cold water supplies to each fixture:
    - .1 Chrome plated rigid supply pipes each with screwdriver stop, reducers, escutcheon.
  - .2 Waste:
    - .1 Brass P trap with clean out on each fixture not having integral trap.
    - .2 Chrome plated in all exposed places.
- .9 Chair carriers:
  - .1 Factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.

## **3 Execution**

### **3.1 INSTALLATION**

- .1 Mounting heights:
  - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
  - .2 Wall-hung fixtures: as indicated, measured from finished floor.
  - .3 Physically handicapped: to comply with most stringent of either NBCC or CAN/CSA B651.

### **3.2 ADJUSTING**

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
  - .1 Adjust water flow rate to design flow rates.
  - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
  - .1 Aerators: operation, cleanliness.
  - .2 Vacuum breakers, backflow preventers: operation under all conditions.
  - .3 Wash fountains: operation of flow-actuating devices.
- .4 Thermostatic controls:

- .1      Verify temperature settings, operation of control, limit and safety controls.

End of Section



## **1 General**

### **1.1 RELATED SECTIONS**

- .1 Related Sections:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 35 29 - Health And Safety Requirements
  - .3 Section 01 45 00 - Testing and Quality Control.
  - .4 Section 01 78 00 - Closeout Submittals.
  - .5 Section 01 91 13 - General Commissioning Requirements.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM).
  - .1 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .2 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA).
  - .1 AWWA C700, Cold Water Meters-Displacement Type, Bronze Main Case.
  - .2 AWWA C701, Cold Water Meters-Turbine Type for Customer Service.
  - .3 AWWA C702-1, Cold Water Meters-Compound Type.
- .3 Canadian Standards Association (CSA International).
  - .1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
  - .2 CSA-B79, Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
  - .3 CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .5 Plumbing and Drainage Institute (PDI).
  - .1 PDI-G101, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
  - .2 PDI-WH201, Water Hammer Arresters Standard.

### **1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
  - .2 Indicate dimensions, construction details and materials for specified items.
- .3 Instructions: submit manufacturer's installation instructions.
- .4 Manufacturers' Field Reports: manufacturers' field reports specified.
- .5 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:
  - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
  - .2 Details of operation, servicing and maintenance.
  - .3 Recommended spare parts list.

### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health And Safety Requirements.

## **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse in accordance with Section 01 74 22 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
  - .5 Fold up metal banding, flatten and place in designated area for recycling.

## **2 Products**

### **2.1 CLEANOUTS**

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access Covers:
  - .1 Wall Access: face or wall type, stainless steel square or round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
  - .2 Floor Access: cast iron body and frame with adjustable secured nickel bronze top and:
    - .1 Plugs: bolted bronze with neoprene gasket.
    - .2 Cover for Unfinished Concrete Floors: cast iron round, gasket, vandal-proof screws.
- .3 For Process Cleanouts see Section 22 13 19 - Drainage Waste and Vent Piping - Process Sanitary.

### **2.2 WATER HAMMER ARRESTORS**

- .1 Closed copper tube chamber with permanently sealed 410 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N O-rings pressure packed and lubricated with FDA approved Dow Corning No. 11 silicone compound. All units shall be designed in accordance with ASSE 1010 for sealed wall installations without an access panel. Size and install in accordance with Plumbing and Drainage Institute requirements (PDI WH 201).

### **2.3 BACK FLOW PREVENTERS**

- .1 Preventers: to CSA-B64 Series, application as indicated.
  - .1 Reduced Pressure Principle Type: up to NPS 10 c/w isolation valves on inlet and outlet, two independent check valves, test cocks, internal relief valve, access cover, inlet strainer and air gap drain.
  - .2 Double Check Valve Assembly: up to NPS 12 c/w isolation valves on inlet and outlet, two independent check valves, test cocks and inlet strainer.

### **2.4 VACUUM BREAKERS**

- .1 Breakers: Spill resistant vacuum breaker one piece modular check and float assembly made of engineered thermo plastic and housed in a lead free bronze body. Springs shall be stainless steel. The valve shall be constructed with a molded diaphragm separating the air inlet from the potable water supply to prevent spillage.

### **2.5 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

## **2.6 WATER MAKE-UP ASSEMBLY**

- .1 Complete with backflow preventer, pressure gauge on inlet and outlet, pressure reducing valve to CSA B356, pressure relief valve on low pressure side, strainer on inlet and gate valves on inlet and outlet.

## **2.7 TRAPS**

- .1 Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as pipe connected to. Slip joints are not permitted on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

## **2.8 TRAP SEAL PRIMERS**

- .1 For single fixtures only: Brass, with integral vacuum breaker, NPS1/2 solder ends, NPS1/2 drip line connection.
- .2 Up to four fixtures: Metered water quantity from distribution unit. Locate maximum 3 m from fixture.
- .3 Up to 12 fixtures: Electronic trap priming manifold with:
  - .1 Vacuum breaker
  - .2 Pre-set 24 hour time clock
  - .3 Manual override switch
  - .4 120V solenoid valve
  - .5 120V or 3-wire connection
  - .6 NPS 3/4 inlet connection
  - .7 Calibrated manifold
  - .8 Water hammer arrestor
  - .9 Mounted in steel cabinet
  - .10 Compression outlet fittings
  - .11 Inlet shutoff valve
  - .12 Supplies minimum 59 ml at 138 kPa.
- .4 All power / electrical requirements for trap primer assemblies shall be the responsibility of this contractor. All electrical to be completed by licensed electrician. Coordinate all work with electrical Sub Trade Contractor as stipulated under this contract.
- .5 Contractor to Include Additional (PVB) backflow prevention as required by AHJ Standard of Acceptance: Wilkins Model 460.

## **2.9 STRAINERS**

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS2 and under, bronze body, screwed ends, with brass cap, tapped blow-off connection and plug.
- .3 NPS2 1/2 and over, cast iron body, flanged ends, with bolted cap and tapped blow-off connection with bronze ball valve.

## **3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

### **3.2 INSTALLATION**

- .1 Install in accordance with National Plumbing Code of Canada, and.
- .2 Install in accordance with manufacturer's instructions and as specified.
- .3 Clean and adjust floor drains and cleanouts on completion of finished floor, coordinate installation with G.C.

### **3.3 CLEANOUTS**

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

### **3.4 NON-FREEZE WALL HYDRANTS**

- .1 Install 600 mm above finished grade unless otherwise indicated.

### **3.5 NON-FREEZE GROUND HYDRANT**

- .1 Install with top of box flush with ground and with drainage connection to discharge as indicated.

### **3.6 WATER HAMMER ARRESTORS**

- .1 Provide water hammer arrestors at all solenoid valves, at all groups of two or more flush valves, at all quick opening or closing valves, at all medical washing equipment, fixture on branch supplies to or groups of fixtures, and where indicated as required by PDI-WH 201.

### **3.7 BACK FLOW PREVENTORS**

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
  - .1 Reduced pressure type where backflow would constitute health hazard.
  - .2 Double check type where backflow would constitute a nuisance or be aesthetically objectionable or material which would not constitute a health hazard.
- .2 Provide Hub drain to terminate under BFP Discharge, hard pipe to nearest sanitary line.

### **3.8 BACKWATER VALVES**

- .1 Install in main sewer lines, where indicated.
- .2 Install in access pit as indicated.

### **3.9 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.

### **3.10 TRAP SEAL PRIMERS**

- .1 Install for floor drains and elsewhere, as indicated.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Consultant.
- .3 Install PEX piping to floor drain or fixture.

### **3.11 STRAINERS**

- .1 Install with sufficient room to remove basket.

### **3.12 WATER MAKE-UP ASSEMBLY**

- .1 Install on valved bypass.
- .2 Pipe discharge from relief valve to nearest floor drain.

### 3.13 START-UP

- .1 General:
  - .1 In accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, supplemented as specified herein.
- .2 Timing: start-up only after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.
- .4 Roof Drains:
  - .1 Check drains are located at low point in roof.
  - .2 Adjust wires to suit actual roof slopes.
  - .3 Cleanout sumps.
  - .4 Verify provisions for movement of roof systems.

### 3.14 TESTING AND ADJUSTING

- .1 General:
  - .1 In accordance with Section 01 91 13 - General Commissioning Requirements : General Requirements, supplemented as specified.
- .2 Timing:
  - .1 After start-up deficiencies rectified.
  - .2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Application tolerances:
  - .1 Pressure at fixtures: +/- 70kPa.
  - .2 Flow rate at fixtures: +/- 20%.
- .4 Adjustments:
  - .1 Verify that flow rate and pressure meet design criteria.
  - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .5 Floor drains:
  - .1 Verify operation of trap seal primer.
  - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
  - .3 Check operations of flushing features.
  - .4 Check security, accessibility, removeability of strainer.
  - .5 Clean out baskets.
- .6 Vacuum breakers, backflow preventers, backwater valves:
  - .1 Test tightness, accessibility for O&M of cover and of valve.
  - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
  - .3 Verify visibility of discharge from open ports.
- .7 Access doors:
  - .1 Verify size and location relative to items to be accessed.
- .8 Cleanouts:
  - .1 Verify covers are gas-tight, secure, yet readily removable.
- .9 Water hammer arrestors:
  - .1 Verify proper installation of correct type of water hammer arrester.
- .10 Wall, Ground hydrants:
  - .1 Verify complete drainage, freeze protection.
  - .2 Verify operation of vacuum breakers.
- .11 Pressure regulators, PRV assemblies:
  - .1 Adjust settings to suit locations, flow rates, pressure conditions.
- .12 Strainers:

- .1 Clean out repeatedly until clear.
- .2 Verify accessibility of cleanout plug and basket.
- .3 Verify that cleanout plug does not leak.
- .13 Hose bibbs, sediment faucets:
  - .1 Verify operation at all low points.
- .14 Hydronic system water Make-up Assembly:
  - .1 Verify operation.
- .15 Commissioning Reports:
  - .1 In accordance with Section 01 91 13 - General Commissioning Requirements: Reports, supplemented as specified.
- .16 Training:
  - .1 In accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M Personnel, supplemented as specified.
  - .2 Demonstrate full compliance with Design Criteria.

End of Section

## **1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 35 29 - Health and Safety Requirements
- .3 Section 01 45 00 - Testing and Quality Control
- .4 Section 01 78 00 - Closeout Submittals
- .5 Section 01 91 13 - General Commissioning Requirements

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM).
- .2 Canadian Standards Association (CSA International)

### **1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures
- .2 Manufacturer's Literature and Data: Include the Following
  - .1 Illustrations and descriptions of equipment and devices
  - .2 Catalog and model numbers for each item
  - .3 Fabrication, anchorage, and installation details.
  - .4 Weights and dimensions.
  - .5 Electrical data
  - .6 Performance data.
- .3 Instructions: Submit Manufacturers Installation Instructions
- .4 Field Test reports: Indicate dates and times of tests and certify test results
- .5 Factory Test Reports: Provide manufacturers QC checklist or other reports that indicate comprehensive factory testing has been performed, and the results of these tests have been certified.
- .6 Closeout Submittals: Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals including:
  - .1 Manufacturer's literature and data
  - .2 Operating and Maintenance instructions
  - .3 Factory and Field test reports

## **2 Products**

### **2.1 STEEL PIPE AND FITTINGS**

- .1 Pipe: Black Steel, ASTM A53, Schedule 40
- .2 Fittings: 2-1/2" or less - Screwed fittings malleable iron, to ASME B16.3, Class 150. 3" or greater - ASTM A234 Grade WPB, ASTM B16.9 butt weld or approved equal
- .3 Valves: Gate Valves: MSS SP-80 Class [125] [150,] bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, flanged or threaded ends to suit piping.
- .4 Ball Valves: MSS SP-110 Class 150, bronze, chrome-plated brass ball, full port, teflon seats and stuffing box ring, lever handle, flanged or threaded ends to suit piping.

### **2.2 COPPER TUBE AND FITTINGS**

- .1 Tubing shall be type "L", drawn ASTM B88.
- .2 Fittings shall be cast copper alloy ASME B16.18 or wrought copper and bronze ASME B16.22.
- .3 Joints: solder grade 95TA ASTM B32.

### **3 Execution**

#### **3.1 INSTALLATION**

- .1 Install unit as per manufacturer's recommendations. Locate where indicated. Contractor to provide miscellaneous steel mounting frame as needed.
- .2 Ensure that door to unit opens without interference by or with adjacent equipment to facilitate maintenance
- .3 Install controls where indicated.
- .4 Manufacturers representative to be on site for commissioning of unit.
- .5 Install piping close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.
- .6 Slope piping in direction vacuum pump to facilitate drainage.
- .7 Use eccentric reducers at pipe size change to provide positive drainage.
- .8 Ream pipes, clean scale and dirt inside and outside before and after assembly.
- .9 Provide pressure test as required by AHJ. Pressure test piping for leak detection purposes to hold pressure for minimum 4 hours.

End of Section



## **1 General**

### **1.1 DESCRIPTION**

- .1 Provide complete laboratory packaged reverse osmosis (RO) water treatment system producing high purity water by removal of dissolved minerals, bacteria, particles and organic impurities. Designed for continuous automatic operation. The system shall include pre-filter, product storage tank and all devices necessary for fully operational system. RO system operation will be controlled by the water level in the product storage tank.

### **1.2 RELATED WORK**

- .1 Systems for service other than boiler plant make-up water, Section 22 05 00 - Common Work Results for Mechanical.

### **1.3 SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's Literature and Data:
  - .1 Catalog cuts, complete description and specifications of all equipment and accessories
  - .2 Accessories including filters, product storage tank, pressure gages and test kit.
  - .3 Performance data including normal and maximum flow and pressure drop. Certification that required performance will be achieved.
  - .4 Piping.
- .3 Complete detailed layout, setting, arrangement, and installation drawings including. Drawings shall also show all parts of the apparatus including relative positions, dimensions, and sizes and general arrangement of connecting piping.

### **1.4 PROJECT CONDITIONS**

- .1 Influent Water Analysis:
  - .1 See Equipment Schedule.
- .2 Design Parameters:
  - .1 See Equipment Schedule.

### **1.5 APPLICABLE PUBLICATIONS**

- .1 The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- .2 American Society of Mechanical Engineers (ASME):  
B40.100-2005 Pressure Gages and Gage Attachments
- .3 ASTM International (ASTM):  
A269-07 Seamless and Welded Austenitic Stainless Steel Tubing for General Service.  
D1785-06 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- .4 American Water Works Association (AWWA):  
B300-04 Hypochlorites  
B301-04 Liquid Chlorine  
C651-05 Disinfecting Water Mains
- .5 National Electrical Manufacturers Association (NEMA):  
ICS-6-1993(R2001, R2006) Industrial Control and Systems: Enclosures
- .6 National Fire Protection Association (NFPA):  
70- 08 National Electrical Code.
- .7 Department of Health and Human Services, Food and Drug Administration (FDA):  
CFR 21, Chapter 1, Part 175.300, 02 Resinous and Polymeric Coatings

## 2 Products

### 2.1 REVERSE OSMOSIS SYSTEM

- .1 Packaged automatic reverse osmosis system mounted in a plastic casing, designed for project conditions. Equipment arranged on the frame to allow easy access for operating, maintenance and repair. Unit shall include reverse osmosis membrane, pressure vessels, pre-filtration system, high pressure pump and all required piping, wiring and controls for a fully operational Type 1 laboratory grade water system. Standard of Acceptance: See Schedule
- .2 Performance Requirements: See Schedule
- .3 Manual Valves:
  - .1 Pump Throttle Valve: Type 316 stainless steel ball valve, socket welded.
  - .2 Concentrate Throttle Valve, Recycle Throttle Valve: In-line needle style, stainless steel, rated for 300 psi minimum.
  - .3 Inlet Isolation Valve, Product and Concentrate Check Valves: PVC with EPDM seats and seals.
  - .4 Feedwater Sample Valve, Product Water Sample Valve: PVC plug valve with EPDM seats and seals.
  - .5 High Pressure Sample Valve: Type 316 stainless steel plug valve.
- .4 Automatic Valves:
  - .1 Automatic Inlet Shut Off Valve: Solenoid type, diaphragm actuated, normally closed, constructed of glass-filled Noryl thermoplastic.
  - .2 Automatic Membrane Flush Valve: Provide for purging the membranes with fresh water upon machine shut down.
- .5 Piping:
  - .1 Low Pressure Feed, Reject and Recycle Piping (75 psi and under): ASTM D1785, Schedule 80 PVC, socket welded and flanged.
  - .2 RO Product Tubing From Each Membrane Housing: ASTM D1785, Schedule 80 PVC, socket welded and flanged.
  - .3 Low Pressure Control and Pressure Gage Tubing: Polyethylene.
  - .4 High Pressure Reject and Recycle Piping (above 75 psi): ASTM A269, Type 304 Schedule 10 stainless steel with butt welded joints.
  - .5 High Pressure Control and Pressure Gage Tubing: 1000 psi burst nylon.
- .6 Controls:
  - .1 Electronic PLC or microprocessor controller providing automatic control for all operating functions. Motor starter panel. All in FRP enclosures rated NEMA 4. All wiring factory-installed and tested. Comply with Section 26 05 16 Wires and Cables (600 VOLTS AND BELOW) and NFPA 70.
  - .2 Autoflush indicator and control to flush RO concentrate at shut down or at predetermined intervals.
  - .3 Warning Alarms: Low quality product, low feed pressure, high feed temperature.
  - .4 Automatic Shutdowns and Alarms: Low feed pressure, low product quality, pretreatment out of service, storage tank full.
  - .5 Status Indicators: Low feed pressure, low quality, flow alarm, high feed water temperature, product divert to drain valve open, pretreatment lockout, storage tank full.
  - .6 Low and High pressure safety switches.
  - .7 Tank water level control switches.
  - .8 Miscellaneous Controls: Elapsed run time indicator, alarm horn, chemical pump receptacles, convenience receptacles, auxiliary contacts.
- .7 Instrumentation and Displays:
  - .1 All instrumentation readouts panel-mounted in FRP enclosures rated NEMA 4. All factory wiring. Comply with NFPA 70.
  - .2 Digital flow indicators for, product, reject, recycle.

- .3 Pressure gages for inlet, cartridge filter outlet, RO feed, RO concentrate, and RO product.
- .4 Conductivity indicator measuring product quality with digital displays, alarm relays and automatic temperature compensation.
- .5 Conductivity probe mounted in the RO product.
- .8 Reassembly:
  - .1 Unit shall be shipped to the site completely assembled and tested. If units or sections are to be disassembled at the site to allow for installation in a limited space, the unit shall be reassembled and tested for intended operation.

## **2.2 PRE-FILTER**

- .1 Single multi-media filter sized for the RO machine inlet flow rate. Filter designed for suspended solids removal down to 5 10 microns and automatic backwash cycle.
- .2 Media Tank: FRP designed for 150 psi. Pre-piped internal backwash distributor and filtered water collector.
- .3 Filter Media: Top layer of anthracite, middle layer of silica sand, bottom layer of multi-grade garnet. Install filter media at job site.
- .4 Backwash Cycle: Top-mounted, piston-operated control valve with pre-sized drain line flow control orifice. The cycle shall be initiated by and adjustable seven day electronic time clock. Include RO lockout switch.
- .5 Replacement Filter Media: Provide elements for one complete replacement.

## **2.3 ACTIVATED CARBON FILTER**

- .1 Single filter sized for the RO machine inlet flow rate. Designed to remove chlorine and prevent RO membrane damage.
- .2 Media Tank: FRP designed for 150 psi. Pre-piped internal backwash distributor and filtered water collector.
- .3 Filter Media: 12 x 40 mesh bituminous coal-based activated carbon. Install media at job site.
- .4 Backwash Cycle: Top-mounted, piston-operated control valve with pre-sized drain line flow control orifice. The cycle shall be initiated by and adjustable seven day electronic time clock. Include RO lockout switch.

## **2.4 RO WATER STORAGE TANK**

- .1 Free-standing, closed-top, flat-bottom. Top access manway, PVC bulkhead fittings for high and low level alarm switches, RO permeate inlet, RO permeate discharge and drain. Install 0.2 micron tank vent filter at the top head. Vented to atmosphere.
- .2 Materials of Construction: Linear polyethylene in one piece.
- .3 Tank Water Level Control: Adjustable float switch that signal starting and stopping RO pump. High and low level alarm switches.

## **2.5 PRESSURE GAGES**

- .1 ASME B40.100, Grade A, 1% accuracy, 110 mm (4-1/2 inches) diameter, all metal case, bottom connected. White dials, black hands, graduated from 0 to 700 kPa (0 to 100 psi) and identity labeled.

## **2.6 WATER TESTING EQUIPMENT**

- .1 Furnish water testing equipment in a portable cabinet specially made for the installed equipment. Include sufficient materials for 6 months of normal testing procedures.
- .2 Silt Density Index (SDI) apparatus to measure degree of suspended solids feeding the RO membranes. Include pressure regulator, pressure gage, filter holder, 600 mL beaker, sample valve, tubing and 0.45 micron filter papers.
- .3 Test kit to measure total water hardness, total iron, free chlorine, pH.

### **3 Execution**

#### **3.1 REQUIRED TECHNICAL SERVICES**

- .1 Provide services of a qualified manufacturer's representative to check complete installation for conformance to manufacturer's recommendations, put system into service, make all adjustments required for full conformance to design and specified requirements, and perform all demonstrations and tests.

#### **3.2 FLUSHING AND DISINFECTING**

- .1 Flush and disinfect new water lines and RO system and tank interiors in accordance with AWWA C651.
- .2 Material:
  - .1 Liquid chlorine: AWWA B301.
  - .2 Hypochlorite: AWWA B300.

#### **3.3 STARTUP AND TESTING**

- .1 Operating: Tests shall be run in presence of Contracting Officers Technical Representative (COTR) or Resident Engineer (RE).
- .2 Procedure:
  - .1 Operate RO system at constant maximum required capacity for one hour after demineralized RO product water is produced. When necessary, waste product water to sewer to maintain above flow rate. Product water production shall begin when a sample shows that demineralization complies with requirements.
  - .2 Demonstrate all features of the control system including diagnostics and flow and cycle indications.
- .3 The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior to notice.

End of Section