

GENERAL

The following changes in the Tender Documents are effective IMMEDIATELY. This addendum will form part of the Contract Documents

APPROVED ALTERNATIVE MATERIALS

APPROVED AS EQUAL	SPECIFIED
Humidifier(s)	Nortec
Boiler Venting	Duravent
Suction Diffuser(s)	Taco
Flexible Connection(s)	Flex-Hose

SPECIFICATIONS

1. Mechanical

- a. Refer to Sections 23 21 13.02
 - i. Updated description for pipe joints and fittings. Removed grooved connection description. Piping 2 ½ and above to be welded.
- b. Refer to Sections 23 05 23.02, 23 05 23.05 and 23 21 13.02
 - i. Removed grooved connection description.
- c. Refer to Sections 23 22 13
 - i. Updated steam line requirements. Steam lines shall be made of medical gas copper.
- d. Refer to Sections 23 05 23.05 and 25 30 02
 - i. Remove pneumatic components description. Pneumatic systems are not to be used.

QUESTIONS

1. *On the structural drawing detail 1/S1 it shows support angles on six new openings. On Mechanical 1/M3 it shows reusing 3 of those openings. No angle will be supplied to the existing 3 because although it shown on structural, it also states to be installed in new openings. Please clear up how many openings get reinforced.*

Answer: Allow for reinforcement of new and existing openings

2. *In regards to hot water heating pipe&fittings, the way i take it from the spec. Is that the roll grooved system (victaulic) is acceptable 21/2 and over ? Black pipe*

Answer: All new hot water piping shall be welded, black pipe.

3. *In relation to steam is this okay with sch 40 and 21/2 and over to be welded? Black pipe. In relation to condensate is this okay at sch 80 , 21/2 and over to be welded or is sch 40 also okay black pipe*

Answer: Steam piping shall be medical gas copper type L, to match humidifier manufacturer's recommendation.

4. *As far as controls are concerned I understand that johnson controls are to be the main supplier here.*

Answer: Controls to be provided by Johnson Controls since building already has controls by JCI.

5. *In relation to drawing m12 relating to temporary heat is there a requirement to supply complete temporary heating unit and (what size would this unit be based on) or would the temporary heat be supplied from the existing galaxy boiler system. Also in specifying this type of unit would you have any input as to where these would be rented from or who would be most familiar as to obtaining these.*

Answer: The contractor is responsible for providing and implementing temporary heating complete with boilers, pumps and all necessary accessories for proper operation. It must be equal in capacity to existing building heating system. Regarding the galaxy boilers, the total input of the 5 boilers is 1,995,000 BTU/hr and output is 1,635,000 btu/hr. It represents only a fraction of the building heating capacity, since each Saskatoon Boiler has an input rating of 3,770,000 BTU/hr and output rating of 3,014,000 BTU/hr.

6. *Can the heating output data and specifications for the start up of the Galaxy Boilers in the 3rd floor Fan Room be provided for temporary heat use as per section 01 11 00 item 1.3.3.2 in the work sequence? Can drawings of the building be provided for planning of temporary heating lines from the Galaxy Boilers in the 3rd floor Fan Room to tie into the 2nd floor boiler room HWS and HWR lines?*

Answer: Please refer to question #5.

7. *Who is responsible for the cost or rental auxiliary heating plant? If the mechanical contractor is supplying the auxiliary heating plant, what is the heating capacity of boilers 1, 2, 3 or what capacity is required for the auxiliary heating? Is the commissioning agent a third-party agent hired by the owner? Or supplied by the Mechanical contractor?*

Answer: The commissioning agent shall be supplied by the mechanical contractor, as per item 1.2.3. in section 01 91 13 General Commissioning Requirements. Regarding the temporary heating plant, please refer to question #5.

8. *The existing MCC appears to be 65 KAIC rated – is there a KAIC rating required for the new breakers to be installed in the existing MCC*

Answer: New breakers installed within the existing MCC are to be 65kA rated.

9. *Motor Schedule Drawing E2 – for pumps P1/2/23 notes reference “new electrical lead lag refer to Note 6” – note 6 only indicates new breakers in starter cell. Its likely this would be achieved through the VFD via controls system – please advise.*

Answer: Correct, the lead/lag configuration is to be through the VFDs.

CLARIFICATION

1. Install stainless steel vent type BH for the new humidifiers. The CPVC vent type shall be used only in cases where BH vent type is not compatible and if permitted by the manufacturer.

END OF ADDENDUM 5

Part 1 General

1.1 Related Requirements

- .1 Section 23 21 13 02 – Hydronic System: Steel.

1.2 References

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1- 05 , Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASTM International Inc.
 - .1 ASTM A49- 01(2006) , Standard Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A126- 04 , Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .3 ASTM A536- 84(2004)e1 , Standard Specification for Ductile Iron Castings.
 - .4 ASTM B61- 08 , Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B62- 02 , Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM B85/B85M- 08 , Standard Specification for Aluminum-Alloy Die Castings.
 - .7 ASTM B209- 07 , Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-61- 03 , Pressure Testing of Steel Valves.
 - .2 MSS SP-70- 06 , Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP-71- 05 , Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS SP-82- 1992 , Valve Pressure Testing Methods.
 - .5 MSS SP-85- 2002 , Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 Action And Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.

1.4 Closeout Submittals

- .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 Delivery, Storage And Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 Maintenance Material Submittals

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size, minimum 1.
 - .3 Stem packing: one for every 10 valves, each size, minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- .3 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:
 - .1 Lubricant gun for expansion joints.

Part 2 Products

2.1 Material

- .1 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
 - .1 Gate valves: MSS SP-70.
 - .2 Globe valves: MSS SP-85.
 - .3 Check valves: MSS SP-71.
- .3 Requirements common to valves, unless specified otherwise:
 - .1 Body, bonnet: cast iron to ASTM B209 Class B.
 - .2 Connections: **flanged** ends to ANSI B16.1.
 - .3 Inspection and pressure testing: to MSS SP-82.
 - .4 Bonnet gasket: non-asbestos.

- .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
- .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
- .7 Gland packing: non-asbestos.
- .8 Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
- .9 Identification tag: with catalogue number, size, other pertinent data.
- .4 All products to have CRN registration numbers.

2.2 Gate Valves

- .1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B62.
 - .3 Seat rings: renewable bronze to ASTM B62, screwed into body.
 - .4 Stem: bronze to ASTM B62.
 - .5 Operator: handwheel
 - .6 Bypass: complete with union and NPS globe valve as Section 23 05 23.01 - Valves - Bronze,
- .2 NPS 2 1/2-8, outside screw and yoke (OS Y), bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
 - .3 Seat rings: renewable bronze screwed into body.
 - .4 Stem: manganese-bronze.

2.3 Underwriters Approved Gate Valve

- .1 NPS 2 1/2 - 14, OS Y:
 - .1 Approvals: UL and FM approved for fire service.
 - .2 UL and FM Label: on valve yoke.
 - .3 Body, Bonnet: cast iron to ASTM A126 Class B. Wall thicknesses to ANSI B16.1 and ULC C-262 (B).
 - .4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.
 - .5 Packing gland: bronze.
 - .6 Stem: manganese bronze. Diameter to ULC C-262 (B).
 - .7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).
 - .8 Bosses for bypass valve, drain: on NPS 4 and over.

- .9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: EPDM coated cast iron with bronze disc rings.
- .10 Disc seat ring: self-aligning, Milwood undercut on NPS 3 - 12.
- .11 Pressure rating:
 - .1 NPS 2-1/2 - 12: 1.7 Mpa CWP.
 - .2 NPS 14-1.2: 1.2 MPa CWP.
- .12 Operator: handwheel.
- .13 Bypass: complete with union and NPS globe valve as Section 23 05 23.01 - Valves - Bronze.

2.4 Globe Valves

- .1 NPS 2 1/2 - 10, OSY:
 - .1 Body: with multiple-bolted bonnet.
 - .2 WP: 860 kPa steam, 1.4 MPa CWP.
 - .3 Bonnet-yoke gasket: non-asbestos.
 - .4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
 - .5 Seat ring: renewable, regrindable, screwed into body.
 - .6 Stem: bronze to ASTM B62.
 - .7 Operator: handwheel.
 - .8 Bypass: complete with union and NPS globe valve as Section 23 05 23.01 - Valves – Bronze.

2.5 Bypasses For Gate And Globe Valves

- .1 Locations: on valves as indicated.
- .2 Size of bypass valve:
 - .1 Main valve up to NPS 8: NPS 3/4.
 - .2 Main valve NPS 10 and over: NPS 1.
- .3 Type of bypass valves:
 - .1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.
 - .2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.

2.6 Valve Operators

- .1 Install valve operators as follows:
 - .1 Handwheel: on valves except as specified.
 - .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in mechanical equipment rooms.
 - .3 Motors:
 - .1 Application: Motorized Isolation Valves.
 - .2 Three way mixing valve.

2.7 Check Valves

- .1 Swing check valves, Class 125:
 - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. **Flanged** ends: plain faced with smooth finish.
 - .1 Up to NPS 16: cast iron to ASTM A126 Class B
 - .2 NPS 18 and over: cast iron to ASTM A126 Class C.
 - .2 Ratings:
 - .1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.
 - .2 NPS 14 - 16: 860 kPa steam; 1.03 MPa CWP.
 - .3 NPS 18 and over: 1.03 MPa CWP.
 - .3 Disc: rotating for extended life.
 - .1 Up to NPS 6: bronze to ASTM B62.
 - .2 NPS 8 and over: bronze-faced cast iron.
 - .4 Seat rings: renewable bronze to ASTM B62 screwed into body.
 - .5 Hinge pin, bushings: renewable bronze to ASTM B62.
- .2 Swing check valves, NPS 2 1/2 - 8 Class 250:
 - .1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.
 - .2 Flanged ends: 2 mm raised face with serrated finish.
 - .3 Rating: 250 psi steam; 500 psi CWP.
 - .4 Disc: rotating for extended life.
 - .1 Up to NPS 3: bronze to ASTM B61.
 - .2 NPS 4 - 8: iron faced with ASTM B61 bronze.
 - .5 Seat rings: renewable bronze to ASTM B61, screwed into body.
 - .6 Hinge pin, bushings: renewable, bronze to ASTM B61.
 - .7 Hinge: galvanized malleable iron.
 - .8 Identification tag: fastened to cover.

2.8 Silent Check Valves

- .1 Construction:
 - .1 Body: malleable with integral seat.
 - .2 Pressure rating: Class 125, WP = 860 kPa.
 - .3 Connections: **flanged** ends.
 - .4 Disc: bronze renewable rotating disc.
 - .5 Seat: renewable, EPDM.
 - .6 Stainless steel spring, heavy duty.

Part 3 Execution

3.1 Installation

- .1 Install rising stem valves in upright position with stem above horizontal.

3.2 Cleaning

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Clean installed products in accordance to manufacturer's recommendation.
- .3 Waste Management: separate waste materials for reuse recycling in accordance with
 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 Related Requirements

- .1 Section 23 05 05 Installation of Pipework.

1.2 References

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ASME B1.20.1- 1983(R2006) , Pipe Threads, General Purpose (Inch).
 - .2 ASME B16.1-05, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25,125 and 250.
 - .3 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings: NPS through 24.
 - .4 ANSI/ASME B16.11-05, Forged Fittings, Socket-Welding and Threaded.
 - .5 ANSI/ASME B16.25-07, Buttwelding Ends.
 - .6 ANSI/ASME B16.34-04, Valves - Flanged, Threaded and Welding Ends.
- .2 American Petroleum Institute (API)
 - .1 API Std. 609-04, Butterfly Valves: Double Flanged, Lug- and Wafer-Type.
- .3 ASTM International Inc.
 - .1 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
 - .3 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .4 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate Metric.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-67-02a, Butterfly Valves.

1.3 Action And Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit data for valves specified in this section.
- .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.

1.4 Closeout Submittals

- .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 Delivery, Storage And Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 Maintenance Material Submittals

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size, minimum 1.
 - .3 Stem packing: one for every 10 valves, each size, minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- .3 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:
 - .1 Lubricant gun for expansion joints.

Part 2 Products

2.1 Butterfly Valves - Resilient Seat - 200 Psig

- .1 Except to specialty valves, to be of single manufacturer.
- .2 To be suitable for dead-end service.
- .3 CRN registration number required for products.
- .4 Sizes:
 - .1 **Lug type: NPS 2 to 30.**
- .5 Pressure rating for tight shut-off at temperatures up to maximum for seat material.
 - .1 NPS 2 - 12: 200 psig.
 - .2 NPS 14 - 48: 200 psig.

- .6 Minimum seat temperature ratings to 135 degrees C.
- .7 Application: on-off operation.
- .8 Full lug body (threaded).
- .9 Operators:
 - .1 NPS 2 - 6: handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel. Standard coating: black laquer.
 - .2 NPS 8 - 30: manual enclosed gear operator as specified elsewhere in this section.
- .10 Designed to comply with MSS SP-67 and API 609.
- .11 Compatible with ANSI Class 125/Class 150 flanges.
- .12 Construction:
 - .1 Body: ductile iron.
 - .2 Disc: aluminum bronze.
 - .3 Seat: EPDM.
 - .4 Shaft: 316.
 - .5 Taper pin: 316 SS.
 - .6 Key: carbon steel.
 - .7 O-Ring: EPDM.
 - .8 Bushings: luberized bronze.

2.2 Butterfly Valves - Resilient Seat - 285 Psig

- .1 Sizes:
 - .1 **Lug type: NPS 2 to 48.**
- .2 Pressure rating: 285 psig at 135 degrees C.
- .3 Lug body: 150 ANSI bolt pattern.
- .4 Full lug body (threaded).
- .5 Application: for on-off service.
- .6 Operators:
 - .1 NPS 2 - 6: handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel.
 - .2 NPS 8 - 24: manual enclosed gear operator.
 - .3 Install parallel or perpendicular to pipeline.
- .7 Designed to comply with MSS SP-67 and API Std. 609.
- .8 Compatible with ANSI B16.1 Class 125 (iron) and ANSI B16.5 Class 150 (steel) flanges.

- .9 Construction:
 - .1 Body: ductile iron.
 - .2 Disc: aluminum bronze.
 - .3 Seat: EPDM.
 - .4 Refer to manufacturer's literature for additional materials.
 - .5 Shaft: 316 stainless steel.
 - .6 Taper pin: 316 SS.
 - .7 Blowout proof stem.
 - .8 O-Ring: EPDM.
 - .9 Bushings: Teflon.
 - .10 Disc shall not be pinned to shaft.
 - .11 Bubble tight shutoff with downstream flanges removed, class 6 shutoff.

2.3 Mounting Flanges

- .1 Class 125 cast iron to ANSI B16.1 or Class 150 steel to B16.5 pipe flanges.

2.4 Pneumatic Actuators

.1 Not Used

2.5 Electric Actuators

- .1 Operation: designed to provide precise quarter turn electric operation.
 - .1 Torque range: up to 1.130 N-m and speed ranges from 10 seconds to 30 seconds to move from fully open to fully closed.
 - .2 Gear train within actuator to provide smooth continuous rotary power stroke for accurate automatic valve positioning. Factory-set, field adjustable cam-actuated travel limit switches to provide precise control of shaft rotation.
- .2 Construction:
 - .1 Castings: heavy duty industrial grade for rugged use.
 - .2 Actuators: continuous duty with high efficiency single phase reversing capacitor motor with thermal overload protection.
 - .3 Gears and pinions constructed from hardened steel.
 - .4 Gear train to be permanently lubricated.
 - .5 Mechanical brake to ensure that gear is locked in precise position.
- .3 Electrical:
 - .1 Standard voltage: 120 VAC. 60 Hz.
 - .2 Control options: 4-20 Ma DC
 - .3 CSA approved.
 - .4 Electrical rating: NEMA IV.

Part 3 Execution

3.1 Preparation

- .1 Valve and mating flange preparation.
 - .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
 - .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
 - .3 Install butterfly valves with disc in almost closed position.
 - .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

3.2 Installation Of Valves

- .1 Install in accordance with manufacturer's instructions.
- .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
- .3 Verify suitability of valve for application by inspection of identification tag.
- .4 Mount actuator on to valve prior to installation.
- .5 Handle valve with care so as to prevent damage to disc and seat faces.
- .6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.
- .7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

3.3 Actuator Installation

- .1 Air hoses or electrical connections to be made by actuator manufacturer.
- .2 Cycle valve operation from fully closed to fully open then back to fully closed.
- .3 At same time, check travel stop settings for proper disc alignment.

3.4 Cleaning

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Clean installed products in accordance to manufacturer's recommendation.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 Related Requirements

- .1 Section 23 05 05 – Installation of Pipework.
- .2 Section 23 07 15 – Thermal Insulation for Piping.
- .3 Section 23 05 23.01 - Valves – Bronze
- .4 Section 23 05 23.02 - Valves - Cast Iron.
- .5 Section 23 05 17 - Pipe Welding.
- .6 Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.
- .7 Section 23 05 00 - Common Work Results for HVAC.
- .8 Section 23 08 01 - Performance Verification Mechanical Piping Systems.

1.2 References

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C111/A21.11-06, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-10, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - .2 ASME B16.3- 06, Malleable Iron Threaded Fittings: Classes 150 and 300.
 - .3 ASME B16.5- 09, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.
 - .4 ASME B16.9- 07, Factory-Made Wrought Buttwelding Fittings.
 - .5 ASME B18.2.1- 10, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).
 - .6 ASME B18.2.2- 10, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
- .3 ASTM International
 - .1 ASTM A47/A47M- 99(2009), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M- 10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A536- 84(2009), Standard Specification for Ductile Iron Castings.
 - .4 ASTM B61- 08, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B62- 09, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM E202- 10, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 CSA International

- .1 CSA B242- 05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
- .2 CSA W48- 06, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
 - .1 MSS-SP-67- 2002a, Butterfly Valves.
 - .2 MSS-SP-70- 06, Gray Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71- 05, Gray Iron Swing Check Valves Flanged and Threaded Ends.
 - .4 MSS-SP-80- 08, Bronze Gate, Globe, Angle and Check Valves.
 - .5 MSS-SP-85- 02, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 Action And Informational Submittals

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
 - .2 Indicate on drawings:
 - .1 Components and accessories.
- .4 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .5 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
 - .1 Include special servicing requirements.

1.4 Extra Stock Materials

- .1 Supply spare parts as follows:
 - .1 Valve seats: 1 minimum for every ten valves, each size. Minimum one.
 - .2 Discs: 1 minimum for every ten valves, each size. Minimum one.
 - .3 Stem packing: 1 minimum for every ten valves, each size. Minimum one.
 - .4 Valve handles: 2 minimum of each size.
 - .5 Gaskets for flanges: 1 minimum for every ten flanges.

1.5 Delivery, Storage And Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 Pipe

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
 - .1 To NPS 6: Schedule 40.
 - .2 NPS 8 and over, 10.
 - .3 NPS 12 and over, 10 mm wall thickness.

2.2 Pipe Joints

- .1 **NPS 2 and under: screwed fittings with PTFE tape.**
- .2 **NPS 2-1/2 and over: welding fittings to CSA W48.**

2.3 Fittings

- .1 **Screwed fittings: malleable iron, to ASME B16.3, Class 150.**
- .2 **Pipe flanges and flanged fittings:**
 - .1 **Cast iron: to ASME B16.1, Class 125.**
 - .2 **Steel: to ASME B16.5.**
- .3 **Butt-welding fittings: steel, to ASME B16.9.**
- .4 **Unions: malleable iron, to ASTM A47/A47M.**

2.4 Valves

- .1 Connections:
 - .1 NPS 2 and smaller: screwed ends.
 - .2 NPS 2-1/2 and larger: **flanged** ends.
- .2 Gate valves: to MSS-SP-70:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.

- .2 NPS 2-1/2 and over:
 - .1 Mechanical Rooms: rising stem, split wedge disc, lead free bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
 - .1 Operators: handwheel.
 - .2 Elsewhere: non-rising stem, solid wedge disc, lead free bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
 - .1 Operators: handwheel.
- .3 Butterfly valves: to MSS-SP-67
 - .1 NPS 2-1/2 and over: **lug type**.
- .4 Globe valves: MSS-SP- 85:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2-1/2 and over:
 - .1 With composition disc, lead free bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
 - .2 Operators: handwheel.
- .5 Balancing, for TAB:
 - .1 Sizes: calibrated balancing valves, as specified this section.
 - .2 NPS 2 and under:
 - .1 Mechanical Rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
- .6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .7 Bypass valves on gate valves NPS 8 and larger: NPS 3/4, Globe, with PTFE disc as specified Section 23 05 23.01 - Valves - Bronze.
- .8 Swing check valves: to MSS-SP-71.
 - .1 NPS 2 and under:
 - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2-1/2 and over:
 - .1 **Flanged** ends: as specified Section 23 05 23.02 - Valves - Cast Iron.
- .9 Silent check valves:
 - .1 NPS 2 and under:
 - .1 As specified Section 23 05 23.01 - Valves – Bronze.
 - .2 NPS 2-1/2 and over:
 - .1 **Flanged** ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

- .10 Ball valves:
 - .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.
- .11 Lubricated Plug Valves
 - .1 NPS 2 and under: Class 125, threaded ends, to ASME/ANSI B16.33
 - .2 NPS 2-1/2 and over:
 - .1 As specified Section 23 05 23.02 - Valves - Cast Iron.

Part 3 Execution

3.1 Examination

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 Piping Installation

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

3.3 Circuit Balancing Valves

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.4 Cleaning, Flushing And Start-Up

- .1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.5 Testing

- .1 Test system in accordance with Section 23 05 00 - Common Work Results for HVAC.

3.6 Balancing

- .1 Balance water systems to within plus or minus 5 % of design output.
- .2 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.7 Performance Verification

- .1 In accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems.

3.8 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by hydronic systems installation.

END OF SECTION

Part 1 General

1.1 Related Requirements

- .1 Section 23 05 00 Common Work Results for HVAC.

1.2 References

- .1 American National Standards Institute (ANSI) / American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings: Class 25, 125, 250 and 800.
 - .2 ASME B16.25-07, Buttwelding Ends.
 - .3 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.
 - .4 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings: NPS through 24.
 - .5 ANSI/ASME B16.9-07, Factory-Made Wrought Steel Buttwelding Fittings.
 - .6 ANSI B18.2.1-96(R2005), Square and Hex Bolts and Screws (Inch Series).
 - .7 ANSI/ASME B18.2.2-87(R2005), Square and Hex Nuts (Inch Series).
- .2 American National Standards Institute (ANSI) / American Water Works Association (AWWA)
 - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .3 ASTM International Inc.
 - .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
 - .1 MSS-SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .2 MSS-SP-71-2005, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-80-2003, Bronze Gate, Globe, Angle and Check Valves.
 - .4 MSS-SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 Action And Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:

- .1 Provide manufacturer's printed product literature and datasheets for valves and pipes and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Shop Drawings:
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
- 1.4 Closeout Submittals**
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals
- 1.5 Delivery, Storage And Handling**
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements .
 - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
 - .3 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- 1.6 Extra Materials**
 - .1 **Not Used**
- Part 2 Products**
 - 2.1 Tubing**
 - .1 **Processed for medical gas installations, cleaned and plugged**
 - .1 **Hard copper: to ASTM B819, type MED - L.**
 - 2.2 Fittings**
 - .1 **Service: design pressure 2070 kPa and temperature 121 degrees C.**
 - .2 **Brazed:**
 - .1 **Fittings: wrought copper to ASME B16.22.**
 - .2 **Joints: silver brazed**
 - 2.3 PIPE SLEEVES**
 - .1 **Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.**

Part 3 Execution

3.1 Application

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Piping

- .1 **Install pipework in accordance with manufacturer's recommendation.**
- .2 **Certify that piping is free of contaminants (oils, grease, etc.). Handle and store with care to prevent contamination.**
- .3 **Ensure that all manufacturer's recommendations are followed, including, but not limited to:**
 - .1 **Piping minimum internal diameter.**
 - .2 **Maximum equivalent line length.**
 - .3 **Piping Slope.**
 - .4 **Piping Supporting.**
 - .5 **Piping Insulation.**
 - .6 **Condensate lines and traps**

3.3 Testing

- .1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.
- .2 **Test pressure: 1-1/2 times maximum system operating pressure.**

3.4 System Start-Up

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

3.5 Performance Verification (Pv)

- .1 General:
 - .1 Verify performance in accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems supplemented as specified herein.
- .2 Timing, only after:
 - .1 Pressure tests successfully completed.
 - .2 Flushing as specified has been completed.
 - .3 Water treatment system has been commissioned.
- .3 PV Procedures:
 - .1 Verify complete drainage of condensate from steam coils.
 - .2 Verify proper operation of system components, including, but not limited to:
 - .1 Steam traps - verify no blow-by.
 - .2 Flash tanks.

- .3 Thermostatic vents.
- .3 Monitor operation of provisions for controlled pipe movement including expansion joints, loops, guides, anchors.
 - .1 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
- .4 Humidifiers: for commissioning procedures, refer to Section 23 84 13 - Humidifiers.
- .5 Condensate pumping units: for commissioning procedures, refer to Section 01 91 13 - General Commissioning (Cx) Requirements.

3.6 Cleaning

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 References

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7, Requirements for Watthour Meter Sockets.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B148, Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.2 Definitions

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.3 Action And Informational Submittals

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Pre-Installation Tests.
 - .1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 Existing Conditions

- .1 Cutting and Patching: in accordance with Section 01 73 00 - Execution Requirements supplemented as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to Departmental Representative existing materials removed from Work not identified for re-use.

Part 2 Products

2.1 General

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant.

- .3 Operating conditions: 0 - 32 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 Temperature Sensors

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
 - .1 Thermocouples: limit to temperature range of 200 degrees C and over.
 - .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
 - .3 Sensing element: hermetically sealed.
 - .4 Stem and tip construction: copper or type 304 stainless steel.
 - .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
 - .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 mm.
- .2 Room temperature sensors and display wall modules.
 - .1 Temperature sensing and display wall module.
 - .1 LCD display to show space temperature and temperature setpoint.
 - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
 - .3 Jack connection for plugging in laptop personal computer for access to zone bus.
 - .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
 - .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
 - .6 Stability 0.02 degrees C drift per year.
 - .7 Separate mounting base for ease of installation.
 - .2 Room temperature sensors.
 - .1 Wall mounting, in slotted type covers having brushed aluminum finish

- .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.
- .3 Duct temperature sensors:
 - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm.
 - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.
- .4 Outdoor air temperature sensors:
 - .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

2.3 Temperature Transmitters

- .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
 - .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
 - .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
 - .4 Input and output short circuit and open circuit protection.
 - .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
 - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
 - .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
 - .8 Integral zero and span adjustments.
 - .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 degrees C.
 - .10 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.
 - .11 Transmitter ranges: select narrowest range to suit application from following:
 - .1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.
 - .2 0 to 100 degrees C, plus or minus 0.5 degrees C.
 - .3 0 to 50 degrees C, plus or minus 0.25 degrees C.
 - .4 0 to 25 degrees C, plus or minus 0.1 degrees C.
 - .5 10 to 35 degrees C, plus or minus 0.25 degrees C.

2.4 Humidity Sensors

- .1 Room and Duct Requirements:
 - .1 Range: 5 - 90 % RH minimum.

- .2 Operating temperature range: 0 - 60 degrees C.
- .3 Absolute accuracy:
 - .1 Duct sensors: plus or minus 3%.
 - .2 Room sensors: plus or minus 2%.
- .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
- .5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
- .6 Room sensors: wall mounted as indicated.
- .7 Duct mounted sensors: locate so that sensing element is in air flow in duct.
- .2 Outdoor Humidity Requirements:
 - .1 Range: 0 - 100 % RH minimum.
 - .2 Operating temperature range: -40 - 50 degrees C.
 - .3 Absolute accuracy: plus or minus 2%.
 - .4 Temperature coefficient: plus or minus 0.03%RH/ degrees C over 0 to 50 degrees C.
 - .5 Must be unaffected by condensation or 100% saturation.
 - .6 No routine maintenance or calibration is required.

2.5 Humidity Transmitters

- .1 Requirements:
 - .1 Input signal: from RH sensor.
 - .2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
 - .3 Input and output short circuit and open circuit protection.
 - .4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.
 - .5 Output linearity error: plus or minus 1.0% maximum of full scale output.
 - .6 Integral zero and span adjustment.
 - .7 Temperature effect: plus or minus 1.0 % full scale/ 6 months.
 - .8 Long term output drift: not to exceed 0.25 % of full scale output/ 6 months.

2.6 Pressure Transducers

- .1 Requirements:
 - .1 Combined sensor and transmitter measuring pressure.
 - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
 - .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
 - .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
 - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
 - .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.

- .6 Over-pressure input protection to at least twice rated input pressure.
- .7 Output short circuit and open circuit protection.
- .8 Accuracy: plus or minus 1% of Full Scale.

2.7 Differential Pressure Transmitters

- .1 Requirements:
 - .1 General: Multi-configurable, wet-to-wet differential pressure transducer with 3 valve manifold assembly, display and NEMA 4 enclosure with hinges.
 - .2 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
 - .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
 - .4 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
 - .5 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
 - .6 Integral zero and span adjustment.
 - .7 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
 - .8 Over-pressure input protection to at least twice rated input pressure.
 - .9 Output short circuit and open circuit protection.
 - .10 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.8 Static Pressure Sensors

- .1 Requirements:
 - .1 Multipoint element with self-averaging manifold.
 - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
 - .2 Accuracy: plus or minus 1 % of actual duct static pressure.

2.9 Static Pressure Transmitters

- .1 Requirements:
 - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
 - .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
 - .3 Accuracy: 0.4 % of span.
 - .4 Repeatability: within 0.5 % of output.
 - .5 Linearity: within 1.5 % of span.
 - .6 Deadband or hysteresis: 0.1% of span.
 - .7 External exposed zero and span adjustment.
 - .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.10 Velocity Pressure Sensors

- .1 Requirements:
 - .1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
 - .2 Maximum pressure loss: 37Pa at 1000 m/s.
 - .3 Accuracy: plus or minus 1 % of actual duct velocity.

2.11 Velocity Pressure Transmitters

- .1 Requirements:
 - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
 - .2 Calibrated span: not to exceed 125 % of duct velocity pressure at maximum flow.
 - .3 Accuracy: 0.4 % of span.
 - .4 Repeatability: within 0.1 % of output.
 - .5 Linearity: within 0.5 % of span.
 - .6 Deadband or hysteresis: 0.1% of span.
 - .7 External exposed zero and span adjustment.
 - .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.12 Liquid And Steam Flow Meters

- .1 Requirements:
 - .1 Pressure rating: as specified in I/O summaries.
 - .2 Temperature rating: as specified in I/O summaries.
 - .3 Repeatability: plus or minus 0.2 %.
 - .4 Accuracy and linearity: plus or minus 1.0 %.
 - .5 Flow rangability: at least 10:1.
 - .6 Ends:
 - .1 NPS 2 and under: screwed.
 - .2 NPS 2.1/2 and over: flanged.

2.13 Pressure And Differential Pressure Switches

- .1 Requirements:
 - .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
 - .2 Adjustable setpoint and differential.
 - .3 Switch: snap action type.
 - .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
 - .5 Accuracy: within 2% repetitive switching.

- .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
- .7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.14 Temperature Switches

- .1 Requirements:
 - .1 Operate automatically.
 - .2 Adjustable setpoint and differential.
 - .3 Accuracy: plus or minus 1 degrees C.
 - .4 Snap action rating: Switch to be DPST for hardwire and EMCS connections.
 - .5 Type as follows:
 - .1 Room: for wall mounting on standard electrical box with protective guard.
 - .2 Duct, general purpose: insertion length = 460 mm.
 - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
 - .4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
 - .5 Strap-on: with helical screw stainless steel clamp.

2.15 Tank Level Switches

- .1 Requirements:
 - .1 Indicate high/low water level and to alarm.
 - .2 For mounting on top of tank.
 - .3 Maximum operating temperature: 120 degrees C.
 - .4 Snap action contacts rated 15 amp at 120 V.
 - .5 Adjustable setpoint and differential.

2.16 Wind Velocity Transmitters

- .1 Requirements:
 - .1 3-cup anemometer and airfoil vane mounted on common vertical axis, designed for mast mounting.
 - .2 Anemometer:
 - .1 Range: 0-160 km/h.
 - .2 Threshold: 3.0 km/h.
 - .3 Accuracy: +/- 2%.
 - .3 Airfoil vane
 - .1 Range: 0-360 degrees with infinite resolution potentiometer with no loss of reading at transition point.
 - .2 Starting threshold: 1.1 M/s.
 - .3 Accuracy: +/- 0.5%.

- .4 Output signals: 4 to 20 Ma into 500 ohm load.
- .5 Provide two output signals: velocity, direction.
- .6 Mast: aluminum, size and height as indicated.
- .7 Provide at least 3 stainless steel guys, turnbuckles, anchor bolts.
Follow manufacturers installation guidelines.

2.17 Solenoid Control Air Valves

- .1 **Not Used**

2.18 Air Pressure Gauges

- .1 **Not Used**

2.19 Electromechanical Relays

- .1 Requirements:
 - .1 Double voltage, DPDT, plug-in type with termination base.
 - .2 Coils: rated for 24V DC. Other voltage: provide transformer.
 - .3 Contacts: rated at 5 amps at 120 V AC.
 - .4 Relay to have visual status indication

2.20 Solid State Relays

- .1 General:
 - .1 Relays to be socket or rail mounted.
 - .2 Relays to have LED Indicator
 - .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
 - .4 Operating temperature range to be -20 degrees C to 70 degrees C.
 - .5 Relays to be CSA Certified.
 - .6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.
 - .7 Operational frequency range, 45 to 65 HZ.
- .2 Input:
 - .1 Control voltage, 3 to 32 VDC.
 - .2 Drop out voltage, 1.2 VDC.
 - .3 Maximum input current to match AO (Analog Output) board.
- .3 Output.
 - .1 AC or DC Output Model to suit application.

2.21 Current Transducers

- .1 Requirements:
- .2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
 - .1 4-20 mA DC.

- .2 0-1 volt DC.
- .3 0-10 volts DC.
- .4 0-20 volts DC.
- .3 Frequency insensitive from 10 - 80 hz.
- .4 Accuracy to 0.5% full scale.
- .5 Zero and span adjustments. Field adjustable range to suit motor applications.
- .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.22 Current Sensing Relays

- .1 Requirements:
 - .1 Suitable to detect belt loss or motor failure.
 - .2 Trip point adjustment, output status LED.
 - .3 Split core for easy mounting.
 - .4 Induced sensor power.
 - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
 - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
 - .7 Adjustable latch level.

2.23 Control Valves

- .1 Body: forged brass, nickel plated body, globe style.
 - .1 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
 - .2 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
 - .3 Packing easily replaceable, 2 EPDM O-rings, lubricated.
 - .4 Ball: Stainless Steel.
 - .5 Stem: Stainless steel.
 - .6 Seat: PTFE.
 - .7 Characterizing Disc: replaceable, Tefzel.
 - .8 NPS 2 and under:
 - .1 Screwed National Pipe Thread (NPT) tapered female connections.
 - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
 - .3 Rangeability 50:1 minimum.
 - .9 NPS 2 and larger:
 - .1 Flanged connections.
 - .2 Valves to ANSI Class 150 or 250, valves to bear ANSI mark.
 - .3 Rangeability 100:1 minimum.
- .2 Butterfly Valves NPS 2 and larger:
 - .1 Body: for chilled water ANSI Class 150 cast iron lugged body installed in locations as indicated. For steam and heating water ANSI Class 150 carbon steel lugged body.

- .2 End connections to suit flanges that are ANSI Class 150.
- .3 Extended stem neck to provide adequate clearance for flanges and insulation.
- .4 Pressure limit: bubble tight sealing to 170 kilopascals.
- .5 Disc/vane: 316 stainless steel.
- .6 Seat: for service on chilled water PTFE (polytetrafluoroethylene. For service on steam and heating water PTFE.
- .7 Stem: 316 stainless steel.
- .8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
- .9 Maximum flow requirement as indicated on control valve schedule.
- .10 Maximum pressure drop as indicated on control valve schedule: pressure drop not to exceed one half of inlet pressure.
- .11 Valves are to be provided complete with mounting plate for installation of actuators.

2.24 Pneumatic Valve Actuators

- .1 **Not Used**

2.25 Electronic / Electric Valve Actuators

- .1 Requirements:
 - .1 Construction: steel, cast iron, aluminum.
 - .2 Control signal: 0-10V DC or 4-20 mA DC.
 - .3 Positioning time: to suit application. 90 sec maximum.
 - .4 Fail to normal position as indicated.
 - .5 Scale or dial indication of actual control valve position.
 - .6 Size actuator to meet requirements and performance of control valve specifications.
 - .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
 - .8 Minimum shut-off pressure: refer to control valve schedule.

2.26 Watthour Meters And Current Transformers

- .1 Requirements:
 - .1 Include three phases, test and terminal blocks for watthour meter connections and connections for monitoring of current. Provide two transformers for 600 V 3 wire systems for watthour meter use. Accuracy: plus or minus 0.25 % of full scale.
 - .2 Watthour meter sockets: to ANSI C12.7.
 - .3 Potential and current transformers: to ANSI/IEEE C57.13.
 - .4 Potential transformers: provide two primary fuses.
 - .5 Demand meters: configure to measure demand at 15 minute intervals.

2.27 Surface Water Detectors

- .1 Requirements:

- .1 Provide alarm on presence of water on floor.
- .2 Expendable cartridge sensor.
- .3 Internal waterproof switch.
- .4 One set of dry contacts 2 amps at 24 V.
- .5 Unaffected by moisture in air.
- .6 Self-powered.

2.28 Panels

- .1 wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.29 Wiring

- .1 In accordance with Division 26
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: 20AWG stranded twisted pair.
 - .2 Analog input and output: shielded 20 minimum stranded twisted pair.

Part 3 Execution

3.1 Installation

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.
- .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.

- .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
- .3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .4 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Maximum conduit fill not to exceed 40%.
 - .4 Design drawings do not show conduit layout.
- .5 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

3.2 Temperature And Humidity Sensors

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Outdoor installation:
 - .1 Protect from solar radiation and wind effects by non-corroding shields.
 - .2 Install in NEMA 4 enclosures.
- .4 Duct installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
 - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
 - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
 - .2 Wire multiple sensors in series for low temperature protection applications.
 - .3 Wire multiple sensors separately for temperature measurement.
 - .4 Use software averaging algorithm to derive overall average for control purposes.
- .6 Thermowells: install for piping installations.
 - .1 Locate well in elbow where pipe diameter is less than well insertion length.

- .2 Thermowell to restrict flow by less than 30%.
- .3 Use thermal conducting paste inside wells.

3.3 Panels

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.4 Magnehelic Pressure Indicators

- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Departmental Representative.

3.5 Pressure And Differential Pressure Switches And Sensors

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
 - .1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.6 I/P Transducers

- .1 **Not Used**

3.7 Air Pressure Gauges

- .1 **Not used.**

3.8 Identification

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.9 Air Flow Measuring Stations

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.10 Testing And Commissioning

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION