
PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Section 25 05 03 - EMCS: Project Records Documents.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C12.7, Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13, Requirements for Instrument Transformers.
- .2 Canadian Standards Association
 - .1 CSA Type 1 Enclosure
 - .2 CSA Type 4X Enclosures
 - .3 CSA Type 12 Enclosures

1.3 SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- .1 Submit operating and maintenance data for inclusion in operation and maintenance manual in accordance with Section 25 05 03 - EMCS: Project Records Documents.

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. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.
- .3 Operating conditions: 0 - 32 EC 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 to be unaffected by external transmitters (eg. 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 CSA 4X enclosures.
- .8 Devices to be installed in user occupied space must not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 PRODUCTS SUPPLIED BY OWNER

- .1 The following are a complete list of products that are supplied by the owner and shall be utilized in this contract:

Material Description	Qty
cp-ipc	1
cp-expio	4
536RV005 Full Perf Pad	1
536RVASY Full Panel	1
D21-P SCR	19
HTESPCGS002 Wall Module	17
RC840/u	15
TR100VA001 100va Transformer	2
TR21/u	3

2.3 TEMPERATURE SENSORS

- .1 General: except for VAV box control to be resistance or thermocouple type to following requirements:
 - .1 Thermistors 10 K ohm, $\pm 0.2^{\circ}$ C accuracy, less than 0.1° C drift over 10 year span. Power supply 5 V dc, 10-35 Vdc, 24 Vac..
 - .2 RTD's: 1000 ohm at 0 EC (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohmEC.
 - .3 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 mm as indicated.
- .2 Sensors:
 - .1 Room type: wall mounting, in slotted type covers, LCD display $^{\circ}$ C or $^{\circ}$ F, with guard as indicated. Dual set point momentary push button, override switch.
 - .2 Room type for VAV boxes: as for room type, above. Include setpoint adjustment, local indication, push button override for night set back function.
 - .3 General purpose duct type: suitable for insertion into ducts at any angle, insertion length 460 mm.
 - .4 Averaging duct type: continuous filament with minimum immersion length 6000 mm. Bend probe at field installation time to 100 mm radius at any point along probe without degradation of performance.
 - .5 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 CSA 4X enclosure.
 - .6 Immersion type: spring loaded probe, NPT $\frac{1}{2}$ fitting insertion to suit pipe size.

2.4 TEMPERATURE TRANSMITTERS

- .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 ohm at 0 deg C, platinum resistance detector type sensors.
 - .2 Power supply: 575 ohms at 24 V DC into load of 575 ohms. Power supply effect less than 0.01° deg 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 ohm RTD sensor: not to exceed 22.5 mA.
 - .8 Integral zero and span adjustments.
 - .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 EC.

- .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 °C to plus 50 °C, plus or minus 0.5 °C.
 - .2 0 to 100 °C, plus or minus 0.5 °C.
 - .3 0 to 50 °C, plus or minus 0.25 °C.
 - .4 0 to 25 °C, plus or minus 0.1 °C.
 - .5 10 to 35 °C, plus or minus 0.25 °C.

2.5 HUMIDITY SENSORS

- .1 Requirements:
 - .1 Range: 5 - 95 % RH minimum.
 - .2 Operating temperature range: -40°C to 85°C.
 - .3 Absolute accuracy:
 - .1 Duct sensors: plus or minus 5 %.
 - .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 Maintenance: by simple field method such as washing with solvent or mild detergent solution so as to remove anticipated airborne contaminants.
 - .6 Maximum sensor non-linearity: plus or minus 0.5% RH with defined curves.
 - .7 Room sensors: wall mounted as indicated.
 - .8 Duct mounted sensors: locate so that sensing element is between 1/3 and 2/3 distance across any duct dimension.
 - .9 Sensors to be unaffected by external transmitters such as walkie-talkies. Demonstrate to Department Representative.
 - .10 Power supply: 18-35 Vdc, 18-32 Vac with temperature sensor.

2.6 HUMIDITY TRANSMITTERS

- .1 Requirements:
 - .1 Input signal: from 1000 ohm RTD.
 - .2 Output signal: 4 - 20 mA into 1000 ohm maximum load, 0-5 Vdc, 0-10 Vdc.
 - .3 Input and output short circuit and open circuit protection.
 - .4 Output accuracy: not to exceed 0.1 % of full span.
 - .5 Output linearity error: plus or minus 1.0 % maximum of full scale output.
 - .6 Integral zero and span adjustment.
 - .7 Temperature range: 0-70°C, -40°C to 85°C for outside air.
 - .8 Long term output drift: not to exceed 0.25 % of full scale output/ 6 months.

2.7 PRESSURE/CURRENT (P/I) TRANSMITTERS

- .1 Requirements:

- .1 Range: as indicated in I/O summaries.
 - .1 Pressure sensing elements: bourdon tube, bellows or diaphragm type.
 - .2 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA, 0-5V, 0-10V.
- .3 Output variations: ± 1 % 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 1% of full scale output over entire range.
- .5 Integral zero and span adjustment.
- .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 EC.
- .7 Over-pressure input protection to at least twice rated input pressure.
- .8 Output short circuit and open circuit protection.
- .9 Pressure ranges: see I/O Summaries.
- .10 Accuracy: plus or minus 1 % of full scale.
- .11 LCD Display.

2.8 DIFFERENTIAL PRESSURE (KPA) TRANSMITTERS

- .1 Requirements:
 - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
 - .2 Output signal: 4 - 20 mA, 0-5V, 0-10V.
 - .3 Output variations: ± 1 % 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 1 % of full scale output over entire range.
 - .5 Integral zero and span adjustment.
 - .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 EC.
 - .7 Over-pressure input protection to at least twice rated input pressure.
 - .8 Output short circuit and open circuit protection.
 - .9 The unit to have a NPT connections. The enclosure shall be an integral part of the unit.
 - .10 LCD Display.

2.9 DIFFERENTIAL PRESSURE (PA) TRANSMITTERS

- .1 Requirements:
 - .1 Output signal: 4 - 20 mA in 400 ohms, 0-5V into 5K ohms minimum, 0-10 V into 10K ohms minimum.
 - .2 Output variations: ± 1 % full scale for supply voltage variations of plus or minus 10%.
 - .3 Integral zero and span adjustment.

- .4 Temperature effects: not to exceed plus or minus 3% full scale/ 50 C.
- .5 Output short circuit and open circuit protection.
- .6 The unit to have a NPT ½ conduit connection. The enclosure shall be an integral part of the unit.
- .7 Pressure ranges: see I/O Summaries.
- .8 LCD Display.

2.10 FAN SYSTEM STATIC PRESSURE SENSORS

- .1 As per 2.10

2.11 FAN SYSTEM STATIC PRESSURE TRANSMITTERS

- .1 Requirements:
 - .1 Output signal: 4 - 20 mA in 400 ohms, 0-5V into 5K ohms minimum, 0-10 V into 10K ohms minimum.
 - .2 Output variations: $\pm 1\%$ full scale for supply voltage variations of plus or minus 10%.
 - .3 Integral zero and span adjustment.
 - .4 Temperature effects: not to exceed plus or minus 3% full scale/ 50 C.
 - .5 Output short circuit and open circuit protection.
 - .6 The unit to have a NPT ½ conduit connection. The enclosure shall be an integral part of the unit.
 - .7 Pressure ranges: see I/O Summaries.
 - .8 LCD Display.

2.12 DUCT SYSTEM 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: 37 Pa at 1000 m/s.
 - .3 Accuracy: plus or minus 1 % of actual duct velocity.

2.13 FAN SYSTEM VELOCITY PRESSURE TRANSMITTERS

- .1 Requirements:
 - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
 - .2 Calibrated span: not to exceed 25 % 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 The unit to have a NPT ½ conduit connection. The enclosure shall be an integral part of the unit.

2.14 TURBINE FLOW METERS

.1 Requirements:

- .1 Flow range: as specified in I/O summaries.
- .2 Pressure rating: 1035 kPa (gauge) at 38 EC.
- .3 Temperature rating: 5 to 260 EC.
- .4 Repeatability: plus or minus 0.1 %.
- .5 Accuracy and linearity: plus or minus 0.5 %.
- .6 Flow rangability: at least 10:1.
- .7 Output voltage: 30 to 300 mV peak-to-peak into 10 Kohm load.
- .8 Body material: brass, bronze or cast iron.
- .9 Ends:
 - .1 NPS 2 and under: screwed or flanged
 - .2 NPS 2 1/2 and over: flanged.

2.15 FREQUENCY-TO-DC TRANSMITTERS FOR TURBINE METERS

.1 Requirements:

- .1 Input: greater than 5000 ohm.
 - .1 Range: greater than 100 mV less than 20 V peak-to-peak, 200 through 400 Hz.
- .2 Span adjustment: fully adjustable.
- .3 Zero adjustment: 0 to 10% of output.
- .4 Output: 4 to 20 mA into 500 ohm load.
- .5 Load effect: plus or minus 0.1 % of span zero to maximum load resistance.
- .6 Linearity and repeatability: plus or minus 0.05 % of span.
- .7 Power input: 24 V DC plus or minus 10 %.
- .8 Input, output and power input transformer isolated.
- .9 Enclosure: general purpose CSA 1.

2.16 PRESSURE AND DIFFERENTIAL PRESSURE SENSORS AND SWITCHES

.1 Requirements:

- .1 Range: as indicated in I/O summaries.
 - .1 Pressure sensing elements: bourdon tube, bellows or diaphragm type.
- .2 Adjustable setpoint and differential.
- .3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.
- .4 Sensor 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 sensor pressure and accuracy ratings:
 - .1 Chilled and condenser water: 860 kPa.
 - .2 Hot water: 860 kPa.
 - .3 Low pressure steam, compressed air: 1050 kPa. Range: 0 to 200 kPa. Accuracy: plus or minus 3 kPa.
 - .4 Medium pressure steam, compressed air: 1050 kPa. Range: 0 to 700 kPa. Accuracy: plus or minus 7 kPa.
 - .5 High pressure steam: 2100 kPa. Range: 0 to 2100 kPa. Accuracy: plus or minus 14 kPa.
 - .6 High temperature water: 2700 kPa. Range: 0-2700 kPa. Accuracy: plus or minus 25 kPa.
 - .7 For fan operation: Range: 0 to 3000 Pa. Adjustable differential: 10 to 300 Pa.
- .7 Provide sensors with isolation valve and snubber between sensor and pressure source on liquid service.
- .8 Sensors on steam and high temperature hot water service: provide pigtail syphon.

2.17 TEMPERATURE SWITCHES

- .1 Requirements:
 - .1 Range: see I/O summaries.
 - .2 Temperature sensor: liquid, vapour or bimetallic type. Operate automatically. Reset automatically, except as follows:
 - .1 Freeze protection: manual reset. Optional if software does not auto restart.
 - .2 Fire detection: manual reset. Optional if software does not auto restart.
 - .3 Duct Heater: high limit manual reset in addition to automatic reset.
 - .3 Adjustable setpoint and differential.
 - .4 Accuracy: plus or minus 1 EC.
 - .5 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.
 - .6 Type as follows:
 - .1 Room: for wall mounting on standard electrical box with or without protective guard as indicated.
 - .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 Freeze detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 300 mm length.
 - .5 Strap-on: with helical screw stainless steel clamp.

2.18 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 EC.
- .4 Mechanical switch or snap action contacts rated 15 amp at 120 V.
- .5 Adjustable setpoint and differential.

2.19 LIQUID LEVEL SWITCHES

.1 Requirements:

- .1 Liquid level activated switch sealed in waterproof and shockproof enclosure.
- .2 Complete with float, flexible cord, weight. Instrument casing to be suitable for immersion in measured liquid.
- .3 N.O./N.C. Contacts rated at 15 amps at 120V AC. CSA approval for up to 250 volt 10 amps AC.

2.20 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 Anemometer range: 0-360° 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 signal: 4 to 20 mA into 500 ohm load.
 - .5 Provide two output signals: velocity, direction.
 - .6 Mast: aluminum, size and height as indicated. Provide at least 3 stainless steel guys, turnbuckles, anchor bolts. Follow manufacturers installation guidelines. Lightning protection as indicated on electrical drawings.

2.21 SOLAR SENSORS

- .1 Monitor solar irradiation as indicated.
- .2 Pyranometer, black and white, producing proportional 0-50 mV signal. Include converter for 4-20 mA signal.

2.22 CURRENT/PNEUMATIC (I/P) TRANSDUCERS

.1 Requirements:

- .1 Input range: 4 to 20 mA.
- .2 Output range: proportional 20-104 kPa.
- .3 Housing: dustproof or panel mounted.
- .4 Internal materials: suitable for continuous contact with industrial standard instrument air.
- .5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 2 % of full scale over entire range.
- .6 Integral zero and span adjustment.
- .7 Temperature effect: plus or minus 2.0 % full scale/ 50 EC or less.
- .8 Regulated supply pressure: 206 kPa maximum.
- .9 Air consumption: 16.5 ml/s maximum.
- .10 Integral gauge manifold c/w gauge (0-206 kPa).

2.23 SOLENOID CONTROL AIR VALVES

- .1 Coil: 120V AC or 24V DC, as indicated.
- .2 Complete with manual over-ride.
- .3 Shall have the capacity to pass .07 l/s air at 104 kPa differential.

2.24 AIR PRESSURE GAUGES

- .1 Diameter: 38 mm minimum.
- .2 Range: zero to two times operating pressure of measured pressure media to nearest standard range.

2.25 ELECTRICAL RELAYS

.1 Requirements:

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

2.26 SOLID STATE RELAYS

.1 Requirements:

- .1 CSA approved.
- .2 Suitable to the application as recommended by manufacturer.
- .3 Voltage range: 75-265 VAC
- .4 Panel mounting.

- .5 Suitable for AC or DC loads.
- .6 Output surge absorbing element for inductive on/off loads.
- .7 Input capacitor/resistor circuit for pulse noise absorption.
- .8 For input inductive noise use twisted-pair wires for electromagnetic noise and shielded cable for static noise.

2.27 CURRENT TRANSDUCERS

- .1 Requirements:
 - .1 Range: in accordance with Equipment Schedules.
 - .2 Purpose: measure line current and produce proportional signal in one of following ranges:
 - .1 4-20 mA DC.
 - .2 0-5 volt DC.
 - .3 0-10 volts DC.
 - .4 2-10 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 the MCC or starter enclosure.

2.28 CURRENT SENSING RELAYS

- .1 Requirements:
 - .1 Complete with metering transformer ranged to match load, plug-in base and shorting shunt to protect current transformer when relay is removed from socket.
 - .2 Suitable for single or 3 phase metering into single relay.
 - .3 To have adjustable latch level, adjustable delay on latch and minimum differential of 10 % of latch setting between latch level and release level.
 - .4 3-Phase application: provide for discrimination between phases.
 - .5 To have adjustable latch level to allow detection of worst case selection. To be powered from control circuit of motor starter being metered. Relay and base to be mounted in adjacent auxiliary cabinet only if control circuit power to be brought into auxiliary cabinet. Adjustments to be acceptable from auxiliary cabinet.
 - .6 Relay contacts: capable of handling 10 amps at 240 V AC.

2.29 CONTROL DAMPERS

- .1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 2438 mm high. Multiple sections to have stiffening mullions and jack shafts.
- .2 Materials
 - .1 Frame: 2.3 mm minimum thickness galvanized steel.

- .2 Blades: galvanized steel with two sheets 0.5 mm thick or otherwise reinforced to ensure specified low leakage when fully closed.
- .3 Bearings: oil impregnated sintered bronze. Provide thrust bearings for vertical blades.
- .4 Linkage and shafts: zinc plated steel.
- .5 Seals: replaceable neoprene or stainless steel spring on sides, top, bottom of frame, along all blade edges and blade ends.
- .3 Performance:
 - .1 Capacity: refer to I/O Summaries.
 - .2 0.02 L/s.m 2 maximum allowable leakage against 1000 Pa static pressure.
 - .3 Temperature range: minus 50°C to plus 100°C.
 - .4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.

2.30 PNEUMATIC CONTROL DAMPER OPERATORS

- .1 Requirements:
 - .1 Piston type with spring return for "fail-safe" in Normally Open or Normally Closed position, as indicated.
 - .2 Operator: size so as to control dampers against maximum pressure or dynamic closing pressure (whichever is greater).
 - .3 Adjustable spring and stroke external stops to limit strokes in either direction.
 - .4 Full relay type positioner with interconnecting linkage for mechanical feedback of actual damper position.
 - .5 Multiple section dampers over 1200 mm long: to be driven from both ends.

2.31 ELECTRONIC CONTROL DAMPER OPERATORS

- .1 Requirements
 - .1 Push-pull proportional type as indicated.
 - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
 - .3 Operator: size so as to control dampers against maximum pressure or dynamic closing pressure (whichever is greater).
 - .4 Power requirements: 5 VA maximum at 24 V AC.
 - .5 Operating range: 4-20 mA, 0-10 V DC, 2-10 V DC..

2.32 CONTROL VALVES

- .1 Requirements:
 - .1 NPS 2 and under: bronze with screwed ends.
 - .2 NPS 2 1/2 and over: cast iron with flanged ends.
 - .3 Trim: type 316 stainless steel.
 - .4 Leakage: 0.5 % of rated flow maximum.

- .5 Two or three port as indicated. Normally Open or Normally Closed, as indicated.
- .6 Flow characteristics: linear or equal percentage as indicated.
- .7 Rangeability: 50:1 minimum.
- .8 Performance: Capacity refer to I/O Summaries and Valve Schedule.

2.33 PNEUMATIC VALVE ACTUATORS

.1 Requirements:

- .1 Construction: steel, cast iron, aluminum.
- .2 Diaphragm: moulded Buna-N rubber, nylon reinforced.
- .3 Spring return to normal position.
- .4 Spring range adjustment and position indicator.

2.34 ELECTRONIC/ELECTRIC VALVE ACTUATORS

.1 Requirements:

- .1 Construction: steel, cast iron, aluminum.
- .2 Control voltage: 0-5, 0-10, 2-10V DC, or 4-20 mA.
- .3 Positioning time: to suit application, 90 sec maximum.
- .4 Spring return to normal position as indicated.

2.35 WATTHOUR METERS AND CURRENT TRANSFORMERS

.1 Requirements:

- .1 Include three phases, test and terminal blocks for watthour meter connections and connections to FID for monitoring of current. Provide three potentiometer transformers for 600 V 4 wire systems for watthour meter use. Accuracy: plus or minus 0.25 % of full scale. For chiller applications: To have instantaneous indicator with analog or digital display.
- .2 Watthour meter sockets: to ANSI C12.7.
- .3 Potentiometer 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.

2.36 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.

2.37 PANELS

- .1 Either free-standing or wall mounted enameled steel cabinets with hinged and key-locked front door.
- .2 To be modular multiple panels as required to handle requirements with additional space to accommodate future capacity as required by Owner's Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.38 CONTROL AIR COMPRESSOR STATIONS

- .1 Requirements: Provide 2 high pressure, compressors, receiver mounted, base mounted, each complete with belts, guards, intake muffler, replaceable cartridge intake cleaner, starter, pressure switches, alternator.
- .2 Capacity: size to maintain air pressure, meet all control air requirements on 25 % maximum running time.
- .3 Receiver: size to suit running time. Complete with automatic drain, pressure relief valve, pressure gauge ASME code rated for 1400 kPa.
- .4 Vibration isolation: 5 % transmissibility.
- .5 Refrigerated air drier:
 - .1 2 continuous operating type, complete with refrigerant evaporator, mechanical condensate separator, installed with 2 isolating valves. Designed for 1400 kPa maximum operating pressure.
 - .2 Capacity: sized for full capacity of air compressors, to reduce dewpoint to minus 10EC when dehydrating at 700 kPa. Maximum pressure drop 19 kPa at rated capacity.
 - .3 Provide 2 filter and PRV assemblies, with isolating valves and filter element, having 99% efficiency in removal of 0.5 micron diameter solid particles and oil aerosols and with indication of degree of saturation. Piping to be such that one dryer is always in circuit and active.

2.39 ELECTRONIC VAV TERMINAL CONTROL BOX

- .1 Terminal box sized to deliver air quantities as per mechanical VAV Box Schedule.
- .2 Box complete with factory installed averaging air velocity sensor.
 - .1 Provide removable air flow sensor with minimum 4 point sensing with +/- 5% accuracy at 10 deg C to 35 deg C and 40 to 1000 l/s.

- .3 Box to include direct damper shaft mounted actuator, of the non stall, full linear with position feedback type. Actuator to de-energize when at desired position.
- .4 Box to be complete with power transformer and control wiring to damper actuator and termination terminals for room sensors and other specified sensors and auxiliary devices.
- .5 Box to include VAV Controller as described in Section 25 30 01-EMCS: Building Controllers with appropriate mounting plate and protective cover.

2.40 ELECTRONIC AIR FLOW MEASUREMENT STATIONS AND TRANSMITTERS

- .1 Each station to contain an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. The velocity sensing elements to be of the thermal, temperature compensated thermistor type, with linearizing means. The sensing elements to be distributed across the duct cross section in the quantity and pattern set forth for measurements and instruments of ASHRAE and SMACNA for the traversing of ducted air flows. The resistance to air flow through the airflow measurement station not to exceed 20 Pa gauge at an airflow of 10 m/s. Station construction suitable for operation at airflows of up to 25 m/s over a temperature range of 5 to 50 degrees C, and accuracy plus or minus 3 percent over a range of 0.625 to 12.5 m/s scaled to air volume.
- .2 Transmitters to produce a linear, temperature compensated 4-20 mAdc output corresponding to the required velocity pressure measurement. The transmitter to be a 2-wire, loop powered device with local indication where indicated. The output error of the transmitter not to exceed 0.5 percent of the calibrated measurement.

PART 3 EXECUTION.

3.1 INSTALLATION

- .1 Install field control devices, conduit and wire in accordance with manufacturers recommended methods, procedures and instructions. Wiring and conduit above 50 volts by electrical Division. Coordinate requirements with Electrical Contactor.
- .2 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in CSA 2 enclosures or as required for specific applications. Provide for electrolytic isolation in all cases when dissimilar metals make contact.
- .3 Support field-mounted transmitters, sensors on pipe stands or channel brackets.
- .4 Install wall mounted devices on plywood panel properly attached to wall.

3.2 TEMPERATURE AND HUMIDITY SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.

- .2 To be readily accessible and adaptable to each type of application so as 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 stainless steel shields.
 - .2 Install in CSA 4X enclosures.
- .4 Duct installations
 - .1 Do not mount in dead air space.
 - .2 Location to be 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 so as to respond to air temperature only.
 - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors:
 - .1 Sensor length to be not less than 1000 mm per square metre of duct cross-sectional area.
 - .2 Use multiple sensors where single sensor does not meet minimum length ratio. Wire multiple sensors in series for freeze protection applications.
 - .3 Wire multiple sensors separately for temperature measurement.
 - .4 Use either software averaging algorithm to derive overall average for control purposes or separate inputs, based on site requirements.
- .6 Thermowells: install for piping installations. Where pipe diameter is less than well insertion length, locate well in elbow. Thermowell to restrict flow by less than 30%.

3.3 PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Use modular multiple panels if necessary to handle all requirements, with space for additional 20% PCU or FID if applicable without adding additional panels. Space to accommodate maximum capacity of associated controller (ECU, LCU, MCU, PCU, TCU).
- .3 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .4 Identify wiring and conduit clearly.

3.4 MAGNEHELIC PRESSURE INDICATORS

- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensors (as approved by the Owner's Representative).
- .2 Locations to be as indicated or specified.

3.5 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

- .1 Install isolation valve and snubber on sensors between sensor and pressure source. In addition, protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.6 I/P TRANSDUCERS

- .1 Install air pressure gauge on outlet.

3.7 PRESSURE GAUGES

- .1 Install on pneumatic systems only.
- .2 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.
- .3 Install pressure gauge on output of controller and auxiliary cabinet pneumatic devices.

3.8 AIR PRESSURE GAUGES

- .1 Install on pneumatic systems only.
- .2 Install on pneumatic devices including I/P's, pilot positioners, motor operators.

3.9 PNEUMATIC VALVE ACTUATORS

- .1 Install full relay type positioner having interlocking linkage for mechanical feedback of actual valve position on all modulating valves except radiation and unit heaters.

3.10 TANK LEVEL SWITCHES

- .1 Mount in top of tank in threaded coupling.

3.11 LIQUID LEVEL SWITCHES

- .1 Suspend float in sump from flexible cord and with weight mounted not more than 50 mm above switch.

3.12 IDENTIFICATION

- .1 Identify field devices properly.
- .2 Refer to Section 25 05 54 - EMCS: Identification.

3.13 AIR FLOW MEASURING STATIONS

- .1 Cap manifold until cleaning of ducts is completed.

3.14 TESTING

- .1 Calibrate and test field devices for accuracy and performance. Submit report detailing tests performed, results obtained to Department Representative for approval. Owner's Representative will verify results at random. Provide testing equipment and manpower necessary for this verification.

3.15 COMMISSIONING

- .1 Refer to Section 25 08 20 - EMCS: Warranty and Maintenance.

END OF SECTION