Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, valve actuators, low voltage current transformers.

.2 Related Sections:

.1 Section 23 33 15 - Dampers - Operating.

.2 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.

.3 Section 25 05 01 - EMCS: General Requirements.

.4 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.5 Section 25 05 54 - EMCS: Identification.

.6 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

.7 Section 26 05 00 - Common Work Results for Electrical.

.8 Section 26 27 26 - Wiring Devices.

1.2 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 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions for specified equipment and devices.

1.3 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.

Part 2 Products

2.1 PRECISION OF TRANSMISSION

.1 The complete transmission system shall have a minimum accuracy of:

.1 ± 0.5 °C (± 1 °F) in all cases;

.2 ± 3% R.H. in all cases.

.2 This accuracy shall correspond to cumulate accuracies of transmitters, converters transmission lines, amplifiers, coders, decoders and indicators.

2.2 ELECTRONIC AND/OR NUMERICAL TRANSMITTERS

.1 General

.1 Equipped with the necessary elements to allow a linear transmission along the entire transmission range. They shall be of sturdy construction and allow easy access. They must be compatible with controllers.

.2 Sensors and transmitters must not be affected by external signal such as portable transceiver.

.2 Temperature

.1 Ambient temperature sensors or transmitter must be wall-mounted with slotted covers and protected as per indications.

.2 Temperature sensors and transmitters inside air ducts must be mountable on different orientations. Their length must be sufficient to allow for a temperature reading at the center of the duct.

.3 Transmitters located in mixing boxes shall be long enough to allow proper sampling.

.4 Outside temperature sensors or transmitters must be protected from the wind and the sun by rust proof baffles. They must have a threaded fitting to receive a conduit from a watertight junction box, type NEMA 4.

.5 Temperature transmitter must minimally have the following characteristics:

.1 Integrated a zero adjustments and a range adjustments;

.2 Smallest temperature range suitable for the specified usage. As an example:

.1 - 40 to 60 °C (- 40 to 140 °F) for the outside temperature;

.2 0 à 50 °C (32 à 122 °F) for outside supply air temperature, for room temperature and for chilled water;

.3 0 to 100 °C (32 to 212 °F) for hot water.

.6 Precision: ± 0.5 °C (± 1 °F).

.3 Relative humidity

.1 Supply transmitters with all necessary components to compensate for anticipated temperature variations at reading location.

.2 Incorporated device to adjust the zero and the measuring range:

.1 Minimum range 5 to 95% R.H.;

.2 Precision: ± 3% R.H.

.4 Pressure differential

.1 Sensor must measure pressure differentials. It must be built to resist maximum pressures even if one line is not connected.

.2 Material shall be corrosion resistant independently of the carried media.

.3 Incorporated device to adjust the zero and the measuring range.

.4 Precision: ± 1% of the scale.

.5 Pressure

.1 Operating from a pressure differential, to be selected to ensure proper operations at all time.

.2 Entrance protection against overpressure to at least twice the normal entering pressure.

.3 Material shall be corrosion resistant independently of the carried media.

.4 Incorporated device to adjust the zero and the measuring range.

.5 Precision: ± 1% of the scale.

.6 Current

.1 Combined sensor/transducer, to measure line current and produce proportional signal.

.1 Precision: ± 2% of scale.

.2 Field adjustable range to suit motor applications.

.3 Acceptable products: Veris or approved equivalent.

.7 Water flow meter

.1 Equipped with a measuring tube and transmitter with integrated power supply. Precision must be ± 2% of the nominal value indicated on diagrams. Response must be linear up to 5% of nominal flow indicated on diagrams.

.2 These devices shall be an electromagnetic flow meter of the industrial type.

.3 The transmitter must have a 4 to 20 mA output signal compatible with the building automation system.

.4 Equipped with a flanged stainless steel measuring tube.

.5 Acceptable products: Proline Promag Endress & Hauser or approved equivalent.

.8 Air flow measuring station

.1 Air flow measuring station to be installed in ventilation duct or in the inlet of the fan as required.

.2 The precision of the arrangement (flow measuring station and transmitter) shall be ± 2 % of scale.

.3 The unit start-up must be executed by a manufacturer’s qualified technician.

.4 Acceptable products: Air Monitor, Brandt, Ebtron or approved equivalent.

.9 Carbon dioxide

.1 Continuous CO2 level transmitter using the principle of non-dispersive infrared. Scale from 0 to 2000 PPM with ± 3 % accuracy. Output signal: 0 to 10 V d.c. or 4 to 20 mA.

.2 The unit includes a sampling tube, analyser and transmitter installed in a ventilated case for wall or duct mounting.

.3 Acceptable products: Honeywell IAQ Point, Armstrong AMC-310 or approved equivalent.

.10 CO and NO2 detection

.1 Transmitter with appropriate sensor, with microprocessor, temperature compensation and analog output. Local unit with local audible alarm and alarm relay, 4 to 20 mA output signal, UL and CSA. . The unit, including the analyzer and the transmitter shall be installed in a wall-mounted enclosure.

.2 Visual indication:

.1 Supply;

.2 Alarm;

.3 Defect.

.3 Electrochemical cell for CO detection, range from 0 to 250 ppm at ± 3%.

.1 Alarm levels:

.1 Alarm 1st level: 25 PPM;

.2 Alarm 2nd level: 200 PPM.

.4 Electrochemical cell for NO2 detection, range from 0 to 10 ppm at ± 3%

.1 Alarm levels:

.1 Alarm 1st level: 0.72 PPM;

.2 Alarm 2nd level: 2 PPM.

.5 Acceptable products: Honeywell Analytics, Armstrong AMC or approved equivalent.

.11 Refrigeration Gas Detector

.1 Monitor with infrared sensor, microprocessor, temperature compensation and analog output. Scale from 0 to 1000 ppm with a resolution of 1 ppm. Central unit with display, keyboard, local audible alarm and alarm relay. Use a sufficient number of detectors to adequately cover the area.

.2 Designed for refrigerant R134A or R410A used in chillers.

.3 Visual indicator:

.1 Normal operation;

.2 First level alarm: 250 PPM;

.3 Second level alarm: 500 PPM;

.4 Malfunction.

.4 Alarm relays to BAS for control and remote supervision:

.1 First level alarm (activates emergency ventilation);

.2 Second level alarm (activates audible and visual alarm for room evacuation);

.3 Malfunction.

.5 Audible alarm:

.1 Audible alarm level of 10 dB higher than the surrounding sound level;

.2 A frequency differing to the fire alarm.

.6 Stroboscope

.1 Red color, distinct from fire alarm.

.7 Location of remote sound and stroboscope alarms

.1 In the chiller room, close to the chillers;

.2 Beside every door to the chiller room.

.8 Acceptable product: Honeywell Analytics VA301EM, Armstrong AMC or approved equivalent

2.3 THERMOMETRIC WELLS

.1 Provide the required wells. Provide them to the concerned Sections for their installation.

.2 The wells shall be made from Type 316 stainless steel.

2.4 ELECTRONIC ACTUATORS

.1 General

.1 Supply actuator with fastening devices as required.

.2 actuator must be proportional with a working range between 0 and 10 V c.c. or between 4 and 20 mA c.c, depending on the case.

.2 Control valve actuators

.1 All control valve actuators must be electronic DDC type. Except for terminal units, all control valve actuators must have a return spring to come back to their normal position on loss of power.

.2 Actuators for motorized valves for convectors may have modulating or floating, electronic or electric control.

.3 With indication on measurement scale of the actual position of the valve.

.3 Register actuators

.1 Install in sufficient quantity to ensure proper operation any time. Select actuators according to operating pressures and register dimensions. Install, on fresh air and on exhaust air registers, actuators corresponding to a 50% surface oversize.

.2 Actuators must be equipped with a return spring allowing registers to return to their specified positions in case of a failure.

.3 Provide auxiliary contacts to confirm full opening and closing of registers.

.4 VAV box actuators

.1 Actuators may have modulating or floating, electronic or electric control.

2.5 CONTROL VALVES

.1 General

.1 Valves shall be made of materials ensuring resistance to operating pressures and temperatures. Supply valves with linear characteristics for chilled water and steam services. Supply "equal percentage" valves for all other services. All 3 way valves shall be «equal percentage» type.

.2 All characteristics given on drawings to be considered, as follows:

.1 CV: theoretical result;

.2 D: diameter in millimetres (inches) for reference only.

.3 Normally open or normally closed valve as per indications.

.4 Stainless steel shaft.

.5 Trim and seat in a material compatible with specified use.

.6 Replaceable trim.

.7 Valve of nominal diameter less or equal to DN 2

.1 NPT thread conical sleeve;

.2 Class 250 as per ANSI specifications and bearing their approval seal.

.8 Valve of nominal diameter greater or equal to DN 2½

.1 Flanged ends;

.2 Class 150 or 250 as specified and as per ANSI specifications and bearing their approval seal.

.2 2-way: (RC2-)

.3 3-way: (RC3-)

.4 Selection

.1 Check all pressures and operating temperature pressure losses, specified flows to ensure accurate control and stable operation at all times. All calculations, results and operating pressures and closing pressures shall be handed to Engineer for verification. They are part of the shop drawings.

2.6 ELECTRICAL SWITCHES (I...)

.1 General

.1 Sealed electrical switch, activated by an adjustable mechanism linked to a detection sensor.

.2 Freezestat (IG-).

.1 Anti-freeze switch must open circuit when temperature falls below set point. Sensing element is 6 m (20') long and detects the lowest temperature point along the capillary length. Complete with manual reset device.

.3 Humidity (IH-)

.1 The switch must open its circuit when the humidity rises above the set point. The set point range goes from 15% H.R. to 95% H.R. with a 5% H.R differential.

.4 Pressure (IP-)

.1 Adjustable set point switch with SPDT contact. This switch opens its circuit on a rise or a drop in pressure. Detecting element is isolated from pressure source (steam, hot water, etc.).

.2 Entrance protection against overpressure to at least twice the normal entering pressure.

.3 Siphon tube protection for pressure switch on steam and on high temperature hot water.

.5 Level (IN-)

.1 SPDT contact switch sealed inside a waterproof case. This switch opens its circuit on water detection in the pan.

2.7 ELECTRONIC ROOM TEMPERATURE SENSOR

.1 Electronic sensor mounted in a compact casing equipped with a display window allowing to read the room temperature measured by the sensor. It also has a set point adjustment device in a pre-programmed range with + and – buttons. Furthermore, by pressing the + and – buttons, the set point appears temporarily for 5 seconds.

2.8 THERMOSTATS

.1 Line voltage room thermostats

.1 Line voltage wall mounted thermostat.

.2 22 A full load at 120 V.

.3 Temperature range from 10 to 25 °C.

.4 Single pole.

.5 Thermometer range from 10 to 25 °C.

.6 Scale divisions: OFF - 5 - 10 - 15 - 20 - 25 - °C.

2.9 LOCAL CONTROL PANELS (PCL-)

.1 The local control panels must be made of metal. The panels' dimensions must be sufficiently large to allow the installation of all control equipments inside. Each system's control panel must be located near the corresponding system.

.2 When several systems are part of a same lean-to, the controls can be grouped in the same area.

.3 Embed the concerned system's indicators on the front part on hinges. Mount on the front part of the panel a complete and detailed control diagram, covered in plastic.

.4 Install a pocket inside, in order to put the control diagram and the sequence of the corresponding system.

.5 Equip the front part with a key-lock device. Hand over two (2) keys to the Owner.

.6 The whole assembly must be CSA approved.

.7 Each cabinet and apparatus installed on the front panel must be clearly identified with a white ebonite plate with black writing.

.8 Each panel must be provided with the required metallic structure.

2.10 ELECTRIC RELAY

.1 Plug-in type with suitable mounting base. CSA approved and with sufficient contact capacity depending on application. Provided with dust proof casing and status light.

.1 Single pole relay, double throw (RESPDT-);

.2 Double pole relay, double throw (REDPDT-).

.2 Time delay relays (RET…)

.1 They are CSA approved and they shall have sufficient contact capacity depending on application. Provided with dust proof casing;

.2 They are of sturdy construction c/w desired time adjustment;

.3 Primarily of two types:

.1 on delay (RETOD-);

.2 off delay (RETFD-).

2.11 VARIABLE FREQUENCY SPEED CONTROLLERS

.1 Certifications

.1 Variable speed controllers shall be CSA or cUL approved.

.2 The complete unit including the cabinet, the speed controller, the bypass circuit and other components shall be CSA approved.

.2 Manufacturer’s shop drawings shall include:

.1 Dimensions and weights;

.2 Technical specifications;

.3 Wiring diagrams.

.3 Type of load

.1 The load is made up of variable torque centrifugal fans and centrifugal pumps.

.2 The speed controller shall operate adequately at all speeds. Verify with the system suppliers the motor starting and running torques at different speeds.

.3 The speed controller shall be capable of starting the system when the system is in forward or reverse rotation, at any speed. Should the controller not be capable of starting the unit when in reverse rotation, install breaking resistors on the D.C. bus to prevent system rotation when not energized.

.4 Cabinet

.1 Speed controller and bypass shall be installed in a NEMA 1 enclosure.

.2 The cabinet shall have ventilation slots to eliminate internal heat build-up.

.3 The cabinet shall be wall mount.

.4 It shall have hinged door with handle and lock and key.

.5 Equipped with safety switch complete with the possibility to lock the lever in the “open” position with padlocks.

.6 3-way selector “AUTO-OFF-BYPASS” which allows operation to be set as automatic control, or off-line for servicing or bypass mode should the UFD fail .

.7 The following components shall be shown on LCD display on the outer face of the door:

.1 “CONTROLLER RUNNING”;

.2 “CONTROLLER FAULT”;

.3 “MOTOR FAULT”;

.4 “BYPASS MODE”.

.5 Bypass circuit

.1 Should the speed controller fail, its bypass circuit shall permit the full voltage operation of the motor.

.2 Bypass circuit uses contactors to completely isolate the speed controller and allow the full voltage operation of the motor and servicing of the speed controller in the bypass mode.

.3 The bypass circuit shall have all the control elements to stop the motor from the stop control components described later.

.4 Speed controller and the bypass circuit with a common power supply.

.5 The motor circuit, when in the bypass mode, is protected against short-circuits by the fuses in the electrical distribution panel supply to the controller. Install internal fuses in the controller as required by the Codes/and/or the speed controller. Install class 20 overload heater in the bypass circuit to protect the motor.

.6 Speed controller

.1 Input characteristics:

.1	Voltage:	600 V a.c. ± 10%;
.2	Number of phases:	3;
.3	Frequency:	60 Hz ± 2 Hz;
.4	Input power factor minimum at any speed:	0.95;
.5	Efficiency:	0.95.

.2 Output characteristics

.1	Power:	HP according to indications;
.2	Voltage:	575 V;
.3	Frequency:	0 to 120 Hz;
.4	Maximum carrier frequency:	2 kHz;
.5	Waveform type:	PWM;
.6	Direct current:	100%;
.7	One minute peak current:	150%.

.3 The unit to be of the programmable microprocessor type with control panel and alphanumeric display.

.4 The following functions to be programmable:

.1 Starting and running frequencies;

.2 V/Hz ratio;

.3 Acceleration/deceleration;

.4 Boost;

.5 Speed.

.5 The following information to be displayed:

.1 Output voltage;

.2 % load;

.3 % speed;

.4 Ready to start;

.5 Operation in automatic mode or local mode.

.6 Unit protected against the following events which are displayed on the alphanumeric panel:

.1 Loss of phase;

.2 Under voltage;

.3 Over voltage;

.4 Overload;

.5 Short circuit;

.6 Ground fault;

.7 Overheating;

.8 Internal component failure.

.7 Environmental operating conditions:

.1	Ambient temperature:	0 to 40 °C (32 to 104 °F)
.2	Relative humidity (non condensing):	20 to 90% R.H.
.3	Altitude:	3300 feed (1000 m)

.7 Inductors

.1 A 3 % smoothing inductor on the d.c. bus and a 5% input inductance shall be supplied on all variable speed drives. Shunt type filters shall not be accepted. The total current harmonic distortion not to exceed 30% at the a.c. controller input of each controller.

.2 In order to reduce the wave reflexion between the controller and the motor, a 3% inductor shall be installed at the drive output if the motor is installed more them 10 m away from speed controller. Make standing wave tests and supply a written report showing the wave shapes on an oscilloscope with or without the inductor.

.8 Control signals

.1 The following control elements stop the motor when the speed controller or the bypass circuit drives it. Provide the necessary control circuits:

.1 Signal from the control panel:

.1 Start/stop signal.

.2 Control elements directly connected to the speed controller:

.1 Motor thermistors (Thermistor trip circuits to be compatible with the motor thermistors);

.2 Fire alarm contact;

.3 External protection (frost detection, disconnect auxiliary contact closing).

.2 The speed controller accepts the 0 to 10 V d.c. or 4 to 20 mA speed signal from the control panel and communicates with the control panel according to the BACnet MS/TP protocol.

.3 The following signals shall be transmitted to the control panel:

.1 Speed;

.2 Output frequency

.3 Unit fault contact;

.4 Bypass status contact (in bypass mode);

.5 Proof of operation contact obtained by a current reading on one phase of the motor circuit.

.9 Acceptable products:

.1 ABB, ACH 550

.2 Siemens, SED2;

.3 Danfoss, VLT;

.4 Trane, TR200;

.5 Allen-Bradley, Power Flex;

.6 Yaskawa, P1000 or Z1000.

2.12 WIRING

.1 In accordance with Section 26 27 10 - Modular Wiring System and 26 27 26 - Wiring Devices.

.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 Power wiring for field digital device: #18AWG.

.2 Analog input and output: #20 minimum stranded twisted pair.

Part 3 Execution

3.1 INSTALLATION

.1 Install all systems and their control systems according to verified shop drawings and in compliance to manufacturer’s recommendations. The installation must be done by qualified workers having a license issued by the Province of Québec.

.2 Install all conduits, cables, sleeves, outlet boxes, system cabinets, terminal boxes, anchoring, devices, etc. in accordance with requirements edicted in the electricity chapter of the building construction code and all appropriate sections in applicable local codes.

.3 Conduits installation

.1 Install conduits and cables parallel to building structural lines without interfering with equipment from other trades.

.2 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.

.4 Provide, install and connect every electrical interlock required between each motors in order to ensure proper sequences of operation as specified.

.5 Prewired equipments specified in other Sections are not included in this Section. In these cases, provide, install and perform all required connections from these equipments to their respective control panels.

.6 Provide, install and start-up softwares in the operator stations.

.7 Position of probes and thermostats shown on drawings are approximate and shall be used as a reference only. The exact position will be determined on-site.

.8 In no case, must the probe or room thermostat be affected by the sun or by any other source of heat or cold or by any air draft.

.9 When a probe or a thermostat has to be installed on a cold or hot wall, provide and install an insulated and ventilated base.

.10 Protect outside probes from any interaction with sun and wind with the use of rust proof screens.

.11 For temperature probes installed in a thermowell, fill the inside wall of the thermowell with a heat transfer agent.

.12 Install and connect gas detector and accessories as required by manufacturer.

.13 Provide and install an appropriate metallic support for any automation device installed on an insulated ventilation duct.

.14 Terminals controllers into finished room shall be installed inside metallic boxes. Theses boxes' cover shall hide the space between the metal and the construction around the boxes. The construction shall be approved by the Engineer and shall include a lock compatible with the institution nature.

.15 When allowed by code, install an isolation valve and a shock absorber between the pressure sensor and the measured pressure source:

.1 In steam and hot water networks, protect sensible elements with a siphon tube placed between the isolation valve and the sensors.

.16 Protect the air flow measuring station until the ducts are completely cleaned.

3.2 TESTS, CALIBRATION

.1 Calibration

.1 Calibrate all control equipments for perfect operation.

.2 Check and adjust controls. This shall be demonstrated to Engineer.

.3 Cooperation must be provided in tests and calibration of other Section devices and systems when interfacing with the present Section.

.2 Tests results acceptance will not relieve the Contractor's responsibility to ensure that all systems are conforming to the contract requirements.

3.3 START-UP

.1 Ensure that every control panel has been installed as per drawings and specifications and as per verified shop drawings before the start-up of the system.

.2 Once the installation is completed, test, adjust all the control, automation and security devices specified in this Section. The tests must include, at least the following:

.1 Using an outside probe, read and record temperature, humidity and/or static pressure for every control point of every system. Compare these values with the recorded values of every installed probe.

.2 Simulate every DI (digital input) to verify the settings and to ensure proper functioning of all contacts.

.3 Simulate every DO (digital output) to ensure proper functioning and to verify delays.

.4 Simulate every AO to ensure proper functioning of all controlled equipments, to verify proper shut-downs and to verify all signals.

.5 To optimize system performances, fine tune all PID values and, if required, modify logical sequences to better suit the installation needs.

.6 Simulate all freeze conditions and ensure proper operation sequences of all equipments. Also verify these controls when the outside temperature is below -18 °C (0 °F). These tests must be performed in the presence of the Engineer.

.7 Simulate all alarms for every control panel. These tests must be performed in the presence of the Engineer.

.8 Perform required corrections and adjustments and provide a fully functioning system to the Departmental Representative satisfaction.

.3 Coordinate start-up with the Departmental Representative to ensure the systems are available when required. Notify in writing the operation personnel of the commissioning calendar in order to have all the required authorized personnel and the Departmental Representative present during the whole process.

.4 Verify, test and bring online every sensor and control device.

.5 Demonstrate, in the presence of the Departmental Representative each programmed sequence and document results in writing. Any difference with the specifications and drawings and the real behavior will be documented, corrected and tested again.

.6 Document start-up work on the worksheets as per documentation good practices.

END OF SECTION