

PART 1 - GENERAL

- 1.1 SUMMARY .1 Related Sections:
- .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 25 05 54 - EMCS: Identification.
 - .3 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
- 1.2 REFERENCES .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
- .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE).
- .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA International).
- .1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
- .1 CEA-709.1-B-2002, Control Network Protocol Specification.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .1 Material Safety Data Sheets (MSDS).
- .7 Transport Canada (TC).
- .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 ACRONYMS AND
ABBREVIATIONS

.1 Acronyms used in EMCS:

- .1 AEL - Average Effectiveness Level.
- .2 AI - Analog Input.
- .3 AIT - Agreement on International Trade.
- .4 AO - Analog Output.
- .5 BACnet - Building Automation and Control Network.
- .6 BC(s) - Building Controller(s).
- .7 BECC - Building Environmental Control Center.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

1.4 DEFINITIONS

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
 - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
 - .2 Point Name: composed of two parts, point identifier and point expansion.
 - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
 - .1 Area descriptor: building or part of building where point is located.
 - .2 System descriptor: system that point is located on.
 - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
 - .2 Point expansion : comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
 - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
 - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
 - .3 Point Object Type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
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1.4 DEFINITIONS
(Cont'd)

- .3 Point Object Type:(Cont'd)
 - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
 - .1 Printouts: to ANSI/IEEE 260.1.
 - .2 Refer also to Section 25 05 54 - EMCS: Identification.

1.5 SYSTEM
DESCRIPTION

- .1 Refer to control schematics and for system architecture.
- .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
 - .1 Building Controllers.
 - .2 Control devices as listed in I/O point summary tables.
 - .3 OWS(s).
 - .4 Data communications equipment necessary to effect EMCS data transmission system.
 - .5 Field control devices.
 - .6 Software/Hardware complete with full documentation.
 - .7 Complete operating and maintenance manuals.
 - .8 Training of personnel.
 - .9 Acceptance tests, technical support during commissioning, full documentation.
 - .10 Wiring interface co-ordination of equipment supplied by others.
 - .11 Miscellaneous work as specified in these sections and as indicated.
- .3 Design Requirements:
 - .1 Design and provide conduit and wiring linking elements of system.
 - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.
 - .3 Location of controllers as reviewed by Departmental Representative Engineer Consultant prior to installation.
 - .4 Provide utility power to EMCS and emergency power to EMCS as indicated.
 - .5 Metric references: in accordance with CAN/CSA Z234.1.

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1.5 SYSTEM
DESCRIPTION
(Cont'd)

- .4 Language Operating Requirements:
 - .1 Provide English operator selectable access codes.
 - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
 - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
 - .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
 - .5 Include, in English:
 - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
 - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in French and English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.
 - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review:
 - .1 Equipment list and systems manufacturers at time of bid tender within 48 h after award of contract.
 - .2 List of existing field control devices to be re-used and included in bid tender, along with unit prices.

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1.6 SUBMITTALS
(Cont'd)

- .3 Quality Control:
- .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
 - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
 - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Submittals and Review Process. Label or listing of specified organization is acceptable evidence.
 - .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
 - .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
 - .6 Permits and fees: in accordance with general conditions of contract.
 - .7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative Engineer Consultant.
 - .8 Existing devices intended for re-use: submit test report.

1.7 QUALITY
ASSURANCE

- .1 Have local office within 100 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
- .2 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .3 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

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1.8 EXISTING
CONDITIONS -
CONTROL COMPONENTS

- .1 Utilize existing control wiring and piping as indicated.
- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
 - .1 Do not modify original design of existing devices without written permission from Departmental Representative.
 - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
 - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.
 - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .4 Non-functioning items:
 - .1 Provide with report specification sheets or written functional requirements to support findings.
 - .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
 - .1 Be responsible for items repaired or replaced by Departmental Representative.
 - .2 Be responsible for repair costs due to negligence or abuse of equipment.
 - .3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by Departmental Representative

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1.8 EXISTING
CONDITIONS -
CONTROL COMPONENTS
(Cont'd)

- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 MANUFACTURER'S
RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

3.2 PAINTING

- .1 Painting: in accordance with Section 09 91 99- Interior Painting, supplemented as follows:
- .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
 - .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
 - .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
 - .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes.
.1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).
.2 Related Sections.
.1 Section 01 33 00 - Submittal Procedures.
.2 Section 25 05 01 - EMCS: General Requirements.
.3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- 1.2 DEFINITIONS .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.
- 1.3 SUBMITTALS .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.
- 1.4 DETAIL SHOP DRAWING REVIEW .1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
.1 Wiring diagrams.
.2 Piping diagrams and hook-ups.
.3 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
.4 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
.1 Sensing element type and location.
.2 Transmitter type and range.
.3 Associated field wiring schematics, schedules and terminations. .. Pneumatic schematics and schedules
.4 Complete Point Name Lists.
.5 Setpoints, curves or graphs and alarm limits (high and low, 3 types

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1.4 DETAIL SHOP .1
DRAWING REVIEW .4
(Cont'd)

- (Cont'd)
- .4 (Cont'd)
 - .5 (Cont'd)
 - critical, cautionary and maintenance),
signal range.
 - .6 Software and programming details
associated with each point.
 - .7 Manufacturer's recommended
installation instructions and procedures.
 - .8 Input and output signal levels or
pressures where new system ties into
existing control equipment.
 - .5 Control schematics, narrative
description, CDL's fully showing and
describing automatic and manual procedure
required to achieve proper operation of
project, including under complete failure of
EMCS.
 - .6 Graphic system schematic displays of air
and water systems with point identifiers and
textual description of system, and typical
floor plans as specified.
 - .7 Complete system CDL's including
companion English language explanations on
same sheet but with different font and
italics. CDL's to contain specified energy
optimization programs.
 - .8 Listing and example of specified
reports.
 - .9 Listing of time of day schedules.
 - .10 Mark up to-scale construction drawing to
detail control room showing location of
equipment and operator work space.
 - .11 Type and size of memory with statement
of spare memory capacity.
 - .12 Full description of software programs
provided.
 - .13 Sample of "Operating Instructions
Manual" to be used for training purposes.
 - .14 Outline of proposed start-up and
verification procedures. Refer to Section
25 01 11 - EMCS: Start-up, Verification and
Commissioning.

PART 1 - GENERAL

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|-------------------------------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>1.1 SUMMARY</u> | .1 | Section Includes.
.1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.
.2 Related Sections.
.1 Section 01 33 00 - Submittal Procedures.
.2 Section 25 05 01 - EMCS: General Requirements. |
| <u>1.2 REFERENCES</u> | .1 | Canadian Standards Association (CSA International).
.1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations. |
| <u>1.3 DEFINITIONS</u> | .1 | For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements. |
| <u>1.4 SYSTEM DESCRIPTION</u> | .1 | Language Operating Requirements: provide identification for control items in English. |
| <u>1.5 SUBMITTALS</u> | .1 | Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.
.2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording. |
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PART 2 - PRODUCTS

2.1 NAMEPLATES FOR PANELS

- .1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 mm high, black.
- .4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by chain plastic tie.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by stick-on labels using point identifier.
- .2 Location: as directed by Departmental Representative.
- .3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative's.

2.5 WIRING

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 CONDUIT

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review".

PART 3 - EXECUTION

3.1 NAMEPLATES AND LABELS

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS

- .1 Correct existing nameplates and legends to reflect changes made during Work.

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|-----|-------------------------------------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.6 | CONTROL DAMPERS
(Cont'd) | .5 | Jack shafts:(Cont'd)
.4 Use same manufacturer as damper sections. |
| 2.7 | PNEUMATIC CONTROL DAMPER ACTUATORS | .1 | Requirements:

.1 Piston type with spring return for "fail-safe" in Normally Open or Normally Closed position, as indicated.
.2 Operator: size to control dampers against maximum pressure and dynamic opening/closing pressure, whichever is greater.
.3 Adjustable spring and stroke external stops to limit strokes in either direction.
.4 For modulating applications provide with full relay type positioner with interconnecting linkage for mechanical feedback. Adjust to operate between range of 20-90 kPa unless otherwise indicated in control sequence of operation or input/output summary sheet.
.5 Positioners not required on single damper sections with less than 1 m ² face area. |
| 2.8 | ELECTRONIC CONTROL DAMPER ACTUATORS | .1 | Requirements:

.1 Direct mount proportional type as indicated.
.2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
.3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
.4 Power requirements: 5 VA maximum at 24 V AC.
.5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
.6 For VAV box applications floating control type actuators may be used.
.7 Damper actuator to drive damper from full open to full closed in less than 120 seconds. |

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, and low voltage current transformers.
 - .2 Related Sections:
 - .1 Section 23 33 14 - Dampers - Balancing.
 - .2 Section 07 84 00 - Firestopping.
 - .3 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
 - .4 Section 25 05 01 - EMCS: General Requirements.
 - .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 01 - Common Work Results - Electrical.
 - .8 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B 148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
 - .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.

- 1.2 REFERENCES (Cont'd)
- .5 Canadian Standards Association (CSA International).
- .1 CSA-C22.1-02, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.
- 1.3 DEFINITIONS
- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.
- 1.4 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.
- 1.5 EXISTING CONDITIONS
- .1 Cutting and Patching: in accordance with Building Standards and Codes.
- .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. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant, assembly.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.
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2.1 GENERAL
(Cont'd)

- .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 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.
 - .2 Sensing element: hermetically sealed.
 - .3 Stem and tip construction: copper or type 304 stainless steel.
 - .4 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
- .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 Integral thermistor sensing element 10,000 ohm at 24 degrees.

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2.2 TEMPERATURE
SENSORS
(Cont'd)

- .2 (Cont'd)
 - .1 (Cont'd)
 - .4 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
 - .5 Stability 0.02 degrees C drift per year.
 - .6 Separate mounting base for ease of installation.
 - .2 Room temperature sensors.
 - .1 Wall mounting, in slotted type covers having brushed aluminum brushed stainless steel finish, with guard as indicated.
 - .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 or as indicated.
 - .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
SWITCHES

- .1 Requirements:
 - .1 Operate automatically. Reset automatically, except as follows:
 - .1 Low temperature detection: manual reset.
 - .2 High temperature detection: manual reset.
 - .2 Adjustable setpoint and differential.
 - .3 Accuracy: plus or minus 1 degrees C.
 - .4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.

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2.3 TEMPERATURE SWITCHES
(Cont'd)

- .1 Requirements:(Cont'd)
- .5 Type as follows:
 - .1 Room: for wall mounting on standard electrical box with 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 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.

2.4 ELECTROMECHANICAL 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

2.5 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.

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2.5 SOLID STATE
RELAYS
(Cont'd)

- .3 Output.
 - .1 AC or DC Output Model to suit application.

2.6 CONTROL
DAMPERS

- .1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 1219 mm high. Three or more sections to be operated by jack shafts.
- .2 Materials:
 - .1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.
 - .2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.
 - .3 Bearings: maintenance free, synthetic type of material.
 - .4 Linkage and shafts: aluminum, zinc and nickel plated steel.
 - .5 Seals: synthetic type, mechanically locked into blade edges.
 - .1 Frame seals: synthetic type, mechanically locked into frame sides.
- .3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.
 - .1 Size/Capacity: refer to damper schedule
 - .2 25 L/s/m² maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.
 - .3 Temperature range: minus 40 degrees C to plus 100 degrees 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.
- .5 Jack shafts:
 - .1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
 - .2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
 - .3 Install using manufacturers installation guidelines.

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- 2.9 CONTROL VALVES .1 Body: globe style, characterized ball.
- .1 Flow characteristic as indicated on control valve schedule: linear, equal percentage, quick opening.
 - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
 - .3 Normally open Normally closed, as indicated.
 - .4 Two Three port, as indicated.
 - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
 - .6 Packing easily replaceable.
 - .7 Stem, stainless steel.
 - .8 Plug and seat, stainless steel, brass, bronze.
 - .9 Disc, replaceable, material to suit application.
 - .10 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.
 - .11 NPS 2½ and larger:
 - .1 Flanged connections.
 - .2 Valves to ANSI Class 150 or 250 as indicated, 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 and wafer body installed in locations as indicated. For steam and heating water ANSI Class 150 carbon steel lugged body and wafer 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, aluminum bronze to ASTM B 148.
 - .6 Seat: for service on chilled water PTFE (polytetrafluoroethylene), EPDM (ethylene propylene diene monomer). For service on steam and heating water PTFE, RTFE (reinforced PTFE).
 - .7 Stem: 316 stainless steel.
 - .8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
 - .9 Flow characteristic linear.
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2.9 CONTROL VALVES .2
(Cont'd)

Butterfly Valves NPS 2 and larger:(Cont'd)
.10 Maximum flow requirement as indicated on control valve schedule.
.11 Maximum pressure drop as indicated on control valve schedule: pressure drop not to exceed one half of inlet pressure.
.12 Normally open Normally closed, as indicated.
.13 Valves are to be provided complete with mounting plate for installation of actuators.

2.10 PNEUMATIC .1
VALVE ACTUATORS

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.
.5 Provide pilot positioners on modulating control valves over 50 mm and where indicated on drawings and I/O summary. Positioners to operate between 20 to 90 kPa unless otherwise noted or required by sequence.
.6 Minimum shut-off pressure: refer to control valve schedule.

2.11 ELECTRONIC / .1
ELECTRIC VALVE
ACTUATORS

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.

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

- 2.13 WIRING
- .1 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
 - .2 Wiring must be continuous without joints.
 - .3 Sizes:
 - .1 Field wiring to digital device: #18AWG 20AWG stranded twisted pair.
 - .2 Analog input and output: shielded #18 minimum solid copper #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.

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3.1 INSTALLATION
(Cont'd)

- .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 01 - Common Work Results - Electrical.
 - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
 - .3 Refer to electrical control schematics included as part of control design schematics in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.
 - .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
 - .5 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.
 - .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative Engineer Consultant to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
- .7 Mechanical: supply and install:
 - .1 Pipe Taps.
 - .2 Wells and Control Valves.
 - .3 Air flow stations, dampers, and other devices.
- .8 VAV Terminal Units: supply, install and adjust as required.
 - .1 Air probe, actuator and associated vav controls.

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|---------------------------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3.1 <u>INSTALLATION</u>
(Cont'd) | .8 | VAV Terminal Units:(Cont'd)
.2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.
.3 Co-ordinate air flow adjustments with balancing trade. |
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| 3.2 <u>TEMPERATURE AND HUMIDITY SENSORS</u> | .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. |
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- 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 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.
- 3.5 AIR PRESSURE GAUGES
- .1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.
 - .2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.
- 3.6 IDENTIFICATION
- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.
- 3.7 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.

PART 1 - GENERAL

- 1.1 REFERENCES .1 Public Works and Government Services Canada (PWGSC) / Real Property Branch / Architectural and Engineering Services.
.1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English:
<ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>
- 1.2 SEQUENCING .1 Present sequencing of operations for systems, in accordance with MD13800 - Energy Management and Control Systems (EMCS) Design Manual.
.1 Re-use existing sequence of operations.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED .1 Not Used.