

1.0 GENERAL**.1 References and Related BCIT Standards**

- .1 Division 22 Plumbing.
- .2 Division 25 Integrated Automation.
- .3 Division 26 Electrical.

.2 Requirements

- .1 Control system must be BACnet compatible.

.3 Submittals

- .1 Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2 Product Data:
 - .1 Provide description and engineering data for each control system component and software module.
- .3 Shop Drawings:
 - .1 Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational of sequences.
 - .2 Submit valves schedule indicating size, flow, and pressure drop.
 - .3 For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- .4 Provide design data for control devices, sensors, damper, and valve operators.
- .5 Provide manufacturer's Instructions for manufactured components.
- .6 Provide Operation and Maintenance Data includes inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
- .7 Provide manufacturer's warranty.
- .8 Provide two (2) of each type of thermostat, exposed temperature sensor, and pipeline pressure sensor.

.4 Quality Assurance

- .1 Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five (5) years documented experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience approved by manufacturer.
- .3 Design system: Under design and direct supervision of a Professional Engineer and licensed in the Province of British Columbia.

Consultants are to provide complete specifications, and review these Technical Standards documents to include BCIT requirements within the specifications as applicable to the project.

- .4 Regulatory Requirements: Products Requiring Electrical Connection: Listed and classified by ULC and CSA.

.5 Project Conditions

- .1 Project Record Documents: Accurately record actual location of control components, including panels, thermostats, and sensors.
- .2 Weather Data: Import current weather and forecast data through BCIT Web software EntelliWeb to DDC System to enable control strategies.

.6 Warranty

- .1 Correct defective Work within a one (1) year period after Substantial Completion. Provide a complete parts and labour Warranty for the Warranty period.
- .2 Provide five (5) year manufacturer's warranty for Control Panels, Control Damper Actuators, and Control Valves and (1) Year of service and maintenance warranty of control system.
- .3 Provide complete service of controls systems, including call backs. Make minimum of four (4) complete normal inspections of approximately seven (7) hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports, during warranty period.

2.0 PRODUCTS

.1 Control Panels

- .1 Unitize cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.
- .2 NEMA 250, general purpose utility enclosures with enamelled finished face panel.
- .3 Each piece of equipment shall be controlled by its own controller to enable independent control in case of communication failure. All I/O points specified associated with particular equipment shall be integral to its controller.
- .4 Provide common keying for all panels.

.2 Control Valves

- .1 Belimo Ball Valves:
 - .1 Up to 50 mm Bronze body, bronze trim, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
 - .2 Over 50 mm Iron body, bronze trim, flanged ends, renewable seat and disc.
- .3 Hydronic Systems:

- .1 Rate for service pressure of 860 kPa at 121°C.
 - .2 Size for 20 kPa maximum pressure drop at design flow rate.
 - .3 Two-way valves with equal percentage characteristics, three-way valves with linear characteristics. Size two-way valve operators to close valves against pump shut off head.
- .2 Butterfly Pattern:
 - .1 Iron body, stainless steel disc, resilient replaceable seat for service to 121°C wafer or lug ends, extended neck.
 - .2 Hydronic Systems:
 - .1 Rate for service pressure of 860 kPa at 121°C.
 - .2 Size for 7 kPa maximum pressure drop at design flow rate.
- .3 Electronic Operators:
 - .1 Valves: spring return to normal position as indicated on freeze, fire, or temperature protection.
 - .2 Select operator for full shut off at maximum pump differential pressure.
- .4 Radiation Valves:
 - .1 Bronze body, bronze trim, two (2) or three (3) port as indicated, replaceable plugs and seats, union and threaded ends.
 - .2 Rate for service pressure of 860 kPa at 121°C.
 - .3 Size for 20 kPa maximum pressure drop at design flow rate.
 - .4 Two-way valves with equal percentage characteristics, three way valves with linear characteristics. Size two-way valve operators to close valves against pump shut off head.
 - .5 Operators (Two Position): Synchronous motor with enclosed gear train, dual return springs, valve position indicator; 24 v DC, 0.4 amp. Valves: Spring return to normal position for temperature protection.
 - .6 Operators (Modulating): Self-contained, linear motorized actuator with approximately 19mm stroke, 60 second full travel with transformer and SPDT contacts: 24 v DC, 6 watt maximum input.
- .3 Dampers
 - .1 Standard of Acceptance: Tamco 9000 series.
 - .2 Performance: Test to AMCA 500.

- .3 Frames: Galvanized steel welded or riveted with corner reinforcement, minimum 2.7mm (12 gauge).
- .4 Blades: Extruded aluminum, maximum blade size 150 mm wide, 1200 mm long, minimum 0.85mm (22 gauge) attached to minimum 13 mm shafts with set screws. Exposed shaft ends shall be saw-cut with black paint in saw-cut, aligned with damper blade for positive position indication.
- .5 Blade Seals: Neoprene inflatable, mechanically attached, field replaceable.
- .6 Jamb Seals: Spring stainless steel.
- .7 Shaft Bearings: Graphite impregnated nylon sleeve, with thrust washers at bearings.
- .8 Linkage Bearings: Graphite impregnated nylon.
- .9 Leakage: Less than 1/2% based on approach velocity of 10 m/sec and 1.0 kPa.
- .10 Maximum Pressure Differential: 1.5 kPa.
- .11 Temperature Limits: -40 to 93°C.

.4 Damper Operators

- .1 General: Provide smooth proportional control throughout its entire range with sufficient power for air velocities 20% greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two (2) position control and for fail safe operation. Provide Belimo brand actuators, or approved alternative.
- .2 Electric Operators: Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch, minimum position potentiometer, and 24 V dc, 24 va transformer, as required.
- .3 Number: Sufficient to achieve unrestricted movement throughout damper range. Provide one (1) damper operator for maximum 3.34 m2 damper section.

.5 Input / Output Sensors

- .1 Temperature:
 - .1 Resistance temperature detectors with resistance tolerance of plus or minus 0.1% at 21°C interchangeability less than plus or minus 0.2%, time constant of 13 seconds maximum for fluids and 200 seconds maximum for air.
 - .2 Measuring current maximum 5 mA with maximum self-heat of 0.017°C/mW (0.031°F/mW) in fluids and 0.008°C/mW (0.014°F/mW) in air.
 - .3 Provide two wire 10k thermistor type and shield for input bridge circuit.
 - .4 Use insertion elements in ducts not affected by temperature stratification or smaller than 1 m2. Use averaging elements where larger or prone to stratification sensor length 2.5 m (8 feet) or 5 m (16 feet) as required.

- .5 Insertion elements for liquids: with brass socket, minimum insertion length of 60mm.
- .6 Room sensors: Locking cover.
- .7 Outside air sensors: Watertight inlet fitting, shielded from direct rays of sun.
- .8 Room security sensors: Stainless steel cover plate with insulated back and security screws.
- .2 Humidity Sensors:
 - .1 Elements: Accurate within 5% full range with linear output.
 - .2 Room Sensors: With locking cover [matching pneumatic thermostats used], span of 10 to 80% relative humidity.
 - .3 Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 – 100% relative humidity.
- .3 Static Pressure Sensors:
 - .1 Unidirectional with ranges not exceeding 150% of maximum expected input.
 - .2 Temperature compensate with typical thermal error or 0.06% of full scale in temperature range of 5 to 40°C.
 - .3 Accuracy: 1% of full scale with repeatability 0.3%.
 - .4 Output: 0 - 5 vdc with power at 12 to 28 vdc.
- .4 Equipment Operation Sensors:
 - .1 Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 1250 Pa.
 - .2 Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 50 to 400 kPa.
 - .3 Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175% of rated motor current.
- .5 Damper Position Indication:
 - .1 Provide feedback from damper actuator to indicate actual damper position on DDC Controls Graphics.
- .6 Carbon Dioxide Detectors / Sensors:
 - .1 Manufacturer: AirSense™ Elite Beam Model 310e, or equal, no digital indication required.
 - .2 Technical data: For analogue output to DDC System.

Operating principle	Non-dispersive infrared (NDIR)
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Gas sampling method	Diffusion or available duct kit
Measurement range	0-2000 ppm
Repeatability	± 20 ppm
Measurement accuracy	± 5% of reading or 75 ppm, whichever is greater
Recommended calibration interval	5 years
Warm up time	Less than 1 minute
Power requirements	18 - 30 VDC or 18 - 28 VRMS AC
Power consumption	Less than 1 watt
Operating temperature range	0 - 50° Celsius
Operating humidity range	5 - 95% RH, non-condensing
Optional relay contact rating	3 Amps @ 24 VAC
Voltage output (linear)	V 0 - 10 VDC full scale standard. Range field adjustable from 1-10 VDC
Current output (linear)	4-20 mA (RLOOP : 400 maximum)
Optional relay setpoint range	0 to full scale

.7 Carbon Monoxide Detectors:

- .1 Single or multichannel dual level detectors, using solid state sensors with three (3) year minimum life. Sensor replacement time: maximum 15 minutes. Suitable over temperature range of -5 to 55°C.
- .2 Individual indicators for each level, initially calibrated for 50 ppm and 100 ppm for Warning and Alarm condition respectively.
- .3 Maximum response time to 100 ppm CO calibration gas: Two (2) minutes.

.6 Thermostats

.1 Electric Room Thermostats:

- .1 Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
- .2 Service: Cooling and heating.
- .3 Covers: Locking, with set point adjustment, set point indication, and digital space temperature readout.

.2 Line Voltage Thermostats:

- .1 Integral manual On/Off/Auto selector switch, single or two pole as required.
- .2 Dead band: Maximum 1°C.
- .3 Cover: Locking with set point adjustment, set point indication, and digital space temperature indication.
- .4 Rating: Motor load.

.3 Room Thermostat Accessories:

- .1 Thermostat Protective Covers: Cast Brushed aluminum.
- .2 Insulating Bases: For thermostats located on exterior walls.
- .3 Thermostat Guards: Cast metal mounted on separate base.

- .4 Adjusting Key: As required for device.
- .5 Aspirating Boxes: Where indicated for thermostats requiring flush installation.
- .4 Outdoor Reset Thermostats:
 - .1 Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable set point.
 - .2 Scale range: 2 to 35°C.
- .5 Immersion Thermostat:
 - .1 Remote bulb or bimetallic rod and tube type, proportional action with adjustable set point and adjustable throttling range.
- .6 Airstream Thermostats:
 - .1 Remote bulb or bimetallic rod and tube type, proportional action with adjustable set-point in middle of range and adjustable throttling range.
 - .2 Averaging service remote bulb element: 6 m.
- .7 Electric Low Limit Duct Thermostat:
 - .1 Snap acting, single pole, single throw, manual reset switch which trips if temperature sensed across any 300 mm of bulb length is equal to or below set point.
 - .2 Bulb length: Minimum 6 m.
 - .3 Provide one (1) thermostat for every 1.86 m² of coil surface.
- .8 Electric High Limit Duct Thermostat:
 - .1 Snap acting, single pole, single throw, manual reset switch which trips if temperature sensed across any 300 mm of bulb length is equal to or above set point.
 - .2 Bulb length: Minimum 6 m.
 - .3 Provide one (1) thermostat for every 1.86 m² of coil surface.
- .7 Transmitters**
 - .1 Building Static Pressure Transmitter:
 - .1 One (1) pipe, [direct acting, double bell] [differential type with temperature compensation, scale range 2.5 to 1500 kPa positive or negative, and sensitivity of 0.125 kPa Transmit electronic signal to receiver with matching scale range.
 - .2 Pressure Transmitters:

- .1 One (1) pipe direct acting indicating type for gas, liquid, or steam service, range suitable for system, proportional electronic output.
- .3 Temperature Transmitters:
 - .1 One (1) pipe, directly proportional output signal to measured variable, linearity within plus or minus 1/2% of range for 93°C span and plus or minus 1% for 10°C span, with 93°C temperature range, compensated bulb, averaging capillary, or rod and tube operation on 138 kPa (20 psig) input pressure and 20 to 100 kPa output.
- .4 Humidity Transmitters:
 - .1 One (1) pipe, directly proportioned output signal to measured variable, linearity within plus or minus 1% for 70% relative humidity span, capable of withstanding 95% relative humidity without loss of calibration.

3.0 EXECUTION

.1 Examination

- .1 Beginning of installation means installer accepts existing conditions.
- .2 Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- .3 Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- .4 Control cabling and wiring shall be run independently in conduits, and/or in separate raceways provided by the Controls Trade for their own use unless otherwise agreed or directed.

.2 Installation

- .1 Check and verify location of thermostats, humidistats and other exposed control sensors with plans and room details before installation.
 - .1 Locate 1200 mm above floor, unless otherwise noted on Architectural wall elevations.
 - .2 Align with lighting switches and humidistats.
 - .3 Do not install thermostats/room temperature sensors over top of, beside, or near dimmer switches or other lighting control switch banks. Do not install in middle of wall.
- .2 Mount freeze protection thermostats using flanges and element holders.
- .3 Mount outdoor reset thermostats sensing elements outdoors with sun shield, as necessary.
- .4 Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.

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- .5 Mount control panels serving specific main air handling units or large packaged equipment adjacent to associated equipment on vibration free walls or free standing angle iron supports.
 - .1 Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
 - .2 Install general control panels for services in main Mechanical Room unless noted otherwise.
 - .3 Route controls services back to main Mechanical Room, unless noted otherwise.
- .6 Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- .7 Provide conduit and electrical wiring to Division 26 Electrical standards.
 - .1 Do not place controls wiring in Division 26 Electrical cable trays unless prior written acceptance is obtained.
 - .2 Clearly label control wiring on maximum 3M centres that it is Controls Wiring and its service.

*** END OF INSTRUMENTATION AND CONTROLS FOR HVAC SECTION ***