

1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .3 Section 01 78 00 - Closeout Submittals
- .4 Section 21 05 01 – Common Work Results for Mechanical.
- .5 Section 22 05 00 – Common Work Results for Plumbing.
- .6 Section 23 05 93 – Testing and Balancing.
- .7 Section 23 31 00 – Air Distribution.
- .8 Electrical Sections – Division 26.

1.1 WORK BY OTHER SECTIONS

- .1 Section 22 05 00 (Plumbing Trade) to distribute and mount all pipe connected equipment including valves, immersion controllers, thermometers, flow switches etc. in their respective locations, as supervised by this Section.
- .2 Section 23 31 00 (Air Distribution) to distribute and mount all motorized dampers in their respective locations, as supervised by this Section.
- .3 Electrical wiring performed by Division 26:
 - .1 Electrical to supply and install all conduits, wire, & connections from the distribution panels to line side of magnetic starters and thermal overload switches. Including from load side of starters and switches to motors.
 - .2 Electrical to supply and install conduit, wire and connections for line voltage control devices on single phase equipment such as:
 - .1 Electrical thermostats, pressure electric switches, aquastats for unit heaters and force flow-heating units.
 - .2 Float switches, pressure switches, alternators for sump pumps, sewage pumps, etc. and other mechanical wiring required but not specified in this section of the specifications.
 - .3 All safety controls must be wired in series with both “HAND” and “AUTO” starter switch positions to ensure against damage to equipment and/or system.
 - .4 Normal and/or emergency power source wiring to Controls Systems panels and other devices or groups of devices requiring 120 volt normal and/or emergency power source.

- .5 All control wiring for boilers in accordance with wiring diagrams supplied by boiler manufacturer.

1.2 ELECTRICAL WIRING PERFORMED BY THIS SECTION

- .1 Supply and installation of all conduit, wire, electric relays, connections and other devices required for control conduit wiring for systems as specified in this Section, whether line or low voltage, shall be responsibility of the Controls Trade, except as noted above.
- .2 The Controls Trade shall either use its own electricians, retain and pay for services of successful Division 26, or use an electrical sub-trade acceptable to consultant to supply and install all conduit and wiring for systems as specified in this section.
- .3 Factory trained servicemen in employ of manufacturer, shall make final wiring connections on all components, mount and electrically connect all controls.
- .4 Electrical wiring shall be installed in conformance with CSA & ULC Including latest adopted versions of the Manitoba Building Code, National Building Code of Canada, and standards set in Division 26 of this specification.
- .5 Ensure that adequate conduit is installed during initial phases of construction, to accommodate total systems requirements.
- .6 Wire all safety controls in series with both "HAND" and "AUTO" starter positions to ensure that systems are properly protected.
- .7 The Controls Contractor shall provide all other conduit and wiring required for Control systems operation, including tie-ins from relays supplied by the Controls Contractor to motor starting circuits.
- .8 As a minimum, provide separate, dedicated conduit system for each of the following. Conduit to be minimum 19mm EMT.
- .9 Sensor and control wiring for stand-alone electric control systems.
- .10 If approved by system manufacturer, cable up to 30 volts may be installed in extra low voltage communication cable tray.
- .11 Refer to Division 26 for conduit and cable identification requirements.
- .12 The Controls Contractor shall provide detailed wiring diagrams for remote supervisory panels supplied with outdoor equipment, connections between Controls supplied equipment and DX cooling equipment.

1.3 SCOPE OF WORK

- .1 Provide labour, materials, equipment and services necessary for, and incidental to the supply and installation of the controls systems shown on the drawings and described in

this specification, so as to leave the Departmental Representative with a complete and functioning system.

- .1 The Contract Documents are performance based, diagrammatic and approximately to scale, intended to convey the scope of work and indicate the general arrangement and approximate location of equipment and components. Not all accessories and components have been shown or specified. Include any wiring not indicated or specified but required for automatic control system.
- .2 Control system installed to be fail-safe.
- .3 Even though the work is not completely shown, or is shown schematically, and all details are not shown or specified, it is expected that the contractor be familiar enough with his field of work to complete the project to the standards generally adhered to by the local industry, including good workmanship and common sense.
- .4 Provide both office and field engineering to develop a complete and comprehensive control system, based on the outline specifications and system schematics.
- .5 It shall be the responsibility of the Controls Contractor to provide the detailed sequence of operation and the appropriate equipment and accessories, subject to acceptance by the Engineer.
- .6 Provide equipment, personnel and materials necessary to assist with air balancing.
- .7 System control shall be provided for all equipment fulfilling the intent of the entire mechanical tender package.

1.4 START-UP AND COMMISSIONING

- .1 Start-up and Commissioning shall be undertaken prior to the Occupancy Stage of each Construction Phase.
- .2 Provide equipment, personnel and materials necessary to put the Control Systems into operation.
- .3 Coordinate and cooperate with all the other contractors to place the Mechanical Systems into operation to the satisfaction of the Departmental Representative.
- .4 Provide equipment, personnel, material, and information necessary to assist the Mechanical Contractor in completing the Commissioning Process.
- .5 Keep field records of what is done. Mark record prints to facilitate accurate and complete as-build information.

- .6 Finalize commissioning and manuals the following cooling season, if not verified previously due to weather.
- .7 Provide Departmental Representative instruction on site.

1.5 QUALITY ASSURANCE AND CONTRACTOR QUALIFICATIONS

- .1 Execute work of this Section only by skilled tradesmen regularly employed in the manufacture and installation of controls systems.
- .2 All equipment and materials shall be new and C.S.A. approved, unless specifically noted otherwise.
- .3 All similar equipment and/or materials shall be by the same manufacturer.
- .4 All aspects of the installation must comply with the most stringent of the applicable building codes, local regulations, and by-laws.
- .5 Provide office and field personnel who are factory trained and authorized to design and install these systems.

1.6 SHOP DRAWINGS

- .1 Submit Shop Drawings prior to installation, consisting of product and sizing data for all equipment and components, including, but not limited, to:
 - .1 Dampers
 - .2 Actuators
 - .3 Valves
 - .4 Thermostats
- .2 Submit drawings showing piping/tubing layouts and wiring diagrams, with written sequences of operation, and component descriptions.

2 PRODUCTS AND MATERIALS

2.1 GENERAL

- .1 All equipment and materials shall be new and C.S.A. approved, unless specifically noted otherwise.
- .2 Components shall be of the latest available model. Replacement parts shall be readily available from local dealers.
- .3 All similar equipment and or materials shall be by the same manufacturer.
- .4 Components shall be electric/electronic. No pneumatic components will be allowed.

- .5 The controls system shall be designed, and components selected, so as to be fail-safe, operating to protect the building, the occupants and vulnerable equipment from harm or damage in the event of a failure of the controls system or the power system.

2.2 NAMEPLATES, LABELS AND TAGS

- .1 Nameplates, labels and tags shall include function, setpoint and equipment names and ID numbers.
- .2 Nameplates shall be engraved plastic laminate, minimum 75 mm x 25 mm with minimum 6 mm high white letters on black background, mechanically fastened to equipment with screws or rivets.
- .3 Labels shall be self adhesive white tape with black embossed lettering, similar to Brother P-touch. 'Dymo' labels will not be acceptable.
- .4 Tags shall be engraved, all metal, attached with metal key chains.

2.3 VANDAL PROOF COVERS

- .1 Provide vandal proof covers (guards) on all wall mounted thermostats, temperature sensors, humidistats and humidity sensors in public areas.

2.4 PIPING/TUBING AND POWER AND CONTROL WIRING AND ACCESSORIES

- .1 Control wiring and conduit shall meet or exceed the requirements of C.S.A., U.L.C., the current edition of the Canadian Electrical Code, and all local Code requirements as well as the requirements as specified in Division 16.
- .2 The Controls Contractor shall provide piping/tubing and power and control wiring required by the control systems.
- .3 The Controls Contractor shall provide power transformers required by the controls systems.
- .4 The Controls Contractor shall provide all interlock piping/tubing and wiring required by the control systems, including pneumatic/electric switches, piping/tubing and wiring between control system components such as low limit protection, thermostats, alarms, motor starters and motor interlocks, etc., as required to achieve the control function specified in the schematic drawings and sequences of operation.
- .5 All control wiring, regardless of voltage, shall be installed in a continuous, dedicated system of rigid metal tubing (EMT). Maximum lengths of 2 M of flexible metal conduit will be accepted for final connections to devices and equipment.
 - .1 Plenum-rated cable will be acceptable in the crawlspace, if it is allowed by code, installed neatly (without dips and sags), and securely fastened to the structure.

2.5 AIR SYSTEM CONTROL DAMPERS AND DAMPER OPERATORS

- .1 Control dampers shall be all metal construction as follows:
 - .1 Blades maximum 125 mm wide and 1200 mm long.
 - .2 Modules to be maximum of 1200 mm wide and 1200 mm long.
 - .3 Multiple sections to have stiffening mullions and jack shafts.
 - .4 Sealed bearings.
 - .5 Linear flow vs. position characteristics.
 - .6 Low leakage design with edge seals and blade seals.

- .2 Materials:
 - .1 Frame: 2.5mm thick galvanized sheet steel.
 - .2 Blades: two (2) sheets 0.8mm thick or 1.6mm galvanized sheet steel.
 - .3 Bearings: oil impregnated sintered bronze. Provide additional thrust bearings for vertical blades.
 - .4 Linkage: zinc plated steel.
 - .5 Seals: replaceable neoprene seals or ss spring on side, top and bottom of frame and along all blade edges and blade ends.

- .3 Mixing dampers shall be of parallel blade or opposed blade design to eliminate stratification of air streams.
- .4 Damper operators shall be spring return, fail safe models. Power return operators will not be accepted.
- .5 Damper operators shall be sized to provide adequate power for opening, closing and modulating the dampers as required. They may be 24V or 120V at the Contractor's option.
- .6 Outdoor dampers/operators shall be suitable for proper operation down to -50 deg. F and be weatherproof.
- .7 Provide operators for the air handling unit mixing dampers supplied by the equipment manufacturer as part of the air handling units.
- .8 Provide each operator with a bracket for attaching to ductwork, building structure or equipment.
- .9 Mixing dampers: dampers mixing cold and warm air shall be parallel blade mounted at right angles to each other with blades opening to mix the air streams.
- .10 50 l/s m² maximum allowable leakage against 1.0 kPa static pressure.
- .11 Damper operators to be electric proportional or two (2) position type as required, with adjustable forward and return stops, aluminum housing and spring return.
- .12 Operators mounted outside shall be complete with internal heater.
- .13 Valve operators shall be of type to withstand temperatures likely to be encountered in application.
- .14 Size operators to guarantee component operation under maximum load. No operator shall be required to drive more than 2.5 sq.m. (27sq.ft.) of damper.

2.6 DIRTY FILTER PRESSURE SWITCH/GAUGES

- .1 Where shown on the schematic diagrams for all air filters in AHU-1 provide adjustable pressure switch/gauges to permit local readout and remote monitoring of air filter conditions.

- .2 Provide static pressure probes (SPP) and mount the gauges where they can be easily read. Provide lamacoid labels to identify the filter bank and the changeout pressure.
- .3 Differential pressure switch/gauges for local indication and remote monitoring of filter pressure drops shall be equal to:
 - .1 Dywer Series 3000 Photohelic pressure switch/gauge c/w adjustable signal flag, zeroing valves, mounting kit, aluminum connecting tubing, and static pressure probes with compression fittings.
- .4 Differential pressure range shall be suitable for 0 to 1".

2.7 INDOOR/OUTDOOR PRESSURE DIFFERENTIAL TRANSMITTERS

- .1 Where shown on the floor plans, provide pressure differential transmitter to permit remote monitoring of indoor/outdoor pressure differential.
- .2 Differential pressure switch/gauges for remote monitoring of indoor/outdoor pressure differential shall be equal to:
Dywer Series 600 Photohelic pressure differential transmitter c/w 4-20 mA analog output.
- .3 Pressure range shall be suitable for -0.5" to 0.5".

2.8 THERMOSTATS

- .1 Room thermostats and sensors shall be located where shown on drawings. Mount thermostats and sensors approximately 1370mm (54") above finished floor.
- .2 Calibrate all thermostats and confirm to Departmental Representative that this work has been done.
- .3 Provide adjustable set-point with operating range from 16 deg. C. to 32 deg. C.
- .4 Thermostats to be direct or reverse acting or remote sensing to suit system. Provide set-point indicator and thermometer to indicate area temperature.
- .5 Thermostats to have blank covers with concealed adjustment and thermometers inside cover. Private offices to have exposed thermometer and adjustment.
- .6 Provide heavy-duty plastic guards on thermostats in public areas such as entranceways, washrooms, corridors, retail areas, other unsupervised areas, and as otherwise noted.

2.9 REMOTE ELEMENT THERMOSTAT

- .1 Die cast aluminum body with die cast zinc cover. Body finish of erudite and cover sprayed silver. Suitable for surface mounting. 3 mm F.P.T. air connections with an integral 0-207 kPa output gauge. Provide 2.44m averaging element for air flow sensing with 1.2m copper capillary. Element range to be - 34 to 149 deg. C. (-30 to +300 deg. F.). Instrument ambient temperature limits to be - 29 deg. C. to 65.5 deg. C. (-20 to +150 deg. F.). Dials to have dual ranges - one side -18 deg. C. to +51 deg. C. (-1 to +124 deg. F.) and 43.3 deg. C. to 106.6 deg. C. (110 to 224 deg. F.) and be spaced 1 deg. C. (2 deg. F.) apart.

2.10 REMOTE BULB CONTROLLER - ELECTRIC - TWO POSITION

- .1 Cold rolled steel cover with baked enamel finish. Precision snap-acting contacts in dust-tight and tamper-proof enclosure. Ranges shall be available to cover over -34 deg. C. to 54 deg. C. (-30 deg. F. to 130 deg. F.). Companion wells and duct flanges available for mounting sensing bulb. Remote capillary system of 1.8 m, 2.4 m or 3 m depending on range selected and shall be liquid filled. Manual or automatic reset on limit applications shall also be available.

2.11 AIR FLOW SWITCHES

- .1 Where required for airflow indication, provide duct pressure sensors operating on the velocity pressure principal, sensing actual air velocity using an appropriate pitot tube tip as a velocity pressure probe (VPP).
 - .1 Differential pressure sensors piped across fans will not be accepted.
 - .2 Current sensing switches are an acceptable substitute.

2.12 MANUAL TIMERS

- .1 Where required for manual override, provide wall mounted spring return timer for 0-8 (unless otherwise specified) hours in 15 minute increments.

2.13 REMOTE TRANSMITTERS

- .1 Pneumatic feed back type and available with either immersion bulbs or 2400 mm (8 ft.) sensing elements. Available ranges as required by the installation.

2.14 RECEIVER CONTROLLERS

- .1 Provided to match scales of remote transmitters with adjustable set point and throttling ranges, indicating output gauge; reversible.

2.15 TEMPERATURE INDICATION

- .1 Provide 75 mm (3") diameter direct reading dial type field calibratable temperature gauges in required ranges suitable for surface mounting on ductwork, or flush mounting

on instrument cabinet face, with capillary tube lengths to suit. Accuracy: plus or minus 1% at centre of scale.

2.16 FREEZE PROTECTION

- .1 Provide electric type freeze protection cutouts, with labeled reset buttons mounted on the front of local control panels.
- .2 All air systems introducing outside air shall have low temperature protection. Provide if not part of unit. Electric low limit thermostat in air stream with low point sensitivity element to serpentine entire coil face.
- .3 Thermostat for each coil bank wired in series to activate alarm and shut down fans.
- .4 Two (2)-position manual reset type.

2.17 PANELS - GENERAL

- .1 Provide all pre-wired control panels, except for those furnished as part of equipment under other sections.
- .2 Fabricate fully enclosed, lockable cabinets using minimum 14 gauge all steel construction with enamel finish:
 - .1 Use hinged locking door.
 - .2 Common key all locks.
- .3 Provide either wall mount or freestanding panels as required by the actual installation.
- .4 Where heat-generating equipment is to be mounted inside of an enclosure, provide vented cabinets.
- .5 Mount all routinely operated, manually adjusted, and indicating devices on the panel door. Enclose all other devices.
- .6 Mount plasticized control schematics inside the panels.

2.18 MISCELLANEOUS DEVICES

- .1 Provide all necessary relays, positioners, clocks, transformers, etc. as required to interface with and make a complete and operable system.

2.19 OPERATING INSTRUCTIONS SERVICE AND GUARANTEE

- .1 Provide operating instructions for the temperature control system in accordance with the General Conditions of the contract and include a description of the sequence of operation and "as-built" drawings of the system schematics.

- .2 Upon completion of the installation, all control equipment supplied under this contract shall be adjusted to place the system in complete operating condition subject to Consultant's approval. All adjustments shall be made in coordination with the field engineer responsible for balancing the air systems. The control system shall be guaranteed against defects in workmanship and material for a period of one (1) year under normal use and service from the date of beneficial occupancy.

3 INSTALLATION AND EXECUTION

3.1 COMPONENTS - GENERAL

- .1 Mount all controllers and relays within control panel cubicles.
- .2 Mount exposed components for easy access and protect from damage.
- .3 Locate all local control panels as shown on the drawings or as directed by the Departmental Representative or Engineer.
- .4 Damper operators: do not install in ducts or fresh air intakes.
- .5 Sensor elements for remote thermometers: where installed to sense a common temperature condition with a controller, strap both elements together.
- .6 Provide brass wells of sizes to suit sensor bulbs, c/w unions and dielectric elements as required.
- .7 Mount gauges and thermometers for easy readability.
- .8 Install the air compressor and after drier convenient to a floor drain and pipe condensate and blow-down lines thereto. Run drain lines on walls. Do not run drain piping across floors in areas required for access.

3.2 NAMEPLATES, LABELS AND TAGS

- .1 Provide nameplates for all panels and major components.
- .2 Provide labels inside of panels and cabinets, and at all remote locations, for adjustment and readout points.
- .3 Provide tags at all valves and equipment not suited for attaching nameplates.
- .4 Identify all equipment mounted on the front of control panels with 50 mm x 75 mm (2" x 3") lamacoid nameplates.
- .5 Identify instruments inside of control panels with labels.

3.3 PIPING/TUBING AND POWER AND CONTROL WIRING AND ACCESSORIES

- .1 Control wiring shall be connected from specific breakers in power panels. Refer to Electrical Drawings.
- .2 Run piping and conduit neatly clipped to walls or structural members, parallel to and at right angle to, building lines.

3.4 PROJECT COMPLETION

- .1 Prior to the Occupancy Stage of each Construction Phase:
 - .1 Start-up and Commission the Controls Equipment and Systems.
 - .2 Assist the Mechanical Contractor in the Start-up and Commissioning of the Mechanical systems.
 - .3 Calibrate all thermostats, valves, damper motors, relays, etc, provided under this contract.
 - .4 Verify and optimize the system.
 - .5 Provide three complete instruction manuals, complete with "as constructed" schematics, for insertion into the Operation and Maintenance Manuals.
 - .6 Provide instructions to Departmental Representative as required.

3.5 CALIBRATION AND ADJUSTMENT OF CONTROLS SYSTEMS

- .1 All components shall be calibrated before the areas are occupied in order to minimize the disruption to the occupants following the takeover the building.
- .2 Upon completion of the installation phase of the project, calibrate and adjust all controls systems and components installed under this contract to provide acceptable space conditions and proper functioning of the systems. Keep a written log of the calibration data for each device, including the instrumentation against which the equipment is calibrated. Include this log in the Operation and Maintenance manuals.
- .3 If requested, the Contractor shall be prepared to provide written documentation of recent calibration checks for all instrumentation and sensors.

3.6 VERIFICATION AND OPTIMIZATION OF THE OPERATION OF THE MECHANICAL SYSTEMS

- .1 The installation shall be completely tested, demonstrating that the equipment and systems installed are performing in the manner intended.
- .2 Provide equipment, personnel and materials necessary to produce written records for verification of the operation of all control systems and all equipment.

- .3 Provide equipment, personnel and materials necessary to adjust the controls systems as part of the overall optimization of the mechanical systems.
- .4 Adjust control set points and tune control algorithm performance to optimize the operation of the systems.

3.7 SEQUENCE OF OPERATION

- .1 DOMESTIC HOT WATER SYSTEM, WATER HEATERS TWH-1 - TWH-5.
 - .1 Tankless Water Heaters have integral operating and safety controls.
- .2 TYPICAL HEAT/COOL FURNACE/CENTRAL AIR UNITS AND HRV UNITS.
 - .1 Heat/cool/auto, fan on/off/auto, wall-mounted thermostat supplied with Furnace, to be installed and wired by Controls Contractor. Refer also to HVAC Equipment schedule.
 - .2 Power and control wiring by Division 26.
 - .3 Sequence of operation:
 - .1 On a call for heating or cooling from the thermostat, the Furnace/Central Air heating or cooling shall energize.
 - .2 On a call for Fan from the thermostat, the HRV shall energize.
- .3 ELECTRIC BASEBOARD HEATERS:
 - .1 Supply 115 V wall mounted heating only thermostats (with lockbox in common areas).
 - .2 Provide transformers, relays and power and control wiring as required.
 - .3 On a call for heat from the thermostat, the baseboard heater control valve shall be energized.
- .4 GAS UNIT HEATERS
 - .1 Supply 115 V integral unit mounted heating only thermostats.
 - .2 On a call for heat from the thermostat, the corresponding electric unit heater fan shall energize.
 - .3 Provide a heavy-duty metal guard for thermostat.
 - .4 Provide an adjustable ambient lock out which will prevent the unit heater from cycling with the outdoor temperature above 55F. (13C.).
- .5 WEEPING TILE SUMP PUMPS SP-1, SP-2.
 - .1 Pumps shall come with a control panel and an alarm panel shipped loose, for installation and wiring by the Electrical Contractor.
 - .2 Duplex pumps shall come with float switches shipped loose, for installation by the Plumbing Contractor and wiring by the Electrical Contractor.
 - .3 Provide control wiring between floats and control panel.
 - .4 Provide control wiring between control panel and alarm panel.

.6 MISCELLANEOUS EXHAUST FAN CONTROL:

.1 As per Exhaust fan Schedule.

.7 RANGE HOOD RH-1

.1 Unit comes with integral Manual Switch.

.8 MISCELLANEOUS ALARMS

.1 Monitor weeping tile sump high level alarms (typical of 2 systems).

.2 Monitor Furnace and Unit Heater status and alarm.

.3 Trouble in any of these systems shall alarm at the Carbon Monoxide Alarm Panel where space will be available for inputs.

END OF SECTION