

PART 1 - GENERAL

- | | | |
|--|----|--|
| <u>1.1 RELATED SECTIONS</u> | .1 | Section 01 74 11 - Cleaning. |
| | .2 | Section 07 84 00 - Firestopping. |
| <u>1.2 REFERENCES</u> | .1 | Canadian General Standards Board (CGSB) |
| | .1 | CAN/CGSB-1.181-[99], Ready-Mixed Organic Zinc-Rich Coating. |
| <u>1.3 WASTE MANAGEMENT AND DISPOSAL</u> | .1 | Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management & Disposal. |
| | .2 | Remove from site and dispose of packaging materials at appropriate recycling facilities. |
| | .3 | Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site for recycling in accordance with Waste Management Plan. |
| | .4 | Divert unused metal materials from landfill to metal recycling facility approved by Departmental representative. |

PART 2 - PRODUCTS

- | | | |
|---------------------|----|-----------|
| <u>2.1 NOT USED</u> | .1 | Not Used. |
|---------------------|----|-----------|

PART 3 - EXECUTION

- | | | |
|-------------------------------------|----|--|
| <u>3.1 CONNECTIONS TO EQUIPMENT</u> | .1 | In accordance with manufacturer's instructions unless otherwise indicated. |
| | .2 | Use valves and either unions or flanges for isolation and ease of maintenance and assembly. |
| | .3 | Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement. |

- 3.2 CLEARANCES .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.
- 3.3 DRAINS .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .4 Drain valves: NPS 3/4 ball valves unless indicated otherwise, with hose end male thread, cap and chain.
- 3.4 AIR VENTS .1 Install manual air vents at high points in piping systems.
- .2 Install isolating ball valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.
- 3.5 DIELECTRIC COUPLINGS .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 50mm and under: isolating unions.
- .4 Over 50mm: Isolating flanges.

- 3.6 PIPEWORK
INSTALLATION
- .1 Screwed fittings jointed with Teflon tape.
 - .2 Protect openings against entry of foreign material.
 - .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
 - .4 Assemble piping using fittings manufactured to ANSI standards.
 - .5 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
 - .6 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
 - .7 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
 - .8 Install, except where indicated, to permit separate thermal insulation of each pipe.
 - .9 Group piping wherever possible and as indicated.
 - .10 Ream pipes, remove scale and other foreign material before assembly.
 - .11 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
 - .12 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless otherwise indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.

- .6 Use ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.
- .7 Install butterfly valves on chilled water and related condenser water systems only.
- .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
- .9 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.13 Check Valves:

- .1 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.7 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
 - .2 Other floors: Terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.

- .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
- .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
- .4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION FOR FIRESTOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.
- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning, supplemented as specified in relevant sections of Division 23.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

- 3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK .1 Advise Departmental representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections of Division 23.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Division 22 and 23.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental representative.
- 3.12 EXISTING SYSTEMS .1 Connect into existing piping systems at times approved by Departmental representative, in writing.
- .2 Request written approval 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.
- .4 Ensure daily clean-up of existing areas.

END OF SECTION

PART 1 - GENERAL

- | | | |
|---|----|--|
| <u>1.1 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00 - Submittal Procedures. |
| <u>1.2 OPERATION AND MAINTENANCE DATA</u> | .1 | Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. |
| <u>1.3 DESCRIPTION</u> | .1 | Adjustable Frequency motor Drive (AFD) consisting of a pulse width modulated (PWM) inverter designed for use on a Standard NEMA Design B induction motor. The drive manufacturer shall supply the drive and all necessary controls as herein specified. Third party fabrications of AFD Control Panels are not acceptable. |
| <u>1.4 ACCEPTABLE MATERIALS</u> | .1 | Where materials are specified by trade name, refer to the Project Specific Instruction to Bidders for procedure to be followed in applying for approval of alternatives. |

PART 2 - PRODUCTS

- | | | | | | | | | | | |
|--------------------------------------|--|--|----|--|----|--|----|--|----|---|
| <u>2.1 VARIABLE FREQUENCY DRIVES</u> | .1 | AFD line voltage tolerance to operate from +30% and -35% of nominal voltage. | | | | | | | | |
| | .2 | AFD enclosure shall be UL listed as a plenum rated. (NEMA 1) | | | | | | | | |
| | .3 | All AFDs shall have the following standard features: <table> <tr> <td>.1</td> <td>All AFDs shall have the same removable HVAC keypad, regardless of voltage and horsepower rating. The keypad shall be capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple AFDs.</td> </tr> <tr> <td>.2</td> <td>The keypad shall include Hand-Off-Auto buttons; Fault Reset and a Help Button to include "on-line" assistance for programming and troubleshooting.</td> </tr> <tr> <td>.3</td> <td>There shall be a built-in real time clock in the AFD keypad.</td> </tr> <tr> <td>.4</td> <td>The AFD shall be capable of starting into a coasting load (either rotation)</td> </tr> </table> | .1 | All AFDs shall have the same removable HVAC keypad, regardless of voltage and horsepower rating. The keypad shall be capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple AFDs. | .2 | The keypad shall include Hand-Off-Auto buttons; Fault Reset and a Help Button to include "on-line" assistance for programming and troubleshooting. | .3 | There shall be a built-in real time clock in the AFD keypad. | .4 | The AFD shall be capable of starting into a coasting load (either rotation) |
| .1 | All AFDs shall have the same removable HVAC keypad, regardless of voltage and horsepower rating. The keypad shall be capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple AFDs. | | | | | | | | | |
| .2 | The keypad shall include Hand-Off-Auto buttons; Fault Reset and a Help Button to include "on-line" assistance for programming and troubleshooting. | | | | | | | | | |
| .3 | There shall be a built-in real time clock in the AFD keypad. | | | | | | | | | |
| .4 | The AFD shall be capable of starting into a coasting load (either rotation) | | | | | | | | | |

- .5 The AFD shall have the ability to automatically restart after a fault. The number of attempts and time delay between attempts shall be programmable.
 - .6 The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.
 - .7 The AFD shall have an integral 5% impedance input line choke/reactor to reduce the harmonics to the power line and to add protection from AC line transients.
 - .8 The AFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.
- .4 All AFDs to have the following standard features:
- .1 Two (2) programmable analog inputs: 0/4-20mA or 0/2-10VDC signals.
 - .2 Two (2) programmable analog outputs (0/4-20mA). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.
 - .3 Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices.
 - .4 Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 Amps at 250VAC; open collector outputs are not acceptable.
 - .5 The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics. The keypad shall utilize the following assistants:
 - .1 Start-up assistants.

- .2 Parameter assistants
- .3 Maintenance assistant
- .4 Troubleshooting assistant
- .6 All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete words: Output Frequency; Motor Speed (RPM, %, or Engineering units); Motor Current; Calculated Motor Torque; Calculated Motor Power (kW); DC Bus Voltage; Output Voltage
- .7 The AFD shall include a fireman's override input. Upon receipt of a contact closure from the fireman's control station, the AFD shall operate at an adjustable preset speed. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands) and force the motor to run at the adjustable, preset speed. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the AFD shall resume normal operation.
- .8 Serial Communications, the AFD shall have a BACnet RS-485 port as standard. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). Each AFD shall have its own BACnet interface drop. Multiple AFD drops sharing one BACnet module shall not be permitted.
- .9 EMI/RFI filters. All AFDs shall include EMI/RFI filters. The onboard filters shall allow the AFD assemble to be CE Marked and the AFD shall meet product standard EN 61800-3 for the First Environment restricted level.

- 2.2 OPTIONAL FEATURES
- .1 Optional features to be furnished by the drive manufacturer. All optional features shall be cUL Listed or CSA by the drive manufacturer as a complete assembly. The bypass enclosure door and VFD enclosure must be interlocked such that input power is turned off before either enclosure can be opened.
 - .2 A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor, service (isolation) switch and VFD input fuses are required. Bypass designs, which have no VFD only fuses, or that incorporate fuses common to both the VFD and the bypass will not be accepted
 - .3 Door interlocked padlockable Disconnect that will disconnect all input power from the drive and all internally mounted options.
 - .4 The following operators shall be provided:
 - .1 Bypass Hand-Off-Auto
 - .2 Drive mode selector and light
 - .3 Bypass mode selector and light
 - .4 Bypass fault reset
 - .5 Bypass LDC display, 2 lines, for programming and status / fault / warning indications
 - .5 Motor protection from single phase power conditions - The Bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in Bypass mode are not acceptable.
 - .6 The system (VFD and Bypass) tolerated voltage window shall allow the system to operate from a line of +30%, -35% nominal voltage (230Vac, 480Vac 575Vac) as a minimum. The system shall incorporate circuitry that will allow the drive or bypass contactor to remain "sealed in" over this voltage tolerance at a minimum.

- .7 The Bypass system shall NOT depend on the VFD for bypass operation. The bypass shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the enclosure for repair / replacement.
- .8 Serial communications - the bypass and VFD shall be capable of being monitored and or controlled via serial communications. Provide communications protocols for ModBus; Delta Controls ORCA; Alerton Envision for BACtalk Version 2.6; Siemens Building Technologies FLN (P1) and BACnet in the bypass controller.
- .9 BACnet Serial communication bypass capabilities shall include, but not be limited to; bypass run-stop control; the ability to force the unit to bypass; and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, bypass current (in amps), bypass kilowatt hours (resettable), bypass operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relays output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional bypass status indications and settings shall be transmitted over the serial communications bus - keypad "Hand" or "Auto" selected, and bypass selected.
- The DDC system shall also be able to monitor if the motor is running under load in both VFD and bypass (proof of flow) in the VFD mode over serial communications or Form-C relay output. A minimum of 40 field parameters shall be capable of being monitored in the bypass mode.
- .10 Run permissive circuit - there shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, time-clock control, or serial communications) the VFD and bypass shall provide a dry contact closure that will signal the damper to open (VFD motor does not

operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD system input and allows motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close.

- .11 The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor operation shall be indicated on the Bypass LCD display as well as over the serial communications protocol.
- .12 The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 - 120 seconds.
- .13 The bypass control shall be programmable for manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will generate an automatic transfer to bypass and which faults require a manual transfer to bypass.
- .14 There shall be an adjustable motor current sensing circuit for the bypass and VFD mode to provide proof of flow indication. The condition shall be indicated on the keypad display, transmitted over the building automation protocol and on a relay output contact closure.
- .15 The bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs.
- .16 The relay outputs from the bypass shall be programmable for any of the following indications.
 - .1 System started
 - .2 System running
 - .3 Bypass override enabled

Building Modernization Phase II 10 Weldon St, Shediac, NB Project No. R.039554.001	VARIABLE FREQUENCY DRIVE	Section 23 05 13.01 Page 7 2013.07.17
---	-----------------------------	---

- .4 Drive fault
- .5 Bypass fault
- .6 Bypass H-O-A position
- .7 Motor proof of flow (broken belt)
- .8 Overload
- .9 Bypass selected
- .10 Bypass run
- .11 System started (damper opening)
- .12 Bypass alarm
- .13 Over temperature

.17 The digital inputs for the system shall accept 24VAC or 24VDC. The bypass shall incorporate internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 ma of 24 VDC for use by others to power external devices.

.18 Customer Interlock Terminal Strip - provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs. The user shall be able to select the text to be displayed on the keypad when the safety opens. Example text display indications include "Firestat", "Freezestat", "Over pressure" and "Low pressure". The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.

.19 Class 10, 20, or 30 (selectable) electronic motor overload protection shall be included.

2.3 ACCEPTABLE MATERIALS

.1 ABB "ACH550-BDR", Allen Bradley, Cutler Hammer or approved equal.

2.4 SIZE .1 Drive shall be in accordance with the following:

ITEM	MOTOR SIZE kW	VOLTAGE
AHU-1	22.4	600/3
AHU-3	11.2	600/3
RAF-1	7.5	600/3
RAF-3	3.73	600/3
HCR-1	5.6	600/3
HCR-2	5.6	600/3
CCR-1	11.2	600/3
CCR-2	11.2	600/3
KEF-1	1.12	600/3
AC-7SF	7.46	600/3
AC-7RF	1.50	600/3

.2 The EMCS Contractor must provide new Nema Premium Efficiency Motors on all fans listed and the pumps shown with new motors above, which shall be listed and certified as inverter duty. The TEFC premium efficiency severe duty motors shall exceed EP Act/NRCan efficiency levels, EEV certified and be all cast iron construction. The motors shall have Class F insulation with Class B temperature rise at nameplate HP rating. The motors shall have 1.15 service factor and regreasable bearings with internal bearing caps. Standard of acceptance: ABB PESD.

PART 3 - EXECUTION

3.1 VARIABLE FREQUENCY DRIVES .1 Variable Frequency Drives listed in this section shall be the responsibility of the EMCS Contractor, as per Section 25 90 01 - EMCS Field Installation.

3.2 START-UP SERVICE .1 The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

Building Modernization Phase II 10 Weldon St, Shediac, NB Project No. R.039554.001	VARIABLE FREQUENCY DRIVE	Section 23 05 13.01 Page 9 2013.07.17
---	-----------------------------	---

.2 Warranty

- .1 The VFDs and motors shall be warranted by the manufacturer and contractor for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

3.3 EXAMINATION .1

Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VFD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.

- .2 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.

END OF SECTION

PART 1 - GENERAL

- | | | |
|-----------------------|----|--|
| <u>1.1 REFERENCES</u> | .1 | American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) |
| | .1 | ASHRAE 90.1-[01], Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard). |
| | .2 | Electrical Equipment Manufacturers' Association Council (EEMAC) |
| | .3 | Health Canada/Workplace Hazardous Materials Information System (WHMIS) |
| | .1 | Material Safety Data Sheets (MSDS). |
| <u>1.2 SUBMITTALS</u> | .1 | Submittals: in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Product Data: |
| | .1 | Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations. |
| | .1 | Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 02 81 01 - Hazardous Materials. |
| | .2 | Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of New Brunswick. |
| | .3 | Quality Control: in accordance with Section 01 45 00 - Quality Control. |
| | .1 | Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties. |
| | .2 | Instructions: submit manufacturer's installation instructions. |

- .1 Departmental Representative will make available one (1) copy of systems supplier's installation instructions.

.4 Closeout Submittals

- .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 QUALITY ASSURANCE .1

Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.

- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING .1

- Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 GENERAL .1

Motors to be high efficiency, in accordance with local Hydro company standards and the requirements of ASHRAE 90.1.

2.2 MOTORS .1

Provide motors for mechanical equipment as specified.

- .2 If delivery of specified motor will delay delivery or installation of any equipment, install motor approved by Departmental representative for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

- .3 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated, service factor of 1.15 minimum.

- .4 Motors 373 W to 1.49 KW to: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3-phase, 600 V, unless otherwise specified or indicated, service factor of 1.15 minimum.
- .5 Motors 1.49 kW and larger:
 - .1 Provide motors for mechanical equipment as specified.
 - .2 If delivery of specified motor will delay delivery or installation of any equipment, install motor approved by Departmental representative for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
 - .3 High efficiency TEFC design and all quoted efficiencies shall be guaranteed in accordance with test method CSA C390-10. Motors shall meet CSA Z299 quality standards. Motor frames and end bracket shall be of heavy gauge cast iron construction. Blowers shall be one piece construction with maximum NSLP levels of 85dBa @ 900 mm unloaded.
 - .4 Motor and fan bearings shall be selected for a basic rating fatigue life (L-10) of 200,000 hours at maximum operating speed and horsepower.
 - .5 Fan motors shall meet, at a minimum, NEMA MG-1, Table 12-12 Full Load Efficiencies for 60 Hz NEMA Premium (CEE).
 - .6 Motors shall be suitable for use with variable frequency drives, per NEMA MG-1 Part 30, and have voltage-spike-resistant insulation system.

- 2.3 TEMPORARY MOTORS .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental representative for temporary use. Work will only be accepted when specified motor is installed.

- 2.4 BELT DRIVES
- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
 - .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
 - .3 For motor under 1.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
 - .4 For motors 1.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
 - .5 Correct size of sheave to be determined during commissioning.
 - .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
 - .7 Motor slide rail adjustment plates to allow for centre line adjustment.
 - .8 Supply one set of spare belts for each set installed.
- 2.5 DRIVE GUARDS
- .1 Provide guards for unprotected drives.
 - .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm diameter holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
 - .3 Provide means to permit lubrication and use of test instruments with guards in place.
 - .4 Install belt guards to allow movement of motors for adjusting belt tension.

- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

PART 3 - EXECUTION

- | | | |
|--|----|---|
| <u>3.1 MANUFACTURER'S INSTRUCTIONS</u> | .1 | Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet. |
| <u>3.2 INSTALLATION</u> | .1 | Fasten securely in place. |
| | .2 | Make removable for servicing, easily returned into, and positively in position. |
| <u>3.3 FIELD QUALITY CONTROL</u> | .1 | Site Tests: conduct following tests [in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS. |
| | .2 | Manufacturer's Field Services: <ul style="list-style-type: none"> .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS. .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions. .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE. |

- 3.4 CLEANING .1 Proceed in accordance with Section 01 74 11
- Cleaning.
- .2 Upon completion and verification of
performance of installation, remove surplus
materials, excess materials, rubbish, tools
and equipment.

END OF SECTION

PART 1 - GENERAL

- 1.2 REFERENCES .1 American National Standards
Institute/American Society of Mechanical
Engineers (ANSI/ASME)
- .1 ANSI/ASME B31.1-[1998], Power Piping.
 - .2 ANSI/ASME B31.3-[2000], Process Piping
Addenda A.
 - .3 ANSI/ASME B31.3-[2001], Process Piping
Addenda B.
 - .4 ANSI/ASME Boiler and Pressure Vessel
Code-[1998]:
 - .1 Section I: Power Boilers.
 - .2 Section V: Nondestructive
Examination.
 - .3 Section IX: Welding and Brazing
Qualifications.
- .2 American National Standards
Institute/American Water Works Association
(ANSI/AWWA)
- .1 ANSI/AWWA C206-[97], Field Welding of
Steel Water Pipe.
- .3 American Welding Society (AWS)
- .1 AWS C1.1-[2000], Recommended Practices
for Resistance Welding.
 - .2 AWS Z49.1-[1999], Safety Welding,
Cutting and Allied Process.
 - .3 AWS W1-[2000], Welding Inspection
Handbook..
- .4 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-48.2-[92], Spot Radiography
of Welded Butt Joints in Ferrous
Materials.
- .5 Canadian Standards Association (CSA
International)
- .1 CSA W47.2-[M1987(R1998)],
Certification of Companies for Fusion
Welding of Aluminum.
 - .2 CSA W48 series-[01], Filler Metals and
Allied Materials for Metal Arc
Welding.
 - .3 CSA B51-[97], Boiler, Pressure Vessel
and Pressure Piping Code.
 - .4 CSA-W117.2-[01], Safety in Welding,
Cutting and Allied Processes.

- .5 CSA W178.1-[02], Certification of Welding Inspection Organizations.
- .6 CSA W178.2-[01], Certification of Welding Inspectors.
- .7 CAN/CGSB-48.2-92, Spot Radiography of Welded Butt Joints in Ferrous Materials.
- .8 AWS B3.0-1980, Welding Procedures and Performance Qualifications.
- .9 AWS C1.1-66, Recommended Practices for Resistance Welding.
- .10 AWS W1-1980, Welding Inspection.
- .11 ANSI/AWWA C206-88, Field Welding of Steel Water Pipe.

1.2 QUALIFICATIONS .1

Welders

- .1 Welding qualifications in accordance with CSA B51.
- .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
- .3 Furnish welder's qualifications to Departmental representative.
- .4 Each welder to possess identification symbol issued by authority having jurisdiction.
- .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

.2 Inspectors

- .1 Inspectors qualified to CSA W178.2 and have a welding certificate issued by Labour Canada.

1.3 QUALITY ASSURANCE .1

Registration of welding procedures in accordance with CSA B51.

- .2 Copy of welding procedures available for inspection.
- .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.
- .4 Welder must have a welding certificate issued by Labour Canada and the New Brunswick Department of Advanced Education.

PART 2 - PRODUCTS

2.1 ELECTRODES .1 Electrodes: in accordance with CSA W48 Series.

PART 3 - EXECUTION

3.1 WORKMANSHIP .1 Welding: in accordance with ANSI/ASME [B31.1] [B31.3], ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and special procedures specified elsewhere in Division 22 and 23 applicable requirements of provincial authority having jurisdiction and Labour Canada.

3.2 INSTALLATION REQUIREMENTS .1 Identify each weld with welder's identification symbol.

.2 Backing rings:
.1 Where used, fit to minimize gaps between ring and pipe bore.
.2 Do not install at orifice flanges.

.3 Fittings:
.1 50mm and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

3.3 INSPECTION AND TESTS - GENERAL REQUIREMENTS .1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental representative before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Departmental representative.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.4 SPECIALIST EXAMINATIONS AND TESTS

- .1 General
 - .1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Departmental representative.
 - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
 - .3 Inspect and test 10% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests.
- .2 Hydrostatically test welds to requirements of the National Plumbing Code and ANSI/ASME B31.1.
- .3 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .4 Failure of visual examinations:
 - .1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental representative of total of up to 10% of welds, selected at random by Departmental representative by particle tests.

- .5 Magnetic particle tests for piping systems.

3.5 DEFECTS CAUSING REJECTION

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.
- .2 In addition, chilled water systems below 860 kPa:
 - .1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of

pipe.

- .2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.
- .3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.
- .4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm.
- .5 Repair cracks and defects in excess of 0.8 mm in depth.
- .6 Repair defects whose depth cannot be determined accurately on basis of visual examination or particle tests.

3.6 REPAIR OF WELDS <u>WHICH FAILED TESTS</u>	.1	Re-inspect and re-test repaired or re-worked welds at Contractor's expense.
--	----	---

END OF SECTION

Building Modernization Phase II 10 Weldon St, Shediac, NB Project No.: R.039554.001	THERMOMETERS AND PRESSURE GAUGES - PIPING SYSTEMS	Sect 23 05 19.01 Page 1 2013.07.17
--	---	--

PART 1 - GENERAL

- 1.1 SECTION INCLUDES .1 Materials and installation for thermometers and pressure gauges in piping systems.
- 1.2 RELATED SECTIONS .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 23 05 53.01 - Mechanical Identification.
- 1.3 REFERENCES .1 American Society of Mechanical Engineers (ASME).
- .1 ASME B40.100-[01], Pressure Gauges and Gauge Attachments.
- .2 ASME B40.200-[01], Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB).
- .1 CAN/CGSB-14.4-[M88], Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
- .2 CAN/CGSB-14.5-[M88], Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.
- 1.4 SUBMITTALS .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data.
- .3 Submit manufacturer's product data for following items:
- .1 Thermometers.
- .2 Pressure gauges.
- .3 Wells.
- 1.5 HEALTH AND SAFETY .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

PART 2 - PRODUCTS

- 2.1 GENERAL .1 Design point to be at midpoint of scale or range.

- | | | |
|--|----|---|
| <u>2.2 DIRECT READING
THERMOMETERS</u> | .1 | Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB 14.4 and ASME B40.200.
.1 Acceptable materials: Trerice Pipe A405, Duct X99, Winters, Weiss, Weksler. |
| <u>2.3 REMOTE READING
THERMOMETERS</u> | .1 | 100 mm diameter liquid filled activated dial type: to CAN/CGSB-14.5, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and stainless steel case for wall mounting.
.1 Acceptable materials: Trerice L80, Winters, Wiess, Weksler. |
| <u>2.4 THERMOMETER WELLS</u> | .1 | Copper pipe: copper or bronze. |
| | .2 | Steel pipe: stainless steel. |
| <u>2.5 PRESSURE GAUGES</u> | .1 | 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.
.1 Acceptable materials: Trerice 450 LFB, Winters, Weiss, Weksler. |
| | .2 | Provide:
.1 Snubber for pulsating operation.
.2 Diaphragm assembly for corrosive service.
.3 Gasketed pressure relief back with solid front.
.4 Bronze stop cock.
.5 Oil filled for high vibration applications. |

PART 3 - EXECUTION

- | | | |
|-------------------------|----|--|
| <u>3.1 GENERAL</u> | .1 | Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units. |
| | .2 | Install between equipment and first fitting or valve. |
| <u>3.2 THERMOMETERS</u> | .1 | Install in wells on piping. Provide heat conductive material inside well. |

.2 Install in locations as indicated on inlet and outlet of:

.1 Water heating and cooling coils.

.3 Install wells as indicated only and for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in following locations:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of control valves.

.3 Inlet and outlet of coils.

.4 In other locations as indicated.

.2 Install gauge cocks for balancing purposes.

.3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

END OF SECTION

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
- .1 Bronze - valves.
 - .2 Sustainable requirements for construction and verification.
 - .3 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 35 29 - Health and Safety Requirements.
 - .3 Section 01 78 00 - Closeout Submittals.
 - .4 Section 23 05 05 - Installation of Pipework.
- 1.2 REFERENCES .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
- .1 ANSI/ASME B1.20.1-[1983(R2001)], Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18-[2001], Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A 276-[04], Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B 62-[02], Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B 283-[99a], Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B 505/B 505M-[02], Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
- .1 MSS-SP-25-[1998], Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80-[2003], Bronze Gate Globe, Angle and Check Valves.

- .3 MSS-SP-110-[1996], Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit data for valves specified in this section.
- .3 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 All products to have CRN registration numbers.
- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.
 - .2 Copper tube systems: Solder ends to ANSI/ASME B16.18.
- .3 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

- .4 Check Valves:
 - .1 Requirements common to check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: screwed with hexagonal shoulders.
 - .2 2" and under, swing type, bronze disc, Class 125:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
 - .3 Acceptable materials: Crane Fig. 37, Jenkins, Kitz.
 - .3 2" and under, swing type, bronze disc, Class 150:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
 - .3 Acceptable materials: Soldered: Crane Fig. 1342, Jenkins, Kitz. Screwed: Crane Fig. 137, Jenkins, Kitz.
- .5 Ball Valves:
 - .1 2" and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B 62.
 - .2 Pressure rating: Class 125, 4134 kPa cold, 1034 kPa steam.
 - .3 Connections: Screwed ends to ANSI B1.20.1 and with hexagonal shoulders, solder ends to ANSI.
 - .4 Stem: tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable hard stainless steel ball and Teflon seats.
 - .7 Stem seal: TFE with external packing nut.

- .8 Operator: removable lever handle, valve stem extension on cold insulated pipe.
- .9 Acceptable materials: Kitz #58 Thread and #59 soldered, Apollo, Newman, Hattersly.

PART 3 - EXECUTION

- | | | |
|-------------------------|----|--|
| <u>3.1 INSTALLATION</u> | .1 | Install rising stem valves in upright position with stem above horizontal. |
| | .2 | Remove internal parts before soldering. |
| | .3 | Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal. |

END OF SECTION

PART 1 - GENERAL

- 1.1 REFERENCES .1 American National Standards Institute (ANSI) American Society of Mechanical Engineers (ASME).
- .1 ANSI/ASME B16.1-1989, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
- .2 American Society for Testing and Materials (ASTM).
- .1 ASTM A 49-87, Specification for Heat-Treated Carbon Steel Joint Bars.
- .2 ASTM A 126-84 (1991), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- .3 ASTM B 61-93, Specification for Steam or Valve Bronze Castings.
- .4 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.
- .5 ASTM B 85-92, Specification for Aluminum-Alloy Die Castings.
- .6 ASTM B 209-92, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
- .1 SP-70-1990, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .2 SP-71-1990, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
- .3 SP-82-1992, Valve Pressure Testing Methods.
- .4 SP-85-1994, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
- 1.2 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit data for all valves specified this section.
- 1.3 CLOSEOUT SUBMITTALS .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

- 1.4 SPARE PARTS .1 Furnish following spare parts:
- .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size. Minimum 1.
 - .3 Stem packing: one for every 10 valves, each size. Minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- 1.5 ACCEPTABLE MATERIALS .1 Where materials are specified by trade name, refer to the Project Specific Instruction to Bidders for procedure to be followed in applying for approval of alternatives.

PART 2 - PRODUCTS

- 2.1 GENERAL .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
- .1 Gate valves: MSS SP-70.
 - .2 Globe valves: MSS SP-85.
 - .3 Check valves: MSS SP-71.
- .3 Requirements common to all valves, unless specified otherwise:
- .1 Body, bonnet: cast iron to ASTM B 209 Class B.
 - .2 Connections: flanged ends to ANSI B 16.1.
 - .3 Inspection and pressure testing: to MSS SP-82.
 - .4 Bonnet gasket: non-asbestos.
 - .5 Stem: to have precision-machined Acme or 60E V threads, top screwed for handwheel nut.
 - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
 - .7 Gland packing: non-asbestos.
 - .8 Handwheel: Die-cast aluminum alloy to ASTM B 85 or malleable iron to ASTM A 49. Nut of bronze to ASTM B 62.
 - .9 Identification tag: with catalogue number, size, and other pertinent data.

- 2.2 BUTTERFLY VALVES.1 2½" and over, Class 200, CWP, for chilled water application to MSS SP-67.
- .1 Lug water type, iron body.
 - .2 18-8, 316 Stainless Steel disk.
 - .3 Stem type 416 stainless steel.
 - .4 Seats: replaceable cartridge style, EPDM.
 - .5 Operator
 - .1 10 position level lock for sizes 2½" to 6" inclusive.
 - .6 Acceptable Material: Crane Fig. 44 - 5 x 2, Jenkins, Lunkenheimer

- 2.3 VALVE OPERATORS.1 Install valve operators as follows:
- .1 Handwheel: on all valves except as specified.
 - .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in Mechanical Equipment Rooms.

- 2.4 CHECK VALVES.1 Swing check valves, Class 125:
- .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.
 - .1 Up to 16": cast iron to ASTM A 126 Class B.
 - .2 Ratings:
 - .1 2½" to 12": 860 kPa steam; 1.4 MPa CWP.
 - .3 Disc: Rotating for extended life.
 - .1 Up to 6": bronze to ASTM B 62.
 - .4 Seat rings: renewable bronze to ASTM B 62 screwed into body.
 - .5 Hinge pin, bushings: renewable bronze to ASTM B 62.
 - .6 Identification tag: fastened to cover.
 - .7 Hinge: galvanized malleable iron.
 - .8 Acceptable Material: Crane Fig. 373, Jenkins, Lunkenheimer.

PART 3 - EXECUTION

- 3.1 INSTALLATION.1 Install rising stem valves in upright position with stem above horizontal.

END OF SECTION

PART 1 - GENERAL

- 1.1 REFERENCES .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
- .1 ANSI/ASME B1.20.1-1983 (R1992), Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
 - .3 ANSI/ASME B16.5-96, Pipe Flanges and Flanged Fittings.
 - .4 ANSI/ASME B16.11-1996, Forged Fittings, Socket-Welding and Threaded.
 - .5 ANSI/ASME B16.25-1997, Buttwelding Ends.
 - .6 ANSI/ASME B16.34-1996, Valves - Flanged, Threaded and Welding Ends.
- .2 American Society for Testing and Materials (ASTM).
- .1 ASTM A126-95e1, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B209M-96, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
- .1 MSS SP 67-1995, Butterfly Valves.
- 1.2 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- 1.3 CLOSEOUT SUBMITTALS .1 Submit maintenance data for incorporation into manual specified in Section 01 33 00 - Submittal Procedures.
- 1.4 SPARE PARTS .1 Furnish following spare parts:
- .1 Valve seats: one for every 10 valves each size, minimum 1 inch.
 - .2 Discs: one for every 10 valves, each size. Minimum 1.
 - .3 Stem packing: one for every 10 valves, each size. Minimum 1.

- .4 Valve handles: 2 of each size.
- .5 Gaskets for flanges: one for every 10 flanged joints.

PART 2 - PRODUCTS

- | | | |
|---|-----|--|
| <u>2.1 GENERAL</u> | .1 | Except for specialty valves, to be single manufacturer. |
| <u>2.2 LOCKSHIELD KEYS</u> | .1 | Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated. |
| <u>2.3 BUTTERFLY VALVES - RESILIENT SEAT - 200 PSIG</u> | .1 | Except to specialty valves, to be of single manufacturer. |
| | .2 | To be suitable for dead-end service. |
| | .3 | Sizes: Lug Wafer type: 50 mm to 750 mm. |
| | .4 | Pressure rating for tight shut-off at temperatures up to maximum for seat material. |
| | .1 | 2" - 12": 1378 kPag. |
| | .2 | 14" to 48": 1378 kPag. |
| | .5 | Minimum seat temperature ratings to 135°C. |
| | .6 | Application: On-off operation. |
| | .7 | Full lug body (threaded). |
| | .8 | Operators: |
| | .1 | 2" to 6": Handles capable of locking in any of ten (10) positions - 0 to 90°. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latchplate and mounting hardware: cadmium plated carbon steel. Standard coating: Black laquer. |
| | .2 | 8" to 30": Manual enclosed gear operator. |
| | .9 | Designed to comply with MSS SP-67 and API 609. |
| | .10 | Compatible with ANSI Class 125/Class 150 flanges. |

- .11 Construction:
 - .1 Body ductile iron, epoxy coated.
 - .2 Disc: 316 SS.
 - .3 Seat: Buna-N.
 - .4 Shaft: 416 stainless steel.
 - .5 Taper pin: 316 SS.
 - .6 Key: stainless.
 - .7 O-Ring: Buna-N.
 - .8 Bushings: Teflon.
- .12 Acceptable materials: Crane Fig. 44 - B x B, Jenkins, Lunkenheimer, Kitz, Victaulic.

2.4 MOUNTING FLANGES.1 Class 125 cast iron to ANSI B16.1 or Class 150 steel to B16.5 pipe flanges.

PART 3 - EXECUTION

- 3.1 INSTALLATION.1 Preparation:
- .1 Valve and mating flange preparation.
 - .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
 - .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
 - .3 Install butterfly valves with disc in almost closed position.
 - .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.
 - .2 Valve Installation:
 - .1 Install in accordance with manufacturer's instructions.
 - .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
 - .3 Verify suitability of valve for application by inspection of identification tag.
 - .4 Mount actuator on to valve prior to installation.
 - .5 Handle valve with care so as to prevent damage to disc and seat faces.

- .6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.
- .7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

END OF SECTION

PART 1 - GENERAL

- | | | |
|-------------------------------|----|---|
| <u>1.1 GENERAL</u> | .1 | This section applies to Plumbing, Liquid Heat Transfer and Fire Protection. |
| <u>1.2 REFERENCES</u> | .1 | American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) |
| | .1 | ANSI/ASME B31.1-[04], Power Piping. |
| | .2 | American Society for Testing and Materials International (ASTM) |
| | .1 | ASTM A 125-[1996(R2001)], Specification for Steel Springs, Helical, Heat-Treated. |
| | .2 | ASTM A 307-[04], Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength. |
| | .3 | ASTM A 563-[04a], Specification for Carbon and Alloy Steel Nuts. |
| | .3 | Factory Mutual (FM) |
| | .4 | Health Canada/Workplace Hazardous Materials Information System (WHMIS) |
| | .1 | Material Safety Data Sheets (MSDS). |
| | .5 | Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS) |
| | .1 | MSS SP 58-[2002], Pipe Hangers and Supports - Materials, Design and Manufacture. |
| | .2 | ANSI/MSS SP69-[2003], Pipe Hangers and Supports - Selection and Application. |
| | .3 | MSS SP 89-[2003], Pipe Hangers and Supports - Fabrication and Installation Practices. |
| | .6 | Underwriter's Laboratories of Canada (ULC) |
| <u>1.3 SYSTEM DESCRIPTION</u> | .1 | Design Requirements: |
| | .1 | Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies. |
| | .2 | Base maximum load ratings on allowable stresses prescribed by MSS SP 58. ASME B31.1 or |

- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of New Brunswick, Canada.
- .3 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available one (1) copy of systems supplier's installation instructions.
- .5 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

- 1.5 QUALITY ASSURANCE .1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
- 1.6 DELIVERY, STORAGE, AND HANDLING .1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 - PRODUCTS

- 2.1 GENERAL .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP 58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- 2.2 PIPE HANGERS .1 Finishes:
- .1 Pipe hangers and supports: after manufacture.
 - .2 Ensure steel hangers in contact with copper piping are copper plated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam (to be used only when top flange is not accessible):
- .1 Cold piping 2" maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut.
 - .1 Rod: 9 mm UL listed.
 - .2 Cold piping 2½" or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP 58 and MSS-SP 69.
 - .3 Acceptable materials: Anvil Fig. 292, Myatt, Taylor, Hunt.

- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping 2" maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP 69.
 - .1 Acceptable materials: Anvil Fig. 92, Myatt, Taylor.
 - .2 Cold piping 2½" or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
 - .1 Acceptable materials: Anvil Fig.227, Myatt, Taylor, Hunt.
- .4 Upper attachment to concrete:
 - .1 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP 69.
 - .1 Acceptable materials: Anvil Fig.281, Myatt.
- .5 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies: submit drawing with loading.
 - .2 Steel brackets: submit drawing with loading.
 - .3 Sway braces for seismic restraint systems: to Section 230548 - Vibration and Seismic Controls.
- .6 Hanger rods: threaded rod material to MSS SP 58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .7 Pipe attachments: material to MSS SP 58:
 - .1 Attachments for steel piping: carbon steel black.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.

.8 Cold piping, steel or cast iron: hot piping steel, with less than 25 mm horizontal movement, hot piping steel, with more than 300 mm middle attachment length, adjustable clevis to MSS-SP-58, Type 1. ULC listed.

.1 Acceptable materials: Anvil, Fig. 260, Myatt, Taylor.

.9 Cold copper piping, hot copper piping with less than 25 mm horizontal movement, hot copper piping with more than 300 mm middle attachment length, adjustable clevis to MSS-SP-58, Type 1. Copper plated.

.1 Acceptable materials: Anvil Fig. CT-65, Myatt, Taylor.

.10 Suspended hot piping, steel and copper, with horizontal movement in excess of 25 mm, hot steel piping with middle attachment 300 mm or less, pipe roller to MSS-SP-58, Type 43.

.1 Acceptable materials: Anvil Fig. 174, Myatt, Taylor.

.11 Bottom supported hot piping, steel and copper, pipe roller stand to MSS-SP-58, Type 45.

.1 Acceptable materials: Anvil Fig. 271, Myatt, Taylor.

.12 Suspended hot piping, steel and copper with horizontal movement less than 25 mm, with noise more than 300 mm middle attachment, adjustable clevis to MSS SP-58, Type 1, ULC listed.

.1 Acceptable materials: Anvil Fig. 260, Myatt, Taylor.

2.3 RISER CLAMPS

.1 Steel or cast iron pipe: black carbon steel to MSS SP 58, type 42, UL listed.

.1 Acceptable materials: Anvil Fig. 216, Myatt, Taylor.

.2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.

.1 Acceptable materials: Anvil fig. CT-121, Myatt, Taylor.

.3 Bolts: to ASTM A 307.

.4 Nuts: to ASTM A 563.

2.4 INSULATION

PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.1 Acceptable materials: Anvil Fig. 167, Myatt, Taylor.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

.1 Acceptable materials: Anvil Fig. 160 to 166, Myatt, Taylor.

2.5 EQUIPMENT

SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings, stamped by an Engineer registered in the Province of New Brunswick.

2.6 EQUIPMENT ANCHOR

BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.7 OTHER EQUIPMENT

SUPPORTS

.1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.

.2 Submit structural calculations with shop drawings, stamped by an Engineer registered in the Province of New Brunswick.

PART 3 - EXECUTION

3.1 MANUFACTURER'S

INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

- 3.2 INSTALLATION .1 Install in accordance with:
- .1 manufacturer's instructions and recommendations.
 - .2 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
 - .3 Clevis plates:
 - .1 Attach to concrete with four (4) minimum concrete inserts, one (1) at each corner.
 - .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
 - .5 Use approved constant support type hangers where:
 - .1 vertical movement of pipework is 13 mm or more,
 - .2 transfer of load to adjacent hangers or connected equipment is not permitted.
 - .6 Use variable support spring hangers where:
 - .1 transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 variation in supporting effect does not exceed 25 % of total load.
- 3.3 HANGER SPACING .1 Plumbing piping: to most stringent requirements of the Canadian Plumbing Code, MSS SP-69, Provincial Code and authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
 - .3 Copper piping: up to NPS 1/2: every 1.5 m.

.4 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.5 Within 300 mm of each elbow.

Maximum Pipe Size:	Maximum Spacing	
	Steel	Copper
up to 1¼"	2.1 m	1.8 m
1½"	2.7 m	2.4 m
2"	3.0 m	2.7 m
2½"		
3"	3.6 m	3.0 m
4"	2.4 m	2.4 m

.6 Pipework greater than NPS 12: to MSS SP 69.

3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

.4 Equalizing loads:

.1 Adjust hangers to equalize load.

.2 The maximum for mechanical shall not exceed 4.46 kg/m².

.3 The maximum point load on any hanger shall not exceed 204 kg.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.
- .5 Equalize loads:
 - .1 Adjust hangers to equalize load.
 - .2 The maximum for mechanical shall not exceed 4.46 kg/m².
 - .3 The maximum point load on any hanger shall not exceed 204 kg.

END OF SECTION

PART 1 - GENERAL

- | | | |
|---------------------------------|----|--|
| <u>1.1 REFERENCES</u> | .1 | ANSI/NFPA 13-2002, Installation of Sprinkler Systems. |
| <u>1.2 SHOP DRAWINGS</u> | .1 | Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Provide system shop drawings complete with performance and product data. |
| | .3 | Provide detailed drawings of all seismic control measures for boiler stacks. |
| <u>1.3 ACCEPTABLE MATERIALS</u> | .1 | Where materials are specified by trade name, refer to the Project Specific Instruction to Bidders for procedure to be followed in applying for approval of alternatives. |

PART 2 - PRODUCTS

- | | | |
|-----------------------------|----|---|
| <u>2.1 GENERAL</u> | .1 | Size and shape of bases type and performance of vibration isolation to be as indicated. |
| <u>2.2 ELASTOMERIC PADS</u> | .1 | Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces. |
| | .2 | Acceptable material: Vibro-Acoustics, Vibron, Korfund, Greenheck. |
| <u>2.3 SPRINGS</u> | .1 | Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices. |
| | .2 | Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0. |
| | .3 | Cadmium plate for all installations. |
| | .4 | Colour code springs. |

- .5 Acceptable material: Vibro-Accoustics, Vibron, Korfund, Greenheck.

2.4 SPRING MOUNTS

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.
- .6 Acceptable material: Vibro-Accoustics, Vibron, Korfund, Greenheck.

2.5 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, molded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with molded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut.

- | ITEM | BASE | VIBRATION ISOLATOR | DEFLECTION (mm) | STANDARD OF ACCEPTANCE |
|-------|------|--------------------|-----------------|-------------------------|
| RAF-1 | B-2 | M-3 | 50 | Vibro-Acoustic Type FS |
| RAF-3 | B-2 | H-3 | 50 | Vibro-Acoustic Type SHR |
| EF-1 | | H-1 | 25 | Vibro-Acoustic Type HD |
| EF-2 | | H-2 | 50 | Vibro-Acoustic Type SH |
| EF-3 | | H-1 | 25 | Vibro-Acoustic Type HD |
| EF-4 | | H-2 | 50 | Vibro-Acoustic Type SH |
| EF-5 | | H-1 | 25 | Vibro-Acoustic Type HD |

ITEM	BASE	VIBRATION ISOLATOR	DEFELCTION (mm)	STANDARD OF ACCEPTANCE
EF-7 & EF-8		H-1	25	Vibro-Acoustic Type HD
AHU-1		M-3	50	Vibro-Acoustic Type FS Supplied with unit
AHU-2		M-3	50	Vibro-Acoustic Type FS Supplied with unit
Condenser #1		M-5	50	Vibro-Acoustic Type RDM
Condenser #2		M-5	50	Vibro-Acoustic Type RDM
CRAC-1 Condenser		M-1		Vibro-Acoustic Type CSR
CRAC-2 Condenser		M-1		Vibro-Acoustic Type CSR
Chiller		M-1		Vibro-Acoustic Type RSR

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.
- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
- .1 Up to 100 mm: first 3 points of support. 125 mm to 200 mm: first 4 points of support. 250 mm and Over: first 6 points of support.
 - .2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

- 3.2 SITE VISITS .1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to departmental representative.
- .2 Provide departmental representative with notice 24 hours in advance of visit.
- .3 Make adjustments and corrections in accordance with written report.
- 3.3 TESTING .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93 - Testing Adjusting and Balancing for HVAC.
- .2 Vibration measurements shall be taken for equipment as indicated.
- .3 Provide departmental representative with notice 24 hours in advance of commencement of tests.
- .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
- .5 Submit complete report of test results including sound curves.

END OF SECTION

PART 1 - GENERAL

- | | | |
|------------------------------|----|--|
| <u>1.1 SUMMARY</u> | .1 | Related Sections: |
| | .1 | Section 09 91 23 - Interior Painting. |
| <u>1.2 REFERENCES</u> | .1 | Canadian Gas Association (CGA) |
| | .1 | CSA/CGA B149.1-[05], Natural Gas and Propane Installation Code. |
| | .2 | Canadian General Standards Board (CGSB) |
| | .1 | CAN/CGSB-1.60-[97], Interior Alkyd Gloss Enamel. |
| | .2 | CAN/CGSB-24.3-[92], Identification of Piping Systems. |
| | .3 | National Fire Protection Association (NFPA) |
| | .1 | NFPA 13-[2002], Standard for the Installation of Sprinkler Systems. |
| | .2 | NFPA 14-[2003], Standard for the Installation of Standpipe and Hose Systems. |
| <u>1.3 SUBMITTALS</u> | .1 | Product Data: |
| | .2 | Submittals: in accordance with Section 01 33 00 - Submittal Procedures. |
| | .3 | Product data to include paint colour chips, other products specified in this section. |
| | .4 | Samples: |
| | .1 | Submit samples in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Samples to include nameplates, labels, tags, lists of proposed legends. |
| <u>1.4 QUALITY ASSURANCE</u> | .1 | Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Health and Safety: |
| | .1 | Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements. |

- | | | |
|---|----|--|
| 1.5 DELIVERY,
STORAGE, AND
HANDLING | .1 | Packing, shipping, handling and unloading: |
| | .1 | Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements. |
| | .2 | Deliver, store and handle materials in accordance with manufacturer's written instructions. |

PART 2 - PRODUCTS

- | | | |
|--|----|---|
| 2.1 MANUFACTURER'S
EQUIPMENT NAMEPLATES | .1 | Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer. |
| | .2 | Lettering and numbers raised or recessed. |
| | .3 | Information to include, as appropriate: |
| | .1 | Equipment: manufacturer's name, model, size, serial number, capacity. |
| | .2 | Motor: voltage, Hz, phase, power factor, duty, frame size. |
| 2.2 EXISTING
IDENTIFICATION
SYSTEMS | .1 | Apply existing identification system to new work. |
| | .2 | Where existing identification system does not cover for new work, use identification system specified this section. |
| | .3 | Before starting work, obtain written approval of identification system from Departmental Representative. |
| 2.3 PIPING SYSTEMS
GOVERNED BY CODES | .1 | Identification: |
| | .1 | Natural gas: to CSA/CGA B149.1 and authority having jurisdiction. |
| 2.4 IDENTIFICATION OF
PIPING SYSTEMS | .1 | Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise. |
| | .2 | Pictograms: |
| | .1 | Where required: Workplace Hazardous Materials Information System (WHMIS) regulations. |

- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth, vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from Departmental Representative.
 - .2 Colours for legends, arrows: to following table:

<u>Background Colour:</u>	<u>Legend, arrows:</u>
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW RECIRC
Domestic cold water supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Steam (Humidifier)	Yellow	LB STEAM
Condensate (Humidifier)	Yellow	ST CONDENSATE RET
Make-up Water	Green	MAKE-UP
Refrigerant Liquid	Yellow	REF LIQUID
Refrigerant Gas	Yellow	REF GAS

<u>2.5 IDENTIFICATION DUCTWORK SYSTEMS</u>	.1	50 mm high stenciled letters and directional arrows 150 mm long x 50 mm high. Identify service source and system.
	.2	Colours: back, or coordinated with base colour to ensure strong contrast.
<u>2.6 VALVES, CONTROLLERS</u>	.1	Brass tags with 12 mm stamped identification data filled with black paint.
	.2	Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
<u>2.7 CONTROLS COMPONENTS IDENTIFICATION</u>	.1	Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
	.2	Inscriptions to include function and (where appropriate) fail-safe position.

- 2.8 LANGUAGE .1 Identification in English and French.
- .2 Use one nameplate and label for both languages.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 TIMING .1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.
- 3.3 INSTALLATION .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.
- 3.4 NAMEPLATES .1 Locations:
- .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
- .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
- .1 Do not paint, insulate or cover, in any way.
- 3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.

- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

Building Modernization	MECHANICAL	Section 23 05 53.01
Phase II	IDENTIFICATION	Page 7
10 Weldon St, Shediac, NB		
Project No.: R.039554.001		2013.07.17

- 3.7 CLEANING .1 Proceed in accordance with Section 01 74 11
- Cleaning.
- .2 Upon completion and verification of
performance of installation, remove surplus
materials, excess materials, rubbish, tools
and equipment.

END OF SECTION

PART 1 - GENERAL

- 1.1 SUMMARY .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.
- 1.2 GENERAL .1 A balancing and certifying agent, hereinafter referred to as "The Agency", shall balance and certify all air handling systems including exhaust systems, and all liquid heat transfer systems. The Agency shall also perform duct leakage testing on all ductwork as specified. The Balancing Agency shall be hired by the Air Distribution Contractor and shall be an independent agency certified by the Associated Air Balance Council (AABC). All work done by this agency shall be by qualified technicians under the direct supervision of an AABC certified test and balance Engineer.
- .2 The agency shall be responsible to the Owner but report jointly to the departmental representative and the Contractor. Report in writing to the department representative any discrepancies or items not installed in accordance with the contract documents.
- .3 Balance and test all systems in accordance with the most stringent measures stipulated in Associated Air Balance Council (AABC) "National Standards for Total System Balance", Latest Edition. Final balancing and certifying reports shall include details of actual test procedures used and subsequent results.
- .4 Submit six (6) copies of the Balancing and Certifying report upon completion of the work.

- 1.3 CONTRACTOR'S RESPONSIBILITY
- .1 The Contractor shall provide the Agency, within thirty (30) days of tender close, with one set of contract documents, and as issued, change orders.
 - .1 Provide applicable shop drawings within thirty (30) days of their approval.
 - .2 The Contractor shall cooperate with the selected Agency in the following manner:
 - .1 Provide immediate labour and tools to make corrections when required without undue delay. Install balancing flow and temperature sensing and regulating devices and equipment as well as balancing dampers as required by the Agency and approved by the department representative. Extra allowances will be made by the Crown for devices required over and above contract documents.
 - .2 Contractor shall operate air and liquid systems and equipment as and when required by the Agency or the departmental representative.
 - .3 Before balancing commences, the following work must be complete:
 - .1 All equipment operable in safe and normal operation.
 - .2 Environmental control systems complete and operable.
 - .3 Proper thermal overload protection in place for electrical equipment.
 - .4 Air Systems:
 - .1 Filters clean and in place.
 - .2 Duct systems clean of debris.
 - .3 Fire and volume dampers in place and open.
 - .4 Access doors closed and duct end caps in place.
 - .5 All outlets installed and connected.
 - .6 Duct system leakage test complete.
 - .5 Liquid Systems:
 - .1 Flushed, filled and vented.
 - .2 Correct pump rotation.

- .3 Proper strainer baskets clean and in place.
- .4 Service and balance valves open.
- .5 Liquid treatment system operable.
- .6 The Contractor shall inform the Agency in writing of any major changes made to systems during construction and shall provide the Agency two (2) sets of as-built drawings prior to starting of balancing.

1.4 AGENCY'S
RESPONSIBILITY

- .1 Within 60 days of tender award, the Agency shall perform a pre-construction contract drawings and specifications review and shall meet the departmental representative and provide:
 - .1 A written report on any deficiencies in the documents.
 - .2 Recommend where additional balancing devices should be installed.
 - .3 Detail those balance and inspection procedures stipulated in the AABC National Balancing Standards or the NEBB Procedural Standards for Balancing which shall not be followed and applied to this project.
- .2 The agency shall perform a complete review and inspection of the mechanical work during construction. These inspections shall occur at regular intervals to provide for a minimum of two (2) inspections. After each inspection, the agency shall meet with the departmental representative and provide a written report to recommend any corrective action.
- .3 Leave all system components in proper working order and correct settings.
 - .1 Replace belt guards.
 - .2 Close access doors.
 - .3 Close doors to electrical switch boxes.
 - .4 Restore thermostats to specified settings.

- .4 All recorded data shall represent a true, actually measured, or observed condition. Any observed abnormal conditions in the mechanical systems or conditions which prevent Total System Balance, shall be reported immediately to the departmental representative.
- .5 Permanently mark the settings of all valves, dampers and other adjustment devices to allow the settings to be restored. Set and lock all memory stop balancing devices.
- .6 Prior to starting testing and balancing, submit to the departmental representative the following:
 - .1 A list of instruments to be used for testing and balancing.
 - .2 Calibration date for instrument and the serial no. for calibration.
 - .3 Report in writing the sequence in which areas and equipment will be tested and balanced.
- .7 The Agency is to verify control system operation as specified, and report on any installation problems observed. The Agency shall limit its activities to setting controls to a proper fixed mode to prevent any changes during the balancing procedure. This also provides a verification of control operation, which is valuable to all parties. Physical change in the control system, such as relocating sensors, or calibrating controllers, is the responsibility of Section 25 55 00 - EMCS DDC Control. The Agency shall work closely with each Contractor to identify and correct problems.

1.5 AIR SYSTEM
BALANCING

- .1 The Agency shall perform the following work:
 - .1 Test and adjust blower rpm to design requirements.
 - .2 Test and record motor full load amperes.
 - .3 Make pitot tube traverse of main supply, return and exhaust and obtain design l/s at fans.

- .4 Test and record system static pressure, suction and discharge.
- .5 Test and adjust system for design l/s outside air.
- .6 Test and adjust each diffuser, grille, and register to plus or minus 10% of design requirements.
- .7 Identify each diffuser, grille and register as to location and area.
- .8 Identify and list size, type and manufacturer of diffusers, grilles, registers and all testing equipment.
- .9 Co-ordinate with Section 13840 - EMCS DDC Control to obtain the balanced air quantities at dampers as indicated.

1.6 LIQUID HEAT
TRANSFER SYSTEM
BALANCING

- .1 The Liquid Heat Transfer Systems balancing shall not begin until the Agency has verified the following:
 - .1 System is completely filled.
 - .2 System is clean.
 - .3 System is free of air.
 - .4 All service valves are open.
 - .5 All strainers are provided with clean sleeves having proper perforation.
 - .6 Two-way valves are properly piped.
 - .7 All coils are correctly piped.
 - .8 Coil fins are straight and clean.
 - .9 Proper balancing devices are in place and correctly located:
 - .1 Pressure taps.
 - .2 Thermometer wells.
 - .3 Balancing valves and balancing flow stations.
 - .10 Automatic temperature control system is in operation.
 - .11 There is no entrained air in the suction piping to pumps in an open system, which can have a negative effect on the pump performance.
 - .12 The pressure is adequate to completely fill the system.
- .2 The Agency shall measure the amperes of all pump motors before hydronic balancing is started and shall take proper steps to correct and report any overloads.
- .3 The Agency shall not continue the hydronic balancing if at any time hazardous conditions are observed.

- .4 The Balancing Agency shall apply any necessary correction factor to the indicated value to account for the density of the fluid flowing in the system.

1.7 DUCT LEAKAGE
TESTING

- .1 The Agency shall:
 - .1 Measure and record duct leakage rate.
 - .2 Report any unusual conditions at time of test.
 - .3 Identify leakage source in any non-complying situation.
 - .4 Submit verification report.
 - .5 All openings in the duct system shall be carefully sealed shut by the Contractor. Sealing shall conform to the recommendation of the Balancing Agency.
 - .6 Duct systems shall be separate and sealed in sections according to the recommendations of the Balancing Agency.
 - .7 The test kit shall consist of:
 - .1 Test blower.
 - .2 Calibrated orifice tube.
 - .3 Two manometers.
 - .4 Flexible tubing for connecting to the duct system.
 - .8 The Contractor shall provide test connections where required by the Agency for connection of the test apparatus.
 - .9 The system static pressure tap shall be in the system duct and shall be at 300 mm from the test connection. Static pressure taps in the orifice tube shall not be used to read system static pressure.
 - .10 The inlet opening of the test blower shall be blocked off before the test blower is started. The inlet opening shall then be opened slowly to prevent overpressurizing the system.
 - .11 All new low pressure supply return and exhaust ductwork shall be tested at 500 Pa w.g. static pressure with a maximum leakage of 1.5%. All medium pressure ductwork shall be tested at 750 Pa w.g. with a maximum leakage of 1.5%.

- .12 System 1 shall be tested at 750 Pa.
System 3 shall be tested at 750 Pa.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not used.

END OF SECTION

PART 1 - GENERAL

- | | | |
|-----------------------------|----|---|
| <u>1.1 RELATED SECTIONS</u> | .1 | Section 01 33 00 - Submittal Procedures. |
| | .2 | Section 23 05 29 - Hangers and Supports. |
| <u>1.2 REFERENCES</u> | .1 | American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) |
| | .1 | ANSI/ASHRAE/IESNA 90.1-[01], SI; Energy Standard for Buildings Except Low-Rise Residential Buildings. |
| | .2 | American Society for Testing and Materials International, (ASTM) |
| | .1 | ASTM B 209M-[02], Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric). |
| | .2 | ASTM C 335-[95], Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation. |
| | .3 | ASTM C 411-[97], Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation. |
| | .4 | ASTM C 449/C 449M-[00], Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement. |
| | .5 | ASTM C 547-[00], Specification for Mineral Fiber Pipe Insulation. |
| | .6 | ASTM C 553-[00], Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications. |
| | .7 | ASTM C 612-[00a], Specification for Mineral Fiber Block and Board Thermal Insulation. |
| | .8 | ASTM C 795-[92], Specification for Thermal Insulation for Use with Austenitic Stainless Steel. |
| | .9 | ASTM C 921-[92(1998)e1], Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel. |
| | .3 | Canadian General Standards Board (CGSB) |
| | .1 | CGSB 51-GP-52Ma-[89], Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation. |

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).

.5 Underwriters Laboratories of Canada (ULC)
.1 CAN/ULC-S102-[M88(R2000)], Surface Burning Characteristics of Building Materials and Assemblies.
.2 CAN/ULC-S701-[01], Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.3 DEFINITIONS .1 For purposes of this section:
.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
.2 "EXPOSED" - will mean "not concealed" as defined herein.
.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:
.1 CRD: Code Round Ductwork,
.2 CRF: Code Rectangular Finish.

1.4 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 SAMPLES .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.6 MANUFACTURERS' INSTRUCTIONS .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Installation instructions to include procedures used, and installation standards achieved.

1.7 QUALIFICATIONS .1 Installer: specialist in performing work of this section, and have at least three (3) years successful experience in this size and type of project, qualified to standards, member of TIAC.

- 1.8 DELIVERY, STORAGE AND HANDLING
- .1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
 - .2 Protect from weather and construction traffic.
 - .3 Protect against damage from any source.
 - .4 Store at temperatures and conditions recommended by manufacturer.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING .1 In accordance with CAN/ULC-S102:

- .1 Maximum flame spread rating: 25.
- .2 Maximum smoke developed rating: 50.

- 2.2 INSULATION .1 Mineral fibre as specified herein includes glass fibre.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.
 - .3 TIAC Code C-1: Rigid mineral fibre board to CAN/CGSB51.10, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.
 - .1 Application on square and rectangular supply air ductwork, and to 4m from exhaust outlets and fans.
 - .2 Standard of Acceptance: Own Corning Canada Type 701 FRK, Knauf, Manson, Certain Teed.
 - .4 TIAC C-1A: Scored semi-rigid fibrous glass board material with factory jacketed kraft aluminum foil ASJ jacketing.
 - .1 Material: to ASTM C 795

- .2 Jacket: to ASTM C 1136
- .3 Application on round supply ducts larger than 500mm, and exhaust to 4m from outlet.
- .4 Standard of Acceptance: Owen Corning Pipe and Tank Insulation, Knauf, Manson, Certain Teed.
- .5 TIAC Code C-2: Mineral fibre blanket to ASTM C 553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.
 - .1 Mineral fibre: to ASTM C 553
 - .2 Jacket: to CGSB 51-GP-52Ma
 - .3 Maximum "k" factor: to ASTM C 553
 - .4 Application on round supply ductwork: 500 mm and less - thickness 50 mm and exhaust ductwork to 4m from exterior.
 - .5 Standard of Acceptance: Owens Corning Canada Type 100 all service duct wrap, Knauf, Manson, Certain Teed.

2.3 JACKETS

- .1 Jackets: Venture Clad
Provide a 5-ply laminate, zero permeability, absolute vapor barrier, stucco embossed Venture Clad 1577CW-E, as manufactured by Venture Tape Group, or equal. The jacket shall have high puncture and tear resistance and be a self-adhesive material exceed UL723 requirements. The jacket shall be installed in strict accordance with the manufacturer's recommendations.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.
- .4 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .5 Contact adhesive: quick-setting
- .6 Tie wire: 1.5 mm stainless steel.

- .7 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .8 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

END OF SECTION

PART 1 - GENERAL

- | | | |
|---------------------------------|----|--|
| <u>1.1 RELATED SECTIONS</u> | .1 | Section 23 05 93 - Testing, Adjusting and Balancing for HVAC. |
| <u>1.2 REFERENCES</u> | .1 | American Society for Testing and Materials. |
| | .2 | ASTM E 202-94A, Test Methods for Analysis of Ethylene Glycols and Propylene Glycols. |
| <u>1.3 ACCEPTABLE MATERIALS</u> | .1 | Where materials are specified by trade name, refer to the Project Specific Instruction to Bidders for procedure to be followed in applying for approval of alternatives. |
| | .2 | All materials shall be low in V.O.C. (Volatile Organic Compound) emissions. |

PART 2 - PRODUCTS

- | | | |
|--------------------------------------|----|--|
| <u>2.1 CLEANING SOLUTIONS</u> | .1 | Tri-sodium phosphate: 0.40 kg per 100 L water in system. |
| | .2 | Sodium carbonate: 0.40 kg per 100 L water in system. |
| | .3 | Low-foaming detergent: 0.01 kg per 100 L water in system. |
| <u>2.2 CLEANING HYDRONIC SYSTEMS</u> | .1 | Timing |
| | .1 | Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning are carried out. |
| | .2 | Cleaning Agency: |
| | .1 | Retain qualified water treatment specialist to perform system cleaning. |
| | .3 | Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist. |

- .4 Cleaning procedures:
 - .1 Provide detailed report outlining proposed cleaning procedures at least four (4) weeks prior to proposed starting date. Report to include:
 - .1 Cleaning procedures, flow rates, elapsed time.
 - .2 Chemicals and concentrations to be used.
 - .3 Inhibitors and concentrations.
 - .4 Specific requirements for completion of work.
 - .5 Special precautions for protecting piping system materials and components.
 - .6 Complete analysis of water to be used to ensure water will not damage systems or equipment.
- .5 Conditions at time of cleaning of systems
 - .1 Systems to be free from construction debris, dirt and other foreign material.
 - .2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.
 - .3 Strainers to be clean prior to initial fill.
 - .4 Install temporary filters on pumps not equipped with permanent filters.
 - .5 Install pressure gauges on strainers to detect plugging.
- .6 Report on Completion of Cleaning
 - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
 - .1 Fill system with water; ensure air is vented from system.
 - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
 - .3 Use water meter to record volume of water in system to +/- 0.5%.
 - .4 Add chemicals under direct supervision of chemical treatment supplier.

- .5 Closed loop systems: circulate system cleaner at 60°C for at least 36 hours. Drain as quickly as possible. Refill with water plus inhibitors. Test concentrations and adjust to recommended levels.
- .6 Flush velocity in system mains and branches to be adequate so as to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
- .7 Add chemical solution to system.
- .8 Establish circulation, raise temperature slowly to maximum design or 82°C minimum. Circulate for 12 hours, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38°C. Drain as quickly as possible. Refill with clean water. Circulate for 6 hours at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).
- .9 Ensure all mains and all branches are open to system during cleaning and flushing procedure.

PART 3 - EXECUTION

- | | |
|---|--|
| <u>3.1 START-UP OF
HYDRONIC SYSTEMS</u> | <ul style="list-style-type: none"> .1 After cleaning is completed and system is filled: <ul style="list-style-type: none"> .1 Establish circulation and expansion tank level, set pressure controls. .2 Ensure all air is removed. .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature. .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals. .5 Clean out strainers repeatedly until system is clean. .6 Commission water treatment systems. |
|---|--|

Building Modernization Phase II 10 Weldon St, Shediac, NB Project No. R.039554.001	CLEANING AND START-UP OF MECHANICAL PIPING SYSTEM	Section 23 08 02 Page 4 2013.07.17
---	---	--

- .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
- .8 Repeat with water at design temperature.
- .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and all other noises.
- .10 Bring system up to design temperature and pressure slowly over a 48 hour period.
- .11 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .12 Adjust pipe supports, hangers, and springs as necessary.
- .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
- .15 Re-tighten all bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
- .16 Check operation of drain valves.
- .17 Adjust valve stem packing as systems settle down.
- .18 Fully open all balancing valves (except those that are factory-set).
- .19 Check operation of over-temperature protection devices on circulating pumps.
- .20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END OF SECTION

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes.
- .1 Materials and installation for steel piping, valves and fittings for hydronic systems.
 - .2 Related Sections.
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
 - .3 Section 01 35 29 - Health and Safety Requirements.
 - .4 Section 01 78 00 - Closeout Submittals].
 - .5 Section 21 05 01 - Common Work Results for Mechanical.
 - .6 Section 23 05 17 - Pipe Welding.
 - .7 Section 23 05 05 - Installation of Pipework.
 - .8 Section 23 05 23.01 - Valves - Bronze.
 - .9 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- 1.2 REFERENCES .1 American Society of Mechanical Engineers (ASME).
- .1 ASME B16.1-[98], Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.3-[98], Malleable Iron Threaded Fittings.
 - .3 ASME B16.5-[03], Pipe Flanges and Flanged Fittings.
 - .4 ASME B16.9-[01], Factory-Made Wrought Buttwelding Fittings.
 - .5 ASME B18.2.1-[03], Square and Hex Bolts and Screws (Inch Series).
 - .6 ASME B18.2.2-[87(R1999)], Square and Hex Nuts (Inch Series).
 - .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 47/A 47M-[99], Standard Specification for Ferritic Malleable Iron Castings.

- .2 ASTM A 53/A 53M-[02], Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- .3 ASTM A 536-[84(1999)e1], Standard Specification for Ductile Iron Castings.
- .4 ASTM B 61-[02], Standard Specification for Steam or Valve Bronze Castings.
- .5 ASTM B 62-[02], Standard Specification for Composition Bronze or Ounce Metal Castings.
- .6 ASTM E 202-[00], Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .3 American Water Works Association (AWWA).
 - .1 AWWA C111-[00], Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242-[M1980(R1998)], Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CAN/CSA W48-[01], Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-[025], Butterfly Valves.
 - .2 MSS-SP-70-[98], Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-[97], Cast Iron Swing Check Valves Flanged and Threaded Ends.
 - .4 MSS-SP-80-[03], Bronze Gate, Globe, Angle and Check Valves.
 - .5 MSS-SP-85-[02], Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

- | | | |
|-----------------------|----|--|
| <u>1.3 SUBMITTALS</u> | .1 | Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures. |
|-----------------------|----|--|

- .2 Closeout Submittals.
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- 1.4 QUALITY ASSURANCE .1 Health and Safety.
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
- 1.5 MAINTENANCE .1 Extra Materials.
 - .1 Provide following spare parts:
 - .1 Valve seats: one for every ten valves, each size. Minimum one.
 - .2 Discs: one for every ten valves, each size. Minimum one.
 - .3 Stem packing: one for every ten valves, each size. Minimum one.
 - .4 Valve handles: two of each size.
 - .5 Gaskets for flanges: one for every ten flanges.

PART 2 - PRODUCTS

- 2.1 PIPE .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
 - .1 To 2": Schedule 40, seamless.
- 2.2 PIPE JOINTS .1 2" and under: screwed fittings with PTFE tape.
 - .2 2½" and over: welding fittings and flanges to CAN/CSA W48.
 - .3 Flanges: raised face, slip-on to AWWA C111.
 - .4 Orifice flanges: slip-on raised face, 2100 kPa.
 - .5 Flange gaskets: to AWWA C111.
 - .6 Pipe thread: taper.
 - .7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.
 - .8 Roll grooved coupling gaskets: type EPDM.

- 2.3 FITTINGS .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
- .1 Cast iron: to ASME B16.1, Class 125.
- .2 Steel: to ASME B16.5.
- .3 Butt-welding fittings: steel, to ASME B16.9.
- .4 Unions: malleable iron, to ASTM A 47/A 47M and ASME B16.3.
- 2.4 VALVES .1 Connections:
- .1 2" and smaller: screwed ends.
- .2 2½" and larger: Flanged ends.
- .2 Balancing, for TAB:
- .1 General:
- .1 Y style globe valve, designed to provide precise flow measurements and control, with valved ports for connecting to differential pressure meter.
- .2 Accuracy:
- .1 Readout to be within plus or minus 2% of actual flow at design flow rate.
- .3 2" and under:
- .1 Pressure die cast zinc dezincification resistant copper alloy stainless steel construction; maximum WP: 1.7 Mpa; Max. temp: 121°C, screwed ends, Teflon disc, screwed in bonnet.
- .2 Flow control: at least 4 full turns of handwheel with digital hand wheel and tamper proof mechanical memory.
- .4 2½" and over:
- .1 Body and Epoxy resin coated cast iron: bonnet and trim of zinc-dezincification resistant copper alloy; bonnet bolts of stainless steel maximum AP: 1.7 Mpa; Maximum temp: 121°C, ANSI Class 125 flanged ends.

- .2 Flow control: at least 8 full turns of handwheel with vernier type ring settings and tamperproof concealed mechanical memory.
- .5 Insulation: use prefabricated shipping packaging of 5.4 R polyurethane as insulation for installation.
- .6 Drain connection:
 - .1 $\frac{3}{4}$ "valved and capped drain connection suitable for hose socket to be incorporated into the valve body or provided as separate item.
- .7 Acceptable materials: Armstrong CBV, Tour & Anderson STA., Newman Hattersley, Danfoss.
- .3 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .4 Swing check valves:
 - .1 2" and under:
 - .1 As specified Section 23 05 23.01 - Valves - Bronze.
- .5 Silent check valves:
 - .1 2" and under:
 - .1 As specified Section 23 05 23.01 - Valves - Bronze.
- .6 Ball valves:
 - .1 2" and under: as specified Section 23 05 23.01 - Valves - Bronze.

PART 3 - EXECUTION

- | | | |
|--|----|--|
| 3.1 PIPING
<u>INSTALLATION</u> | .1 | Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work. |
| 3.2 CIRCUIT
<u>BALANCING VALVES</u> | .1 | Install flow measuring stations and flow balancing valves on return from fan coil and radiant heating. |
| | .2 | Remove handwheel after installation and when TAB is complete. |

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.3 TESTING .1 Test system in accordance with Section 21 05 01 - Mechanical General Requirements.

3.4 BALANCING .1 Balance water systems to within plus or minus 5% of design output.

.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

END OF SECTION

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
- .1 The supply and installation of Hydronic Specialties Equipment.
 - .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 35 29 - Health and Safety Requirements.
 - .3 Section 01 78 00 - Closeout Submittals.
- 1.2 REFERENCES .1 American Society of Mechanical Engineers (ASME).
- .1 ASME-[04], Boiler and Pressure Vessel Code.
 - .2 American Society for Testing and Materials, (ASTM).
 - .1 ASTM A 47/A 47M-[99], Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 278M-[01], Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (345 degrees C).
 - .3 ASTM A 516/A 516M-[96(e1)], Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A 536-[84(1999)e1], Specification for Ductile Iron Castings.
 - .5 ASTM B 62-[93], Specification for Composition Bronze or Ounce Metal Castings.
 - .3 Canadian Standards Association (CSA International).
 - .1 CSA B51-[03], Boiler, Pressure Vessel, and Pressure Piping Code.
- 1.3 SUBMITTALS .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets.

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate on product data air vents, air separators, valves, pot feeders and strainers.
 - .3 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- 1.4 QUALITY ASSURANCE .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
- PART 2 - PRODUCTS
- 2.1 PIPE LINE STRAINER .1 NPS 1/2 to 2: bronze body to ASTM B 62, screwed connections, Y pattern.
- .2 NPS 2 1/2 to 12: cast iron body to ASTM, Class 30 flanged connections.
 - .3 Blowdown connection: NPS 1.
 - .4 Screen: stainless steel with 1.19 mm perforations.
 - .5 Working pressure: 860 kPa.
 - .6 Acceptable material: Watts Series 77S and 77F-D, Armstrong, Sarco, Sureflow, Victaulic.
- 2.2 MANUAL AIR VENT .1 Manual air vent: brass body and 3 mm connection, rated 690 kPa working pressure.
 - .1 Acceptable materials: Amtrol, Taco, Braukman, Maid of the Mist.
- 2.3 AUTOMATIC AIR VENT .1 Industrial high capacity float vent: cast iron body and 15 mm connection, rated at 860 kPa working pressure.
- .2 Float: Solid material suitable for 115°C working temperature.

- .3 Acceptable materials: Armstrong, Bell and Gossett, Sarco, Taco.

2.4 DIAPHRAGM TYPE EXPANSION TANK

- .1 Vertical, painted steel, pressurized diaphragm type expansion tank.
- .2 Diaphragm sealed in replaceable butyl, suitable for 115°C operating temperature.
- .3 Working pressure: 860 kPa with ASME stamp and certification.
- .4 Air precharged to 137.8 kPa.
- .5 Size:

Mark	Total Volume (L)	Acceptance Volume (L)	Size (mm)	Initial Pressure (kPa)	Standard of Acceptance
EXT-1	340	128	1591 x 610	275	AMTROL AX-180
EXT-2	340	128	1591 x 610	275	AMTROL AX-180

2.5 AIR SEPARATOR - IN-LINE

- .1 Working pressure: 860 kPa.
- .2 Tangential flow with strainer.
- .3 Size: Heating 4"; Cooling 6".
- .4 Acceptable Material: Armstrong,.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Install as indicated and to manufacturer's recommendations.
- .2 Run drain lines and blow off connections to terminate above nearest drain.
- .3 Maintain proper clearance to permit service and maintenance.
- .4 Should deviations beyond allowable clearances arise, request and follow departmental representative's directive.
- .5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

- 3.2 STRAINERS .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.
- .4 Install ahead of each automatic control valve.
- 3.3 AIR VENTS .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink.

END OF SECTION

PART 1 - GENERAL

- 1.1 SECTION INCLUDES .1 Materials, equipment selection, installation and start up for hydronic system pumps.
- 1.2 RELATED SECTIONS .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29 - Health and Safety Requirements.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 01 91 13 - General Commissioning (Cx) Requirements.
- 1.3 REFERENCES .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
- .1 Standard 90.1-2001 Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers Advisory Council (EEMAC).
- .3 Canadian Standards Association (CSA International).
- .1 CAN/CSA-B214-[01], Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers Association (NEMA).
- .1 NEMA MG 1-[2003], Motors and Generators.
- 1.4 SUBMITTALS .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

- .4 Submit product data of pump curves for review showing point of operation.
- .5 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.
- .6 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

PART 2 - PRODUCTS

2.1 IN-LINE CURCULATORS

- .1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: brass or bronze.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135°C.
- .5 Coupling: rigid self-aligning.
- .6 Motor: resilient mounted, drip proof, sleeve bearing, 1750 r/min.
- .7 Capacity: In Schedule.
- .8 Design pressure: 1200 kPa.
- .9 Acceptable material: Armstrong, Bell & Gossett, Leitch.
- .10 Pumps shall be in accordance with following schedule:

MARK	FLOW (l/s)	METER/ HEAD	MOTOR (kW/Volt/Ph)	SIZE	STANDARD OF ACCEPTANCE
HCR-1 HCR-2	14.17	19.8	5.6/600/3	4 x 4 x 10	Armstrong 4300
CCR-1 CCR-2	31.18	21.3	11.2/600/3	6 x 6 x 10	Armstrong 4300

- 2.2 ACCESSORIES .1 Suction Guides:
- .1 Install on the suction of each pump a suction guide with outlet flow stabilizing guide vanes, removable stainless steel strainer and fine mesh start-up strainer.
 - .2 Supply valve with cast iron body with 125 psig flanged ports.
 - .3 Flo-Trex Valves:
 - .1 Install on the discharge side of each pump a Flo-Trex combination valve. Each valve shall incorporate the following three functions in one body: tight shut-off, spring-closure type silent non-slam check and effective throttling. The body shall have 6mm NPT connections on each side of the valve seat. Two connections to have brass pressure and temperature metering ports, with EPDM check valves and gasketed caps. Two other connections to be supplied with drain plugs. Metering ports shall be interchangeable with drain ports to allow for measurement flexibility when installed in tight locations. The valve disc shall be bronze plug and disc type with EPDM seat to ensure tight shut-off and silent check operation. The valve stem shall be stainless steel with flat surfaces provided for adjustment with open-end wrench.
 - .2 For grooved piping, valve body shall be ductile iron with grooved ends Armstrong anti-rotation Armgrip lugs on the inlet and outlet of the body.
 - .3 Flange adapters, where necessary, are to be Armstrong Armgrip ANSI-125 or ANSI-250 ductile iron flanges with anti-rotation lugs and EPT gaskets.
 - .4 Valve body shall be cast iron with ANSI-125 flanged ports.
 - .4 Standard of Acceptance:

Pump	Suction Guide/Size	Flo-Trex Valve Size
HCR-1 and HCR-2	Armstrong SG-44	Armstrong FTV-4FA
CCR-1 and CCR-2	Armstrong SG-66 - 6"	Armstrong FTV-6FA

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Do work in accordance with CAN/CSA-B214.
- .2 In line circulators: Install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.
- .3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
- .4 Pipe drain tapping to floor drain.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge test cocks.
- 3.2 START-UP .1 General:
- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements supplemented as specified herein.
- .2 In accordance with manufacturer's recommendations.
- .2 Procedures:
- .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
- .2 After starting pump, check for proper safe operation.
- .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
- .4 Run-in pumps for 12 continuous hours.
- .5 Verify operation of over-temperature and other protective devices under low-and no-flow condition.
- .6 Eliminate air from scroll casing.
- .7 Adjust alignment of piping and conduit to ensure true flexibility at all times.

- .8 Eliminate cavitation, flashing and air entrainment.
- .9 Adjust pump shaft seals, stuffing boxes, glands.
- .10 Measure pressure drop across strainer when clean and with flow rates as finally set.

END OF SECTION

PART 1 - GENERAL

- 1.1 RELATED SECTION .1 Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Charts.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 35 29 - Health and Safety Requirements.
- .4 Section 01 45 00 - Quality Control.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 02 81 01 - Hazardous Materials.
- .7 Section 23 05 01 - Installation of Pipework.
- 1.2 REFERENCES .1 American Society of Mechanical Engineers (ASME)
- .1 ASME B16.22-[01], Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
- .2 ASME B16.24-[02], Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
- .3 ASME B16.26-[88], Cast Copper Alloy Fittings for Flared Copper Tubes.
- .4 ASME B31.5-[01], Refrigeration Piping and Heat Transfer Components.
- .2 American Society for Testing and Materials International (ASTM)
- .1 ASTM B 280-[03], Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA International)
- .1 CSA B52-[99], Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
- .1 EPS 1/RA/1-[96], Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- 1.3 SUBMITTALS .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.
 - .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .4 Instructions: submit manufacturer's installation instructions.
 - .5 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- 1.4 QUALITY ASSURANCE .1 Pre-Installation Meeting:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Charts.
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

PART 2 - PRODUCTS

- 2.1 TUBING .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B 280, type ACR.
 - .2 Annealed copper: to ASTM B 280, with minimum wall thickness as per CSA B52 and ASME B31.5.
- 2.2 FITTINGS .1 Service: design pressure 2070 kPa and temperature 121°C.
 - .2 Brazed:
 - .1 Fittings: wrought copper to ASME B16.22.
 - .2 Joints: silver solder, 45% Ag-15% Cu or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
 - .3 Flanged:
 - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
 - .2 Gaskets: suitable for service.
 - .3 Bolts, nuts and washers: to ASTM A 307, heavy series.
 - .4 Flared:
 - .1 Bronze or brass, for refrigeration, to ASME B16.26.
- 2.3 PIPE SLEEVES .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.
- 2.4 VALVES .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

PART 3 - EXECUTION

- | | | |
|--|----|--|
| <u>3.1 MANUFACTURER'S INSTRUCTIONS</u> | .1 | Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet. |
| <u>3.2 GENERAL</u> | .1 | Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 01 - Installation of Pipework. |
| <u>3.3 BRAZING PROCEDURES</u> | .1 | Bleed inert gas into pipe during brazing. |
| | .2 | Remove valve internal parts, solenoid valve coils, sight glass. |
| | .3 | Do not apply heat near expansion valve and bulb. |
| <u>3.4 PIPING INSTALLATION</u> | .1 | General: <ul style="list-style-type: none"> .1 Soft annealed copper tubing: bend without crimping or constriction hard drawn copper tubing: do not bend. Minimize use of fittings. |
| | .2 | Hot gas lines: <ul style="list-style-type: none"> .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation. .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter. .3 Provide inverted deep trap at top of risers. .4 Provide double risers for compressors having capacity modulation. <ul style="list-style-type: none"> .1 Large riser: install traps as specified. .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser. |

- | | | |
|--|----|--|
| <u>3.5 PRESSURE AND
LEAK TESTING</u> | .1 | Close valves on factory charged equipment and other equipment not designed for test pressures. |
| | .2 | Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively. |
| | .3 | Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests. |
| <u>3.6 FIELD QUALITY
CONTROL</u> | .1 | Site Tests/Inspection:
.1 Close service valves on factory charged equipment. |
| | .2 | Ambient temperatures to be at least 13°C for at least 12 hours before and during dehydration. |
| | .3 | Use copper lines of largest practical size to reduce evacuation time. |
| | .4 | Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil. |
| | .5 | Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed. |
| | .6 | Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
.1 Twice to 14 Pa absolute and hold for 4 h.
.2 Break vacuum with refrigerant to 14 kPa.
.3 Final to 5 Pa absolute and hold for at least 12 h.
.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
.5 Submit test results to departmental representative. |

- .7 Charging:
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
 - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
 - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to departmental representative.
- .9 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.

3.7 DEMONSTRATION .1 Instructions:

- .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.

3.8 CLEANING .1 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

- 3.9 DECOMMISSIONING .1 Each piece of equipment being decommissioned must have a Decommissioning Notice filled out. Three copies of the form must be provided for each piece of machinery being commissioned - one set to go into the Maintenance Manuals, one set to the Consultant and one set to the Commissioning Manager with SNC-Lavalin, so the halocarbon inventory can be adjusted.
- .2 Federal Halocarbon Regulations must be followed for work conducted on equipment containing refrigerants during this project. The process is as follows:
- .1 Each piece of equipment that will be decommissioned must have a Decommissioning Notice filled out. These must be submitted to the SNC-Lavalin Cx Manager ASAP so that the buildings Halocarbon inventory can be properly adjusted. All information must be filled out and the final destination of the equipment must be indicated.
 - .2 An ADS Tag must also be filled out for each piece of equipment. These ODS Tags will be provided by the on-site building staff. All required information must be filled out which will include items such as total amount of refrigerant recovered and final destination of equipment if a scrap yard, which one, etc. The original ODS must accompany the unit to its final destination and a copy of the Tag must be kept on-site for 5 years.
 - .3 The equipment identified above must be recovered of its refrigerant before it leaves the property. Recovery of refrigerant off site is not permitted.
 - .4 For new equipment installed during this project, the process is similar except in reverse (no Decommissioning Notice is required obviously). But the refrigeration technician will be required to fill out a new ODS tag for each piece of equipment. For each piece of equipment with a capacity of over 5 tons, a dedicated log book will be provided as these systems must be

- leak tested every 6 months. Smaller systems are not required to be leak tested therefore share a common logbook. This process must be followed for all new items installed, regardless of their charging capacity.
- .5 For all forms required, the process shall be obtained from the SNC-Lavalin Commissioning Manager.

END OF SECTION

Building Modernization	METAL DUCTS -	Sect 23 31 13.01
Phase II	LOW PRESSURE TO	Page 1
10 Weldon St, Shediac, NB	500 PA	
Project No.: R.039554.001		2013.07.17

PART 1 - GENERAL

<u>1.1 SUMMARY</u>	.1	Section Includes:
	.1	Materials and installation of low-pressure metallic ductwork, joints and accessories.
	.2	Sustainable requirements for construction and verification.
	.2	Related Sections:
	.1	Section 01 33 00 - Submittal Procedures.
	.2	Section 01 35 29 - Health and Safety Requirements.
	.3	Section 07 84 00 - Firestopping.
	.4	Section 23 05 29 - Hangers and Supports.
	.5	Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
<u>1.2 REFERENCES</u>	.1	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
	.2	American Society for Testing and Materials International, (ASTM).
	.1	ASTM A 480/A 480M-[03c], Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
	.3	Health Canada/Workplace Hazardous Materials Information System (WHMIS).
	.1	Material Safety Data Sheets (MSDS).
	.4	National Fire Protection Association (NFPA).
	.1	NFPA 90A-[02], Standard for the Installation of Air-Conditioning and Ventilating Systems.
	.5	Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
	.1	SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition [1995] and Addendum No. 1, [1997].

Building Modernization Phase II 10 Weldon St, Shediac, NB Project No.: R.039554.001	METAL DUCTS - LOW PRESSURE TO 500 PA	Sect 23 31 13.01 Page 2 2013.07.17
--	--	--

- .2 SMACNA HVAC Air Duct Leakage Test Manual, [1985], 1st Edition.
- .3 IAQ Guideline for Occupied Buildings Under Construction [1995], 1st Edition.

1.3 SUBMITTALS .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE .1 Certification of Ratings:

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
- .3 Indoor Air Quality (IAQ) Management Plan.
 - .1 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

PART 2 - PRODUCTS

2.1 SEAL CLASSIFICATION .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	A

All supply, return on system AHU-3 and exhaust ductwork.

- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape or combination thereof.

Building Modernization	METAL DUCTS -	Sect 23 31 13.01
Phase II	LOW PRESSURE TO	Page 3
10 Weldon St, Shediac, NB	500 PA	
Project No.: R.039554.001		2013.07.17

	.3	Class C: transverse joints and connections made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.
<u>2.2 SEALANT</u>	.1	Sealant: Water based, polymeric emulsion fire resistant duct sealer, temperature range of minus 30°C to plus 65°C.
<u>2.3 TAPE</u>	.1	Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.
<u>2.4 DUCT LEAKAGE</u>	.1	Maximum leakage of 1 ½ % at 500 Pa.
<u>2.5 FITTINGS</u>	.1	Fabrication: to SMACNA.
	.2	Radiused elbows.
	.1	Rectangular: standard radius.
	.2	Round: smooth radius. Centreline radius: 1.5 times diameter.
	.3	Mitred elbows, rectangular:
	.1	To 400 mm: with double thickness turning vanes.
	.2	Over 400 mm: with double thickness turning vanes.
	.4	Branches:
	.1	Rectangular main and branch: with radius on branch 1.5 times width of duct.
	.2	Round main and branch: enter main duct at 45 degrees with conical connection.
	.3	Provide volume control damper in branch duct near connection to main duct.
	.4	Main duct branches: with splitter damper.
	.5	Transitions:
	.1	Diverging: 20 degrees maximum included angle.
	.2	Converging: 30 degrees maximum included angle.
	.6	Offsets:
	.1	Full radiused elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

2.6 FIRE STOPPING .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.

.2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL .1 Lock forming quality: to ASTM A 653/A 653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA, minimum 0.7 mm.

.3 Joints: to SMACNA.

2.8 HANGERS AND SUPPORTS .1 Hangers and Supports: [in accordance with Section 23 05 29 - Hangers and Supports t.

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to ASHRAE and SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp.

.3 For steel beams: manufactured beam clamps.

PART 3 - EXECUTION

- | <u>3.1 GENERAL</u> | .1 | Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, and SMACNA. | | | | | | | | |
|-------------------------------|---------|--|-----------|---------|------|------|---------|------|---------------|------|
| | .2 | Do not break continuity of insulation vapour barrier with hangers or rods. | | | | | | | | |
| | .1 | Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated. | | | | | | | | |
| | .3 | Support risers in accordance with ASHRAE and SMACNA. | | | | | | | | |
| | .4 | Install breakaway joints in ductwork on sides of fire separation. | | | | | | | | |
| <u>3.2 HANGERS</u> | .1 | Strap hangers: install in accordance with SMACNA. | | | | | | | | |
| | .2 | Angle hangers: complete with locking nuts and washers. | | | | | | | | |
| | .3 | Hanger spacing: in accordance with ASHRAE and SMACNA as follows: | | | | | | | | |
| | | <table> <tr> <th>Duct Size</th> <th>Spacing</th> </tr> <tr> <td>(mm)</td> <td>(mm)</td> </tr> <tr> <td>to 1500</td> <td>3000</td> </tr> <tr> <td>1501 and over</td> <td>2500</td> </tr> </table> | Duct Size | Spacing | (mm) | (mm) | to 1500 | 3000 | 1501 and over | 2500 |
| Duct Size | Spacing | | | | | | | | | |
| (mm) | (mm) | | | | | | | | | |
| to 1500 | 3000 | | | | | | | | | |
| 1501 and over | 2500 | | | | | | | | | |
| <u>3.3 SEALING AND TAPING</u> | .1 | Apply sealant to outside of joint to manufacturer's recommendations. | | | | | | | | |
| | .2 | Bed tape in sealant and recoat with minimum of one (1) coat of sealant to manufacturers recommendations. | | | | | | | | |
| <u>3.4 LEAKAGE TESTS</u> | .1 | Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC. | | | | | | | | |
| | .2 | In accordance with SMACNA HVAC Duct Leakage Test Manual. | | | | | | | | |
| | .3 | Do leakage tests in sections. All duct sections must be tested. | | | | | | | | |
| | .4 | Make trial leakage tests as instructed to demonstrate workmanship. | | | | | | | | |

Building Modernization	METAL DUCTS -	Sect 23 31 13.01
Phase II	LOW PRESSURE TO	Page 6
10 Weldon St, Shediac, NB	500 PA	
Project No.: R.039554.001		2013.07.17

- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three(3) branch takeoffs and all 90 degrees elbows.
- .7 Complete test before performance insulation or concealment work.

3.5 FIELD QUALITY CONTROL

- .1 Cleaning
 - .1 Clean all new ductwork to NADCA ACR 2006.

END OF SECTION

Building Modernization	METAL DUCTS -	Sect 23 31 13.02
Phase II	MEDIUM PRESSURE TO	Page 1
10 Weldon St, Shediac, NB	750 PA	
Project No.: R.039554.001		2013.07.17

PART 1 - GENERAL

<u>1.1 SUMMARY</u>	.1	Related Sections:
	.1	Section 01 33 00 - Submittal Procedures.
	.2	Section 01 35 29 - Health and Safety Requirements.
	.3	Section 23 05 29 - Hangers and Supports.
	.4	Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
<u>1.2 REFERENCES</u>	.1	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
	.2	American Society for Testing and Materials (ASTM).
	.1	ASTM A 653/A 653M-[04a], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. (Metric).
	.3	Health Canada/Workplace Hazardous Materials Information System (WHMIS).
	.1	Material Safety Data Sheets (MSDS).
	.4	Sheet Metal Air Conditioning Contractors' National Association (SMACNA).
	.1	SMACNA HVAC Duct Construction Standards, Metal and Flexible, [95 (Addendum No. 1, (1997))].
	.2	SMACNA HVAC Air Duct Leakage Test Manual, 1st Edition [1985].
	.3	SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition [1995].
<u>1.3 SUBMITTALS</u>	.1	Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE .1 Certification of Ratings:

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.5 INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN .1 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

PART 2 - PRODUCTS

2.1 DUCTWORK .1 Lock forming quality: to ASTM A 653/A 653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA, minimum 0.7 mm.

.3 Joints: to SMACNA.

.4 Construction - round and rectangular.

.1 Ducts: factory fabricated, with matching fittings and specials to SMACNA.

.2 Fittings:

.1 Elbows: five-piece for 90 degrees, three-piece for 45 degrees. Centreline radius: 1.5 x diameter.

.2 Branches: conical transition with conical branch at 45 degrees and 45 degrees elbow.

.5 Firestopping:

.1 50 x 50 x 3 mm retaining angles around duct, on both sides of fire separation.

.2 Firestopping material must not distort duct.

2.2 SEAL CLASSIFICATION .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
750	A

.2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

2.3 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports.

- .1 Band hangers: use on round and oval ducts up to 500 mm diameter, of same material as duct but next sheet metal thickness heavier than duct.
- .2 Trapeze hangers: ducts over 500 mm diameter or longest side, to ASHRAE, SMACNA.
- .3 Hangers: Type 304 stainless steel angle with Type 304 stainless steel rods to following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
Up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10

.4 Upper hanger attachments:

- .1 For concrete: manufactured concrete inserts.
- .2 For steel joist: manufactured joist clamp.
- .3 For steel beams: manufactured beam clamps.

PART 3 - EXECUTION

3.1 GENERAL

.1 Do work in accordance with ASHRAE and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

- .1 Insulate band hangers 100 mm beyond insulated duct.

- .3 Support risers in accordance with ASHRAE and SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Ensure installation of firestopping does not distort duct.

3.2 HANGERS

- .1 Band hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with as follows:

Duct Size mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 LEAKAGE TESTS

- .1 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Perform leakage tests on all ductwork, in sections.
- .4 Perform trial leakage tests, as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial tests have been achieved.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete tests before performing insulation or concealment Work.

END OF SECTION

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
- .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
- .1 Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
 - .2 Section 01 33 00 - Submittal Procedures.
 - .3 Section 01 35 29 - Health and Safety Requirements.
 - .4 Section 01 45 00 - Quality Control.
 - .5 Section 01 78 00 - Closeout Submittals.
- 1.2 REFERENCES .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
- .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- 1.3 SUBMITTALS .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.
 - .2 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: manufacturer's field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE .1

- Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM) and Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

PART 2 - PRODUCTS

- | | | |
|----------------------------------|----|--|
| <u>2.1 GENERAL</u> | .1 | Manufacture in accordance with SMACNA - HVAC Duct Construction Standards. |
| <u>2.2 FLEXIBLE CONNECTIONS</u> | .1 | Frame: galvanized sheet metal frame 1.6mm thick with fabric clenched by means of double locked seams. |
| | .2 | Material: <ul style="list-style-type: none"> .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m². |
| | .3 | Acceptable materials: Duro Dyne, Dyne Air. |
| <u>2.3 ACCESS DOORS IN DUCTS</u> | .1 | Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame. |
| | .2 | Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation. |
| | .3 | Gaskets: neoprene. |
| | .4 | Hardware: <ul style="list-style-type: none"> .1 Up to 300 x 300 mm: two sash locks complete with safety chain. .2 301 to 450 mm: four sash locks complete with safety chain. .3 451 to 1000 mm: piano hinge and minimum two sash locks. .4 Doors over 1000 mm: piano hinge and two handles operable from both sides. .5 Hold open devices. .6 300 x 300 mm glass viewing panels. |
| | .5 | Acceptable materials: United McGill |
| <u>2.4 TURNING VANES</u> | .1 | Factory fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated. |

- 2.5 INSTRUMENT TEST .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.
- .5 Acceptable materials: Duro Dyne P-4, Dyne Air.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

- 3.2 INSTALLATION .1 Flexible Connections:
- .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
- .1 Size:
 - .1 600 x 600 mm for person size entry.
 - .2 450 x 450 mm for servicing entry.
 - .3 300 x 300 mm for viewing.
 - .4 As indicated.

- .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 VAV and CAV terminal units.
 - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by departmental representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

- 3.3 FIELD QUALITY CONTROL .1 Manufacturer's Field Services:
- .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Once during progress of Work 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within three (3) days of review, and submit, immediately, to departmental representative.
- 3.4 CLEANING .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
- .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.
- 1.2 REFERENCES .1 Sheet Metal and Air Conditioning National Association (SMACNA)
- .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-[1985].
 - .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- 1.3 SUBMITTALS .1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 02 81 01 - Hazardous Materials.
 - .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available one (1) copy of systems supplier's installation instructions.

1.4 QUALITY <u>ASSURANCE</u>	.1	Health and Safety Requirements: .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
---------------------------------	----	--

1.5 DELIVERY, <u>STORAGE, AND HANDLING</u>	.1	Packing, shipping, handling and unloading: .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
---	----	---

PART 2 - PRODUCTS

2.1 GENERAL	.1	Manufacture to SMACNA standards.
2.2 SINGLE BLADE <u>DAMPERS</u>	.1	Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
	.2	Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
	.3	Locking quadrant with shaft extension to accommodate insulation thickness.
	.4	Inside and outside nylon end bearings.
	.5	Channel frame of same material as adjacent duct, complete with angle stop.
	.6	Acceptable materials: Round: AMI MD 200S, Ruskin, Nailer, NCA. Square or rectangular: AMI 200R, Ruskin, Nailer, NCA.
2.3 MULTI-BLADED <u>DAMPERS</u>	.1	Factory manufactured of material compatible with duct.
	.2	Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
	.3	Maximum blade height: 100 mm.
	.4	Bearings: self-lubricating nylon.
	.5	Linkage: shaft extension with locking quadrant.

- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Maximum leakage: 3% at 500 Pa.
- .8 Acceptable materials: Price SCD-57, AMI, Nailer, NCA.

PART 3 - EXECUTION

- | | | |
|--|----|--|
| <u>3.1 MANUFACTURER'S INSTRUCTIONS</u> | .1 | Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet. |
|--|----|--|
-
- | | | |
|-------------------------|----|---|
| <u>3.2 INSTALLATION</u> | .1 | Install where indicated. |
| | .2 | Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions. |
| | .3 | Locate balancing dampers in each branch duct, for supply, return and exhaust systems. |
| | .4 | Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts. |
| | .5 | Dampers: vibration free. |
| | .6 | Ensure damper operators are observable and accessible. |
| | .7 | Corrections and adjustments conducted by departmental representative. |
-
- | | | |
|----------------------------------|----|--|
| <u>3.3 FIELD QUALITY CONTROL</u> | .1 | Tests: <ul style="list-style-type: none">.1 Tests to cover period of not less than two (2) days and demonstrate that system is functioning as specified. |
|----------------------------------|----|--|

- 3.4 CLEANING .1 Proceed in accordance with Section 01 74 11
- Cleaning.
- .2 Upon completion and verification of
performance of installation, remove surplus
materials, excess materials, rubbish, tools
and equipment.

END OF SECTION

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
- .1 Operating dampers for mechanical forced air ventilation and air conditioning systems.
 - .2 Sustainable requirements for construction and verification.
- 1.2 REFERENCES .1 American Society for Testing and Materials International (ASTM)
- .1 ASTM A 653/A 653M-[04a], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
 - .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- 1.3 SUBMITTALS .1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 02 81 01 - Hazardous Materials.
 - .2 Indicate the following:
 - .1 Performance data.
 - .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- | | | |
|--|----|--|
| | .2 | Instructions: submit manufacturer's installation instructions. |
| | .1 | Departmental Representative will make available one (1) copy of systems supplier's installation instructions. |
| | .3 | Closeout Submittals |
| | .1 | Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. |
| <u>1.4 QUALITY ASSURANCE</u> | .1 | Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements. |
| | .2 | Certificates: |
| | .1 | Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency. |
| <u>1.5 DELIVERY, STORAGE, AND HANDLING</u> | .1 | Packing, shipping, handling and unloading: |
| | .1 | Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements. |
| | .2 | Deliver, store and handle materials in accordance with manufacturer's written instructions. |
|
<u>PART 2 - PRODUCTS</u> | | |
| <u>2.1 MULTI-LEAF DAMPERS</u> | .1 | Opposed and parallel blade type, as indicated. Supplied by Section 25 55 00, installed by this Section. |
| | .2 | Operator: by Section 25 55 00. |
| <u>2.2 BACK DRAFT DAMPERS</u> | .1 | Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, counterweighted. |
| <u>2.3 RELIEF DAMPERS</u> | .1 | Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counterweights set to open at 25 Pa static pressure. |

PART 3 - EXECUTION

- | | | |
|--|----|--|
| <u>3.1 MANUFACTURER'S INSTRUCTIONS</u> | .1 | Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet. |
| <u>3.2 INSTALLATION</u> | .1 | Install where indicated, supplied by Section 25 55 00. |
| | .2 | Install in accordance with recommendations of SMACNA and manufacturer's instructions. |
| | .3 | Seal multiple damper modules with silicon sealant. |
| | .4 | Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories. |
| | .5 | Ensure dampers are observable and accessible. |
| <u>3.3 CLEANING</u> | .1 | Proceed in accordance with Section 01 74 11 - Cleaning. |
| | .2 | Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment. |

END OF SECTION

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
- .1 Fire and smoke dampers, and fire stop flaps.
 - .2 Sustainable requirements for construction and verification.
- 1.2 REFERENCES .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
- .1 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN4-S112, Fire Test of Fire Damper Assemblies.
 - .2 CAN4-S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
 - .3 ULC-S505, Fusible Links for Fire Protection Service.
- 1.3 SUBMITTALS .1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 02 81 01 - Hazardous Materials.
 - .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Smoke dampers.
 - .3 Fire stop flaps.

- .4 Operators.
- .5 Fusible links.
- .6 Design details of break-away joints.

- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available one (1) copy of systems supplier's installation instructions.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

- 1.4 QUALITY ASSURANCE.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
- .2 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

- 1.5 MAINTENANCE.1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide following:
 - .1 Three (3) fusible links of each type.

- | | | |
|---|----|--|
| 1.6 DELIVERY,
STORAGE, AND
HANDLING | .1 | Packing, shipping, handling and unloading: |
| | .1 | Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements. |
| | .2 | Deliver, store and handle materials in accordance with manufacturer's written instructions. |

PART 2 - PRODUCTS

- | | | |
|------------------|----|--|
| 2.1 FIRE DAMPERS | .1 | Fire dampers: arrangement Dynamic curtain type fire damper, blades out of air stream, Type B and C, listed and bear label of ULC, meet requirements of provincial fire authority, Fire Commissioner of Canada (FCC) and ANSI/NFPA 90A, authorities having jurisdiction. Fire damper assemblies to be fire tested in accordance with CAN4-S112. |
| | .2 | Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation. |
| | .3 | Top hinged: offset interlocking blade curtain type; sized to maintain full duct cross section as indicated. |
| | .4 | Fusible link actuated, having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow. |
| | .5 | 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced. |
| | .6 | Rating: 1 ½ hours |
| | .7 | Acceptable products: National Controlled Air FDD Series, Ruskin, NCA, AMI, Greenheck, Nailor, Air Management. |

PART 3 - EXECUTION

- | | | |
|--|----|--|
| <u>3.1 MANUFACTURER'S INSTRUCTIONS</u> | .1 | Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet. |
| <u>3.2 INSTALLATION</u> | .1 | Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing. |
| | .2 | Maintain integrity of fire separation. |
| | .3 | After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction. |
| | .4 | Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories. |
| | .5 | Coordinate with installer of firestopping. |
| | .6 | Ensure access doors/panels, fusible links, damper operators are easily observed and accessible. |
| | .7 | Install break-away joints of approved design on each side of fire separation. |
| <u>3.3 CLEANING</u> | .1 | Proceed in accordance with Section 01 74 11 - Cleaning. |
| | .2 | Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment. |

END OF SECTION

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
- .1 Materials and installation of flexible ductwork, joints and accessories.
 - .2 Sustainable requirements for construction and verification.
 - .3 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 35 29 - Health and Safety Requirements.
- 1.2 REFERENCES .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
 - .3 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-[02], Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-[02], Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
 - .4 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible).
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition [1995].
 - .5 Underwriters' Laboratories Inc. (UL).
 - .1 UL 181-[96], Standard for Factory-Made Air Ducts and Air Connectors.
 - .6 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC-S110-[1986(R2001)], Fire Tests for Air Ducts.

- 1.3 SUBMITTALS .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples: submit samples with product data of different types of flexible duct being used in accordance with Section 01 33 00 - Submittal Procedures.
- 1.4 QUALITY ASSURANCE .1 Certification of Ratings:
- .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

PART 2 - PRODUCTS

- 2.1 GENERAL .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.
- 2.2 NON-METALLIC - ACOUSTIC INSULATED .1 Type 1: non-collapsible, coated mineral base perforated fabric type helically supported by and mechanically bonded to steel wire with factory applied flexible mineral fibre acoustic insulation and encased in Type M vapour barrier.
- .2 Performance:
- .1 Factory tested to 1.5 kPa without leakage.
- .2 Maximum relative pressure drop coefficient: 3.
- .3 Acoustical performance: Minimum attenuation (dB/m) to following table:

Frequency (Hz)					
Duct	125	250	500	1000	2000
Diam:					
100	0.6	3	12	27	0
150	1.2	3	12	22	27
200	2.0	5	12	19	20
300	2.4	5	12	16	15

.3 Standard of acceptance: Termaflex M-KE.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION.1 Install in accordance with: CAN/ULC-S110, UL-181, NFPA 90A, NFPA 90B, SMACNA.

.2 Maximum length shall be 1.3 m.

END OF SECTION

PART 1 - GENERAL

- | | | |
|-----------------------------|----|---|
| <u>1.1 RELATED SECTIONS</u> | .1 | Section 01 33 00 - Submittal Procedures. |
| <u>1.2 REFERENCES</u> | .1 | American Society for Testing and Materials (ASTM) |
| | .1 | ASTM C 177-97, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus. |
| | .2 | National Fire Protection Association (NFPA) |
| | .1 | NFPA 90A-99, Installation of Air Conditioning and Ventilating Systems. |
| | .2 | NFPA 90B-99, Installation of Warm Air Heating and Air Conditioning Systems. |
| | .3 | Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) |
| | .1 | SMACNA HVAC Duct Construction Standards, Metal and Flexible-95 (Addendum No.1, Nov. 97). |
| | .4 | Underwriter's Laboratories of Canada (ULC) |
| | .1 | CAN/ULC-S102-88 (R2000), Surface Burning Characteristics of Building Materials and Assemblies. |
| <u>1.3 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00 - Submittal Procedures. |

PART 2 - PRODUCTS

- | | | |
|-----------------------|----|--|
| <u>2.1 DUCT LINER</u> | .1 | General: |
| | .1 | Flame retardant polyethylene foam, 20mm extruded roll. |
| | .2 | Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102. |
| | .3 | UL94NBF (Horizontal burn). |
| | .4 | Thermal resistance per ASTM C518 (R-Value) of approximately 7.95 W/(m ² .°C) |
| | .5 | Thermal conductivity per ASTM C518 (K-value) of approximately .058 W(m.°C) |
| | .6 | Water absorption per ASTM D3575 of less than 0.1% (kg/square metre). |

- .2 Standard of Acceptance: Cellu-Cushion 84
- 2.2 ADHESIVE .1 Meet requirements of NFPA 90A and NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29°C to plus 93°C.
- 2.3 FASTERNERS .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.
- 2.4 JOINT TAPE .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.
- 2.5 SEALER .1 Meet requirements of NFPA 90A and NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68°C to plus 93°C.

PART 3 - EXECUTION

- 3.1 GENERAL .1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.
- 3.2 DUCT LINER .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
 - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres.
- 3.3 JOINTS .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
 - .1 Bed tape in sealer.
 - .2 Apply two coats of sealer over tape.

Building Modernization	DUCT LINERS	Section 23 33 53
Phase II		Page 3
10 Weldon St, Shediac, NB		
Project No. R.039554.001		2013.07.17

- .2 Replace damaged areas of liner at discretion of departmental representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

END OF SECTION

PART 1 - GENERAL

- | | | |
|---|----|---|
| <u>1.1 REFERENCES</u> | .1 | AMCA 99-L.E., Standards Handbook. |
| | .2 | ANSI/AMCA 210-L.E., Laboratory Methods of Testing Fans for Rating. |
| | .3 | AMCA 300-L.E., Reverberant Room Method for Sound Testing of Fans. |
| | .4 | AMCA 301-L.E., Methods for Calculating Fan Sound Ratings from Laboratory Test Data. |
| | .5 | ANSI/ASHRAE 51-L.E., Laboratory Methods of Testing Fans for Rating. |
| | .6 | CGSB 1-GP-181M-L.E., Coating, Zinc Rich, Organic, Ready Mixed. |
| <u>1.2 SHOP DRAWINGS AND PRODUCT DATA</u> | .1 | Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Product data to include fan curves and sound rating data, showing point of operation. |
| <u>1.3 OPERATION AND MAINTENANCE DATA</u> | .1 | Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. |
| <u>1.4 MAINTENANCE MATERIALS</u> | .1 | Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals. |
| | .1 | Spare parts to include: |
| | .1 | Matched sets of belts. |
| | .2 | Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual. |
| <u>1.5 MANUFACTURED ITEMS</u> | .1 | Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force. |

PART 2 - PRODUCTS

- 2.1 FANS - GENERAL .1 Capacity, total static pressure, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
- .2 Sound ratings: comply with AMCA Air Moving and Conditioning Association 301, tested to AMCA 300.
- .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.
- .5 Motors: sizes as specified in Schedule on drawings.
- .6 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards, fan inlet, outlet safety screens, where indicated.
- .7 Factory primed before assembly in colour standard to manufacturer.
- .8 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .9 Vibration isolation: to Section 23 05 48 - Vibration Isolation Measures.
- .10 Flexible connections: to Section 23 33 00 - Air Duct Accessories.
- .11 Bearings shall be heavy duty grease lubricated, ball or roller pillow block type. Bearings shall be selected for a basic rating fatigue life (L-10) of 200,000 hours at maximum operating speed and horsepower for each construction level.

- .12 Each assembled fan shall be run at the factory at the specified fan RPM and vibration signatures shall be taken on each bearing in the horizontal, vertical and axial direction. The maximum allowable fan vibration shall be 3.8 mm/sec peak velocity, filter in measured at the fan RPM.

2.2 MIXED FLOW
INLINE BELT DRIVE -
RAF-1 AND RAF-3

- .1 Fan shall be duct mounted, belt driven mixed flow inline.
- .2 Fan shall be listed by Underwriters Laboratories (UL 705 and UL listed for Canada, cUL705). Fan shall bear the AMCA certified ratings seal for sound and air performance.
- .3 Fan shall be of welded and bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 12 gauge epoxy coated steel with integral inlet and outlet flanges. The fan housing shall include an inspection door, oriented 180° from the motor that provides access to the fan for cleaning or inspection. Adjustable motor plate shall utilize threaded studs for positive belt tensioning. Extended lube lines shall be furnished for lubrication of fan bearings. Mounting brackets shall be welded to the outer housing to accommodate universal mounting feet for vertical or horizontal installation. Motor shall be side mounted. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- .4 Wheel shall be centrifugal non-overloading mixed flow type. Wheels shall be constructed with wheel cone, spherical back plate and single thickness cambered blades. Wheels shall be statically and dynamically balanced in accordance with ANSI S2.19 to Grade G6.3. Wheel cones and fan inlet cone shall be matched and shall have precise running tolerances.
- .5 All steel fan components shall be epoxy coated with an electrostatically applied, baked polyester powder coating. Each

component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.

- .6 Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- .7 Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be regreasable ball type in a cast iron pillow block housing selected for a minimum L10 life in excess of 200,000 hours at maximum cataloged operating speed.
- .8 Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- .9 Fan shall be complete with spring isolators in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .10 Mixed flow fan schedule:

Mixed Flow Fan Schedule							
Fan Tag	Volume	Static (Pa)	RPM	Motor kW	Volt/PH	Fan Noise LwA	Standard of Acceptance
RAF-1	7510	500	1050	7.5	600/3	83/87	Greenheck QEI-30-11-100
RAF-2	5687	250	1339	3.73	600/3	87/90	Greenheck QEI-24-11-100

2.3 ADJUSTABLE
DISCHARGE INLINE -
EF-2 AND EF-4

- .1 Galvanized steel housing, backward inclined aluminum wheel, bolted access panels, integral duct connection flanges and corrosion resistant fasteners.

- .2 Belt driven with adjustable motor plate and pulley.
- .3 Pillow block bearing.
- .4 Vibration isolation to Section 23 05 48.
- .5 Flexible connections to Section 23 33 00.
- .6 Fan performance shall be in accordance with the following schedule:

Mark	Volume (l/s)	Static (Pa)	RPM	Motor (kW/Volt)	Volt/Ph	Fan Noise Sones	Standard of Acceptance
EF-2	802	156	1563	0.373	120/1	13.9	Greenheck BSQ-130-5
EF-4	118	156	1802	0.187	120/1	15.2	Greenheck BSQ-100-4

- 2.4 CEILING MOUNTED - EF-1, EF-3, EF-5, EF-6, EF-7 and EF-8
- .1 Corrosion resistant galvanized steel housing and scroll, designer grille with adjustable mounting brackets, spring loaded aluminum back draft dampers and acoustical insulation. Round duct collar double inlet forward curved wheel.
 - .2 External electrical access, knockouts junction box and disconnect.
 - .3 Fan shall have an AMCA rating and bear seal.
 - .4 Accessories: Variable speed control and a time delay switch, which will allow fan to run for 1 to 60 minutes after the switch is shut-off. Switch shall be set for 15 minutes. Brick vent, isolation kit.
 - .5 Fan performances shall be in accordance with the following:

Mark	Volume (l/s)	Static (Pa)	RPM	Motor (kW/Volt)	Volt/Ph	Fan Noise Sones	Standard of Acceptance
EF-1	35	94	767	0.080	120/1	1.0	Greenheck SP-B110
EF-3	115	94	1050	0.08	120/1	3.0	Greenheck SP-A290
EF-5	35	94	767	0.08	120/1	1.0	Greenheck SP-B110
EF-6	35	156	853	0.08	120/1	2.5	Greenheck SP-B110

Mark	Volume (l/s)	Static (Pa)	RPM	Motor (kW/Volt)	Volt/Ph	Fan Noise Sones	Standard of Acceptance
EF-7	80	125	900	48 Watts	120/1	3.1	Greenheck SP-A200
EF-8	80	125	900	48 Watts	120/1	3.1	Greenheck SP-A200

2.5 UP BLAST ROOF
EXHAUST BELT DRIVE
AND DIRECT DRIVE -
KEF-1

- .1 Spun aluminum exhaust fans shall be centrifugal belt driven. Fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. The windband shall be welded to the one-piece curb cap and on all sizes with UL/CUL-762.
- .2 Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Drive frame assembly shall be constructed of heavy gauge steel. Motors and drives shall be mounted on vibration isolators, out of the airstream where no steel to steel contact between rotating components and the base shall occur. Fresh air for motor cooling shall be drawn into the motor compartment through a 64 square centimeter tube free of discharge contaminants. Motors and drives shall be readily accessible for maintenance.
- .3 Motors on direct drive fans shall be in accordance with the following:
- .1 Motor Enclosures: Totally enclosed air over
 - .2 Motors shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and furnished at the specific voltage and phase.
 - .3 Mounted on vibration isolators, out of the airstream.
 - .4 For motor cooling there shall be fresh air drawn into the motor compartment through an area free of discharge contaminants.

- .5 Accessible for maintenance.
- .4 Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the cast type, keyed and securely attached to the wheel and motor shafts.
- .5 Motor pulleys shall be adjustable for final system balancing. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A conduit chase shall be provided through the base to the motor compartment for ease of electrical wiring.
- .6 All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.
- .7 Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number for future identification.
- .8 Roof Mounted Upblast Exhaust Fans:
 - .1 A leakproof fan housing shall be constructed with a one piece windband with an integral rolled bead for added strength and shall be joined to the curbcap with a continuously welded seam.
- .9 Fan shall be installed on a 600 mm high field-built roof curb.
- .10 Fan shall be complete with backdraft damper, birdscreen and disconnect switch.

- .11 Fans shall be in accordance with the following schedule:

Mark	Air Flow (l/s)	Static (Pa)	RPM	Motor (kW/V/P)	Sones	Standard of Acceptance
KEF-1	1777	312	1091	1.12/600/3	18.6	Greenheck CUBE-220 HP-7

PART 3 - EXECUTION

- 3.1 FAN INSTALLATION .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration Isolation Measures and flexible electrical leads.
- .2 Install fans with 100 mm flexible connection on inlet. Ensure metal bands of connectors are parallel with minimum 75 mm flex between ductwork and fan during running.
- .3 Install fan restraining snubbers as indicated.
- .4 Flexible connections shall not be in tension during running.
- .5 Provide sheaves and belts required for final air balance.

END OF SECTION

PART 1 - GENERAL

- | | | |
|-------------------------------|----|---|
| <u>1.1 SUMMARY</u> | .1 | Section Includes: |
| | .1 | Variable volume boxes, constant volume bypass, and fan powered and electronic variable air volume boxes. |
| | .2 | Sustainable requirements for construction and verification. |
| <u>1.2 REFERENCES</u> | .1 | American National Standards Institute (ANSI) |
| | .1 | ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating. |
| | .2 | ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems. |
| | .2 | Health Canada/Workplace Hazardous Materials Information System (WHMIS) |
| | .1 | Material Safety Data Sheets (MSDS). |
| | .3 | International Organization of Standardization (ISO) |
| | .1 | ISO 3741-[2001], Acoustics- Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms. |
| | .4 | Underwriter's Laboratories (UL) |
| | .1 | UL 181-2003, Factory-Made Air Ducts and Air Connectors. |
| <u>1.3 SYSTEM DESCRIPTION</u> | .1 | Performance Requirements: |
| | .1 | Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards. |
| <u>1.4 SUBMITTALS</u> | .1 | Product Data: |
| | .1 | Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations. |

- .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 02 81 01 - Hazardous Materials.
 - .2 Test data: to ANSI/AMCA 210.
 - .1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.
 - .2 Sound power level with minimum inlet pressure of 0.25, 0.5, 1, 1.5 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency.
 - .3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of New Brunswick, Canada.
 - .2 Indicate the following:
 - .1 Capacity.
 - .2 Pressure drop.
 - .3 Noise rating.
 - .4 Leakage.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

- .1 Departmental Representative will make available one (1) copy of systems supplier's installation instructions.

- .4 Closeout Submittals:

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE .1

Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.6 DELIVERY,
STORAGE, AND
HANDLING .1

Packing, shipping, handling and unloading:

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with manufacturer's written instructions.

- .2 Waste Management and Disposal: with Section 01 74 21 - Construction/Demolition Waste Management & Disposal.

1.7 MAINTENANCE .1

Extra Materials:

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

PART 2 - PRODUCTS

<u>2.1 MANUFACTURED UNITS</u>	.1	Terminal units of the same type to be product of one manufacturer.
<u>2.2 ELECTRONIC VARIABLE AIR VOLUME BOXES</u>	.1	Pressure independent, reset to air flow between zero and maximum air volume.
	.2	At inlet velocity of 10 m/s, differential static pressure for unit with attenuator section not to exceed 50 Pa.
	.3	Sound ratings of assembly not to exceed 30 NC at 375 Pa.
	.4	Air velocity, pressure sensor shall be cross configuration as standard to manufacturer. The sensor shall have twelve total pressure sensing ports and a centre averaging chamber. The airflow sensor shall amplify the sensed airflow signal.
	.5	Signals between temperature sensing device, velocity controller, velocity sensor and damper actuator and digital control package.
	.6	Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.
	.7	Terminal unit to be CSA certified.
	.8	Casing: 0.75 mm thick galvanized steel, internally lined with 20 mm thick fibre-free foam insulation to UL 181 and ANSI/NFPA 90A. Mount control components inside protective metal shroud.
	.9	Silencer section shall have 18 mm thick fiber-free foam insulation.
	.10	Damper: heavy gauge steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

- .11 Sizes and capacity: as indicated in following schedule.
- .12 Standard of Acceptance: Price SDV Series

2.3 EXHAUST VARIABLE AIR VOLUME RETURN BOXES

- .1 The exhaust variable air volume boxes shall have round 0.90 mm duct connections, all welded type 316 stainless steel.
- .2 The damper shall be 1.0 mm, type 316 stainless steel with Teflon damper shaft bearings and damper gasket. Damper shaft shall be type 316 stainless steel.
- .3 In the full closed position, air leakage across the closed damper shall not exceed 5 l/s at 750 Pa with ultra low leakage components.
- .4 A cross configuration airflow sensor shall be located in the inlet to the unit. The sensor shall have twelve total pressure sensing ports and center averaging chamber to accurately average the flow across the inlet of the assembly. The air flow sensor shall amplify the sensed airflow signal.
- .5 The box section shall have 25 mm thick fiberglas insulation, enclosed with 1.0 mm type 316 stainless steel, to reduce radiated noise.
- .6 Acceptable materials: E.H. Price SDV.

2.4 TERMINAL UNIT PERFORMANCE

- .1 Terminal unit performance shall be in accordance with the following table.
 - .1 EAT for coils: 15.6°C
 - .2 All coils are 600V/3, with SCR control.

Tag	Unit Size	Max (Primary l/s)	Min (Primary l/s)	Reheat (l/s)	Min Oper PD (Pa)	Min Discharge NC	Capacity kW
VS1-1	10	315	126	158	2.49	23	2.6
VS1-2	10	274	109	137	2.49	25	2.3
VS1-3	10	274	109	137	2.49	25	2.3
VS1-4	8	179	109	109	2.49	23	1.9
VS1-5	12	426	170	213	2.49	24	3.6
VS1-6	6	47	32	47	2.49		0.9
VS1-7	6	47	32	47	2.49		0.8
VS1-8	8	176	70	88	2.49	20	1.5

Tag	Unit Size	Max (Primary l/s)	Min (Primary l/s)	Reheat (l/s)	Min Oper PD (Pa)	Min Discharge NC	Capacity kW
VS1-9	10	304	122	152	2.49	23	2.6
VS1-10	12	443	177	222	2.49	24	3.8
VS1-11	6	104	42	71	2.49	20	1.2
VS1-12	12	272	144	165	2.49	23	2.8
VS1-13	10	315	126	158	2.49	23	2.7
VS1-14	10	315	126	158	2.49	23	2.7
VS1-15	10	415	166	208	2.49	24	3.5
VS1-16	12	476	190	238	2.49	24	4.0
VS1-17	14	719	216	360	2.49		6.1
VS1-18	6	94	31	47	2.49		1.0
VS1-19	12	425	144	212	2.49		3.6
VS1-20	10	326	104	163	2.49		2.8
VS1-21	12	472	144	236	2.49		4.0
VS1-22	7	236	71	118	2.49		2.0
VS1-23	7	189	57	94	2.49		1.6
VS1-24	8	300	90	150	2.49		2.5
VS1-25	6	66	31	64	2.49		1.1
VS1-26	10	340	104	170	2.49		2.9
VS1-27	6	52	31	47	2.49		.8
VS1-28	6	52	31	47	2.49		.8
VS1-29	6	66	31	47	2.49		.8
VS1-30	10	425	170	212	2.49	25	3.6
VS1-31	10	530	212	212	2.49	26	3.6
VS1-32	10	530	212	212	2.49	26	3.6
VS3-1	6	100	33	61	2.49		1.0
VS3-2	6	80	33	47	2.49		0.8
VS3-3	9	382	115	191	2.49		3.2
VS3-4	8	287	86	143	2.49		2.4
VS3-5	8	287	86	143	2.49		2.4
VS3-6	12	651	195	326	2.49		5.6
VS3-7	10	460	138	230	2.49		3.9
VS3-8	8	271	81	136	2.49		2.3
VS3-9	8	264	79	132	2.49		2.3
VS3-10	6	97	31	48	2.49		0.8
VS3-11	6	47	31	47	2.49		0.8
VS3-12	6	100	33	61	2.49		1.0
VS3-13	12	651	195	326	2.49		6.55
VS3-14	7	149	47	75	2.49		1.3
VS3-15	14	722	217	361	2.49		6.1
VS3-16	7	146	47	73	2.49		1.3
VS3-17	8	272	82	136	2.49		2.3
VS3-18	10	432	129	216	2.49		3.6
VS3-19	14	722	217	361	2.49		6.1
VS3-20	8	287	86	143	2.49		2.4
VS7-1	10	414	124	207	2.49		3.5
VS7-2	6	94	38	47	2.49		.8
VS7-3	6	73	31	47	2.49		.8
VS7-4	6	73	31	47	2.49		.8
VS7-5	8	300	120	150	2.49		2.5
VS7-6	8	208	83	104	2.49		1.8

Tag	Unit Size	Max (Primary l/s)	Min (Primary l/s)	Reheat (l/s)	Min Oper PD (Pa)	Min Discharge NC	Capacity kW
VS7-7	10	400	122	203	2.49		3.4
VS7-8	8	327	99	124	2.49		2.9
VS7-9	6	113	45	57	2.49		1.0
VS7-10	8	225	90	112	2.49		1.9
VS7-11	6	94	38	47	2.49		.8
VS7-12	8	304	122	152	2.49		2.5
VS7-13	8	258	103	129	2.49		2.2
VS7-14	8	258	103	129	2.49		2.2
VS7-15	8	255	102	127	2.49		2.1
VS7-16	8	248	99	124	2.49		2.1
VS7-17	8	174	70	87	2.49		1.5
VS7-18	6	94	38	47	2.49		.8
VR1-1	16	1391	417		2.49		
VR1-2	16	1422	427		2.49		
VR1-3	16	1391	417		2.49		
VR1-4	12	844	253		2.49		
VR1-5	12	844	253		2.49		
VR1-6	12	844	253		2.49		
VR1-7	16	1391	417		2.49		
VR1-8	10	637	191		2.49		
VR3-1	16	1896	758		2.49		
VR3-2	16	1896	758		2.49		
VR3-3	16	1896	758		2.49		
VR7-1	14	744	223		2.49		
VR7-2	14	1151	345		2.49		
VR7-3	16	1151	345		2.49		
VR7-4	12	657	197		2.49		
VE1-1	12	864	0		2.49		
VE1-2	10	357	0		2.49		
VE1-3	5	75	0		2.49		
VE1-4	5	75	0		2.49		
VE1-5	5	75	0		2.49		
VE1-6	8	330	0		2.49		

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 INSTALLATION .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.

- .3 Install with at least 1.3 m of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.
- .4 Locate controls, dampers and access panels for easy access.

- B 3.3 CLEANING
- .1 Proceed in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

- 1.1 RELATED SECTION .1 Section 21 05 01 - Mechanical General Requirements.
- 1.2 USE OF SYSTEMS .1 Use of new permanent heating and / or ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:
- .1 Entire system is complete, pressure tested, cleaned, flushed out.
 - .2 Specified water treatment system has been commissioned; water treatment is being continuously monitored.
 - .3 Building has been closed in; areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .4 There is no possibility of damage from any cause.
 - .5 Supply ventilation systems are protected by 60 % filters, which shall be inspected daily, changed every 2 weeks or more frequently as required.
 - .6 Return systems have approved filters over all openings, inlets, outlets.
 - .7 All systems will be:
 - .1 operated as per manufacturer's recommendations or instructions.
 - .2 operated by Contractor.
 - .3 monitored continuously by Contractor.
 - .8 Warranties and guarantees are not thereby relaxed.
 - .9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental representative.
 - .10 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as- new" condition, filters in air systems replaced.
- .2 Filters referred to herein are over and above those specified elsewhere in this specification.

.3 Exhaust systems are not included in any
approvals for temporary heating ventilation.

PART 2 - PRODUCTS .1 Not applicable

PART 3 - EXECUTION .1 Not applicable

END OF SECTION

Building Modernization Phase II 10 Weldon St, Shediac, NB Project No.: R.039554.001	DIFFUSERS, REGISTERS AND GRILLES	Section 23 37 13 Page 1 2013.07.17
--	-------------------------------------	--

PART 1 - GENERAL

- | | | |
|-------------------------------|----|---|
| <u>1.1 SUMMARY</u> | .1 | <p>Section Includes:</p> <ul style="list-style-type: none"> .1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial. .2 Sustainable requirements for construction and verification. |
| <u>1.2 SYSTEM DESCRIPTION</u> | .1 | <p>Performance Requirements:</p> <ul style="list-style-type: none"> .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards. |
| <u>1.3 SUBMITTALS</u> | .1 | <p>Product Data:</p> <ul style="list-style-type: none"> .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations. <ul style="list-style-type: none"> .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 02 81 01 - Hazardous Materials. .2 Indicate following: <ul style="list-style-type: none"> .1 Capacity. .2 Throw and terminal velocity. .3 Noise criteria. .4 Pressure drop. .5 Neck velocity. |
| | .2 | <p>Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.</p> <ul style="list-style-type: none"> .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties. |

- .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available one (1) copy of systems supplier's installation instructions.

1.4 QUALITY ASSURANCE .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING .1 Packing, shipping, handling and unloading:

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6 MAINTENANCE .1 Extra Materials:

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

PART 2 - PRODUCTS

2.1 GENERAL .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.

.2 Frames:

- .1 Full perimeter gaskets.
- .2 Plaster frames where set into plaster or gypsum board.
- .3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: as directed by departmental representative.

- | | | |
|--|----|--|
| 2.2 MANUFACTURED
UNITS | .1 | Grilles, registers and diffusers of same generic type, products of one manufacturer. |
| | .2 | Of size, type and capacity, as shown on schedule, on drawings. |
| 2.3 SUPPLY GRILLES
S-1, S-2, S-3, S-4,
AND S-5 | .1 | <p>Square Plaque Diffuser: Diffusers shall consist of a precision formed back cone of one-piece seamless construction that incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct. An inner plaque assembly shall be incorporated and shall drop no more than 6mm below the ceiling plane to assure proper air distribution performance. The inner plaque assembly shall be completely removable from the diffuser face to allow for full access to any dampers or other ductwork components located near the diffuser neck. Finish shall be B12 white powder coat. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering as per ASTM D610 and ASTM D714.</p> |
| | .2 | Grille S-1: Four-way diffusion for installation in T-bar. |
| | .3 | Grille S-2: Provide with sectioning baffles for two-way 180° diffusion in T-bar. |
| | .4 | Grille S-3: Provide with sectioning baffles for two-way 90° diffusion in T-bar. |
| | .5 | Grille S-4: Provide with sectioning baffles for two-way 180° diffusion for drywall. |
| | .6 | Standard of acceptance: Price SPD. |

- 2.4 SUPPLY DIFFUSER S-6 .1 Diffusers shall have two discharge slots, 25mm wide, with aerodynamically curved "ice tong" shaped pattern controllers for 180° air pattern control and air flow dampering if required. The diffuser border shall be heavy extruded aluminum construction with extruded aluminum spacers and mitered end flanges, angle en caps. Continuous length units shall be provided with factory assembled corner modules to suit drawings and on site conditions. The diffuser border shall be finished in B12 White Powder Coat. Paint finish shall pas 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering as per ASTM D610 and ASTM D714.
- .2 Standard of acceptance: Price 48/SDS100/2/14/ZZ/B12.
- 2.5 RETURN/EXHAUST DIFFUSERS R-1, R-2, R-3, R-4, E-1, E-3 AND 3-4 .1 Diffuser shall consist of a perforated air distribution face of no less than 51% free area, a heavy gauge steel backpan with round/square inlet collars as noted on plans. The perforated face shall be removable from the diffuser face and shall be fitted with hinges to facilitate the removal of face screen for cleaning purposes. The perforated face screen shall be steel. The finish of the diffuser shall be B12 White Powder Coat. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering as per ASTM D610 and ASTM D714. Refer to schedule on drawing for sizes and installation requirements.
- .2 Standard of acceptance: Price PDDR.

- 2.6 EXHAUST GRILLE .1 Grilles shall be 45° deflection fixed
E-2 louvre type with blades spaced 19mm on
centre. The blades shall run parallel to
the floor. Both blades and border shall be
of heavy extruded aluminum construction.
The grille shall be finished in B12 White
Powder Coat. Paint finish shall pass 500
hours of salt spray exposure with no
measurable creep in accordance with ASTM
D1654 and 1000 hours with no rusting or
blistering as per ASTM D610 and ASTM D714.
Refer to schedule on drawing for sizes and
installation requirements.
- .2 Standard of acceptance: Price 60/F/B12.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S .1 Compliance: comply with manufacturer's
INSTRUCTIONS written recommendations or specifications,
including product technical bulletins,
handling, storage and installation
instructions, and datasheet.
- 3.2 INSTALLATION .1 Install in accordance with manufacturer's
instructions.
- .2 Install with flat head stainless steel
screws in countersunk holes where
fastenings are visible.
- 3.3 CLEANING .1 Proceed in accordance with Section 01 74 11
- Cleaning.
- .2 Upon completion and verification of
performance of installation, remove surplus
materials, excess materials, rubbish, tools
and equipment.

END OF SECTION

PART 1 - GENERAL

- | | | |
|---|----|---|
| <u>1.1 REFERENCES</u> | .1 | ASHRAE 52-L.E., Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter". |
| | .2 | ULC C710-L.E., "Grease Extractors for Exhaust Ducts". |
| | .3 | CAN4-S111-L.E., "Fire Tests for Air Filter Units". |
| | .4 | CAN/CGSB-115.10-L.E., Filters, Air, Disposable, for Removal of Particulate Matter from Ventilating Systems. |
| | .5 | CAN/CGSB-115.18-L.E., Filter, Air Extended Area Panel Type, Medium Efficiency |
| <u>1.2 SHOP DRAWINGS AND PRODUCT DATA</u> | .1 | Submit shop drawing and product data in accordance with Section 01 33 00 - Submittal Procedures. |
| <u>1.3 MAINTENANCE DATA</u> | .1 | Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. |
| <u>1.4 MAINTENANCE MATERIALS</u> | .1 | Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals. |
| <u>1.5 CERTIFICATION OF RATING</u> | .1 | Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards. |

PART 2 - PRODUCTS

- | | | |
|--------------------|----|--|
| <u>2.1 GENERAL</u> | .1 | Filters: suitable for air at 100% RH and air temperatures between minus 40°C and 50°C. |
| | .2 | Number of units, size and thickness of panels as indicated. |

- .3 Refer to Section 23 73 11 - Air Handling Units - Packaged, for MERV 13 filter requirements.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL .1 Install in accordance with manufacturer's recommendations.

3.2 SPARE FILTERS .1 Furnish in accordance with Section 21 05 01 - Mechanical General Requirements, paragraph "Special Tools and Spare Parts".

- .2 Provide a set of filters for each unit at start-up, a set when the project is complete and one spare set.

END OF SECTION

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Section 23 05 48 - Vibration Isolation Measures.
<u>1.2 REFERENCES</u>	.1	Canadian Standards Association (CSA). .1 CSA B51-M1991, Boiler, Pressure Vessel, and Pressure Piping Code.
	.2	American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME). .1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 1992.
<u>1.3 SHOP DRAWINGS</u>	.1	Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Indicate the following: .1 General arrangement showing terminal points, instrumentation test connections. .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement. .3 Foundations with loadings, anchor bolt arrangements. .1 Piping hook-ups. .2 Equipment electrical drawings. .3 All miscellaneous equipment.
<u>1.4 ACCEPTABLE MATERIALS</u>	.1	Where materials are specified by trade name, refer to the Project Specific Instruction to Bidders for procedure to be followed in applying for approval of alternatives.
	.2	All materials shall be low in V.O.C. (Volatile Organic Compound) emissions.
<u>1.5 CLOSEOUT SUBMITTALS</u>	.1	Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
<u>1.6 MAINTENANCE MATERIALS, SPECIAL TOOLS AND SPARE PARTS</u>	.1	Maintenance materials to include: .1 Spare parts for 1 year of operation. .2 Spare gaskets. .3 Spare gauge glass inserts. .4 Probes and sealants for electronic indication. .5 Safety valve test gauge.

PART 2 - PRODUCTS

- 2.1 GENERAL .1 Boiler Capacity - Hot Water
1. The 95 litre capacity hot water boiler shall be rated 252 kW at 600 V, 3 ph, 60 Hz. Unit shall be suitable to operate under the following conditions: system flow rate 14.2 l/s; outlet water temperature 76.6°C; return water temperature 71.1°C; system operating pressure 275 kPag.
 - .2 Flow through boiler shall not exceed 10.8 l/s.
- 2.2 BOILER .1 The vessel shall be constructed in accordance with ASME Boiler Code.
- .2 The vessel shall be designed for 1102 kPag.
 - .3 The relief valve shall be per ASME Code, set at 516 kPag.
 - .4 The vessel shall be insulated with a double wrap of 50mm fiber blanket insulation having .019 kg/m³ density.
 - .5 The boiler shall be UL listed, and bear the Underwriters Laboratories' label.
 - .6 The boiler shall be of the packaged type, factory assembled, wired, and tested.
 - .7 The boiler shall be mounted on a full size structural steel base.
 - .8 The boiler enclosure shall be 1.6mm steel.
 - .9 The entire enclosure shall be finished in light blue enamel paint.
 - .10 The overall dimensions of the boiler shall be 914mm long, 813mm wide, and 1549mm high.
- 2.3 HEATING ELEMENTS .1 The heating elements shall be individually mounted, rod type, and field replaceable with standard tools.
- .2 The heating watt density shall not exceed 6.45 cm².

.3 The heating elements shall be Incoloy sheathed.

.4 There shall be 42 at 6 kW each.

2.4 TRIM AND CONTROLS

.1 The units shall be complete with the following:

- .1 Main lugs for supply circuits.
- .2 Supplemental internal branch circuit fuses, current limiting, rated at 200,000 amps interrupting capacity.
- .3 Fused 120 V control circuit transformer.
- .4 Magnetic contactors rated at 500,000 cycles.
- .5 Integral high temperature limit.
- .6 Low water cutoff.
- .7 Pressure-temperature gauge.
- .8 Pilot switch.
- .9 Pilot lights for power on, low water, high temperature or pressure.
- .10 Relief valve.
- .11 Drain valve.
- .12 Solid state proportional temperature control with progressive step control with adjustable span and inter-stage time delay. There shall be seven (7) steps of 36 kW.

2.5 STANDARD OF ACCEPTANCE

.1 Cleaver Brooks, Model WB-122.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with ANSI / ASME Boiler and Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make all required piping connections to all inlets and outlets recommended by boiler manufacturer.
- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment / system.

- .4 Mount unit level using specified vibration isolation in Section 23 05 48 - Vibration Isolation Measures.
- .5 Pipe hot water relief valves full size to nearest drain.

3.2 MOUNTING AND ACCESSORIES

- .1 Safety valves and relief valves:
 - .1 Run separate discharge from each valve.
 - .2 Terminate discharge pipe as indicated.
 - .3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.

3.3 COMMISSIONING

- .1 Manufacturer to:
 - .1 Certify installation.
 - .2 Start up and commission installation.
 - .3 Carry out on-site performance verification tests.
 - .4 Demonstrate operation and maintenance, minimum 2 days, on site.
- .2 Provide departmental representative at least 24 h notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

END OF SECTION

PART 1 - GENERAL

- 1.1 REFERENCES .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
- .1 ANSI/ARI-550/590, Latest Edition, Water Chilling Packages.
- .2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-51.40- M80, Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
- .3 Canadian Standards Association (CSA)
- .1 CSA B52- M 1995, Mechanical Refrigeration Code.
- .4 Environment Canada
- .1 EPS 1/RA/2- 1996, Code of Practice for the Reduction of Chlorofluorocarbons Emissions from Refrigeration and Air Conditioning Systems Canadian Environmental Protection Act Code of Practice.
- .5 LEED
- .1 LEED Canada Design and Construction 2009
- .6 ANSI/ASHRAE 15.
- 1.2 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
- .1 Equipment including connections, control assemblies and ancillaries, identifying factory assemblies.
- .2 Wiring as assembled and schematically.
- .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
- .4 Type of refrigerant used.

- | | | | |
|-----|---|----|--|
| 1.3 | <u>ACCEPTABLE MATERIALS</u> | .1 | Where materials are specified by trade name, refer to the Project Specific Instruction to Bidders for procedure to be followed in applying for approval of alternatives. |
| 1.4 | <u>MAINTENANCE AND ENGINEERING DATA</u> | .1 | Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. |
| | | .2 | Data to include: <ul style="list-style-type: none"> .1 Description of equipment giving manufacturers name, type, model year, capacity and serial numbers. .2 Provide part load performance curves, including at conditions specified and at AHRI standard conditions for from 20% to 100% load in 10% increments. .3 Details on operation, servicing and maintenance. .4 Recommended spare parts list. |

PART 2 - PRODUCTS

- | | | | |
|-----|-----------------------------|----|---|
| 2.1 | <u>OPERATING CONDITIONS</u> | .1 | Provide four (4) water-cooled liquid chillers with the total capacity of 723.9 kW cooling, with 154 kW input at 100% load; 588.9 kW cooling, with 102.6 kW input at 75% load; 410 kW cooling, with 62.1 kW input at 50% load; and 209.9 kW cooling, with 32.8 kW input at 25% load. |
| | | .2 | Chiller shall be designed to operate using R-410a refrigerant. |
| | | .3 | Chiller shall be designed for parallel evaporator water flow. |
| | | .4 | The liquid to be chilled will be water containing corrosion inhibitors. |
| | | .5 | Chiller shall be designed to operate using 600 volt, 3-phase, 60 Hz electrical power supply. |

- 2.2 HIGH EFFICIENCY .1 The chiller shall incorporate the following
WATER COOLED DUAL features:
SCROLL COMPRESSOR .1 Dual high efficiency 18,7 kW 3500 rpm
410A CONDENSERLESS scroll compressors, rubber-mounted to
CHILLER chiller frame.
- .2 Two steps of capacity control by
compressor cycling, 100%, 50% and off.
- .3 Compressor internal thermal motor
protection and high discharge
temperature sensors.
- .4 Dual circuit 175 kW evaporator (88 kW
each circuit) 316L plates copper
brazed.
- .5 Evaporator certified to UL 207 7th
edition and C22.2 no. 140.3-M1987.
- .6 Insulated with 20mm closed cell
flexible thermal insulation.
- .7 Refrigeration rating 4478 kPa at 195°C
and water rating of 2756 kPa at 195°C.
- .8 Chilled water piping and valves rated
for 1034 kPa.
- .9 Chilled water vane type flow switch.
- .10 Leaving chilled water freeze safety.
- .11 2.7mm thick formed stainless steel
sheet metal front supports and front
panel with formed galvanized steel
sheet metal back supports, base frame,
side and top panels assembled with
nickel plated nuts and bolts.
- .12 NEMA 12 (EEMAC 12) control panel.
- .13 Complete with a through-the-door non-
fused disconnect, on-off switch and
power on light.
- .14 575/3/60 control panel
- .15 Compressor three phase fuses
- .16 Compressor contactors
- .17 24 VAC - 250VA control transformer
with primary and secondary fuses.
- .18 Chiller controller senses and displays
all operating and fault conditions
with liquid crystal display located on
the control panel door.
- .19 Chiller certified to CAN/CSA C22.2 No.
236 / UL 1995 3rd 2005 Heating and
Cooling Equipment
- 2.3 CHILLER .1 The chiller controller shall incorporate
CONTROLLER the following:
- .1 Four line liquid crystal display
located in control panel door.

- .2 Displays in English all operating and fault conditions.
- .3 Automatically takes control of chiller if BMS fails or communications is lost and automatically reports back to BMS when problem is corrected.
- .4 Controls evaporator and condenser motorized valves.
- .5 Senses and displays entering and leaving chilled water temperatures.
- .6 Senses and displays low leaving chilled water temperature (freezestat).
- .7 Senses and displays refrigerant high pressure and low pressure each circuit.
- .8 Second mechanical high pressure cut in compressor control circuit, to protect against controller failure.
- .9 Senses and displays suction temperatures and alarms on low suction temperature.
- .10 Displays compressor motor internal protection fault sensing winding and discharge temperatures.
- .11 Displays water flow switch fault.
- .12 The system shall come with a Native BACnet MS/TP network interface card.

2.4 SYSTEM FAILURE .1

- If BMS fails or the communication cable is cut, the chiller shall go to the standalone mode and the following shall occur:
- .1 Protects chiller from fault conditions.
 - .2 Prevents short cycling of compressors by setting minimum run time and off time.
 - .3 Sets "stage up time" and "stage down" of compressors and capacity control steps.
 - .4 Lead-Lags compressors on a first in/first out basis to try and equalize run time.
 - .5 Changes the lead compressor if one has accumulated more run time by 12 hours.
 - .6 Logs the number of compressors starts and run hours of each compressor.

- 2.5 SYSTEM MODE .1 Protects chiller from all the fault conditions above.
- .2 All other functions controlled by BMS.
- .3 Each inlet water header shall incorporate a built-in 30-mesh (maximum) in-line strainer system to prevent heat exchanger fouling and accommodate 100% flow filtration with a minimum surface area of 3065 sq cm per module.
- .4 Standard of Acceptance: Tandem WCLX050DZV.
- 2.6 CHILLER REMOTE CONDENSER FOR 410A .1 Each condenser shall meet the following:
- .1 Total heat of rejection at 35°C ambient and 48.8°C condensing is 503 kW.
- .2 Galvanized steel frame and coil housing.
- .3 Copper tubes mechanically bonded to aluminum fins and rated for 4478 kPa.
- .4 Condenser has two coils and each coil has two refrigeration circuits.
- .5 Two (2) fans wide by four (4) fans long, total of eight (8) fans.
- .6 Each fan is 750mm in diameter and direct driven by a 1.12 kW 1140 rpm weatherproof motor.
- .7 Fan cycling of fans two to four and speed control of the first each circuit, this combined with flooded condenser will allow operation down to -1.1°C.
- .8 Weatherproof control panel.
- .9 Weatherproof through-the-door non-fused disconnect.
- .10 A 120 volt control transformer with primary and secondary fuses.
- .11 Fan three phase fuses.
- .12 Fan contactors.
- .13 Thermostats or pressure switches pressure for control of fan cycling.
- .14 Remote start interlock contacts for starting of fans when compressor starts.

- | | | |
|----------------------------------|----|--|
| | .2 | The unit shall have the following options: |
| | .1 | Electro fin coating of coils for additional corrosive protection. |
| | .2 | Copper fins for additional corrosive. |
| | .3 | Standard of Acceptance: Tandem Trac 4-Circuit Condenser. |
| <u>2.7 EXTERNAL STRAINER</u> | .1 | One 6" flanged SST Strainer with 30 mesh filter screen, pressure differential alarm and automatic flush package. |
| | .2 | Standard of acceptance: Thompson MLS-6. |
| <u>2.8 CLEANING KIT</u> | .1 | The heat exchanger cleaning kit shall consist of all components required to clean the brazed heat exchangers on the condenser and evaporator, and be mounted on a heavy-duty wheeled cart. The kit shall include the following components: |
| | .1 | Two (2) FlushGun™ with Victaulic connectors to clean individual passages of the heat exchanger. |
| | .2 | One (1) 0.746 kW, 120 volt, 413 kPa pump. |
| | .3 | One (1) 56 litre holding tank suitable for use with detergents and mild acid. |
| | .4 | All necessary hoses and connectors. |
| | .2 | All acids and detergents required for the first clean shall be supplied with the unit. |
| | .3 | Acceptable products: Tandem |
| <u>2.9 WARRANTY AND START-UP</u> | .1 | Manufacturer's Warranty: Manufacturer shall provide full parts-only warranty coverage for entire chiller for a period of one year. All parts shall be warranted against defects in material and workmanship. Similar parts-only coverage shall be provided for the chillers compressors for a period of five years. The warranty period shall commence on the equipment start-up date. |

- .2 Manufacturer shall provide the services of a Factory Authorized Service Engineer to provide complete start-up supervision. Factory Authorized Service Engineer shall also be responsible for assembly of the chillers cabinetry package and electrical bus bar system. After start-up a manufacturer's representative shall provide a minimum of 16 hours of operator training to the owner's designated representative.
- .3 Contractor shall coordinate with BMS Contractor to provide the following information required to program the interface:
 - .1 Device interface
 - .2 Station address
 - .3 Baud rate

END OF SECTION

Building Modernization Phase II 10 Weldon St, Shediac, NB Project No. R.039554.001	AIR HANDLING UNITS PACKAGED	Section 23 73 11 Page 1 2013.07.17
---	--------------------------------	--

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Section 23 05 48 - Vibration Isolation Measures.
	.2	Section 23 84 13 - Humidifiers.
	.3	Section 23 33 00 - Air Duct Accessories.
	.4	Section 23 33 15 - Dampers: Operating.
<u>1.2 REFERENCES</u>	.1	American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
	.1	ANSI/ARI 430-89, Central Station Air Handling Units.
	.2	Canadian General Standards Board (CGSB)
	.1	CAN/CGSB 1.181-92, Ready-Mixed Organic Zinc-Rich Coating.
<u>1.3 SHOP DRAWINGS AND PRODUCT DATA</u>	.1	Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Indicate following: fan, fan curves showing point of operation, motor drive, bearings, filters, mixing box, dampers, VAV, coil plus all performance data.
<u>1.4 MAINTENANCE DATA</u>	.1	Provide maintenance data for incorporation into manual as specified in Section 01 78 00 - Closeout Submittals.
	.2	Include following: fan, bearings, motor, damper, VAV control, air volume.
<u>1.5 MAINTENANCE MATERIALS</u>	.1	Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
	.2	Provide one spare set of filters.
	.3	Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.6 EXTRA MATERIALS .1 Spare filters: in addition to filters to be installed immediately prior to acceptance by departmental representative, supply one (1) complete set of filters for each filter unit or filter bank.

1.7 ACCEPTABLE MATERIALS .1 Where materials are specified by trade name, refer to the Project Specific Instruction to Bidders for procedure to be followed in applying for approval of alternatives.

.2 All materials shall be low in V.O.C. (Volatile Organic Compound) emissions.

1.8 WARRANTY .1 H&V unit shall have 18-month warranty from date of shipment.

PART 2 - PRODUCTS

2.1 H&V UNIT .1 General Description

- .1 Unit will be complete with fans, motors, coils, dampers, access doors and other components/options, as shown on product drawings, wiring diagrams, and as described in performance specifications.
- .2 Fans and drives will be balanced to limit vibration at operating speeds.
- .3 Unit will be split as required. Move unit on to site. Lifting lugs shall be provided for proper lifting.
- .4 Unit casing will be factory insulated.
- .5 Units will be ETL labeled.

.2 Unit Casing

- .1 Designed for indoor applications.
- .2 Casing leakage shall not exceed 1% of design l/s at ± 2000 Pa static pressure differential across casing.
- .3 Panel deflection shall not exceed L/240 at ± 2000 Pa static pressure differential across casing.
- .4 Unit casing shall consist of a structural frame and insulated roof, wall, and floor panels.
- .5 Removal of wall panels shall not affect structural integrity of units.

- .6 Unit shall have double wall, 50mm insulated panels for walls, roof, and floor. Exterior skin will be galvanized sheet steel. Individual segments will have galvanized sheet steel as described in performance specifications.
- .7 Floor panels shall be double wall construction, designed to provide at most L/240 deflection when subjected to a 126 kg load at mid-span.
- .8 Unit casing will be insulated with spray injected foam to achieve a minimum thermal resistance of RSI 2.289 (M²-°C)W.
 - .1 Insulation application meets the requirements of NFPA 90A.
- .9 Double wall access doors will be provided on sections.
 - .1 Stainless steel hinges permit a 180° door swing.
 - .2 Access door will be of the same material type as exterior/interior casing.
 - .3 Access door latches will use a roller cam latching mechanism.
- .3 Fans
 - .1 Fans shall provide l/s and static pressure, as shown in performance specifications.
 - .2 Fans shall be Class II, as required to meet selected RPM and horsepower shown in performance specifications.
 - .3 Fans shall be DWDI housed.
 - .4 Fans shall have airfoil blades, as shown in performance specifications.
 - .5 Airfoil fans shall bear the AMCA Seal. Airfoil fan performance shall be based on tests in accordance with AMCA standard 210 and shall comply with the requirements of AMCA certified ratings programs for air and sound. Airfoil wheels shall comply with AMCA standards 99-2408-69 and 99-2401-82.

- .6 Fans shafts shall be polished steel and sized such that the first critical speed will be at least 125% of the maximum operating speed for the fan pressure class. Shaft shall be coated with an anti-corrosion coating.
- .7 Fan and motor assembly shall be internally mounted on a common base. Fan and motor base shall be spring isolated on a full width isolator support channel. Isolation shall have 50mm static deflection Type M3 per section 23 05 48. Standard of acceptance: Vibro Acoustics Type FS.
 - .1 Fan motor shall be on an adjustable base.
 - .2 Fan discharge shall be connected to cabinet via a flexible connection.
 - .3 Access doors shall be provided.
- .4 Bearings and Drives
 - .1 Fan bearings shall have average life (L10) of at least 200,000 hours. Bearing fatigue life ratings shall comply with ANSI/AFBMA 9.
 - .2 DWDI fans shall be belt-driven.
 - .3 Re-greaseable fan bearings shall be factory lubricated and equipped with standard hydraulic grease fittings.
 - .4 Fan drives shall be selected for a 1.5 service factor and shall be furnished with anti-static belts.
 - .1 Drives 11.2 kW or smaller on constant volume fans shall be adjustable pitch (present conditions).
 - .2 Drives 14.9 KW or larger shall be fixed pitch (future condition).
 - .3 Sheaves shall be machined from close grain cast iron and statically balanced.
 - .4 Drive belts shall be V type, precision molded, raw edge construction, anti-static, oil and heat resistant.

- .5 Electrical Motors
 - .1 Fan motors shall be built in accordance with the latest NEMA and IEEE standards.
 - .2 Fan motors shall comply with ASHRAE Standard 90.1.
 - .3 Fan motors shall be furnished in sizes, electrical power and starting characteristics as shown in performance specifications.
 - .1 Fan motors shall be rated for continuous, full load duty at 40°C ambient temperature and 1.15 service factor.
 - .2 Fan motors shall be NEMA design ball bearing type.
 - .1 Direct drive plenum fans shall be coupled with motors that closely match required fan RPM.
 - .3 Fan motors shall meet, at a minimum, NEMA high efficiency standards.
 - .4 Motors shall be suitable for use with variable frequency drives, per NEMA MG-1 Part 30.
- .6 Fan Motor Disconnects
 - .1 Fan motor disconnects shall be provided with unit, as shown in performance specifications.
 - .2 Disconnect shall be housed in a NEMA 1 enclosure, and shall be mounted on the primary access side of segment.
 - .3 Disconnect shall be suitable for use as an OSHA lockout/tagout disconnect when applied in accordance with part IV, Department of Labor OSHA 29 CFR Part 1910, Control of Hazardous Energy Source (lockout/tagout): final rule.
 - .4 Disconnects shall be provided with an integral ground lug.
 - .1 16A to 100A disconnects shall have two (2) #14 ground wires.
- .7 Fan Motor Starters
 - .1 Motor starters shall be supplied by Division 26 with units, as shown in submittal documents.

- .8 Filters - to Section 23 44 00 - HVAC Air Filtration
 - .1 Filter segments shall be provided. Filter tracks/frames shall be an integral part of the unit.
 - .2 Filters shall be shipped to a customer defined location.
 - .3 Filter types, nominal sizes, efficiencies, and performance characteristics shall meet performance specifications.
 - .4 Filter access will be provided via access doors on filter segments or adjacent segments as required by filter loading scheme.
 - .5 Filter blank-off shall be provided to meet present performance requirements.
- .9 Dampers
 - .1 Dampers shall be factory installed.
 - .2 Dampers shall have airfoil blades with extruded vinyl edge seals and flexible metal compressible jamb seals.
 - .3 Dampers shall have a maximum leakage rate of 1.9 l/s per square foot at 250 Pa w.g. and comply with ASHRAE 90.1.
 - .4 Maximum damper torque requirement shall be 8.51 Nm/m².
 - .5 Damper blades shall be parallel acting to promote mixing.
- .10 Appurtenances
 - .1 Safety grates capable of supporting a 136 kg load shall be provided over bottom openings, as shown in performance specifications.
 - .2 Base rails suitable for rigging and lifting shall be provided, as shown on product drawings.
 - .3 Lifting lugs shall be provided where required for proper lifting.
- .11 Finishes
 - .1 External unit surfaces shall be factory cleaned prior to finishing or shipping.
 - .2 Unpainted air-handling units constructed of galvanized steel shall pass the ASTM B-117 test for 220-hour salt spray solution (5%) without any sign of red rust.

- .3 Unit shall be painted, as shown in performance specifications.
 - .1 Painted units shall be prime-coated prior to painting.
 - .2 Paint shall be acrylic polyurethane.
 - .3 Painted unit shall exceed 500-hour salt spray test, with (5%) solution, without any sign of red rust when tested in accordance with ASTM B-117.

.12 Performance:
.1 Fans

	AHU-1	AHU-3
Supply Fan	SF-1	SF-2
Airflow (l/s)	9204	6419
Type	AF	AF
Class	S	S
Total Static Pressure (Pa)	1287.5	945
External Static Pressure (Pa)	750	500
RPM	1337	1308
Brake Horsepower (kW)	15.2	7.71
Horsepower	22.4	11.2
Size	28-28	25-25
Voltage	600/3	600/3

- .2 Filters
 - .1 Filter Cartridges: Pleated Media Filters
 - .1 Media: 100% synthetic non-woven made with recycled materials and achieving MERV 13 using the electrostatic method of particle capture.
 - .2 Media support shall be continuously laminated to an expanded metal grid on the air leaving side.
 - .3 Pleat design shall be a radial wedge which allows for total media usage.
 - .4 Media frame shall be constructed from two pieces of die cut high wet strength carrier board. The frame shall be designed with diagonal and

2013.07.17

horizontal support members bonded to the media on the air entering and leaving sides.

- .5 Filters shall be UL900 Class 2 listed.
- .6 A nominal 600 x 600 x 50 high capacity shall hold 75 grams of dust at 375 Pa.
- .7 Independent test reports are required to validate filter performance.
- .8 Operating temperature: 82.22°C.
- .9 Initial resistance to airflow shall not exceed 57.5 Pa at airflow of 2.5 m/s for a 100mm deep pleat.
- .10 Standard of acceptance: Flanders Pre Pleat M13, AAF, Farr.

.2 Schedule: Filters

	AHU-1	AHU-3
Quantity/Size	12 - 600 x 500 4 - 400 x 500	18 - 600 x 300
MERV 13 Final Filter Thickness/EFF	100mm/80-85%	100mm/80-85%

- .1 Unit shall be supplied with filter frame to satisfy future conditions.
- .2 Unit shall be supplied with filters to satisfy present conditions.

.3 Cooling Coils:

	AHU-1	AHU-3
Type	Water	Water
Fins/M	394	472
Tube/circuit	4	4
Rows	6	4
Height	1397	1334
Length	2286	1928
Face Area	3.19	2.54
Connections	3"	3"
EAT °C	12.7	12.7
LAT °C	7.2	7.2
Total kW	238.4	166.3

2013.07.17

	AHU-1	AHU-3
APD Pa	175	120
WPD M/h	3.75	3.02
Flow l/s	10.26	7.11

.4 Electric Coils:

	AHU-1	AHU-3
Element Type	Open	Open
Segment Length (mm)	685	685
Air Pressure Drop (Pa)	10	7.5
Voltage	575	575
kW	100	50
Temperature Rise (°C)	9.1	6.5
Amp. Draw	100.41	50.2
Control	SCR	SCR

.5 The units shall have the following components:

- .1 Filter/mixing box section
- .2 400mm access section
- .3 An electric heat section
- .4 Cooling coil section
- .5 Supply fan section top horizontal outlet

.6 Sound requirement:

Ducted Discharge Sound	AHU-1	AHU-3
63 Hz	98	96
125 Hz	96	93
250 Hz	98	95
500 Hz	94	89
1000 Hz	90	85

.7 Standard of Acceptance: York Solutions.

.13 Tests and Inspections

- .1 Fan skid shall be run-balanced at specified speed to insure smooth, operation.
 - .1 Constant volume fan assemblies shall be balanced at design RPM.
 - .2 Filter-in measurements shall be taken in horizontal and vertical axes on drive and opposite-drive sides of fan shafts.

- .3 Constant speed fan vibration limits: filter-in measurements shall not exceed 4 mils.
- .2 Unit wiring with voltage greater than 30Vac will be hipot tested prior to shipping.

PART 3 - EXECUTION

- | | | |
|-------------------------|----|--|
| <u>3.1 INSTALLATION</u> | .1 | Provide appropriate protection apparatus. |
| | .2 | Install units in accordance with manufacturer's instructions and as indicated. |
| | .3 | Ensure adequate clearance for servicing and maintenance. |
| <u>3.2 FANS</u> | .1 | Install fan sheaves required for final air balance. |
| | .2 | Install flexible connections at fan inlet and fan outlets. |
| | .3 | Verify vibration isolators. |

END OF SECTION

PART 1 - GENERAL

- | | | |
|-----------------------|----|--|
| <u>1.1 REFERENCES</u> | .1 | American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI) |
| | .1 | ANSI/ARI 210/240-[03], Unitary Air-Conditioning and Air-Source Heat Pump Equipment. |
| | .2 | ARI 270-[95], Sound Rating of Outdoor Unitary Equipment. |
| | .2 | ANSI/UL 1995 B-[1998], Standard for Heating and Cooling Equipment. |
| | .3 | Canadian Standards Association (CSA International) |
| | .1 | CSA B52-[99], Mechanical Refrigeration Code. |
| | .2 | CSA C22.1 HB-[02], Canadian Electrical Code Handbook. |
| | .4 | Health Canada / Workplace Hazardous Materials Information System (WHMIS) |
| | .1 | Material Safety Data Sheets (MSDS). |
| | .5 | National Fire Protection Association |
| | .1 | NFPA 90A-[02], Standard for the Installation of Air Conditioning and Ventilating Systems. |
| <u>1.2 SUBMITTALS</u> | .1 | Submittals in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Coordinate submittal requirements and provide submittals required. |
| | .3 | Product Data: |
| | .1 | Submit manufacturer's printed product literature, specifications and datasheet for packaged rooftop HVAC units. |
| | .4 | Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing. |
| | .5 | Shop Drawings: |
| | .1 | Submit shop drawings to indicate project layout and dimensions; indicate: |

- .1 Equipment, piping, and connections, together with control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
- .2 Control equipment shipped loose, showing final location in assembly.
- .3 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
- .4 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.
- .5 Fan performance curves.
- .6 Details of vibration isolation.
- .7 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.
- .8 Type of refrigerant used.
- .6 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .7 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .8 Instructions: submit manufacturer's installation instructions.
- .9 Manufacturer's Field Reports: manufacturer's field reports specified.

- .10 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include data as follows:
 - .1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.
 - .2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

1.3 QUALITY ASSURANCE .1

Pre-Installation Meeting:

- .1 Convene pre-installation meeting two week prior to beginning work of this Section and on-site installations.
 - .1 Verify project requirements.
 - .2 Co-ordination with other building subtrades.
 - .3 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.4 WARRANTY .1

For work of this Section 23 74 00 Packaged Outdoor HVAC Equipment, 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to 24 months.

PART 2 - PRODUCTS

2.1 GENERAL .1

Units shall be specifically designed for outdoor rooftop installation on a roof curb and be completely factory assembled and tested, piped, internally wired, fully charged with R-410A compressor oil and shipped in one piece. Units shall be available for direct expansion cooling with electric heating. Filters, outside air system, return air system, non-fused disconnect switches and all operating and safety controls shall be furnished factory installed. All units shall be cULus approved and factory run tested. Cooling capacity shall be rated in accordance

with AHRI Standard 360. All units shall have decals and tags to aid in service and indicate caution areas. Electrical diagrams shall be printed on long life water resistant material and shall ship attached to control panel doors.

2.2 CASING .1

Exterior panels shall be zinc coated galvanized steel, phosphatized and painted with a slate grey air-dry finish durable enough to withstand a minimum of 500 hours consecutive salt spray application in accordance with standard ASTM B117. Screws shall be coated with zinc-plus-zinc chromate. Heavy gauge steel hinged access panels with tiebacks to secure door in open position shall provide access to filters and heating sections. Refrigeration components, supply air fan and compressor shall be accessible through removable panels as standard. Unit control panel, filter section, Double Wall Construction hinged access doors shall provide access to filters, return/exhaust air, heating and supply fan section. All access doors and panels shall have neoprene gaskets. Interior surfaces or exterior casing members shall have 15mm Tuf-Skin fiberglass insulation. Unit base shall be watertight with heavy gauge formed load bearing members, formed recess and curb overhang. Unit lifting lugs shall accept chains or cables for rigging. Lifting lugs shall also serve as unit tiedown points.

2.3 COMPRESSORS .1

The 3-D Scroll compressors shall have a simple mechanical design with only three major moving parts. The 3-D Scroll provides a completely enclosed compressor chamber with optimized scroll profiles which leads to increased efficiency. The 3-D Scroll includes a direct-drive, 3600 rpm, suction gas cooled hermetic motor. Dependent on the compressor model, motor protection is provided by an external 24 VAC module which provides protection against incorrect phase sequence, excess motor temperatures, over current protection, and phase loss. The 3-D compressor shall include centrifugal oil pump, scroll tips seals, internal heat shield that lowers the heat transfer from discharge and suction gas, oil level sight glass and oil charge valve. Some compressor models also provide a dip tube that allows for oil draining, in

addition to a low leakage internal discharge check valve to help prevent refrigerant migration. Each compressor shall have a crankcase heater installed, properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles.

2.4 PHASE AND VOLTAGE .1
MONITOR

Voltage monitor shall protect 3-phase equipment from phase loss, phase reversal, and low voltage. Any fault condition shall produce a Failure Indicator LED, and send the unit into an emergency stop condition. cULus approved.

2.5 SUPPLY FAN .1

Supply fan motors shall be enclosed fan cooled. The supply fans shall be dynamically balanced in factory. Supply fan shall be test run in unit and shall reach rated rpm. The 60 Hz supply fan motors shall meet the Energy Independence Security Act of 2007 (EISA).

2.6 FORWARD CURVED .1
SUPPLY FAN

Supply fans shall have two double-inlet, forward-curved fans mounted on a common shaft with fixed sheave drive. Fans shall be factory-tested to reach rated rpm before the fan shaft passes through first critical speed. Fan shaft shall be mounted on two grease lubricated ball bearings designed for L10 200,000 hours average life. Extended grease lines shall allow greasing of bearings from unit filter section. Fan motor and fan assembly shall be mounted on common base to allow consistent belt tension with no relative motion between fan and motor shafts. Entire assembly shall be completely isolated from unit and fan board by 50mm deflection spring isolation.

2.7 EVAPORATOR COIL .1

Internally enhanced copper tubing of 1/2" O.D. shall be mechanically bonded to heavyduty aluminum fins of configured design. All coils shall be equipped with thermal expansion valves and factory pressure and leak tested.

2.8 AIR-COOLED .1
CONDENSER COIL

Condenser coils shall have all Aluminum Microchannel coils. All coils shall be leak tested at the factory to ensure pressure integrity. The condenser coil is pressure tested to 4478 kPag. Subcooling circuit(s) shall be provided as standard.

2.9 CONDENSER FANS AND.1
MOTORS

All condenser fans shall be vertical discharge, direct drive fans, statically balanced, with steel blades and zinc plated steel hubs. Condenser fan motors shall be three-phase motors with permanently lubricated ball bearings, built-in current and thermal overload protection and weathertight slingers over motor bearings.

2.10 UNIT CONTROLLER .1

DDC microprocessor controls shall be provided to control all unit functions. The control system shall be suitable to control CV or VAV applications. The controls shall be factory-installed and mounted in the main control panel. All factory-installed controls shall be fully commissioned run tested at the factory. The unit shall have a Human Interface Panel with a 16 key keypad, a 2 line X 40 character clear English display as standard to provide the operator with full adjustment and display of control data functions. The unit controls shall be used as a stand-alone controller, or as part of a building management system involving multiple units. The control must interface completely with the building energy management system.

- .1 The unit shall be equipped with a microprocessor control system. This system shall consist of temperature and pressure sensors, printed circuit boards, and a unit mounted HumanInterface Panel. Modules shall be individually replaceable for ease of service. All microprocessors, boards and sensors shall be factory mounted, wired and tested. The microprocessor boards shall be stand-alone DDC controls not dependent on communications with an on-site PC or a Building Management Network. The microprocessors shall be equipped with on-board diagnostics, indicating that all hardware, software and interconnecting wiring are in proper operating condition. The modules shall be protected to prevent RFI and voltage transients from affecting the board's circuits. All field wiring shall be terminated at separate, clearly marked terminal strip. Direct field wiring to the I/O boards is not acceptable. The

microprocessor's memory shall be non-volatile EEPROM type requiring no battery or capacitive backup, while maintaining all data.

- .2 The Human Interface Panel's keypad display character format shall be 40 characters x 2 lines. The character font shall be 125 x 175 dot matrix plus cursor. The display shall be Supertwist Liquid Crystal Display (LCD) with blue characters on a ray/green background which provides high visibility and ease of interface. The display format shall be in clear English. Two or three digit coded displays are not acceptable.
- .3 The keypad shall be equipped with 16 individual touch-sensitive membrane key switches. The switches shall be divided into four separate sections and be password protected from change by unauthorized personnel. The six main menus shall be STATUS, SETPOINTS, DIAGNOSTICS, SETUP, CONFIGURATION and SERVICE MODE.

- .2 90-95 percent cartridge filter, MERV 14: 300mm deep cartridge filters shall be mounted in a galvanized steel frame. Filters shall be Class 1 listed by Underwriters Laboratories and have a 90-95% dust spot efficiency per ASHRAE 52-76. To ensure maximum cartridge filter life, two-inch MERV 7 prefilters shall be provided.

2.11 100% MODULATING .1
RETURN FAN WITH CONTROL

A single width plenum fan with airfoil blade shall be mounted on a shaft with fixed sheave drive. The fan shall be dynamically balanced for the operating envelop and tested in factory before being installed in unit. The plenum fan shall be test run as part of unit final run test. Fan operating envelop rpm shall be below first critical speed. Fan shaft shall be mounted on two grease lubricated ball or roller bearings designed for L10 200,000-hour average life. Extended grease lines shall be provided to allow greasing of bearings from section base rail. Fan motor and assembly shall be mounted on common base to allow consistent belt tension with no relative motion between fan and motor shafts. The entire assembly shall be completely isolated from unit with 50mm spring isolators. The 100 percent modulating relief

damper shall be modulated in response to building pressure. A differential pressure control system, shall use a differential pressure transducer to compare indoor building pressure to outdoor ambient atmospheric pressure. The control system shall modulate the discharge dampers to control the building pressure to within the adjustable, specified deadband that shall be adjustable at the Human Interface Panel. The return fan VFD shall modulate in response to return duct static pressure. All 60 Hz return fan motors meet the Energy Independence Security Act of 2007.

- | | | |
|--|----|--|
| <u>2.12 VARIABLE
FREQUENCY DRIVE</u> | .1 | The VFDs shall be as specified in Section 23 05 13.01 - Variable Frequency Drives |
| | .2 | An AC Drive/Off/Bypass Hand selector switch will be provided for installation in the unit control box. |
| <u>2.13 BYPASS CONTROL</u> | .1 | Provides full nominal airflow in the event of drive failure. |
| <u>2.14 ECONOMIZER
CONTROL WITH DRY BULB</u> | .1 | Used with the fresh air economizer, an outdoor temperature sensor is included for comparing the outdoor dry bulb temperature to a locally adjustable temperature setpoint. The setpoint is programmed at the human interface to determine if outdoor air temperature is suitable for economizer operation. |
| <u>2.15 0-100%
MODULATING ECONOMIZER</u> | .1 | Operated through the primary temperature controls to automatically utilize OA for "free" cooling. Automatically modulated return and OA dampers shall maintain proper temperature in the conditioned space. Economizer shall be equipped with an automatic lockout when the outdoor high ambient temperature is too high for proper cooling. Minimum position control shall be standard and adjustable at the Human Interface Panel or with a remote potentiometer or through the building management system. A spring return motor shall ensure closure of OA dampers during unit shutdown or power interruption. Mechanical cooling shall be available to aid the economizer mode at any ambient. Low leak economizer dampers shall be standard with a leakage rate of 2.5 percent of nominal airflow (189 l/s/ton) at 250 Pa static pressure. |

- 2.16 ULTRA LOW-LEAK ECONOMIZER DAMPERS .1 Standard low leak dampers shall be provided with chlorinated polyvinyl chloride gasketing added to the damper blades and rolled stainless steel jamb seals to the sides of the damper assembly. Ultra low-leak economizer dampers shall have a leakage rate of one percent based on testing data completed in accordance with AMCA Standard 500 at AMCA Laboratories.
- 2.17 ELECTRIC HEATING.1 All electric heat models shall be completely assembled and have wired electric heating system integral within the rooftop unit. Heavy duty nickel chromium elements internally wired with a maximum density of 40 watts per square inch shall be provided. Heater circuits shall be 48 amps or less, each individually fused. Automatic reset high limit control shall operate through heater backup contactors. The 575 volt electric units shall have factory mounted nonfused disconnect switch located in the main control panel to serve the entire unit. The electric coil shall have modulating control with an SCR.
- 2.18 HOT GAS BYPASS .1 Valve, piping and controls are all included on circuit 2 to allow operation at low airflow, avoiding coil frosting and damage to compressor. When suction pressure falls below valve adjustable setpoint, the valve modulates hot gas to the inlet of the evaporator.
- 2.19 BACnet COMMUNICATION INTERFACE MODULE .1 Provides control and monitoring of the rooftop by a third party building management system utilizing Native BACnet protocol.
- 2.20 SOLID DOUBLE WALL CONSTRUCTION .1 The primary function of sheet metal liners is to provide a mechanical fastener for insulation and prevent the possibility of loose insulation fibers from entering the airstream. 1.6 mm exterior liners are welded to 1.0mm interior liners. All interior airstream insulation will be lined, with the exception of the vertical supports, which have foil faced insulation. cULus approved.

2.21 SLOPED DRAIN PAN.1 Double sloping drain pan promotes runoff of standing water inside the unit. The base pans in evaporator section of unit are constructed of 1.6mm. The evaporator drain pan is constructed of 2.0mm steel. Note: Coil end supports are constructed of 1.6mm galvanized steel.

2.22 PERFORMANCE.1 Performance shall be in accordance with the following:

Tags	AC-7
Design airflow (L/s)	3419
Exhaust Airflow (L/s)	3077
Cooling EDB (C)	26.67
Cooling EWB (C)	19.44
Ambient DB (C)	35.00
Leaving Coil DB (C)	12.66
Leaving Coil WB (C)	12.17
Leaving Unit DB (C)	14.19
Leaving Unit WB (C)	12.79
Gross total capacity (kW)	85.66
Gross sensible capacity (kW)	59.77
Gross latent capacity (kW)	25.89
Net total capacity (kW)	79.24
Net sensible capacity (kW)	53.36
Net sensible heat ratio (%)	67.33
Output htg capacity (kW)	30.02
Output htg capacity w/fan (kW)	30.02
Heating EAT (C)	10.00
Heating LAT (C)	17.27
Heating delta T (C)	7.27
Supply duct static pressure (Pa)	435.89
Return duct static pressure (Pa)	249.08
Component S.P. drop (Pa)	280.72
Total static pressure (Pa)	965.69
Supply motor BHP calculated (kW)	5.74
Supply fan RPM calculated (rpm)	1163
Exhaust motor BHP calculated (kW)	1.45
Exhaust fan RPM calculated (rpm)	1028
System power (kW)	32.16
EER @ AHRI (EER)	10.3
IPLV @ AHRI (IPLV)	0.0
Rated capacity at AHRI (kW)	83.81
HCFC-410A refrigerant charge - circuit 1 (kg)	12.7
IEER (EER)	13.8

Tags	AC-7
Return damper drop (Pa)	56.79
Supply fan efficiency (%)	42.60
Supply motor count ()	1

2.23 STANDARD OF .1 Trane Model SEHLF255.
ACCEPTANCE

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install as per manufacturers' instructions on
roof curbs provided by manufacturer.

.2 Manufacturer to certify installation,
supervise start-up and commission unit.

.3 Run drain line from cooling coil condensate
drain pan to discharge over roof drain.

3.2 FIELD QUALITY .1
CONTROL

Manufacturer's Field Services:

.1 Have manufacturer of products supplied
under this Section review work involved
in handling, installation/application,
protection and cleaning of its product,
and submit written reports, in
acceptable format, to verify compliance
of work with Contract.

.2 Provide manufacturer's field services,
consisting of product use
recommendations and periodic site visits
for inspection of product installation,
in accordance with manufacturer's
instructions.

.3 Provide the services of a factory trained
technician for onsite start-up,
commissioning and technical support.

.4 Provide the services of a factory trained
technician to modify sequence as
directed by departmental
representative.

.2 Obtain reports within three (3) days of review
and submit immediately to departmental
representative.

.3 General:

.1 In accordance with Section 23 08 02 -
Cleaning and Start-up of Mechanical
Piping Systems.

- .4 Verify accessibility, cleanability, drainage of drain pans for coils, humidifiers.
- .5 Performance Verification:
 - .1 General:
 - .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems, supplemented as specified herein.
 - .2 Rooftop Air Handling Units:
 - .1 Set zone mixing dampers for full cooling, except that where diversity factor forms part of design set that % of zone dampers to full heating.
 - .2 Set outside air and return air dampers for minimum outside air.
 - .3 Check for smooth, vibration less correct rotation of supply fan impeller.
 - .4 Measure supply fan capacity.
 - .5 Adjust impeller speed as necessary and repeat measurement of fan capacity.
 - .6 Measure pressure drop each component of air handling unit.
 - .7 Set outside air and return air dampers for the % of outside air required by design and repeat measurements of fan capacity.
 - .8 Reduce differences between fan capacity at minimum and maximum outside air less than 5%.
 - .9 Reduce difference between fan capacity at full cooling and fan capacity at full heating to less than 5%.
 - .10 OAD: verify for proper stroking, interlock with RAD.
 - .11 Measure DBT, WBT of SA, RA, EA.
 - .12 Measure air cooled condenser discharge DBT.
 - .13 Measure flow rates (minimum and maximum) of SA, RA, EA, relief air.
 - .14 Simulate maximum cooling load and measure refrigerant hot gas and suction temperatures and pressures.

- .15 Use smoke test to verify no short-circuiting of EA, relief air to outside air intake or to condenser intake.
- .16 Simulate maximum heating load and:
 - .1 Verify temperature rise across heat exchanger.
- .17 Measure radiated and discharge sound power levels under maximum heating demand and under maximum cooling demand with compressors running.
- .18 Verify operating control strategies, including:
 - .1 Early morning warm-up cycle.
 - .2 Freeze protection.
 - .3 Economizer cycle operation, temperature of change-over.
 - .4 Alarms.
 - .5 Voltage drop across thermostat wiring.
 - .6 Operation of remote panel including pilot lights, failure modes.
- .19 Set zone mixing dampers for full heating and repeat measurements.
- .20 Measure leakage past zone mixing dampers by taking temperature measurements. Reduce leakage to less than 5%.
- .21 Measure return fan capacity.
- .22 Adjust impeller speed as necessary and repeat measurement of return fan capacity.
- .23 Check capacity of heating unit.
- .24 Measure DX refrigeration system performance.
- .25 Refer to other sections of these specifications for PV procedures for other components.
- .3 Start-Up:
 - .1 General: in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .4 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.

.5 Verify accessibility, clean ability, drainage of drain pans for coils, humidifiers.

.6 Commissioning Reports:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports supplemented as specified herein. Include:

.1 Report forms as specified Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.

3.3 DEMONSTRATION .1 Training: in accordance with Section 01 91 13- General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.

3.4 CLEANING .1 Perform cleaning operations as specified in Section 01 74 11 - Cleaning, Section 23 08 02 - Cleaning and Start-up of Mechanical Piping System, and in accordance with manufacturer's recommendations.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Section 01 33 00 - Submittal Procedures.
	.2	Section 01 78 00 - Closeout Submittals.
<u>1.2 REFERENCES</u>	.1	American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
	.1	ASHRAE 52.1-[92], Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
	.2	American Society for Testing and Materials (ASTM International)
	.1	ASTM C 547-[00], Specification for Mineral Fibre Pipe Insulation.
	.3	Canadian General Standards Board (CGSB)
	.1	CAN/CGSB-115.10-[M90], Disposable Air Filters For Removal of Particulate Matter from Ventilating Systems.
	.2	CAN/CGSB-115.15-[M91], High Efficiency, Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
	.4	Canadian Standards Association (CSA International)
	.1	CSA B52-[99], Mechanical Refrigeration Code.
	.2	CAN/CSA-C656-[M92(R1998)], Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.
	.5	Environment Canada, (EC)/Environmental Protection Services (EPS)
	.1	EPS 1/RA/2-[1996], Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
	.2	Environment Canada-[1994], Ozone-Depleting Substances Alternatives and Suppliers List.
<u>1.3 SHOP DRAWINGS AND PRODUCT DATA</u>	.1	Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

Building Modernization Phase II 10 Weldon St, Shediac, NB Project No. R.039554.001	COMPUTER ROOM AIR CONDITIONING	Section 23 81 23 Page 2 2013.07.17
---	-----------------------------------	--

	.2	Indicate major components and accessories including sound power levels of units.
	.3	Type of refrigerant used.
<u>1.4 CLOSEOUT SUBMITTALS</u>	.1	Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
<u>1.5 WARRANTY</u>	.1	For refrigeration compressors, the 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to 5 years.
	.2	Contractor hereby warrants refrigeration compressors in accordance with GC 24, but for 5 years.
<u>1.6 EXTRA MATERIALS</u>	.1	Furnish following spare parts:
<u>PART 2 - PRODUCTS</u>	CRAC-1 and CRAC-2	
<u>2.1 DESIGN REQUIREMENTS</u>	.1	The Mission Critical Cooling system shall be a self-contained, factory-assembled unit with upflow air delivery. The system shall have a net total cooling capacity of 35.7 kW with a net sensible cooling capacity of 31.6 kW based on an entering air temperature of 23.9°C dry bulb and 16.2°C wet bulb. The unit is to be supplied with 575 volt 3 ph 60 Hz electrical service. Net capacities shall include losses due to fan motor heat.
<u>2.2 FRAME</u>	.1	The frame shall be MIG welded, formed sheet metal. It shall be protected against corrosion using the autophoretic coating process. The frame shall be capable of being separated into three parts in the field to accommodate rigging through small spaces.
	.1	Upflow Top Air Supply, Front Throw: The supply air shall exit from the top of the cabinet with the air throw towards the front.
	.2	Upflow Air Return, Front: The return air shall enter the unit from the front of the cabinet through factory installed grilles. Grilles shall be painted black.

- .3 Exterior Panels: The exterior panels shall be insulated with a minimum 25mm, 0.68 kg density fiber insulation. The main front panel shall have captive 1/4 turn fasteners. The main unit colour shall be selected by the Architect from standard available colours.

2.3 FILTERS, UPFLOW .1
FRONT RETURN

Filter located in separate filter box accessible from lower unit panel.

- .1 Filters, 4: Filters shall be deep pleated 100mm filters with an ASHRAE 52.2 MERV8 rating (45% ASHRAE 52.1) or ASHRAE 52.2 MERV11 rating (60-65% ASHRAE 52.1).

2.4 BLOWER SECTION .1

The blower section shall be designed for 2596 l/s at an external static pressure of 125 Pa. The fans shall be the centrifugal type, double width double inlet and shall be dynamically balanced as a completed assembly. The shaft shall be heavy duty steel with self-aligning, permanently sealed, pillow block bearings with a minimum L10 life of 200,000 hours. The fans shall draw air through the A-frame coil to ensure even air distribution and maximum coil performance. A static regain duct shall be factory-installed to the bottom of the blower.

- .1 Motor: The fan motor shall be 3.7 kW at 1750 RPM @ 60hz, mounted to an automatic, spring-tensioning base. The motor shall be removable from the front of the cabinet.
 - .1 Premium Efficiency Motor: The fan motor shall be Open Drip-Proof, Premium efficiency and shall meet NEMA Premium standard.
- .2 Drive Package: The motor sheave and fan pulley shall be double-width fixed pitch. Two belts, sized for 200% of the fan motor horsepower shall be provided with the drive package. An auto-tension system shall provide constant tension on the belts. Belts, shaft, blower bearings, sheave and pulley shall be warranted for five years (parts only).

- 2.5 HUMIDIFIER .1 A humidifier shall be factory-installed inside the unit. Bypass air slots shall be included to enable moisture to be absorbed into the air stream. The humidifier capacity shall be 5.0 kg/hr. The humidifier shall be removable from the front of the cabinet.
- .1 Infrared Humidifier: The humidifier shall be of the infrared type consisting of high intensity quartz lamps mounted above and out of the water supply. The humidifier pan shall be stainless steel and arranged to be removable without disconnecting high voltage electrical connections. The complete humidifier section shall be pre-piped, ready for field connection to water supply. The humidifier shall be equipped with an automatic water supply system and shall have an adjustable water-overfeed to prevent mineral precipitation. A high-water detector shall shut down the humidifier to prevent overflowing. A factory-provided air-gap shall prevent backflow of the humidifier supply water.
- 2.6 SCR REHEAT .1 The environmental control unit shall include a factory-installed reheat to control temperature during dehumidification.
- .1 3-Stage Electric Reheat: The electric reheat coils shall be low watt density, 304/304 stainless steel fin tubular construction, protected by thermal safety switches, shall be 15 kW controlled by multiple pulse to achieve tight temperature control. The reheat elements shall be removable from the front of the cabinet.
- 2.7 DUAL REFRIGERATION SYSTEM.1 Each unit shall include two (2) independent refrigeration circuits and shall include hot gas mufflers, liquid line filter driers, refrigerant sight glass with moisture indicator, externally equalized expansion valves and liquid line solenoid valves. Compressors shall be located outside the airstream and shall be removable and serviceable from the front of the unit.

- .1 Digital Scroll Compressors: The compressor shall be scroll-type with a variable capacity operation capability. Compressor solenoid valve shall unload the compressor and allow for variable capacity operation. The compressor shall be suction gas cooled motor, vibration isolators, thermal overloads, automatic reset high pressure switch with lockout after three failures, rotalock service valves, pump down low pressure transducer, suction line strainer, and a maximum operating speed of 3500 RPM.
- .2 Evaporator Coil: The evaporator coil shall be A-frame design with offset orientation and have 1.6 m² face area, three rows deep. It shall be constructed of rifled copper tubes and aluminum fins and have a maximum face velocity of 1.6 m/s at 2596 l/s. A stainless steel condensate drain pan shall be provided.
- .3 R-407C Refrigerant: The system shall be designed for use with R-407C refrigerant, which meets the EPA clean air act for phase-out of HCFC refrigerants.

2.8 MICROPROCESSOR .1
CONTROL WITH SMALL
GRAPHIC DISPLAY

- The unit control shall be factory-set for Intelligent Control which uses "fuzzy logic" and "expert systems" methods. Proportional and Tunable PID shall also be user selectable options.
- .1 Internal unit component control shall include the following:
 - .1 Compressor Short Cycle Control - Prevents compressor short-cycling and needless compressor wear.
 - .2 System Auto Restart - The auto restart feature will automatically restart the system after a power failure. Time delay is programmable.
 - .3 Sequential Load Activation - On initial startup or restart after power failure, each operational load is sequenced with a minimum of one second delay to minimize total inrush current.

- .4 Hot Water/Econ-O-Coil Flush Cycles
- Hot water reheat coils and Econ-O-Coils are periodically flushed to prevent a buildup of contaminants.
- .5 Predictive Humidity Control -
calculates the moisture content in the room and prevents unnecessary humidification and dehumidification cycles by responding to changes in dew point temperature.
- .2 The control shall be compatible with all remote monitoring and control devices. Options are available for BMS interface via MODbus, Jbus, BACNet, Profibus and SNMP.
- .3 The control processor shall be microprocessor based with a 128x64 dot matrix graphic front monitor display and control keys for user inputs mounted in an ergonomic, aesthetically pleasing housing. The display & housing shall be viewable while the unit panels are open or closed. The controls shall be menu driven. The display shall be organized into three main sections: User Menus, Service Menus and Advanced Menus. The system shall display user menus for: active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in % of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes within the service menus. Service menus shall include: setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode. A password shall be required to access the advanced menus which include the factory settings and password menus.

- .4 The User Menus Shall be Defined as Follows:
 - .1 Active Alarms: Unit memory shall hold the 200 most recent alarms with time and date stamp for each alarm.
 - .2 Event Log: Unit memory shall hold the 400 most recent events with id number, time and date stamp for each event.
 - .3 Graphic Data View: Eight graphic records shall be available: return air temperature, return air humidity, supply air temperature, outdoor temperature and four custom graphs.
 - .4 Unit View - Status Overview: Simple or Graphical "Unit View" summary displays shall include temperature and humidity values, active functions (and percent of operation) and any alarms of the host unit.
 - .5 Total Run Hours: Menu shall display accumulative component operating hours for major components including compressors, Econ-O-Coil (FC), fan motor, humidifier and reheat.
 - .6 Various Sensors: Menu shall allow setup and display of optional custom sensors. The control shall include four customer accessible analog inputs for sensors provided by others. The analog inputs shall accept a 4 to 20 mA signal. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC if desired. The gains for each analog input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display.
 - .7 Display Setup: Customer shall pre-select the desired grouping of display languages at the time of the order from the following choices:

- .1 Group 1: English, French, Italian, Spanish, German
- .2 Group 2: English, Russian, Greek
- .3 Group 3: English, Japanese, Chinese, Arabic
- .8 Service Contacts: Menu shall allow display of local service contact name and phone number.
- .9 The Service Menus Shall be Defined as Follows:
- .10 Setpoints: Menu shall allow setpoints within the following ranges:
 - .1 Temperature Setpoint 18-29°C*
 - .2 Temperature Sensitivity 0.6-5.6°C
 - .3 Humidity Setpoint 20-80% RH*
 - .4 Humidity Sensitivity 1-30% RH
 - .5 High Temperature Alarm 2-32°C
 - .6 Low Temperature Alarm 2-32°C
 - .7 High Humidity Alarm 15-85% RH
 - .8 Low Humidity Alarm 15-85% RH
- * The microprocessor may be set within these ranges, however, the unit may not be able to control to extreme combinations of temperature and humidity.
- .11 Standby Settings/Lead-Lag: Menu shall allow planned rotation or emergency rotation of operating and standby units.
- .12 Timers/Sleep Mode: Menu shall allow various customer settings for turning on/off unit.
- .13 Alarm Setup: Menu shall allow customer settings for alarm notification (audible/local/remote). The following alarms shall be available:
 - .1 High Temperature
 - .2 Low Temperature
 - .3 High Humidity
 - .4 Low Humidity

- .5 Compressor Overload (Optional)
- .6 Main Fan Overload (Optional)
- .7 Humidifier Problem
- .8 High Head Pressure
- .9 Change Filter
- .10 Fan Failure
- .11 Low Suction Pressure
- .12 Unit Off
- .14 Audible Alarm: The audible alarm shall annunciate any alarm that is enabled by the operator.
- .15 Common Alarm: A programmable common alarm shall be provided to interface user selected alarms with a remote alarm device.
- .16 Remote Monitoring: All alarms shall be communicated to the monitoring system with the following information: Date and time of occurrence, unit number and present temperature and humidity.
- .17 Sensor Calibration: Menu shall allow unit sensors to be calibrated with external sensors.
- .18 Maintenance/Wellness Settings: Menu shall allow reporting of potential component problems before they occur.
- .19 Options Setup: Menu shall provide operation settings for the installed components.
- .20 System/Network Setup: Menu shall allow Unit-to-Unit (U2U) communication and setup for teamwork modes of operation (up to 32 units).
- .21 Teamwork Modes of Operation: Saves energy by preventing operation of units in opposite modes multiple units.
- .22 Auxiliary Boards: Menu shall allow setup of optional expansion boards.
- .23 Diagnostics/Service Mode: The control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be

indicated as on or off at the front display. Control outputs shall be able to be turned on or off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

- .5 Advanced Menus
 - .1 Factory Settings: Configuration settings shall be factory-set based on the pre-defined component operation.
 - .2 Change Passwords: Menu shall allow new passwords to be set or changed.
- .6 Microprocessor Control With Large Graphic Display
 - .1 The unit control with large graphic display shall include all of the features as the with small graphic display, except that it includes a larger graphical display and shall include the additional features of: "System View", Spare Parts List, Unit Diary.
 - .2 The control processor shall be microprocessor based with a 320x240 dot matrix graphic front monitor display panel and control keys for user inputs mounted in an ergonomic, aesthetically pleasing housing.
 - .3 System View - Status Overview: "System View" shall display a summary of operation for the total number of operating units within a Unit-to-Unit (U2U) configuration.
 - .4 Spare Parts List: Menu shall include a list of critical spare parts, their quantity and part numbers.
 - .5 Unit Diary: Menu shall include a free field area within the unit memory where unit history may be stored for reference.

- 2.9 MISCELLANEOUS .1 Non-Locking Disconnect Switch
OPTIONS .1 The manual disconnect switch shall be mounted in the high voltage section of the electrical panel. The switch shall be accessible with the door closed.
- .2 High Temperature Sensor
.1 The firestat shall be factory-installed in the unit and shall be factory-set to 52°C. It shall immediately shut down the environmental control system when activated. The sensor shall be mounted with the sensing element in the return air.
- .3 Condensate Pump, Dual Float
.1 The condensate pump shall have a minimum capacity of 548 l/h at 58 kPa head. It shall be complete with integral dual-float switches, pump-and-motor assembly and reservoir. The secondary float shall send a signal to the local alarm and shut down the unit upon high water condition.
- 2.10 AIR-COOLED .1 The indoor evaporator unit shall include
SYSTEMS refrigerant piping, with a factory holding charge of nitrogen. The hot-gas and liquid lines shall be spun shut and shall include a factory-installed Schrader valve. Field relief of the Schrader valve shall indicate a leak-free system.
- .1 Air-Cooled Condenser: The manufactured outdoor air-cooled condenser shall be the low profile, multiple direct drive, propeller fan type. The condenser shall balance the heat rejection of the compressor at 35°C ambient. The condenser shall be constructed of aluminum and contain a copper tube, aluminum fin coil arranged for vertical air discharge.
- .1 Lee-Temp System: The winter control system for the air-cooled condenser shall be Lee-Temp. The Lee-Temp system shall allow startup and positive head pressure control with ambient temperatures as low as -34.4°C. The Lee-Temp

package shall include the following components for each refrigeration circuit: insulated receiver, pressure relief valve, head pressure three-way control valve and rotalock valve for isolating the refrigerant charge. The Lee-Temp receiver shall be factory-insulated and mounted ready for the field connection to the air-cooled condenser. The Lee-Temp heater shall require a separate power supply of 145 volt, single phase.

- .2 Condenser Disconnect Switch: A disconnect switch shall be factory-mounted and wired to the condenser control panel, accessible from the exterior.

2.11 DISCHARGE AIR PLENUM FOR UPFLOW UNITS, WITH DISCHARGE GRILLE(S) .1 The air plenum shall be constructed of 20 gauge steel, powder coated to match unit color. The plenum shall be 24" high. Discharge air grilles shall be painted black and shall be included on the Front of the plenum.

2.12 STANDARD OF ACCEPTANCE .1 Liebert VS035AUDOEI precision cooling unit with DCSL205B Outdoor Condenser.

PART 3 - EXECUTION

3.1 GENERAL .1 Install as indicated, to manufacturer's recommendations, and in accordance with EPS 1/RA/2.

.2 Manufacturer to certify installation.

.3 Run drain line from cooling coil condensate drain pan to condensate pump, then to floor drain in Mechanical Room. Terminate over nearest floor drain.

3.2 EQUIPMENT PREPARATION .1 Provide services of manufacturer's field departmental representative to set and adjust equipment for operation as specified.

END OF SECTION

PART 1 - GENERAL

<u>1.1 SUMMARY</u>	.1	Related Sections: .1 Section 01 33 00 - Submittal Procedures. .2 Section 01 35 29 - Health and Safety Requirements. .3 Section 01 45 00 - Quality Control. .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal. .5 Section 01 78 00 - Closeout Submittals. .6 Section 02 81 01 - Hazardous Materials. .7 Section 26 05 00 - Common Work Results - Electrical.
<u>1.2 REFERENCES</u>	.1	Health Canada / Workplace Hazardous Materials Information System (WHMIS) .1 Material Safety Data Sheets (MSDS).
<u>1.3 SUBMITTALS</u>	.1	Submittals in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Product Data: .1 Submit manufacturer's printed product literature, specifications and datasheet for electric incremental cooling units, and accessories. Include information as follows: .1 Replacement data for motor element, thermostat and switch. .2 Mounting methods. .3 kW rating. .4 Cabinet material thicknesses. .5 Physical size. .6 Finish. .7 Cabinet surface temperature.
	.3	Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
<u>1.4 QUALITY ASSURANCE</u>	.1	Health and Safety: .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

- | | | |
|--|----|---|
| 1.5 DELIVERY,
STORAGE AND
HANDLING | .1 | Waste Management and Disposal: |
| | .1 | Separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal. |

PART 2 - PRODUCTS

- | | | |
|--------------------------|----|--|
| <u>2.1 COOLING UNITS</u> | .1 | Indoor Variable Refrigerant Flow Cooling Unit: |
| | .1 | The unit shall be a ceiling mounted ducted indoor fan coil with a fixed rear return and a horizontal discharge supply, and shall have a modulating linear expansion device. The unit shall match the outdoor cooling unit. The unit shall support individual control using M-NET DDC controllers. The unit shall feature external static pressure settings up to 200 Pa. Units shall have the ability to control supplemental heat. |
| | .2 | The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. |
| | .3 | The unit cabinet shall be ceiling-concealed, ducted. The cabinet panel shall have provisions for a field installed filtered outside air intake. |
| | .4 | The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings. The indoor unit shall have a ducted air outlet system and ducted return air system. |

- .5 Filter: Return air shall be filtered by a rear return filter box with long-life filter on all indoor units.
- .6 The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. The condensate shall be gravity drained from the fan coil. Both refrigerant lines to the indoor units shall be insulated.
- .7 The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz. The system shall be capable of:

Mark	Serving Room	Load (kW)	Cooling CAP (kW)	Heating CAP (kW)	AVR Flow (l/s)	Standard of Acceptance (Mitsubishi)
NAC-3A	330	1.76	1.8	2.0	125	PEFY-P06NUMAU-E
NAC-3B	325	1.76	1.8	2.0	125	PEFY-P06NUMAU-E
NAC-1A	105	1.76	1.8	2.0	125	PEFY-P06NUMAU-E
NAC-1B	122	1.76	1.8	2.0	125	PEFY-P06NUMAU-E
NAC-1C	141	1.76	1.8	2.0	125	PEFY-P06NUMAU-E
NAC-1D	154	14.1			567	PEFY-P48NUMAU-E

- .8 Unit fans shall be set medium speed.
- .9 Standard of acceptance: Mitsubishi City Multi, model PEFY-P-NMAU-E, Fujitsu, VRF.

PART 3 - EXECUTION

- | | | |
|--|----|--|
| <u>3.1 MANUFACTURER'S INSTRUCTIONS</u> | .1 | Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet. |
| <u>3.2 INSTALLATION</u> | .1 | Install in accordance with manufacturer's written instructions. |

.2 Make power and control connections.

3.3 FIELD QUALITY .1 Site Tests/Inspection:
CONTROL .1 Perform tests in accordance Section
26 05 00 - Common Work Results -
Electrical.
.2 Set controls and operate each unit.
.3 Take readings and record:
.1 Current.
.2 Air velocity at discharge.
.3 Discharge air temperature.

3.4 CLEANING .1 Perform cleaning operations in accordance with
manufacturer's recommendations.
.2 On completion and verification of performance
of installation, remove surplus materials,
excess materials, rubbish, tools and
equipment.

END OF SECTION

PART 1 - GENERAL

- 1.1 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 10 10 - General Instructions.
- .2 Indicate:
- .1 Equipment, capacity and piping connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed support, sizes and location of mounting bolt holes.
- 1.2 MAINTENANCE DATA .1 Provide maintenance data for incorporation into manual specified in Section 01 10 10 - General Instructions.

PART 2 - PRODUCTS

- 2.1 FORCED FLOW HEATERS H-3 .1 Cabinet heaters:
- .1 Wall-mounted semi-recessed.
- 2 Cabinet construction:
- .1 Cabinet: 1.6 mm thick furniture steel with removeable fronts to allow easy access to blower, motor and heating elements.
 - .2 Element: hot water heating coil
 - .3 Vanes: pressed, mounted on baffle for removable as unit.
 - .4 Finish: phosphatized and finished with 3 coats baked enamel.
 - .5 Grille: heavy duty bar grille of clear anodized aluminum, paintable.
- .3 Elements: heating coils 15.8 mm, seamless copper tubes expanded into aluminum fins to form permanent mechanical bond.
- .1 Two rows for hot water.
 - .2 Female pipe coil connections.
- .4 Blowers: two double inlet type centrifugal aluminum fans mounted directly on a double ended motor shaft.

- .5 Motors: permanent split capacitor type, steel shell, die cast aluminum shields, galvanized steel cradle.
 - .1 Resilient mount
 - .2 Self aligning sleeve bearings, horizontal mount, class AB@ insulation, thermally protected.
 - .3 Speed switch: solid state 3 speed control with off position.
- .6 Filters: removable 25 mm thick fibrous glass throwaway type filters.
- .7 Insulation: 13 mm flexible fiber glass duct liner on back and sides of external box.
- .8 Hinged panel: for easy access of piping, valve, filter and full access to fan deck.
- .9 Capacity: See drawing.
- .10 Control:
 - .1 3 speed switch key operated with integral overloads in cabinet.
 - .2 Low limit aquastat strapped on to hot water heating supply set to prevent fan operating below 27°C.
 - .3 Complete with auxiliary relays and transformers.
 - .4 Wall mounted thermostats: line voltage type, electronic. Supplied by this section, wired by Division 26.
- .11 Standard of acceptance: Rosemex F400A-RW4.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - .1 Install in accordance with manufacturer's instructions.
 - .2 Provide double swing pipe joints as indicated.
 - .3 Check final location with departmental representative if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow departmental representative's directive.

- .4 Hot water units: for each unit, install ball valve on inlet and calibrated balancing valve on outlet of each unit. Install drain valve at low point. Install manual air vent at high point.
- .5 Clean finned tubes and comb straight.
- .6 Provide supplementary suspension steel as required.

END OF SECTION

PART 1 - GENERAL

- 1.1 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
- .1 Equipment, capacity, piping and connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
 - .3 Special enclosures.
- 1.2 ACCEPTABLE MATERIALS .1 Where materials are specified by trade name, refer to the Project Specific Instruction to Bidders for procedure to be followed in applying for approval of alternatives.
- 1.3 MAINTENANCE DATA .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- 1.4 SAMPLES .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

PART 2 - PRODUCTS

- 2.1 GENERAL .1 The linear radiant ceiling panels shall consist of extruded aluminum with copper tubing of 16 mm OD diameter mechanically fastened to the aluminum face plate. A non-hardening heat conductive paste shall be placed between the copper tubing and the aluminum face plate. Panel capabilities shall be in accordance with the following schedule.

Mark	Width	Flow (l/s/m)	Rows	Capacity (w/m)
H-1	600	0.018	6	411
H-2	450	0.012	4	289

- .2 Panels shall be finished in a standard manufacturer's colour.

- .3 Planks shall interlock using tongue and groove connection and be held together using aluminum cross channels with spring clips.
- .4 All plank interlocking to be done at the factory with return bends factory installed prior to going on site.
- .5 The length of the panels shall be based on lengths supplied by the Mechanical Contractor. The factory to allow for expansion before the final cut.
- .6 Panels shall be supplied with tee-mounting frames with mitred corners.
- .7 Performance - Radiant Panels shall produce a minimum heating output as indicated on the Drawings.
- .8 Insulation in accordance with Section 21 07 19 - Thermal Insulation for Piping.
- .9 Acceptable Materials: Twa Panel Systems Inc., Engineered Air, Rosemex, Sigma, Mark Hot.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 The Mechanical Contractor shall coordinate with other trades working in the ceiling to achieve a neat, well coordinated overall installation.
- .2 All inter-connecting of radiant panels by the Mechanical Contractor shall consist of 16 mm flexible interconnectors. Connection to supply and return piping with 16 mm OD soft copper.
- .3 Hanger wires shall be installed as recommended by the manufacturer. Where cross tees are used between panel ends the cross tee shall be fastened to the wall moulding and main tee and the tee shall be flush with exposed edge of moulding. Panels shall be supported independently of ceiling system.

- .4 All radiant panels shall be installed by personnel wearing clean white gloves to avoid soiling of panel face.
- .5 All system piping shall be thoroughly cleaned, flushed, drained and refilled before radiant panels are connected to the system.
- .6 Each group or zone of coils shall be given a pressure test in accordance with procedures specified elsewhere. No loss in pressure shall occur during the test. All joint shall be leak-tested, with the coil under test pressure.
- .7 No installation of finished ceiling surface panels shall begin until all glazing has been completed and all exterior opening closed in.
- .8 All active panels shall be covered with a minimum of 50 mm thick batt insulation in accordance with Section 21 07 19 - Thermal Insulation for Piping.
- .9 Install 360 degree piping interconnects in a horizontal plane to prevent potential air locking.
- .10 Provide shut off ball valves and balancing valves for each panel, or banks of panels controlled by a single control valve.

END OF SECTION

PART 1 - GENERAL

- | | | |
|---|----|--|
| <u>1.1 SHOP DRAWINGS AND PRODUCT DATA</u> | .1 | Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures. |
| <u>1.2 MAINTENANCE DATA</u> | .1 | Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and Section 21 05 01 - Mechanical General Requirements. |
| <u>1.3 MAINTENANCE MATERIALS</u> | .1 | Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals. |
| | .2 | Furnish list of individual manufacturer's recommended spare parts for equipment, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing, for inclusion into operating manual. |
| <u>1.4 MANUFACTURED ITEMS</u> | .1 | Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force. |

PART 2 - PRODUCTS

- | | | |
|---------------------------------------|----|--|
| <u>2.1 ELECTRODE STEAM HUMIDIFIER</u> | .1 | Humidifiers shall be CSA certified and UL listed electrode steam generating type with electronic capacity control from 20 to 100%. |
| | .2 | Units shall have proportional and integral auto-adaptive control to automatically adapt to incoming water conditions. |
| | .3 | Humidifiers shall have the following features: <ul style="list-style-type: none">.1 Modulation control.2 Micro-computer electronics.3 Cylinder drain after no call for humidification for three days..4 BMS interface..5 VAV control system..6 Auto pulse drain valve..7 Status lamps..8 On/Off controls.9 Manual output adjustment. |

- .10 Independent circuits on multi-cylinder units.
- .11 Fill cup with air gap.
- .12 Door interlock switch.
- .13 High water shut-off
- .14 Key lock doors.
- .4 Units shall have a two-year warranty.
- .5 Humidifier shall have manifold with a maximum vapour trail of 500 mm.
- .6 Unit shall be supplied with one complete set of spare cylinders.
- .7 Humidifier shall be suitable for 600V/3 phase.
- .8 Unit shall be supplied with an air flow switch and a high limit humidistat.
- .9 Humidifiers shall have a capacity of in accordance with the following schedule.

Tag	Kg/hr	Input (kW)	Voltage	Cylinders / Circuits	Standard of Acceptance
HM-1	43	34	600/3	1/1	Nortec NHTC-100
HM-3	21	17	600/3	1/1	Nortec NHTC-050
HM-7	11.4	10.2	600/3	1/1	Nortec NHTC-030

- .10 Distributions for the humidifier shall be in accordance with the following schedule.

Tag	Distributor Type	Duct Size	Maximum Vapour Trail
HM-1	Short Absorption Manifold	1225 x 825	300mm
HM-3	Short Absorption Manifold	1475 x 725	300mm
HM-7	Short Absorption Manifold	1650 x 650	300mm

- .11 The humidifier shall have a 5.0 micron water filter on the inlet to the humidifier. The filter shall have a clear see through housing, a pressure release button and be FDA C FR-21 compliant. Unit shall be equal to an Aqua-Pure model APO9T as manufactured by Cuna. Supply 2 (two) spare filter cartridges.

- .12 Condensate lift pumps shall be UL listed and CSA certified with a high temperature Noryl tank rated at 88°C and a stainless steel impeller shaft. The unit shall pump 454 l/h with a 6m lift. The unit shall be suitable for 120V/1 with a safety overflow switch wired to ON/OFF circuit on the humidifiers.

.1 Standard of acceptance: Nortec Drain Water Sump P/N 142-9527.

- .13 Piping between the humidifier and the distributor shall be Type AL hard copper with soldered fitting.

- .14 Standard of acceptance: Nortec Type NHTC series, Carnes.

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Install in accordance with manufacturer's instructions.

END OF SECTION