

Part 1 General

1.1 SCOPE OF WORK

- .1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.100, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
 - .2 CAN/CGSB-14.5, 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.

Part 2 Products

2.1 GENERAL

- .1 Design point to be at mid point of scale or range.

2.2 DIRECT READING THERMOMETERS

- .1 Liquid action, 89 mm dial thermometer, variable angle type, liquid filled, 0 to 115°C dual range.
- .2 Acceptable Material: “Trerice”, model V80030.

2.3 THERMOMETER WELLS

- .1 Use thermowells for all thermometers.
- .2 Copper pipe: copper or bronze wells.
- .3 Steel pipe: brass wells.

2.4 PRESSURE GAUGES

- .1 89 mm, dial type, liquid filled, stainless steel having 1.6% accuracy 6 mm NPT connection, 0 – 450 kPa dual range (kPa & PSI).
- .2 Acceptable Material: Trerice, Model 610 CB.
- .3 Provide:
 - .1 Isolation ball valve on all pressure gauge connections.
 - .2 Snubber for pulsating operation.
 - .3 No petcocks.

Part 3 Execution

3.1 GENERAL

- .1 Install gauges 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.

3.2 THERMOMETERS

- .1 Install in locations as indicated on drawings.
- .2 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

- .1 Install in locations as indicated on drawings.
- .2 Use extensions where pressure gauges are installed through insulation.

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

- .1 Materials and requirements for the identification of rooftop units, fans, boiler, hot water tank, pumps, including the installation and location of identification systems.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data to include paint colour chips, other products specified in this section.

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 SYSTEM NAMEPLATES

- .1 Provide nameplates for all equipment designated by Tags as indicated in the drawings. e.g. PU-1, EF-2.
- .2 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .3 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, square corners, letters accurately aligned and machine engraved into core.
- .4 Sizes:
 - .1 Conform to following table:

Type	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.5 Locations:

- .1 Terminal cabinets, control panels: use Type 5.
- .2 Equipment in Mechanical Rooms: use Type 8.
- .3 Equipment elsewhere: sizes as appropriate.

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 00 – Painting, has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC or CSA registration plates as required by respective agency.

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.

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 QUALIFICATIONS OF TAB PERSONNEL

- .1 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems..
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.
- .2 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .3 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .4 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .5 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .6 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to Contract Administrator adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB. Contact Contract Administrator for final instructions prior to beginning TAB.
- .2 Review specified standards and report to Contract Administrator in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Contract Administrator for verification of TAB reports.

1.9 START OF TAB

- .1 Start TAB when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weather stripping, sealing, and caulking.
- .2 Pressure, leakage, other tests specified elsewhere Division 23.
- .3 Provisions for TAB installed and operational.

- .4 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 10 %, minus 5 %.
 - .2 Hydronic systems: plus or minus 5%.

1.11 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2 % of actual values.

1.12 INSTRUMENTS

- .1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .2 Calibrate within 3 months of TAB.

1.13 TAB REPORT

- .1 Format in accordance with AABC.
- .2 TAB report to show results in SI units and to include:
 - .1 System schematics.

- .3 Submit 1 copy of TAB Report to Contract Administrator for verification and approval, in English, in D-ring binders, complete with index tabs.

1.14 SETTINGS

- .1 After TAB is completed to satisfaction of Contract Administrator, replace drive guards, close access doors, lock devices in set positions, and ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.15 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Contract Administrator.

1.16 AIR SYSTEMS

- .1 Standard: TAB to most stringent of TAB standards of AABC or ASHRAE.
- .2 Do TAB of following systems:
 - .1 New rooftop units (RTU-1 and RTU-2) and new return fan (RTU-1 RF) and all associated supply and return grilles and ductwork.
 - .2 New exhaust fans (EF-1,2,3,4,5,6, and 7) and all associated ductwork.
- .3 Test all fire dampers.
- .4 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.
- .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dew point), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of dampers, grille, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include, but not be limited to, following as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.17 WATER SYSTEMS

- .1 Do TAB on all water systems including:
Flow balance of:
 - .1 Hydronic Circulation Pump (PU-1)

- .2 Domestic Hot Water Recirculation Pump (PU-2)
- .3 New hydronic radiators (R-1,2,3,4,5,6,7,8,9, and 10) and existing hydronic radiators.
- .2 Set water flows as noted. Obtain pump operating pressures, motor amperages and characteristics.
- .3 Measure domestic water recirculation flow rates at all automatic flow balancing valves and record flows in balance report.

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

- .1 Provide and install all duct insulation as shown on the drawings.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .2 ASTM C411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-M88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.

1.4 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.

1.5 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.

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, includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("K" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.
 - .1 Application: on exterior of air intake ducts and exhaust ducts (where shown on drawings) 48 in. or more across the bottom.
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.
 - .1 Application: Round ducts and rectangular ducts less than 48 in. across the bottom. Do not use in mechanical rooms.
 - .2 Mineral fibre: to ASTM C553.
 - .3 Jacket: to CGSB 51-GP-52Ma.
 - .4 Maximum "K" factor: to ASTM C553.
- .5 Insulation thickness: 2 in.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Surfaces clean, dry and 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 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.

- .2 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .4 Fasteners: At 12 in. oc in horizontal and vertical directions, minimum two rows each side.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .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.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 CLEANING SOLUTIONS

- .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.

2.2 RUST REMOVER AND PREOPERATIONAL CLEANER

- .1 Rust remover and preoperational cleaner shall meet the following criteria:
 - .1 Remove rust, oil-based coating, and organic debris.
 - .2 Passivate mild steel and copper surfaces.

- .3 Non-corrosive to base metals including mild steel, copper, brass, aluminum, and cast iron.
- .4 Neutral pH cleaner. Safe with non-metallic substances such as natural and synthetic rubbers, neoprene, Buna N, Hypalon, Teflon, and plastics.
- .2 At no cost to the owner, the supplier will provide a "Product Operating Manual" that will outline all phases of required treatment for the product.
- .3 The supplier will provide Material Safety Data Sheets for the product along with all other materials and/or training to satisfy the requirements of WHMIS.
- .4 Acceptable Product: "Betz" Ferroquest FQ7101

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 CLEANING HYDRONIC SYSTEMS

- .1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is 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.
- .4 Cleaning procedures:
 - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
 - .1 Cleaning procedures, flow rates, elapsed time.
 - .2 Chemicals and concentrations 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 used to ensure water will not damage systems or equipment.
- .5 Conditions at time of cleaning of systems:
 - .1 Systems: free from construction debris, dirt and other foreign material.
 - .2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.

- .3 Strainers: 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 Preoperational Cleaning: Recirculate a 2 to 6% solution 24 to 72 hours. After the cleaning flush with fresh water and initiate system treatment.
 - .2 Rust Removal: Recirculate a 5 to 30% solution for a minimum of 72 hours. Maintain the recommended pH range for hydronic equipment.
 - .3 Fill system with water, ensure air is vented from system.
 - .4 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).
 - .5 Use water metre to record volume of water in system to +/- 0.5%.
 - .6 Add chemicals under direct supervision of chemical treatment supplier.
 - .7 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
 - .8 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
 - .9 Add chemical solution to system.
 - .10 Establish circulation, raise temperature slowly to 88 degrees C. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h 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).

3.3 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
 - .1 Establish circulation and expansion tank level, set pressure controls.
 - .2 Ensure 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 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
- .7 Repeat with water at design temperature.
- .8 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
- .9 Bring system up to design temperature and pressure slowly over a 4 hour period.
- .10 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .11 Adjust pipe supports, hangers, and springs as necessary.
- .12 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .13 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
- .14 Check operation of drain valves.
- .15 Adjust valve stem packings as systems settle down.
- .16 Fully open balancing valves (except those that are factory-set).
- .17 Check operation of over-temperature protection devices on circulating pumps.
- .18 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

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 SCOPE OF WORK

- .1 Electrical controls for new rooftop units (RTU-1 and RTU-2) and new return fan (RTU-1 RF), new exhaust fans (EF-1,2,3,4,5,6, and 7), new radiators (R-1,2,3,4,5,6,7,8,9, and 10), and existing radiators. Controls sub-contractor to design, supply, install, and commission a fully functional control system to achieve the stated Sequence of Operations. Electrical sub-contractor to provide manual switches as indicated. Refer to drawings M16.0 and M18.0 for further details.

1.2 SUBMITTALS

- .1 Shop Drawings and 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.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Closeout Submittals:
 - .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 SEQUENCE OF OPERATIONS

- .1 Heating Mode:
 - .1 Rooftop units RTU-1 and RTU-2 heat incoming fresh air to 70°F. Provide discharge air temperature control with space temperature reset. Boiler B-1 and radiators are on. Radiator control valves modulate heating as required to maintain space temperature at 70°F.
- .2 Cooling Mode:
 - .1 Rooftop units RTU-1 and RTU-2 provide economizer operation or cooling to maintain 74°F space temperature. Provide free economizer cooling in shoulder seasons. Boiler B-1 and radiators are off. Night temperature setback to 78°F.
- .3 Occupied Time:
 - .1 Rooftop units RTU-1 and RTU-2 are on and pressure sensors modulate fresh air and return air dampers to maintain positive building pressure. Washroom exhaust fans EF-1 and EF-4 are on. Kitchen exhaust fan EF-6 is on. Exhaust fans EF-3 and EF-7 operate as required by cooling thermostats to maintain space temperature.
- .4 Unoccupied Time:
 - .1 Rooftop units RTU-1 and RTU-2 shut off and fresh air dampers close. Exhaust fans EF-1, EF-4, EF-5, and EF-6 are off. Exhaust fans EF-3 and EF-7 operate as required by cooling thermostats to maintain space temperature. Pressure sensors to detect changes in building pressure due to exhaust fan operation and turn on RTU-1 and/or

RTU-2 and modulate fresh air and return air dampers to achieve positive building pressure. Thermostats to turn on RTU-1 and/or RTU-2 as required during cooling season to maintain night temperature setpoint. Radiators to provide heating as required in heating season.

- .5 Manual Operation:
 - .1 Service room exhaust fan EF-2 controlled by manual switch. Dishwasher exhaust fan EF-5 controlled by manual switch. Manual override switch shall be provided for kitchen exhaust fan EF-6.

Part 2 Products

2.1 PRE-WIRED EQUIPMENT AND FACTORY INSTALLED CONTROLS

- .1 General:
 - .1 All control panels shall be factory wired and tested, and approved by Standards Council of Canada authorized approval agency using components certified for use in Canada
 - .2 Wiring shall be in accordance with the Canadian Electrical Code, Part 1, and sections of Part 2 of the Code pertaining to specific equipment type and purpose.
 - .3 All electrical circuits shall undergo a dielectric strength test (CSA C22.2-0), and shall be factory tested and checked as to proper function.
 - .4 All electrical panels shall have a hazard notice indicating potential shock or arc flash hazards.
- .2 Motor Overloads:
 - .1 All fractional horsepower motors shall have integral self-resetting overloads. All integer motors shall have separate overloads. Operator accessible resets shall be provided at the front of the control panel to permit a local reset of the overload trip.

2.2 CUSTOM CONTROLS

- .1 Refer to drawings M16.0 and M18.0 for required controls.
- .2 Controls sub-contractor shall provide all controls needed to achieve the Sequence of Operations. Controls sub-contractor shall coordinate with HVAC equipment vendor to accommodate control system design with vendor-supplied controls. Controls sub-contractor shall supply the following controls as indicated on mechanical drawings for new rooftop units (RTU-1 and RTU-2), new exhaust fans (EF-1,3,4,6, and 7), new radiators (R-1,2,3,4,5,6,7,8,9, and 10), and existing radiators:
 - .1 Thermostats.
 - .2 7-day programmable timeclocks.
 - .3 Control valves. Size valves as noted on drawing M16.0.
 - .4 Pressure sensors.
 - .5 Manual switch.

- .3 Electrical sub-contractor to supply and install manual switches (120V/1ph) for new exhaust fans EF-2 and EF-5.

Part 3 Execution

3.1 INSTALLATION

- .1 Install units in accordance with manufacturer's instructions and as indicated.
- .2 All wiring, conduit and electrical installations by controls or other sub-contractor completing work for the mechanical trade shall conform to all appropriate electrical specifications.
- .3 Control wiring and associated conduit for 24VAC/DC systems shall be provided by the controls sub-contractor. Power wiring (eg 120VAC) and associated conduit shall be provided by the electrical sub-contractor.
- .4 Install all panels with electrical components to provide a minimum of 1 meter clear access for operations or troubleshooting access.

3.2 COMMISSIONING

- .1 Contractor to commission all new systems as required. Units to be tested in all operating sequences.
- .2 Controls sub-contractor to provide sign-off sheets for every piece of equipment and sign off that commissioning has been completed. Submit completed sign-off sheets to Contract Administrator.

3.3 FUSES

- .1 Spare fuses shall be provided by the supplier to be used during commissioning.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for piping, valves and fittings for new gas fired boiler (B-1), new hot water tank (HWT-1), and new rooftop units (RTU-1 and RTU-2).
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 78 00 - Closeout Submittals.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - .4 ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A47/A47M-(2004), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM B75M-99, Standard Specification for Seamless Copper Tube [Metric].
 - .4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
 - .1 CAN/CSA B149.1HB-00, Natural Gas and Propane Installation Code Handbook.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.

- .2 NPS2 1/2 and over, plain end.

2.2 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.

2.3 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
 - .3 Welding: butt-welding fittings.
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
 - .5 Bolts and nuts: to ASME B18.2.1.
 - .6 Nipples: schedule 40, to ASTM A53/A53M.
- .2 Copper pipe fittings, screwed, flanged or soldered:
 - .1 Cast copper fittings: to ASME B16.18.
 - .2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

- .1 Provincial Code approved, lubricated ball type.

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 PIPING

- .1 Install in accordance with CAN/CSA B149.1, supplemented as specified.
- .2 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.

3.3 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
- .2 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 products, 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 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of work at 25% and 60% complete.
 - .3 Upon completion of work, after cleaning is carried out.
- .3 Obtain reports within 3 days of review and submit immediately to Consultant.
- .4 PV procedures:
 - .1 Test performance of components.

3.5 ADJUSTING

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.
- .2 Pre-Start-Up Inspections:
 - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
 - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 CLEANING

- .1 Cleaning: in accordance with CAN/CSA B149.1, supplemented as specified.
- .2 Perform cleaning operations in accordance with manufacturer's recommendations.
- .3 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 for steel piping, valves and fittings for hydronic heating systems.
- .2 Related Sections.
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 78 00 - Closeout Submittals.
 - .3 Section 21 05 01 - Common Work Results - Mechanical.
 - .4 Section 23 05 01 - Installation of Pipework.
 - .5 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .6 Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.3, Malleable Iron Threaded Fittings.
 - .3 ASME B16.5, Pipe Flanges and Flanged Fittings.
 - .4 ASME B16.9-01, Factory-Made Wrought Butt welding Fittings.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .2 ASTM A536, Standard Specification for Ductile Iron Castings.
- .3 Canadian Standards Association (CSA International).
 - .1 CAN/CSA W48, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

1.3 SUBMITTALS

- .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.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53, Grade B, as follows:
 - .1 To NPS 6, Schedule 40.

2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with Teflon tape.
- .2 Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.
- .3 Pipe thread: taper.

2.3 FITTINGS

- .1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.
- .2 Unions: malleable iron, to ASTM A47M and ANSI/ASME B16.3.
- .3 Butt - welding fittings: steel, to ANSI/ASME B16.9.

2.4 VALVES & EQUIPMENT

- .1 Gate Valve - NPS 2 and under, screwed:
 - .1 Rising stem: to MSS SP-80, Class 125, 860 kPa, bronze body, solid wedge disc.
 - .2 Acceptable material: Toyo 293, Kitz 24 or approved alternate.
- .2 Flow Balance Valves:
 - .1 Size: 1/2 inch – 2-1/2 inch
 - .1 Forged brass body, nickel-plated brass ball, Teflon seals, combination P/T test valves and air vents, memory stop with graduated markings. Valve comes fully assembled.
 - .2 Acceptable Product: “Speedset”
- .3 Ball Valves:
 - .1 NPS 2 and under:
 - .1 TO ASTM B62, 4 MPa WOG, bronze body, screwed ends, TFE seal, hard chrome solid ball, PTFE seats and lever handle.
 - .2 Acceptable Product: “Toyo” Fig. 5044A, “Kitz” 58, or approved equal.
- .4 Two Way Control Valves:
 - .1 Solenoid actuated control valve with wiring to a wall mounted thermostat. Valve to be constructed of a bronze body, EPDM rubber o-ring seals and stainless steel stem.
 - .2 Acceptable Product: “Honeywell”

- .5 Three Way Control Valves:
 - .1 Solenoid actuated control valve with wiring to a wall mounted thermostat. Valve to be constructed of a bronze body, EPDM rubber o-ring seals and stainless steel stem.
 - .2 Acceptable Product: "Honeywell"
- .6 Automatic Air Vents:
 - .1 Automatic air vent suitable for hot water heating system with semi steel body and stainless steel float. Size = 1/2 in.
 - .2 Acceptable Product: Hamlet and Garneau Model MV-15.
- .7 Air Separator:
 - .1 2 in. Vortex air separator shall be designed and constructed to Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, fitted with a NPT vent connection for an air vent.
 - .2 Additional NPT tapping on the bottom of the air separator to facilitate blow-down.
 - .3 Provide air separator where shown on drawings and schematics.
 - .4 Fabricated steel body and carbon steel ANSI flanges.
 - .5 Acceptable Product: "Armstrong" Model: VA, c/w heavy duty cast iron float type air vent.
- .8 Chemical Pot Feeder:
 - .1 7.6 L bypass feeder, 1380 kPa (200 psig) working pressure, 11 gauge steel tank shell and heads, cast iron with Buna N seal tank cap.
 - .2 Acceptable Product: "BetzDearborn – Neptune Bypass Feeder" Model: BDF-2.
 - .3 Accessories: Provide initial chemical treatment, test kit, and site inspections as supplied by BetzDearborn.
- .9 Sidestream Filter:
 - .1 Filter housing and cartridge, cast iron head, carbon steel shell, 19 mm (3/4") inlet and outlet, carbon steel capscrew drain.
 - .2 Acceptable Product: "BetzDearborn – Filterite" Model: LMO10 and 30 micron filter cartridge.
- .10 Flow Indicator:
 - .1 20 mm flow indicator, 304 stainless steel body and internals, fused glass window, metric and U.S. scales (15-30 LPM and 4-9 GPM), stainless steel return spring, 1082 kPa maximum pressure.
 - .2 Acceptable Product: "BetzDearborn" Model: Filter-Mate 3/4

2.5 EXPANSION TANK, EXP-1:

- .1 ASME rated diaphragm expansion tank with pre-charge air connection and 1/2" system connection.

- .1 Volume: 21.7 gallons
 - .2 Acceptance Volume: 11.3 gallons
 - .3 Fluid: Water
 - .4 Height: 29-½ in. Diameter: 16-¼ in.
 - .5 Maximum Working Pressure: 125 psi
 - .6 Maximum Working Temperature: 240°F
 - .7 Shell: Carbon Steel Diaphragm: Heavy duty butyl
- .2 Acceptable Product: "Amtrol" AX-40V

Part 3 Execution

3.1 PIPING INSTALLATION

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipework.
- .2 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .3 Install pipe to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.
- .4 Slope piping in direction of drainage and for positive venting.
- .5 Use eccentric reducers at pipe size change installed to provide drainage or positive venting.
- .6 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .7 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.
- .8 Assemble piping using fittings manufactured to ANSI standards.

3.2 CIRCUIT BALANCING VALVES

- .1 Install flow balancing valves as indicated.
- .2 Install valves with stems upright or horizontal unless approved otherwise by Consultant.
- .3 Install gate valves at all branch take-offs to isolate each piece of equipment as indicated.

3.3 CLEANING, FLUSHING AND START-UP

- .1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.
- .2 System to be operational, hydrostatically tested and with safety devices functional, before flushing and cleaning is carried out.
- .3 Retain qualified water treatment specialist to oversee or perform system cleaning.

- .4 Strainers to be clean prior to and after cleaning.
- .5 Flush entire water system after pressure test for a minimum of 4 hours.
- .6 Fill with solution of water and non-foaming, phosphate-free detergent to the concentration recommended by supplier. Circulate for a minimum of 8 hours.
- .7 Drain and flush for 2 hours. Remove strainer screen/basket and clean. Re-install after obtaining approval.
- .8 When cleaning is completed, agency overseeing or performing cleaning procedures to submit report, complete with certificate of compliance with specifications of cleaning component suppliers.

3.4 FILLING OF SYSTEM

- .1 Refill hydronic system with treated water from main water supply.

3.5 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
 - .1 Establish circulation and set pressure controls.
 - .2 Ensure all air is removed.
 - .3 Check pumps to be free from air, debris, possibility of cavitation when the system is at design temperature.
 - .4 Clean out strainers and remove start-up strainers.
 - .5 Commission water treatment systems.
 - .6 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and all other noises.
 - .7 Adjust pipe supports, hangers, springs as necessary.
 - .8 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
 - .9 Check operation of drain valves.
 - .10 Adjust valve stem packings as systems settle down.
 - .11 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.6 TESTING

- .1 Test system in accordance with Section 21 05 01 - Common Work Results For Mechanical.
- .2 Test pressure: 621 kPa (90 psi).

3.7 BALANCING

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

- .2 Install flow measuring stations and flow balancing valves as indicated.

3.8 AIR VENTS

- .1 Install at ALL system high points. Install air vents with isolation ball valve.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials, equipment, installation and start up for hydronic system pump PU-1.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.

1.3 REFERENCES

- .1 Electrical Equipment Manufacturers Advisory Council (EEMAC).
- .2 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B214, Installation Code for Hydronic Heating Systems.
- .3 National Electrical Manufacturers Association (NEMA).
 - .1 NEMA MG 1, Motors and Generators.

1.4 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data of pump curves for review showing point of operation.
- .3 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.
- .4 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 HYDRONIC PUMP PU-1:

- .1 Capacity: 54 usgpm against total differential head of 45 ft.
- .2 Construction: in-line, base mounted, centrifugal, bronze fitted, standard seal (Buna-Carbon/Ceramic). Design for 175 psi maximum working pressure and 225 deg F maximum operating temperature.
- .3 Motor: 1.5 HP, 575/3/60, 1.05 BHP, 1750 RPM.
- .4 Supports: provide as recommended by manufacturer.

- .5 Flanged connections, Suction size: 1 ½”, Discharge side: 1 ½”.
- .6 Provide spare pump ready for future changeout should the operating pump malfunction.
- .7 Acceptable Product: “Bell & Gossett”, model Series 1½x1½x7B

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. If pump is mounted on vertical piping, support in accordance with manufacturer’s recommendations.
- .3 Base mounted type: supply templates for anchor bolt placement. Furnish anchor bolts with sleeves. Place level, shim unit and grout. Align coupling in accordance with manufacturer’s recommended tolerance. Check oil level and lubricate.
- .4 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.
- .5 Check rotation prior to start-up.
- .6 Install pressure gauges isolation ball valves and equipment as shown on schematics.
- .7 Ensure glycol makeup unit is full of 40% propylene glycol/water mixture after all air has been expelled from system.

3.2 START-UP

- .1 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 Check base for free-floating, no obstructions under base.
 - .5 Run-in pumps for 12 continuous hours.
 - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
 - .7 Eliminate air from scroll casing.
 - .8 Adjust alignment of piping and conduit to ensure true flexibility at all times.
 - .9 Eliminate cavitation, flashing and air entrainment.
 - .10 Measure pressure drop across strainer when clean and with flow rates as finally set.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A653/A653M-[03], Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .2 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 the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 96-11, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .3 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.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.

1.3 SUBMITTALS

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

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:
 - Maximum Pressure (Pa)
500
- .2 Transverse joints and connections made air tight with duct sealant. Longitudinal seams sealed. Seal all joints.

2.2 SEALANT

- .1 Sealant: Water based, ULC classified for surface burning characteristics.
 - .1 Acceptable Material: Duro Dyne DWN water based duct sealer.

2.3 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
 - .1 Rectangular: standard radius or short radius without turning vanes. Centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 15-3/4 inch: with single thickness turning vanes.
 - .2 Over 15-3/4 inch: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct, 45 degrees entry on branch.
 - .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.

2.4 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

2.5 KITCHEN EXHAUST SYSTEMS

- .1 Construct in accordance with NFPA 96.
- .2 Material: 16 gauge black steel.
- .3 Thickness, fabrication and reinforcement: to SMACNA.
- .4 Access: Provide access doors in accordance with NFPA 96.

2.6 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 20 inch. Larger ducts to use trapeze hangers.
- .2 Hanger configuration: to SMACNA.
- .3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA following table:

Duct Size (inch)	Angle Size (inch)	Rod Size (inch)
up to 30	1 x 1 x 1/8	1/4
30 to 40	1-1/2 x 1- 1/4 x 1/8	1/4
40 to 60	1-1/2 x 1- 1/4 x 1/8	3/8

- .1 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp or steel plate washer.
 - .3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 4 inch beyond insulated duct.
- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 HANGERS

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

Duct Size (inch) to 60	Spacing (inch) 120
------------------------------	--------------------------

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intake.
 - .2 Exhaust discharges.Slope ducts to drain back outside.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Solder or weld joints of bottom and side sheets.
 - .2 Seal all other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards louvers served.
 - .1 Slope header ducts down toward risers.
 - .2 Provide drain piping to floor.

3.4 KITCHEN EXHAUST SYSTEMS

- .1 Install to NFPA 96.

3.5 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.

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 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedure.
 - .2 Section 01 78 00 - Closeout Submittals.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

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.
 - .3 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees Celsius to plus 90 degrees Celsius, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (0.0236 inch) 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 (0.0236 inch) thick complete with sheet metal angle frame and 25 mm (1 inch) thick rigid glass fibre insulation.
- .3 Gaskets: foam rubber.
- .4 Hardware:
 - .1 Up to 300 x 300 mm (12 x 12 inch): two sash locks.
 - .2 301 to 450 mm (12 to 18 inch): four sash locks.
 - .3 451 to 1000 mm (18 to 40 inch): piano hinge and minimum two sash locks.
 - .4 Hold open devices.

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.
 - .2 Length of connection: 100 mm (4 inch).
 - .3 Minimum distance between metal parts when system in operation: 75 mm (3 inch).
 - .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 As indicated.

- .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Devices requiring maintenance.
 - .3 Required by code.
 - .4 Motorized and back draft dampers.
- .3 Elsewhere as indicated.

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.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
- .2 Single thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

2.3 SINGLE BLADE DAMPERS

- .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 (4 inch).
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 MULTI-BLADED DAMPERS

- .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 inch).
- .4 Bearings: pin in bronze bushings.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

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 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 multi-blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Operating 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.

Part 2 Products

2.1 BACK DRAFT DAMPERS

- .1 Automatic gravity operated multi leaf, heavy gauge extruded aluminum construction with synthetic (acetal) sleeve bearings, vinyl blade seals and internal plated steel blade-to-blade linkage.
- .2 Acceptable Product: "Greenheck".

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 where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Dampers: vibration free.
- .5 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .6 Ensure dampers are observable and accessible.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Fire dampers.

1.2 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

.1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 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.

.2 Indicate the following:

.1 Fire dampers.

.2 Fusible links.

.2 Closeout Submittals:

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

Part 2 Products

2.1 FIRE DAMPERS

.1 Fire dampers: meet requirements of authorities having jurisdiction. Fire damper assemblies 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.

- .1 Fire dampers: fire rated as indicated on drawings.
- .2 Fire dampers: automatic operating type and have **dynamic** rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: guillotine type; sized to maintain full duct cross section.
- .4 Fusible link actuated, spring closure and lock in closed position when released.
- .5 Retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced in accordance with dampers listing.
- .6 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
- .7 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damper HVAC and in manufacturer's instructions for fire dampers shall be followed.
- .8 Dynamic fire dampers that will close in the event of a fire and where airflow continues.
- .9 Use only Type B or C dampers, except for locations where fire damper is directly behind a grille. Where fire dampers are located directly behind a grille, use Type A dampers.
- .10 Acceptable Product: "Naylor", "Greenheck" or approved equal.

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 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 Co-ordinate 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Supply, installation, testing and commissioning of new exhaust fans EF-1 to EF-7 and return fan RTU-1 RF.

1.2 REFERENCES

.1 Air Conditioning and Mechanical Contractors (AMCA)

- .1 AMCA Publication 99, Standards Handbook.
- .2 AMCA 300, Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

- .1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

- .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 in force.
- .2 Capacity: flow rate, total static pressure, W (HP), efficiency, revolutions per minute, power, model, size, sound power data.
- .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .4 Sound ratings: comply with AMCA 301, tested to AMCA 300.
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210.

1.4 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.

.2 Provide :

- .1 Fan performance curves showing point of operation and efficiency.
- .2 Sound rating data at point of operation.

- .3 Indicate:
 - .1 Motors, sheaves, bearings, shaft details, wheels, bearings, hose accessories.
- .4 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 FANS GENERAL

- .1 Motors:
 - .1 Sizes as indicated.
 - .2 Premium efficiency motors are to be provided unless specified.
- .2 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .3 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 EF-1: EXHAUST FAN

- .1 Belt drive centrifugal inline cabinet fan, galvanized steel housing, sound absorbing insulation, backward inclined aluminum wheel, integral duct connection flanges, ball bearing motors, adjustable motor pulley, adjustable motor plate, fan shaft mounted in ball bearing pillow blocks, static free belts, corrosion resistant fasteners, vibration isolator hangers, CSA approved, UL listed.
- .2 Rated for 625 CFM @ 0.25" W.C., 809 FRPM.
- .3 Motor: 115V/60/1, ¼ HP, 1725 RPM, ODP, thermal overload protection.
- .4 AMCA certified sound rating not to exceed 6.5 Sones.
- .5 Acceptable Product: "Greenheck" BSQ-120-4 or approved equal.

2.3 EF-2: EXHAUST FAN

- .1 Direct drive centrifugal inline cabinet fan, galvanized steel housing, sound absorbing insulation, backward inclined aluminum wheel, two bolted access panels, integral duct connection flanges, sleeve bearing motors, corrosion resistant fasteners, vibration isolator hangers, CSA approved, UL listed.
- .2 Rated for 150 CFM @ 0.2"WC, 1550 FRPM.
- .3 Motor: 115V/60/1, 1/40 HP, 1550 RPM, TEAO, thermal overload protection.
- .4 AMCA certified sound rating not to exceed 3.9 Sones.
- .5 Acceptable Product: "Greenheck" SQ-60-D or approved equal.

2.4 EF-3: EXHAUST FAN

- .1 Direct drive centrifugal inline cabinet fan, galvanized steel housing, sound absorbing insulation, backward inclined aluminum wheel, two bolted access panels, integral duct connection flanges, sleeve bearing motors, corrosion resistant fasteners, vibration isolator hangers, CSA approved, UL listed.
- .2 Rated for 200 CFM @ 0.2"WC, 1300 FRPM.
- .3 Motor: 115V/60/1, 1/50 HP, 1300 RPM, TEAO, thermal overload protection.
- .4 AMCA certified sound rating not to exceed 3.7 Sones.
- .5 Acceptable Product: "Greenheck" SQ-75-G or approved equal.

2.5 EF-4: ROOF EXHAUST FAN

- .1 Direct drive upblast centrifugal roof exhaust fan, aluminum housing, backward inclined aluminum curb cap with prepunched mounting holes, drain trough, sleeve bearing motor, motor isolated on shock mounts, corrosion resistant fasteners, CSA approved, UL listed, complete with roof curb.
- .2 Rated for 200 CFM @ 0.2"WC, 1300 FRPM.
- .3 Motor: 115V/60/1, 1/60 HP, 1300 RPM, ODP, thermal overload protection.
- .4 AMCA certified sound rating not to exceed 2.8 Sones.
- .5 Acceptable Product: "Greenheck" CUE-070-G complete with roof curb, or approved equal.

2.6 EF-5: ROOF EXHAUST FAN

- .1 Belt drive upblast centrifugal roof exhaust fan, aluminum housing, backward inclined aluminum wheel, curb cap with prepunched mounting holes, motor and drives isolated on shock mounts, drain trough, ball bearing motors, adjustable motor pulley, adjustable motor plate, fan shaft mounted in ball bearing pillow blocks, bearings meet or exceed temperature rating of fan, static resistant belts, corrosion resistant fasteners, internal lifting lugs, CSA approved, UL listed, complete with roof curb.
- .2 Rated for 500 CFM @ 0.2"WC, 916 FRPM.
- .3 Motor: 115V/60/1, ¼ HP, 1725 RPM, ODP, thermal overload protection.
- .4 AMCA certified sound rating not to exceed 4.8 Sones.
- .5 Acceptable Product: "Greenheck" CUBE-099-4 complete with roof curb, or approved equal.

2.7 EF-6: KITCHEN EXHAUST FAN

- .1 Belt drive, centrifugal, roof mounted upblast fan suitable for kitchen grease exhaust, heavy gauge aluminum housing, nylon washers, galvanized steel base, backward inclined wheel, ball bearing motor, static resistant belts, adjustable pitch motor pulleys, welded aluminum

grease spout, high heat operation to 300°F, complete with vented hinged roof curb and grease box, UL listed, meets NFPA 96.

- .2 Rated for 2800 CFM @ 0.5" S.P.
- .3 Motor: 208V/60/3, 1 HP, 1284 RPM, ODP, mounted on vibration isolators.
- .4 Air and sound ratings to be certified by HVI and be cUL listed.
- .5 Acceptable Product: "CaptiveAire" NCA14FA or approved equal.

2.8 EF-7: EXHAUST FAN

- .1 Belt drive centrifugal inline cabinet fan, galvanized steel housing, sound absorbing insulation, backward inclined aluminum wheel, two bolted access panels, integral duct connection flanges, ball bearing motors, adjustable motor pulley, adjustable motor plate, fan shaft mounted in ball bearing pillow blocks, static free belts, corrosion resistant fasteners, vibration isolator hangers, CSA approved, UL listed.
- .2 Rated for 625 CFM @ 0.4"WC, 715 FRPM.
- .3 Motor: 115V/60/1, 1/3 HP, 1725 RPM, ODP, thermal overload protection.
- .4 AMCA certified sound rating not to exceed 4.3 Sones.
- .5 Acceptable Product: "Greenheck" model BSQ-160HP-3 or approved equal.

2.9 RTU-1 RF: RETURN FAN FOR ROOFTOP UNIT

- .1 Belt drive centrifugal inline fan, galvanized steel housing, 1" thick sound absorbing insulation, backward inclined aluminum wheel, integral duct connection flanges, access panels, ball bearing motors, adjustable motor pulley, adjustable motor plate, fan shaft mounted in ball bearing pillow blocks, static free belts, corrosion resistant fasteners, vibration isolator hangers, motor cover, CSA approved, UL listed.
- .2 Rated for 3,200 CFM @ 0.25" W.C., 439 FRPM.
- .3 Motor: 115V/60/1, ½ HP, 1725 RPM, ODP.
- .4 AMCA certified sound rating not to exceed 7.5 Sones.
- .5 Fan Dimensions: Not to exceed 37" x 39" x 55"
- .6 Acceptable Product: "Greenheck" BSQ-240-5 or approved equal.

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 FAN INSTALLATION

- .1 Install flexible duct connectors at inlet and outlet of fans.
- .2 Ensure that fan housing does not touch rigid duct while in operation.
- .3 Ensure no unusual vibration or noise is present.
- .4 Use vibration isolation as specified above.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

1.2 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.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

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.

.3 Concealed manual volume control damper operators.

.4 Colour: as indicated on grille schedule.

.5 Acceptable Manufacturer: "E.H. Price Ltd", as per grille schedule

2.2 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.3 GRILLE SCHEDULE

.1 As indicated on drawings. Refer to architectural for grille colours.

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 instructions.
- .2 Install with stainless steel (or colour matched) screws in countersunk holes where fastenings are visible.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Mechanical louvers, intakes & vents.

1.2 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.
 - .2 Indicate following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.

Part 2 Products

2.1 FIXED LOUVERS - ALUMINUM

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Performance rated in accordance with AMCA certification.
- .3 Material: extruded aluminum, 39° blade angle.
- .4 Louver depth: 4" (as per louver schedule)
- .5 Drainable blade with 5" blade spacing.
- .6 Frame: 4" deep one piece extruded Aluminum, minimum 0.081" thick.
- .7 Design wind load: 25 psf (100 mph).
- .8 Screen: standard bird screen, ½" x ½", re-galvanized, 19 gauge.
- .9 Free area velocity at beginning point of water penetration is to be at least 849 fpm as defined by AMCA Standard 511. Pressure drop at beginning of water penetration to be 0.12" w.c. or less.
- .10 Finish: factory painted, color by Architect.
- .11 Acceptable Material: "E.H. Price", sizes as per Louvers Schedule.

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 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as required.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.
- .4 At elevations as per Architectural sections.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Included:
 - .1 Supply and installation of new kitchen range hood RH-1 and associated grease filters.
- .2 Related Sections:
- .3 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 Canadian Standards Association, (CSA International)
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .3 Underwriter's Laboratories of Canada (ULC)

1.3 SUBMITTALS

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

Part 2 Products

2.1 RANGE HOOD, RH-1

- .1 168" L x 48" W x 24" H hood, 430 stainless steel construction.
- .2 Four UL listed compact fluorescent lights complete with light switches.
- .3 Roof outlet, two 13" x 10" connections for exhaust duct risers
- .4 Sloped grease trough to 1 gallon (maximum) removable grease cup
- .5 Joints and seams welded liquid-tight
- .6 Capacity: 2800 CFM
- .7 Maximum cooking temperature: 450°F
- .8 1" wide insulated 430 SS backsplash, 80" H x 168" L.
- .9 Acceptable Product: "CaptiveAire" 4824ND-2-PSP-F range hood, or approved equal

2.2 GREASE FILTER TYPE

- .1 To NFPA 96.

- .2 ULC labelled.
- .3 Six stainless steel grease extracting filters, baffles with handles, 16” H x 20” L x 2” D.
- .4 Materials:
 - .1 Welded type 304 stainless steel
 - .2 Washable filters
 - .3 Drain connector.
- .5 Acceptable Product: “Kleen-Gard” MEA # 247-96-E or approved equal.

Part 3 Execution

3.1 INSTALLATION

- .1 Install hoods in accordance with manufacturers instructions.
- .2 Install filter/filter media prior to acceptance.

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

- .1 Supply and install gas-fired, water heating boiler B-1.
- .2 Supply and install all accessories required for a complete system, including low water cut-outs, PRV's, etc.
- .3 Supply and install flu gas venting.
- .4 Commission boilers and boiler controls to ensure proper operation.
- .5 Vendor shall provide on-site commissioning assistance for the boilers and vendor supplied controls.
- .6 The controls contractor shall be responsible for mounting and wiring all remote-mounted sensors and controls supplied with vendor-supplied equipment.

1.2 SUMMARY

- .1 Section Includes:
 - .1 Heating boiler units:
 - .1 Gas.
 - .2 Installation.
 - .3 Commissioning.

1.3 REFERENCES

- .1 American Boiler Manufacturer's Association (ABMA)
- .2 American National Standards Institute (ANSI)
- .3 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 2004.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .5 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.4 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.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate the following:
 - .1 General arrangement showing dimensions, terminal points, instrumentation test connections.
 - .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
 - .3 Foundations with loadings, anchor bolt arrangements.
 - .4 Piping hook-ups.
 - .5 Equipment electrical drawings.
 - .6 All miscellaneous equipment.
 - .7 Capacity.
- .3 Closeout Submittals:
 - .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 GENERAL

- .1 Start-up, instruction, on-site performance tests: 3 days total.
- .2 Trial usage:
 - .1 Contract Administrator may use boilers for test purposes prior to acceptance and commencement of warranty period.
 - .2 Supply labour, materials and instruments required for tests.
- .3 Temporary use by contractor:
 - .1 Contractor may use boilers only after written approval from Contract Administrator.
 - .2 Monitor and record performance continuously. Keep log of maintenance activities carried out.
 - .3 Refurbish to as-new condition before final inspection and acceptance.

2.2 B-1: HIGH EFFICIENCY CONDENSING GAS BOILER

- .1 General Requirements
 - .1 Furnish and install ULTRA 310 packaged, modulating, sealed combustion, power-vented, high efficiency gas-fired boiler(s) with cast aluminum heat exchangers that use outside air for combustion.

- .2 Boiler shall have I=B=R Hydronics Institute gross output at 100% fire rate 252 MBH per boiler
- .3 Boiler(s) shall be 92.8% minimum DOE efficient as required by National Energy Conservation Act or ASHRAE 90.1
- .4 Boiler shall be capable of full modulation firing with a turn down of up to 5 to 1.
- .5 Boiler(s) shall be manufactured by ISO 9001 registered company to conform to Section IV of the ASME Boiler and Pressure Vessel Code.
 - .1 Individual cast aluminum mono block to be fire tested and hydrostatically pressure tested at factory in accordance with asme requirements.
 - .2 Maximum allowable working pressure 30PSIG water as listed on the rating label
- .2 Boiler Construction
 - .1 Boiler heat exchanger to be made of cast aluminum mono block heat exchanger.
 - .2 Boiler main components:
 - .1 The combustion chamber will be sealed and located at the top of the mono block casting which will be of counter flow design, to assure that sediment and any lime that might form will fall to the bottom, away from the crown sheet area.
 - .2 Boiler(s) shall be supplied with a gas valve designed with negative pressure regulation (fan suction “pulls” gas through valve rather than gas pressure “pushing” gas through valve). This enables the boiler to operate in a safe condition at a de-rated output, even if the inlet gas pressure should drop to as low as 4 inches W.C. The inlet (natural) (propane) gas pressure to the boiler gas valve should be a minimum of 4” W.C. and a maximum of 13” W.C. If inlet gas pressure exceeds 13” W.C., a 100% lock-up type gas pressure regulator of adequate size must be installed in gas supply piping and adjusted to prevent pressure in excess of 13” W.C.
 - .3 The burner shall be premix combustion type, made with stainless steel and a woven metal fiber outer covering providing a wide range of modulating firing rates.
 - .4 The boiler shall be equipped with a variable speed blower system, capable of modulating the boiler firing rate.
 - .5 The boiler shall be equipped with a device capable of controlling the air/fuel ratio through a 5 to 1 turndown ratio.
 - .6 The control system shall have a 3.5” LCD electronic display for boiler set-up, boiler status, and boiler diagnostics.
 - .7 The control system shall provide 3 separate priorities that provide control of set point temperatures, outdoor reset curves, max/min. firing rates, running times and control of 1 to 3 circulators.

- .3 Venting and Combustion Air
 - .1 Boiler must be capable of using outside air piped directly to boiler for combustion. Inlet and termination of these pipes must be connected to either, through the roof or sidewall terminations as recommended by the manufacturer.
 - .2 The boiler shall be direct vent using Schedule 40 PVC complete with 4" concentric vent termination.
 - .3 4" diameter air intake piping and 4" vent air piping shall use a 4" concentric vent kit complete with rain cap and birdscreen.
- .4 Boiler Trim
 - .1 All electrical components to be high quality manufacture and bear UL label.
 - .2 Water boiler(s) controls furnished:
 - .1 High limit temperature control (190 degrees F maximum allowable boiler water temperature).
 - .2 Combination pressure-temperature gauge. Gauge dial clearly marked and easy to read.
 - .3 ASME certified pressure relief valve, set to relieve at 30 PSIG.
 - .4 Flue gas, outlet water temperature, and return water temperature sensors.
 - .5 Low water protection.
 - .6 Built-in freeze protection.
 - .7 Boiler loop circulator.
 - .8 Power and control 3 circulators
 - .9 Circulator(s) Exercising
 - .3 Condensate neutralization kit on condensate drain line.
 - .4 Boiler Manuals
 - .1 The boiler(s) shall be provided with complete instruction manuals, including:
 - .1 Boiler Installation Manual.
 - .2 User's Manual.
 - .5 Acceptable Product: "Weil-McLain" Ultra 310

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 ANSI/ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make required piping connections to 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.
- .5 Flue gas venting:
 - .1 Install factory engineered vent system in accordance to manufacturers recommendations. No insulation is required.
- .6 Combustion air duct to be of standard sheet metal, insulated as indicated on drawings.

3.3 FIELD TESTING

- .1 The boiler manufacturer, or his authorized representative, shall test all boiler and burner interlocks, actuators, valves, controllers, gauges, thermometers, pilot lights, switches, etc. Any malfunctioning component shall be replaced.
- .2 All adjustments to boiler, burner, and boiler control system shall be performed by the boiler manufacturer or his authorized representative.

3.4 STARTUP, INSTRUCTION AND WARRANTY SERVICE

- .1 The boiler manufacturer or his authorized representative shall provide start-up and instruction for each new boiler, including burner and boiler control system. The manufacturer may dispatch factory-trained technicians in the direct employ of the manufacturer's local authorized representative for field services as specified herein. Start-up and instruction shall cover all components assembled and furnished by the manufacturer whether or not of his own manufacture.

3.5 MOUNTINGS AND ACCESSORIES

- .1 Safety valves and relief valves:
 - .1 Run separate discharge from each valve.

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

- .1 Provide and install new packaged rooftop units RTU-1 and RTU-2.
- .2 Start-up and test RTU-1 and RTU-2.
- .3 Co-ordinate with controls contractor for the commissioning of the equipment specified in this Section.
- .4 The controls contractor shall be responsible for mounting and wiring all remote-mounted sensors and controls.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate following: fan curves showing point of operation, motor drive, filters, mixing box dampers, unit dimensions, accessories provided, control panel design, wiring diagram; include performance data and sequence of operation. Provide service access as shown on the drawings.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include following: fan data, fan curves, motor, air volume, hydronic heating and cooling data, and controls schematic.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Spare filters: in addition to filters installed immediately prior to acceptance by Consultant, supply 3 complete sets of replacement filters for each rooftop unit.

Part 2 Products

2.1 ROOFTOP UNITS, RTU-1 AND RTU-2

- .1 General Description
 - .1 Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fan, dampers, condenser fans, and gas heater.

- .2 Unit shall be factory assembled and tested including leak testing of the coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the controls compartment's literature pocket.
 - .3 Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
 - .4 Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.
 - .5 Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
 - .6 Installation, Operation and Maintenance manual shall be supplied within the unit.
 - .7 Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's access door.
 - .8 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's access door.
- .2 Construction
- .1 All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
 - .2 Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F.
 - .3 Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
 - .4 Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Refrigerant piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
 - .5 Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
 - .6 Access to filters, dampers, cooling coils, heaters, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
 - .7 Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
 - .8 Units with cooling coils shall include double sloped 304 stainless steel drain pans.

- .9 Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
 - .10 Unit shall include lifting lugs on the top of the unit.
 - .11 Unit base pan shall be provided with 1/2 inch thick foam insulation.
- .3 Electrical
- .1 Unit shall be provided with standard power block for connecting power to the unit.
 - .2 Unit shall be provided with factory installed and factory wired, non-fused safety disconnect switch.
 - .3 Unit shall be provided with factory installed and factory wired 115V, 15 amp GFI outlet with outlet disconnect switch in the unit control panel.
 - .4 Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more that 10% out of balance on voltage, the voltage is more that 10% under design voltage, or on phase reversal.
 - .5 Unit shall be provided with manual reset low temperature limit controls which shut off the unit when the discharge temperature reaches a field adjustable setpoint.
- .4 Supply Fans
- .1 Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
 - .2 Blowers and motors shall be dynamically balanced and mounted on rubber isolators.
 - .3 Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
 - .4 Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency
- .5 Cooling Coils
- .1 Evaporator Coils
 - .1 Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
 - .2 Coils shall have interlaced circuitry and shall be standard capacity.
 - .3 Coils shall be helium leak tested.
 - .4 Coils shall be furnished with a factory installed thermostatic expansion valves.
- .6 Refrigeration System
- .1 Unit shall be factory charged with R-410A refrigerant.
 - .2 Compressors shall be Variable Speed scroll type with thermal overload protection, independently circuited, and carry a 5 year non-prorated warranty. Compressores shall be capable of modulation from 10-100% of its capacity.
 - .3 Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors

shall be fabricated of double wall, rigid polyurethane foam insulated panels to prevent the transmission of noise outside the cabinet.

- .4 Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
 - .5 Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.
 - .6 Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides, and factory installed liquid line filter driers.
 - .7 Provide 5 minute time delay and 20 second delay stage timer.
 - .8 RTU-1 shall include 1 Variable Capacity Compressor. RTU-2 shall include 1 Variable Capacity Compressor and 1 On / Off Compressor.
- .7 Condensers
- .1 Air-Cooled Condenser
 - .1 Condenser fans shall be vertical discharge, axial flow, direct drive fans.
 - .2 Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
 - .3 Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
 - .4 Coils shall be helium leak tested.
- .8 Gas Heating
- .1 Unit shall included natural gas furnace equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the controls compartment. Specified gas heating assemblies shall be capable of operating at any firing rate between 100% and 30% of their rated capacity.
 - .2 Stainless steel heat exchanger furnace shall carry a 25 year non-prorated warranty.
 - .3 Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.
 - .4 Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
 - .5 Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.

- .9 Filters
 - .1 Unit shall include 2 inch thick, fiberglass throwaway filters with an ASHRAE efficiency of 25% and MERV rating of 4, upstream of the cooling coil.
- .10 Outside Air/Economizer
 - .1 Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 CFM of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Damper assembly shall be controlled by spring return enthalpy activated fully modulating. Unit shall include outside air opening bird screen, outside air hood with rain lip and barometric relief dampers.
- .11 Controls
 - .1 Factory installed and Factory provided Controller.
 - .2 Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested.
 - .3 Controller shall be capable of standalone operation with unit configuration, set point adjustment, sensor status viewing, unit alarm viewing.
 - .4 Controller shall include non-volatile memory to retain all programmed values, without the use of an external battery, in the event of a power failure
 - .5 Unit shall modulate cooling with constant air flow to meet space temperature cooling loads.
 - .6 Unit shall modulate heating with constant air flow to meet supply air temperature with room temperature reset.
 - .7 Provide discharge air temperature control with space temperature reset.
- .12 Curbs
 - .1 Provide 14" high solid bottom roof curbs. Curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.
- .13 Rooftop unit schedule:

ROOFTOP UNIT SCHEDULE				
Tag		RTU-1	RTU-2	
MANUFACTURER		Aaon	Aaon	
MODEL		RN-008-4-0-CA01-3K9	RN-020-4-0-BA0-3C9	
SUPPLY	CFM:	3,200	8,000	

	ESP ("WC):	1.0	1.0	
	MOTOR (HP):	3	5	
	BLOWER:			
COOLING	EAT (DB/WB) (°F):	82.00/67.83	81.13/67.14	
	LAT (DB/WB) (°F):	60.08/58.75	58.52/57.53	
	TOTAL OUTPUT (BTU/H):	90,170	234,950	
HEATING	EAT (DB/WB) (°F):	48.1/44.7	26.3/26.3	
	LAT (DB/WB) (°F):	82.8/59.4	76.2/52.2	
	TOTAL INPUT (BTU/H):	150,000	540,000	
	TOTAL OUTPUT (BTU/H):	120,000	432,000	
REMARKS:				

Part 3 Execution

3.1 INSTALLATION

- .1 Install units in accordance with manufacturer's instructions and as indicated.
- .2 Ensure adequate clearance for servicing and maintenance.
- .3 Provide roof curbing.

3.2 FANS

- .1 Fan sheaves required for final air balance to be provided by Section 23 05 93 Testing, Adjusting and Balancing for HVAC.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 23 09 33 - Electric and Electronic Control System for HVAC.
- .3 Section 26 05 01 - Common Work Results - Electrical.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data to include:
 - .1 Replacement data for motor element, thermostat and switch.
 - .2 Mounting methods.
 - .3 kW rating, voltage, phase.
 - .4 Cabinet material thicknesses.
 - .5 Physical size.
 - .6 Finish.
 - .7 Thermostat, transformer, controls where integral.

Part 2 Products

2.1 FORCED AIR HEATERS

- .1 Forced air heaters ceiling mounted, recessed, commercial type as follows:
 - .1 Enclosure:
 - .1 Steel, 1.2 mm thick.
 - .2 Knockouts for 12 mm diameter conduit left, right, bottom and rear.
 - .3 Grill and frame finished epoxy/polyester powder paint.
 - .2 Elements and Fan:
 - .1 Stainless steel tubular heating elements with aluminum fins.
 - .2 Motor: totally enclosed, lifetime –lubricated ball bearing motor, with fan delay purge and thermal overload protection.

- .2 Controls:
 - .1 Built-in tamperproof controls. 'On-Off-Fan Only' selector switch and temperature control knob.

2.2 MANUFACTURES

- .1 Ouellet ODS Series or approved equivalent.

Part 3 Execution

3.1 INSTALLATION

- .1 Install heaters in accordance with manufacturer's instructions.
- .2 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 New finned tube radiation heaters, R-1 to R-10.
 - .2 New radiator enclosures for existing finned tube radiation heaters, RC1 to RC6.

1.2 REFERENCES

- .1 Hydronic Institute of Boiler and Radiator Manufacturers (IBR)

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.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate:
 - Equipment, capacity, piping, and connections.
 - Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
 - Special enclosures.
- .3 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 RADIATOR, R-1

- .1 Hydronic wallfin horizontal double row radiator elements.
- .2 Performance: 2,455 BTUH/ft at 190°F average water supply temperature, 1 FPS velocity (1.6 GPM flow rate), and 65°F entering air temperature.
- .3 Copper-aluminium element shall be 3/4" nominal I.D. seamless copper with 4"x4" aluminum fin. Fins to be stamped for rigidity and have integral collars to provide even spacing of 48 fins/foot and maximum heat transfer. Tube ends suitable for sweat connecting.
- .4 Heavy gauge element hangers shall be provided for mounting on the wall.

- .5 Enclosure cabinets shall be constructed of 16 gauge steel. 6" H x 11" D. Cabinets will be supported at the top by joggle strip mounted to the wall and at the bottom by support brackets. Provide all end caps and panel joiners. Confirm required length on site prior to ordering equipment.
- .6 Refer to architect for colours and finish.
- .7 Acceptable Product: "Sigma" 44C075 element and FST-06P2T radiator enclosure, or approved equal. Refer to Radiator Schedule for dimensions.

2.2 RADIATORS, R-2, R-3, R-4, R-5, R-6, R-7, R-8, R-9 & R-10

- .1 Hydronic wallfin single row radiator element.
- .2 Performance: 1,556 BTUH/ft at 190°F average water supply temperature, 1 FPS velocity (1.6 GPM flow rate), and 65°F entering air temperature.
- .3 Copper-aluminium element shall be 3/4" nominal I.D. seamless copper with 4"x4" aluminum fin. Fins to be stamped for rigidity and have integral collars to provide even spacing of 48 fins/foot and maximum heat transfer. Tube ends suitable for sweat connecting.
- .4 Heavy gauge element hangers shall be provided for mounting on the wall.
- .5 Enclosure cabinets shall be constructed of 16 gauge steel 24" H x 5-1/4" D. Cabinets will be supported at the top by joggle strip mounted to the wall and at the bottom by support brackets. Provide all end caps and panel joiners. Confirm required length on site prior to ordering equipment.
- .6 Refer to architect for colours and finish.
- .7 Acceptable Product: "Sigma" 44C075 element and SWE-24T enclosure, or approved equal. Refer to Radiator Schedule for dimensions.

2.3 RADIATOR ENCLOSURES, RC1, RC2, AND RC3

- .1 Radiator enclosures for existing single row radiator elements, flat top outlet grille, open bottom air intake, 12" H x 5-1/4" D. Confirm required length on site prior to ordering equipment.
- .2 Enclosure cabinets shall be constructed of 16 gauge steel. Cabinets will be supported at the top by joggle strip mounted to the wall and at the bottom by support brackets. Provide all end caps and panel joiners.
- .3 Refer to architect for colours and finish.
- .4 Acceptable Product: "Sigma" SWE-12T or approved equal. Refer to Radiator Schedule for dimensions.

2.4 RADIATOR ENCLOSURE, RC4 AND RC5

- .1 Radiator enclosures for existing horizontal double row radiator elements, flat top outlet grille, open bottom air intake, pedestal base, 6" H x 11" D. Confirm required length on site prior to ordering equipment.

- .2 Enclosure cabinets shall be constructed of 16 gauge steel. Cabinet will be supported at the top by joggle strip mounted to the wall and at the bottom by pedestal bases. Provide all end caps and panel joiners.
- .3 Refer to architect for colours and finish.
- .4 Acceptable Product: "Sigma" FST-06P2T or approved equal. Refer to Radiator Schedule for dimensions.

2.5 RADIATOR ENCLOSURE, RC6

- .1 Radiator enclosures for existing single row radiator element, flat top outlet grille, front air inlet, 10" H x 5-1/4" D. Confirm required length on site prior to ordering equipment.
- .2 Enclosure cabinets shall be constructed of 16 gauge steel. Cabinet will be supported at the top by joggle strip mounted to the wall and floor mounted at the bottom. Provide all end caps and panel joiners.
- .3 Refer to architect for colours and finish.
- .4 Acceptable Product: "Sigma" SWE-10TF or approved equal. Refer to Radiator Schedule for dimensions.

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 manufacturer's instructions.
- .2 Install in accordance with piping layout and approved shop drawings.
- .3 Provide for pipe movement during normal operation.
- .4 Maintain sufficient clearance to permit performance of service maintenance.
- .5 Check final location with Contract Administrator if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Contract Administrator's directive.

- .6 Valves:
 - .1 Install valves with stems upright or horizontal unless approved otherwise.
 - .2 Install isolating ball valves on inlet and balancing valves on outlet of each unit.
 - .3 Refer to “23 21 16 Hydronic Systems – Steel” for valve specifications.
- .7 Clean finned tubes and comb straight.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.46-M1988, Electric Air-Heaters.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for unit heaters. Include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Limitations.
 - .8 Colour and finish.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 61 33 - Hazardous Materials. WHMIS acceptable to Labour Canada, and Health Canada.
- .4 Submit product data sheets for unit and baseboard heaters.
 - .1 Include product characteristics, performance criteria, physical size, limitations and finish.
- .5 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, and cleaning procedures.

1.4 CLOSEOUT SUBMITTALS

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

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable manufacturers:
 - .1 Unit Heater:
 - .1 Ouellet OAS series or approved equivalent.
 - .2 Baseboard Heater:
 - .1 Ouellet OFM series or approved equivalent

2.2 UNIT HEATERS

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Fan type unit heaters with built-in high-heat limit protection, fan-delay switches.
- .3 Fan motor: totally enclosed][permanently lubricated ball bearing type with resilient mount.
 - .1 Built-in fan motor thermal overload protection.
- .4 Hangers: as required.
- .5 Elements: tubular stainless steel with aluminum fins.
- .6 Cabinet: steel, 1.2mm thick, fitted with 4 brackets for rod or wall mounting. Phosphatized and finished with epoxy/polyester powder paint.

2.3 UNIT HEATER CONTROLS

- .1 Wall mounted thermostats: type: low voltage, to Section 23 09 33 - Electric and Electronic Control System for HVAC.

2.4 BASEBOARD HEATERS

- .1 Baseboard heater: to CSA C22.2 No.46.
- .2 Elements: tubular steel with aluminum fins floating on high-temperature nylon bushings eliminating expansion noise.
- .3 Cabinet: steel, 1.2 mm thick, fitted for wall mounting.
 - .1 Phosphatized and finished with epoxy/polyester powder paint

2.5 BASEBOARD HEATERS CONTROLS

- .1 Wall mounted thermostats: low voltage, to Section 23 09 33 - Electric and Electronic Control System for HVAC.

Part 3 Execution

3.1 INSTALLATION

- .1 Suspend unit heaters from ceiling or mount on wall as indicated.
- .2 Install thermostats in locations as indicated in mechanical drawings.
- .3 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

END OF SECTION