

PART 1 - GENERAL

1.1 GENERAL

- .1 This Section covers items common to more than one section of the Mechanical Divisions 21, 22, 23 and 25.
- .2 "Provide" shall mean "supply, install and connect".
- .3 Provide new materials, equipment and plant of proven design and quality, and of current models with published ratings for which replacement parts are readily available.

1.2 EQUIPMENT LIST

- .1 Complete list of equipment to be used on this project by adding manufacturer's name and model number. Submit for approval within one week of award of contract.
- .2 The Contractor is to complete the following list of equipment with manufacturer's name and model number:
 - .1 Heat exchanger: Alpha Laval Model CB30-18H/
 - .2 Roof-mounted exhaust fans: MK Plastics Model CNW.
 - .3 Control and instrumentation: Honeywell.
- .3 It is the Contractor's responsibility to ensure that the equipment to be used will meet the performance specifications and will fit the spaces allocated.
- .4 Submit for approval within 48 h after Award of Contract.

1.3 CUTTING AND
REMEDIAL WORK

- .1 Cutting and remedial work is specified in Section 01 11 00 and 01 73 00.
- .2 Assume full responsibility for laying out mechanical work and for any damage caused by incorrectly located equipment and mechanical services.
- .3 Set sleeves and mark openings in concrete forms and in masonry before placing of concrete and erection of masonry.

1.4 CO-ORDINATION

- .1 Locate distribution systems, equipment and materials to provide minimum interference and maximum useable space.
- .2 Where interference occurs, Departmental Representative shall approve relocation of equipment and materials.

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| <u>1.5 DRAWINGS</u> | <ul style="list-style-type: none">.1 Working drawings, except where dimensioned, indicate general mechanical layouts only. Do not scale..2 Existing equipment and services shown on the drawings:<ul style="list-style-type: none">.1 The information shown on the drawings is incomplete and is for reference only. Some of the existing equipment, ducts, pipes and other services are not shown on the drawings..2 The Contractor shall make arrangements to examine existing conditions, determine conditions affecting the work, and verify sizes and location of existing equipment, ducts, pipes and any other services. Refer to Section 01 11 00 and 01 41 00 for instructions regarding site visits..3 Unless the discrepancies are noted and reported to the Departmental Representative prior to close of the bid, the Contractor shall be responsible for the work to relocate existing equipment and to reroute existing ducts, pipes and any other services required for the installation of new work at no extra cost to the contract..3 If required by Departmental Representative, provide field drawings to show relative positions of various services. Obtain approval before beginning work. |
| <u>1.6 SHOP DRAWINGS AND PRODUCT DATA SHEETS</u> | <ul style="list-style-type: none">.1 Submit shop drawings and product data sheets for major equipment listed in each section..2 Submit early enough to permit Project Schedules to be met..3 Show materials; sizes, dimensions, performance ratings, curves and operating characteristics, compliance with codes and standards, wiring, controls, piping diagrams, installation instructions, fabrication, assembly and installation details..4 For additional requirements pertaining to shop drawings and product data refer to Section 01 11 00 and 01 33 00 and 01 78 00. |
| <u>1.7 OPERATION AND MAINTENANCE DATA</u> | <ul style="list-style-type: none">.1 Supply operating and maintenance instructions complete with names and addresses of spare parts suppliers in accordance with requirements of Section 01 11 00 and 01 78 00. |
| <u>1.8 EQUIPMENT DESIGN AND INSTALLATION</u> | <ul style="list-style-type: none">.1 Uniformity:<ul style="list-style-type: none">.1 For equipment or material of same type or classification, use product of one manufacturer. |

- .2 Installation:
 - .1 Install equipment to manufacturer's recommendations with adequate and easy access for inspection, servicing and lubrication.
 - .2 Install equipment to permit maintenance and disassembly with minimum disturbance to connecting piping and duct systems and without interference with building structure or equipment.
 - .3 Provide screwdriver stops on supplies to plumbing fixtures.
 - .4 Provide support brackets, bases, and all necessary fastenings.

1.9 ELECTRIC MOTORS
AND CONTROLS

- .1 Electrical equipment shall bear CSA label. Obtain inspection labels required by Provincial authority having jurisdiction.
- .2 Use high efficiency motors. Minimum acceptable motor efficiency levels shall be based on the latest table of motor efficiency levels in accordance with CSA C390-10, Test methods, marking requirements, and energy efficiency levels for three-phase induction motors.
- .3 Unless otherwise specified or indicated, motors $\frac{1}{2}$ HP and larger shall be 3 phase.
- .4 Refer to Electrical Division 26 regarding specifications of power wiring (i.e. wiring carrying the full load current), conduits, starters, disconnect switches, etc., for mechanical equipment specified in Mechanical Divisions. Unless noted and specified in Electrical Divisions to be provided by Electrical Divisions, all field installed power wiring, conduit, starters, disconnect switches, etc., shall be provided by Mechanical Divisions.
- .5 Provide motors, control wiring and controls together with associated relays, signalling devices, thermostats, control transformers, firestats, pressure switches, electric- pneumatic switches, required to form a complete control system for the equipment specified in Mechanical Divisions.

1.10 EQUIPMENT
SUPPORTS

- .1 Provide vibration free guards on exposed drives and rotating parts to meet safety requirements of Provincial Ministry of Labour and local authorities having jurisdiction.
- .2 Provide 20 mm mesh wire screen on inlet or outlet of exposed fan blades.

- .3 Provide restraining chains and fasteners to hold access doors open when doors close in direction of air pressure.

1.11 PIPING SUPPORTS

- .1 Unless noted otherwise, fabricate equipment supports from structural grade steel. Submit structural calculations with shop drawings.

1.12 PIPING INSTALLATION

- .1 Conform to requirements of ASME B31.1-2012, Power Piping.
- .2 Provide dielectric couplings where piping of dissimilar metals are joined.
- .3 Provide easily accessible unions close to equipment, to permit easy removal of equipment with minimum disturbance to piping systems.
- .4 Valves:
 - .1 Provide easy access for servicing and operation. Install access doors where concealed.
 - .2 Install with stems above horizontal.
- .5 Drainage:
 - .1 Provide easily accessible drain valves at low points to permit complete drainage of piping systems.
 - .2 Extend equipment drain piping to discharge into floor or hub drain.
 - .3 Provide drain piping from drain pan of air handling units, full size of outlet connection and equip with deep-seal trap.
- .6 Expansion and Contraction:
 - .1 Make adequate provision for expansion and contraction of piping systems.
 - .2 Use expansion joints and compensators, flexible connections, pipe loops and offsets as indicated and required.
 - .3 Support piping to prevent any stress or strain from occurring at connections to equipment.
 - .4 Install and guide expansion joints in accordance with manufacturer's recommendations.
 - .5 Provide steel anchors welded to piping, fastened to building structure or embedded in concrete pier so that forces acting on anchor points are restrained without causing damage to structure or systems.
 - .6 Base design axial traverse on temperature difference between -18°C ambient and corresponding fluid temperature plus 25% safety factor.

1.13 PIPE HANGERS
AND SUPPORTS

- .1 Fabricate hangers, supports and sway braces in accordance with ASME B31.1-2012.
- .2 Provide adjustable clevis type hangers on all sizes of pipe except where roller type hangers are required.
- .3 Minimum 150 mm hanger rod length.
- .4 Provide hangers on piping with heated or cooled contents as follows:
 - .1 Rigid hangers when rod length is 300 mm or more, pipe expansion to hanger rod length ratio is less than 1:24 and hanger is supported from top of structural steel.
 - .2 Swing hangers when rod length is 300 mm or more, pipe expansion to hanger rod length ratio is less than 1:6 and hanger is supported from top of structural steel.
 - .3 Roller hangers when rod length is less than 300 mm or pipe expansion to hanger rod length ratio is more than 1:6 or hanger is not supported from top of structural steel.
- .5 On uninsulated copper piping, ensure steel hangers in contact with copper piping are copper plated. Copper pipe shall not contact steel, iron or cinder materials. Covered 12 mm diameter copper pipe may be supported on copper straps.

1.14 SLEEVES,
ESCUTCHEONS AND PLATES

- .1 Sleeves:
 - .1 Provide schedule 40 steel pipe sleeves where pipes pass through masonry or concrete walls or floors. Apply watertight caulking compound between pipe and sleeve in exterior walls.
- .2 Escutcheons and plates:
 - .1 Provide on pipes passing through finished walls, partitions, floors and ceilings.
 - .2 Use chrome or nickel plated brass, solid type, with set screws for ceiling or wall mounting. For equipment rooms, use cast-iron type.

1.15 TESTS

- .1 Give 48 hours notice of date when tests will be made.
- .2 Conduct tests in presence of Departmental Representative and representatives of agencies having jurisdiction.
- .3 Bear all costs in connection with all tests.
- .4 Obtain acceptance certificates from authorities have jurisdiction. Work shall not be considered complete until certificates are delivered to the Departmental Representative.

- .5 Piping pressure tests:
 - .1 Fill water piping with water and test at 1-1/2 times system operating pressure or at 860 kPa, whichever is greater.
 - .2 Maintain test pressures without loss for four hour period.
 - .3 Test natural gas systems with nitrogen gas at 690 kPa for 24 hour period without loss.
 - .4 Repair leaks and defects. Retest until approved by Departmental Representative.
- .6 Flushing and cleaning:
 - .1 After pressure tests are completed and approved, prior to start-up and placing into operation, flush and clean out piping systems.
 - .2 For water and oil systems fill with solution of water and approved non-foaming, phosphate free detergent. Circulate solution throughout piping systems.
 - .3 Flush and drain systems until free of dirt, sludge, oil, grease and other foreign material. Clean strainers.
 - .4 Refill water systems with clean water.
 - .5 Use compressed air to remove moisture from interior surfaces of fuel oil piping systems before filling with oil.
- .7 Testing plumbing systems:
 - .1 Conform to requirements of National Building Code, Saskatchewan Plumbing Code, and Municipal regulations.
 - .2 Test in presence of Departmental Representative and Municipal Plumbing Inspector.
- .8 Testing and balancing of heating, ventilating, and air-conditioning systems:
 - .1 Use qualified personnel approved by the Departmental Representative to test and balance systems and keep records of operating results.
 - .2 After systems balanced and tests concluded, submit test and balance report showing relevant operating data of equipment and systems.
 - .3 Report shall certify compliance with requirements of drawings and specifications.

1.16 PAINTING

- .1 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

1.17 ACCESS DOORS

- .1 Supply access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.
- .2 Flush mounted 600 x 600 mm for body entry and 300 x 300 mm for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .3 Material:
 - .1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by Departmental Representative.
 - .2 Remaining areas: use prime coated steel.
- .4 Installation:
 - .1 Locate so that concealed items are accessible.
 - .2 Locate so that hand or body entry (as applicable) is achieved.

1.18 DRAIN VALVES

- .1 Minimum NPS 3/4 unless otherwise specified: bronze, with hose end male thread and complete with cap and chain.

1.19 IDENTIFICATION

- .1 Existing identification systems:
 - .1 Apply existing identification system to new work.
 - .2 Where existing identification system does not cover for new work, use identification system specified this section.
 - .3 Before starting work, obtain written approval of identification system from Departmental Representative.
- .2 Identification of piping systems:
 - .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB- 24.3-92 except where specified otherwise.
 - .2 Pictograms:
 - .1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.
 - .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3-92.
 - .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

- .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from Departmental Representative.
 - .2 Colours for legends, arrows: To following table:

Background colour: Yellow	Legend, arrows: BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:

Background
Colour

Contents	Marking	Legend
City water	Green	CITY WATER
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic CW supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Natural gas	to Codes	
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

- .4 Identification ductwork systems:
 - .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
 - .2 Colours: black, or co-ordinated with base colour to ensure strong contrast.
- .5 Valve tags: brass tags with 12 mm stamped identification data filled with black paint.
- .6 Location of identification on piping and ductwork systems:
 - .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: At not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
 - .2 Adjacent to each change in direction.
 - .3 At least once in each small room through which piping or ductwork passes.
 - .4 On both sides of visual obstruction or where run is difficult to follow.
 - .5 On both sides of separations such as walls, floors, partitions.
 - .6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
 - .7 At beginning and end points of each run and at each piece of equipment in run.
 - .8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc.

1.20 INSTRUCTION OF
OPERATION STAFF

- .1 Furnish competent instructors to fully instruct operating staff in care, adjustment and operation of mechanical systems. Use factory trained instructors.
- .2 Instruct during regular work hours before systems accepted and turned over to operating staff for regular operation.
- .3 Where significant changes or modifications in equipment are made under terms of guarantee, instruct operating staff about changes or modifications.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not used.

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PART 3 - EXECUTION

3.1 NOT USED .1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section.
- .2 Standard: TAB to be to most stringent of TAB standards of AABC, NEBB, SMACNA and ASHRAE.
- .3 Do TAB of all systems, equipment, components, controls specified in Mechanical Divisions.
- .4 TAB shall be performed by an independent TAB agency engaged by the Contractor.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Names of all personnel it is proposed to perform TAB to be submitted to and approved by Departmental Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 Qualifications: personnel performing TAB to be current member in good standing of AABC, NEBB, or NBCTA.
- .4 Quality Assurance: perform TAB under direction of supervisor qualified by AABC, NEBB, or NBCTA.

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 so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all 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 be 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 so as 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 Departmental Representative adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of all 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 Mechanical Divisions.

1.8 OPERATION OF SYSTEMS DURING TAB

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

1.9 START OF TAB

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB only when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weatherstripping, sealing, caulking.
 - .3 All pressure, leakage, other tests specified elsewhere Divisions 21, 22, 23 and 25.
 - .4 All provisions for TAB installed and operational.
 - .5 Start-up, verification for proper, normal and safe operation of all 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 All 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 Hydronic systems: plus or minus 10%.
- .2 All other HVAC systems: plus 5%, minus 5%.

1.11 ACCURACY
TOLERANCES

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

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
 - .1 Proposed methodology and procedures for performing TAB if different from referenced standard.
 - .2 Proposed check lists and report forms.

1.14 PRELIMINARY TAB
REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 TAB REPORT

- .1 Format to be in accordance with referenced standard.

- .2 TAB report to show all results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 All reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30% of all reported results.
- .3 Number and location of verified results to be at discretion of Departmental Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.18 COMPLETION OF TAB

- .1 TAB to be considered complete only when final TAB Report received and approved by Departmental Representative.

1.19 AIR SYSTEMS

- .1 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, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .2 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of each damper, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At each controller, controlled device.
- .3 Locations of systems measurements to include, but not be limited to, following as appropriate: Each main duct, main branch, sub-branch, run-out (or

grille, register or diffuser).

- 1.20 HYDRONIC SYSTEMS .1 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: Flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power voltage, noise, vibration.
- .2 Locations of equipment measurement: To include, but not be limited to, following as appropriate:
- .1 Inlet and outlet of each heat exchanger (primary and secondary sides), boiler, chiller, coil, humidifier, cooling tower, condenser, pump, PRV, control valve, other equipment causing changes in conditions.
- .2 At each controller, controlled device.
- .3 Locations of systems measurements to include, but not be limited to, following as appropriate: Supply and return of each primary and secondary loop (main, main branch, branch, sub-branch of all hydronic systems, inlet connection of make-up water.
- 1.21 DOMESTIC HWC SYSTEMS .1 Meet all requirements as specified for hydronic systems.
- .2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: Inlet and outlet of each heater, tank, pump, circulator, at each controller, controlled device.
- .3 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.
- 1.22 OTHER SYSTEMS .1 Plumbing systems:
- .1 Flush valves: adjust to suit project pressure conditions.
- .2 Pressure booster systems: test for capacity and pressures under all conditions and at all times.
- 1.23 OTHER TAB REQUIREMENTS .1 Refer to other mechanical specification sections for additional requirements.
- 1.24 POST- OCCUPANCY TAB .1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, in occupied areas.

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PART 2 - PRODUCTS

2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not used.

END OF SECTION

PART 1 - GENERAL

- 1.1 MINIMUM STANDARDS .1 Conform to or exceed Provincial Codes, Local Municipal By-Laws, all codes of utility authorities having jurisdiction.
- 1.2 REFERENCES .1 Material and installation standards:
.1 ASTM B209-10, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
.2 ASTM C547-11, Standard Specification for Mineral Fiber Pipe Insulation.
.3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
.4 CAN/ULC-S702-09, Standard for Mineral Fiber Thermal Insulation for Buildings.
- 1.3 PRODUCT DATA SHEETS .1 Submit product data sheets and installation instructions in accordance with Section 01 11 00, 01 33 00 and 01 78 00.

PART 2 - PRODUCTS

- 2.1 THERMAL INSULATION AND JACKETING .1 Insulate heating and cooling piping with 25 mm thick rigid mineral fibre sleeving and factory applied all service jacket.
- .2 Fastenings: use self-adhesive tape rated <25 for flame spread, and <50 for smoke development.
- .3 Provide canvas cover over insulated piping in exposed areas. Canvas cover to be compact, firm, ULC listed heavy plain weave, cotton fabric at 220 g/m². Provide two coats of diluted fire retardant lagging adhesive over canvas covering.
- .4 Provide polyvinyl chloride (PVC) cover over insulated piping in exposed areas:
.1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
.2 Colours: to match adjacent finish paint by Departmental Representative.
.3 Minimum service temperatures: -20°C.
.4 Maximum service temperature: 65°C.
.5 Moisture vapour transmission: 0.02 perm.
.6 Fastenings:
.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching colour.

- .5 Provide aluminum cover over insulated piping in exposed areas:
 - .1 To ASTM B209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: smooth.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .6 Provide weatherproofing for all outdoor pipe insulation. Apply two 3 mm thick coats of asphalt or vinyl mastic with glass reinforcing fibre between coats, lapping joints a minimum of 305 mm.
- .7 Make good all existing insulation where previously damaged by others or damaged by work under this Contract.
- .8 Fire rated duct wrap shall be 2 layers of 3M 15A with 2 hour fire resistance rating. Complete installation shall be in accordance with manufacturer's installation instructions and ULC.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install material in accordance with referenced standards and manufacturer's written instructions.

END OF SECTION

PART 1 - GENERAL

1.1 MINIMUM STANDARDS .1

Conform to or exceed:

- .1 Ontario Gas Utilization Code.
- .2 CSA Standards.
- .3 ASME Boiler and Pressure Vessel Code 2010.
- .4 ASHRAE Standards.
- .5 Provincial Codes, Local Municipal By-Laws, all codes of utility authorities having jurisdiction.

1.2 REFERENCES .1

Material and installation standards:

- .1 CAN/CSA-B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.
- .2 CSA-B51S1-05, Supplement No. 1 to CSA-B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.
- .3 CAN/CSA-B52-05, Mechanical Refrigeration Code.
- .4 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.
- .5 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Coupling.
- .6 ASTM A53-10/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .7 ASTM A516/A516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate-and Lower- Temperature Service.
- .8 ASTM B209-10, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .9 ASTM C547-11, Standard Specification for Mineral Fiber Pipe Insulation.
- .10 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .11 ASME B16.1-2010, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- .12 ASME B16.3-2011, Malleable-Iron Threaded Fittings: Classes 150 and 300.
- .13 ASME B16.5-2009, Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 Metric/Inch Standard.
- .14 ASME B16.9-2007, Factory Made Wrought Butt welding Fittings.
- .15 CAN/CGSB-14.4-M88, Thermometers, Liquid- in-glass, Self-indicating Commercial/Industrial Type.
- .16 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

1.3 SHOP DRAWINGS AND .1
PRODUCT DATA SHEETS

Submit shop drawings and product data sheets in accordance with Sections 01 11 01, 01 33 00, 01 78 00 and 23 05 00 for the following:

- .1 Diaphragm type expansion tank.
- .2 Glycol mixing and fill equipment.

- .3 Pressure reducing valve.
- .4 Backflow preventer.
- .5 Pumps.
- .6 Chemical pot feeder.

PART 2 - PRODUCTS

2.1 HEATING AND COOLING PIPING AND FITTINGS

- .1 Pipe: black steel, schedule 40 to ASTM A53/A53M.
- .2 Pipe joints:
 - .1 Size NPS 2 and smaller: screwed fittings with teflon tape.
 - .2 Size NPS 2-1/2 and larger: welded fittings and flanges to ASME B16.5.
 - .3 Roll grooved: mechanical coupling to CSA B242.
- .3 Fittings:
 - .1 Malleable iron screwed fittings: Class 150 to ASME B16.3.
 - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
 - .3 Steel butt-welding fittings: to ASME B16.9.
 - .4 Unions: malleable iron to ASME B16.3.
- .4 Ream pipes and tubes. Hammer and clean scale and dirt, inside and outside, before assembly.

2.3 HEATING AND COOLING VALVES

- .1 Gate valve size NPS 2 and smaller: Class 125, 860 kPa screwed, bronze body, solid wedge disc and rising stem.
- .2 Globe valve size NPS 2 and smaller: Class 150, 1 MPa screwed, bronze, screwed over bonnet, renewable composition disc.
- .3 Globe valve size NPS 2-1/2 and larger: Class 125, 860 kPa, FF flange, cast iron body, bronze trim, OS&Y, bolted bonnet, bronze disc and seat ring.
- .4 Butterfly valve size NPS 2-1/2 to NPS 5: Class 150, 1 MPa WOG water, cast iron body with bronze disc and stainless steel stem, replaceable EPT-Nordel rubber seat lug wafer body, locking handle.
- .5 Suction guide: pump fitting combination 90° elbow, stainless steel in-line strainer, reducing elbow, flow stabilizing outlet guide vanes.
- .6 Swing check valve size NPS 2 and smaller: Class 125, 860 kPa, bronze body, screwed ends, swing disc, screw in cap, bronze disc, regrindable seat.

- .7 Swing check valve size NPS 2-1/2 and larger:
Class 125, 860 kPa cast iron body, FF flanged,
regrindable renewable seat, bronze disc, bolted
cap.
- .8 Silent check valve size NPS 2 and smaller:
Class 125, 860 kPa, cast steel, wafer style, brass
seatings, brass inner valve, stainless steel spring
with heavy duty spring in vertical down flow
application.
- .9 Silent check valve size NPS 2½ and larger;
Class 125, 860 kPa, cast steel, wafer style, bronze
trim, stainless steel spring with heavy duty spring
in vertical down flow application.
- .10 Lubricated plug cocks NPS 2 and smaller: Class 150,
1 MPa, bronze body.
- .11 Balancing valve: Dynamic balance valves to be
isolation "Y" type complete with integral isolation
valve, strainer and flow control cartridge.

2.4 PIPE SLOPE

- .1 Slope water piping up in direction of flow 1:500.
- .2 Slope horizontal water drainage piping down in
direction of flow 1:240 minimum.

2.5 PIPE VENTING

- .1 Make reductions in water piping with eccentric
reducing fittings so that air cannot collect in
piping except at air vents and air separators.
- .2 Provide, at high points on lines and on equipment
connections and as indicated, collecting chambers
and high capacity float operated automatic air
vents.
- .3 Automatic air vents:
 - .1 Standard float vent with brass body and
NPS 1/8 connection and rated at 690 kPa
working pressure.
 - .2 Float: solid material suitable for 115°C
working temperature.
- .4 Provide where indicated in-line air separator
approved by ASME for 860 kPa working pressure.

2.6 STRAINERS

- .1 Provide strainers ahead of each pump, each
automatic control valve (except radiation) and as
indicated.
- .2 Install in horizontal or down flow lines. Ensure
clearance for removal of basket.

- .3 Strainers:
 - .1 Body: "Y" type, cast iron, semi-steel or bronze.
 - .2 Screen: stainless steel.
 - .3 Ends: threaded for sizes NPS 2 and smaller, flanged for sizes over NPS 2.
 - .4 Working pressure: 860 kPa.

2.7 THERMOMETERS AND PRESSURE GAUGES

- .1 Thermometers:
 - .1 To CAN/CGSB-14.4-M88, industrial, variable angle, liquid filled, 175 mm scale length, direct reading.
 - .2 Thermometer wells to be brass or stainless steel.
 - .3 Install in supply and return water piping of central system air heating and cooling coils, heat exchangers.
- .2 Pressure gauges:
 - .1 100 mm dial, 1/2 of 1% accuracy, bronze stop cock, snubber for pulsating action, compound type for pump suction; direct reading. Select ranges so normal operating pressure is at mid-scale.
 - .2 Install in supply and return water piping of air heating and cooling coils, water chillers, heat exchangers, in pump suction and discharge; pressure reducing valves.

2.8 DIAPHRAGM TYPE EXPANSION TANK

- .1 Vertical, cylindrical galvanized steel pressurized diaphragm type expansion tank.
- .2 Capacity and size as indicated on the drawings.
- .3 Diaphragm sealed in EPDM suitable for 115°C operating temperature and glycol system.
- .4 Working pressure: 860 kPa with ASME stamp and certification.
- .5 Air precharged to 248 kPa (initial fill pressure of system).

2.9 GLYCOL MIXING AND FILL EQUIPMENT

- .1 Provide automatic glycol mixing and fill equipment.
- .2 Fill pump to be manufactured by Axiom Industries Model P-CSR-107 complete with mix tank, pump, lid, fill assembly, pressure tank, pressure switch, gauges and adjustable discharge pressure regulator.
- .3 Mix tank shall be plastic 208 L capacity.

2.10 IN-LINE STANDARD .1
DUTY CIRCULATING PUMPS

Construction:

- .1 Volute: cast iron radially split, with tapped openings for gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: non-ferrous.
- .3 Shaft: stainless steel shaft and sleeve.
- .4 Seal assembly: mechanical for normal hot water application to 135°C.
- .5 Coupling: flexible rigid self-aligning.
- .6 Motor: resilient mounted, drip proof, sleeve bearing.

.2 Capacity and size: as indicated.

.3 Ensure pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

2.11 SINGLE SUCTION .1
CENTRIFUGAL PUMPS

Construction:

- .1 General: bronze fitted pump complete with motor.
- .2 Base: fabricated steel.
- .3 Shaft: alloy steel with two point support, machined shoulders for ball bearing mounting.
- .4 Impeller: bronze enclosed type, keyed drive with locking nut or screw.
- .5 Volute: cast iron radially split, end suction, flanged suction and discharge, with drain plug, vent cock, suction and discharge pressure tapplings, mechanical seal, oil lubricated.
- .6 Coupling: flexible self-aligning.
- .7 Motor: EEMAC Class B, squirrel cage induction, 1725 r/min. continuous duty, drip proof, ball bearing, maximum temperature rise 50°C.

.2 Capacity and size: as indicated.

.3 Provide templates for anchor bolt placement. Furnish anchor bolts with sleeves. Place level, shim unit and grout. Align coupling. Check rotation prior to starting up. Check oil level and lubricate.

.4 Ensure pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

.5 Pipe drain tapping to floor drain.

2.12 CHEMICAL POT .1
FEEDER

Pot feeder: malleable cast iron closed container with built-in screen and venturi, ASME rated working pressure of 1200 kPa minimum, having

capacity of 7.5 L with NPS 3/4 inlet and outlet connections.

2.13 THERMAL INSULATION AND JACKETING

- .1 Insulate heating and cooling piping with 25 mm thick rigid mineral fibre sleeving and factory applied all service jacket.
- .2 Fastenings: use self-adhesive tape rated <25 for flame spread, and <50 for smoke development.
- .3 Provide canvas cover over insulated piping in exposed areas. Canvas cover to be compact, firm, ULC listed heavy plain weave, cotton fabric at 220 g/m². Provide two coats of diluted fire retardant lagging adhesive over canvas covering.
- .4 Make good all existing insulation where previously damaged by others or damaged by work under this Contract.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install material and equipment in accordance with referenced standards and manufacturer's written instructions.

3.2 FLUSHING AND CHEMICAL CLEANING

- .1 Provide flushing and chemical cleaning of the following items to remove dirt, sludge, oil, grease and other foreign material:
 - .1 Boilers.
 - .2 Chillers.
 - .3 Entire heating water piping system.
 - .4 Entire cooling water piping system.
- .2 Use qualified water treatment company to furnish a copy of recommended cleaning or boil-out procedures and cleaning chemicals for review by the Departmental Representative.
- .3 Flushing and cleaning shall be under the strict supervision of the water treatment company. Submit report certified by the water treatment company that the recommended cleaning procedures have been followed and that adequate cleaning of the boilers and entire heating water system has been provided.
- .4 The completion of flushing and cleaning shall be subject to the inspection and approval of the Departmental Representative. Give forty-eight (48) hours advance notice of date when it will be ready for inspection. Drain entire heating water system and remove boiler cover plates before inspection is conducted.

3.3 FILLING OF
HYDRONIC SYSTEMS

- .1 Refill systems with clean soft water adding water treatment as required.
- .2 Charge glycol systems with glycol solution of 50/50% ethylene by weight with inhibitor for both testing and final operation.

3.4 BALANCING

- .1 Use qualified personnel and approved instruments to balance each hydronic system.
- .2 Submit water balancing report showing measurements of flow, pressure and temperature at location of inlet and outlet of each:
 - .1 Heat exchanger.
 - .2 Coil.
 - .3 Boiler.
 - .4 Chiller.
 - .5 Pump.
 - .6 Wall fin or cabinet convector.
 - .7 Unit heater.
 - .8 Fan coil unit.
- .3 Provide all fittings and take-off points for balancing.
- .4 Permissible deviation from design quantities shall be 10%.
- .5 Balance hydronic systems including low pressure hot water heating, chilled water, condenser water, glycol systems.
- .6 Standard: testing, adjusting and balancing (TAB) to be to most stringent of TAB standards of ASHRAE.
- .7 Do TAB of all hydronic systems.
- .8 Qualifications: personnel performing TAB to be current member in good standing of NEBB or NBCTA.
- .9 Quality assurance: perform TAB under direction of supervisor qualified by NEBB or NBCTA.
- .10 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: Flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power voltage, noise, vibration.
- .11 Locations of equipment measurement: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of each heat exchanger (primary and secondary sides), boiler, chiller, coil, humidifier, cooling tower, condenser, pump, PRV, control valve, other

- equipment causing changes in conditions.
- .2 At each controller, controlled device.
- .12 Locations of systems measurements to include, but not be limited to, following as appropriate: Supply and return of each primary and secondary loop (main, main branch, branch, sub-branch of all hydronic systems, inlet connection of make-up water.

END OF SECTION

PART 1 - GENERAL

- 1.1 MINIMUM STANDARDS .1 Conform to or exceed:
- .1 CSA Standards.
 - .2 ASHRAE Standards.
 - .3 SMACNA Standards.
 - .4 Provincial Codes, Local Municipal By-Laws, all codes of utility authorities having jurisdiction.
- 1.2 REFERENCES .1 Material and installation standards:
- .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2006.
 - .2 SMACNA Duct Leakage Test Manual 1985.
 - .3 NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems.
 - .4 CAN/ULC-S110-07, Standard Methods of Test for Air Ducts.
 - .5 CAN/ULC-S112-10, Standard Method of Fire Test of Fire Damper Assemblies.
 - .6 CAN/ULC-S702-09, Standard for Mineral Fibre Thermal Insulation for Buildings.
 - .7 CAN/CSA-B52-05(R2009), Mechanical Refrigeration Code.
 - .8 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.
 - .9 CGSB 51-GP-52Ma-89, Vapour Barrier Jacket and Facing Material.
 - .10 ASTM A653-10/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvanealed) by the Hot-Dip Process.
 - .11 ASTM B209-10, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - .12 ASTM B280-08, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - .13 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .14 ASTM C518-10, Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - .15 ASTM C534-08/534M-08, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - .16 ASTM C547-11, Standard Specification for Mineral Fiber Pipe Insulation.
 - .17 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .18 ASTM C919-08, Standard Practice for Use of Sealants in Acoustical Applications.
 - .19 ASTM C1071-05e1, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

- .20 ASTM F683-10, Standard Practice for Selection and Application of Thermal Insulation for Piping and Machinery.
- .21 ASTM G21-09, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .22 ASTM G22-76(1996), Standard Practice for Determining Resistance of Plastics to Bacteria.

1.3 SHOP DRAWINGS AND .1
PRODUCT DATA SHEETS

- Submit shop drawings and product data sheets in accordance with Sections 01 11 00, 01 33 00, 01 78 00 and 23 05 00 for the following:
- .1 Fire dampers.
 - .2 Motorized dampers.
 - .3 Air intake louvres.
 - .4 Roof-mounted exhaust fans.
 - .5 Controls and instrumentation.

PART 2 - PRODUCTS

2.1 LOW PRESSURE
DUCTWORK

- .1 Material: forming steel FS Type A steel with Z275 designation zinc coating to ASTM A653/A653M, minimum 30% recycled content.
 - .1 Exhaust ductwork, fittings, balance dampers, backdraft dampers, etc. shall be 316 galvanized steel minimum 16 gauge all joints, seams, butt connections, etc. shall be welded.
- .2 Gauge and construction of ducts and fittings shall be in accordance with SMACNA HVAC Duct Construction Standards for rectangular ducts for positive and negative static pressure up to 500 Pa with leakage rate of 5% maximum.
- .3 Seal classification: All longitudinal and transverse joints and connections made airtight with sealant.
- .4 Hangers:
 - .1 Ducts shall be supported with 10 mm steel rods and 50 x 50 x 6 mm angles. Maximum spacing of hangers to be 2.5 m.
 - .2 Hanger attachments: manufactured concrete inserts, expansion shields and bolted steel clamps. Do not weld rods to steel deck or use powder actuated fasteners.
 - .3 All ductwork supports, fasteners, etc. in storage rooms shall be stainless steel.
- .5 Radius of duct elbow shall be at least equal to the width of the elbow. Use square elbow with double thickness turning vanes when space is limited.

- .6 Provide balancing dampers at all branch ducts and as indicated. Each damper shall be fitted with locking type quadrant operator.
- .7 Duct leakage: in accordance with SMACNA HVAC Duct Leakage Test Manual.
- .8 Applications: supply air ducting downstream of VAV boxes, all exhaust air ducting, and all return air ducting.

2.2 FLEXIBLE DUCTWORK

- .1 Factory fabricated Class 1 air duct to CAN/ULC-S110. Flame spread rating not to exceed 25 and smoke developed rating not to exceed 50.
- .2 Duct must withstand 2.5 kPa internal pressure.
- .3 Material: triple lock flexible aluminum.
- .4 Support flexible ducts at 1.2 m centres. Do not lay ducts across any lighting fixtures or hot surfaces.
- .5 Maximum length of flexible duct connections: 1 m.
- .6 Make connections between flexible duct and terminal devices airtight with duct sealer.

2.3 ACOUSTIC DUCT LINING

- .1 Except noted otherwise, provide 25 mm thick rigid fibrous glass duct liner to ASTM C1071, density 48 kg/m³, with neoprene coating on air side.
- .2 For supply air ducting downstream of humidifier provide rectangular duct liner: 25 mm thick meeting ASTM C1071 with air surface coated with acrylic coating treated with EPA register anti-microbial agent proven to resist microbial growth as determined by ASTM G21 and ASTM G22.
 - .1 'ksi' Value: ASTM C518, 0.036 at 24°C.
 - .2 Noise reduction coefficient: .65 or higher based on "Type A mounting" and tested in accordance to ASTM C423.
 - .3 Maximum velocity: 25.4 m/sec.
 - .4 Adhesive: meeting ASTM C919.
 - .5 Fasteners: duct liner galvanized steel pins, welded or mechanically fastened.
- .3 Fasten duct liner to interior sheet metal surfaces with 100% coverage of an approved fire resistant bonding adhesive. Ductwork with any side greater than 300 mm shall have additional mechanical fasteners spaced at not more than 300 mm centres.
- .4 Seal edges, pin penetrations and joints with an approved fire resistant mastic. Protect leading and

trailing edges with sheet metal edging.

- .5 Flame spread rating on interior lining shall not exceed 25, smoke development shall not exceed 50.
- .6 Duct sizes indicated on the drawing are sizes of inside liner. Increase sheet metal sizes to suit.

2.4 DUCT SEALANTS AND TAPES

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of -30°C to +93°C.

2.5 DUCT ACCESS DOORS

- .1 Provide for access to fire or other dampers and for service or inspection, and for cleanouts where required, panel type access doors, 300 x 300 mm unless otherwise stated, complete with two sash locks.

2.6 BALANCING DAMPERS

- .1 Approved units of thicknesses and type of construction in accordance with SMACNA HVAC Duct Construction Standards or as noted.
- .2 Splitter dampers: where indicated with control rod with locking device on exterior of duct. Damper to be single thickness one gauge heavier than duct.
- .3 Single blade butterfly dampers: where indicated with locking quadrant.
 - .1 Round butterfly dampers to be 1.6 mm thick in medium pressure ducts and 0.8 mm in low pressure ducts.
 - .2 Rectangular butterfly dampers to thicknesses indicated in SMACNA.
- .4 Multi-leaf opposed blade dampers: designed to SMACNA details with locking quadrant.

2.7 FIRE DAMPERS

- .1 Fire dampers: listed and bear label of ULC, and shall meet requirements of Federal Fire Commissioner (FFC), CAN/ULC-S112 "Test of Fire Damper Assemblies", and authorities having jurisdiction.
- .2 Factory fabricated for fire rating requirement to maintain integrity of membrane being pierced.
- .3 Fire dampers shall be single-blade, multi-blade or curtain type, sized to maintain full flow cross section as indicated.
- .4 Complete with frame and 40 x 40 x 3 mm steel angle on full perimeter of frame on both sides of barrier being pierced.

- .5 Provide at each fire damper an access door for access to fusible links.
- .6 Follow NFPA 90A and manufacturer's installation instructions including the installation of drywall filler pieces when installed in a gypsum board wall.

2.8 ROOF-MOUNTED EXHAUST FANS

- .1 Provide CSA approved and labelled roof-mounted exhaust fans of capacities and performance as indicated on the drawings.
- .2 Exhaust fans shall be belt-driven centrifugal type complete with spun aluminum housing, centrifugal wheel, aluminum birdscreen, backdraft damper, unit-mounted disconnect switch. See drawings for sound ratings.

2.9 AUTOMATIC CONTROLS

- .1 Refer to Section 25 00 00, Automatic Controls System.

2.10 THERMAL INSULATION AND JACKETING

- .1 Insulate all supply air ducting outside air intake ducting, all exhaust air ducting from fan to exhaust louvre, all return air ducting in Mechanical rooms.
- .2 Material:
 - .1 On exposed rectangular ducting: 25 mm thick rigid mineral glass fibre board to ASTM C612-04e1 and vapour barrier jacket to CGSB 51-GP-52Ma.
 - .2 On concealed rectangular ducting: 25 mm thick glass fibre blanket to CAN/ULS-S702 and vapour barrier jacket to CAN/CGSB 51-GP-52Ma. 25 mm thick rigid mineral glass fibre board to ASTM C612-04e1 and vapour barrier jacket to CGSB 51-GP-52Ma.
 - .3 On round ducting: 25 mm thick glass fiber blanket to CAN/ULS-S702 and vapour barrier jacket to CGSB 51-GP-52Ma.
- .3 Fastenings on rectangular ducts:
 - .1 Use 50% coverage of insulation adhesive. Flame spread 15, smoke development 0.
 - .2 If duct is over 635 mm wide, provide weld pins in addition to insulation adhesive. Place weld pins at not more than 200 mm centres, and not less than 2 rows per side.
- .4 Fastenings on round ducts: Use 100% coverage of insulation adhesive of flame spread 15, smoke development 0, and 100 mm wide self-adhesive tape rated under 25 for flame spread and under 50 for smoke development.

- .5 Vapour barriers: Use quick-setting adhesive for joints and lap sealing of vapour barriers. Flame spread 10, smoke development 0.
- .6 Vapour barriers and insulation to be complete over the full length of duct or surface, without penetration for hangers, standing duct seams and without interruption at sleeves.
- .7 Provide canvas cover over all insulated ducts in exposed areas. Canvas cover to be compact, firm, ULC listed heavy plain weave, cotton fabric at 272 g/m². Provide two coats of diluted fire retardant lagging adhesive over canvas covering.
- .8 Provide weatherproofing for all outdoor duct insulation. Apply two 3 mm thick coats of asphalt or vinyl mastic to external type duct insulation, with a glass reinforcing fibre between coats lapping joints a minimum of 305 mm. Secure 10 mm thick plywood over all horizontal ducts exposed to weather, and cover plywood with sheet metal. Turn over all edges.
- .9 Provide weatherproofing for all outdoor duct insulation. Aluminum:
 - .1 To ASTM B209 with moisture barrier.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Smooth.
 - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.
 - .1 Stainless steel, type: 316.

PART 3 - EXECUTION

3.1 EXISTING AND REUSED CONTROLS

- .1 Recalibrate and test existing and reused control devices shown on the drawings.
- .2 Report any inoperative control device to Departmental Representative immediately and obtain Departmental Representative's instructions.

3.2 INSTALLATION

- .1 Install material and equipment in accordance with referenced standards and manufacturer's written instructions.
- .2 Make good all existing insulation where previously damaged by others or damaged by work under this contract.

3.3 AIR BALANCING

- .1 Use qualified personnel and approved instruments to balance each air system to air flow rates specified on the drawings.

- .2 Standard: Testing, Adjusting and Balancing (TAB) to be to most stringent of this section or TAB standards of ASHRAE.
- .3 Do TAB of all air systems.
- .4 Qualifications: personnel performing TAB to be current member in good standing of NEBB.
- .5 Quality assurance: Perform TAB under direction of supervisor qualified by NEBB.
- .6 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, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .7 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of each damper, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At each controller, controlled device.
- .8 Locations of systems measurements to include, but not be limited to, following as appropriate: Each main duct, main branch, sub-branch, run-out (or grille, register or diffuser).
- .9 Permissible deviation from design air quantities shall be 5%.
- .10 Permanently mark settings of all splitters, dampers and other adjustment devices.
- .11 For additional requirements refer to Sections 23 05 00, Section 23 05 93.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 National Fire Prevention Association (NFPA)
 - .1 NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. WITHDRAWN
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type (Reaffirmed April 1985).
 - .3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type (Reaffirmed April 1985).
 - .4 CAN/CGSB-115.13-85, Filter Media, Automatic Roll (Reaffirmed April 1985).
 - .5 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .6 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .7 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems.
 - .8 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
 - .9 CAN/CGSB-115.20-95, Polarized Media Air Filter.
- .4 Underwriters' Laboratories of Canada
 - .1 ULC-S111-07, Standard Method of Fire Tests for Air Filter Units.
 - .2 ULC-S649-06, Grease Filters for Commercial and Institutional Kitchen Exhaust Systems.

1.2 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawing and product data in accordance with Section 01 33 00.

1.3 CLOSEOUT
SUBMITTALS

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

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|--------------------------------------|----|--|
| <u>1.4 MAINTENANCE
MATERIALS</u> | .1 | Provide maintenance materials in accordance with Section 01 78 00. |
| | .2 | Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual. |

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| <u>1.5 EXTRA MATERIALS</u> | .1 | Spare filters: in addition to filters to be installed immediately prior to acceptance by Departmental Representative, supply 2 complete sets of filters for each filter unit or filter bank in accordance with section 01 78 00. |
|----------------------------|----|--|

PART 2 - PRODUCTS

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|--------------------|----|---|
| <u>2.1 GENERAL</u> | .1 | Media: suitable for air at 100% RH and air temperatures between minus 40 and 50°C. |
| | .2 | Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated. |
| | .3 | Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule. |

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|------------------------|----|---|
| <u>2.2 ACCESSORIES</u> | .1 | Holding frames: permanent channel section construction of same material as casing/hood, 1.6 mm thick, except where specified otherwise. |
| | .2 | Seals: to ensure leakproof operation. |
| | .3 | Blank-off plates: as required, to fit all openings and of same material as holding frames. |
| | .4 | Access and servicing: through doors/panels on each side. |

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|-------------------------------------|---|--|----|---|----|--|
| <u>2.3 COTTON PANEL
FILTERS</u> | .1 | Disposable pleated reinforced cotton dry media: to CAN/CGSB-115.18. | | | | |
| | .2 | Holding frame: slide in channel for side access. | | | | |
| | .3 | Performance: <table> <tr> <td>.1</td> <td>Average atmospheric dust spot efficiency MERV8 (30-35%) to ASHRAE 52.1.</td> </tr> <tr> <td>.2</td> <td>Average synthetic dust weight arrestance 92% to ASHRAE 52.1.</td> </tr> </table> | .1 | Average atmospheric dust spot efficiency MERV8 (30-35%) to ASHRAE 52.1. | .2 | Average synthetic dust weight arrestance 92% to ASHRAE 52.1. |
| .1 | Average atmospheric dust spot efficiency MERV8 (30-35%) to ASHRAE 52.1. | | | | | |
| .2 | Average synthetic dust weight arrestance 92% to ASHRAE 52.1. | | | | | |

- .4 Fire Rated: to ULC-S111.
- .5 Nominal thickness: 25 mm.
- .6 Acceptable material: EN779i2012 efficiency 64, final pressure drop 250 Pa, rigid water resistant cardboard, fully supported media bonded onto a wire support grid, diagonal stiffener, rounded pleats.

2.4 FILTER GAUGES - DIAL TYPE

- .1 Diaphragm actuated, direct reading.
- .2 Range: 0 to 2 times initial pressure.

2.5 FILTER GAUGES - MANOMETER TYPE

- .1 Inclined acrylic tube.
- .2 Complete with levelling screws.
- .3 Range: 0 to 2 times initial pressure.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.2 ACTIVATED CARBON TYPE FILTERS

- .1 During testing, adjusting and balancing, install substitute media.
- .2 Install permanent media only after all painting is completed.

3.3 REPLACEMENT MEDIA

- .1 Replace all media with new upon acceptance.

3.4 FILTER GAUGES

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED
REQUIREMENTS

- .1 Section 23 20 00.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Boiler and Pressure Vessel Code, 2010.
- .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada For New Construction and Major Renovations 2009.
 - .2 LEED Canada For Core and Shell 2009.
- .3 CSA International
 - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 ADMINISTRATIVE
REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section and on-site installation, with Contractor's Representative and Departmental Representative in accordance to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.

1.4 ACTION AND
INFORMATIONAL
SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for heat exchangers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Shop drawings to indicate project layout, including layout and dimensions of heat exchangers and system.

- .1 Indicate manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.
 - .4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .6 Manufacturer's Instructions: submit manufacturer's installation instructions.
 - .7 Manufacturers Reports:
 - .1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.
- 1.5 CLOSEOUT SUBMITTALS
 - .1 Submit in accordance with Section 01 78 00.
 - .2 Operation and Maintenance Data: submit operation and maintenance data for heat exchangers for incorporation into manual.
- 1.6 MAINTENANCE MATERIAL SUBMITTALS
 - .1 Extra Stock Materials:
 - .1 Submit in accordance with Section 01 78 00.
- 1.7 DELIVERY, STORAGE AND HANDLING
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect heat exchangers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Plate Heat Exchanger:
 - .1 Water to glycol.
 - .1 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code CSA B51 and provincial pressure vessel regulations.
 - .2 Frames: carbon steel with baked epoxy enamel paint, stainless steel side bolts and shroud.
 - .3 Plates: type 316 stainless steel.
 - .4 Gaskets: as recommended by manufacturer to suit fluid temperature.
 - .5 Supports: as indicated.
 - .6 Piping connections: as indicated.
 - .7 Capacity: as indicated.
 - .1 Primary: water: 0.428 L/s 82.2 degrees C to 60 degrees C. Pressure drop: 11.23 kPa.
 - .2 Secondary: 0.4725 L/s, 35 degrees C to 57.22 degrees C. Pressure drop: 13.78 kPa.
 - .8 Dimensions: as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for heat exchanger installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.
- .3 Tube in shell heat exchangers: arrange piping so that tube bundle can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.

- .4 Plate exchangers: install in accordance with manufacturer's recommendations.

3.3 APPURTENANCES

- .1 Install with safety relief valve.
- .2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Perform tests as directed by Departmental Representative to ensure heat exchangers are functional.
 - .2 Obtain reports within 3 days of review and submit immediately to Departmental Representative.
- .2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
- .3 Manufacturer's Field Services:
 - .1 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .2 Ensure manufacturer's representative is present before and during testing.
 - .3 Schedule site visits:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.

3.5 SYSTEM START-UP

- .1 General: perform start-up operations in accordance with contract documents and manufacturer's recommendations.
- .2 Check heater for cleanliness on primary and secondary sides.
- .3 Check water treatment system is complete, operational and correct treatment is being applied.
- .4 Check installation, settings, operation of relief valves and safety valves.
- .5 Check installation, location, settings and operation of operating, limit and safety controls.
- .6 Check supports, seismic restraint systems.

- .7 General: perform performance verification as per design conditions listed.
- .8 Timing: only after TAB of hydronic systems have been successfully completed.
- .9 Primary side:
 - .1 Measure flow rate, pressure drop, and water temperature at heater inlet and outlet.
 - .2 Control valve: verify proper operation without binding, slack in components. Measure pressure and temperature at control valve inlet or if control is three-port type, pressure drop across inlet to common, bypass to common, inlet to bypass.
 - .3 Secondary side:
 - .1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.
 - .2 Verify installation and operation of air elimination devices.
 - .4 Calculate heat transfer from primary and secondary sides.
 - .5 Simulate heating water temperature schedule and repeat above procedures.
 - .6 Verify settings, operation, safe discharge from safety valves and relief valves.
 - .7 Verify settings, operation of operating, limit and safety controls and alarms.
 - .8 Provide all test data for inclusion in the O&M manuals.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

3.7 DEMONSTRATION

- .1 Training: provide training in accordance with Section 01 79 00, supplemented as follows:

3.8 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by heat exchanger installation.

END OF SECTION