GENERAL MECHANICAL PROVISIONS

1. GENERAL

1.1 Intent

.1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.

.2 Contract documents and drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.

.3 Mechanical contractor to supply all labour, materials, equipment and services required for complete safe installation of mechanical work in accordance with the intent of this specification and as shown on the drawings.

.4 Follow manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

.5 Install equipment generally in locations and routes shown. Run piping and ductwork close to building structure, parallel to building lines to maximize headroom and with minimum interference with other services and free space. Remove and replace improperly installed equipment to satisfaction of the Contract Administrator at no extra cost.

.6 Install equipment to provide access and ease of maintenance.

.7 Connect to equipment specified in other Sections and to equipment supplied and installed by others or by the City. Uncrate equipment, move in place and install complete; start-up and test.

.8 Install control valves, control dampers, thermal wells, and other devices on piping and ducts supplied under this contract.

1.2 Coordination of Work

.1 Cooperate and coordinate with other trades on the project.

.2 Make reference to electrical, mechanical, structural and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.

.3 Verify space and headroom limitations for work to be installed.

.4 Where dimensional details are required, work with the applicable architectural and structural drawings.

1.3 Permits

.1 Contractor shall arrange for inspections of the work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.

1.4 Examination of Site

.1 Before submitting tender, visit and examine the site and note all characteristics and features affecting the work. No allowances will be made for any difficulties encountered or any expenses incurred because of any conditions of the site or item existing thereon, which is visible or known to exist at the time of tender.

.2 Claims for extra compensation will not be entertained for any arising work which would reasonably have been ascertained by the site visit.

1.5 Quality of Work

.1 All work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Contract Administrator.

.2 Work which does not conform to standards accepted by the Contract Administrator and the trade may be rejected by the Contract Administrator. The Contractor shall redo rejected work to the accepted standard at no cost to the City.

1.6 References

.1 Conform to all referenced codes and standards to their latest edition.

1.7 Metric Conversion

.1 All units in this division are expressed in SI units.

.2 Submit all shop drawings and maintenance manuals in SI units.

.3 On all submittals (shop drawings etc.) use the same SI units as stated in the specification.

.4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:

.1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment and piping.

.2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

mm (in. NPS)	mm (in. NPS)	mm (in. NPS)
3 (1/8)	65 (2½)	375 (15)
6 (1/4)	65 (2½)	450 (18)
10 (3/8)	75 (3)	500 (20)
15 (1/2)	100 (4)	600 (24)
20 (3/4)	125 (5)	750 (30)
25 (1)	150 (6)	
30 (1¼)	200 (8)	
40 (1½)	250 (10)	
50 (2)	300 (12)	

.5 Metric Duct Sizes:

.1 The Metric duct sizes are expressed as 25 mm = 1 inch.

1.8 Alternate Materials and Equipment

.1 The price submitted for this contract shall be based on the use of materials and equipment as specified or as contained within the Acceptable Manufacturers List.

.2 Requests for approval for tendering purposes of equivalent materials or equipment shall be submitted to the Contract Administrator no later than seven (7) working days prior to the closing date of tender for mechanical trade, complete with all applicable technical data, including performance curves and physical details. Approval of requests shall only be given by addendum.

.3 The Contractor shall, in his quotation, indicate the degree of approval obtained from the Contract Administrator. In the event that the product has been approved as "Alternate Only", this shall be stated in the quotation, and the Contractor shall bear any and all costs for design/system modifications to accommodate the “alternate” equipment.

.4 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, meet the space, capacity, and noise requirements outlined.

.5 The Contractor shall be fully responsible for any additional work or materials required by the trades or other contractors to accommodate use of other than specified materials or equipment. Extras will not be approved to cover such work.

1.9 Drawings and Specifications

.1 Drawings and specifications are complementary each to the other, and what is called for by one shall be binding as if called for by both.

.2 Should any discrepancy appear between drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of the plans and specifications, obtain a

ruling from the Contract Administrator, before submitting a tender. If this is not done, it will be assumed that the most expensive alternate had been included.

.3 Examine all contract documents, including all drawings and specifications, and work of other trades to ensure that work is satisfactorily carried out without changes to building.

1.10 Shop Drawings

.1 Submit detailed shop drawings for review in accordance with Section 01300.

.2 Identify materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalogue material. Do not assume applicable catalogues are available in the Contract Administrator's office. Maintenance and operating manuals are not suitable submittal material.

.3 Clearly mark submittal material using arrows, underlining or circling to show differences from specified, e.g. ratings, capacities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps seals materials or painting.

.4 Include weights, dimensional, and technical data sufficient to check if equipment meets requirements. Include wiring, piping, and service connection data and motor sizes. Provide centre of gravity diagrams for the use of the seismic Contract Administrator.

.5 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Contract Administrator.

.6 Do not order equipment or material until the Contract Administrator has reviewed and returned shop drawings.

.7 Prior to submission to the Contract Administrator, the Contractor shall review all shop drawings. By this review, the Contractor certifies that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data, and certifies that he has checked and coordinated each shop drawings with the requirements of the work of the contract documents. The Contractor's review of each shop drawing shall be indicated by stamp, date and signature of the Contractor's designated project manager.

1.11 Cutting, Patching and Coring

.1 Provide holes and sleeves, cutting and fitting required for mechanical work.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the Structural Contract Administrator before cutting or burning structural members.

.4 Provide openings and holes required in precast members for mechanical work. Cast holes 100 mm or larger in diameter. Field-cut smaller than 100 mm.

.5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

1.12 Excavation and Backfill

.1 Refer to requirements of Division 2.

.2 Provide all excavating to facilitate installation of the mechanical work, including shoring, pumping, 150 mm compacted sand bedding under and first 300 mm of compacted sand over piping and ducting.

1.13 Installation of Equipment

.1 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.

.2 Maintain permanent access to equipment for maintenance.

1.14 Fire-Stopping

.1 Fire-stop all pipe, duct, conduit and wire penetrations through floors and walls, designated as fire and/or smoke separations. The Contractor is required to coordinate with the architectural drawings to contractual rated wall types and installation details.

.2 Fire-stopping materials to meet ULC CAN 2S115. Acceptable Materials: "Tremco" or "National Firestopping", or Hilti CP680 Cast-in-Place Firestopping System.

.3 Preparation of surfaces and installation of fire-stopping materials shall be carried out as per manufacturer's instructions.

1.15 Connections to Existing Services

.1 Maintain liaison with the Contract Administrator and provide a schedule to interrupt, re-route or connect to water, sewer, heating, or gas systems, with minimum interruption of services.

.2 Major services shall not be interrupted before all preparatory work is completed and all required materials are on site. Provide a minimum of forty eight (48) hours notice for all service shutdown.

.3 Interruptions and shutdowns of existing services shall be by the City.

1.16 Equipment and Materials

.1 Materials and equipment installed shall be new, full weight and of quality specified.

.2 Each major component of equipment shall bear manufacturer’s name, address, catalogue and serial number in a conspicuous place.

.3 Where two or more products of the same type are required, products shall be of the same manufacturer.

1.17 Equipment Protection and Clean-Up

.1 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.

.4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.18 Electrical Motors

.1 Supply mechanical equipment complete with electrical motors.

.2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, Canadian Electrical Code Part 1, IEEE and ANSI. All motors to be CSA labelled. All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch. All motors intended for use with a variable speed drive shall be inverter duty rated.

.3 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.

.4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection.

.5 Motors less than 0.5 hp shall be 120 V, 60 Hz, 1 phase. Motors 0.5 hp and larger shall be 3 phase at the indicated voltage.

.6 All motors shall be 1800 rpm unless otherwise indicated.

.7 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.

.8 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.

.9 Refer to electrical specifications, Division 16, for voltage, frequency, and phase data. This shall take precedence over any reference in Division 15.

.10 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.

.11 Minimum certified motor efficiency shall be as outlined the following table, or premium efficiency, whichever is higher.

Minimum Efficiency (%) *

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1	75.5	82.5	80.0	74.0
1.5	82.5	84.0	85.5	77.0
2	84.0	84.0	86.5	82.5
3	85.5	87.5	87.5	84.0
5	87.5	87.5	87.5	85.5
7.5	88.5	89.5	89.5	85.5
10	89.5	89.5	89.5	88.5
15	90.2	91.0	90.2	88.5

(*) As defined in CSA C390 or IEEE 112B Nominal Standards

1.19 Access Doors

.1 Provide access doors for maintenance or adjustment purposes for all mechanical system components including:

- Valves
- Volume and splitter dampers
- Fire dampers
- Cleanouts and traps
- Controls, coils and terminal units
- Expansion joints
- Filters
- Strainers

.2 Steel frame access panel with stainless steel piano-type hinge, channel reinforced steel door panel, three "Symmons" fasteners per door. Door panel recessed to receive ceiling or wall material to give finished appearance showing only hinge and fasteners. Provide acoustic gasket between door panel perimeter and steel frame. Rated access doors shall be UL-listed.

.3 Sizes to be 200 mm x 200 mm for cleanout, 300 mm x 300 mm for hand 600 mm x 600 mm for body access minimum.

.4 Provide ULC-listed fire rated access doors installed in rated wall and ceilings.

1.20 Miscellaneous Metals

.1 Provide all necessary miscellaneous metals to hang or support materials, equipment and provide access for work under this contract.

.2 All miscellaneous metals shall be prime painted.

.3 Miscellaneous metals shall include but are not limited to:

.1 Hangers for equipment, piping and ductwork.

.2 Support for equipment.

1.21 Escutcheon and Plates

.1 Provide escutcheon and plates on piping and ductwork passing through finished walls, floors and ceilings.

.2 Escutcheons shall be split type, stainless or chrome plated steel.

1.22 Painting and Identification

.1 Coordinate colour coding of piping and equipment with work of Division 9.

.2 Colour code mechanical equipment, piping and exposed ductwork. Refer to colour coding schedule below.

.3 Legend and direction of flow arrows shall consist of adhesive backed labels, yellow colour, with minimum 20 mm high black lettering equal to Brady System B-500, vinyl cloth labels for non-insulated surfaces; and Brady B 946 for insulated surfaces.

.4 For colour coding for Medical Gas, refer to CSA Standard for Non-Flammable Medical Gas Piping Systems Z305.1.

.5 Identify piping with labels, colour bands, and flow arrows. Provide identification at 3 m maximum intervals, before and after pipes pass through walls, at all sides of tees, behind access doors and in equipment rooms as required.

.6 Apply colour bands at both ends of the label with primary colour bands used to secure both ends of individual labels. Refer to colour schedule at end of this section.

.7 Provide 20 mm diameter brass, with metal photo black numbers, or white lamacoid with black engraved numbers, secured to valve stem with key chain.

Provide neat, typewritten directories, giving valve number, services and location. Frame one copy under glass for wall mounting as directed, second copy to be forwarded to City. Include copies in O&M Manuals.

.8 Tag automatic controls, instruments and relays and match/key to control shop drawing identification numbers. Tag all equipment and control panels.

.9 Identify electric starting switches, thermostats controlling motors, remote push button stations, and controls equipment supplied under this division with lamacoid plates having 6 mm (1/4 in) minimum letter size. Identification to state equipment controlled.

.10 Identify the usage of duct access panels with self-adhesive Brady stick-on coloured labels. Apply labels conforming to the following schedule.

	Colour	Letters
Cleaning and service access	yellow	C.A.
Controls, including heat sensors	black	C.
Dampers (backdraft, balance and control)	blue	D.
Fire dampers	red	F.D.
Smoke dampers and detectors	red	S.D.

Note: Provide black lettering for yellow or white background, white for all other colours.

1.23 Colour Coding Schedule

.1 Colour numbers are called for in Canadian Government Specification No. 5-GP-1a. Colours assigned from CGSB 1-GP-12c for colour code identification.

MECHANICAL PRIMARY COLOURS FOR PIPE LINES/EQUIPMENT

1. Yellow..... 505-102
2. Light Blue 502-106
3. Green..... 503-107
4. Orange..... 508-102
5. Brown 504-103
6. Red..... 509-102
7. White..... 513-101
8. Aluminum 515-101
9. Purple 501-101
10. Grey 501-107

SECONDARY COLOURS FOR BANDS

1. Red..... 509-102
2. Orange..... 508-102
3. Blue..... 502-106

BANDING

1. Red.....To indicate extremely hazardous material

2. Orange.....To indicate mildly hazardous material
3. Blue.....To indicate non-hazardous material

.2 Identification Symbols and Colour for Piping

	Pipe Colour	**Stripe Colour**	**Symbol**
Condensate	Green	Orange	Cond.
Domestic Cold Water	Light Blue	None	Dom. Cold Wat.
Domestic Hot Water	Green	Orange	Dom. Hot Wat.
Drains	Aluminum	Red/Orange	Drain

.3 Identification Symbols and Colours for Equipment:

	Pipe Colour	**Stripe Colour**	**Symbol**
Fan Guards - Motor Guards	Red Machinery Enamel		
Hangers, Brackets, Hanger Rods	Black Machinery Enamel		
Heat Exchangers	Green	Orange	None
Pumps - Regular	Aluminum	None	None
Supports	Black	None	None
Tanks – Cold Water Storage	Green	Orange	Cool Water
Tanks – Hot Water (Insulated)	Green	Orange	None
Valves Uninsulated	High Heat Aluminum		

.4 Mechanical Control Systems

.1 Conduit pull boxes, terminal boxes and junction boxes - GREY Covers - GREY with black ‘C’.

.2 Main and secondary control panels, factory finish acceptable - control contractor to install company label to identify.

.5 Ductwork

All ductwork in mechanical rooms to be identified as follows, complete with directional arrows:

Return Air ..... R/A
Supply Air..... S/A
Outdoor Air..... O/A
Exhaust Air ..... EX/A

1.24 Temporary Heat

.1 Do not use the permanent system for temporary heating purposes without written permission from the Contract Administrator.

.2 Thoroughly clean and overhaul permanent equipment used during the construction period, replace worn or damaged parts before final inspection.

.3 Use of permanent systems for temporary heat shall not modify terms of warranty.

.4 Operate heating systems under conditions which ensure no temporary or permanent damage. Operate with proper safety devices and controls installed and fully operational. Operate systems only with treated water as specified.

.5 Air systems shall not be used for temporary heating.

.6 When permanent systems are used for temporary heat, provide alarm indicating system failure. Connect alarm to independent alarm company system.

.7 Where pumps are used for temporary heating, replace mechanical seals, regardless of condition, with new mechanical seals.

1.25 Temporary or Trial Usage

.1 Temporary or trial usage by the City or Contract Administrator of mechanical equipment supplied under contract shall not represent acceptance.

.2 Repair or replace permanent equipment used temporarily.

.3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

.4 Avoid thermal shock to heating system by coordination with the City during planning, construction and operation of temporary heating system.

1.26 Acceptable Manufacturers/Suppliers and Agencies

.1 The following listed manufacturers are acceptable for their ability to meet the general design intent, quality and performance characteristics of the specified product. The list does not endorse the acceptability of all products available from the listed manufacturers/suppliers.

.2 It remains the responsibility of the Contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.

.3 The Contractor shall be fully responsible for any additional work or materials, to accommodate the use of equipment from the acceptable manufacturers and suppliers list.

.4 Submit within fourteen (14) days of contract award a copy of the list underlining the name of the manufacturer whose price was carried in the tender. If no manufacturers' names are submitted, it will be assumed that the price carried in the tender was that of the specified manufacturer or where the specified product is generic, the first acceptable manufacturer listed for each item and equipment.

.5 List of Acceptable Manufacturers/Suppliers and Agencies:

• Access Doors	Maxam, Acudor, Milcor, Can.Aqua, Mifab
• Air Flow Measuring Air Monitor, Air Stations	Cambridge, Sentinel, Ebtron
• Air Handling Units (Heat Recovery Ventilator)	Venmar
• Air Terminals - Grilles Registers, Diffusers	E.H. Price, Titus, Anemostat, Nailor
• Air Valves - Mixing, Constant Volume and VAV	E.H. Price, Titus, Trane
• Air Vents	Hoffman, Maid-O-Mist, Taco
• Chimney and Breeching	Metalbestos P/S, Van Packer P/S, Metal Fab PIL
• CO and Combustible Gas Detector	ACME, Armstrong, Critical Environment Technology, Cromag, MSA
• Coils - Heating and Cooling	Trane, Aerofin, Engineered Air, Colmac, McQuay
• Condensing Units	Trane, Dunham Bush, York
• Condensors - Air Cooled Refrigerant	Trane, Carrier, Engineered Air, Keeprite
• Controls contractors and/or Suppliers	Barber Coleman, Barcol, Delta, Honeywell, Johnson Controls, Siemens
• Dampers – Backdraft	Airolite, Vent-Aire, Penn, T.A. Morrison
• Dampers – Balancing	Maxam, Ruskin
• Dampers – Control	Ruskin, Tamco
• Dampers - Smoke-Fire Combination	Ruskin, Controlled Air, Prefco
• Domestic Water Heaters - Electric	Jetglas, Aerco, AO Smith, Ruud-Rheem, State
• Drains - Floor, Roof, Cleanouts Trap Primers, Water Hammer Arrestors	Zurn, Ancon, PPP, J.R. Smith
• Expansion Compensators	Flexonics, Tube Turn, Hyspan, Hydroflex, Metraflex, United Flexible, Mason
• Expansion Joints	Flexonics, Hyspan, Hydroflex, Metraflex, United Flexible, Mason

• Fans - Axial (Belted-Adjustable Pitch)	Woods, Joy
• Fans - Axial (Belted-Fixed Pitch, Direct Drive-Adjustable Pitch)	Northern, Chicago, Woods, Joy, CB&F
• Fans - Axial (Variable Pitch in Motion)	Woods, Joy
• Fans - Bathroom Exhaust	ACME, Broan, Penn Zephyr, Reversomatic, Nutone, Broan
• Fans - Centrifugal	Buffalo, Twin City, Trane, Chicago, Barry Blower, Northern
• Fans - Grease Exhaust	Cook, Greenheck, ACME, Carnes, Garland
• Fans - In-Line Centrifugal	Greenheck, Jenn Air, Ammerman, ILG, Cook, Penn, Twin-City, Carnes
• Fans - In-Line Centrifugal (Tubular)	Chicago, Greenheck, Twin-City, Barry/CML, Northern Blower
• Fans - Kitchen Range Hoods	Nutone, Lau, Broan
• Fans - Propeller	Greenheck, Cook, Penn, Jenn Air, ACME, Powerline, Joy
• Fans - Roof and Wall Mounted	Greenheck, Ammerman, Powerline, ACME, Loren Cook, Penn, Jenn Fan, ILG, Carnes, Twin City
• Filters	Cambridge, AAF, Pacific, FARR
• Fire Dampers	Controlled Air, Ruskin, Canadian Advanced Air, Maxam, Nailor
• Flexible Connectors - Ducting	Thermaflex, G.I. Industries Type IHP
• Flexible Connectors - Piping	Flexonics, Tube Turn, Atlantic, Hyspan, Hydroflex, Metraflex, United Flexible, Mason
• Flexible Duct	Thermaflex, Wiremold, GI Industries Type H.P.
• Flow Meter - Orifice Plate	Gerand
• Flow Meter - Pitot Tube	Presco, Annubar
• Flow Meter - Venturi	Gerand, Presco
• Gauges - Air	Dwyer, Magnehelic
• Gauges - OWG Pressure	Trerice, Marsh, Ashcroft, Weiss
• Grooved Mechanical Pipe Joints	Victaulic, Mech Line (only where permitted)
• Hose Bibbs	Jenkins, Dahl, Crane, Toyo, Kitz, Mifab
• Insulation - Piping and Duct	Fibreglass Canada, Manson, Knauf Fibreglass, Plasti-Fab, Manville
• Louvres	Price/Airolite, Penn, Airstream, West Vent, Nailor, Ruskin, Ventex

• Meters, Positive Displacement	Neptune, Rockwell
• Pipe Restraints	Trelleborg
• Piping Hangers and Saddles	Grinnell, Myatt
• Plug Cocks	DeZurik, Newman-Milliken
• Plumbing Brass	Crane, American Standard, Cambridge Brass, Waltec, Kohler, Symmons
• Plumbing Fixtures	Crane, American Standard, Kohler
• Plumbing Fixtures - Prefab FRP	Aquarius, Acrylic Tubs
• Plumbing: Floor Drains, Roof Drains, Hose Bibbs	Mifab, Zurn, Smith
• Pumps - Sump	Monarch, Barnes, Hydromatic, Myers, Zoeller
• Pumps - Base Mounted	Armstrong, B & G, Taco, Leitch, Grundfos
• Strainers	Armstrong, Sarco, Mueller, Toyo, Anderson, Metraflex, Yarway
• Tanks - Expansion	Bell & Gossett, AS Leitch, Sanford, Westeel-Rosco Steelweld, Clemmer, Wheatley
• Thermometers	Trerice, Marsh, Ashcroft, Winters
• Valves - Gate, Globe, Swing, Check, Ball	Jenkins, Toyo, Crane, Kitz, Milwaukee
• Valves - Shower	Symmons, Powers
• Valves - Silent Check	Val-matic, APCO, StreamFlo
• Vent Caps	Jenn-Air, Penn Ventilator
• Vent Sets	Greenheck, Trane, Sheldons, Buffalo, New York, Brundage, Loren Cook, Lau
• Vibration Isolation	Mason, Vibro Acoustic
• Water Closet Seats	Olsonite, Moldex, Beneke

1.27 Related Work in Other Sections

.1 Refer to other specification sections to complete list of equipment supplied by others.

1.28 Installation

.1 Change to rough-in of services or final equipment connections due to a change in the make of equipment from that specified shall be made at no extra cost to the City, provided that proper shop drawings are available for rough-in. Prior to commencing installation of rough-in for the equipment, coordinate with the final reviewed equipment shop drawings and with the manufacturer.

.2 Exposed piping shall be painted as per Contract Administrator's instructions.

.3 Arrange piping connections to allow for equipment removal.

2. PRODUCTS

2.1 Counter Flashing Materials

.1 Counterflashings: galvanized sheet steel of 0.85 mm (22 ga) minimum thickness.

.2 Counterflashings are attached to mechanical equipment and lap the base flashings on the roof curbs.

.3 All joints in counterflashings shall be flattened and soldered double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around the top edge. Storm collars shall be used above all roof jacks.

.4 Vertical flange section of roof jacks shall be screwed to face of curb.

3. EXECUTION

.1 Not Applicable.

END OF SECTION

DOCUMENTATION

1. GENERAL

1.1 Scope

.1 Operating and Maintenance Manuals.

.2 Record Drawings.

1.2 Quality Assurance

.1 Work specified in this section shall be performed by the Contractor.

2. PRODUCTS

2.1 Operating and Maintenance Manuals

.1 Refer to Section 01300 Submittals.

.2 Index binder according to the following system:

1.0 Mechanical Systems:

Title page

1.1 List of Mechanical Drawings:

1.2 System Descriptions:

Provide complete description of the operating sequence for all systems. Include detailed system description, with individual components described, explanation of how components interface with others and to the complete system, location of thermostats, controllers or operating variances, and controller operating setpoints.

1.3 Operating Division:

Provide complete and detailed operation of major components and systems. Provide information on location of components, how to energise switches and controls, how components interface with other components, operation of controls including operational sequence, operational changes for summer of winter operation, how to accomplish the changeover, complete trouble shooting sequence, emergency operating sequences in event of major component failure, and safeguards to indicate if equipment goes off-line.

1.4 Maintenance and Lubrication Division:

Provide general maintenance and lubrication schedule for major components to include daily, weekly, monthly, semi-annual and yearly checks and tasks. Explain how to execute maintenance tasks required for typical equipment such as bearings, drives, motors, and filters. Compile this information for equipment and separate from shop drawings.

1.5 List of Equipment Suppliers and Contractors:

Provide list of equipment suppliers and contractors, including address and telephone number. Outline procedures for purchasing parts and equipment.

Certification (2.0, 2.1, ...):

Include copy of test data on degreasing and flushing of heating system, analysis of system water taken at time system was put into operation, hydrostatic or air tests performed on piping systems, equipment alignment certificates, copy of balancing data for air and water systems, copy of valve tag identification and pipe colour code, inspection approval certificates for plumbing system, heating and ventilation systems and operational tests on oil-fired equipment.

Shop Drawings and Maintenance Bulletins (3.0, 3.1, ...):

Provide materials received in compliance with clause "Shop Drawings".

2.2 Record Drawings

.1 Refer to Section 01300 Submittals.

.2 The Contractor shall keep on site, available to the Contract Administrator at all times and particularly for each regularly scheduled site meeting, a complete set of prints, edge bound, that are to be updated daily showing any and all deviations and changes from the Contract Drawings. This set of drawings is to be used only for this purpose, and must not be used as the daily general reference set.

.3 Provide record drawings which identify location of dampers, access doors, tagged valves, and actual room names or numbers. As well, deviations that are to be recorded shall include in general, items that are significant or are hidden from view and items of major importance to future operations and maintenance, and to future alterations and additions including cleanouts and isolation valves.

3. EXECUTION

3.1 General

.1 Submit documents to the Contract Administrator for approval prior to transmitting to the City.

3.2 Record Drawings

.1 Enter dimensions from building line to all buried services, including co-ordinates and depth elevations of manholes, tanks, outside shut-off valves, and other similar elements.

.2 Service connections to sewer lines entering a building shall be recorded as to horizontal dimension from a convenient building element with suitable depth elevations relating to main floor level and sea level datum.

.3 Sewer lines which are placed beneath floor slabs shall be located such that each point of entry, change in direction, and irregularity is located by dimension from column grid lines on the as-built drawings. Depth below slabs shall be given.

.4 At Substantial Performance, employ a competent CAD draftsperson to transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings, and change orders (CO), on a copy of tender CAD files. From these files plot a set of as-built sepias. Drafting quality shall be same as original drawings.

The CAD disks may be borrowed from the Contract Administrator. Each "as-built" sepia shall bear the Contractor's identification, the date of record and the notation "We hereby certify that these drawings represent the As-Built Record of Construction". The Contractor's signature and company seal shall be placed below that notation.

.5 At Substantial Performance, employ a competent drafts person to transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings and CO on a set of reverse sepias. Drafting quality shall be same as original drawings.

The sepias may be purchased from the Contract Administrator at cost. Each "as-built" sepia shall bear the Contractor's identification, the date of record and the notation "We hereby certify that these drawings represent the As-Built Record of Construction". The Contractor's signature and company seal shall be placed below that notation.

.6 Provide a reduced set (11”x17”) of record drawings to be included in the Maintenance Manual.

END OF SECTION

TESTING

1. GENERAL

1.1 Scope

.1 Test domestic (potable) water piping.

.2 Test sanitary sewer piping.

.3 Test refrigerant piping.

.4 Test low velocity ducts.

.5 Performance testing of equipment.

.6 Manufacturer's start-up of equipment.

1.2 Quality Assurance

.1 Test equipment and material where required by specification or authority having jurisdiction to demonstrate its proper and safe operation.

.2 Test procedures in accordance with the current applicable portions of ASME, ASHRAE, and other recognised test codes as far as field conditions permit.

.3 Perform tests on site to the satisfaction of the Contract Administrator.

.4 Piping, fixtures or equipment shall not be concealed or covered until inspected and approved by the Contract Administrator. Provide ample written notice (two working days) to the Contract Administrator before tests.

.5 Co-ordinate with Contract Administrator at start of project, those tests that will require witnessing by the Contract Administrator.

.6 Prior to starting, testing, balancing, adjusting and cleaning processes, verify with Contract Administrator any tests required to be witnessed. Provide sufficient notice to Contract Administrator prior to commencement of procedures.

.7 Contract Administrator shall be allowed to witness any testing, adjusting, starting, balancing and cleaning procedures.

.8 Assume all costs associated with starting and testing, including the supply of testing or cleaning medium.

.9 All starting, testing procedures shall be in accordance with applicable portions of the latest, current ASME, ASHRAE, AABC, CSA, NFPA, SMACNA, ASTM and ASPE codes and standards.

.10 Personnel involved in starting, testing, balancing and adjusting procedures shall be experienced in the design and operation of mechanical equipment and systems being checked and shall be able to interpret results of the reading and tests.

.11 Assume all liabilities associated with starting, testing and balancing procedures.

1.3 Submittals

.1 Obtain certificates of approval, acceptance, and comply with current rules and regulations from authorities having jurisdiction and include in Operating and Maintenance Manuals.

.2 Perform tests as specified and upon completion of mechanical installation. Provide certification of tests with detailed data as required. Itemise each test as to time performed and personnel responsible. Include in Operating and Maintenance Manuals.

1.4 Liability

.1 Take charge of plant during tests, assume responsibility for damages in event of injury to personnel, building or equipment and bear costs for liability, repairs, and restoration in this connection.

2. PRODUCTS

Not Applicable.

3. EXECUTION

3.1 Pressure Tests

.1 Provide equipment, materials and labour for tests and pay expenses. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy. Install permanent gauges and thermometers used for tests just prior to tests to avoid possible changes in calibration.

.2 Carry out tests for eight-hour period and maintain pressure with no appreciable pressure drop. Where leakage occurs, repair and re-test and pay necessary costs for re-witnessing.

.3 Drainage Systems: Test by filling with water to produce water pressure to 30 kPa (5 psi) minimum and 62 kPa (10 psi) maximum.

.4 Water Piping: Test to 1-1/2 times maximum working pressure or 1033 kPa (150 psi), whichever is greater, water pressure measured at system low point.

.5 Ducts: Test ducts as per current edition of SMACNA Manual.

.6 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubble test for air.

.7 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by re-making joints in screwed fittings, cutting out and re-welding welded joints, re-making joints in copper lines. Do not caulk.

3.2 General

.1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested. Conduct tests as soon as conditions permit. Make changes, repairs, and adjustments required prior to operating tests.

.2 Meet with Division 16 manufacturers, suppliers, and other specialists as required to ensure all phases of work are properly co-ordinated prior to the commencement of each particular testing procedure. Establish all necessary manpower requirements.

.3 Operate and test motors and speed switches for correct wiring and sequences and direction of rotation. Check and record overload heaters in motor starters.

.4 Confirm voltages and operating amperages at full load.

.5 Failure to follow instruction pertaining to correct starting procedures may result in re-evaluation of equipment by an Independent Testing Agency selected by City at Contractor's expense. Should results reveal equipment has not been properly started, equipment may be rejected, removed from site, and replaced. Replacement equipment shall also be subject to full starting procedures, using same procedures specified on the originally installed equipment.

3.3 Procedures

.1 Procedures shall be identified in the following five (5) distinct phases:

.1 Pre-Starting: Visual inspection.

.2 Starting: Actual starting procedure.

.3 Post-Starting: Operational testing adjusting or balancing, and equipment run-in phase.

.4 Pre-Interim Acceptance of the Work: Final cleaning, re-testing, balancing and adjusting, and necessary maintenance.

.5 Post-Interim Acceptance of the Work: Repeat tests and fine-tuning resulting from corrective action of deficiency clean-up.

.2 Check specified and shop drawing data against installed data.

TESTING

.3 Check the installation is as defined by contract documents and as per manufacturer's recommendations including manufacturer's installation check sheets.

END OF SECTION

SUPPORTS, ANCHORS AND SEALS

1. GENERAL

1.1 Scope

.1 Pipe hangers and supports.

.2 Duct hangers and supports.

.3 Flashing for mechanical equipment.

.4 Sleeving for mechanical equipment.

.5 Pipe anchors.

1.2 Reference Standards

.1 Pipe supports shall meet the requirements of current edition of ANSI B31.1, Power piping.

.2 Duct hangers shall follow the recommendations of the current edition of the SMACNA Duct Manuals.

1.3 Submittals

.1 Submit shop drawings of each factory-manufactured component.

1.4 General Requirements

.1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade; provide for expansion and contraction and to accommodate insulation; provide insulation protection saddles.

.2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.

.3 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a 5 to 1 safety factor.

.4 Fasten hangers and supports to building steel or inserts in concrete construction.

.5 Provide and set sleeves required for equipment, including openings required for placing equipment. Provide sleeves for all pipe and duct penetrations through walls, ceilings, floors and footings.

.6 Dielectrically isolate dissimilar metals.

.7 Obtain approval from the Contract Administrator prior to drilling for inserts and supports for piping systems.

.8 Obtain approval from the Contract Administrator prior to using percussion type fastenings.

.9 Use of piping or equipment for hanger supports is not permitted.

.10 Use of perforated band iron, wire or chain as hangers is not permitted.

.11 Do not weld piping, ductwork or equipment supports to building metal decking or building structural steel supports unless prior written approval has been obtained from the Contract Administrator.

.12 Supply and install all special structural work required for installation of fans and mechanical systems.

2. PRODUCTS

2.1 Inserts

.1 Inserts shall be malleable iron case or galvanised steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.

.2 Size inserts to suit threaded hanger rods.

2.2 Pipe Hangers and Supports

.1 Hangers, Pipe sizes 15 mm to 40 mm: adjustable wrought steel ring.

.2 Hangers, Pipe sizes 50 mm to 100 mm and Cold Pipe Sizes 150 mm and Over: adjustable wrought steel clevis.

.3 Wall Support, Pipe Sizes to 75 mm: cast iron hook.

.4 Wall Support, Pipe Sizes 100 mm and over: welded steel bracket and wrought steel clamp, adjustable steel yoke and cast iron roll for hot pipe sizes 150 mm and over.

.5 Vertical Support: steel riser clamp.

.6 Floor Support, Pipe Sizes to 100 mm and All Cold Pipe Sizes: cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.

.7 Install hangers so they cannot become disengaged by movements of supported pipe.

.8 Provide copper plated hangers and supports for copper piping or provide sheet lead packing between hanger or support and piping. Provide galvanised hangers and supports for galvanised piping.

2.3 Hanger Rods

.1 Provide steel hanger rods, threaded both ends, threaded one end, or continuous threaded.

2.4 Duct Hangers and Supports

.1 Conform to current edition of SMACNA handbooks.

2.5 Flashing

.1 Steel Flashing: 0.55 mm (26 ga) galvanised steel.

.2 Lead Flashing: 25 kg/m² (5 lb/ft²) sheet lead for waterproofing, 5 kg/m² (1 lb/ft²) sheet lead for soundproofing.

.3 Safes: 25 kg/m² (5 lb/ft²) sheet lead or 0.5 mm (0.02 in) neoprene.

.4 Caps: Steel, 0.7 mm (24 ga) thickness minimum, 1.6 mm (16 ga) thickness at fire resistance structures.

2.6 Sleeves

.1 Pipes through Floors: Form with 1.2 mm (18 ga) galvanised steel.

.2 Pipes through Beams, Walls, Fire Proofing, Footings, Potentially Wet Floor: Form with steel pipe or 1.2 mm (18 ga) thickness galvanised steel.

.3 Ducts: Form sleeves with galvanised steel.

.4 Size large enough to allow for expansion with continuous insulation.

2.7 Pipe Seals

.1 Provide “Link-seal” pipe sealing system where passing through room foundation walls.

2.8 Finishes on Hanger Rods, Hangers and Supports

.1 All steel hanger rods, hangers and supports shall be galvanised or factory primed with alkyd red oxide primer to CAN/CGSB 1.40.

3. EXECUTION

3.1 Inserts

.1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

.2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying piping over 100 mm or ducts over 1500 mm wide.

.3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.

.4 Where inserts are omitted, provide concrete clevis plate anchored to the slab.

3.2 Pipe Hangers and Supports

.1 Support horizontal steel and copper piping as follows:

Nominal Pipe Size	Distance Between Supports		Hanger Rod Diameter
	Steel	Copper	
15 mm	1.8 m (6 ft)	1.5 m (5 ft)	10 mm (0.4 in)
20 mm to 40 mm	2.1 m (7 ft)	1.8 m (6 ft)	10 mm (0.4 in)
50 mm & 65 mm	3.0 m (10 ft)	2.4 m (8 ft)	10 mm (0.4 in)
80 mm & 100 mm	3.6 m (12 ft)	3.0 m (10 ft)	16 mm (0.6 in)
150 mm to 300 mm	4.2 m (14 ft)	4.0 m (13 ft)	19 mm (¾ in)
350 mm to 450 mm	6.0 m (20 ft)	--	25 mm (1 in)

.2 Install hangers to provide minimum 12 mm (½ in) clear space between finished covering and adjacent work.

.3 Place a hanger within 300 mm of each horizontal elbow.

.4 Use hangers which are vertically adjustable 40 mm minimum after piping is erected.

.5 Support horizontal soil pipe near each hub with 1500 mm maximum spacing between hangers.

.6 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.

.7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.8 Where practical, support riser piping independently of connected horizontal piping.

.9 Use oversized hangers to accommodate pipe insulation thickness. For pipes up to 50 mm, use high density rigid pipe insulation at hanger location, with an insulation protection shield. For pipes 65 mm and over, use insulation protection saddle.

3.3 Low Velocity Duct Hangers and Supports

.1 Hanger Minimum Sizes:

.1 Up to 750 mm wide: 25 mm x 1.6 mm (16 ga) at 3000 mm spacing.

.2 790 to 1200 mm wide: 40 mm x 1.6 mm (16 ga) at 3000 mm spacing.

.3 Over 1200 mm wide: 40 mm x 1.6 mm (16 ga) at 2400 mm spacing.

.2 Horizontal Duct on Wall Supports Minimum Sizes:

.1 Up to 450 mm wide: 40 mm x 1.6 mm (16 ga) or 25 x 25 x 3 mm (11 ga) at 2400 mm spacing.

.2 475 mm to 1000 mm wide: 40 mm x 40 mm x 3 mm (11 ga) at 1200 mm spacing.

.3 Vertical Duct on Wall Supports Minimum Sizes at 3600 mm spacing:

.1 Up to 600 mm wide: 40 mm x 1.6 mm (16 ga).

.2 625 mm to 900 mm wide: 25 mm x 25 mm x 3 mm (11 ga).

.3 925 mm to 1200 mm wide: 30 mm x 30 mm x 3 mm (11 ga).

.4 Over 1200 mm wide: 50 mm x 50 mm x 3 mm (11 ga).

.4 Vertical Duct Floor Supports Minimum Sizes, Riveted or Screwed to Ducts:

.1 Up to 1500 mm wide: 40 mm x 40 mm x 3 mm (11 ga).

.2 Over 1500 mm wide: 50 mm x 50 mm x 3 mm (11 ga).

3.4 Equipment Bases and Supports

.1 Provide for floor-mounted equipment, reinforced concrete housekeeping bases poured directly on structural floor slab 100 mm thick minimum, extended 100 mm minimum beyond machinery bedplates. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment. Refer to structural specifications and drawings for further details.

.2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

.3 Rigidly anchor ducts and pipes immediately after vibration connections to equipment.

3.5 Flashing

.1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.

.2 Flash vent and soil pipes projecting 75 mm minimum above roof membrane with lead worked 25 mm minimum into hub, 200 mm minimum clear on sides with minimum 600 mm x 600 mm sheet size. For pipes through outside walls turn flange back into wall and caulk.

.3 Flash floor drains over finished areas with lead 250 mm clear on sides with minimum 900 mm x 900 mm sheet size. Fasten flashing to drain clamp device.

.4 Provide curbs for mechanical roof installations minimum 200 mm high. Flash and counterflash with steel; solder and make waterproof.

.5 Provide continuous lead or neoprene safes below air supply casings, built-up mop sinks, shower stalls, shower room floors located above finished rooms. Solder at joints, flash into floor drains and turn up 150 mm into walls or to top of curbs and caulk into joints.

.6 Provide lead flashing around ducts and pipes passing from equipment rooms, installed according to manufacturer's data for sound control.

3.6 Sleeves

.1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeve.

.2 Extend sleeves through potentially wet floors 25 mm above finished floor level. Caulk sleeves full depth and provide floor plate.

.3 Piping and duct work passing through floor, ceiling or wall, close off space between duct and sleeve and non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

.4 Piping passing through mechanical room floor, roof or wall, close off space between pipe and sleeve with synthetic rubber compound mechanical type seals.

.5 Sleeves provided through walls or floors where liquids could potentially pass from one side to the other, provide sleeves with a 25 mm "flange" welded to the external face of the sleeve at the mid point of the thickness of the structure to provide a water stop.

.6 Install chrome-plated escutcheons where piping passes through finished surfaces.

END OF SECTION

PIPE AND PIPE FITTINGS

1. GENERAL

1.1 Quality Assurance

.1 Domestic Water, Drainage and Vent Piping: current Provincial and Municipal Codes.

.2 Refrigerant Piping: CSA B52, Mechanical Refrigeration Code.

.3 Non-specified pipe joining and pipe fitting methods such as T-drill and press fit are not permitted in any piping system covered under Division 15.

2. PRODUCTS

2.1 Pipe

	Service	Material
.1	Sanitary drainage, and vent, inside building, above ground	PVC-DWV, CAN/CSA-B182.1, .2 and/or .4.
.2	Sanitary drainage, and vent, inside building, below ground	PVC-DWV, CAN/CSA-B182.1, .2 and/or .4.
.3	Domestic (potable) water, above ground (inside building)	Type L hard copper for cold water and Type K hard copper for hot water and recirc. water for sizes up to 100 mm, ASTM B88M
.4	Domestic water service (Potable water fill line)	PVC, Class 150, conforming to CSA B137.3 and AWWA C900, complete with tracer wire
.5	Equipment drains and overflows and sump pump discharge piping	Sch.40, galvanised steel, ASTM A120 Type L hard copper ASTM B88M
.6	Refrigerant	ACR copper, ASTM B280

2.2 Fittings and Joints

	Service	Material	Joint
.1	Sanitary drainage and vent inside building, above ground	PVC-DWV	Solvent weld
		PVC- Gravity Sewer	Hub & spigot with gasket

	Service	Material	Joint
.2	Domestic water, above ground	Wrought copper, bronze	Lead free solder, brazed for pipes over 50 mm
		Cast bronze	Screwed
.3	Domestic water, buried	PVC	Hub & spigot, with O-ring
.4	Equipment drains and overflows and sump pump discharge	Galvanised banded malleable iron	Screwed
		Wrought copper, bronze	50-50 solder
		Cast brass	Screwed
.5	Refrigerant	Wrought copper	Brazed, phos copper alloy

2.3 Unions, Flanges and Couplings

.1 Flange bolting: For systems up to 120°C (250°F), use carbon steel stud bolts, semi-flushed and heavy hex nuts, ASTM A307-GrB.

3. EXECUTION

3.1 Preparation

.1 Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove foreign material from piping.

3.2 Connection

.1 Make screwed joints with full cut standard taper pipe threads with approved non-toxic joint compound applied to male threads only.

.2 Make joints for plain end pipe with gasket and clamp type mechanical fastener.

.3 Use galvanised couplings with galvanised pipe.

.4 Make connections to equipment, specialty components, and branch mains with unions or flanges.

.5 Provide dielectric type connections wherever joining dissimilar metals in open systems. Brass adapters and valves are acceptable.

.6 Use insulating plastic spacers for copper pipe installation in metal studs.

3.3 Route and Grades

.1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls.

Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furring to a minimum.

.2 Slope water piping 0.2% and provide hose bibb drains at low points.

.3 Equip low points with 20 mm drain valves and hose nipples.

.4 Provide air collection chambers with manual air vent at all high points of system. Collection chambers to be 25 mm dia. or line size whichever is greater and 150 mm high minimum. Square tees may only be used to assist with complete venting and draining.

.5 Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting. Top flat for water pipes.

.6 Grade horizontal drainage and vent piping 2% minimum, unless noted otherwise.

.7 Pipe the discharge from all relief valves, safety valves, vents, drains, equipment blowdowns, water columns and overflows to the nearest building drain.

3.4 Installation

.1 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.

.2 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.

.3 Install piping material specified as inside the building to 2400 mm outside of building.

END OF SECTION

VALVES AND STRAINERS

1. GENERAL

1.1 Scope

.1 Ball valves.

.2 Check valves.

1.2 Manufacturer

.1 Provide valves of the same type by the same manufacturer throughout.

.2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

1.3 Shop Drawings

.1 Submit copies of valves "ordering schedule" for review before ordering valves.

.2 Submit detailed shop drawings clearly indicating make, model, size, pressure rating, materials of construction and intended service.

2. PRODUCTS

2.1 Domestic Cold Water System

.1 Ball Valves up to 50 mm: Brass body, chrome plated brass ball, threaded or solder ends, TFE seat and packing. 4134 kPa (600 psi) non-shock WOG rating. Threaded, Red-White Fig. 5044A. Solder joint, Red-White Fig. 5049A.

.2 Swing Check Valves up to 50 mm: Bronze body, screw-in cap, replaceable disc, 860 kPa (125 psi) steam rating. Threaded, Red-White Fig. 236. Solder ends, Red-White Fig. 237.

2.2 Domestic Hot Water System

.1 Valves to be used in the hot water section of the system shall be exactly as specified in the cold water section with one exception, that all composition disc valves shall be fitted with discs suitable for hot water.

3. EXECUTION

3.1 Installation and Application

.1 Install valves with stem upright or horizontal, not inverted.

.2 Provide drain valves at main shut-off valves, low points of piping and apparatus and terminal units.

.3 Size drain lines and drain valves equal to size of apparatus drain connection.

.4 For pipe sizes 20 mm and over, minimum drain size to be 20 mm.

.5 Provide male NPT nipples with threaded pipe cap for drain sizes over 20 mm where not piped directly to floor drains.

END OF SECTION

TANKS

1. GENERAL

1.1 Scope

.1 Domestic hot water storage tanks.

.2 Potable water storage tanks

.3 Accessories and connection to piping system.

.4 Saddles and structural supports.

.5 Provide shop drawings for all scheduled tanks.

1.2 Standards

.1 Construct pressure tanks to current ASME Code for Unfired Pressure Vessels.

.2 Comply with current Provincial Government Regulations.

1.3 Submittals

.1 Submit specifications as part of shop drawings for tanks.

2. PRODUCTS

2.1 Domestic Hot Water Storage Tanks

.1 Tank shall be steel, rated for working pressure. Screwed connections shall be stainless steel.

.2 Line with internal corrosive resistant concrete lining of approximately 20 mm thickness. Line flanged connections. Clean and prime coat before lining.

.3 Tank shall be complete with access manhole and steel support saddles.

.4 Construct tank with necessary tappings for installation of accessories. Include tank drain, bottom water inlet and top outlet, thermometer (range 5°C (40°F) to 93°C (200°F)) and pressure relief valve suitable for maximum working pressure.

.5 Provide domestic hot water storage tank complete with two (2) inspection tappings, one near the top and the other near the bottom. Supply tank with factory attached magnesium anodes to provide cathodic protection against corrosion.

2.2 Vertical Potable Water Storage Tanks

.1 Tanks shall be polyethylene, for normal water pressure. 749 mm diameter x 1625 mm high. Rotationally molded seamless construction. They shall meet Health Canada and FDA approved regulation 21 CFR 177.1520(3)3.1.

.2 Tank shall be complete with manhole and strong support base.

.3 All fittings shall be heavy duty polypropylene bulkhead, size and location as per mechanical drawings.

3. EXECUTION

3.1 Installation

.1 Flush and clean potable water storage tank prior to delivery to site and keep sealed during construction.

.2 Install FRP tanks in accordance with ULC-S615, tank manufacturer's installation instruction, and environmental regulations.

.3 Provide water for testing of tanks, and provide full water fill prior to turning over to the City, after all testing and commissioning is complete.

.4 To protect the domestic hot water storage tank from corrosion following installation method shall be used:

.1 Isolate heater tube bundle from the tank by the use of an isolation rubber ring around the tube, preventing physical contact of the tube sheet with the retaining studs, and an electrical isolation gasket on each side of the tube sheet.

.2 Electrically isolate the piping from the tank by using isolation gasket on flanged connections; and isolation bushing on threaded connections. Use isolation unions, and dielectric nipples.

.3 Tube bundles requiring support structures inside the tank should be isolated by using dielectric pads between bundle and support structure.

.4 Any attachments of electrical wiring, temperature sensors, etc., must be isolated from tank fittings with dielectric bushings.

.5 Provide dielectric pads between the tank and the saddle.

.6 Provide dielectric pads between welded-on legs and floor; and isolation washers and sleeves for the bolts.

3.2 Performance

.1 Provide tanks of dimensions and capacities as indicated on the drawings and/or tank schedule in Section 15999.

END OF SECTION

DUCT INSULATION

1. GENERAL

1.1 Scope

.1 Duct thermal insulation.

.2 Adhesives, tie wires, tapes.

1.2 Quality Assurance

.1 Insulation shall be installed by skilled workmen regularly engaged in this type of work.

.2 Materials shall meet fire and smoke hazard ratings as stated in this section and defined in applicable current building codes.

1.3 Submittals

.1 Submit shop drawings which indicate complete material data, "K" value temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

.2 Submit samples of proposed insulating materials and recovering.

1.4 Job Conditions

.1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement, poor workmanship or material defects.

2. PRODUCTS

2.1 General

.1 Insulation Material, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives: Composite fire and smoke hazard ratings shall not exceed 25 from flame spread and 50 for smoke developed.

.2 Insulating materials and accessories shall withstand service temperatures without smouldering, glowing, smoking or flaming.

.3 Recovery Jackets:

- ULC labelled thermo-canvas.

.4 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labelled.

2.2 Materials

.1 Exposed Rectangular Ducts: Rigid fibrous glass or mineral fibreboard insulation, "K" value maximum 0.035 W/m°C (0.25 BTUh-in/(sqft°F)) at 24°C (75°F). Factory applied reinforced aluminum foil vapour barrier for cold ducts. Hot duct service temperature 20°C (68°F) to 65°C (150°F). Cold ducts service temperature -40°C (-40°F) to 65°C (150°F).

.2 Round Ducts and Concealed Rectangular Ducts: Flexible fibrous glass or mineral fibre insulation, "K" value maximum 0.035 W/m°C (0.25 BTUh-in/(sqft°F)) at 24°C (75°F). Factory applied reinforced aluminum foil vapour barrier for cold ducts. Hot duct service temperature 20°C (68°F) to 65°C (150°F). Cold duct service temperature -40° (-40°F) to 65°C (150°F).

3. EXECUTION

3.1 Preparation

.1 Do not install covering before ductwork and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions where possible.

3.2 Installation

.1 Ensure insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation materials, properly sealed.

.2 Finish insulation neatly at hangers, supports and other protrusions.

.3 Do not insulate ductwork with external thermal insulation where acoustic duct insulation is specified.

.4 Locate insulation or cover seams in least visible locations. Locate seams on ductwork in ceiling spaces on the underside of the duct.

.5 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Make smooth any uneven insulated surface before recovering.

.6 Exposed Rectangular Ducts: Secure rigid insulation with galvanised anchors or welded pins on 400 mm centres. Secure in place with retaining pins. Seal all insulation joints and breaks with joint tape. Seal adhesive; cover joints with 100 mm strips of open mesh cloth imbedded between two coats of lap seal adhesive. Use vapour barrier tape for insulation joints or breaks on cold ducts.

.7 Round Ducts and Concealed Rectangular Ducts: Adhere flexible insulation to ductwork with adhesive applied in 150 mm wide strips on 400 mm centres. Provide annealed tie wire tied at 400 mm centres for securing duct insulation. Butt insulation and seal joints and breaks with lap seal adhesive; cover joints with joint tape. Use vapour barrier tape for cold ducts.

3.3 Insulation Installation Thickness Schedule

Ducts and Equipment	Insulation Thickness (mm)	Recovery Jacket
.1 Exhaust Ducts within 3000 mm of Exterior Walls or Openings	25	Canvas
.2 Outside Air Intake Ducts (O/A on HRV-1 and crawlspace)	50	Canvas

END OF SECTION

PUMPS

1. GENERAL

1.1 Scope

.1 All pumps except where integral with a manufactured piece of equipment.

.2 Pumps controls where self contained.

1.2 Submittals

.1 Submit with shop drawings certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Show pump weights, motor and pump operating or efficiencies and electrical power characteristics.

1.3 Quality Assurance

.1 Pumps shall be aligned by qualified millwright and alignment certified.

.2 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, operate within 25% of midpoint of published maximum efficiency curve.

.3 Motors shall be high efficiency and/or inverter only as specified in Section 15010.

2. PRODUCTS

2.1 General

.1 Statically and dynamically balance rotating parts.

.2 Pumps shall operate at 1750 rev/min unless specified otherwise.

.3 Pump connections shall be flanged or union connection.

2.2 Potable Water Pump System

.1 Type: Centrifugal, multi-stage, direct connected.

.2 Pump Sleeve: Stainless steel

.3 Impeller: Stainless steel

.4 Shaft: Stainless steel.

.5 Drive: Integrated variable frequency drive

.6 Working pressure: 999.7 kPa (145 psi)

.7 Accessories: Included as a complete package are a pressure transducer, 8-litre stainless steel diaphragm tank, stainless steel fittings and stainless steel check valve.

.8 Standard of acceptance: Grundfos CHIE-Plus Constant Pressure Package.

2.3 Sump Pump

.1 Type: Completely submersible centrifugal.

.2 Casing: Stainless steel.

.3 Controls: Simplex control panel complete with field adjustable diaphragm float switch and separate liquid level control high level alarm

.4 Standard of acceptance: Grundfos KP series.

3. EXECUTION

3.1 Installation

.1 Provide drains for bases and stuffing boxes piped to and discharging into floor drains.

.2 Provide air cock and drain connection on horizontal pump casings.

.3 Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 100 mm and over.

.4 Check and align pumps prior to start-up.

3.2 Performance

.1 Refer to the Pump Schedule in Section 15999.

END OF SECTION

PLUMBING GENERAL

1. GENERAL

1.1 Scope

.1 Floor drains.

.2 Cooling equipment condensate drains.

.3 Sumps.

.4 Domestic water heaters.

.5 Storm and sanitary sewer service connections.

.6 Water service connections.

1.2 General Requirements

.1 Provide materials, equipment and labour to install plumbing as required by Provincial and Local Codes and as specified herein.

.2 Provide water and drainage connections to equipment furnished in other sections of this specification.

1.3 Submittals

.1 Submit shop drawings for review by the Contract Administrator, in accordance with the general conditions. Provide shop drawings for the following items:

.1 Floor Drains

.2 Domestic Water Heaters

2. PRODUCTS

2.1 Floor Drains

.1 Floor drains shall have lacquered cast iron body with double drainage flange, weep holes combined two piece body reversible clamping device and adjustable nickel/bronze strainer. Shower and washroom floor drains shall have a removable perforated sediment bucket.

2.2 Sump

.1 Reinforced plastic sumps shall have necessary drainage fittings and connections.

.2 Provide cover over sump pit.

2.3 Domestic Water Heaters

.1 Construct electric domestic water heaters to CAN/CSA C22.2 No. 110. Heaters exceeding an input of 30 kW (100 MBH) or an inside diameter of 610 mm must also meet the requirements of Boiler and Pressure Vessel Safety Act.

.2 Refer to equipment schedules in Section 15999 for specific selection.

2.4 Trap Seal Primers

.1 Bronze automatic trap primer complete with sediment strainer, union and access door for concealed installations with 15 mm copper tubing connections between primer valve and floor drain.

3. EXECUTION

3.1 Installation

.1 Bury outside water and drainage pipe minimum 2400 mm, unless noted otherwise.

.2 Where floor drains are located over occupied areas, provide waterproof installation.

.3 Install trap primers on all floor drains.

.4 Drainage lines shall grade 2% unless otherwise indicated on drawings.

.5 Install pressure reducing valves to limit maximum static pressure at plumbing fixtures to 550 kPa (80 psi).

.6 Locate plumbing vents minimum 5 m. from air intakes.

.7 Provide a heat trap loop in domestic hot water supply piping at domestic hot water storage tank.

END OF SECTION

PLUMBING FIXTURES AND TRIM

1. GENERAL

1.1 Scope

.1 Plumbing fixtures and trim.

.2 Splash pads.

1.2 General Requirements

.1 Provide new fixtures, CSA approved, free from flaws and blemishes with finished surfaces clear, smooth and bright.

.2 Provide CSA approved plumbing fittings. Visible parts of fixture brass and accessories shall be heavily chrome plated.

.3 Fixtures shall be product of one manufacturer. Fittings of same type shall be of product of one manufacturer.

.4 Protect fixtures against use and damage during construction.

1.3 Job Conditions

.1 Check millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

2. PRODUCTS

2.1 Water Closet

.1 Water Closet: '6 LPF Low consumption' tank toilet , floor mounted, vitreous china, with 'ever clean' anti-microbial ceramic glaze, elongated front syphon jetted action bowl, fully glazed 2-1/8" (54mm) internal trapway, 9" x 8" (229mm x 203mm) large water surface, and 'speed connect' lined tank complete with oversized 3" (75mm) flush valve with flapper, 'flush right' system, water control (without float) for quiet refill, 1.3 gal. (6l) flush, with sanitary dam on bowl, four point tank stabilization and bolt caps. American Standard 'Cadet 3 Elongated' #2386.500

.2 Seat: Elongated heavy duty solid plastic open front seat with cover, reinforced stainless steel check hinge, posts, washers and nuts. Centoco #820STS

.3 Supply: Polished, rigid horizontal integral sweat tube with v.p. combination wheel handle/loose key ball valve angle stop, escutcheon and flexible riser. McGuire #H172BV

.4 Accessories: Provide floor flange, flange bolts and gasket.

2.2 Lavatory

.1 Lavatory: 102mm (4") centres, 686mm front to back x 508mm wide x 76 - 165mm deep (27" x 20" x 3 - 6-1/2"), non-splash bowl design, wall hung, vitreous china, flat slab design, front overflow for concealed arm support, and c/w ATS Spec “Sanitary Safti-covers” #BF-1. American Standard ‘Wheelchair basin’ #9141.011

.2 Basin Carrier: Extended concealed arm, block base feet support. SMITH Series #0700-Z-27.

.3 Faucet: Chicago Faucets #802-V-317-XK C.P. basin faucet, 102mm (4") C.C., solid cast brass lead-free body, 1/4 turn ceramic disc valve faucet wheelchair access,

.4 Drain: Offset open grid strainer, cast brass. McGuire #155WC.

.5 Basin Supplies: Polished, rigid angle brass, V.P. loose key stops, escutcheon, braided flexible risers, combination wheel handle/loose key ball valve stops and 12mm (1/2”) integral sweat tubes. McGuire #H170BRVB

.6 P-trap: Polished P-trap, cast brass, 17 GA (1.5 mm), and c/w escutcheon. McGuire #8872C-17T

3. EXECUTION

3.1 Installation

.1 Install each fixture with its own trap, easily removable for servicing and cleaning. At completion thoroughly clean plumbing fixtures and equipment.

.2 Provide chrome plated rigid or flexible supplies to fixtures with screwdriver stops, reducers and escutcheons.

.3 Install wall mounted lavatories and urinals and water closets with approved wall carriers.

.4 Caulk gap between mop sink and wall with silicone sealant.

.5 Provide covering to exposed piping as per local codes.

3.2 Fixtures Rough-In Schedule

.1 Rough-in fixture piping connections in accordance with the following table of minimum sizes.

PLUMBING FIXTURES AND TRIM

	Hot Water	Cold Water	Waste	Vent
Lavatories	15 mm	15 mm	40 mm	30 mm
Floor Drains	--	--	75 mm	40 mm
Water Closet (Tank Type)	--	15 mm	75 mm	50 mm

END OF SECTION

FIRE EXTINGUISHERS

1. GENERAL

1.1 Scope

.1 Fire extinguishers.

.2 Fire extinguisher cabinets and mounting hardware.

1.2 General Requirements

.1 Provide portable hand extinguishers where indicated on drawings and specified herein.

1.3 Quality Assurance

.1 Fire protection equipment and installation shall be approved by local Fire Commissioner.

.2 Equipment and installation shall meet the requirements of NFPA 10 Portable Fire Extinguishers.

1.4 Submittals

.1 Submit shop drawings for review. Submit with shop drawings Material Safety Data Sheets (MSDS) for each chemical used in the Fire Extinguishers.

2. PRODUCTS

2.1 Portable Hand Fire Extinguishers

.1 Multi-Purpose Dry Chemical: Pressurised with hose and shut-off nozzle or integral shut-off nozzle and mounting brackets, 2.27 kg (5lb) ABC rating.

3. EXECUTION

3.1 Installation

.1 Install extinguishers so that the bottom of extinguisher is no more than 1200 mm above floor.

3.2 Schedules

	Location	Cabinet Type	Size	Rating
.1	Office	Wall Bracket	2.27 kg (5 lb)	2-A:10-BC
.2	Mechanical Room	Wall Bracket	2.27 kg (5 lb)	2-A:10-BC

END OF SECTION

UNIT HEATERS AND BASEBOARD HEATERS

1. GENERAL

1.1 Scope

.1 Electric Unit heaters.

.2 Electric baseboard heaters.

1.2 Quality Assurance

.1 Terminal heat transfer units shall be product of manufacturer regularly engaged in production of such units who issues complete catalogue data on such products.

1.3 Submittals

.1 Submit, in addition to shop drawings, schedules of electric unit heaters and baseboard heaters with a comparison of specified heat required to actual heat output provided.

2. PRODUCTS

2.1 General

.1 Factory apply baked primer coat on metal surfaces of enclosure or cabinet of unit heaters.

2.2 Unit Heaters

.1 Casing: 16 gauge steel cabinet construction with an 18 gauge base assembly and finished in almond powder.

.2 Louvres: Adjustable discharge grille to direct air flow up or down.

.3 Fan: Direct drive propeller type, statically and dynamically balanced. Horizontal models complete with sleeve bearings and fan guard.

.4 Mounting: Complete with ceiling mounting bracket

.5 Heating Element: Corrosion-resistant copper clad steel radiation fins.

.6 Motor: 1550 rpm heavy duty motor with built-in thermal overload protection, permanently sealed bearings and factory installed line fuses.

.7 Integral Automatic Reset Thermal Cutout: Overheat protection.

2.3 Electric Baseboard Heaters

.1 Chromalox Model BL4810W1

.2 Heating capacity: 1000 watt

.3 Electrical: 240/1/60

.4 Length: 1210 mm

.5 Colour: White

.6 Finish: Polyester powder coated cabinet

.7 Heating Element: Nickel chromium element totally enclosed in a stainless steel sheath and aluminum fins.

.8 Control Options: 240V low voltage relay and 24V transformer and wall thermostat

.9 Warranty: 10 years

3. EXECUTION

3.1 Installation

.1 Ceiling mount unit heater in crawlspace with factory approved mounting bracket.

.2 Wallmount baseboard heater in mechanical room.

.3 Follow manufacturer's installation instructions.

3.2 Performance

.1 Refer to Equipment Schedules.

END OF SECTION

AIR COOLED CONDENSING UNITS

1. GENERAL

1.1 Scope

.1 Air cooled refrigerant condensing unit package.

.2 Refrigerant piping and accessories.

.3 Controls.

.4 Charge of refrigerant and oil.

.5 Start-up and commissioning.

1.2 Quality Assurance

.1 Conform to current requirements of CSA, UL, Provincial and Municipal Codes.

.2 Materials in contact with refrigerant shall be corrosion resistant.

.3 Units shall be product of manufacturer regularly engaged in production of refrigeration units and who issues complete catalogue data on such products.

1.3 Submittals

.1 Submit with shop drawings, schematic layouts showing condensing units, cooling coils, refrigerant piping and accessories required for complete system, including equipment weights and detailed performance data, with full wiring diagram for power and controls.

.2 Submit complete pipe sizing data.

1.4 Start-up and Testing

.1 Supply initial charge of refrigerant and oil for each refrigeration system. Losses of oil or refrigerant prior to acceptance of equipment or due to defects covered under guarantee shall be replaced. Supply to the City, one complete charge of lubricating oil in addition to that placed in the system.

.2 Charge the system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.

.3 Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

.4 Provide cooling season start-up, winter season shut-down for first year of operation.

.5 Inspect and test for refrigerant leaks every six months during first year of operation.

2. PRODUCTS

2.1 Type

.1 Units shall be self-contained, packaged, factory assembled and prewired suitable for outdoor use consisting of casing, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, screens.

2.2 Cabinet

.1 Construct of heavy gauge sheet metal with baked-on powder finish and wire coil guard

2.3 Compressor

.1 Provide serviceable, scroll compressor, resiliently mounted compressor with positive lubrication, crankcase heater, internal pressure relief valve, motor overload protection, balanced refrigeration system, service valves and filter drier.

.2 Provide timer circuits to prevent rapid loading and unloading for system stabilisation.

2.4 Condenser

.1 Coil: Seamless copper tubing with aluminum fins.

.2 Fans: Vertical discharge, direct drive axial fans, resiliently mounted with guard and motor.

.3 Motors: Permanently lubricated ball bearing motors with built-in current and overload protection.

2.5 Refrigerant

.1 No R-22 shall be used.

.2 Use only environmentally friendly R407 and R410 refrigerants.

2.6 Controls

.1 Provide high and low pressure cut-outs for compressor, oil pressure control, non-recycling pump-down and reset relay.

.2 Unit shall be controlled by HRV-1

3. EXECUTION

3.1 Performance

.1 Refer to equipment schedules.

END OF SECTION

INDOOR PACKAGED HEAT RECOVERY VENTILATION UNIT

1. GENERAL

1.1 Scope

.1 Supply and install one indoor packaged heat recovery ventilation unit (HRV-1).

.2 Indoor packaged heat recovery ventilation unit is designed to be installed on the perimeter wall of the building. Unit may be exposed or hidden. Unit can be used with ductwork or in a ductless system.

.3 Unit is capable of transferring mainly sensible energy as listed in the equipment schedule.

.4 Unit is designed as a complete ventilation/HVAC unit with the additional option of heat/cool accessory modules.

.5 The unit shall circulate indoor air only on a call for heating or cooling in unoccupied mode.

1.2 Quality Assurance

.1 It is the intent of this specification that the manufacturer provides air handling units designed and manufactured specifically to the requirements of this project. Overall dimensions and configuration are to be as shown on the plans and as described in the specifications. Take responsibility for the engineering and operational integrity of the air handling units.

.2 Unit construction shall be per the construction details included at the end of this section, and as described herein.

.3 Unit shall be constructed in accordance with CSA C22.2 and UL 1812 and shall carry the ETL and (C)ETL label of approval.

.4 Provide unit produced by a recognised manufacturer who maintains a local service agency and parts stock.

.5 Air flow rates, external static pressures, coil face velocities, filter face velocities, water and air side pressure drops shall be the same or better than specified for alternate selections.

.6 Fans shall be to AMCA standards, and bear AMCA “certified” seal.

.7 Coils and energy recovery components shall be ARI certified, and bear ARI seal.

.8 Insulation shall comply with NFPA 90A requirements for flame spread and smoke generation.

.9 All units shall be run tested prior to shipment.

1.3 Delivery, Storage and Handling

.1 Unit shall be stored and handled per unit manufacturer's recommendations.

1.4 Warranty

.1 Unit shall have a 2 year warranty on all parts not including the flat plate heat exchanger.

.2 Flat plate heat exchanger shall have a 15 year unconditional warranty.

.3 Manufacturers without a 15 year warranty shall supply an extra flat plate heat exchanger for the entire unit. Core to be turned over to the City at the time of delivery for stocking purposes.

1.5 Submittals

.1 Submit shop drawing which shall include the following minimum information. Shop drawings submitted without this information shall be automatically rejected.

.1 Construction details: submit unit construction drawings for the following components:

.1 Side panels, including connection details.

.2 Top panel, including connection details.

.3 Floor, including connection details.

.4 Doors, hinges, latch, viewing port.

.5 Fan, motor and drive, mounting and isolation.

.6 Coil section.

.7 Pipe and conduit penetration through casing or floor.

.8 Drain pan.

.2 Materials of Construction: indicate material and gauge of all construction components.

.3 Mass Distribution Drawings: show point loads and recommended method of unit installation.

.4 Fan Performance Data: submit fan performance curves as well as performance tables.

.5 Air Blenders: make, model, selection criteria and pressure drop curves.

.6 Coils: Selection criteria indicating air side and fluid side capacities, in and out conditions, velocities, pressure drops and fouling factors. Submit a drawing showing headers, circuiting arrangement, connection sizes, and materials of construction.

.7 Air Filters: media, efficiency rating, velocity, pressure drop charts and capacities. Indicate mounting method and arrangement.

.8 Detailed composite wiring diagrams showing factory installed wiring, including wiring of the control components.

.9 Sound Levels: submit sound power levels generated by the air handling unit at the inlet and outlet of the unit and outside the fan section. List for individual octave bands in dB referenced to A rating.

2. PRODUCTS

2.1 Components

.1 Indoor vertical draw through heat recovery unit consisting of a flat plate heat exchanger, ventilation air fan, exhaust air fan, necessary dampers, temperature sensors and controls. All regularly maintained parts must be serviceable in just minutes.

2.2 Unit Cabinet

.1 Cabinet is designed for indoor wall mounting on the perimeter of the building. Cabinet may be exposed to occupants or hidden behind the wall.

.2 Unit shall include white, baked on, polyester pre-painted galvanized steel package. Cabinet shall withstand 10 years without cracking, chipping, peeling, brazing or spotting.

.3 Cabinet shall be insulated throughout with 1" [25mm] fire retardant material.

.4 Removable full access doors on front of cabinet.

.5 Unit shall include drain pans with bottom drains.

.6 Bottom Base

.1 Unit shall include a bottom base with return air grille.

.2 Bottom base to be color matched to the unit ventilator.

2.3 Blowers

.1 Fan ratings are based on tests made in accordance with AMCA Standard 210.

.2 Blowers must be selected to operate on a stable, efficient part of the fan curve when delivering air quantities scheduled against static of the system.

.3 Fan blades shall be statically and dynamically balanced and tested prior to shipment.

.4 Fan shall be provided with internal vibration isolation mounts.

.5 Fan discharge shall be as noted on the plans.

.6 Blowers shall provide two speed operation.

2.4 Motors

.1 Motors shall be continuous duty, permanently lubricated and matched to the fan loads.

.2 Motor selection must include a 15% service factor.

.3 Motors shall be two (2) speed.

2.5 Filtration

.1 Standard filtration shall be 30 pores per inch, permanent, washable reticulated foam filters.

.2 25mm (1") disposable, 30% medium efficiency (MEF) for supply and exhaust.

2.6 Heating

.1 Unit shall include integrated heating (proportional electric heat).

.2 Heating module capacity shall be as noted in the equipment schedule.

2.7 Cooling

.1 Unit shall provide cooling via separate DX cooling coil and condensing unit package. See section 15700 Air Cooled Condensing Units.

2.8 Electrical Requirements

.1 Unit shall have single point power connection only.

.2 230/120/1/60

.3 All controls shall be factory mounted and wired, requiring only field installation of remote sensing devices and wiring to unit mounted terminal strips.

.4 Unit shall include a non-fused external disconnect switch.

2.9 Flat Plate Heat Exchanger

.1 Aluminum plate heat exchanger designed to meet NFPA 90A requirements for smoke development and flame spread.

.2 Energy recovery performance for component shall be rated in accordance with ARI Standard 1060-2001 and CERTIFIED to ARI. Actual performance in packaged equipment may vary.

2.10 Air Outlets

.1 Outside Air Drainable Wall Louver

.1 Unit shall include 457 x 508mm [18" x 20"] drainable outside air wall louver.

.2 Unit shall include an insulated motorized outside air damper.

.2 Exhaust Wall Louver

.1 Unit shall include 356 x 356mm [14" x 14"] exhaust wall louver.

.2 Unit shall include an insulated motorized air exhaust damper.

2.11 Controls

.1 Operating Characteristics

.1 Unit shall be capable of providing a constant volume of air at a specified external static pressure at all fan operating speeds.

.2 Unit shall be provided with factory mounted electromechanical controls.

.3 All service connectors shall be quick disconnect type.

.4 Unit circuitry shall allow the following operational characteristics:

.1 2 stage heating control

.2 2 stage cooling control

.3 Occupied contact

.4 Unoccupied contact

.5 Fans low speed

.6 Fans high speed

.5 Internal thermostat will provide trim heating such that the supply air leaving temperature is not below 13°C [55°F].

.6 T7300D 2007 remote wall thermostat shall be provided by the manufacturer. Cabinet or remote field mounting is possible.

.7 Defrost

.1 Damper/Recirculation Defrost Cycle Unit shall be equipped with recirculation defrost to prevent frost from forming on the heat exchanger and to prevent negative pressure from occurring in the building envelope.

.8 CO2 Controller

.1 Sensing control is included to activate high speed ventilation for CO2 control.

2.12 Acceptable Manufacturers

.1 Venmar CES Inc. Model: HRV450w.

3. EXECUTION

3.1 Assembly

.1 Pipe units to permit coil removal.

.2 Any piping or conduit passing through the unit casings must be sealed with rubber grommets and retaining plates to prevent air or water leakage.

3.2 Heat Recovery Ventilation Unit Schedule

.1 Refer to Equipment Schedules.

END OF SECTION

FANS

1. GENERAL

1.1 Scope

.1 Bathroom exhaust fan.

.2 Crawlspace Exhaust fan.

1.2 Quality Assurance

.1 Conform to AMCA Bulletins regarding construction and testing. Fans shall bear AMCA certified rating seal.

.2 Fans shall bear CSA label.

.3 Motors: refer to Section 15010.

1.3 Submittals

.1 Submit with shop drawings acoustical data and fan curves showing fan performance with fan and system operating point plotted on curves, including equipment weights and centre of gravity diagrams for suspended fans.

1.4 Job Conditions

.1 Do not operate fans for any purpose, temporary or permanent until ductwork is clean, filters are in place, bearings are lubricated and fan has been run under close supervision of unit manufacturer.

1.5 Alternates

.1 Equivalent fan selections shall not increase motor kilowatts, increase rpm, increase noise level, increase tip speed by more than 10%, or increase inlet air velocity by more than 20%, from that of the specified fan.

2. PRODUCTS

2.1 General

.1 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.

.2 Fans are to be capable of accommodating static pressure variations of ±10% with no objectionable operating characteristics.

.3 Exhaust fans must be listed by ULC.

.4 External static pressure means external to the fan cabinet and all accessories such as backdraft dampers, mixing boxes, filters and coils, etc. These accessories if supplied as part of the unit are considered as internal losses for fan.

2.2 General Exhaust Fans

.1 Provide sidewall direct drive axial fan.

.1 Fabricated or cast aluminum propeller and hub, statically and dynamically balanced

.2 Motor shall have permanently lubricated sealed for life bearings

.3 Motor drive frame and assemblies and fan panels shall be galvanised or painted steel

.4 Drive frame assemblies shall be welded wire or formed channels

.5 Fan panels shall have pre-punched mounting holes, formed flanges and inlet venture.

2.3 Bathroom Exhaust Fan

.1 Provide inline cabinet fan with quiet multi-blade, forward curved wheel in steel housing for between stud mounting.

.2 Resiliently mount direct driven fan and motor. Motor shall be plug-in type with permanently lubricated bearings.

.3 Provide one piece aluminum intake grille.

.4 Provide backdraft damper.

.5 Noise level not to exceed 2.3 sones at design air volume.

3. EXECUTION

3.1 Installation

.1 Where inlet or outlet is exposed, provide safety screen.

.2 Following manufacturer’s installation procedure.

.3 Provide line voltage dehumidistat for humidity control of crawlspace fan.

3.2 Performance

.1 Refer to Equipment Schedule.

END OF SECTION

DUCTWORK

1. GENERAL

1.1 Scope

.1 Ductwork and plenums.

.2 Fasteners.

.3 Sealants.

.4 Duct cleaning.

1.2 Definitions

.1 Duct sizes shown on plans are inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes inside ducts.

1.3 Quality Assurance

.1 Ductwork shall meet the requirements of NFPA No. 90A - Air Conditioning and Ventilating Systems and NFPA No. 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems;

.2 Fabricate in accordance with SMACNA duct manuals and ASHRAE handbooks.

.3 Flexible air duct shall conform to NFPA 90A and UL181 standard for factory made air duct materials and air duct connectors.

1.4 Submittals

.1 Submit shop drawings and samples of duct fittings for approval, including particulars such as gauge sizes, welds and configurations prior to start of work.

1.5 Alternatives

.1 Obtain written permission from the Contract Administrator prior to making variations in duct configuration or sizes. Size alternatives using ASHRAE table for circular equivalents of rectangular ducts.

2. PRODUCTS

2.1 Materials

.1 Ducts: galvanised steel lock forming quality, having galvanised coating of 380 g/m^2 (1.25 oz/ft^2) for both sides.

.2 Fasteners: use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts. Weld kitchen exhaust ducts.

.3 Sealant: water resistant, fire resistive, compatible with mating materials.

.4 Flexible Duct: flexible air duct shall be used where shown on drawings. Length of flexible duct shall not exceed 900 mm. Flexible duct shall be polymetric liner banded to a steel wire helix, wrapped with fiberglass insulation and outer fiberglass reinforced metalled vapour barrier jacket. Flexible duct rated for 12 m/s (2400 fpm) velocity and pressure rated for 500 Pa (2 in.wg.) positive and 500 Pa (2 in.wg.) negative.

.1 Standard Acceptance: Thermaflex M-KE.

3. EXECUTION

3.1 Plenum Gauges

.1 Fabricate fan plenums and plenums downstream of fan in accordance with SMACNA manual.

.2 Fabricate plenums between fan and upstream apparatus of 1.6 mm (16 ga) thick material.

.3 Fabricate plenums between filters and upstream apparatus of 1.3 mm (18 ga) thick material.

3.2 Duct Sealing

.1 All supply, return and exhaust duct joints, longitudinal as well as transverse, should be sealed using:

.1 Slip Joints: apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.5 mm (0.06 in) use heavy mastic type sealant.

.2 Flanged Joints: soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.

.3 Other Joints: heavy mastic type sealant.

.2 Duct tapes as sealing method are not permitted.

.3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.

.4 Prior to sealing all ductwork, demonstrate sealing of a section of each type of duct and obtain approval from the Contract Administrator.

.5 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application.

3.3 Installation

.1 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.

.2 Coordinate the location of duct access doors. Refer to Section 15835 - Duct Accessories.

.3 Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

.4 Interrupt duct linings at fire, balancing backdraft and smoke dampers so as not to interfere with operation of devices. Provide sheet metal edge protection over linings on both sides of damper device.

.5 Shield ductwork from dust and construction material during construction. Clean any ductwork found to be dirty at no extra cost to the Contract.

.6 Protect carbon steel ductwork exposed to weather by painting or coating with suitable weather resistant material.

.7 Install ducts associated with fans subject to forced vibration with flexible connections immediately adjacent to equipment. Refer to Section 15835 - Duct Accessories.

.8 Do not use flexible duct to change direction. Provide a minimum of three (3) duct diameters of straight metal duct between box inlet and flexible connector.

.9 Connect diffusers or troffer boots to low pressure ducts with 300 mm maximum length of flexible duct. Hold in place with caulking compound and strap or clamp.

.10 Prove that ductwork is substantially airtight before covering or concealing.

.11 Clean duct systems and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters or bypass during cleaning.

.12 Clean systems with power vacuum machines.

.13 Fabricate ductwork from field measurements and not from plans and shop drawings exclusively. Failure to do so will not constitute an extra to the Contract.

.14 Complete metal ducts within themselves with no single partition between ducts. Where width of duct exceeds 450 mm, cross brace for rigidity. Open corners are not acceptable.

.15 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

.16 Construct tees, bends and elbows with radius of not less than 1-1/2 times width of cut on centre line. Where not possible and where rectangular elbows are specified, provide double wall air foil type turning vanes. Where acoustical lining is provided, provide turning vanes of perforated metal type with fibreglass inside.

.17 Increase duct sizes gradually, not exceeding 15° divergence wherever possible. Maximum divergence upstream of equipment to be 30° and 45° convergence downstream.

.18 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled. Seal seams on fresh air and exhaust ducts watertight with mastic or low velocity duct sealant.

.19 Set plenum doors 150 mm above floor. Arrange door swings so that fan static holds door in closed position.

END OF SECTION

DUCT ACCESSORIES

1. GENERAL

1.1 Scope

.1 Access doors.

.2 Fire dampers.

.3 Balancing dampers.

.4 Flexible connections.

.5 Backdraft dampers.

1.2 Quality Assurance

.1 Fire dampers shall be ULC listed and constructed in accordance with ULC Standard S 112 “Fire Dampers”.

.2 Fusible links on fire dampers shall be constructed to ULC Standard S 505.

.3 Demonstrate re-setting of fire dampers to authorities having jurisdiction and Contract Administrator.

.4 Access doors shall be ULC labelled.

.5 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems. Fabricate in accordance with ASHRAE Handbooks and SMACNA Duct Manuals.

.6 Prove all dampers to inspector at job completion.

1.3 Submittals

.1 Submit shop drawings of factory fabricated assemblies.

2. PRODUCTS

2.1 Duct Access Doors

.1 Fabricate rigid and close-fitting doors of galvanised steel with sealing gaskets and suitable quick fastening locking devices. Duct access panels with screws are not acceptable. Install minimum 25 mm thick insulation with suitable sheet metal cover frame for insulated ductwork.

.2 Fabricated with two butt hinges and two sash locks for sizes up to 450 mm two hinges and two compression latches with outside and inside handles for sizes up to 600 mm x 1200 mm and an additional hinge for larger sizes.

2.2 Fire Dampers

.1 Fabricate of galvanised steel or prime coated black steel weighted to close and lock in closed position when released by fusible ink.

.2 Fire dampers shall be curtain type with damper blades retained out of air stream in a recess so free area of connecting ductwork is not reduced.

.3 Fusible links shall be set for 71°C (160°F).

2.3 Balancing Dampers

.1 Fabricate of galvanised steel, minimum 1.6 mm (16 ga). Full blade-length shafts of hollow square construction with blades rigidly fastened along entire blade length.

.2 Lockable quadrant type operating mechanism with end bearings on accessible rectangular ducts up to 400 mm deep and on accessible round ducts.

.3 Wide pitch screw operating mechanism with crank operator and end bearings on accessible rectangular ducts 425 mm and over in depth and on all inaccessible rectangular and round ducts.

.4 On rectangular ducts up to 275 mm deep construct of single blade (butterfly) type.

.5 On rectangular ducts 300 mm to 400 mm deep construct of two opposed blades mechanically interlocked with pivots at quarter points.

.6 On rectangular ducts over 425 mm deep construct of multiple opposed blades mechanically interlocked with blades no greater than 200 mm deep and pivots equally spaced.

.7 On round ducts construct of single blade (butterfly) type. On 500 Pa (2 in wg) class and on all dampers over 300 mm diameter fabricate with full blade-length shaft.

.8 Construct damper blades for medium and high pressure systems to block air passage 70% maximum. Provide complete with locking type handles.

.9 Provide over-ride limiting stops on all operating mechanisms.

.10 Identify the air flow direction and blade rotation and open and close positions on operating mechanism.

.11 On round ductwork install operating mechanism on a steel mounted base firmly secured to the ductwork.

.12 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

2.4 Flexible Connections

.1 Fabricate of ULC approved neoprene coated flameproof glass fabric approximately 150 mm wide tightly crimped into metal edging strip and attached to ducting and equipment by screws or bolts at 150 mm intervals. Flexible connection airtight at 500 Pa (2 in wg).

2.5 Backdraft Dampers

.1 Construct of minimum 1.3 mm (18 ga) aluminum channel frame.

.2 Construct of minimum 0.6 mm (24 ga) aluminum blades, complete with stiffeners along trailing edge. Fabricate single blade dampers for duct sizes to 240 mm, multiblade dampers for ducts greater than 240 mm.

.3 Provide full blade-length shafts complete with brass or nylon bearings.

.4 Provide neoprene anti-clatter blade strips on pivot side of blades.

.5 Construct blade connecting linkage of minimum 2.0 mm (12 ga) aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.

.6 Maximum blade length of 750 mm.

.7 Backdraft damper suitable for 10 m/s (2000 fpm) face velocity.

3. EXECUTION

3.1 Application

.1 Provide access door minimum 450 mm x 350 mm or 50 mm smaller than duct dimension for cleaning and inspection at positions indicated by drawings and as follows:

.1 Both sides of turning vanes in all ducts.

.2 At each fire damper location.

.3 At each side of all heating or cooling coils.

.4 At all locations of internally duct mounted devices including automatic dampers, damper motors and control sensors and devices.

.2 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Fire dampers shall be

complete with required perimeter mounting angles sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.3 At each point where ducts pass through duct shall be sealed with non-combustible material.

.4 Provide balancing dampers at points on supply and exhaust systems where branches are taken from larger ducts as required for proper air balancing.

.5 Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and/or where indicated on drawing.

.6 All fire dampers and fire stop flaps are to be left in the closed position for balancing contractor to fix open.

.7 Support ceiling fire stops from the structure above the fire stop and not from air outlets on associated ductwork.

END OF SECTION

AIR OUTLETS

1. GENERAL

1.1 Scope

.1 Diffusers.

.2 Grilles and registers.

.3 Outside louvres.

1.2 Quality Assurance

.1 Air flow tests and sound level measurement shall be made in accordance with applicable ADC equipment test codes, ASHRAE Standards and AMCA Standards.

.2 Unit rating shall be approved by ADC and AMCA.

.3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.

.4 Outside louvres shall bear AMCA seal for free area and water penetration.

1.3 Project Conditions

.1 Review requirements of outlets as to size, finish and type of mounting prior to submitting shop drawings and schedules of outlets.

.2 Positions indicated are approximate only. Check locations of outlets and make necessary adjustments in position to conform with Architectural features, symmetry and lighting arrangement.

1.4 Submittals

.1 Submit shop drawings with complete catalogue information, materials of construction, dimensions and accessories for all air outlets, louvres and components in this specification section, and as scheduled.

.2 Submit colour selection charts of finishes for approval prior to fabrication.

2. PRODUCTS

2.1 General

.1 Refer to Equipment Schedules in Section 15999 for Air Outlet Schedule.

.2 Base air outlet application on space noise level of NC 30 maximum.

.3 Provide supply outlets with sponge rubber seal around the edge.

.4 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.

.5 Provide plaster frame for diffusers located in plaster surfaces.

.6 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.

2.2 Outside Louvres

.1 See Section 15802

3. EXECUTION

3.1 Priming

.1 Paint ductwork visible behind air outlets matte black.

3.2 Sizing

.1 Size outside air louvres as indicated on drawings.

.2 Size air outlets as indicated on drawings.

END OF SECTION

TESTING, ADJUSTING AND BALANCING

1. GENERAL

1.1 Related Documents

.1 All Division 15 Specification Sections, Drawings, and General Provisions of the Contract apply to Work of this Section, as do other documents referred to in this Section.

1.2 Scope of Work

.1 The Contractor will contract with and independent testing, adjusting, and balancing (TAB) agency to test, adjust, and balance the heating, ventilation, and air conditioning (HVAC) systems.

.2 The work included in this section consists of furnishing labour, instruments, and tools required in testing, adjusting and balancing the HVAC systems, as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results.

.3 The items requiring testing, adjusting, and balancing include the following:

.1 Air Systems:

.1 Supply Fan AHUs (HRV-1)

.2 Zone branch and main ducts

.3 Diffusers, Registers and Grilles

1.3 Definitions, References, Standards

.1 AABC: the Associated Air Balance Council is a non-profit association of independent, certified agencies specializing in testing, adjusting, and balancing HVAC systems. The AABC National Standards provides standards and operational criteria for HVAC systems.

.2 All Work shall be in accordance with the latest edition of the Associated Air Balance Council National Standards. If these contract documents set forth more stringent requirements than the AABC National Standards, these contract documents shall prevail.

1.4 Qualifications

.1 Agency Qualifications: the TAB Agency shall be a current member of the AABC.

1.5 Submittals

.1 Qualifications: the TAB agency shall submit a company resume listing personnel and project experience in air and hydronic system balancing and a copy of the agency's test and balance engineer certificate.

.2 Procedures and Agenda: the TAB agency shall submit the TAB procedures and agenda proposed to be used.

.3 Sample Forms: the TAB agency shall submit sample forms, which shall include the minimum data required by the AABC National Standards.

1.6 Testing Adjusting and Balancing Preparation and Coordination

.1 Shop Drawings, submittal data, up-to-date revisions, change orders, and other data required for planning, preparation, and execution of the TAB work shall be provided to the TAB agency no later than 30 days prior to the start of TAB work.

.2 System installation and equipment start-up shall be complete prior to the TAB agency's being notified to begin.

.3 The building control system shall be complete and operational. The Contractor shall install all necessary computers and computer programs, and make these operational. Assistance shall be provided as required for reprogramming, coordination, and problem resolution.

.4 All test points, balancing devices, identification tags, etc., shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.

.5 Qualified installation or start-up personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

1.7 Reports

.1 Final TAB Report: the TAB agency shall submit the final TAB report for review by the Contract Administrator. All outlets, devices, HVAC equipment, etc., shall be identified, along with a numbering system corresponding to report unit identification. The TAB agency shall submit an AABC "National Project Performance Guaranty" assuring that the project systems were tested, adjusted and balanced in accordance with the project specifications and AABC National Standards.

1.8 Deficiencies

.1 Any deficiencies in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the appropriate responsible person.

.2 The work necessary to correct items on the deficiency listing shall be performed and verified by the Contractor before the TAB agency returns to retest. Unresolved deficiencies shall be noted in the final report.

2. INSTRUMENTATION

.1 All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments shall be in accordance with the requirements of AABC National Standards.

3. EXECUTION

3.1 General

.1 The specified systems shall be reviewed and inspected for conformance to design documents. Testing, adjusting and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with AABC National Standards.

.2 Adjustment tolerances shall be plus or minus ten percent unless otherwise stated.

.3 Equipment settings, including manual damper quadrant positions, manual valve indicators, fan speed control levers, and similar controls and devices shall be marked to show final settings.

.4 All information necessary to complete a proper TAB project and report shall be per AABC standards unless otherwise noted. The descriptions for work required, as listed in this section, are a guide to the minimum information needed.

3.2 Air Systems

.1 The TAB agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set in the full open position. The TAB agency shall perform the following:

.1 TAB procedures in accordance with the AABC National Standards:

.1 For supply fans:

.1 Fan speeds: test and adjust fan rpm to achieve maximum or design air flow rate.

.2 Current and voltage: test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.

.3 Pitot-tube traverse: perform a pitot-tube traverse of main supply and return ducts, as applicable to obtain total air flow rate.

.4 Outside air: test and adjust the outside air on applicable equipment using a pitot-tube traverse.

.5 If a traverse is not practical use the mixed-air temperature method if the inside and outside temperature difference is at least 11°C (20°F) or use the difference between pitot-tube traverses of the supply and return air ducts.

.6 Static pressure: test and record system static profile of each supply fan.

.2 For zone, branch and main ducts:

.1 Adjust ducts to within design air flow rate requirements. As applicable, at least one zone balancing damper shall be completely open. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.

.3 For diffusers, registers and grilles:

.1 Tolerances: test, adjust, and balance each diffuser, grille, and register to within ten percent of design requirements. Minimize drafts.

.2 Identification: identify the type, location, and size of each grille, diffuser, and register. This information shall be recorded on air outlet data sheets.

.4 For coils:

.1 Air temperature: once air flows are set to acceptable limits, take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.

3.3 Additional Tab Services

.1 Preconstruction Plan Check and Review:

.1 The TAB agency shall review the project documents and contractor submittals for their effect on the TAB process and overall performance of the HVAC system. It shall submit recommendations for enhancements or changes to the system within 30 days of document review.

.2 Job Site Inspections:

.1 During construction, the TAB agency shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the HVAC systems. Inspections shall be conducted a minimum of two times. (Typically, these are

performed when 60 percent of the total system is installed and again when 90 percent of the total system is installed, prior to insulation of the duct and piping). The TAB agency shall submit a written report of each inspection.

.3 Verification of HVAC Controls:

.1 The TAB agency shall be assisted by the building control systems contractor in verifying the operation and calibration of all HVAC and temperature control systems. The following tests shall be conducted:

.1 Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water resets, fire and freeze stats, and other safety devices.

.2 Verify that all controlling instruments are calibrated and set for design operating conditions.

.4 Temperature Testing:

.1 To verify system control and operation, a series of three temperature tests shall be taken at approximately two hour intervals in each separately controlled zone. The resulting temperatures shall not vary more than 1°C (2°F) from the thermostat or control setpoint during the tests. Outside temperature and humidity shall also be recorded during the testing periods.

.5 TAB Report Verification:

.1 At the time of final review, the TAB agency may be required to recheck, in the presence of the Contract Administrator, specific or random selections of data recorded in the certified report. Points and areas for recheck shall be selected by the Contract Administrator. Measurements and test procedures shall be the same as approved for the initial work for the certified report. Selections for recheck, specific plus random, will not exceed ten percent of the total number tabulated in the report.

END OF SECTION

LIST OF SCHEDULES

1. LIST OF SCHEDULES

.1 Air Handling Unit Schedule

.2 Exhaust Air Fan Schedule

.3 Cooling Coil Schedule

.4 Electric Unit Heater Schedule

.5 Tank Schedule

.6 Pump Schedule

.7 Air Cooled Condensing Unit Schedule

.8 Air Outlet Schedule

.9 Domestic Hot Water Tank Schedule

LIST OF SCHEDULES

1.1 Air Handling Unit Schedule

TAG	HRV-1
Location	Mechanical room
Area Served	Scale facility
Type	Heat recovery ventilator
Manufacturer	Venmar
Model	HRV 450w
Supply Fan	
- Tag	n/a
- Volume, L/s (cfm)	236 (500)
- ESP, Pa (in.wg.)	125 (0.5)
- Fan Type	
- Fan Speed, rpm	
- Motor Power, kW (hp)	
- Power Supply	208/1/60
Return Fan	
- Tag	
- Volume, L/s (cfm)	
- ESP, Pa (in.wg.)	
- Fan Type	
- Speed, rpm	
- Motor Power, kW (hp)	
- Power Supply	
Minimum Outdoor Air, L/s (cfm)	47 (100)
Heating Section	
- Type	Electric resistance
- Electric Element, kW	7.5
- Temperature Rise, °C (°F)	29 (53)
- MCA / MOP	46.4 / 50
DX Coil	See 15999 Schedule 1.3
- Tag	
- Size, H x L, mm	
- Face Area, m² (ft²)	
- Rows / FPI	
- Face Velocity, m/s (fpm)	
- Air side P.D. Pa (in.wg.)	
- Clg. Capacity, kW (TR)	
- EAT DB/WB, ºC (°F)	
- LAT DB/WB, ºC (°F)	

LIST OF SCHEDULES

1.1 Air Handling Unit Schedule (Cont'd.)

TAG	HRV-1
Condensing Unit	See 15999 Schedule 1.6
- No. of Cond. Fans	
- Cond. Fan Power, kW (hp)	
- No. of Compressors	
- Power Supply	
Minimum Circuit Ampacity	
Arrangement	
- Supply Outlet	Top ducted
- Return Inlet	Bottom Plenum
- Outdoor Air Inlet	Rear
- Exhaust Air Outlet	Rear
Physical Data	
- Overall Depth, mm	521
- Overall Width, mm	813
- Overall Height, mm	1651
- Overall Weight, kg	159

1.2 Exhaust Air Fan Schedule

TAG	SPF-1	EF-1
Function	Crawlspace exhaust	Washroom Exhaust
Location	Crawlspace	Washroom
Volume, L/s (cfm)	66 (140)	46 (98)
E.S.P. Press, Pa (in.wg.)	37 (0.15)	62 (0.25)
Fan Speed, RPM	1550	950
Motor Power, W	39	80
Power Supply (V/Ph/Hz)	120/1/60	120/1/60
Drive	Direct	Direct
Type	Sidewall propeller	Inline Cabinet
Arrangement	Inline	Inline
Manufacturer	Greenheck	Greenheck
Model	S1-8-426-D	CSP-B110
Control	Temperature and humidistat control	Light Switch
Accessories & Remarks		

Accessories: (Select
1. Gasketted bolted access door
2. Housing drain with plug

Appropriate)

3. Totally enclosed belt guard
4. Shaft and bearing guard
5. Extended grease fittings
6. Fan base and vibration isolators
7. Weatherproof motor
8. Drive cover
9. Shaft seal

1.3 Cooling Coil Schedule

TAG	UH-1
Location	Mechanical Room
Type	Vertical Air Flow
Capacity, kW (MBH)	5.3 (18.1)
Air Flow Rate l/sec (cfm)	283 (600)
Size H x L x W, mm	451 x 359 x 414
Face Velocity m/sec (fpm)	2.5 (492)
Max Airside ΔP, Pa (in wg)	30 (0.12)
EAT DB/WB ºC (ºF)	23.7/17.6 (74.7/63.7)
LAT DB/WB ºC (ºF)	14.6/14 (58.3/57.2)
Manufacturer	Carrier
Model	CAPV 2414

1.4 Electric Unit Heater Schedule

TAG	UH-1
Location	Crawlspace
Type	Electric Forced Air
Capacity, kW (MBH)	5 (17.1)
Temp. Rise ºC (ºF)	22.2 (40)
Air Flow, L/s (cfm)	191 (405)
Power Supply, V/ph/Hz	240/1/60
Manufacturer	Chromalox
Model	UB-502

LIST OF SCHEDULES

1.5 Tank Schedule

TAG	TNK-1	TNK-2	SP-1
Service	Potable water	Sewage holding	Sump pit tank
Location	Mechanical room	Crawlspace	Crawlspace
Type	Polyethylene tank	Polyethylene tank	Polyethylene tank
Capacity, L (USgal)	568 (125)	2955 (780)	200 (53)
Diameter, mm	750	N/A	450
Height/Length, mm	1630	3048 x 1524 x 787	1200
Manufacturer	Equinox	Equinox	Equinox
Model	E-125W	E650 LP-S	E SP-1848
Accessories	c/w float switch, control panel & L.E.D.	c/w float switch, control panel, L.E.D. & buzzer warning	

1.6 Pump Schedule

TAG	P-1	P-2
Function	Potable Water Pump	Sump pump
Location	Mechanical room	Sump pit
Type	Multi-stage centrifugal pump	Fully submersible
Impeller	Stainless steel	
Casing	Stainless steel	
Medium Pumped	Potable water	water
Design Pressure, Pa (psi)	999.7 (145)	
Maximum Operating Temp., ºC (ºF)	120 (248)	70 (158)
Pump Speed, RPM	3500	N/A
Design Flow Rate, L/s (USgpm)	0.50 (8.0)	1.26 (20)
Discharge Head, kPa (ft. water)	197 (66)	38.8 (13)
Suction/Discharge Sizes, mm	25/25	32
Motor Power, kW (hp)	0.75 (1.0)	0.9 (0.25)
Power Supply, V/ph/Hz	208/1/60	120/1/60
Manufacturer	Grundfos	Grundfos
Model	CHIE 2-40 (Plus)	KP150
Note	1	2

Notes:

1. Grundfos “Plus” line is a package that comes complete with an 8L stainless steel pressure tank, 4-20mA signal pressure transducer, discharge manifold, fittings and check valve.
2. Sump pump comes complete with simplex control panel, float switch and high level alarm.

LIST OF SCHEDULES

1.7 Air Cooled Condensing Unit Schedule

TAG	CU-1
Service	Building Cooling
Location	Exterior wall mounted (see drawings)
Manufacturer	Carrier
Model	24ACA318A003
Capacity, kW (MBH)	5.27 (18)
Refrigerant	R410a
Compressor L.R.A.	58.3
Compressor R.L.A.	13.5
Fan F.L.A.	0.75
M.C.A.	17.6
Electrical (V/ph/Hz)	230/1/60
Remarks	Complete with: Uncased DX cooling coil (Carrier model: CAPVU1814ACA) with TX valve and refrigeration lineset.

1.8 Air Outlet Schedule

Tag	Manufacturer Model No.	Border/ Frame	Blade Orientation	Neck Size (mm)	Fastening	Finishes
A	E.H. Price 520	32 mm Frame	Front blades parallel to short dimension	See Drawings	Counter-sunk	White powder coat
B	E.H. Price 530	32 mm Frame	Front blades parallel to short dimension	See Drawings	Counter-sunk	White powder coat

LIST OF SCHEDULES

1.9 Domestic Hot Water Tank Schedule

TAG	HWT-1
Service	Scale facility
Location	Mechanical room
Manufacturer	Bradford White
Model	LD-WH6U3
Dimensions	
Capacity, L (USgal)	23 (6)
Height, mm	400
Diameter, mm	356
Element Size, kW	1.5
Recovery Rate @ 56°C , L/hr (USgph)	22.7 (6)
Electrical, V/ph/Hz	208/1/60
Remarks	Wall hung model

END OF SECTION