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**COMMON WORK RESULTS FOR HVAC**

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**1. GENERAL**

**1.1 Intent**

- .1 Provide complete, fully tested and operational HVAC systems to meet the requirements described herein and in complete accordance with current edition of 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 Follow manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .4 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.
- .5 Install equipment to provide access and ease of maintenance.
- .6 Connect to equipment specified in other Sections. Uncrate equipment, move in place and install complete; start-up and test.
- .7 Install control valves, control dampers, thermal wells, and other devices on piping and ducts.
- .8 'Provide' shall mean 'supply and install'.

**1.2 Coordination of Work**

- .1 Make reference to electrical, plumbing, controls, 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.
- .2 Where dimensional details are required, work with the applicable architectural and structural drawings.
- .3 Full-size and detailed drawings shall take precedence over scale measurements from drawings. Drawings shall take precedence over specifications.
- .4 Any areas indicated as space for future materials or equipment shall be left clear.

**1.3 Permits**

- .1 All work shall comply with provincial, municipal, bylaws and authorities having jurisdiction.
- .2 Obtain all permits and pay all fees applicable to the Work.

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- .3 Contractor shall arrange for inspections of the Work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.

**1.4 Metric Conversion**

- .1 All units in this division are expressed in SI units.
- .2 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)	

- .3 Metric Duct Sizes:
  - .1 The Metric duct sizes are expressed as 25 mm = 1 inch.

**1.5 Substitute Materials and Equipment**

- .1 The Contract shall be based on the use of materials and equipment as specified or as contained within the Acceptable Manufacturers List.
- .2 The Contractor may request substitutions if they believe that such substitutions will not impact the functionality of the Work. Such requests must include a description of why the substitution is equal or better than the original requirement. Where such substitutions require an engineering change, the Contractor shall engage a professional engineer to sign and seal the request. Time spent reviewing requests for substitutions whether approved or not, will be charged to the Contractor and deducted from the Contractors next progress claim.
- .3 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.

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- .4 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.

### 1.6 Shop Drawings

- .1 Provide Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures, for all scheduled equipment and as specified in specific equipment sections of this specification. Submit electronic copies in pdf format using original documents or create the pdf. Scanned copies shall be rejected. For printed submittals, submit original printed documents. Photocopied or faxed documents will be rejected.
- .2 Submit all Shop Drawings and maintenance manuals in SI units. On all Shop Drawings use the same SI units as stated in the Specification or in the schedules or both. Where information is not produced in the same SI units as stated in the Specification or in the schedules or both, the Contractor will provide converted values. Shop Drawings not presented in the same SI units as stated in the Specification or in the schedules or both or without converted values will be rejected.
- .3 Clearly mark each Shop Drawing with the Specification Section number together with the clause number or schedule number and the item tag number (where applicable) to which it refers. Failure to include this information on Shop Drawings will result in the drawings being rejected.
- .4 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.
- .5 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.
- .6 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 Consultant.
- .7 Installed materials and equipment shall meet specified requirements regardless of whether or not Shop Drawings are reviewed by the Contract Administrator.
- .8 Do not order equipment or material until the Contract Administrator has reviewed and returned Shop Drawings.
- .9 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 Drawing with the requirements of the Work. The Contractor's review of each Shop Drawing shall be indicated by stamp, date and signature of the Contractor's designated project manager.
- .10 Retain one copy of Shop Drawings on Site for review.

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### 1.7 Salvage

- .1 Remove from Site all equipment, ducting or piping which is no longer required because of work under this Contract.
- .2 Turnover to and deliver to the City's storage area all items which have been determined to have salvage value and have been removed due to the Work.

### 1.8 Cutting, Patching and Coring

- .1 Provide holes and sleeves, cutting and fitting required for HVAC work.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Obtain written approval from the Contract Administrator before cutting or burning structural members.
- .4 Provide openings and holes required in precast members for HVAC 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.

### 1.9 Outdoor Piping Sealant

- .1 Unless otherwise noted, all outdoor openings around pipe penetrations shall have the gap filled with an adhesive/sealant to provide a weatherproof seal.
- .2 Adhesive/sealant shall be polyurethane based, temperature range of -40°C to 93°C, paintable with the use of primer, sandable, and have high UV resistance.
- .3 Acceptable adhesive/sealant: Silaprene Solid Seal from Faucher Industries (Model: 642-2256, White)
- .4 Acceptable adhesive/sealant: Silaprene Solid Seal from Faucher Industries (Model: 642-2263, Grey)
- .5 Acceptable adhesive/sealant: Silaprene Solid Seal from Faucher Industries (Model: 642-2270, Black)

### 1.10 Installation of Equipment

- .1 Pipe all equipment drains to building drains.
- .2 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.
- .3 Maintain permanent access to equipment for maintenance.

### 1.11 Fire-Stopping

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- .1 Fire-stop all pipe, duct, conduit and wire penetrations through floors and walls, designated as fire and/or smoke separations.
- .2 Fire-stopping materials tested to CAN/ULC-S115. 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.

#### 1.12 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 five (5) working days written notice for all service shutdown.
- .3 Interruptions and shutdowns of existing services shall be by the building/plant maintenance staff.

#### 1.13 Equipment and Materials

- .1 Each major component of equipment shall bear manufacturer's name, address, catalogue and serial number in a conspicuous place.
- .2 Where two or more products of the same type are required, products shall be of the same manufacturer.

#### 1.14 Equipment Protection and Clean-Up

- .1 Protect equipment and materials in storage on Site during and after installation until Total Performance. 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 At no cost to the contract, the Contractor shall repair and/or replace any installed equipment or material which is deemed to be damaged by the Contract Administrator to the Contract Administrator's satisfaction.
- .4 Operate, drain and flush out unsealed bearings and refill with new change of oil, before Total Performance.
- .5 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.
- .6 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .7 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

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**1.15 Electrical Motors**

- .1 Supply HVAC 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, CEC Part 1, IEEE and ANSI. All motors to be CSA labelled. All motors to be approved for use in the designated area classification by authorities having jurisdiction.
- .3 All motors intended for use with a variable speed drive (variable frequency drive) shall be inverter only rated. Variable speed drive shall be matched to motor. Coordinate with Division 26.
- .4 Two speed motors shall have separate winding for each speed.
- .5 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.
- .6 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.
- .7 Motors less than ½ hp shall be 120 V, 60 Hz, 1 phase. Motors ½ hp and larger shall be 3 phase at the indicated voltage.
- .8 All motors shall be 1800 rpm except where indicated.
- .9 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.
- .10 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.
- .11 Refer to electrical specifications, Division 26, for voltage, frequency, and phase data. This shall take precedence over any reference in Division 22.
- .12 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.

**1.16 Access Doors**

- .1 Provide access doors for maintenance or adjustment purposes for all HVAC system components including:
  - .1 Valves
  - .2 Volume and splitter dampers
  - .3 Fire dampers
  - .4 Cleanouts and traps
  - .5 Controls, coils and terminal units

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- .6 Expansion joints
- .7 Filters
- .8 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 Mark removable ceiling tiles used for access with colour coded dots.
- .4 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.
- .5 Provide ULC-listed fire rated access doors installed in rated wall and ceilings.

**1.17 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.
  - .3 Access platforms and catwalks.

**1.18 Escutcheon and Plates**

- .1 Provide escutcheon and plates on piping and ductwork passing through finished walls, floors and ceilings.
- .2 Escutcheons shall be the splitless type, stainless or chrome plated steel.

**1.19 Substantial Performance and Total Performance**

- .1 Progress payments beyond 95% will not be considered unless the following items are completed:
  - .1 Heating air conditioning, plumbing and fire protection systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation. Commissioning checklists must be submitted prior to the request by the Contractor to have a Substantial Performance inspection.
  - .2 The necessary tests on equipment and systems including those required by authorities have been completed with certificates of approval.

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- .3 Air and water systems have been balanced with draft report submitted to the Contract Administrator.
  - .4 Valve tagging and equipment identification is complete.
  - .5 Warranty forms have been mailed to the manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one year.
  - .6 Systems have been chemically cleaned. Flush and initiate water treatment. Provide report from manufacturer's representative to confirm status of treatment.
  - .7 Draft Operating/Maintenance Manuals have been submitted.
  - .8 Operating and Maintenance demonstrations have been provided to the Contract Administrator.
  - .9 Written inspection report by manufacturer's representative has been submitted for noise and vibration control devices and flexible connections.
  - .10 Record drawings have been submitted.
  - .11 Fan plenums have been cleaned, and temporary filters have been replaced with permanent filters.
  - .12 All previously identified deficiencies have been corrected.
- .2 The following shall be an outline checklist of the minimum requirements to be met by the Contractor prior to the Contractor requesting an inspection for final deficiency purposes by the Contract Administrator. In addition to the checklist the Contractor shall provide a list of item known prior to inspection to have been identified as deficient and still to be rectified to the Contract Administrator's satisfaction.
- Complete Commissioning Checklists
  - Final Plumbing Inspection Certificate from local plumbing inspector
  - Final Gas Inspection Certificate from local gas inspector
  - Final Backflow Prevention test reports for all backflow devices
  - Controls Commissioning, Checklist and 15 day trend logs for all major equipment (AHU's, Chiller/Boiler Plants, selected space sensors)
  - Vibration isolation supplier's inspection report
  - Chemical Treatment supplies final inspection and test certificate
  - Potable water main's flushing and chlorination test certificate
  - Sound level tests reports (as required)



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- Major equipment – suppliers start-up test sheets and letters certifying start up. (boilers, chillers, packaged equipment)
  - Final As-Built Drawings ready for review
  - Maintenance and operation manuals, ready for review
- .3 Prior to Final Inspection provide declaration in writing that deficiencies noted at time of inspection for final deficiencies have been corrected and the following items completed prior to the total performance inspection:
- .1 Submit final air and water balance reports.
  - .2 Submit final operating and maintenance manuals.
  - .3 Complete final calibration.
- .4 The Contract Administrator shall provide one (1) visitation for the purpose of Final Inspection. Subsequent visitations if required shall be at the expense of the Contractor.
- .5 The Contractor shall provide qualified personnel in appropriate numbers to operate the facility until substantial performance is declared.

**1.20 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:
  - .1 Access Doors Maxam, Acudor, Milcor, Can.Aqua, Mifab, The Williams Brothers Corporation
  - .2 Air Separators, Relief Valves Armstrong, Bell & Gossett, Taco, Wheatley
  - .3 Air Terminals - Grilles Registers, Diffusers E.H. Price, Titus, Anemostat, Nailor

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.4	Air Vents	Hoffman, Maid-O-Mist, Taco
.5	Balancing Agents	AMS, AHS, DFC, Airdronics
.6	Bypass Filter	Lakos, Sumco, GESL, Pace Chemicals
.7	Chillers - Centrifugal	McQuay
.8	Dampers – Balancing	Maxam, Ruskin
.9	Dampers - Fire	Controlled Air, Ruskin, Canadian Advanced Air, Maxam, Nailor
.10	Flexible Connectors - Ducting	Thermafex, G.I. Industries Type IHP
.11	Flexible Connectors - Piping	Flexonics, Tube Turn, Atlantic, Hyspan, Hydroflex, Metraflex, United Flexible, Mason
.12	Flexible Duct	Thermafex, Wiremold, GI Industries Type H.P.
.13	Gauges - OWG Pressure	Terice, Marsh, Ashcroft, Weiss
.14	Heat Pumps – Water to Water	Tandem, AAF-Enercon, McQuay, Trane, Friedrich,
.15	Heat Pumps – Air to Water	McQuay, AAF-Enercon, Trane, Friedrich
.16	Insulation - Piping and Duct	Fibreglass Canada, Manson, Knauf Fibreglass, Plasti-Fab, Manville
.17	Pipe Restraints	Trelleborg
.18	Piping Hangers and Saddles	Grinnell, Myatt
.19	Plug Cocks	DeZurik, Newman-Milliken
.20	Pumps - Vertical In-Line and Base Mounted	Armstrong, B & G, Taco, Leitch, Grundfos
.21	Strainers	Armstrong, Sarco, Mueller, Toyo, Anderson, Metraflex, Yarway
.22	Tank - Diaphragm Type Expansion	Amtrol, Hamlet and Garneau Inc.
.23	Thermometers	Terice, Marsh, Ashcroft, Winters
.24	Valves - Butterfly	Jenkins, Keystone, DeZurik, Centreline, Monotight, Dresser, Lunkenheimer, Crane, Bray, Toyo, Grinnell
.25	Valves - Circuit Balancing	Armstrong, B & G, Wheatley, Tour & Anderson

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.26 Valves - Swing, Check, Ball	Jenkins, Toyo, Crane, Kitz, Milwaukee
.27 Valves - Silent Check	Val-matic, APCO, StreamFlo
.28 Valves - Suction Diffusers Combination Check and Balance	Armstrong, B&G, Taco
.29 Vibration Isolation	Mason, Vibro Acoustic

**1.21 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. Prior to commencing installation of rough-in for the equipment, coordinate with the final reviewed equipment Shop Drawings and with the manufacturer.
- .2 Arrange piping connections to allow for equipment removal.

**1.22 Maintenance**

- .1 Furnish spare parts in accordance with Section 01 33 00 - Submittal Procedures as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

**2. PRODUCTS**

**2.1 Counter Flashing Materials**

- .1 Counterflashings: galvanized sheet steel of 0.85 mm minimum thickness.
- .2 Counterflashings are attached to HVAC 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.

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**3. EXECUTION**

**3.1 Painting Repairs And Restoration**

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

**3.2 Cleaning**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

**3.3 Field Quality Control**

- .1 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

**3.4 Demonstration**

- .1 Contract Administrator will use equipment and systems for test purposes prior to Total Performance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
  - .1 Domestic hot water heater performance verification.
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to Total Performance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Contractor will record these demonstrations on video tape for future reference.

**END OF SECTION**