

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 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 head room 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 and to equipment supplied and installed by other Contractors or by the City. 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, furnished by Controls Contractor.
- .8 'Provide' shall mean; supply and install'.
- .9 Contract Administrator shall mean Earth Tech (Canada) Inc.

1.2 Co-ordination of Work

- .1 Co-operate and co-ordinate 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 Where dimensional details are required, work with the applicable architectural and structural drawings.
- .4 Full size and detailed Drawings shall take precedence over scale measurements from Drawings. Drawings shall take precedence over specifications.

- .5 Any areas indicated as space for future materials or equipment shall be left clear.

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

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

1.4 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.

1.5 Shop Drawings

- .1 Provide printed copies of shop drawing, in accordance with Section 01300 – Submittals, for all scheduled equipment and as specified in specific equipment sections of this specification.
- .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 additional information as specified in specific equipment sections of this specification.
- .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 Retain one copy of shop drawings on site for review.

1.6 Cutting, Patching and Coring

- .1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.
- .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 mechanical work. Cast holes 100 mm (4 in) or larger in diameter. Field-cut smaller than 100 mm (4 in).
- .5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

1.7 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.

1.8 Connections to Existing Services

- .1 Maintain liaison with the City 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 48 hours notice for all service shutdown.
- .3 Interruptions and shutdowns of existing services shall be by the building/plant maintenance staff.

1.9 Equipment and Materials

- .1 Refer to Section 01600 – Material and Equipment.
- .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.

1.10 Equipment Protection and Clean-Up

- .1 Refer to Section 01600 – Materials and Equipment.
- .2 Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .3 Protect equipment with polyethylene covers and crates.
- .4 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.
- .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.

1.11 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, 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 the Provincial Electrical Protection Branch. All motors intended for use with a variable speed drive (variable frequency drive) shall be inverter only 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 ½ hp shall be 120 V, 60 Hz, 1 phase. Motors ½ hp and larger shall be 3 phase at the indicated voltage.
- .6 All motors shall be 1800 rpm unless indicated otherwise.
- .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 in Manitoba Hydro's latest high efficiency motor incentives program, or the following table, whichever indicates the higher minimum efficiency.

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
20	90.2	91.0	90.2	89.5
25	90.5	91.7	91.3	89.6
30	90.8	91.9	91.4	90.7
40	91.4	92.5	92.3	90.6
50	91.9	92.7	92.3	91.3
60	92.4	93.2	92.9	91.6
75	92.5	93.5	93.1	92.8
100	93.0	93.7	93.5	92.7

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

1.12 Access Doors

- .1 Provide access doors for maintenance or adjustment purposes for all mechanical system components including:
 - Volume and splitter dampers;
 - Controls, coils and terminal units;
 - 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 Mark removable ceiling tiles used for access with colour coded dots.
- .4 Sizes to be 200 mm x 200 mm (8 in x 8 in) for cleanout, 300 mm x 300 mm (12 in x 12 in) for hand 600 mm x 600 mm (24 in x 24 in) for body access minimum.
- .5 Provide ULC-listed fire rated access doors installed in rated wall and ceilings.

1.13 Miscellaneous Metals

- .1 Provide all necessary miscellaneous to hang or support materials, equipment and provide access for work under this Contract.
- .2 All miscellaneous metals shall be prime painted for interior applications and galvanized for exterior applications.
- .3 Miscellaneous metals shall include but not limited to:
 - .1 Hangers for equipment, piping and ductwork.
 - .2 Support for equipment.
 - .3 Access platforms and catwalks.

1.14 Pipe Sleeves

- .1 Pipe sleeves shall be provided for piping passing through walls and floors. Minimum 0.61 mm (24 ga) galvanized sheet metal. Sleeves shall extend 25 mm (1 in) on either side of the wall.

- .2 Schedule 40 steel pipe shall be used as floor pipe sleeves in wet areas with a 50 mm (21 in) up-stand.
- .3 Pipe sleeves are not required where pipes pass through cored concrete walls or floors.

1.15 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.

1.16 Identification

- .1 Co-ordinate colour coding of piping and equipment with work of Division 9.
- .2 Colour code mechanical equipment, piping and exposed ductwork. Refer to colour schedule at end of this section.
- .3 Legend and direction of flow arrows shall consist of adhesive backed labels, yellow colour, with minimum 20 mm (3/4in) high black lettering equal to Brady System B-500, vinyl cloth labels for non-insulated surfaces; and Brady B 946 for insulated surfaces.
- .4 Identify piping with labels, colour bands, and flow arrows. Provide identification at 15 m (50 ft) maximum intervals, before and after pipes pass through walls, at all sides of tees, behind access doors and in equipment rooms as required.
- .5 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.
- .6 Provide 20 mm (3/4 in) 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.

- .7 Tag automatic controls, instruments and relays and match/key to control shop drawing identification numbers. Tag all equipment and control panels.
- .8 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.
- .9 Identify the usage of duct access panels with self adhesive Brady stick-on coloured labels. Apply labels conforming to the following schedule.

	<u>Color</u>	<u>Letters</u>
Cleaning and service access	yellow	C.A.
Controls, including heat sensors	black	C.
Dampers (backdraft, balance & 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.

- .10 Identify the location of the following items of equipment, which are concealed above a ceiling with Avery "Data Dots". Place identification dots on the access panel. The colours shall conform to the following schedule:

Concealed equipment and cleaning access	yellow
Control equipment, including control dampers and valves, and heat sensors	black
Fire, smoke, and sprinkler equipment including dampers	red
Pipe mounted equipment with the exception of fire, smoke, sprinkler and control equipment	green
Balancing Dampers	blue

When T-bar ceilings are installed, adhere "Data Dots" on T-bar framing adjacent to panel to be removed.

1.17 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

.3 Identification Symbols and Colours for Equipment:

	<u>Pipe Colour</u>	<u>Stripe Colour</u>	<u>Symbol</u>
Fan Guards - Motor Guards	Red	Machinery Enamel	
Supports	Black	None	None

.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 to be identified as follows, complete with directional arrows:

Return Air	R.A.
Supply Air	S.A.
Mixed Air	M.A.
Combustion Air	Comb.Air
Relief Air	Relief Air
Exhaust Air	Exh.Air.

1.18 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.

1.19 Substantial and Total Performance

- .1 Prior to requesting an inspection for Substantial Performance, provide a complete list of items, which are deficient.
- .2 A certificate of Substantial Performance will not be granted 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 completion inspection.
 - .2 The necessary tests on equipment and systems including those required by authorities have been completed with certificates of approval.
 - .3 Air and water systems have been balanced with draft report submitted to 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 City.
 - .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.
- .3 The following shall be an outline checklist of the minimum requirements to be met by the Contractor prior to the Contract Administrator's Substantial Performance by the Contractor.

Inspection:

- Complete Commissioning Checklists
- Final Plumbing Inspection Certificate from local plumbing 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 corners)
 - Fire alarm test certificate (via DIV.16)
 - Fire stopping and Fire Damper test letter
 - Chemical Treatment supplies final inspection and test certificate
 - Potable water main's flushing and chlorination test certificate
 - 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
- .4 Prior to Total Performance Inspection provide declaration in writing that deficiencies noted at time of substantial performance inspection 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.
- .5 The Contract Administrator shall provide one (1) visitation for the purpose of total performance inspection. Subsequent visitations if required, shall be at the expense of the Contractor.
- .6 The Contractor shall provide qualified personnel in appropriate numbers to operate the facility until substantial performance is declared.

1.20 Acceptable Manufacturers

- .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 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:
 - .1 Access Doors
 - .1 Maxam
 - .2 Acudor
 - .3 Milcor
 - .4 Can. Aqua, Mifab
 - .2 Air Handling Units
 - .1 AAON
 - .3 Backdraft Dampers
 - .1 Airolite
 - .2 Vent-Aire
 - .3 Penn
 - .4 T.A. Morrison
 - .4 Balancing Dampers
 - .1 Maxam
 - .2 Ruskin
 - .5 Filters
 - .1 Cambridge
 - .2 AAF
 - .3 Pacific
 - .4 FARR
 - .6 Flexible Connectors - Ducting

- .1 Termaflex
- .2 G.I. Industries Type IHP
- .7 Gauges – Air
 - .1 Dwyer
 - .2 Magnehelic

2. PRODUCTS

2.1 Counter Flashing Materials

- .1 Counterflashings: galvanised 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