

- 1 General
- 1.1 **SUMMARY**
 - .1 Section Includes
 - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
 - .2 The terms "Mechanical Work", "Mechanical Contractor" or their derivatives includes the work of Division 21, 22, 23 and 25 unless otherwise specified.
- 1.2 **CODES, REGULATIONS AND STANDARDS**
 - .1 Comply with municipal or provincial codes, rules and regulations and/or authorities having jurisdiction.
 - .2 Comply with the National Building Code in areas where municipal or provincial regulations and/or codes are not mandatory.
 - .3 Comply with the Occupational Health and Safety Act and Regulations for Construction Projects, Ontario Regulation 691.
 - .4 Owners Health and Safety Requirements.
 - .5 Revisions issue: Latest version as amended to date.
- 1.3 **PERMITS AND INSPECTIONS**
 - .1 Material Approvals
 - .1 Obtain special inspection and approvals by CSA and/or local authorities, for materials where specified.
 - .2 Obtain such approval for the particular installation with the co-operation of the material Supplier.
 - .2 Permits
 - .1 Obtain permits required for the installation of mechanical trades work including:
 - .1 Plumbing inspection
 - .2 Pressure vessel inspection
 - .3 Piping and boiler inspection
 - .4 Electrical inspection
 - .2 Arrange for inspections and tests and pay all fees and costs for the permits, inspections and tests. Obtain permits immediately after notification of award of Contract.
 - .3 Obtain copies of Drawings from the Consultant for submission with application for permits.

1.4 **WORKING DRAWINGS AND DOCUMENTS**

.1 Design Drawing Intent

- .1 The Design Drawings are schematic in arrangement, and describe the general design intent but do not show the exact details for the installation. They are not fabrication or installation drawings.
- .2 The Work is suitably outlined on the Drawings with regard to sizes, locations, general arrangements and installation details, and has been generally coordinated for routing of services. The routing of ductwork, piping and equipment arrangement are shown more or less in diagram except where in certain cases the Drawings may include details giving the exact locations and arrangements required.
- .3 The location of equipment, and the associated arrangement of piping, ductwork, and other material describes the general requirements of the Work. Final location is dependant on the actual equipment supplied. The Consultant reserves the right to make reasonable adjustment of up to 1 m to the location of equipment, floor drains, routing of major piping and ductwork, at no cost to the Owner.
- .4 In order to provide clarity to the arrangement of the work, not all details including valves, thermometers, pressure gauges, etc. are shown on the Plan Drawings. Refer to Schematic Drawings, standard details and the Specification for these requirements.
- .5 Where specific installation dimensions for location of equipment and access space requirements are indicated on the Drawings, install to these requirements.
- .6 Where standard details are provided, these show the general installation requirements, and are applicable to each occurrence in the Work, unless otherwise specified or shown.

.2 Contractor Coordination Responsibilities

- .1 Provide the services of a mechanical/electrical coordination supervisor, to coordinate this division of the Work, as well as providing coordination with other divisions and/or contracts. This supervisor may be full time or part time on site, as appropriate to the work stage and complexity of the work, at the discretion of the Owner.
- .2 Where multiple trades are required, the mechanical coordinating supervisor shall be the lead coordinator.
- .3 The Owner reserves the right to require the coordinating supervisor to increase their attendance at site, at no cost to the Owner, if in the Owner's opinion the current level of coordination is not sufficient for the progress of the Work.
- .4 Make changes and modifications as necessary to ensure coordination and to avoid interference and conflicts with other trades.
- .5 Prepare Construction/Installation/Fabrication Drawings, coordinated with other trades and contracts, as required.
 - .1 Provide sufficient detail to disclose critical interferences of major equipment and services to ensure adequate accessibility.

- .2 Specific dimensions for equipment location or access which are shown on the Consultant's drawings.
 - .3 Indicate sleeves, openings and stress points (such as anchors, guides and inserts)
 - .4 Indicate deviation in sizes and weights and also in water, drainage, electric power or other service requirements for all equipment proposed which is different from those shown on the Design Drawings.
 - .5 Provide these Drawings to other trades for coordination with their Work.
 - .6 Update these Drawings as part of the As-Built Drawings, showing actual locations of major equipment, services, access doors, shut-off valves, etc.
 - .6 The Design Drawings show the major requirements for the installation of equipment based on one manufacturer's requirements, but may not show all installation requirements. The Contractor will include as part of the Work the specific manufacturer's installation requirements for the equipment actually provided by the Contractor.
 - .7 The Construction/Installation/Fabrication Drawings are not to be submitted as Shop Drawings. Make them available for viewing at site when requested by the Consultant.
 - .3 Review Before Proceeding (HOLD)
 - .1 Where the word "HOLD" appears on Drawings and other Contract Documents, the Work is included in the Contract.
 - .2 Execute such Work only after verification of dimensions, verification of materials and obtaining Consultant's written permission to proceed.
- 1.5 **COORDINATION AND EXAMINATION**
- .1 Reference
 - .1 To Section 01 10 00.
 - .2 Examination
 - .1 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences.
 - .2 Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.
 - .3 Coordination
 - .1 Coordinate Work of Mechanical Division such that items will properly interface with Work of other divisions. Prepare Installation Drawings of critical locations and submit to Consultant for review.
 - .2 Architectural Drawings, or in their absence, Mechanical Drawings govern all locations.

.4 **Measurements and Deviations**

- .1 Where any parts of the mechanical work are specifically located by dimensions on the Drawings, check and verify these dimensions on site prior to installation.
- .2 Before installing piping, review Architectural, Structural and Electrical Drawings with Mechanical Drawings
- .3 Where interference may occur and departures from arrangements as shown are required, consult with other trades involved, come to agreement as to changed locations or elevations and obtain approval of the Consultant for proposed changes before proceeding with the Work.
- .4 Where site conditions require minor deviations from indicated arrangements or locations, make such changes on approval of the Consultant without additional cost to the Owner.
- .5 Should any discrepancies occur during installation of mechanical work which will necessitate major revisions to the mechanical trades work or the work of other trades or contractors, notify the Consultant immediately and obtain written authorization before proceeding with the work.

1.6 **SCAFFOLDING AND HOISTING EQUIPMENT**

.1 **References**

- .1 To Section 01 10 00.

.2 **Building Attachments**

- .1 Obtain prior written Consultant's approval before drilling, cutting or welding of the building steel or building structure for erection of materials or equipment.

.3 **Overloading**

- .1 During installation of mechanical work, do not load any part of the building structure with a load greater than it is capable of bearing.
- .2 Should any accident occur or damage result through the violation of this requirement, the contractor shall be held solely responsible.
- .3 Design temporary supports used during installation as being equivalent to permanent supports.
- .4 Remove temporary supports at completion of Work.

1.7 **CUTTING AND PATCHING**

- .1 Do not cut, remove or burn structural parts or sections of the building, whether they are steel, concrete or masonry without the written authorization of the Consultant.
- .2 Should cutting, repairing, and patching of previously finished work of other trades be required to allow installation of mechanical work, pay all costs for the trade concerned to perform the work.

1.8 **EXISTING SERVICE**

- .1 Tie-In to Existing Services

- .1 Do not shut down or make tie-in connections to any existing service without written permission of the Owner and/or Consultant.
- .2 Arrange work to minimize interruption to physical access to the building.
- .3 Include for all costs associated with making connections to existing services, including but not limited to, cutting and patching of existing floors, partitions, ceilings and finishes.
- .2 Work in Existing Buildings
 - .1 Route pipes, ducts, conduits and other services to avoid interference with existing installation.
 - .2 Relocate existing services and equipment to suit installation of new work.
 - .3 Cut back and cap existing services not being used, so that finished Work presents a neat and clean appearance.
 - .4 Unless noted to be reused, fixtures and materials being removed become the property of the Contractor and are to be removed from site, unless otherwise noted.
- .3 Continuity of Services
 - .1 Be responsible for any damage to existing systems, including insulation and coverings, when making connections.
 - .2 Keep existing buildings in operation with minimum length of shut-down periods.
 - .3 Include overtime work to tie-in piping or wiring at night or on weekends.
- 1.9 **PROVISION FOR FUTURE**
 - .1 Future Equipment
 - .1 Where indicated as reserved for future equipment or services, leave identified space clear and install services and equipment so that connections can be made in the future.
- 1.10 **SUBMITTALS**
 - .1 Shop Drawings
 - .1 Conform to Section 01 33 00 and the following.
 - .2 Shop Drawings showing more than one size or model will not be considered unless properly marked up.
 - .3 For electrically driven, and fuel fired appliances, provide the following information:
 - .1 Electrical characteristics including voltage, phase, frequency and power rating.
 - .2 For motors, NEMA, class and efficiency ratings
 - .3 Fuel input ratings, including flow rates and pressures

- .4 Equipment performance ratings, including flow rates, pressures, efficiencies, part load values and/or efficiencies (IPLV's), plotted flow characteristics (pump and fan curves) with operating points clearly plotted.
- .4 For other equipment include the following information:
 - .1 Equipment performance ratings, including flow rates, pressures drops.
 - .2 Electrical control power requirements.
- .5 For all equipment, include the following:
 - .1 Equipment dimensions and weights.
 - .2 Itemized product description with optional items clearly marked as being included.
- .6 Provide wiring Shop Drawings:
 - .1 Wiring diagrams and schematics for all equipment which has electrical controls or devices furnished with the equipment.
 - .2 Wiring diagrams alone are not sufficient; schematic and interconnecting drawings, and sequence of operation of equipment are required for review.
 - .3 Clearly indicate the materials and/or equipment being supplied:
 - .1 Details of construction, finish, accurate dimensions, capacities and performance.
 - .2 Certify Drawings correct for construction by the manufacturer, before submission.
 - .3 Identify Equipment Shop Drawings with designations as shown on the Drawings or in the Specifications.
 - .4 If not complied with, Shop Drawings will not be reviewed and will be returned to the Contractor.
 - .4 Coordinate equipment which attaches to and/or where external wiring provided connects to other equipment.
 - .1 Do such coordination whether such equipment is supplied under this or other contracts or subcontracts, for which relevant information will be provided by Owner/Consultant.

1.11 **“AS-BUILT” RECORD DRAWINGS**

- .1 Reference
 - .1 Conform to Section 01 33 00.
 - .2 Maintain an accurate dimensional record of all underground piping and all deviations and changes in aboveground piping and equipment.

1.12 **INSTALLATION AND START-UP INSTRUCTIONS**

.1 Reference

- .1 Conform to Section 01 33 00.
- .2 Submit copies of installation instructions and copies of start-up instructions for any item of equipment when requested by the Consultant.

1.13 **OPERATING AND MAINTENANCE INSTRUCTION MANUALS**

.1 Reference

- .1 Conform to Section 01 33 00.
- .2 In addition, include the following in the manuals:
 - .1 Non-dimensional layout showing location of all electrical devices on mechanical equipment.
 - .2 Operating instructions, including start-up and shut-down procedure.
 - .3 Lubricating instructions and recommended cycle of lubrication for each item of equipment, including various types of lubricants.
 - .4 List of spare parts.
- .3 All the above applies to component parts of equipment whether they are manufactured by the Supplier of the equipment or are supplied as a component part of an item of equipment.

1.14 **CLEANING, TESTING AND APPROVAL RECORDS**

.1 Records

- .1 Maintain records of all pressure tests and flushing and sterilization tests, glycol/water concentrations, inspections and approvals by the plumbing inspector.
- .2 Forward these tests to the Owner on completion of the Work in accordance with Section 01 33 00.
- .3 Forward to Consultant, copy of records on site on completion of each test, cleaning operation, etc.

1.15 **DIMENSIONS AND QUANTITIES**

.1 Dimensions

- .1 Dimensions shown on Drawings are approximate.
- .2 Verify dimensions by reference to Shop Drawings and field measurement.

.2 Quantities

- .1 Quantities or lengths indicated in any of the Contract Documents are approximate only and shall not be held to gauge or limit the Work.

1.16 **TRADE QUALIFICATIONS**

.1 Applicable to the following trades

- .1 Sheet metal workers
- .2 Plumbers
- .3 Steamfitters

.2 Requirements

- .1 Trade workers to have a certificate of qualification as journeyman or apprentice registration for the province where the Work is performed or an interprovincial certificate.
- .2 Ratio of journeyman to apprentice: Not to exceed the defined ratio in the Apprenticeship Act of Ontario.
- .3 On award of Contract, submit a list of trade journeyman and apprentices, together with their certificate and registration numbers.
- .4 Certificates and registration must be provided to the Consultant on request.
- .5 Maintain on-site an up-to-date record listing journeyman and apprentices working on site.

2 Products

2.1 **MATERIALS AND EQUIPMENT**

.1 Materials

- .1 Use new materials and equipment, free from defects impairing strength and durability, as specified or specified equivalent.
- .2 Of Canadian manufacture wherever possible.
- .3 Labelled or listed as required by code and/or inspection authorities.
- .4 Design of mechanical systems has been based on the first listed Supplier and model number/size stated on the equipment schedules on the Drawings. Bear all costs due to physical or performance differences between stated equipment and proposed equipment. These differences include but are not limited to size, layout, arrangement, connection size, location and/or quantity of connections, or performance differences such as noise, power requirements, flow, throw, etc.

.2 Equipment/Structure Coordination

- .1 Locations and dimensions of curbs and roof and floor opening framing, where indicated on the Drawings, are based on an arrangement to suit the above named Supplier.
- .2 Be responsible to verify the actual size requirements of the openings, and notify the Consultant immediately in case the dimension of the unit supplied and the connecting ductwork/piping, etc. are at variance with the dimensions given on the Drawings.

- .3 Bear all costs for modification of curbs and floor/roof openings resulting from failure to notify the Consultant prior to the fabrication or construction of opening framing and curb.

2.2 **STANDARD SPECIFICATIONS**

.1 Product Quality

- .1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all Products provided comply with the latest issue of applicable standard specifications issued by authorities having jurisdiction.
- .2 Do not apply such standard specifications to decrease the quality of workmanship, Products and services required by the Contract Documents.

2.3 **CONTROL AND MONITORING OF MECHNAICAL SYSTEMS (~~FUTURE~~ BAS INTEGRATION)**

.1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:

- .1 Delta Controls
- .2 Reliable Controls
- .3 Schneider Electric SmartX Series
- .4 Distech Controls
- .5 Johnson Controls Facility Explorer
- .6 Honeywell CIPer series, Spyder Models 5 or 7

.2 BAS System Integration:

- .1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) serve, including but not limited to the following:
 - .1 Graphical user interface (monitoring and control)
 - .2 Alarming
 - .3 Data Trending
 - .4 Data Archiving
 - .5 Project Haystack naming convention
- .2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
- .3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.

.3 Licensing Requirements

- .1 Licenses shall be provided to and in the name of the City of Toronto
- .2 Licenses shall be perpetual, transferrable, assignable and royalty free.
- .3 Tridium Licenses shall allow all workbench/supervisor brands complete system access and functionality.

.4 Installer and Manufacturer Qualifications

- .1 Installer shall have an established working relationship with Control System Manufacturer.**
- .2 Installer shall have successfully completed control system's control system training. Upon request, installer shall present record of completed training including course outlines.**
- .3 It is the intent of these specifications to define an open protocol state-of-the-art distributed computerized Building Management and Control System, which is user friendly, has known reliability, is extremely responsive, and which is to be designed, installed, implemented, and supported by a local office of approved bidders.**
- .4 BAS Contractor provides three locations for successful installations of similar open protocol computer-based systems. Sites provided must consist of more than 150 hardware inputs/outputs. Project sites must be local to the location of this project.**

2.4 **MANUFACTURER'S NAMEPLATES**

.1 Metal Nameplates

- .1 Provided with raised or recessed lettering, on each piece of equipment.
- .2 Mechanically fasten nameplate on a metal stand-off bracket arranged to clear insulation.
- .3 Mount on same stand-off Underwriters Laboratories and/or CSA registration plates.

.2 Nameplate Data

- .1 Indicate:
 - .1 Size
 - .2 Capacity
 - .3 Equipment model
 - .4 Manufacturer's name
 - .5 Serial number
 - .6 Voltage
 - .7 Cycle

- .8 Phase and power of motors

2.5 **PHASE AND POWER OF BUILDING ATTACHMENTS**

.1 Welding Studs

- .1 Maximum size: 10 mm for attaching miscellaneous materials and equipment to building steel.
- .2 If the weight of materials or equipment require bolts or studs larger than 10 mm diameter, use steel clips or brackets, secured to building steel by (welding or) bolting as approved by the Consultant.
- .3 Acceptable Manufacturers:
 - .1 Graham
 - .2 Omark
 - .3 Nelson

.2 Self Drilling Expansion Type Concrete Inserts

- .1 To secure miscellaneous equipment and materials to masonry or concrete construction already in place.
- .2 Of sufficient number and size to prevent concrete from breaking away.
- .3 The use of powder or power actuated fasteners will not be allowed unless prior written approval is obtained from the Consultant.
- .4 Acceptable Manufacturers:
 - .1 ITW "Redhead"
 - .2 Star "SSS"
 - .3 USM "Parabolt"

.3 Supports For Any Suspended Items

- .1 Do not fasten/attach to or extend through steel pan type roofs or through concrete slab roofs.

.4 Beam Clamps

- .1 Two-bolt design, and of such type that the rod load is transmitted only concentrically to the beam web centreline.
- .2 The use of "C" and "I" beam side clamps, etc., will not be allowed without written consent of the Consultant.
- .3 Acceptable Manufacturers:
 - .1 Grinnell
 - .2 Myatt

- .3 Carpenter & Paterson
- .4 Taylor Pipe Supports

2.6 **DRIVES AND ACCESSORIES**

.1 Drives

- .1 V-belt drive selection: 150 percent of the motor size rating.
- .2 Sheaves: Cast iron construction with machined grooves.
 - .1 Sheaves 75 mm size and larger diameter: taper lock bushings.
 - .2 Multi-belt drives: Matched sets.
 - .3 Statically and dynamically balance all sheaves as an operating unit.
- .3 Adjustable sheaves:
 - .1 Motors less than 11 kW (15 HP) rating: Adjustable pitch motor sheave with diameter range selected to obtain specified RPM of the driven equipment at approximately the mid-point setting of the sheave.
- .4 Fixed sheaves:
 - .1 Motors of 11 kW (15 HP) and greater: Solid type.

.2 Drive Couplings

- .1 Acceptable Manufacturers:
 - .1 Falk
 - .2 Fast
 - .3 Thomas

.3 Lubricating Devices

- .1 Equipment to have oil reservoirs with level indicators, or pressure grease fittings.
- .2 Inaccessible fittings: Provide extended tubes to an accessible location.
- .3 Grease fittings: Zerk or Alemite.
 - .1 All fittings of one type.

.4 Drive Guards

- .1 To OSHA requirements.
- .2 Build guards of all welded construction on exposed rotating parts or elements and on all drives including the following:
 - .1 V-belt drives
 - .2 Flexible couplings
 - .3 Gear drives

- .3 Construction (except fan drives):
 - .1 Total enclosure type fabricated of minimum 1.3 mm (18 gauge) black sheet steel.
 - .2 Hinged side to allow access for lubrication, inspection or removal of the drive parts.
 - .3 Maximum clearance of openings in guards to rotating parts: Not to exceed 13 mm.
 - .4 Make provision for slide rail adjustment.
- .4 Construction for fan drives:
 - .1 V-belt drives: Total enclosure type as specified above.
 - .2 Enclosure sides: 13 mm mesh, 2.7 mm wire screening.
 - .3 Tachometer holes at shaft centres, reinforced as required to maintain rigidity of guard.
- .5 Flexible drive coupling guards:
 - .1 Location: Between motor and driven equipment.
 - .2 Minimum 1.3 mm (18 gauge) black sheet steel, securely fastened to the equipment baseplate and readily removable.
 - .3 Leave a clearance of approximately 13 to 25 mm between the guard and the coupling.
 - .4 Extend the guard to within 13 mm of both motor and driven equipment housing.
- .6 Rework any substandard guards supplied with mechanical equipment to conform to the above requirements.

2.7 **SEALANTS, CONCRETE AND GROUTS**

- .1 Pipe Sleeve Seals
 - .1 Acceptable Manufacturers:
 - .1 Thunderline "Link-Seal" Series LS
- .2 Concrete
 - .1 Strength: 25 MPa concrete: to CSA-A23.1/A23.2
- .3 Concrete Grouts
 - .1 Acceptable Manufacturers:
 - .1 Sternson "M-Bed Standard"
 - .2 Sika "Sikagrout 212"

- .3 Master Builders "Construction Grout"
 - .4 Meadows "CG-86"
 - .5 Euclid "Euco NS Grout"
 - .6 CPD "Non-Shrink Grout"
 - .4 Bonding Agents
 - .1 Acceptable Manufacturers:
 - .1 Sika "Sikadur 32" Hi-Mod
 - .5 Caulking Compounds
 - .1 Acceptable Manufacturers:
 - .1 Denso-Plast
 - .6 Firestopping
 - .1 ULC listed firestopping assembly
 - .2 Rating to suit wall and floor penetrations
 - .3 Acceptable Manufacturers:
 - .1 Fire Stop Systems
 - .2 Dow Corning
 - .3 3M
 - .4 Tremco
 - .5 A/D Fire Protection System
 - .6 Johns Manville
 - .7 Hilti
- 2.8 **MISCELLANEOUS**
 - .1 Access Doors
 - .1 Minimum size: 200 mm x 200 mm size, unless otherwise specified on the Drawings or in other divisions of the Specifications, or as required to replace or repair said equipment.
 - .2 Material:
 - .1 Fabricated of 2.5 mm (12 gauge) bonderized steel.
 - .2 Fabricated of 2.5 mm (12 gauge) stainless steel in areas finished with tile or marble surfaces.
 - .3 Flush mounted, concealed hinges and screwdriver lock.

- .4 Plast lock and anchor straps.
 - .5 Doors to be of a type and fire rating to suit the particular type of wall or ceiling construction in which they are to be installed.
 - .3 Acceptable Manufacturers:
 - .1 E.H. Price
 - .2 Titus
 - .3 Controlled Air
 - .4 Williams (S.M.S.)
 - .5 Acudor
 - .2 Isolating Unions
 - .1 Acceptable manufacturers:
 - .1 Epco
 - .2 Marpac "Petro"
 - .3 Corrosion Service
 - .3 Fabricated Equipment Supports (Floor Stands and Ceiling or Wall Mounted Supports)
 - .1 Structural steel members of welded construction or steel pipe and fittings, suitably braced and secured to the floor by mild steel floor pads or pipe flanges with bolts or anchors.
- 3 Execution
- 3.1 **GENERAL**
 - .1 Execute Work in accordance with requirements specified in the various sections of Division 23.
 - .2 Lay out Work of each trade so that it does not interfere with work under other divisions of Specifications.
 - .3 Make good any damage to Owner's property or other trade's work caused by improperly locating or carrying out of Work.
 - .4 Supply anchor bolts and templates for installation by other divisions.
 - .5 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided alteration is made before installation.
- 3.2 **EQUIPMENT INSTALLATION**
 - .1 General
 - .1 Install equipment in a compact, neat and workmanlike manner.
 - .2 Align, level and adjust for satisfactory operation.

- .3 Install in such a manner that connecting and disconnecting of piping and accessories can be made readily and that all parts are easily accessible for inspection, operation, maintenance and repair.
 - .4 Install and start up items of equipment in accordance with the manufacturer's printed installation and operating instructions.
 - .2 Noise and Vibration
 - .1 Noise and vibration levels of equipment and systems shall be within design intent.
 - .2 If noise or vibration levels created by any mechanical equipment and systems and transmitted to occupied portions of building or other mechanical work are over the limits, make all necessary changes and additions as approved by the Consultant without additional cost.
 - .3 Lubrication
 - .1 Lubricate all equipment prior to start up in accordance with the manufacturer's printed instructions.
 - .2 Supply all lubrication including sufficient quantity for drainage and refilling of oil sumps, etc., when required by manufacturer's instructions.
- 3.3 **EQUIPMENT SUPPORTS**
 - .1 Housekeeping Bases and Pads
 - .1 Construct bases and pads for all mechanical equipment as required to allow the proper performance of the equipment.
 - .1 Exception: Bases and pads detailed on the Structural Drawings are for purposes of design intent only.
 - .2 Construction:
 - .1 20 m deformed dowel anchors to concrete slabs (six per base or pad).
 - .2 Drill slabs and grout dowels in place.
 - .3 Bond pads and bases to floor. Use grout and bonding agent according to manufacturer's printed instructions.
 - .4 Height of bases and pads: Minimum of 150 mm or as shown.
 - .5 Width and length: Sufficient to extend 75 mm beyond centreline of anchor bolts, or to extend a minimum of 50 mm beyond equipment base.
 - .6 Chamfer all upper perimeter edges of base.
 - .7 On approval of the Consultant, concrete pads of 150 mm maximum thickness may be poured under equipment after equipment is set in place, with concrete fully vibrated into place under the equipment base plate.
 - .3 Layout coordination:

- .1 Verify size of bases shown on Structural Drawings with actual requirements and advise the Consultant and the respective trades if change in size or shape of pad is required.
- .4 Anchor bolts:
 - .1 Supply anchor bolts required for mechanical equipment unless indicated otherwise on the Drawings.
 - .2 Sleeve anchor bolts.
 - .3 Supply anchor bolts and sleeves to trade constructing bases in sufficient time for setting in formwork prior to placing concrete and provide anchor bolt location drawing or template for locating anchor bolts.
 - .4 Check anchor bolt locations for proper position before concrete is poured.
- .2 Setting and Alignment of Equipment - Rotating Equipment (fans, pumps, etc):
 - .1 Use millwrights to set and align to lines established with an engineer's level.
 - .2 Shim equipment using standard brass or bronze shim stock of suitable thickness to provide proper level and alignment.
 - .3 Place 25 mm minimum thick grout between equipment base and concrete pad or foundation.
 - .4 Have Consultant approve equipment settings for equipment mounted on concrete pads or foundations prior to grouting.
 - .5 Re-check alignment prior to start-up of equipment.
- .3 Floor Stands
 - .1 Provide stands for floor mounted equipment.
 - .2 Secure to the floor by mild steel floor pads or pipe flanges with bolts or anchors.
- .4 Ceiling or Wall Mounting
 - .1 Where ceiling or wall mounting is indicated or required, provide a suspended platform, bracket or shelf.
 - .2 Materials: Standard steel members and steel plates of welded construction throughout.
 - .3 Attach to building steel with rod hangers and beam clamps, or attach to precast structure as the case may be.
 - .4 Place additional structural steel as required between building steel where beam spacing does not meet requirements.
 - .5 Do not use inserts unless specifically shown on the Drawings or approved by the Consultant for any particular item of equipment.
 - .6 Attach brackets or shelves to vertical member or sections of the building structure as hereinbefore specified.

.5 Suspended Equipment Support

.1 Provide double locknuts on suspended equipment supports as follows.

.2 Upper attachment

.1 Beam clamp: Provide a double nut on end of beam clamp tie rod.

.2 Supplemental steel: Double nut all mechanical fasteners fixing supplemental steel to building structural steel.

.3 Middle attachment

.1 Upper load bearing point, to beam clamp: Not applicable.

.2 Upper load bearing point, to supplemental steel: Double nut on top of load bearing point, single locknut on underside of bearing point

.3 Lower load bearing point, all: Double nut on underside of bearing point, single locknut on top of bearing point.

.4 Lower attachment

.1 Trapeze hanger or equipment fastening: Refer to middle attachment requirements above.

.5 Apply Loctite 242 to the second nut (and matchmark both nuts).

3.4 **MISCELLANEOUS STEEL**

.1 Hang or support equipment, piping, ductwork etc., with miscellaneous structural supports, platforms, braces as may be required unless Drawings or other sections of the Specifications state otherwise.

.2 Materials and Fabrication

.1 Conform to:

.1 CAN/CSA-S16.1-M for materials, design of details and execution of the work.

.2 CSA-G40.20/G40.21 grade 300W for structural shapes, plates, etc.

.3 CSA W47.1 for qualification of welders.

.4 CSA W48.1-M for electrodes (only coated rods allowed).

.5 CSA W59-M for design of connections and workmanship.

.6 CSA W117.2 for safety.

.3 Construction

.1 Welded construction wherever practicable.

.2 Chip welds to remove slag, and grind smooth.

.3 Bolted joints allowed for field assembly using high strength steel bolts.

.4 Painting and Cleaning

- .1 Clean steel to Steel Structures Painting Council SSPC-SP6, Commercial Blast Cleaning.
- .2 Apply one coat of oil alkyd primer conforming to CISC/CPMA 2.75 to all miscellaneous steel.
- .3 In the field, touch up all bolt heads and nuts, previously unpainted connections and surfaces damaged during erection with primer as hereinbefore specified.
- .4 Apply two coats of primer to all surfaces which will be inaccessible after erection.
- .5 Thoroughly remove all foreign matter from steelwork on completion of installation.

3.5 **CONCRETE INSERTS**

- .1 Install inserts required for attachment of hangers, either for suspension of piping or equipment.
- .2 For masonry or poured concrete construction use expansion type units. Insert into the concrete after concrete has cured. Do not use anchors or inserts installed by explosive means.

3.6 **FLASHINGS**

- .1 Flash and counterflash all gas vent stacks through roof, with Thaler Model MEF-4A.
- .2 Safety vents, plumbing vents and all other pipes passing through roofs, stack flashings will be supplied and installed by roofing trade, unless otherwise shown on Drawings.

3.7 **FIRE STOPPING**

- .1 Submit Shop Drawings, including the following information:
 - .1 ULC/CUL listing number.
 - .2 Installation Drawings for each type of penetration.
 - .3 Installation materials.
- .2 General
 - .1 Seal piping, ductwork, conduits and miscellaneous support steel penetrating fire separations.
 - .2 Install firestopping in accordance with manufacturer's instructions and ULC listing requirements.
 - .3 Provide a written report on completion of firestopping, by area or floor if necessary, indicating the Work is completed and ready for inspection. Do not cover over firestopping, including installation of walls and ceilings, until Work is inspected.

3.8 **ACCESS DOORS**

- .1 Supply access doors for installation by other trades in walls or ceilings where accessibility is required for the operation and/or maintenance of:
 - .1 Concealed valves

- .2 Traps
- .3 Cleanouts
- .4 Dampers
- .5 VAV boxes
- .6 Control equipment

3.9 **SPARE PARTS**

- .1 Furnish spare parts
 - .1 One set of packing glands for each size of pump gland.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket for each heat exchanger
 - .4 One glass for each gauge glass
 - .5 One set of V-belts for each drive
 - .6 One filter cartridge or set of filter media for each filter or filter bank installed

3.10 **PROTECTION**

- .1 Protect Work and materials from weather and other hazards before, during, and after erection, and keep in a clean and orderly manner.
- .2 Protect pipe ends, valves and parts of equipment left unconnected to prevent damage or intrusion of foreign matter. Provide pipe caps for threaded male connections and plugs for threaded female connections.
- .3 Protect plumbing fixtures or mechanical equipment having a baked enamel finish by covering with polyethylene sheet securely held in place.
- .4 Protect finished floor slabs from scuffing, cracking, chipping, staining, cutting and other damage resulting from work of this Contract.
 - .1 Place a 19 mm thick plywood underlaid with 25 mm thick polystyrene insulation board adhered to same, over floor areas when working from or over, such surfaces.
 - .2 Provide such protection below hoist rigs, ladders, pallets of material, and in other circumstances where the flooring is exposed to potential damage.
 - .3 Work damaged due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Owner, at no increase in Contract Price.

3.11 **MAINTENANCE OF BEARINGS**

- .1 During Construction
 - .1 Turn-over rotating equipment at least once a month after delivery;
 - .1 Run-in sleeve type bearings in accordance with manufacturer's recommendations.

- .2 Drain, flush out and refill with new charge of oil or grease.
- .3 Protect bearings, shafts and sheaves against damage, corrosion and dust accumulation.
- .4 Provide extended grease nipples for bearing lubrication.

3.12 **CONSTRUCTION REVIEW**

- .1 The construction review will include milestone and periodic reviews.
- .2 Milestone Reviews
 - .1 Specific milestone reviews will be performed by the Consultant for compliance with the Ontario Building Code, including any or all of the following:
 - .1 Buried drainage
 - .2 Before installation of roofing membrane
 - .3 Before closure of service shafts and pipe chases
 - .4 Before closure of walls
 - .5 Before closure of ceilings
 - .6 Equipment demonstration and training
 - .7 Substantial Performance and deficiency review
 - .8 Total Performance
 - .2 Some or all of these reviews are of portions of the Work which may be concealed. If Work is enclosed before the Consultant can review the installation, the Consultant may direct the Contractor to expose the Work for it to be examined, at no additional cost to the Project, including rework affecting other trades.
 - .3 If deficiencies are noted during any review where Work will be enclosed, correct noted deficiencies and have them reviewed by the Consultant prior to the Work being enclosed.
 - .4 Provide a minimum of seven Calendar Days written notice to the Consultant when requesting each review date.
 - .5 The Consultant will provide a check-list to the Contractor of required milestone reviews which must be completed. Maintain this list on site along with identified test reports, and make available for Consultants review when requested. When completed, include this checklist form with the test reports forms specified in Section 23 08 16.
- .3 Periodic Reviews
 - .1 The Consultant will conduct periodic reviews as required for the Project. These reviews are for the benefit of the Owner to describe the progress and workmanship of the Work and are not intended as any form of quality assurance for the Contractor.

- .2 Deficiencies will generally not be reported as part of this review, as the Work has not been reported by the Contractor as being complete. However, deficiencies may be reported where it may not be possible to correct the Work at a later date, or at great expense.
- .3 The Contractor shall not rely on these periodic reviews to identify deficiencies during the progress of the Work.
- .4 **Deficiency Review**
 - .1 The Consultant will conduct a deficiency review only after the Contractor submits an application for Substantial Performance. As part of this application, the Contractor shall submit their own comprehensive deficiency list of incomplete or incorrect work. Failure by the Contractor to list any deficiency does not relieve the Contractor from correcting or completing the Work.
 - .2 The Consultant shall review the work and any deficiencies noted will be classified as Major or Minor.
 - .1 Major deficiencies are required to be corrected as part of obtaining Substantial Performance.
 - .2 Minor deficiencies may be corrected before or after Substantial Performance.
- .5 **Final Review**
 - .1 The Consultant will conduct a final review only after the Contractor submits a declaration that all of the following has been completed:
 - .1 Noted deficiencies have been corrected
 - .2 Final As-Built Drawings have been submitted to the Owner
 - .3 Final Operating and Maintenance Manuals have been submitted to the Owner
 - .4 Final test reports, including alternate season tests have been submitted to the Owner.
 - .2 The Consultant will only review the deficiency list to confirm these deficiencies have been corrected.

3.13 **PERFORMANCE TESTING AND BALANCING**

- .1 Refer to 23 08 00 series.

3.14 **ADJUSTMENT AND OPERATION OF SYSTEMS**

- .1 When the Work is complete:
 - .1 Adjust equipment items of the various systems for proper operation within the framework of design intent, and the operating characteristics as published by the equipment manufacturer.
 - .2 Complete additional instructions are specified under the respective sections of Division 23.

- .2 The Consultant reserves the right to require the services of an authorized representative of the manufacturer in the event that any item of equipment is not adjusted properly.

- .1 Arrange for such services and pay all costs thereof.

- .2 After completion of adjustments, place systems in full operating condition and advise Consultant that the Work is ready for acceptance.

3.15 **ACCEPTANCE**

- .1 After all equipment has been installed and adjusted and all systems balanced:

- .1 Conduct performance tests in the presence of the Consultant and the Owner.

- .2 Arrange the time for these tests at the convenience of the Consultant and Owner.

- .3 Conduct tests under climatic circumstances to ensure complete and comprehensive tests and of such a manner and duration as the Consultant may deem necessary.

- .2 During these tests:

- .1 Demonstrate the correct performance of all equipment items and of the systems they comprise.

- .2 Should any system or any equipment item fail to function as required, make such changes, adjustments or replacements necessary to meet performance requirements.

- .3 Repeat tests until requirements have been fully satisfied and all systems accepted by the Consultant.

End of Section

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