

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This section covers items common to all Sections of Division 22, and 23.
- .2 This Section shall apply to all trades in all Sections.

1.2 REFERENCES

- .1 All codes and standards to be of latest addition.
- .2 Contractors are advised that coordinator with other trades is required. Contractors are required to review with other sub headers the work indicated on architectural, civil, electrical, structural drawings.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
 - .1 Submit drawings as specified below:
 - .2 Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 Drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals, O&M manuals, shall include Departmental Representative-approved shop drawings bearing stamp and date of Departmental Representative approval.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:

- .1 Control schematics for systems including environmental controls.
- .2 Description of systems and their controls.
- .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
- .4 Operation instruction for systems and component.
- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93.
- .5 Approvals:
 - .1 Submit 1 copy of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual or partial data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Contractor to provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
 - .2 Transfer information weekly to reproducible, revising reproducible to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 Record drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built or record drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO

SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor)
(Date).

- .3 Submit to Departmental Representative for approval and make corrections as directed.
- .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
- .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .6 Remove Design Engineer's stamp from Record Drawings.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One glass for each gauge glass.
 - .4 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, and well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.7 EQUIPMENT INSTALLATION

- .1 In accordance with Manufacturer's instructions unless otherwise indicated.
- .2 Install isolation valves and either unions or flanges for isolation and service of each piece of equipment.

1.8 CLEARANCES

- .1 Provide space for disassembly, removal of equipment and components as recommended by Manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment or components.
- .2 Coordinate with Manufacturer Agent, approved shop drawings to provide adequate service space.

1.9 TRIAL USAGE

- .1 General
 - .1 Commissioning requirements in accordance with Division 01 – General Requirements.
 - .2 Engineer and Commissioning Agent may use equipment and systems for test purpose prior to acceptance. Supply labour, material and instruments required for testing.
- .2 Use of systems during construction
 - .1 Use of mechanical systems during construction may be required by Owner.
 - .2 Use of new and existing permanent heating; cooling, and ventilation are permitted only under following conditions:
 - .1 Entire system is complete, commissioned, pressure tested, cleaned and flushed out.
 - .2 Specified water treatment system has been commissioned; water treatment is being continuously monitored.
 - .3 Building has been closed in; areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .4 There is no possibility of damage.
 - .5 Supply ventilation systems are protected by 60% filters, inspected daily, and changed every 2 weeks or more frequently as required.
 - .6 Return systems have approved filters over openings, inlets and outlets.
 - .7 Systems will be:
 - .1 Operated as per Manufacturer's recommendations and instructions.
 - .2 Operated by Contractor.
 - .3 Monitored continuously by Contractor.
 - .8 Warranties and Guarantees are not relaxed.
 - .9 Regular preventive and other Manufacturer's recommended maintenance routines are performed by Contractor at own expense and under supervision of Departmental representative and Engineer.
 - .10 Refurbish entire system before static completion; clean internally and externally, restore to "as-new" condition and replace filters in air system.
 - .3 Filters specified in this Section are over and above those specified in other Sections of this project.

1.10 REMOVALS

- .1 Contractor is responsible for disposal off-site of all items being removed as part of this Contract.

- .2 Contractor shall provide Owner with option to keep items being removed as part of this Contract prior to disposal off-site.

1.11 FIRESTOPPING

- .1 All fire stopping work is to be performed by General Contractor. Mechanical Contractor shall perform all pipe preparation for fire stopping.
- .2 All Sub-Contractors shall coordinate all fire rated assembly penetrations with General Contractor.
- .3 Sub-Contractor shall provide required clearances between outside surface of pipe and inside surface of sleeve, core drilled hole or listed fire rated system.

1.12 TESTS

- .1 Give 48 hours written notice of date for all tests.
- .2 Insulate or conceal work only after testing and approval by Engineer and Commissioning Agent.
- .3 Conduct tests in presence of Engineer and Commissioning Agent and local authority having jurisdiction where applicable.
- .4 Bear costs including retesting and making good.
- .5 Equipment: test as specified in relevant sections and Commissioning Sections.
- .6 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.13 INTERPRETATION OF PLANS AND SPECIFICATIONS

- .1 These specifications are to be considered as an integral part of the plans which accompany them and neither the plans nor the specifications shall be used alone. The drawings are considered an integral part of the specifications.

Any item which is omitted in one but which is reasonably implied in the other shall be considered properly and sufficiently specified and must, therefore, be provided by this Contractor
- .2 Misinterpretations of the plans or specifications shall not relieve this Contractor of responsibility; final interpretation of details and clauses remains with the Engineer – Architect.
- .3 Where uncertainty exists in the passing of pipes and location of equipment, the General Contractor and or project manager shall be consulted before work is started. Where such materials and equipment have been installed so as to cause interference with the inside treatment of the building, they shall be removed and relocated without additional cost to the Owner.
- .4 The plans do not necessarily show all valves, duct offsets, access panels, connections, balancing fittings, bases, isolators, flexible connections, drains, etc., and this Contractor shall not avail himself of these obvious omissions, but shall install the work complete in essential details so that it will function properly, can be easily balanced and so that repairs and removal of equipment can easily be made.
- .5 Building dimensions shall not be scaled from the Mechanical plans but shall be obtained from on-site dimensions of the building. Any discrepancy between the drawings and the building shall be questioned before proceeding with any installation. The Contractor shall be responsible to confirm on-site dimensions. In existing buildings, confirm dimensions prior to tender.

1.14 CO-OPERATION OF CONTRACTORS

- .1 This Contractor shall become familiar with the work of other contractors and in laying out and installing the work shall co-operate with the other Contractors, so as to facilitate the progress of the work as a whole and avoid interference or delays. Where interference exists, this Contractor shall notify the General Contractor and/or project manager and the engineer before installing the work. Any changes in the work or alterations of the Mechanical Contractor's schedule of procedure required for such co-operation will not be considered as a claim for extra compensation.
- .2 Due to the complexities of many sub-trades, and the restrictive space available in this project, it is required that all trades co-operate closely so as to install all systems in their allotted locations as indicated on the drawings, or coordination on site.
- .3 The drawings are not intended to show all elbows, fittings and offsets required to perform the installation of the work where indicated on drawings. Contractor shall coordinate with all other trades and General Contractor on site. It is the responsibility of the Contractor to review site conditions prior to execution of work. Where services are shown to cross other building services, Contractor shall coordinate with other trades and determine best routing on-site prior to execution of work.
- .4 The Contractor shall review all Structural, Mechanical, Electrical and Architectural drawings to determine possible conflicts.
- .5 Contractor shall coordinate location of all hangers and seismic bracing systems as to avoid interference with other trades.
- .6 No extras will be allowed for lack of coordination or if additional fittings are required to perform the work as shown on the drawings.

1.15 ERRORS AND OMISSIONS

- .1 The drawings are not intended to show every item of accessory equipment, but the Contractor shall tender on and install all essential details to provide for efficiency of operation and ease of maintenance.
- .2 Should this Contractor discover errors or discrepancies in the plans or specifications, he shall refer the matter to the Engineer for change or clarification and shall not proceed with that portion of work until advised by the Engineer to do so.

1.16 MAINTENANCE

- .1 Furnish spare parts in accordance with Division 01 – General Requirements and as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 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 and in accordance with Division 01 – General Requirements.

- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.17 MOTOR REQUIRMENTS FOR HVAC EQUIPMENT

- .1 General
 - .1 Electrical motors, for Mechanical equipment and systems specified by Mechanical division.
 - .2 Mechanical responsibility is specified within these specifications and on mechanical drawings.
 - .3 Control wiring and conduit is specified in electrical division except for conduit, wiring and connections 120 volt and lower which are related to control systems specified in Controls Division. Refer to Electrical Division for quality of materials and workmanship.
 - .4 Motors shall be premium efficiency inverter duty rated for service with VFD's where VFD's specified.
 - .5 All motors shall be high efficiency type.
 - .6 All motor shall be CSA listed.

1.18 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kw: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kw and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustments plates to allow for center line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Division 01 – General Requirements.

1.19 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia. holes on both shaft centers for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.

- .5 Guard for flexible coupling:
 - .1 “U” shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

1.20 CONCRETE CURBS AND PADS

- .1 Concrete curbs and pads shall be performed by the General Contractor for the Mechanical Subcontractor.
- .2 The Mechanical Subcontractor shall provide and coordinate all templates, special cast-in-place feet or mounts and shall lay out the dimensions and locations of the curbs and pads.

1.21 SEQUENCING

- .1 Contractor shall be aware that due to the complex nature of demolition, temporary provisions and construction related to this works, there is a sequencing strategy developed including plans and specifications. Refer to Division 01.
- .2 This Mechanical Contractor shall allow for the works to be built in the order and manner directed.

1.22 SUPERVISION

- .1 This Contractor shall include the services of experienced superintendents, who shall be constantly in charge of the work, together with the qualified journeymen, helpers and labourers, required to properly unload, install, connect, adjust start and operate and test the work involved

1.23 OPENINGS FOR EQUIPMENT

- .1 This Contractor shall be responsible for providing openings to allow the installation of all apparatus and large equipment in this Contract. This Contractor shall make all necessary arrangements to ensure that the required openings are provided and properly located.

1.24 MINIMUM REQUIREMENTS

- .1 All equipment supplied shall conform to and be labelled by CSA.
- .2 All equipment supplied shall be new and first rate production. (No seconds)

1.25 OPENINGS, SLEEVES, CUTTING AND PATCHING

- .1 All openings in walls and floors necessary for the installation of equipment of the specification shall be provided by this Contractor.

- .2 Openings necessary in structural concrete floor, walls and beams shall be made with Schedule 40 steel sleeves installed prior to pouring of concrete. In floors, extend sleeve min. 50mm (2 in.) above finished floor to permit waterproofing.
- .3 Where openings in poured concrete floors or walls are necessary, core drilling only will be permitted.
- .4 This Contractor shall advise the Engineer of all such openings, their size and location and shall obtain his approval prior to cutting of openings.
- .5 In fire rated floors or walls, this Contractor shall coordinate all locations in 1.11 with general contractor.

1.26 ROOF CUTTING AND PATCHING

- .1 All cutting of roof decks and penetrations of roof systems, including flashing, patching, or reinforcing of roofs for all mechanical services extending through roofs shall be done by the General Contractor.
- .2 This Contractor shall advise the General Contractor in sufficient advance time, the size and location of all roof openings required.

1.27 MATERIALS AND WORKMANSHIP

- .1 All materials installed shall be new, full weight, of the best quality with the same brand or manufacturer used for each class of material or equipment.
- .2 All materials and equipment shall be installed in a neat and workmanlike manner by competent specialists for each sub trade. The installation of any materials and equipment
- .3 Not meeting these standards may be condemned by the Engineer and shall be removed and reinstalled at no additional cost to the Owner. This Contractor is responsible for the safety and good condition of the materials and equipment installed until final acceptance by the Owner.
- .4 All tradesmen employed by this Contractor for this work shall be properly licensed journeymen and apprentices qualified to do work in each particular trade. The General Contractor shall have the right to examine each man's credentials and order any unqualified personnel away from the project.

1.28 DEFICIENCIES

- .1 The Engineer will notify this Contractor at various intervals of defective workmanship or installation, deficiencies, etc. This Contractor shall not request revised or updated lists without first submitting a current detailed, item by item, report on the status of all deficiencies as reported to the Contractor on a previous listing.
- .2 When this Contractor notifies the Engineer that the contract is ready for interim deficiency review, a comprehensive deficiency listing will be prepared. If such list exceeds twenty (20) items, the contract shall not be considered ready for final inspection and the Engineer need not furnish the Contractor with such listing.
- .3 Contractor shall sign, date, and return to Departmental Representative the provided formal deficiency review lists to ensure the items have all been corrected prior to next review.

1.29 SUPPORTS

- .1 This Contractor shall supply and erect all structural work necessary for the proper installation and support of all apparatus and equipment under these specifications unless specified in Structural Division. This Contractor shall submit for approval to the Engineer/Architect shop drawings on all structural supports before installation of same.

1.30 GAUGES AND METERS

- .1 All gauge, meters and indicators shall be selected such that the expected operating parameter indicates 50% to 70% of the full scale instrument range.
- .2 Temperature gauges shall be installed at a minimum, at inlet and outlet of each heat exchanger, chiller, tank and where indicated.

1.31 DEFINITIONS

- .1 As indicated: Means that the item or items specified are shown on the drawings.
- .2 Standard of Acceptance: Means that item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a reference standard, shall be deemed to supplement the standard.

1.32 ENERGY CONSUMPTION

- .1 Engineer may reject equipment submitted for approval or review on basis of performance or energy consumed or demanded.

1.33 EQUIPMENT INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated bearings.
- .3 Pipe equipment drains to floor drains.
- .4 Line up equipment and similar items with building walls wherever possible.

1.34 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other divisions.

1.35 DIELECTRIC COUPLINGS

- .1 Provide wherever pipes of dissimilar metals are joined

1.36 COSTS OF ALTERNATE MATERIALS

- .1 Contractor shall bear the cost of all changes required to connect, locate, install, support or integrate alternate equipment to that specified.

1.37 TEMPORARY STORAGE

- .1 This Contractor shall be responsible for materials temporarily stored on site.

1.38 CHANGES & EXTRAS

- .1 No change to the drawings and specifications will be accepted, if not authorized in writing by the Architect/Engineer.
- .2 All work carried out which does not conform to the plans and specifications shall be corrected at the Contractor's expenses.
- .3 The Owner reserves the right to change quantity, quality, or any kind of work or equipment described on the drawings or in the specifications without affecting the validity of the contract.
- .4 Monetary adjustments required by such changes shall be accepted in writing by the Architect/Engineer before alterations are proceeded with by the Contractor

1.39 LAWS & ORDINANCES

- .1 All work performed under this Division shall comply with the requirements of the authorities having jurisdiction, including, but not limited to, the following: Provincial Department of Labour, Provincial Department of Environment, Dominion Fire Commissioner, Provincial Board of Insurance Underwriters, Provincial Department of Health, Plumbing Inspector, Building Inspector, National Building Code of Canada, Local and Municipal By-Laws and Canadian Standards Association

1.40 WARRANTY

- .1 All mechanical work and equipment shall be guaranteed to work satisfactorily for a minimum period of one year from the date of acceptance of substantial completion of the contract, provided any failure is not due to neglect or improper use by the Owner.
- .2 Any certificate given, payment made, partial or entire use of the equipment by the Owner, shall not be construed as acceptance of defective work or improper materials.
- .3 This general guarantee shall not act as a waiver of any specified guarantee for any greater length of time.

1.41 DAMAGE BY LEAKS

- .1 This Contractor shall be responsible for damages to grounds, walks, roads, building, piping systems, electric system and their equipment and contents caused by leaks in the ventilation system being installed. The Contractor shall repair at his expense all damage to incur. All work shall be done as directed by the Owner's representative.

1.42 OPENINGS FOR EQUIPMENT

- .1 This Contractor shall be responsible for openings being left to allow the installation of all apparatus and large equipment in this contract. This Contractor shall make all necessary arrangements with the General Contractor to ensure that the required openings are left and properly located. The General Contractor shall be responsible for the tearing out and making good of any walls necessary for the passage of equipment

1.43 STAGING

- .1 This Contractor shall supply all staging and equipment necessary for the installation of his work

1.44 LABOUR AND WORKMANSHIP

- .1 All tradesmen employed by this Contractor for this work shall be properly licensed journeymen and apprentices qualified to do work in each particular trade. The Architect/Engineer shall have the right to examine each man's credentials and order any unqualified personnel away from the project.
- .2 This Contractor shall be completely responsible for the proper execution of the work as outlined in the plans and specifications. This Contractor shall assume responsibility for workmanship and material defects whether or not they are discovered by the Architect/Engineer.

1.45 COMMISSIONING

- .1 This project will be commissioned. The work of taking the mechanical systems from a static to dynamic state successfully will involve each subcontractor at various times and for various functions on the project. The owner will engage a Commissioning agent, whose requirements for the subcontractors are indicated in section 01.91.13 – General Commissioning Requirements.

In addition, subcontractors are advised that they will also be requested to:

- .1 Participate/Coordinate activities to demonstrate system to Engineer.
- .2 Participate with TAB contractor.

1.46 CEILING COORDINATION

- .1 Contractor shall refer to architectural drawings for final coordination of all ceiling-installed components, such as diffusers, sprinklers, etc. The Architectural drawings shall govern.

1.47 FLOOR PLANS AND SCHEMATICS

- .1 Should any pipe size discrepancies or other material discrepancies arise in reviewing floor plans vs. schematics, request clarification from Engineer.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform General Contractor of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.3 DEMONSTRATION

- .1 Departmental Representative and or owner will use equipment and systems for test or commissioning purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 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 acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Contractor will record these demonstrations on video tape for future reference.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 System Cleaning: Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

3.6 PERMITTING DOCUMENTS

- .1 The design drawings are intended to indicate the design requirements to the Contractor. It is the Contractor's responsibility to obtain all construction permits, and approvals from authorities. The Contractor shall be responsible to prepare all necessary sketches, drawings and submission documents required by the authorities in order to issue approvals and permits.
- .2 Contractor shall carry all costs associated with permitting 3rd party reviews, witnessing, and inspection.

3.7 OPTIMIZATION

- .1 The noted Contractors will provide in his quotation for systems optimization.

- .2 The Engineer's sequences and setpoints specified are intended as a guide designed to create safe, functional and comfortably operating mechanical systems. Each project has a unique set of site conditions which, during start-up and commissioning, will become evident. This Contractor shall allow time for optimizing of setpoints to improve the efficiency of the systems' operations, to lower overall energy use while maintaining the design objectives.
- .3 Optimization will require work on behalf of the EMCS and TAB Contractors and coordinated with the Heating and Ventilation Contractors. Each item will be reviewed with the Design Engineer before trial and if beneficial, adopted to core operating strategies and incorporated to record documents.

3.8 COMMISSIONING

- .1 Contractor shall perform commissioning activities in accordance with Section 01 91 13 – General Commissioning Requirements.
- .2 Contractor shall be responsible to organize and coordinate commissioning activities with their sub-trades, schedule a key personnel, provide all testing equipment required to perform commissioning activities and testing.
 - .1 Contractor shall be responsible to conduct and report on Contractor start-up (CSP) for all systems under their division.
 - .2 Contractor shall be responsible for Verification Program (VP) for all equipment and systems under the division.
 - .3 Contractor shall be responsible to conduct functional testing under performance evaluation (PE) for all equipment and systems under their division.
 - .4 Contractor shall be responsible to conduct training Owner personnel on all equipment and systems under their division.
 - .5 Contractor shall be responsible to document all commissioning activities and testing and provide commissioning procedures required to re-commission equipment and systems in the future.
 - .6 Contractor shall be responsible to collect, organize and turn over all information required to assemble Building Management Manual for the project.

3.9 THERMOMETERS AND PRESSURE GAUGES

- .1 GENERAL
 - .1 Install devices of specified type where indicated. Range shall be selected for design/operating point to be approximately 50% of scale.
 - .2 Shock and vibration resistant.
 - .3 To ASME B40.
 - .4 Position devices for convenient viewing from floor.
- .2 THERMOMETER:
 - .1 Industrial, linear, variable-angle type, mercury-free, 200mm length.
 - .2 Install thermometer in minimum 100mm brass or stainless steel well to suit service.
- .3 PRESSURE GAUGES:

- .1 Industrial, minimum 112mm face, with stainless steel bourdon tube, 0.5% accuracy or full-scale, liquid filled, rear pressure relief gaskets and diaphragm for corrosive service.
- .2 Provide scrubber for pulsating service.
- .3 Provide bronze stop cock.

3.10 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following test in accordance with Division 01 – General Requirements and submit report as described in PART 1 – SUBMITTALS.
- .2 Manufacturer’s Field Services:
 - .1 Obtain written report from manufacturers verifying compliance or work, in handling, installing applying protection and cleaning of product and submit Manufacturer’s Field Reports as described in PART 1 SUBMITTALS AND AS SPECIFIED IN RESPECTIVE SECTIONS.
 - .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 Schedule site visits, to review work, as directed in PART 1 – QUALITY ASSURANCE.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Requirements
 - .1 All sections in divisions 22, 23.

1.2 REFERENCES

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.3 SUBMITTALS

- .1 Product Data.
- .2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.

- .2 Equipment in Mechanical Rooms: use size # 9.

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work. Coordinate with CSC/PSPC project manager for required standards to be followed prior to starting work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1.
 - .2 Sprinklers: to NFPA 13.
 - .3 Note all systems shall be governed by authorities having jurisdiction.

2.5 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Departmental Representative.

.2 Colours for legends, arrows: to following table:

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

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT

2.6 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

.3 Each stencil to indicate system number, i.e. "AHU-1" and "Supply", or "Return".

2.7 VALVES, CONTROLLERS

.1 20mm x 100mm size 3mm laminated plastic tags with engraved letters 10mm high.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 LANGUAGE

.1 Identification in English. Contractor shall submit proposed list for Owner review prior to producing and/or installing identification.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 TIMING

- .1 Provide identification only after painting, specified in Section 09 91 23, has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.

- .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 FIELD QUALITY CONTROL

- .1 Contractor's Verification, include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified wood.
 - .8 Low-emitting materials.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION