

**PART 1 MECHANICAL GENERAL PROVISIONS**

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the requirements set out for the Contractor.

**1.2 APPLICATION**

- .1 This Section applies to all parts of Division 22 and Division 23.
- .2 Divisions 21, 22, 23, and 25 shall constitute the Mechanical Sections of Work.

**1.3 DEFINITIONS**

- .1 Notwithstanding any definition elsewhere in the Contract documents, wherever the term "Provide" is used in relationship to equipment, piping etc., in this Division, it shall mean "Supply, Install and Connect".
- .2 Whenever "Drawings and Specifications" are referred to in these documents, it means "the Contract Drawings and Specifications" (including all addenda and post Contract revisions) of all Disciplines (Architectural, Structural, Mechanical and Electrical).

**1.4 TRADE DEFINITIONS**

- .1 All Work called for in the Contract Documents shall be considered to be within the scope of the Contract, and shall be the responsibility of the Contractor.
- .2 The arrangement of the Drawings and Specifications into Divisions, Sections, and Trades is purely arbitrary, with the sole intention of clarifying the scope and content of the Work required to complete the project. The actual division of the Work amongst the Subcontractors shall be the responsibility of the Contractor, and the actual division of the Work between the Subcontractors shall be the responsibility of the Subcontractors.
- .3 The Contractor, at his option and as per his Contracts with the Subcontractors, may delegate responsibility to the Subcontractors for the division of the Work.
- .4 The Subcontractors, at their option and as per their Contracts with the Subcontractors, may delegate responsibility to the Subcontractors for the division of the Work.
- .5 Sections of the Mechanical specifications, and specific but arbitrary responsibility divisions noted in the Mechanical Specifications, are not intended to delegate functions nor to delegate Work to any specific trade, but may be useful to the Contractor or Subcontractor when dividing the Work amongst the Trades and Sub-trades.
- .6 In the event of a dispute regarding the responsibilities of the various trades and sub-trades, the Contractor and Subcontractors may request information or a recommendation from the Contract Administrators. However, the Contractor and Subcontractor shall be responsible for determining the final division of Work.

**1.5 SCOPE OF WORK**

- .1 In general terms the scope of Work includes all of the mechanical Work required for a new Recreation Centre with Multi-purpose Rooms and Support Areas. This shall include but not necessarily limited to the following:

- .1 Provision of new Plumbing services.
  - .2 Provision of new Ventilation and Air supply systems.
  - .3 Provision of new Gas Heating, Cooling systems.
  - .4 Provision of new Control systems.
  - .5 Start-up and commissioning of all equipment and systems.
- .2 The Mechanical Work shall include all labour, materials, equipment, and tools required to install, test and place into operation a complete and fully operational Mechanical System consisting of the various sub-systems as described in, but not necessarily limited to, the items in the following sections and equipment schedules:
- .1 Section 21 05 01, Mechanical General Provisions
  - .2 Section 21 05 05, Basic Materials and Methods
  - .3 Section 21 07 01, Thermal Insulation
  - .4 Section 22 05 05, Plumbing
  - .5 Section 23 05 53, Sound and Vibration Isolation
  - .6 Section 23 05 93, Testing and Balancing
  - .7 Section 23 08 05, Commissioning
  - .8 Section 23 25 13, Pipe Cleaning and Chemical Treatment
  - .9 Section 23 31 00, Air Distribution
  - .10 Section 25 05 05, Controls
- .3 Refer to the Mechanical Index 21 05 01 for full section and schedule listing.

## **1.6 SITE EXAMINATION**

- .1 Visit and inspect the site of the Work to verify the location and elevation of existing items and services (such as services, equipment, piping, conduit, etc.) which may affect the Bid and Work of this Division, before submission of Bid and proceeding with the Work.
- .2 Make allowance to relocate all existing items/services as required, or to provide alternate locations/routings of new items/services as required. Confirm alternate locations/routings with the City/Contract Administrators prior to submitting Bid in accordance with B4.
- .3 Claims for extra payments resulting from conditions which could have reasonably been foreseen during a pre-bid site examination will not be considered.

## **1.7 CONTRACT DRAWINGS**

- .1 The Drawings for the Mechanical Work are performance drawings, diagrammatic and approximately to scale, intended to convey the scope of Work and indicate the general arrangement and approximate location of apparatus, fixtures and pipe/duct runs. These Drawings do not intend to show Architectural and Structural details.
- .2 Do not scale the Drawings. Obtain information involving accurate dimensions from dimensions shown on the Architectural and Structural drawings, and by site measurement.
- .3 Even though some piping and/or ductwork is not completely shown or is shown schematically, and all details are not shown or specified, it is expected that the Subcontractors be familiar enough with their fields of Work to complete the project to the standards generally adhered to by the local industry, including good workmanship and common sense. The Contract Administrator reserves the right to furnish any additional detail drawings, which, in the judgement of the Contract Administrator, may be necessary

to clarify the Work, and such drawings shall form a part of this Contract. The Work for such Clarifications shall be at no cost to the City.

- .4 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (pipes or ducts around beams, columns etc.), and to provide complete and adequate service clearance.
- .5 The exact location of the Mechanical components may be changed by the Subcontractors to suit site conditions, provided the changes are reviewed with the Contract Administrator, the changes are duly noted on the 'Record' drawings, and the changes do not affect the operation or code-compliance of the system(s). Any such changes shall be at no cost to the City.

### **1.8 CHANGES TO THE SCOPE OF WORK**

- .1 From time to time during construction, changes to the scope of Work may be proposed by the City. These Proposed Changes are to be priced by the Subcontractors in a timely manner. Only after the City has reviewed and accepted the pricing, will these Proposed Changes be added to the Contract.
- .2 Pricing for the Mechanical portions of these Proposed Changes shall be submitted by the Subcontractor to the Contractor complete with price breakdowns as follows:
  - .1 Subcontractor's price c/w labor, material and overhead prices broken out.
  - .2 Pricing shall be submitted on an item-by-item basis. Each Proposed Change may contain more than one item.
  - .3 The City/Contract Administrator reserve the right to request detailed parts and materials breakdown pricing.

### **1.9 LIABILITY**

- .1 Protect and maintain the Work until the project has been completed and turned over to the City. Protect the building and contents from damage during the construction period. Repair all damages without additional cost to the City.
- .2 Special care shall be taken to insure that any existing equipment, structures, components and property are not damaged during the construction period. Repair all damages without additional cost to the City.

### **1.10 WORK SCHEDULE**

- .1 Unless otherwise noted, the Work shall be scheduled for normal hours. The Subcontractors shall be aware that off-hour Work may be necessary for certain locations or types of Work, and shall include the extra costs in the bid price.
- .2 Where the Work requires the Subcontractors to be in occupied areas, or where building services may be disrupted, the Subcontractors shall closely coordinate the hours and areas of Work with the City's and occupants.
- .3 It shall be the responsibility of the Contractor to schedule the Work to meet the City's completion date. The Contractor shall coordinate the sub-trades and adjust the workforce as required to meet the schedule.

**1.11 SUPERVISION**

- .1 Maintain at this job site qualified personnel and supporting staff with proven experience in erecting, supervising, testing and adjusting projects of comparable nature and complexity.
- .2 Supervision personnel and their qualifications are subject to the approval of the Contract Administrator.

**1.12 ENGINEERING SITE REVIEWS**

- .1 The Subcontractor's Work will be reviewed periodically by the City, the Contract Administrator, or their representatives, for the purpose of determining the general quality of the Work. Guidance will be offered to the Subcontractors in regard to interpretation of plans and specifications, to assist them in carrying out the Work. Inspections, and directives given to the Subcontractors, do not relieve the Contractor, and his agents, servants and employees, of his responsibility to provide the Work in all of its parts, in a safe and Workmanlike manner, and in accordance with the plans and specifications, nor impose upon the City, and/or Contract Administrator or their representatives, any responsibility to supervise or oversee the erection or installation of any Work.
- .2 The Contract Administrator will issue inspection reports and deficiency lists from time to time. All deficiencies shall be cleared up to the satisfaction of the Contract Administrator within a reasonably short time period.

**1.13 PATENTS**

- .1 Pay all royalties and license fees, and defend all suits or claims, for infringement of any patent rights, and save the City and Contract Administrator harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Contractor or anyone directly or indirectly employed by him, or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the Work, in violation or infringement on such letters patent or rights.

**1.14 CONSTRUCTION DRAWINGS**

- .1 Where requested, prepare drawings in conjunction with all trades concerned, showing sleeves and openings for passage through structures, and all inserts, equipment bases, sumps and pits, supports, etc.

**1.15 MUNICIPAL AND UTILITY SERVICES**

- .1 Coordinate, arrange, and pay for all municipal and utility relocations, terminations and connections as required and shown on the drawings, complete with all required metering.
- .2 Install all metering equipment in accordance with municipal or utility requirements.
- .3 Test all services and provide report(s) as required by the Authorities Having Jurisdiction.

**1.16 CODES, PERMITS, FEES AND INSPECTIONS**

- .1 Comply with the most stringent requirements of the latest editions of the applicable C.S.A. standards; the requirements of the Authorities Having Jurisdiction; Federal, Provincial and Municipal Codes; and the applicable standards of the Underwriters' Association. These codes and regulations constitute an integral part of these specifications.
- .2 In case of conflict, the codes take precedence over the Contract Documents. In no instance reduce the standard or scope of Work or intent established by the drawings and specifications by applying any of the codes referred to herein.
- .3 Before starting any Work, submit the required number of copies of Drawings and Specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the Contract, but notify the Contract Administrator immediately of such changes, for proper processing of these requirements. Prepare and furnish any additional drawings, details or information as may be required. Information such as heat loss calculations, and other data that may be required can be obtained from the Contract Administrator. Should the authorities require the information on specific forms fill in these forms by transcribing the information provided by the Contract Administrator.
- .4 Apply for, obtain, and pay for all required permits, licenses, inspections, examinations, and fees.
- .5 Arrange for the inspection of all the Work by the Authorities Having Jurisdiction over the Work. On completion of the Work, present to the Contract Administrator the final unconditional certificate of approval of the inspecting authorities. When the Authorities Having Jurisdiction do not normally issue certificates, provide a declaration confirming that the Authorities have inspected and accepted the Work.

**1.17 DESIGN NOISE LEVELS**

- .1 The maximum design noise levels for this project shall be as per ASHRAE Standards.
- .2 All equipment, components and systems shall be selected and installed with the intent of not exceeding these noise levels.
- .3 Where the equipment, components and systems fail to meet the noise level criteria, modifications shall be made as required, at no additional cost to the City.

**1.18 REQUESTS FOR USE OF SUBSTITUTE EQUIPMENT**

- .1 In accordance with B6 manufacturers listed as acceptable "Substitutes" have been deemed by the Contract Administrator as capable of producing equipment and/or material of comparable quality, performance and approximate dimensions, and can be used in the preparation of the bid.
- .2 Manufacturers that are not listed are to review the bid specifications and determine if their products qualify as "equal" to the specified product in all respects.
- .3 Manufacturers are to review all drawing and specifications and familiarize themselves with the project and the product's intended use, performance, physical dimensions, access and service requirements, etc.
- .4 Submit for review in accordance with B6, shop drawings of the proposed products.

- .5 Submit the proposed product's shop drawing(s) along with a copy of the original product specification and indicate all areas of Compliance and Non-Compliance with respect to the proposed product. If non-compliance is indicated, state the variance and how it affects performance, physical dimensions, access and service requirements, installation, etc.
- .6 If Compliance/Non-Compliance information is not provided the submission will not be reviewed and the proposed products will not be allowed for use.

**1.19 SHOP DRAWINGS**

- .1 Present a schedule of shop drawings within 2 weeks after the award of the Contract, indicating the shop drawing submission and equipment delivery dates.
- .2 Shop Drawings submitted by the Contractor shall contain:
  - .1 Project Information such as Name and Address
  - .2 Contractor Information such as Name, Address, Phone Numbers
  - .3 Supplier Information such as Name, Address, Phone Numbers
  - .4 Equipment Identification using the same System Name and Identification Number as the Contract Documents.
  - .5 All Equipment Information required for the Contract Administrator to assess the suitability such as:
    - .1 Make, Model, Size
      - .1 including schedules where numerous similar items are provided
    - .2 Physical Data such as:
      - .1 Dimensions
      - .2 Materials
      - .3 Weights
      - .4 Installation Requirements
      - .5 Installation Clearances
    - .3 Performance Data such as:
      - .1 Volume
      - .2 Pressure
      - .3 Capacity
      - .4 Performance Curves (with specified performance clearly marked)
    - .4 Motor Data such as:
      - .1 Horse Power
      - .2 Voltage/Phases
      - .3 Efficiency
    - .5 Specialty Items such as:
      - .1 Bearings
      - .2 Filters
      - .3 Internal Controls including safety lockouts
      - .4 Safety Items such as relief valves and regulators

- .5 Options
- .6 Wiring and Control Diagrams
- .3 Equipment Information may contain standard manufacturer's brochures, catalogue sheets, schematics, diagrams performance charts, illustrations, etc., but must have:
  - .1 Information which is not applicable crossed off
  - .2 Available listed options which are being provided clearly marked
- .4 Shop Drawing Review:
  - .1 In addition to project identification, date, etc., the form of stamp used in shop drawing review shall contain the following format:
    - .1 Drawing:
      - .1 Reviewed
      - .2 Reviewed As Noted
      - .3 Revise and Re-Submit
      - .4 Not Reviewed
    - .2 This review by the Contract Administrator is for the sole purpose of ascertaining conformance with the general design concept.
    - .3 This review shall not mean that the Contract Administrator approved the detail design inherent in the shop drawings, the responsibility for which shall remain with the Subcontractor submitting same, and such review shall not relieve the Subcontractor of his responsibility for errors or omissions in the shop drawings, or of his responsibility for meeting all the requirements of the Contract documents. The Subcontractors are responsible for confirming and correlating dimensions at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the Work of all sub-trades, as well as compliance with codes and inspection authorities such as C.S.A., etc.
  - .5 Bind one complete set of final shop drawings in each Operating and Maintenance instruction manual.
  - .6 Refer to the Architectural General Specifications for additional information.

## **1.20 COORDINATION**

- .1 The Contractor shall be responsible for the complete coordination amongst all trades, including timing, completion, deliveries, interference of building components and sequencing of the trades.
- .2 The Contractor shall coordinate the Mechanical and Electrical Subcontractors to ensure compatibility of the system components.
- .3 The Contractor shall coordinate the Mechanical and Electrical Subcontractors to ensure access to control panels on mechanical equipment for the purpose of completing fire alarm panel connections.

- .4 The Contractor shall coordinate all trades to ensure that access doors and panels are of the same manufacturer, and of a style appropriate for the intended use.

**1.21 EXPEDITING**

- .1 Continuously check and expedite delivery of equipment and materials. If necessary, inspect at the source of manufacture.
- .2 Continuously check and expedite the flow of necessary information to and from all parties involved.
- .3 Immediately inform the General Contractor if information is required from him.

**1.22 RECORD DRAWINGS**

- .1 Obtain two sets of white prints and as the job progresses accurately record deviations from the Contract documents caused by job conditions and ordered changes to indicate the installed Work. Have the white prints available for inspection at the site at all times, and present for scrutiny at each job meeting.
- .2 At the completion of the Work, submit these sets of "Record" drawings to the Contract Administrator for review. Make changes as requested by the Contract Administrator and resubmit. This process will continue until the "Record" drawings are deemed complete by the Contract Administrator.
- .3 Arrange and pay for two copies of the final 'Record' Drawings to be produced and labeled 'As Constructed'.
- .4 Submit the "Record" and "As-constructed" drawings to the City.
- .5 Refer to the Architectural General Specifications for additional information.

**1.23 CUTTING AND PATCHING**

- .1 The cutting of openings not requiring lintels or other structural support will be the responsibility of the trade requiring the opening. The opening size shall be the minimum required. Patching will be the responsibility of the trades normally engaged in working with the finishing materials required to restore the opening to the original or specified conditions.
- .2 Where openings require lintels or other structural support, or roofing Work, such openings will be specified under other divisions of this specification.
- .3 Cutting, patching, and repairs to existing surfaces required as a result of the removal and/or relocation of existing equipment, piping and/or ductwork, and/or installation of new equipment, piping and/or ductwork in existing buildings is to be included in the bid price.

**1.24 TEMPORARY SERVICES**

- .1 Do not use any of the permanent mechanical systems during construction unless specific written approval is obtained from the Contract Administrator.

- .2 The use of permanent facilities for temporary construction service shall not affect, in any way, the commencement date of the warranty period.
- .3 If the permanent mechanical systems are used during construction, the equipment and systems shall be cleaned and refurbished as required to bring them back to a new/unused condition.

#### **1.25 CHANGING OF EQUIPMENT DRIVES**

- .1 If required, as determined from the review of the preliminary balancing report, changes to the equipment drives shall be carried out as follows:
  - .1 The Balancing Contractor shall be responsible for calculating and obtaining the new drives.
- .2 The Contract shall include one drive change for each Air Handling Unit and each Fan with adjustable pulley drive.

#### **1.26 TEMPORARY AND TRIAL USAGE**

- .1 Permanent systems and/or equipment shall not be used during construction period, without Contract Administrator's written permission.
- .2 The City has the privilege of trial usage of mechanical systems, or parts thereof, for the purpose of testing and learning the operational procedures.
- .3 Assist in the trial usage over a length of time, as deemed reasonable by the Contract Administrator, at no extra cost, and do not waive any responsibility because of trial usage.
- .4 Trial usage shall not be construed as acceptance by the City.
- .5 Provide and pay for all testing required on the system components where, in the opinion of the Contract Administrator, Manufacturer's ratings or specified performance is not being achieved.
- .6 Equipment used during construction period to be thoroughly cleaned and overhauled. Replace worn or damaged parts so equipment is in perfect condition, to entire satisfaction of the Contract Administrator and City. All air filters shall be routinely inspected. Filters shall be cleaned and/or replaced depending on filter type during period in which ventilation units are being used for temporary heat and/or commissioning of system. Contractor to be responsible for and pay all costs for air filter cleaning service. Filters to operate between pressure drops noted in filter manufacturer's catalogue.
- .7 Temporary use of equipment shall in no way relieve Contractor of providing twelve month guarantee on all equipment used. This guarantee period shall commence as of date of final acceptance of building by City as interpreted by Contract Administrator.

#### **1.27 SAFETY DEVICE TESTING**

- .1 Make complete inspections of all safety devices such as: back flow preventors, freeze protection devices; fire dampers, smoke dampers, fire stops, and the like to ensure:

- .1 That safety devices are complete in accordance with the specifications and Manufacturer's recommendations.
- .2 That the safety devices are connected and operating according to all local regulations, and appropriate access is provided.
- .2 On completion of the inspections, provide letters and/or certificates, confirming that inspections have been completed. Insert in each O & M Manual.

**1.28 CLEANING**

- .1 General Clean-up:
  - .1 The worksite shall be maintained in a condition of general cleanliness and tidiness.
  - .2 Provide, erect, maintain and remove temporary protective barriers and shelters. Use drop sheets, temporary walls or other means necessary to limit the spread of construction dirt and debris. Barriers shall be used to minimize the spread of dust, smoke, fumes and noise to other portions of the building.
  - .3 For renovation Work, and for phased Work where part of the building is occupied, coordinate and cooperate with the occupants throughout the duration of the project to maintain the site in a usable condition.
  - .4 For renovation Work, and for phased Work where part of the building is occupied, clean the site to the satisfaction of the occupants at the end of each work day, so as to neither inconvenience the occupants nor hinder the use of the facility.
  - .5 For renovation Work, at the end of the project, provide cleaning services to leave the site in as clean a condition as existed before the commencement of the Work.
- .2 Mechanical Systems Clean-up:
  - .1 At the completion of the project, leave all systems in full operation, the exterior of all new and renovated systems clean, and the Work areas cleaned to the satisfaction of the Contract Administrator, City and Occupants.
  - .2 Clean exposed surfaces of new and renovated mechanical equipment, ductwork, piping, etc.
  - .3 The level of cleaning shall be consistent with the intended use of the building and the mechanical systems.
  - .4 The City reserves the right to inspect the Mechanical Systems to determine the effectiveness of the cleaning. Where cleaning is deemed to be unacceptable, the cleaning shall be re-done at no extra charge to the City.
- .3 Special Cleaning:
  - .1 Polish plated Work.

- .2 Vacuum clean and remove debris from the inside of all new air handling systems, fans, ducts, coils, terminal units, etc.
- .3 Vacuum clean and remove debris from the inside of existing air handling systems, fans, ducts, coils, terminal units, etc., as noted on the floor plans.
- .4 For New Ductwork, provide High Velocity Vacuum Cleaning. Provide Duct Access Doors as required.
  - .1 High Velocity Vacuum Cleaning shall be:
    - .1 Portable
    - .2 Capable of a minimum of 4,000 cfm
    - .3 Equipped with HEPA filtration which is 99.97% efficient for particles no greater than 0.3 microns in size, when system exhausts into the Workplace or Occupied Area
- .5 Duct Cleaning Specialist(s) shall provide a report which shall include:
  - .1 Name, Address and Phone Numbers of the Company.
  - .2 Name(s) of Individuals Performing the Work.
  - .3 Description of the Work Performed, including methods, equipment, and extent of ductwork.
  - .4 A Video Tape showing the Complete Interior of the Full Length of all Main Ducts, with camera angles looking down each Branch Duct.

**1.29 INSTRUCTIONS TO CITY PERSONNEL**

- .1 Prepare a List of the Systems, to be signed by the City after instructions are received.
- .2 Instruct the City's representatives in all aspects of the operation of the systems and equipment. Prepare a List of the Systems, to be signed by the City.
- .3 Arrange and pay for the services of Manufacturers' representatives required for the instruction on specialized portions of the installation.

**1.30 OPERATION AND MAINTENANCE MANUALS**

- .1 Assemble and submit to the Contract Administrator three (3) hard-covered 3-ring binders with index tabs containing a complete set of manufacturers' operating and maintenance instructions showing all major equipment, and apparatus requiring maintenance for approval.
- .2 Instructions shall be complete for installation, operation and maintenance and shall include pertinent information such as detailed drawings, maintenance schedules, and addresses. Instructions shall be reviewed with City's representative to ensure a thorough understanding of the operation.
- .3 The Operation and Maintenance (O & M) manuals shall each contain, but not be limited to the following:

- .1 Table of Contents,
  - .2 A certificate or letter stating that all systems have been commissioned and are operating as specified,
  - .3 Contractor Warranty letter and/or Contractor Sign-off Sheets,
  - .4 All Subcontractor's and suppliers names and telephone numbers,
  - .5 A brief description of systems,
  - .6 Overall Equipment Maintenance schedule with weekly, monthly, yearly maintenance instructions,
  - .7 Equipment Start-up reports,
  - .8 A complete set of reviewed shop drawings,
  - .9 Brochures,
  - .10 Data sheets,
  - .11 Wiring diagrams,
  - .12 Air and water testing and balance reports,
  - .13 Controls 'As-Built' shop drawings,
  - .14 Commissioning information,
  - .15 Valve tag schedule, valve position.
  - .16 Warranty certificates.
- .4 Present all copies of the Operation and Maintenance Manuals to the Contract Administrator for review. The Contract Administrator will review the manuals and return them with comments. The Subcontractor shall make all requested changes. This process shall continue until the Manuals are deemed complete by the Contract Administrator. The Subcontractor shall turn over the completed manuals to the City.

**1.31 SPECIAL TOOLS AND SPARE PARTS**

- .1 Prepare a List of Spare Parts, to be signed by the City on receipt.
- .2 As a minimum, provide spare parts as follows:
  - .1 One set of drive belts for each piece of machinery.
  - .2 One set of filters for each filter section installed.
  - .3 One set of pump seals for each pump.
  - .4 One casing joint gasket for each size of pump.
  - .5 Two screens for each size of strainer.
- .3 Identify spare parts containers as to contents and replacement parts number.
- .4 Provide one set of all specialized parts and tools required to service equipment as recommended by the Manufacturers.

**1.32 WARRANTIES**

- .1 No certificate issued, payment made, or partial or entire use of the system(s) by the City, shall be construed as acceptance of defective Work or material.
- .2 Include copies of all warranty and guaranty certificates and declarations in the Operating and Maintenance Manuals, in the appropriate sections.
- .3 Provide a certificate or declaration indicating the warranty and conditions.
- .4 Warranty satisfactory operation of all Work and equipment installed under this Contract. Repair or replace at no charge to the City, all items which fail or prove to be defective within the Warranty period, provided that the failure is not due to improper usage by the City. Make good all damages incurred as a result of the failure and of the repair of the system(s).
- .5 The warranty shall be for all parts and labour. Do not expect any participation from the City's personnel in the correction of warranty related Work.
- .6 For systems, equipment and components which are used continuously throughout the year, the normal warranty period shall be one calendar year from the date of Substantial Completion. For seasonal equipment, components and systems which are not normally used continuously throughout the year, the warranty period shall include at least one full season of satisfactory operation.
- .7 When equipment or systems are put into use subsequent to the acceptance of the building, or a portion of the building, the warranty period for seasonally used equipment and systems shall be deemed to commence from the date of satisfactory operation, not from the date of final acceptance by the City.

- .8 The City retains the right to demand, and to receive, an extension of the original construction warranty for any equipment, component or system which consistently fails to perform, or which requires repeated repair or adjustment.
- .9 Wherever manufacturer's warranties in excess of the Contractor's warranty are provided, furnish the City with copies of the Certificates, dated and acknowledged, and inserted in the O & M Manuals. The Contractor's Warranty shall include a list of the Manufacturer's extended warranties
- .10 Warranty Work shall be carried out within a reasonable time period following the reporting of the problem. Should the repair time for any failed component be unreasonably long, as determined by the City, make alternate arrangements to have a temporary replacement component made available until such time that the original component is repaired and re-installed. There shall be no additional cost to the City for any temporary replacement component or for any labour required to implement the Work.

### **1.33 DOCUMENTATION AND SYSTEM(S) ACCEPTANCE**

- .1 The Contractor shall prepare a suitable document, to be signed by the City or his representative, confirming:
  - .1 The City has received satisfactory instruction in the operation and maintenance of all equipment and systems.
  - .2 The Operation and Maintenance Manuals have been received and reviewed by the City.
  - .3 The "Record" and "As-constructed" drawings have been received and reviewed by the City.
  - .4 Specified spare parts, components, keys, removable handles, tools and the like, have been received by the City.

### **1.34 COMPLETION**

- .1 The Contractor shall be aware that it is the Contract Administrator's intention to withhold recommendations for payment of progress claims totalling more than 95% of the mechanical Contract until the project is declared Substantially Complete.
- .2 The close-out procedure may entail a take-over and occupancy of the building in more than one stage, depending on the specified phasing and the City's timetable.
- .3 **SUBSTANTIAL COMPLETION**
  - .1 The project will be ready for a Substantial Completion inspection only when it is ready for the City to occupy and utilize the building for its intended purpose.
  - .2 At Substantial Completion, the City will realise that some deficiencies may still exist.
  - .3 In preparation for the inspection to determine Substantial Completion for all or a portion of the project, the Contractor shall ensure and declare in writing that:

- .1 Except for seasonal deficiencies, the Start-up and Verification of the Commissioning Process has been completed, and all systems are fully functional.
  - .2 All systems and equipment have been cleaned.
  - .3 All systems and equipment have been identified and labelled.
  - .4 The preliminary Record drawings have been submitted for review.
  - .5 One set of preliminary O & M Manuals have been submitted for review.
  - .6 One copy of the preliminary Balancing Report has been submitted for review.
  - .7 Instructions to the City's Representative have been given.
  - .8 Maintenance Materials and Spare Parts have been provided.
- .4 When the Contractor is satisfied that the entire project is completed, and after making his own inspection, he shall apply, in writing, to the City and/or Contract Administrator, for an inspection to determine if the project can be deemed to be Substantially Complete.
  - .5 In the letter of request, a date shall be specified upon which the project can be delivered and be Substantially Complete.
  - .6 During the inspection, a deficiency list will be compiled and a report will be issued. These deficiencies shall be corrected or completed in a satisfactory and timely manner.
  - .7 Based on the inspection report, the City will retain a sum of money, sufficient in his estimation to cover the cost of completing the deficiencies.
- .4 TOTAL COMPLETION
    - .1 When the Contractor has determined that the deficiencies noted during the Substantial Completion inspection have been completed or corrected, he shall apply, in writing, to the City and/or Contract Administrator, for a final inspection to determine if the project can be deemed to Totally Complete.
    - .2 In the letter of request, a date shall be specified upon which the project can be delivered and be Totally Complete.
    - .3 In preparation for the inspection to determine Total Completion for all or a portion of the project, the Contractor shall ensure and declare in writing that:
      - .1 All aspects of the Commissioning Process have been completed.
      - .2 The final Record and As-Constructed drawings have been submitted, reviewed and accepted.
      - .3 The final O & M Manuals have been submitted, reviewed and accepted.

- .4 The final Balancing Reports have been submitted, reviewed and accepted.
- .5 The deficiencies noted during the Substantial Completion inspection have been corrected or completed.
- .4 During the inspection, a deficiency list will be compiled and a report will be issued. These deficiencies shall be corrected or completed in a satisfactory and timely manner.
- .5 Based on the inspection report, the City will retain a sum of money, sufficient in his estimation to cover the cost of completing the deficiencies.
- .6 Final Payment will only be made after the project has been determined to be Totally Complete, with all deficiencies satisfactorily corrected.

END OF SECTION 21 05 01

**PART 1 GENERAL**

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the requirements of Section 21 05 01, Mechanical General Provisions.
- .2 Comply with the requirements of Sections 22 06 01 Approved Substitutes for Plumbing and 23 06 01, Approved Substitutes for HVAC.

**1.2 SUBMITTALS**

- .1 Submit shop drawings on access doors, air vents, strainers, thermometers and gauges, flow measurement devices, and air filters.

**1.3 STANDARD OF EQUIPMENT, MATERIALS AND COMPONENTS**

- .1 All equipment, materials and components shall be new and of first class quality.
- .2 All equipment, materials and components shall be of proven design, and of current models with published ratings, for which replacement parts are available.
- .3 All equipment, materials and components shall be tested, certified and labeled by ULC and/or CSA for use in Canada. The certification and labeling shall be appropriate for the intended function of the item being supplied, as dictated by the relevant codes and standards.
- .4 Where items are not adequately certified and labeled by the manufacturer, the Contractor supplying the item shall be responsible for obtaining approval for the use of the item from the local Authority Having Jurisdiction, and shall bear all associated costs.
- .5 Where a manufacturer's name, make or model is specified, it is for the sole purpose of setting a standard of quality, performance, capacity, appearance, size and/or serviceability. Refer to Specification Schedule for approved 'Substitutes' and 'Alternates'.
- .6 Use only Copper, Bronze, Brass and Stainless Steel (no iron) for materials coming in contact with Domestic Water Systems.

**1.4 IDENTIFICATION**

- .1 All equipment, including motors shall come with proper nameplates affixed thereto, showing the manufacturer, make, model, size, serial number, horsepower, voltage, cycles, and all other pertinent data usually provided.
- .2 Identify all equipment, panels and controls with lamacoid nameplates indicating Identification Name and Number.
- .3 Identify all piping with direction-of-flow-arrows and service.
- .4 Identify all valves with metal (aluminum or brass) or lamacoid numbered tags with stamped code lettering and numbers filled with black paint and secured to items. Use for valves and operating controllers of all systems.
- .5 Identify all new ductwork with direction-of-flow-arrows and service.

## **1.5 CONSTRUCTION TECHNIQUES AND METHODS OF INSTALLATION**

- .1 The selected techniques, methods of fabrication and installation, and the size of the labor force shall be suitable to meet the completion schedule.
- .2 The Contractor shall be responsible for determining the most appropriate construction techniques and methods of installation for their portions of the Work.
- .3 The Contractor shall be responsible for laying out the systems, equipment, and components for their portions of the Work.
- .4 The Contractor shall consult with the manufacturers to obtain their installation recommendations, and shall comply with such recommendations and/or with local code requirements, whichever is the most stringent.

## **1.6 FIRE STOPPING**

- .1 Fire Stop Materials shall be provided at all penetrations through fire and smoke separations. Refer to the Architectural Drawings for the locations of all separations.
- .2 Fire Stop Materials shall be as approved by the Authorities Having Jurisdiction.
- .3 Fire Stop Material installation shall be as per Manufacturer's recommendations.
- .4 Refer to the Architectural specifications for additional information.

## **PART 2 Products And Materials**

### **2.1 ACCESS PANELS AND DOORS**

- .1 The Contractor and Subcontractor shall coordinate as required to ensure that access doors supplied by different Sub-subcontractors shall be of the same manufacturer and of a style appropriate for the intended use.
- .2 Provide access doors equal to the fire rating of the wall or ceiling in which it is installed.
- .3 Lay-in type tiles, properly marked, may serve as access panels.
- .4 Provide access doors of welded 12 gauge steel, flush type with concealed hinges, lock and anchor straps, complete with factory prime coat.
- .5 All access panels and doors shall be minimum 300 mm x 300 mm (12" x 12"). Where personnel entry is required, minimum size shall be 600 mm x 600 mm (24" x 24").
- .6 Refer to Specification Section 23 31 00 (Air Distribution) for Duct Access Doors.

### **2.2 HANGERS**

- .1 Provide adjustable Clevis type equal to Grinnell Fig. 65 for pipe sizes up to and including N.P.S. 2.5. For pipe sized N.P.S. 3 and over, provide adjustable Clevis type equal to Grinnell Fig. 260. Use rod sizes as recommended by the manufacturer.

- .2 On copper piping, provide copper plated type hanger or separate piping from hanger with an approved insulating tape or plastic coating.
- .3 Provide oversized hangers to pass over insulation on all insulated water piping. Use insulation saddles to protect insulation.

### **2.3 INSERTS**

- .1 Use factory-made threaded or toggle type inserts as required for supports and anchors, properly sized for the load to be carried.
- .2 Use factory made expansion shields where inserts cannot be placed, but only as approved by the Contract Administrator in writing and for light weights.
- .3 Do not use explosive powder activated tools except with the written permission of the Contract Administrator.

### **2.4 SLEEVES**

- .1 Provide the following for pipe sleeves:
  - .1 Through interior walls, exterior walls above grade, interior non waterproof floors: Machine cut schedule 40 steel pipe, medium cast iron or 18 gauge galvanized steel or plastic.
  - .2 Through walls below grade, waterproof floors, floors in janitor's closets, equipment rooms, and kitchens: machine cut medium cast iron, D.W.V. copper or copper sheet extended 100 mm (4") above the floor and cut flush with the underside.
- .2 Provide the following for ductwork:
  - .1 Where fire dampers are not required in poured walls: removable wood box of required size.
  - .2 Where fire dampers are not required in block or brick walls: masonry to be built around ducting.
  - .3 Where fire dampers are required: 18 gauge galvanized steel or heavier sleeves complete with steel angle framing both sides installed in accordance with requirements of Authorities.
  - .4 Through Equipment Room floors: provide 100 mm (4") high curbs and install as described above.

### **2.5 AIR VENTS (AUTOMATIC)**

- .1 Provide air vents equal to Maid-O-Mist No. 7 series.

### **2.6 STRAINERS**

- .1 Provide where shown on the drawings, strainers equal to Toyo 380 for N.P.S. 1/2" to 2" and Toyo 381 JA for N.P.S. 2.5 and over, rated at 860 kPa (125 psi).

- .2 Strainer baskets: Type 304 stainless steel or Monel, 1.14 mm (0.045") perforations for steam and 3 mm (0.125") perforations for water.

## **2.7 THERMOMETERS AND PRESSURE GAUGES**

- .1 Provide pressure gauges where shown on the drawings: These to be 115 mm (4.5") complete with Tee and snubbers. Scale: kPa and psi to suit application. Range: Indication at middle third of gauge.
- .2 Provide thermometers where shown on the drawings. These to be vari-angle in 175 mm (7") case. Scale: Celsius and Fahrenheit to suit applicaation. Ranges as required to suit systems.
- .3 To attach, use Style 923 Viclets/Style 924 Vic-Wells from Victaulic.

## **2.8 FLOW MEASUREMENT VENTURI**

- .1 Where flow measurement is required for equipment, pumps and coils, the use of Venturi's is needed. Victaulic Style 733 Venturi between 1/2" and 30" is acceptable.
- .2 Piping and Balancing Contractor shall coordinate for exact locations and requirements.

## **2.9 DIELECTRIC CONNECTIONS**

- .1 All connections between copper and carbon steel shall be joined with Victaulic Style 47 Clearflow Dielectric Waterway or equal in accordance with B6.
- .2 Brass valves and fittings are not acceptable.

## **2.10 PIPE AND FITTINGS**

- .1 Domestic Hot and Cold Water (above grade):
  - .1 Type L hard copper with wrought copper or cast bronze fittings using lead-free solder.
- .2 Building Water Service (Domestic or Fire):
  - .1 PVC pressure water pipe.
- .3 Heating water and glycol piping:
  - .1 For pipe sizes up to and including N.P.S. 2, type L hard copper with wrought copper or cast bronze fittings using lead-free solder. Rated at 860 kPa (125 P.S.I.).  
or
  - .2 Schedule 40 ASTM specification A53 steel black pipe with standard black malleable screwed fittings rated at 860 kPa, (125 P.S.I.) for pipe sizes up to and including N.P.S. 2.  
or

- .3 Schedule 40 ASTM specification A53 wrought steel black pipe with standard black steel welding fittings for pipe sizes N.P.S. 2½ and over.  
or
- .4 Victaulic fittings may be used on steel piping.
- .4 Chilled water piping:
  - .1 Schedule 40 ASTM specification A53 steel black pipe with standard black malleable screwed fittings rated at 860 kPa (125 P.S.I.) for pipe sizes up to and including N.P.S. 2.  
or
  - .2 Schedule 40 ASTM specification A53 wrought steel black pipe with standard black steel welding fittings for pipe sizes N.P.S. 2½ and over.  
or
  - .3 Victaulic fittings may be used on steel piping.
- .5 Fire Protection (Sprinkler or Standpipe) piping (above grade):
  - .1 Wrought or black steel pipe, or copper piping, with screwed, mechanical (Victaulic), welded or soldered joints as allowed by the Authorities Having Jurisdiction.
- .6 Condensate drip drains:
  - .1 Drainage grade copper tubing with soldered copper drainage fittings.
- .7 Sanitary Drainage and Vent - internal and within 2.0m (5'-0") of building line:
  - .1 Buried: Medium weight cast iron soil pipe with M.J. fittings with corrugated  
CSA approved M.J. clamp,  
or  
Where approved by the Authorities Having Jurisdiction:  
PVC or ABS with fusion welded fittings.
  - .2 Suspended: Medium weight cast iron soil pipe with M.J. fittings with corrugated  
CSA approved M.J. clamp,  
or  
DWV copper with soldered copper or cast bronze drainage fittings,
  - .3 Vertical Risers in shafts below the top floor:  
Medium weight cast iron soil pipe with M.J. fittings with corrugated  
CSA approved M.J. clamp,
- .8 Storm Drainage - internal and within 2.0m (5'-0") of building line:
  - .1 Buried: Medium weight cast iron soil pipe with M.J. fittings with corrugated  
CSA approved M.J. clamp,

- .2 Suspended: Medium weight cast iron soil pipe with M.J. fittings with corrugated CSA approved M.J. clamp,

## 2.11 VALVES

### .1 General

- .1 It is generally preferable that ball valves and butterfly valves be used in place of gate valves providing they meet the pressure, temperature, and fluid handling requirements of the system.

### .2 Gate Valves

- .1 Valves N.P.S. 2 and smaller for threaded ends: Jenkins #810, Crane #428, Toyo 293, Lunkenheimer #2125, Kitz 24, Nibco T111, Milwaukee #148, Newman Hattersley T607M.
- .2 Valves N.P.S. 2 and smaller for soldered ends: Jenkins #813, Crane #1324, Toyo 299, Lunkenheimer #2131, Kitz 43, Nibco 5134, Milwaukee #149, Newman Hattersley T609M.
- .3 Valves N.P.S. 2½ and larger: iron body non-rising stem, Jenkins #452, Crane #461, Toyo #415A Lunkenheimer #1428, Kitz 75, Nibco F619, Milwaukee F2882-M, Newman Hattersley T501.
- .4 Lockshield valves N.P.S. 2 and smaller: Crane 428 Lockshield, Toyo 293, Lunkenheimer #2127, Kitz 24, Nibco T111LS.

### .3 Ball Valves:

- .1 Valves N.P.S. 2 and smaller for threaded ends: Bronze construction with TEF packing and seat, raised lever handle, Jenkins 33, Crane 9302, Toyo 5044A Lunkenheimer 747 F, Kitz 56, Nibco T580, Milwaukee BA100, Newman Hattersley 1969.
- .2 Valves N.P.S. 2 and smaller for soldered ends: Crane 9322, Toyo 5049, Kitz 57, Nibco S580, Milwaukee BA150, Newman Hattersley 1979.

### .4 Check Valves:

- .1 Spring checks at pumps N.P.S. 2 and larger: Moyes and Groves Ltd. I512WM5S, Checkrite 12CBTU, APCO 300 & 600, Nibco W960.
- .2 Miscellaneous locations:
  - .1 Valves N.P.S. 2 and smaller: Jenkins #4092, Crane #37, Toyo #236, Lunkenheimer #2144, Kitz 22, Nibco T433B, Milwaukee 509, Newman Hattersley 47.
  - .2 Valves N.P.S. 2½ and larger: Iron body flanged, Jenkins #587, Crane #373, Toyo #435A, Kitz 78, Lunkenheimer #1390; Victaulic 2-½" to 3" style 716, 4" to 8" style 715 and 8" to 12" style 711, Nibco F918B, Milwaukee F2474-M, Newman Hattersley 651.

- .5 Drain Down Valves:
  - .1 N.P.S. ¾" to 2": Brass construction ball action valve complete with cap and chain rated 150 psi steam 600 w.o.g. Toyo 5046, Milwaukee BA100H.
- .6 Balancing Cocks:
  - .1 Where gate valves are used for terminal isolation provide DeZurik series 425.
- .7 Butterfly Valves:
  - .1 Cast iron body, bronze or stainless steel discs, Buna N "O" rings, bronze bushings straight through or pinned shafts and stainless steel stem.
  - .2 EPDM rubber resilient seat with temperature range of -40° to 120°C.
  - .3 Tight shut-off to 1100 kPa (150 PSI) and 120°c (250°F).
  - .4 Lug type body tapped for 1100 kPa (150 psi) A.N.S.I. drilling may be used in lieu of spool pieces for equipment removal.
  - .5 Handles and operators: 2" to 6", use lever with multi-position adjustment. For N.P.S. 8 and over use wheel operated, worm gear actuator.
  - .6 Acceptable Standard: Keystone F1000/F1020, Crane Regent 55 Y 4E, Jenkins 2232E, Victaulic "Vic 300", Nibco LD2000-3, Milwaukee M, Newman Hattersley 45-31552, Toyo 918-BES-L.
- .8 Water Service Valves:
  - .1 N.P.S. 2" and smaller - Mueller to utility standard.
  - .2 N.P.S. 2" and larger - Mueller, McAvity, to utility standard.
- .9 Fire Service:
  - .1 N.P.S. 4" and larger above ground: iron body, bronze trim O S & Y, flanged 200 psi, U.L.C./FM approved. McAvity 10269, Nibco F6070TS ULC.
  - .2 N.P.S. 4 and larger buried: non-rising stem, iron body bronze trim, S.S. bolts, integral bonnet, ULC/FM approved, McAvity series 616 or Nibco F609/M609 ULC to suit pipe connections.

## **2.12 WIRING AND ELECTRIC MOTORS**

- .1 Electrically operated equipment shall bear a C.S.A. approval label.
- .2 Electric power wiring for equipment provided by mechanical trades is specified in Division 26.
- .3 Electric control wiring for equipment provided by mechanical trades is specified in Section 25 05 05.

- .4 The wiring of all temperature, level, and flow devices required for the operation or control of mechanical equipment provided under this division, shall be installed under the scope of Work of Section 25 05 05 (Controls), to the standards established under the Electrical Division 26 and in accordance with code requirements. This is with the exception of line voltage controls for 120V or 208V single phase cycling such as force flow thermostats, level controls and the like which shall be wired under Division 26 scope of Work.
- .5 Generally all motors 375 watt (1/2 H.P.) and smaller to be 120 volt, single phase, 60 cycle. Motors shall meet NEMA standard for maximum sound level ratings under full load and have a 1.15 service factor. Single phase motors to be permanent split capacitor type.
- .6 All motors 375 watts to 37.5 kilowatts (1/2 Hp to 50 Hp) supplied under this Contract must meet or exceed the following minimum criteria:
  - .1 Shall be Cema Design Normal torque, low starting current with Class B insulation for operation in maximum ambient of 40°C (105°F).
  - .2 Bearings to be rated for minimum B-10 life of 20,000 hours with a V-belt drive.
  - .3 Service factor shall be 1.15.
  - .4 Motors shall be drip proof unless otherwise specified.
  - .5 Motors shall meet or exceed the following efficiency and power factor criteria for 1800 RPM motors.

EFFICIENCY TIMES POWER FACTOR (Note: F.L. means Full Load)

<u>H.P. (Kw)</u>	<u>F.L.</u>	<u>0.75 F.L.</u>	<u>0.50 F.L.</u>
1 (0.75)	.57	.49	.36
1.5 (1.12)	.61	.54	.41
2 (1.50)	.65	.58	.45
3 (2.25)	.60	.55	.43
5 (3.75)	.69	.64	.53
7.5 (5.62)	.64	.58	.47
10 (7.50)	.69	.65	.54
15 (11.25)	.71	.69	.61

**2.13 IDENTIFICATION**

- .1 Valves:
  - .1 Provide 35 mm (1-3/8") diameter brass or lamacoid tag, with stamped numbers, secured by brass chains to the valve.
- .2 Equipment:
  - .1 Provide 3mm (1/8") thick lamacoid plastic name plate of approved size with bevelled edges having engraved white letters on a black background, giving the name of the equipment or equipment service and it's number, ie: 'Fume Hood Exhaust Fan EF-27'.
- .3 Piping:

- .1 Piping identification shall be pre-manufactured labels, suitably attached for permanence, or stencils with painted lettering. Painted stencils shall be of a suitable color to contrast with the pipe/insulation color.
- .2 New identification shall match existing identification.
- .4 Ductwork:
  - .1 Ductwork identification shall be painted stencils of a suitable color to contrast with the duct/insulation color.

## **2.14 AIR FILTERS**

- .1 Unless specifically noted otherwise, all filters shall be replaceable panel type, for slide-in application, into galvanized steel racks.
- .2 All filter panels shall be pleated media type in cardboard frames. Media shall be 'Medium Efficiency', equal to Farr 30/30.
- .3 All filter media shall be constructed of unbreakable synthetic micro-fibres in 3 stage variable density media.
- .4 Filters shall be listed at least Class II UL flammability.
- .5 No filter shall contain asbestos, micro-glass or Urea-formaldehyde.

## **PART 3 Installation And Execution**

### **3.1 GENERAL INSTALLATION**

- .1 Install equipment, ductwork, conduit and piping in a workmanlike manner to present a neat appearance and to function properly to the acceptance of the Contract Administrator. Install ducts and pipes parallel and perpendicular to building planes. Install piping and ductwork concealed in chases, behind furrings or above ceilings. Install exposed systems neatly, and group to present a neat appearance.
- .2 Install all equipment and apparatus requiring wiring, maintenance, adjustment or eventual replacement with due allowance therefore.
- .3 Include in the Work all requirements of manufacturers shown on the shop drawings.
- .4 Replace all Work unsatisfactory to the Contract Administrator without extra cost.
- .5 Install all ceiling mounted components (Diffusers, Grilles, Sprinklers) in accordance with reflected ceiling drawings, accepted by the Contract Administrator.
- .6 Leave space clear and install all Work to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or materials supplied by other trades. Verify spaces in which Work is to be installed. Install pipe runs etc., to maintain maximum headroom and clearances and to conserve space in shaft and ceiling spaces.

- .7 Confirm on the site the exact location of outlets and fixtures. Confirm location of outlets for equipment supplied by other trades.

### 3.2 ACCESS PANELS AND DOORS

- .1 Install all concealed Mechanical equipment requiring adjustment or maintenance in locations easily accessible through access panels or doors. Install systems and components to result in a minimum number of access panels.
- .2 Provide access doors in walls and ductwork at all fire dampers, motorized dampers, duct mounted coils, smoke detectors, fan inlets and outlets, etc. Indicate access panels on "Record" drawings.
- .3 Access doors shall be supplied by the trade requiring the door, and shall be installed by the appropriate architectural or finishing trade. All pertinent information required for the installation of the access door shall be provided by the supplying trade to the installing trade.
- .4 Prepare detail drawings showing location and type of all access doors in coordination with other trades before proceeding with installation and hand these to the Contractor for approval.
- .5 Size access doors to provide adequate access and commensurate with the type of structure and architectural finish.
- .6 Ensure proper rating of doors in fire separations.

### 3.3 HANGERS

- .1 Hanger rods may be attached to beam or joist clamps, brackets, or concrete inserts. Explosive actuated tools are not permitted. Do not weld to structural steel unless Contract Administrator's approval is given.
- .2 The following tables will determine support points for all piping on this installation:

STEEL PIPE:	<u>NOMINAL SIZE</u>	<u>DISTANCE BETWEEN SUPPORTS</u>
	Up to N.P.S. 1.25	2,400 mm (8 ft.)
	N.P.S. 1.25 - N.P.S. 2.5	3,000 mm (10 ft.)
	N.P.S. 3 and over	3,600 mm (12 ft.)

COPPER PIPE:	<u>NOMINAL SIZE</u>	<u>DISTANCE BETWEEN SUPPORTS</u>
	Up to N.P.S. 0.75	1,800 mm (6 ft.)
	N.P.S. 0.75 - N.P.S. 1	2,400 mm (8 ft.)
	N.P.S. 1.25 - N.P.S. 2	3,000 mm (10 ft.)
	N.P.S. 2.5 and over	3,600 mm (12 ft.)

### 3.4 INSERTS, SLEEVES AND ESCUTCHEONS

- .1 Place inserts only in portion of the main structure and not in any finishing material.
- .2 Supply and locate all inserts, holes, anchor bolts and sleeves in time when walls, floors and roof are erected.
- .3 Seal all sleeves as follows:

- .1 Through all walls: Stop insulation flush with all wall surfaces and seal space between duct or pipe and sleeve with ram packed mineral wool.
  - .2 Through Shaft and Equipment Room walls: apply an approved caulking compound over the ram packed mineral wool on both sides.
  - .3 At Fire Separations and Rated Walls: Provide intumescent 'donut(s)'.
  - .4 Through floors of Equipment Rooms, Kitchens and Janitor's closets: seal as described above for Equipment Room Walls.
  - .5 Through foundation walls, co-operate with the Waterproofing trade and apply an approved caulking compound over ram-packed mineral wool on both sides. Over this, on both sides, apply a layer of glassfab tape imbedded in two coats of an approved mastic compound.  
-or-  
Provide a 'Link-Seal' gasket.
- .4 Cover sleeves and openings around exposed piping in all finished areas with split chrome plated escutcheons. Cover exposed duct sleeves in finished areas with an 18 gauge galvanized steel collar fixed to wall or floor.

### **3.5 AIR VENTS**

- .1 Provide air vents on closed-loop water piping at all high points in the system and at each piece of equipment. Provide shut off cocks to automatic vents.
- .2 Provide automatic air vents on piping mains except where a possibility from water damage would occur, in which case, use manual vents.
- .3 Provide manual air vents at each piece of equipment.

### **3.6 CONTROL COMPONENTS**

- .1 Mount all pipe line devices supplied by the control Subcontractor such as flow switches, valves, separable wells for temperature controllers and sensors.
- .2 Install control devices to guarantee proper sensing. Shield elements from direct radiation and avoid placing them behind obstructions.

### **3.7 PIPE INSTALLATION**

- .1 The piping shown on the drawings is diagrammatic for clearness in indicating the general run and connections, and may or may not be, in all instances, shown in its true position. This does not relieve this Subcontractor from the responsibility for the proper erection of systems of piping in every aspect suitable for the Work intended and as described in the specifications.
- .2 Install all piping in the best workmanlike manner in accordance with the best practices of the trade.
- .3 Install brass and copper pipe tubing free from surface damage. Replace damaged pipe or tubing.

- .4 Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.
- .5 Where steel piping is required to be buried, apply two coats of flint-guard 410-02 (or equal in accordance with B6) bituminous paint to all buried surfaces after assembly and testing.
- .6 Install groups of piping parallel to each other on trapeze hangers, spaced to permit service access, application of insulation, and identification.
- .7 Install piping straight, parallel and close to walls and ceilings, with specified pitch. Use manufactured fittings for direction changes.
- .8 Install piping to avoid any interference with the installation of equipment, other piping, ducts etc. Where it is necessary to offset piping to avoid obstructions, use 45 degree rather than 90 degree elbows.
- .9 Provide long turn pipe fittings not less than pipe wall thickness. Provide line size tees, and where branch lines are more than two sizes smaller than the main, weldolets may be used.
- .10 All openings in pipes and fittings shall be kept plugged or capped during installation, to prevent the entry of dirt and debris.
- .11 Install systems so that they can be thoroughly drained and all air eliminated. Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.
- .12 Provide hose end valves at all low points for complete system drainage, whether shown on the drawings or not.
- .13 Slope all condensate drip drains, and provide suitable cleanouts on every other change in direction.
- .14 Ream the ends of pipes and tubes before installation. Clean the ends of pipes/tubing, and the recesses of fittings to be brazed or soldered. Assemble joints without binding.
- .15 During welding or soldering procedures, provide a fire retardant cloth, mat or blanket to protect the structure, and adequate fire protection equipment at all locations where Work is being done. Close off shaft or confined areas with a fire retardant mat or cloth to prevent sparks or pieces of hot metal from falling down the shaft or area way.
- .16 Make all threaded pipe joints using a thread paste or teflon tape applied to the male thread. Use only non-toxic lubricants which are non-injurious to the gasket material, and suitable for the service for which the pipe is to be used. Use of hemp or similar materials on threaded joints will not be permitted.
- .17 Place all valves and specialties to permit easy operation and access.
- .18 Install gauges and thermostats to permit easy observance.
- .19 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

- .20 Regulate and adjust packing glands, regulating valves and relief valves on completion of the Work

### **3.8 DRAINS**

- .1 Pipe all discharge from relief valves to the floor, in the vicinity of a floor drain.
- .2 Pipe all discharge from drain pans and drain valves to the nearest floor drain or suitable receptacle.
- .3 Provide N.P.S. 3/4 ball valves with hose end outlets at strainers, all low points, at pumps, coils and at each piece of equipment.

### **3.9 PIPING SYSTEM TESTS**

- .1 Do not insulate piping systems until completed, perfected, and proven tight.
- .2 Should leaks develop in any part of the piping system, remove and replace defective sections, fittings, etc.
- .3 Test piping systems and prove tight.
  - .1 Test piping system in sections as required by the progress of this and other Contractor Work and provide all required isolating valves.
  - .2 Test all drain and vent piping pneumatically to a pressure of 14 kPa (2 psi) and prove tight for a period of 1 hour.
  - .3 Test all domestic water piping hydraulically to a pressure of 518 kPa (75 psi) and prove tight for a period of 4 hours.
  - .4 Test all chilled water, heating water, and glycol piping hydraulically to a pressure of 690 kPa (100 psi) and prove tight for a period of 8 hours.
  - .5 Test sprinkler piping as required, to the satisfaction of the Authorities Having Jurisdiction

### **3.10 PUMP AND EQUIPMENT CONNECTIONS**

- .1 Install piping connections to pumps and all other equipment without strain at the pipe connection to this equipment. Where requested by the Contract Administrator, remove the bolts in flanged connections, or disconnect the piping after the installation is complete, to demonstrate that the piping has been so connected.
- .2 Equipment Connections:
  - .1 All fittings N.P.S. 2 and below connecting to equipment: use unions, extra heavy duty pattern, having ground joints, brass seats and diagonal screw.
  - .2 Connections to equipment N.P.S. 2.5 and above: Flanged, standard weight provided with ring gaskets.
  - .3 Install the shut-off valves and flanges/unions, in locations so as to permit the removal of the equipment without disturbing the piping systems.

**3.11 WELDING**

- .1 Only persons who have passed welding tests to the satisfaction of the Authorities Having Jurisdiction and who are certified by them to be qualified welders, shall be permitted to do any welding on this Contract.

**3.12 DIRT ACCUMULATION UNDER CONTROL VALVES**

- .1 If dirt accumulates under the seats of automatic control valves, this Subcontractor is responsible, during the first year's operation, to remove the collected materials under the valve seats and if the seat is damaged, replace same, at no additional cost to the City.

**3.13 PROTECTION**

- .1 Cover openings in equipment, and cover equipment where damage may occur to the finish from weather or construction.
- .2 Cover temporary openings in ducts and pipes with polyethylene sheets, until final connection is made.

**3.14 RIGGING OF EQUIPMENT**

- .1 Provide all rigging, hoisting and handling of equipment as necessary in order to place the equipment in the designated area in the building.
- .2 Direct this Work by qualified people normally engaged in rigging, hoisting and handling of equipment.

**3.15 CONCRETE**

- .1 Concrete Work required for mechanical Work and shown on architectural or structural drawings: Provided by General Contractor.
- .2 Concrete Work required for mechanical Work and not shown on Architectural or Structural drawings - to be provided by this Division.
- .3 Provide in good time, all inserts, sump frames, anchors etc., for mechanical services, required to be built into the forming.
- .4 Provide concrete thrust blocks at each change of direction for underground water piping, as per drawing details.

**3.16 METALS**

- .1 Steel construction required solely for the Work of mechanical trades and not shown on architectural or structural drawings: Provided by this Subcontractor to the acceptance of the Contract Administrator.

**3.17 IDENTIFICATION**

- .1 Equipment:

- .1 Identify all equipment, panels, automatic control devices, etc., with lamacoid name plates.
  - .2 The wording shall be the same as the Drawings and Specifications. Prior to ordering, the wording of all equipment tags shall be submitted to the Contract Administrator for review.
  - .3 Mechanically affix the tags to the equipment using pop rivets or sheet metal screws.
- .2 Valves:
- .1 Provide all major valves with metal or lamacoid numbered tags,
  - .2 Prepare an approved list detailing the valve location, tag numbers and purpose it serves.
  - .3 Mount one (1) copy of the valve list in a glazed frame where advised by the City and provide one additional copy in each O & M manual.
  - .4 The numbering system shall include the service designation (i.e.: DHW, DCW, HWS, HWR, etc.). The service designations shall be the same as the Drawings.
- .3 Piping:
- .1 Identify all piping with service and direction of flow.
  - .2 Piping identification shall be provided at each equipment connection, behind each access door, in each room, and every 9 m (30 ft.) on straight runs of pipe.
  - .3 The location and height of the lettering shall be suitable to be easily read from a standing position in the vicinity of the piping.
  - .4 The service designations (i.e.: DHW, DCW, HWS, HWR, etc.) shall be the same as the Drawings and Specifications.
- .4 Ductwork:
- .1 Identify all ductwork as to service and direction of flow:
  - .2 Ductwork identification shall be provided at each equipment connection, behind each access door, in each room, and every 9 m (30 ft.) on straight runs of ductwork.
  - .3 The location and height of the lettering shall be suitable to be easily read from a standing position in the vicinity of the ductwork.
  - .4 The service designations (i.e.: S/A, E/A, O/A, etc.) shall be the same as the Drawings and Specifications.

### **3.18 FLASHING**

- .1 Flash all mechanical parts passing through or built into an outside wall, or a waterproof floor.

- .2 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.
- .3 Provide counter-flashing on stacks, ducts and pipes passing through roofs to fit over curb flashing.

**3.19 EXCAVATION AND BACKFILL**

- .1 Do all excavation, bedding, backfill and related Work required for mechanical Work in accordance with the requirements of the General Contractor's specifications, except as varied by this article.
- .2 Grade the bottom of the pipe trench excavation as required.
- .3 In firm undisturbed soil, lay pipes directly on the soil and shape soil to fit the lower 1/3 segment of all pipes and pipe bells. Ensure even bearing along the barrels. Backfill excavation and compact to the following standard Proctor densities:
  - .1 Sodded area, excavated material to 50% P.D.
  - .2 Under paving, sand to 95% P.D.
  - .3 Under Floor slabs, sand to 100% P.D.
- .4 In rock and shale excavate to 150 mm (6") below and a minimum of 200 mm (8") to either side of the pipe. Fill back with a bedding of 10 mm (3/8") crushed stone or granular 'A' gravel.
- .5 Prepare new bedding under the pipe in unstable soil, in fill, and in all cases where pipe bedding has been removed in earlier excavation, particularly near perimeter walls of buildings, at manholes and catch basins. Compact to maximum possible density and support the pipe by 200 mm (8") thick concrete cradle, spanning full length between firm supports.
  - .1 Install reinforcing steel in cradle or construct piers every 2400 mm (8 ft.) or closer, down to solid load bearing strata. Provide a minimum of one pier per length of pipe. Use the same method where pipes cross.
- .6 Where excavation is necessary in proximity to, and below the level of, any footing, provide a bed of 14,000 kPa (2000 psi) concrete to the level of the highest adjacent footing. Proximity is determined by the angle of response as established by the Contract Administrator.
- .7 Provide support over at least the bottom one third segment of the pipe in all bedding methods.
- .8 Do not open trench ahead of pipe laying and bedding more than weather will permit.
- .9 Break up rocks and boulders and remove these by drilling and wedging. Do not use blasting unless specifically approved by the Contract Administrator. Do not use for backfill.
- .10 Do all backfilling in 150 mm (6") layers with clean selected materials acceptable to the Contract Administrator.

- .11 During freezing weather or where frozen material is excavated, backfill with dry sand.
- .12 Provide concrete thrust blocks at each change of direction for underground water piping, as per drawing details.
- .13 Dispose of surplus excavated material as directed by the General Contractor.

**3.20 PAINTING**

- .1 Provide all exposed ferrous metal Work on equipment with at least one factory prime coat, or paint one prime coat on the job. Clean up or wire brush all equipment, etc., before painting. Finish painting will be by other Divisions unless otherwise noted.
- .2 This Subcontractor is not required to prime coat or paint ductwork or piping, except to paint gas piping as per code requirements.
- .3 For factory applied finishes, including prime coats, repaint or refinish surfaces damaged during shipment, erection or construction Work.

END OF SECTION 21 05 05

**PART 1 GENERAL**

**1.1 GENERAL REQUIREMENTS**

- .1 Comply with the requirements of Section 21 05 01, Mechanical General Provisions.
- .2 Comply with the requirements of Section 21 05 05, Basic Materials and Methods.
- .3 Comply with the requirements of Sections 22 06 01 Approved Substitutes for Plumbing and 23 06 01 Approved Substitutes for HVAC.

**1.2 WORK PERFORMED UNDER THIS SECTION**

- .1 Supply and installation of external thermal insulation for new piping, ductwork, and equipment.
- .2 Repair of external thermal insulation for existing piping and ductwork.

**1.3 QUALITY ASSURANCE**

- .1 Qualifications: Execute Work of this section only by skilled tradesmen regularly employed in the application of insulation of mechanical systems.

**1.4 DEFINITIONS**

- .1 The word "exposed" where used in this section means any Work which is not concealed in walls, shafts, cavities, ceilings or crawlspaces. Work behind doors, in closets or cupboards, or under counters is considered exposed. Work in Mechanical and Mechanical Rooms is considered exposed.
- .2 The term 'cold piping' refers to the following systems: Chilled Water, Well/Ground Water, Domestic Cold Water, Plumbing Vents, and Condensate Drip Drains.
- .3 The term 'hot piping' refers to Domestic Hot Water Supply and Recirc piping, Tempered Water Supply and Recirc piping, Domestic Hot Water Supply and Recirc piping, Steam and Steam Condensate piping, Glycol Supply and Return piping, and Heating Water Supply and Return piping.

**1.5 SUBMITTALS**

- .1 Submit Shop Drawings for Trap Insulation

**PART 2 PRODUCTS AND MATERIALS**

**2.1 PRE-FORMED PIPE INSULATION FOR COLD PIPING**

- .2 Provide sectional fibreglass pipe insulation in pre-molded sections 900 mm (36") long; split and ready for application; with a maximum "K" factor of 0.035 at 24oC (75oF) mean temperature; and be capable of use on service from -40oC to 260oC (-40oF to 500oF); and with factory applied vapour seal jacket of foil craft laminate with reinforcing of open mesh glass fibre.

**2.2 PRE-FORMED PIPE INSULATION FOR HOT PIPING**

- .3 Provide sectional fibreglass pipe insulation in pre-molded sections 900 mm (36") long; split and ready for application; with a maximum "K" factor of 0.035 at 24oC (75oF) mean temperature; and be capable of use on service from -40oC to 260oC (-40oF to 500oF); and with factory applied vapour all service jacket of paper with reinforcing of open mesh glass fibre.

### **2.3 INSULATION FOR DUCTWORK**

- .1 Exposed rectangular:  
25 mm (1") thick, 48 kg/m<sup>3</sup> (3.0 lbs/ft<sup>3</sup>) density, foil faced fibreglass board.
- .2 Concealed rectangular:  
25 mm (1") thick, 48 kg/m<sup>3</sup> (3.0 lbs/ft<sup>3</sup>) density, foil faced fibreglass board  
  
or  
  
25 mm (1") thick, 12 kg/m<sup>3</sup> (0.75 lbs/ft<sup>3</sup>) density, flexible fibreglass blanket with open mesh, glass fibre reinforced, foil facing.
- .3 Round ductwork:  
25 mm (1") thick, 12 kg/m<sup>3</sup> (0.75 lbs/ft<sup>3</sup>) density, flexible fibreglass blanket with open mesh, glass fibre reinforced, foil facing.
- .4 Ductwork exposed to outdoors or handling outdoor air:  
2 layers of 25 mm (1") thick, 48 kg/m<sup>3</sup> (3.0 lbs/ft<sup>3</sup>) density, foil faced fibreglass board.  
[Note: Duct sections lined with 25 mm (1") thick duct liner need only have 25 mm (1") exterior insulation applied].

### **2.4 INSULATION FOR EQUIPMENT**

- .1 Roof drain bodies:  
25 mm (1") thick, 12 kg/m<sup>3</sup> (0.75 lbs/ft<sup>3</sup>) density, flexible fibreglass blanket with open mesh, glass fibre reinforced, foil facing.

### **2.5 MISCELLANEOUS APPLICATIONS**

- .1 Provide 'Trap-Wrap' or equal insulation on all P-traps on all Lavatories, whether noted as handicap accessible or not.
- .2 Refrigerant Systems:  
Pre-formed, 25 mm (1") thick, closed cell rubber, Imcolock or Armaflex, pipe insulation.

### **2.6 FINISHES**

- .1 Piping (concealed): factory applied jacket.
- .2 Piping (exposed): 170 g/m<sup>2</sup> (6 oz/yd<sup>2</sup>) U.L. labeled canvas with PVC fitting covers.
- .3 Ductwork (concealed): factory applied jacket.
- .4 Ductwork (exposed): 170 g/m<sup>2</sup> (6 oz/yd<sup>2</sup>) U.L. labeled canvas.

- .5 Ductwork (exposed outdoors):
  - .1 two layers of felt paper, tarred and sealed to make weatherproof  
or  
Blueskin poly-type bitumen membrane.
  - .2 Dimple finish 016 aluminum jacket.
- .6 Roof Drain Bodies (concealed): factory applied jacket.
- .7 Refrigerant Piping:
  - .1 Exposed outdoors: Two coats of compatible paint.
  - .2 Indoors: None.

### **PART 3 INSTALLATION AND EXECUTION**

#### **3.1 PIPING**

- .1 Apply insulation at a temperature of approximately 18°C (65°F) over clean, dry surfaces. Butt adjoining sections of insulation firmly together with the longitudinal seam of the jacket located on the bottom half of the pipe.
- .2 On cold piping, insulate and finish all valves, fittings and flanges in the same manner and same thickness as the piping. Use mitred sections of the specified pipe covering.
- .3 On hot piping, do not insulate valves, unions and flanges, and where concealed, do not insulate any fittings - straight runs of pipe only.
- .4 For cold piping, seal longitudinal lap joints with suitable vapour barrier adhesive. Cover all joints with foil faced self-adhesive tape.
- .5 For hot piping, seal longitudinal lap joints with a suitable adhesive/cement capable of withstanding the service temperature. Cover butt joints with a strip of the same material as the jacket, and cement as required.
- .6 Concealed insulated items require no further finish than provided in factory applied jacket.
- .7 All adhesives and finishes: Fire retardant or fire resistant when dry and acceptable to the Authorities Having Jurisdiction.
- .8 For cold piping, seal end joints and perforations with factory furnished 100 mm (4") wide vapour barrier strips applied with the same adhesives and cements as previously specified.
- .9 Seal valves, fittings and flanges on cold piping in a manner as specified for end joints.
- .10 On all cold piping where oversized hangers are used: Protect insulation with a sheet metal saddle installed over the vapour barrier. For piping N.P.S. 1.5" and larger, provide a section of rigid insulation or non-compressible material under the vapour barrier, the same length as the saddle.

### 3.2 DUCTWORK

- .1 Do not insulate ductwork prior to duct sealant being applied.
- .2 Exposed rectangular ductwork: Impale fibreglass board on weld pins and speed washers 300 mm (12") o/c with a minimum of two rows per side on any side greater than 300 mm (12"). Cut pins flush with surface of insulation and cover with foil faced tape. Cover all joints with foil faced adhesive tape.
- .3 Concealed ductwork and exposed round: Apply flexible blanket insulation with an approved adhesive brushed on in 100 mm (4") wide strips 300 mm (12") o/c and at all joints. Seal all joints and perforations with foil faced adhesive tape.
- .4 Where interior lined ductwork is required to be insulated, the thickness of the liner may be deducted from the total thickness of the exterior insulation. This is with the exception of specific items such as exhaust plenums detailed on the drawings.

### 3.3 EQUIPMENT AND MISCELLANEOUS APPLICATIONS

- .1 Roof Drain bodies: Apply flexible blanket with suitable adhesive. Seal joints and edges with foil faced tape.
- .2 P-traps: Refer to 'Miscellaneous Applications' in Part Two of this Specification Section.
- .3 Refrigerant piping: Install using self-locking plastic ties. Seal joints with suitable mastic.

### 3.4 INSULATION THICKNESS SCHEDULE

- .1 Piping:
  - .1 Domestic Cold Water piping: Runouts-12mm (1/2"); piping over 38mm (1 1/2") in size-25 mm (1").
  - .2 Domestic Hot Water Supply and Recirc piping: Runouts-12mm (1/2"); piping over 38mm (1 1/2") in size-25 mm (1").
  - .3 Gas piping penetrating an exterior building surface [for the last 3000 mm (10'-0")]: 25 mm (1")
  - .4 Refrigerant lines: 25 mm (1")
- .2 Ductwork:
  - .1 Supply Ductwork (on all new ductwork whether specifically noted on the drawings or not): 25 mm (1")
  - .2 Fresh Air Intake Ducts to air units: 50 mm (2")
  - .3 Mixed Air ducts from Fresh Air duct to Heating Coil: 50 mm (2")
  - .4 Ducts penetrating an exterior building surface [for the last 3000 mm (10'-0")]: 50 mm (2")

- .5 Ducts outdoors: 50 mm (2")
- .6 Relief Air ducts: 50 mm (2")
- .7 Drip pans: 25 mm (1")
- .3 Equipment and Miscellaneous Applications:
  - .1 Roof Drain bodies: 25 mm (1")
  - .2 P-traps: Refer to 'Miscellaneous Applications' in Part 2 of this Specification Section.
  - .3 Refrigerant Piping: 25 mm (1")

END OF SECTION 21 07 01