

**Georgian Bay General Hospital (GBGH)  
Minor Works - Pharmacy**

**Mechanical Specifications**

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QCG Project # HC-24-104



## **PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP**

### **Division 00 Procurement and Contracting Requirements**

#### **Introductory Information**

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#### **Procurement Requirements**

Not Used

#### **Contracting Requirements**

Not Used

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Not Used

### **FACILITY CONSTRUCTION SUBGROUP**

Not Used

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Not Used

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SITE AND INFRASTRUCTURE SUBGROUP  
Not Used

PROCESS EQUIPMENT SUBGROUP  
Not Used

End of Document

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## **1 General**

### **1.01 Section Includes**

- .1 This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Sections of Mechanical Divisions. It is intended as a supplement to each Section and is to be read accordingly.

### **1.02 References**

- .1 Division 00 and Division 01 apply to and are a part of each Mechanical Division:
  - .1 Division 20 – Common Mechanical Requirements;
  - .2 Division 21 – Fire Suppression;
  - .3 Division 22 – Plumbing;
  - .4 Division 23 – Heating, Ventilating, and Air Conditioning;
  - .5 Division 25 – Integrated Automation.
- .2 The provisions of this Section also apply to the following sections:
  - .1 Section 08 31 00 – Access Doors and Panels.
  - .2 Section 10 44 16 – Fire Extinguishers.

### **1.03 Submittals**

- .1 Submit copy of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations.
- .2 Submit a list of pipe and duct identification colour coding and wording.
- .3 Submit a proposed valve tag chart and a list of proposed valve tag numbering and identification wording.
- .4 Submit any other submittals specified in this Section or other Sections of Mechanical Divisions.

## **2 Products**

### **2.01 Firestopping and Smoke Seal Materials**

- .1 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in Section 20 05 17 – Sleeves and Sleeve Seals for Mechanical Piping, and work is to be done as part of mechanical work unless otherwise specified in Division 07.

### **2.02 Access Doors**

- .1 Access doors to be provided under work of Division 08 by General Trades Contractor.
- .2 Coordinate with Mechanical Contractor and General Trades Contractor to ensure access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and work involving both mechanical and electrical services, where possible, be accessible from common access door. Coordinate work to ensure same common location access doors are not supplied by more than one Division.

- .3 Size access doors to suit the concealed work for which they are supplied, and wherever possible they are to be of standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.
- .4 Access doors in fire rated construction are to be ULC listed and labelled and of a rating to maintain fire separation integrity.
- .5 Identify on reflected ceiling plans and wall elevation drawings, coordinated locations of proposed access door locations and submit to the Consultant for review.

### **3 Execution**

#### **3.01 General Piping and Ductwork Installation Requirements**

- .1 Unless otherwise specified, locate, and arrange horizontal pipes and ducts above or at ceiling on floors, arranged so that under consideration of all other work in area, maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, with Consultant's approval.
- .2 Unless otherwise specified, install work concealed in finished spaces, and concealed to degree possible in partially finished and unfinished spaces. Refer to and examine Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Walls which are painted are considered finished.
- .3 Install pipes and ducts parallel to building lines and to each other.
- .4 Neatly group and arrange exposed work.
- .5 Locate work to permit easy access for service or maintenance as required and/or applicable. Locate valves, dampers and any other equipment which will or may need maintenance or repairs and which are to be installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate accessories at floor level.
- .6 Make connections between pipes of different materials using adapters suitable for application. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.
- .7 Comply with equipment and material manufacturer's installation instructions unless otherwise specified herein or on drawings, and unless such instructions contradict governing codes and regulations.
- .8 Carefully clean ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.
- .9 Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around pipe or duct, except for ductwork at fire barriers, in which case insulation will be terminated at each side of the duct fire damper.
- .10 Inspect surfaces and structure prepared by other trades before performing work. Verify surfaces or structure to receive work has no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of work will constitute acceptance of such surfaces as being satisfactory.
- .11 Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both, is to be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean piping prior to being concealed.

- .12 For factory applied finishes, repaint or refinish surfaces damaged during shipment and installation. Quality of repair work is to match original finish. This requirement also applies to galvanized finishes.
- .13 Where mechanical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminium ductwork, copper or stainless steel pipe, etc.
- .14 Provide screwed unions or flanges in piping connections to equipment and in regular intervals in long (in excess of 12 m (40')) piping runs to permit removal of sections of piping.
- .15 Unless otherwise specified and except where space limitations do not permit, piping elbows are to be long radius. Eccentric reducers are to be installed with straight side at top of piping.

### 3.02 Pipe Joint Requirements

- .1 Do not make pipe joints in walls or slabs.
- .2 Ream piping ends prior to making joints.
- .3 Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After pipe has been screwed into fitting, valve, union, or piping accessory, not more than 2 pipe threads are to remain exposed.
- .4 Site bevel steel pipe to be welded or supply mill bevelled pipe. Remove scale and oxide from bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.
- .5 Welded joints are to be made by CWB certified licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed. Each weld is to be identified with the welder's identification symbol, and welds are not to be concealed until they have been inspected and approved. Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.
- .6 Unless otherwise specified, make flanged joints with Garlock 5500 or equivalent gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than length necessary to screw nut up flush to the end of bolt. Bolts used for flanged connections in piping with a working pressure of 690 kPa (100 psi) and greater are to be ASTM A-193 Grade B-7, with heavy hexagon nuts to ASTM A-194 CL-2H. Provide suitable washers between each bolt head and flange and between each nut and flange.
- .7 A random check of bolted flanged connections will be made to verify flanged connections are properly mated with no shear force acting on bolts. Supply labour to disconnect and reconnect selected flanged joints. If improperly mated joints are found, remove and reinstall affected piping so flanges mate properly. If improperly mated joints are found, additional joints will be checked, and you will be responsible for the repair of any other improper joints discovered.
- .8 Unless otherwise specified make soldered joints in copper piping using flux suitable for and compatible with type of solder being used. Clean the outside of pipe end and inside of fitting, valve, or similar accessory prior to soldering.
- .9 Install mechanical joint fittings and couplings in accordance with manufacturer's instructions.
- .10 Grooves are to be rolled. Make arrangements with coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to manufacturer's instructions with respect to pipe grooving, support, type of gasket required, anchoring and guiding the grooved piping system.

- .11 If pressure crimped couplings and fittings are used, ensure gaskets are fully compatible with piping fluid, and valves and piping accessories are suitable. Use only fitting manufacturer supplied crimping equipment. Comply with manufacturer's latest published specification, instructions, and recommendations with respect to pipe, coupling, and fitting preparation and installation, and support, anchoring and guiding of the piping system.
- .12 Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with manufacturer's recommendations, ASTM D2855, and CSA requirements.
- .13 Install PVC piping with gasketed joints in accordance with manufacturer's current published specifications, instructions and recommendations, and CSA requirements.

### **3.03 Duct Openings**

- .1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by trade responsible for particular construction in which opening is required.
- .2 Size openings for fire dampers to suit damper arrangement with folding blade out of air stream.
- .3 For duct openings except where fire dampers are required, pack and seal space between duct or duct insulation and duct opening as specified above for pipe openings in non-fire rated construction.

### **3.04 Installation of Pipe Escutcheon Plates**

- .1 Provide escutcheon plates suitably secured over exposed piping passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.
- .2 Install plates so they are tight against building surface concerned, completely covering pipe sleeves and/or openings, except where waterproof sleeves extend above floors, in which case fit plate tightly around sleeve.

### **3.05 Supply of Access Doors**

- .1 Supply access doors to give access to mechanical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on drawings.
- .2 Before commencing installation of mechanical work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange mechanical work to suit.
- .3 Access doors will be installed by trade responsible for particular type of construction in which doors are required. Supply access doors to trade installing same at proper time.
- .4 Wherever possible, access doors to be of a standard size for each application. Confirm exact dimensions and minimum size restrictions with the Consultant prior to ordering.
- .5 Group piping and ductwork to ensure minimum number of access doors is required.
- .6 Coordinate with Electrical Contractor and General Trades Contractor to ensure access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and work involving both mechanical and electrical services should, where possible, be accessible from common access door. Coordinate work to ensure common location access doors are not supplied by both Mechanical Divisions and Electrical Divisions.

### 3.06 Installation of Valves

- .1 Generally, valve locations are indicated or specified on drawings or specified in Sections of the Specification where valves are specified, however, regardless of locations shown or specified, following requirements apply:
  - .1 provide shut-off valves to isolate systems, at base of vertical risers, in branch take-offs at mains and risers on floors, to isolate equipment, to permit work phasing as required, and wherever else required for proper system operation and maintenance;
  - .2 install shut-off valves with handles upright or horizontal, not inverted, and located for easy access;
  - .3 unless otherwise specified, provide a check valve in discharge piping of each pump;
  - .4 valve sizes are to be same as connecting pipe size;
  - .5 valves are to be permanently identified with size, manufacturer's name, valve model or figure number and pressure rating, and wherever possible, valves are to be product of same manufacturer;
  - .6 for valves in insulated piping, design of valve stem, handle and operating mechanism is to be such that insulation does not have to be cut or altered in any manner to permit valve operation.

### 3.07 Finish Painting of Mechanical Work

- .1 Finish paint exposed mechanical work as specified and/or scheduled in accordance with requirements of Division 09.
- .2 Touch-up paint damaged factory applied finishes on mechanical work products.

### 3.08 Pipe Leakage Testing

- .1 Before piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test piping for leakage.
- .2 Tests are to be witnessed by the Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.
- .3 When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.
- .4 Gravity Drainage and Vent Piping
  - .1 Test piping in accordance with local governing building code.
  - .2 After fixtures and fittings are set and pipes are connected to building drain or drains, turn on water into pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Perform a smoke test if required by local governing authorities.
- .5 Domestic Water Piping
  - .1 Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for a minimum of 2 hours.
- .6 Sprinkler System Piping



- .1 Test system piping in accordance with requirements of NFPA No. 13, "Installation of Sprinkler Systems", and in accordance with any additional requirements of governing authorities.
- .7 Following requirements apply to all testing:
  - .1 ensure piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing;
  - .2 temporarily remove or valve off piping system specialties or equipment which may be damaged by test pressures prior to pressure testing systems, and flush piping to remove foreign matter;
  - .3 when testing is carried out below highest level of the particular system, increase test pressure by the hydrostatic head of 7 kPa (1 psi) for every 600 mm (24") below the high point;
  - .4 include for temporary piping connections required to properly complete tests;
  - .5 piping under test pressure is to have zero pressure drop for length of test period;
  - .6 tighten leaks found during tests while piping is under pressure. If this is impossible, remove and refit piping and reapply test until satisfactory results are obtained;
  - .7 where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions;
  - .8 tests are to be done in reasonably sized sections so as to minimize number of tests required;
  - .9 in addition to leakage tests specified above, demonstrate proper flow throughout systems including mains, connections and equipment, as well as proper venting and drainage, and include for any necessary system adjustments to achieve proper conditions.

### **3.09 Interruption to and Shut-Down of Mechanical Services and Systems**

- .1 Coordinate shut-down and interruption to existing mechanical systems with Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning, unless otherwise specified in Division 01. Include for costs of premium time to perform work during nights, weekends or other times outside of normal working hours, which may be necessary to comply with stipulations specified herein this Article. Services for operation of existing non-renovated areas of building are to be maintained.
- .2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform Owner and the Consultant in writing 5 working days in advance of proposed shut-down or interruption and obtain written consent to proceed. Do not shut-down or interrupt any system or service without such written consent. Shutdowns of some essential services may require additional advance notification time.
- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize shut-down time and to reinstate systems as soon as possible, and, prior to any shut-down, ensure materials and labour required to complete the work for which shut-down is required are available at site.
- .5 Pipe freezing shall be used to connect new piping to existing piping. Alternative methods may be proposed, if site conditions are evaluated and permit, and are approved by the Consultant.
- .6 Where existing isolation valves do not hold, pipe freezing shall be used to connect new piping to existing piping.

### 3.10 Cutting, Patching and Core Drilling

- .1 Unless otherwise provided by General Trades, perform cutting, patching, and core drilling of existing building required for installation of mechanical work. Perform cutting in a neat and true fashion, with proper tools and equipment to Consultant's approval. Patching is to exactly match existing finishes and be performed by tradesmen skilled in particular trade or application. Work is subject to review and acceptance by the Consultant.
- .2 Criteria for cutting holes for additional services:
  - .1 cut holes through slabs only; no holes to be cut through beams;
  - .2 cut holes 150 mm (6") diameter or smaller only; obtain approval from Structural Consultant for larger holes;
  - .3 keep at least 100 mm (4") clear from beam faces;
  - .4 space at least 3 hole diameters on centre;
  - .5 for holes that are required closer than 25% of slab span from supporting beam face, use cover meter above slab to clear slab top bars;
  - .6 for holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars;
  - .7 submit sleeving drawings indicating holes and their locations for Structural Consultant's review.
- .3 Do not cut or drill any existing work without approval from Owner and Consultant. Be responsible for damage done to building and services caused by cutting or drilling.
- .4 Where pipes pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around pipes or pipe insulation.
- .5 Prior to drilling or cutting an opening, determine, in consultation with Consultant and Owner, and by use of non-destructive radar scan (magnetic scan) of slab or wall, presence of any existing services and reinforcement bars concealed behind building surface to be cut and locate openings to suit. Coring is not permitted through concrete beams or girders.
- .6 Where drilling is required in waterproof slabs, size opening to permit snug and tight installation of a pipe sleeve sized to leave 12 mm (½") clearance around pipe or pipe insulation. Provide a pipe sleeve, constructed of Schedule 40 galvanized steel pipe with a flange at one end and of a length to extend 100 mm (4") above slab, in opening. Secure flange to the underside of slab and caulk void between sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.
- .7 Firestop and seal openings in fire rated construction. Do not leave openings open overnight unless approved by Owner and Consultant.

### 3.11 Packing and Sealing Core Drilled Pipe Openings

- .1 Pack and seal void between pipe opening and pipe or pipe insulation for length of opening as follows:
  - .1 non-fire rated interior construction – pack with mineral wool and seal both ends of opening with non-hardening silicone base caulking compound to produce a water-tight seal;

- .2 exterior walls above grade – pack with mineral wool and seal both ends of sleeves water-tight with non-hardening silicone base caulking compound unless mechanical type seals have been specified;
- .3 exterior walls below grade (and any other wall where water leakage may be a problem) – seal with link type mechanical seals as specified.

### **3.12 Cleaning Mechanical Work**

- .1 Refer to cleaning requirements specified in Division 01.
- .2 Clean mechanical work prior to application for Substantial Performance of the Work.
- .3 Include for vacuum cleaning interior of air handling units and ductwork systems.

**End of Section**

**1 General**

**1.01 Section Includes**

- .1 This Section specifies requirements, criteria, methods, and execution for mechanical demolition work that are common to one or more mechanical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

**2 Products – Not Used**

**3 Execution**

**3.01 Disconnection and Removal of Existing Mechanical Work**

- .1 Where indicated on drawings, disconnect, and remove existing mechanical work, including hangers, supports, insulation, etc. Disconnect at point of supply, remove obsolete connecting services and make system safe. Cut back obsolete piping behind finishes and cap water-tight unless otherwise specified.
- .2 Scope and extent of demolition or revision work is only generally indicated on drawings. Estimate scope, extent and cost of work at site during bidding period site visit(s). Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at site during bidding period site visits will not be allowed.
- .3 If any re-design is required due to discrepancies between mechanical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between mechanical drawings and actual site conditions are of a minor nature, required modifications are to be done at no additional cost.
- .4 Where existing mechanical services extend through, or are in an area to serve items which are to remain, maintain services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during renovation work, so as to be concealed behind new or existing finishes.
- .5 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused.

**End of Section**

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## **1 General**

### **1.01 Section Includes**

- .1 This Section specifies requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. Where requirements of this Section contradict requirements of Division 00 or Division 01, conditions of Division 00 or Division 01 to take precedence.
- .2 Be responsible for advising product vendors of requirements of this Section.

### **1.02 Related Requirements**

- .1 Division 00 and Division 01 apply to and are a part of this Section.

### **1.03 Specifications Language and Style**

- .1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to Contractor, unless stated otherwise.
- .2 Complete sentences by reading "shall", "Contractor shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.
- .3 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.
- .4 When used in the context of a Product, read the word "provide" to mean "supply and install to result in a complete installation ready for its intended use."

### **1.04 Definitions**

- .1 "concealed" – means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.
- .2 "exposed" – means work normally visible, including work in equipment rooms, service tunnels, and similar spaces.
- .3 "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished.
- .4 "provision" or "provide" (and tenses of "provide") – means supply and install complete.
- .5 "install" (and tenses of "install") – means secure in position, connect complete, test, adjust, verify, and certify.
- .6 "supply" – means to procure, arrange for delivery to site, inspect, accept delivery, and administer supply of products; distribute to areas; and include manufacturer's supply of any special materials, standard on site testing, initial start-up, programming, basic commissioning, warranties, and manufacturers' assistance to Contractor.
- .7 "delete" or "remove" (and tenses of "delete" or "remove") – means to disconnect, make safe, and remove obsolete materials; patch and repair/finish surfaces to match adjoining similar construction; include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Owner and reviewed with the Consultant.
- .8 "BAS" – means building automation system; "BMS" – means building management system; "FMS" – means facility management system; and "DDC" means direct digital controls; references to "BAS", "BMS", "FMS" and "DDC" generally mean same.

- .9 "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" – means government departments, agencies, standards, rules and regulations that apply to and govern work and to which work must adhere.
- .10 "OSHA" and "OHSA" – stands for Occupational Safety and Health Administration and Occupational Health and Safety Act, and wherever either one is used, they are to be read to mean local governing occupational health and safety regulations that apply to and govern work and to which work must adhere, regardless if Project falls within either authority's jurisdiction.
- .11 "Mechanical Divisions" – refers to Division 20, Division 21, Division 22, Division 23, Division 25, and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Mechanical Contractor, unless otherwise noted.
- .12 "Electrical Divisions" – refers to Division 26, Division 27, Division 28, and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Electrical Contractor, unless otherwise noted.
- .13 "Consultant" – means person, firm or corporation identified as such in Agreement or Documents, and is licensed to practice in Place of the Work, and has been appointed by Owner to act for Owner in a professional capacity in relation to the Work.
- .14 Wherever words "indicated", "shown", "noted", "listed", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean product referred to is "indicated", "shown", "listed", or "noted" on Contract Documents.
- .15 Wherever words "reviewed", "satisfactory", "as directed", "submit", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "to the satisfaction of", "submitted to", etc., Consultant.

#### **1.05 Documents**

- .1 Documents for bidding include but are not limited to issued Drawings, Specifications and Addenda.
- .2 Specification is arranged in accordance with CSI/CSC 49 Divisions of MasterFormat.
- .3 Drawings and Specifications are portions of Contract Documents and identify labour, products and services necessary for performance of work and form a basis for determining pricing. They are intended to be cooperative. Perform work that is shown, specified, or reasonably implied on the drawings but not mentioned in Specification, or vice-versa, as though fully covered by both.
- .4 Review Drawings and Specifications in conjunction with documents of other Divisions and, where applicable, Code Consultant's report.
- .5 Unless otherwise specifically noted in Specifications and/or on Drawings, Sections of Mechanical Divisions are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and Sections are to be read as a whole.
- .6 Drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of building is to be taken on site. Do not scale Drawings, and do not use Drawings for prefabrication work.
- .7 Drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, offsets, fittings, transformations and similar products required as a result of obstructions and other architectural and/or structural details but not shown on Drawings.

- .8 Locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of equipment and/or materials, other equipment or systems being installed, and of building, all at no additional cost to Contract.
- .9 Specification does not generally indicate specific number of items or amounts of material required. Specification is intended to provide product data and installation requirements. Refer to schedules, Drawings (layouts, riser diagrams, schematics, details) and Specification to provide correct quantities. Singular may be read as plural and vice versa.
- .10 Drawings and Specifications have been prepared solely for use by party with whom Consultant has entered into a contract and there are no representations of any kind made by the Consultant to any other party.
- .11 In the case of discrepancies between the drawings and specifications, documents will govern in order specified in "General Conditions", however, when scale and date of drawings are same, or where discrepancy exists within specification, most costly arrangement will take precedence.

#### **1.06 Metric and Imperial Measurements**

- .1 Generally, both metric and imperial units of measurement are given in Sections of Specification governed by this section. Measurement conversions may be generally "soft" and rounded off. Confirm exact measurements based on application. Where measurements are related to installation and onsite applications, confirm issued document measurements with applicable local code requirements, and/or as applicable, make accurate measurements onsite. Where significant discrepancies are found, immediately notify Consultant for direction.

#### **1.07 Examination of Documents and Site**

- .1 Carefully examine Documents and visit site to determine and review existing site conditions that will or may affect work, and include for such conditions in Bid Price.
- .2 Report to Consultant, prior to Bid Submittal, any existing site condition that will or may affect performance of work as per Documents. Failure to do so will not be grounds for additional costs.
- .3 Upon finding discrepancies in, or omissions from Documents, or having doubt as to their meaning or intent, immediately notify Consultant, in writing.

#### **1.08 Work Standards**

- .1 Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of submission of Bids adopted by and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.
- .2 Where regulatory codes, standards and regulations are at variance with Drawings and Specification, more stringent requirement will apply unless otherwise directed by Owner and reviewed with the Consultant.
- .3 Supplementary mandatory specification and requirements to be used in conjunction with project include but are not limited to following:
  - .1 Air-Conditioning, Heating and Refrigeration Institute (AHRI);
  - .2 Air Movement and Control Association (AMCA);
  - .3 American Iron and Steel Institute (AISI);

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- .4 American National Standards Institute (ANSI);
  - .5 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE);
  - .6 American Society of Mechanical Engineers (ASME);
  - .7 American Society of Testing and Materials (ASTM);
  - .8 American Water Works Association (AWWA);
  - .9 Associated Air Balance Council (AABC);
  - .10 Building Industry Consulting Services, International (BICSI);
  - .11 Canadian Gas Association (CGA);
  - .12 Canadian General Standards Board (CGSB);
  - .13 Canadian Standards Association (CSA);
  - .14 Electrical and Electronic Manufacturers Association of Canada (EEMAC);
  - .15 Electrical Safety Authority (ESA);
  - .16 Electronic Industries Association (EIA);
  - .17 Factory Mutual Systems (FM);
  - .18 Illuminating Engineering Society (IES);
  - .19 Institute of Electrical and Electronic Engineers (IEEE);
  - .20 International Standards Organization (ISO);
  - .21 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS);
  - .22 National Building Code of Canada (NBC);
  - .23 National Electrical Manufacturers Association (NEMA);
  - .24 National Environmental Balancing Bureau (NEBB);
  - .25 National Fire Protection Association (NFPA);
  - .26 National Standards of Canada;
  - .27 NSF International;
  - .28 Occupational Health and Safety Act (OHSA);
  - .29 Ontario Building Code (OBC);
  - .30 Ontario Electrical Safety Code (OESC);
  - .31 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA);
  - .32 Technical Standards and Safety Authority (TSSA);
  - .33 Thermal Insulation Association of Canada (TIAC);



- .34 Underwriters' Laboratories of Canada (ULC);
- .35 Workplace Hazardous Materials Information System (WHMIS);
- .36 Material Safety Data Sheets by product manufacturers;
- .37 Local utility inspection permits;
- .38 Codes, standards, and regulations of local governing authorities having jurisdiction;
- .39 Additional codes and standards listed in Trade Sections;
- .40 Owner's standards.
- .4 Provide applicable requirements for barrier free access in accordance with latest edition of local governing building code.
- .5 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted to appropriate authorities. Be responsible for costs associated with these submittals.
- .6 Unless otherwise specified, install equipment in accordance with equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.
- .7 Work is to be performed by journeyperson tradesmen who perform only work that their certificates permit, or by apprentice tradesmen under direct on site supervision of experienced journeyperson tradesman. Journeyperson to apprentice ratio is not to exceed ratio determined by the Board as stated in Ontario College of Trades and Apprenticeship Act or local equivalent governing body in Place of the Work.
- .8 Journeyperson tradesmen are to have a copy of valid trade certificates available at site for review with the Consultant at any time.
- .9 Experienced and qualified superintendent is to be on-site at times when work is being performed.
- .10 Coordinate work inspection reviews and approvals with governing inspection department to ensure that construction schedule is not delayed. Be responsible for prompt notification of deficiencies to the Consultant and submission of reports and certificates to the Consultant.
- .11 Properly protect equipment and materials on site from damage due to elements and work of trades, to satisfaction of Owner and reviewed with the Consultant. Equipment and materials are to be in new condition upon Substantial Performance of the Work.
- .12 Mechanical piping system work, including equipment, must comply in all respects with requirements of local technical standards authorities and CSA B51, Boiler, Pressure Vessels and Pressure Piping Code. Where required, mechanical work products must bear a CRN number.
- .13 Electrical items associated with mechanical equipment are to be certified and bear stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

#### **1.09 Healthcare Facility Standards**

- .1 Comply with following CAN/CSA Standards:
  - .1 CAN/CSA Z317.13, Infection Control During Construction, Renovation, and Maintenance of Health Care Facilities

- .1 Prepare a list of areas of the work where infection control procedures are to be in force and review list and procedures with healthcare facility's Infection Control Officer or a designated healthcare facility representative prior to commencing work in aforementioned areas. As work proceeds, ensure infection control procedures are being maintained.
- .2 CAN/CSA Z317.1, Special Requirements for Plumbing Installations in Health Care Facilities.
- .3 CAN/CSA Z317.2, Special Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Health Care Facilities.
- .4 CAN/CSA Z8000, Canadian Health Care Facilities.
- .5 CAN/CSA Z8001, Commissioning of Health Care Facilities.

#### **1.10 Permits, Certificates, Approvals, and Fees**

- .1 Contact and confirm with local authorities having jurisdiction including utility providers, requirements for approvals from such authorities. Obtain and pay for permits, certificates, and approvals required to complete Work.
- .2 Be responsible for ensuring that authorities having jurisdiction which require on-site inspection of work, have ample notification to perform inspection, with sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of Work. If any defect, deficiency or non-compliant is found in work by inspection, be responsible for costs of such inspection, including any related expenses, making good and return to site, until work is passed by governing authorities.
- .3 Obtain and submit to Consultant, approval/inspection certificates issued by governing authorities to confirm that Work as installed is in accordance with rules and regulations of local governing authorities and are acceptable.
- .4 Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities.

#### **1.11 Requirements for Contractor Retained Engineers**

- .1 Professional engineers retained to perform consulting services with regard to Project work, i.e. seismic engineer, fire protection engineer or structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in Place of the Work.
- .2 Retained engineer's professional liability insurance is to protect Contractor's consultants and their respective servants, agents, and employees against any loss or damage resulting from professional services rendered by aforementioned consultants and their respective servants, agents, and employees in regards to the Work of this Contract.
- .3 Unless otherwise specified in Division 00 or Division 01, liability insurance requirements are as follows:
  - .1 coverage is to be a minimum of \$1,000,000.00 CDN inclusive of any one occurrence;
  - .2 insurance policy is not to be cancelled or changed in any way without insurer giving Owner minimum thirty days written notice;
  - .3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the Place of the Work;
  - .4 retained consultants are to ascertain that sub-consultants employed by them carry insurance in the form and limits specified above;

- .5 evidence of the required liability insurance in such form as may be required is to be issued to Owner, Owner's Consultant, and Municipal Authorities as required prior to commencement of aforementioned consultant's services.

#### 1.12 Workplace Safety

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for products where required, and maintain one copy at site in a visible and accessible location available to personnel.
- .2 Comply with requirements of Occupational Health and Safety Act and other regulations pertaining to health and safety, including worker's compensation/insurance board and fall protection regulations. When working in confined spaces, comply with requirements of Occupational Health and Safety Act - Ontario Regulation 632, "Confined Spaces" and any other applicable Ministry of Labour requirements.
- .3 If at any time during course of work, hazardous materials other than those identified in Documents and pertaining to Project Scope of Work, are encountered, or suspected that were not identified as being present and which specific instructions in handling of such materials were not given, cease work in area in question and immediately notify Consultant. Comply with local governing regulations with regards to working in areas suspected of containing hazardous materials. Do not resume work in affected area without approval from Owner and reviewed with the Consultant.

#### 1.13 Planning and Layout of Work

- .1 Base installation layout, design, terminations, and supply of accessories, on Contract Documents with specific coordination with reviewed shop drawings.
- .2 Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other as well as other obstructions. Generally, order of right of way for services to be as follows:
  - .1 piping requiring uniform pitch;
  - .2 piping 100 mm (4") dia. and larger;
  - .3 large ducts (main runs);
  - .4 cable tray and bus duct;
  - .5 conduit 100 mm (4") dia. and larger;
  - .6 piping less than 100 mm (4") dia.;
  - .7 smaller branch ductwork;
  - .8 conduit less than 100 mm (4") dia.
- .3 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify Consultant where headroom or ceiling space appears to be inadequate prior to installation of work.
- .4 Do not use Contract Drawing measurements for prefabrication and layout of piping, sheet metal work and such other work. Locations and routing are to generally be in accordance with Contract Drawings, however, prepare layout drawings for such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for work of other trades.

Accurately layout work, and be entirely responsible for work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with Contract Drawings, notify Consultant prior to proceeding with work.

- .5 Prepare plan and interference drawings (at a minimum drawing scale of 1:50 or ¼"=1' 0") of work for coordination with each trade Contractor. Arrange for preparation of detailed section drawings of ceiling spaces of corridors and any other congested areas. Sections are to be cross referenced with plan drawings so that trades may make use of section drawings. Section drawings to indicate lateral and elevation dimensions of major services within ceiling space. Lateral dimensions are to be from grid lines and elevations from top of floor slab. Obtain from Consultant, engineering drawings for this use. Contractors' interference drawings are to be distributed among other Trade Contractors. Submit drawings to the Consultant for review. Failure of General Contractor to prepare and coordinate overall interface drawings of trades does not relieve respective Division Contractor of responsibility to ensure that work is properly planned and coordinated.
- .6 Carry out alterations in arrangement of work that has been installed without proper coordination, study, and review, even if in accordance with Contract Documents, in order to conceal work behind finishes, or to allow installation of other work, without additional cost. In addition, make necessary alterations in other work required by such alterations, without additional cost.
- .7 Shut-off valves, balancing devices, air vents, equipment, and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
- .8 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were missed due to lack of coordination.

#### 1.14 Scheduling

- .1 Include for any and all scheduling, coordination, and construction phasing to suit project, specified in Division 01 and/or as indicated on the drawings. Review exact phasing requirements with Consultant prior to start of Work.
- .2 Phasing and scheduling of Work is required in order to maintain existing building operations. Include costs (including costs for "off hours" work) for scheduling, co-ordination, and construction phasing to suit this project as specified in Division 01 and on drawings. Review phasing requirements with the Consultant prior to start of Work.
- .3 Protect existing areas above, below, and adjacent areas of Work from any debris, noise, or interruptions to existing services to satisfaction of Owner and reviewed with the Consultant. Maintain in operation existing services to these areas to allow Owner to continue use of these areas. If services that are required to be maintained run through areas of renovations, provide necessary protection to services or reroute, in coordination with Owner and Consultant. Include for required premium time work to meet these requirements.
- .4 Work being performed within occupied spaces and work affecting surfaces adjacent to occupied spaces may need to be performed after regular business hours. For areas where spaces are used by Owner on a 24 hours basis or over various hours, coordinate hours of work with Owner on a regular basis to suit Owner's schedule. Execute work at times confirmed with and agreed to by Owner and reviewed with the Consultant, so as not to inconvenience Owner's occupation or in any way hinder Owner's use of building. Include for required premium timework to meet these requirements.
- .5 Project partial occupancy permits may be required throughout project. Provide for each partial permit, required local governing authority certificate and any other testing/verification certificates for systems.

### 1.15 Coordination

- .1 Review Contract Documents and coordinate work with work of each trade. Coordination requirements are to include but not be limited to following:
  - .1 requirements for openings, sleeves, inserts and other hardware necessary for installation of work;
  - .2 concrete work such as housekeeping pads, sumps, bases, etc., required for work, and including required dimensions, operating weight of equipment, location, etc.;
  - .3 depth and routing of excavation required for work, and requirements for bedding and backfill;
  - .4 wiring work required for equipment and systems but not specified to be done as part of mechanical work, including termination points, wiring type and size, and any other requirements.
- .2 Ensure materials and equipment are delivered to site at proper time and in such assemblies and sizes so as to enter into building and be moved into spaces where they are to be located without difficulty.
- .3 Wherever possible, coordinate equipment deliveries with manufacturers and/or suppliers so equipment is delivered to site when it is required, or so it can be stored within building, subject to available space as confirmed with Owner and reviewed with Owner, and protected from elements.
- .4 Ensure proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Comply with code requirements with regards to access space provision around equipment. Remove and replace any equipment which does not meet this requirement.
- .5 Where work is to be integrated, or is to be installed in close proximity with work of other trades, coordinate work prior to and during installation.

### 1.16 Products

- .1 Be responsible for ordering of products (equipment and materials) in a timely manner in order to meet project-scheduling timelines. Failure to order products to allow manufacturers sufficient production/delivery time to meet project-scheduling timelines is an unacceptable reason to request for other suppliers or substitutions.
- .2 Provide Canadian manufactured products wherever possible or required and when quality and performance is obtainable at a competitive price. Products are to be supplied from manufacturer's authorized Canadian representative, unless otherwise noted. Unless otherwise specified, products are to be new and are to comply with applicable respective Canadian standards. References to UL listings of products to include requirements that products are to be also Underwriters Laboratories of Canada (ULC) listed for use in Canada. Products are to meet or exceed latest ANSI/ASHRAE/IES 90.1 standards, as applicable. Do not supply any products containing asbestos materials or PCB materials.
- .3 Systems and equipment of this Project are to be "State of the Art" and be most recent and up to date series/version of product that is available at time of shop drawing review process. Products that have been stored or "on shelf" for an extended period of time will not be accepted. Software is to be of latest version available and be provided with updates available at time of shop drawing review process. Systems are to be designed such that its software is backwards compatible. Future upgrades are not to require any hardware replacements or additions to utilize latest software.
- .4 Products scheduled and/or specified have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In most cases, base specified manufacturers are stated for any product specified by manufacturer's name and model number. Where manufacturers are listed, first name listed is base specified company. Bid Price may be based on products supplied by any of

manufacturers' base specified or named as acceptable for particular product. If manufacturers are not stated for a particular product, base Bid Price on product supplied by base specified manufacturer.

- .5 Documents have been prepared based on product available at time of Bidding. If, after award of Contract, and if successful manufacturer can no longer supply a product that meets base specifications, notify Consultant immediately. Be responsible for obtaining other manufacturers product that complies with base specified performance and criteria and meets project timelines. Proposed products are subject to review and consideration by the Consultant and are considered as substitutions subject to a credit to Contract. In addition, if such products require modifications to room spaces, mechanical systems, electrical systems, etc., include required changes. Such changes are to be submitted in detail to the Consultant for review and consideration for acceptance. There will be no increase in Contract Price for revisions. Above conditions supplement and are not to supersede any specification conditions with regards to substitutions or failure to supply product as per issued documents.
- .6 Listing of a product as "acceptable" does not imply automatic acceptance by the Consultant and/or Owner. It is responsibility of Contractor to ensure that any price quotations received and submittals made are for products that meet or exceed specifications included herein.
- .7 If products supplied by a manufacturer named as acceptable are used in lieu of base specified manufacturer, be responsible for ensuring that they are equivalent in performance and operating characteristics (including energy consumption if applicable) to base specified products. It is understood that any additional costs (i.e. for larger starters, larger feeders, additional spaces, etc.), and changes to associated or adjacent work resulting from provision of product supplied by a manufacturer other than base specified manufacturer, is included in Bid Price. In addition, in equipment spaces where equipment named as acceptable is used in lieu of base specified equipment and dimensions of such equipment differs from base specified equipment, prepare, and submit for review accurately dimensioned layouts of rooms affected, identifying architectural and structural elements, systems and equipment to prove that equipment in room will fit properly meeting design intent. There will be no increase in Contract Price for revisions.
- .8 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to the Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to the Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally, or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are accepted in writing by the Consultant.
- .9 Where products are listed as "or approved equal", certify in writing that product to be used in lieu of base specified product, at least meets space, power, design, energy consumption, and other requirements of base specified product and is equivalent or better than base specified product. When requested by the Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equal" products is at sole discretion of the Consultant. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally, or architecturally, required by acceptance of approved equal product. There must be no increase in Contract price due to Consultant's rejection of proposed equivalent product.
- .10 Whenever use of product other than base specified product is being supplied, ensure corresponding certifications and product information (detailed catalogue and engineering data, fabrication information and performance characteristics) are submitted to the Consultant for review. Failure of submission of these documents to the Consultant in a timely manner to allow for review will result in base specified product to be supplied at Consultant's discretion, at no additional cost to Contract.

- .11 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable may be considered for acceptance by the Consultant if requested in writing with full product documentation submitted, a minimum of 10 working days prior to Bid closing date.
- .12 Any proposed changes initiated by Contractor after award of Contract may be considered by the Consultant at the Consultant's discretion, with any additional costs for such changes if accepted by Owner and reviewed with the Consultant, and costs for review, to be borne by Contractor.
- .13 Whenever use of product other than based specified products or named as acceptable is being supplied, time for process of submission of other products and Consultant's review of products will not alter contract time or delay work schedule.

#### 1.17 Shop Drawings

- .1 At start-up meeting, review with the Consultant products to be included in shop drawing submission. Prepare and submit list of products to the Consultant for review.
- .2 Submit electronic copies of shop drawings unless otherwise directed by the Consultant. Coordinate exact requirements with the Consultant.
- .3 Submit for review, drawings showing detail design, construction, and performance of equipment and materials as requested in Specification. Submit shop drawings to the Consultant for review prior to ordering and delivery of product to site. Include minimally for preparation and submission of following, as applicable:
  - .1 product literature cuts;
  - .2 equipment data sheets;
  - .3 equipment dimension drawings;
  - .4 system block diagrams;
  - .5 sequence of operation;
  - .6 connection wiring schematic diagrams;
  - .7 functionality with integrated systems.
- .4 Each shop drawing or product data sheet is to be properly identified with project name and product drawing or specification reference. Shop drawing or product data sheet dimensions are to match dimension type on drawings.
- .5 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure this requirement is clearly indicated on submission.
- .6 Ensure proposed products meet each requirement of Project. Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS". Include company name, submittal date, and sign each copy. Shop drawings that are received and are not endorsed, dated and signed will be returned to be resubmitted.
- .7 Consultant to review shop drawings and indicate review status by stamping shop drawing copies as follows:
  - .1 "REVIEWED" or "REVIEWED AS NOTED" (appropriately marked) – If Consultant's review of shop drawing is final, Consultant to stamp shop drawing;

- .2 "RETURNED FOR CORRECTION" – If Consultant's review of shop drawing is not final, Consultant to stamp shop drawing as stated above, mark submission with comments, and return submission. Revise shop drawing in accordance with Consultant's notations and resubmit.
- .8 Following is to be read in conjunction with wording on Consultant's shop drawing review stamp applied to each and every shop drawing or product data sheet submitted:
  - .1 "THIS REVIEW BY CONSULTANT IS FOR SOLE PURPOSE OF ASCERTAINING CONFORMANCE WITH GENERAL DESIGN CONCEPT. THIS REVIEW DOES NOT MEAN THAT CONSULTANT APPROVES DETAILED DESIGN INHERENT IN SHOP DRAWINGS, RESPONSIBILITY FOR WHICH REMAINS WITH CONTRACTOR. CONSULTANT'S REVIEW DOES NOT RELIEVE CONTRACTOR OF RESPONSIBILITY FOR ERRORS OR OMISSIONS IN SHOP DRAWINGS OR OF CONTRACTOR'S RESPONSIBILITY FOR MEETING REQUIREMENTS OF CONTRACT DOCUMENTS. BE RESPONSIBLE FOR DIMENSIONS TO BE CONFIRMED AND CORRELATED AT JOB SITE, FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION AND INSTALLATION, AND FOR COORDINATION OF WORK OF SUB-TRADES."
- .9 Submit each system and each major component as separate shop drawing submissions. Submit together, shop drawings for common devices such as devices of each system are to be submitted together.
- .10 Obtain shop drawings for submission from product manufacturer's authorized representatives and supplemented with additional items specified herein.
- .11 Do not order product until respective shop drawing review process has been properly reviewed with the Consultant.
- .12 Where extended warranties are specified for equipment items, submit specified extended warranty with shop drawing submittal.

#### 1.18 Openings

- .1 Supply opening sizes and locations to the Consultant to allow verification of their effect on design, and for inclusion on structural drawings where appropriate.
- .2 No openings are permitted through completed structure without written approval from Owner and reviewed with the Consultant. Show required openings on a copy of structural drawings. Identify exact locations, elevations, and size of proposed openings and submit to the Consultant for review, well in advance of doing work.
- .3 Prior to leaving site at end of each day, walk through areas of work and check for any openings, penetrations, holes, and/or voids created under scope of work of project, and ensure that any openings created under scope of work have been closed off, fire-stopped and smoke-sealed. Unless directed by Owner and reviewed with the Consultant, do not leave any openings unprotected and unfinished overnight.

#### 1.19 Scaffolding, Hoisting and Rigging

- .1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval from Owner and reviewed with the Consultant.
- .2 Immediately remove from site scaffolding, rigging and hoisting equipment when no longer required.
- .3 Do not place major scaffolding/hoisting equipment loads on any portion of structure without approval from Owner and reviewed with the Consultant.



## 1.20 Changes in the Work

- .1 Whenever Consultant proposes in writing to make a change or revision to design, arrangement, quantity, or type of work from that required by Contract Documents, prepare and submit to the Consultant for review, a quotation being proposed cost for executing change or revision.
- .2 Quotation is to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.
- .3 Unless otherwise specified in Division 00 or Division 01, allowable maximum percentages for overhead and profit are to be 7% and 5% respectively.
- .4 Unless otherwise specified in Division 00 or Division 01, following additional requirements apply to all quotations submitted:
  - .1 when change or revision involves deleted work as well as additional work, cost of deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from cost of additional work before overhead and profit percentages are applied to additional work;
  - .2 material costs are not to exceed those published in the latest edition of Allpriser price guide, less 20%;
  - .3 mechanical material labour unit costs are to be in accordance with Mechanical Contractors Association of America Labor Estimating Manual, less 25%;
  - .4 electrical material labour unit costs are to be in accordance with National Electrical Contractors Association Manual of Labor Units at difficult level, less 25%;
  - .5 costs for journeyman and apprentice labour must not exceed prevailing rates at time of execution of Contract and must reflect actual personnel performing work;
  - .6 cost for site superintendent must not exceed 10% of total hours of labour estimated for change or revision, and change or revision must be such that site superintendent's involvement is necessary;
  - .7 costs for rental tools and/or equipment are not to exceed local rental costs;
  - .8 overhead percentage will be deemed to cover quotation costs other than actual site labour and materials, and rentals;
  - .9 quotations, including those for deleted work, to include a figure for any required change to Contract time.
- .5 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable Consultant to expeditiously process quotation and issue a Change Order will not be grounds for any additional change to Contract time.
- .6 Make requests for changes or revisions to work to Consultant in writing and, if Consultant agrees, will issue Notice of Change.
- .7 Do not execute any change or revision until written authorization for the change or revision has been obtained from the Consultant.

#### 1.21 Progress Payment Breakdown

- .1 Prior to submittal of first progress payment draw, submit a detailed breakdown of work cost to assist Consultant in reviewing and approving progress payment claims.
- .2 Payment breakdown is subject to Owner's approval and Consultant's review. Progress payments will not be processed until an approved breakdown is in place. Breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, system testing and verification, and project closeout submittals.
- .3 Indicate equipment, material and labour costs for site services (if applicable) and indicate work of each trade in same manner as indicated on progress draw.

#### 1.22 Notice for Required Field Reviews

- .1 Whenever there is a requirement for the Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect work for deficiencies prior to Substantial Performance of the Work, for commissioning demonstrations, and any other such field review, give minimum 5 working days' notice in writing to the Consultant.
- .2 If Consultant is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until the Consultant advises that it may be concealed.
- .4 When Consultant is requested to perform a field review and work is not ready to be reviewed, reimburse Consultant for time and travel expenses.

#### 1.23 Preliminary Testing

- .1 When directed by the Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with Specification and governing Codes and Regulations, prior to Substantial Performance of the Work.
- .2 When, in Consultant's opinion, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.
- .3 These tests are not to be construed as evidence of acceptance of work, and it is agreed and understood that no claim for delays or damage will be made for injury or breakage to any part or parts of equipment or system due to test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.
- .4 When, in Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from site and replace them with acceptable equipment and/or products, at no additional cost.

#### 1.24 Provisions for Systems/Equipment Used During Construction

- .1 Permanent building mechanical systems are not to be used for temporary heating or cooling purposes during construction.

#### 1.25 Temporary Services

- .1 Coordinate with Prime Contractor, requirements for temporary services including but not limited to temporary heating, cooling, and water. Unless otherwise noted, provide required services in compliance with requirements of local governing building code and local governing inspection authorities.

- .2 Maintain fire protection of areas which may include fire watch during temporary shutdowns of existing systems, in accordance with requirements of local governing code and local governing authorities.

#### 1.26 Record Documentation

- .1 Drawings for this project have been prepared on a CAD system using Revit software of release version reviewed with the Consultant. For purpose of producing record "as built" drawings, copies of Contract Drawings can be obtained from the Consultant.
- .2 As work progresses at site, clearly mark in red in a neat and legible manner on a set of bound white prints of Contract Drawings, changes, and deviations from routing of services and locations of equipment shown on Contract Drawings, on a daily basis. Changes and deviations include those made by addenda, change orders, and site instructions. Use notes marked in red as required. Maintain white print red line as-built set at site for exclusive use of recording as-built conditions, keep set up-to-date at all times, and ensure set is always available for periodic review. As-built set is also to include the following:
  - .1 dimensioned location of inaccessible concealed work;
  - .2 locations of control devices with identification for each;
  - .3 for underground piping and ducts, record dimensions, invert elevations, offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks to be preserved after construction is complete;
  - .4 for fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings;
  - .5 location of piping system air vents;
  - .6 location of concealed services terminated for future extension and work concealed within building in inaccessible locations.
- .3 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to the Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of the Consultant.
- .4 Use final reviewed "as-built" drawing set to provide CAD files of drawings thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by the Consultant as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Consultant.
- .5 Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with Revit software release version confirmed with the Consultant.
- .6 Unless otherwise noted in Division 00 or Division 01, failure to maintain accurate record drawings will incur additional 5% holdback on progress claims until drawings are brought up to date to satisfaction of Owner and reviewed with the Consultant.
- .7 For projects with phased turnover of project (refer to Division 01), review with the Consultant completeness of as-built drawings prior to turn over of an area. Interim as-built drawings to be made available to Owner's maintenance personnel.

- .8 Where part of the Mechanical Scope of Work, retain and pay for services of a land surveyor registered in Place of the Work to measure, verify, and record size, location, invert elevation and pitch of buried piping services, and, when complete, transfer survey work to as-built drawings.

#### 1.27 Operation and Maintenance Data

- .1 For each item of equipment for which a shop drawing is required (except for simple equipment), supply indexed copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Consolidate each copy of data as a PDF file on a USB drive. Consolidated O&M manual PDF to include:
  - .1 front cover: project name; wording – "Mechanical Systems Operating and Maintenance Manual"; and date;
  - .2 introduction sheet listing Consultant, Contractor, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses;
  - .3 equipment manufacturer's authorized contact person name, telephone number and company website;
  - .4 Table of Contents sheet, and corresponding index tab sheets;
  - .5 copy of each "REVIEWED" or clean, updated "REVIEWED AS NOTED" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, company website address, and email address for local source of parts and service; when shop drawings are returned marked "Reviewed As Noted" with revisions marked on shop drawing copies, they are to be revised by equipment supplier to incorporate comments marked on "Reviewed" shop drawings and a clean updated copy is to be included in operating and maintenance manuals;
  - .6 Operating data is to include:
    - .1 pressure test reports, and certificates issued by governing authorities;
    - .2 description of each system and its controls;
    - .3 control schematics for equipment/systems including building environmental controls;
    - .4 wiring and connection diagrams;
    - .5 if applicable, BAS architecture and all required operating data;
    - .6 description of operation of each system at various loads together with reset schedules and seasonal variances;
    - .7 operation instruction for each system and each component;
    - .8 description of actions to be taken in event of emergencies and/or equipment failure;
    - .9 valve tag schedule, and flow diagrams to indicate valve locations.
  - .7 Maintenance data is to include:
    - .1 operation and trouble-shooting instructions for each item of equipment and each system;
    - .2 schedules of tasks, frequency, tools required, and estimated task time;
    - .3 recommended maintenance practices and precautions;

- .4 complete parts lists with numbers.
- .8 Performance data is to include:
  - .1 equipment and system start-up data sheets;
  - .2 equipment performance verification test results, and final commissioning report;
  - .3 final testing, adjusting and balancing reports.
- .9 copies of warranties;
- .10 items requested specifically in Section Articles.
- .2 Operating and maintenance instructions are to relate to job specific equipment supplied under this project and related to Owner's building. Language used in manuals is to contain simple practical operating terms and language easy for in-house maintenance staff to understand how to operate and maintain each system.
- .3 Before applying for a Certificate of Substantial Performance of the Work, assemble one copy of O&M Manual and submit to the Consultant for review prior to assembling remaining copies. Incorporate Consultant's comments into final submission.

#### **1.28 Warranty**

- .1 Unless otherwise specified in Division 00 and Division 01, warrant mechanical work to be in accordance with Contract Documents and free from defects for a period of 1 year from date of issue of a Certificate of Substantial Performance of the Work.
- .2 Where equipment includes extended warranty period, e.g., 5 years, first year of warranty period is to be governed by terms and conditions of warranty in Contract Documents, and remaining years of warranty are to be direct from equipment manufacturer and/or supplier to Owner. Submit signed and dated copies of extended warranties to the Consultant.
- .3 Warranty to include parts, labour, travel costs and living expenses incurred by manufacturer's authorized technician to provide factory authorized on-site service.
- .4 Repair and/or replace any defects that appear in Work within warranty period without additional expense to Owner. Be responsible for costs incurred in making defective work good, including repair or replacement of building finishes, other materials, and damage to other equipment. Ordinary wear and tear and damage caused wilfully or due to carelessness of Owner's staff or agents is exempted.
- .5 Do not include Owner deductible amounts in warranties.
- .6 It is understood that warranties are to commence from time of Substantial Performance of the Work, regardless of what is noted within following Sections of Specification. Be responsible for providing whatever "bridging" or additional extended warranty period is required from time that material is purchased until this time.

#### **1.29 Closeout Submittals**

- .1 Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following as applicable to the project:
  - .1 Operating and Maintenance Manuals;
  - .2 as-built record drawings and associated data;

- .3 extended warranties for equipment as specified;
- .4 operating test certificates, i.e. Sprinkler Test Certificate;
- .5 final commissioning report and TAB report;
- .6 identified keys for equipment and/or panels for which keys are required, and other items required to be submitted;
- .7 other data or products specified.

### 1.30 Instructions to Owner

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
- .2 Train Owner's designated personnel in aspects of operation and maintenance of equipment and systems as specified. Demonstrations and training are to be performed by qualified technicians employed by equipment/system manufacturer/supplier. Supply hard copies of training materials to each attendee.
- .3 Provide training to Owner as specified in trade Sections on the operation and maintenance procedures of mechanical systems and equipment.

### 1.31 Final Inspection

- .1 Submit to Consultant, written request for final inspection of systems. Include written certification that:
  - .1 deficiencies noted during job inspections have been completed;
  - .2 field quality control procedures have been completed;
  - .3 systems have been tested and verified, balanced, and adjusted, and are ready for operation;
  - .4 maintenance and operating data have been completed and submitted to, reviewed with the Consultant and accepted by Owner;
  - .5 tags and nameplates are in place and equipment identifications have been completed;
  - .6 clean-up is complete;
  - .7 spare parts and replacement parts specified have been provided and acknowledged by the Consultant;
  - .8 as-built and record drawings have been completed and submitted to and reviewed with the Consultant and accepted by Owner;
  - .9 Owner's staff has been instructed in operation and maintenance of systems;
  - .10 commissioning procedures have been completed.

**2 Products – Not Used**

**3 Execution**

**3.01 Cleaning**

- .1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Owner and Consultant. Before applying for a Certificate of Substantial Performance of the Work, remove rubbish and debris, and be responsible for repair of any damage caused as a result of work.
- .2 Clean equipment and devices installed as part of this project.

**End of Section**

## **1 General**

### **1.01 Section Includes**

- .1 This Section specifies firestopping and smoke seal requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

### **1.02 Submittals**

- .1 Submit a product data sheet and a WHIMIS sheet for each firestopping and smoke seal product.
- .2 Submit for review, full company name and experience of proposed firestopping and smoke seal system applicator.
- .3 Sleeve and Formed Opening Location Drawings
  - .1 Prepare and submit for review, drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.
  - .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.
  - .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

### **1.03 Closeout Submittals**

- .1 Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

### **1.04 Quality Assurance**

- .1 Applicator is to have a minimum of 3 years of successful experience on projects of similar size and complexity, and applicator's qualifications are to be reviewed by the Consultant.
- .2 Comply with firestopping and smoke seal product manufacturer's recommendations regarding suitable environment conditions for product installation.

## **2 Products**

### **2.01 Pipe Sleeves**

- .1 Galvanized Steel or Cast Iron Pipe – Schedule 40 mild galvanized steel, or Class 4000 cast iron.

### **2.02 Firestopping and Smoke Seal Materials**

- .1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN/ULC-S115 and CAN/ULC-S101 for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than fire resistance rating of surrounding fire rated construction.
- .2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with firestopping manufacturer's recommendations and ULC tested assembly.
- .3 Pipe insulation forming part of a fire and smoke seal assembly is specified in Section entitled Mechanical Insulation.



- .4 Manufacturers:
  - .1 A/D Fire Protection Systems "FIREBARRIER";
  - .2 Tremco Inc. Fire Protection Systems Group "TREMSTOP";
  - .3 3M Canada;
  - .4 Hilti (Canada) Ltd. Firestop Systems;
  - .5 Specified Technologies Inc.

### 2.03 Pipe Escutcheon Plates

- .1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to building surface, each plate sized to completely cover pipe sleeve or building surface opening, and to fit tightly around pipe or pipe insulation.

## 3 Execution

### 3.01 Installation of Pipe Sleeves

- .1 Size sleeves, unless otherwise specified, to leave 12 mm ( $\frac{1}{2}$ ") clearance around pipes, or where pipe is insulated, a 12 mm ( $\frac{1}{2}$ ") clearance around pipe insulation.
- .2 Pack and seal void between pipe sleeves and pipe or pipe insulation in non-fire rated construction for the length of sleeves as follows:
  - .1 pack sleeves in interior construction with mineral wool and seal both ends of sleeves with non-hardening silicone base caulking compound;
- .3 "Gang" type sleeving will not be permitted.
- .4 Where sleeves are provided in non-fire rated construction for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of sleeved opening.

**End of Section**

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## 1 General

### 1.01 Section Includes

- .1 The work covered under this section consists of the furnishing of all necessary labour, supervision, materials, equipment, and services to completely execute the pipe hanger and supports as described in this specification.
  - .1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, provide for expansion and contraction and to accommodate insulation; provide insulation protection saddles.
  - .2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
  - .3 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
  - .4 Fasten hangers and supports to building structure.
  - .5 Provide and set sleeves required for equipment, including openings required for placing equipment.

### 1.02 References

- .1 Pipe supports shall meet the requirements of ANSI/ASME B31.1-1995, Power piping.
- .2 Automatic sprinkler pipe supports shall meet the requirements of NFPA 13-1996, Standard for the Installation of Sprinkler Systems.
- .3 Duct hangers shall follow the recommendations of the SMACNA Duct Manuals.

## 2 Products

### 2.01 Prohibited Materials

- .1 Use of existing piping or equipment for hanger supports is not permitted.
- .2 Use of perforated band iron, wire or chain as hangers is not permitted.

### 2.02 Piping Hangers and Supports

- .1 Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to following requirements:
  - .1 unless otherwise specified, ferrous hanger and support products are to be electro-galvanized;
  - .2 hangers and supports for insulated piping are to be sized to fit around insulation and insulation jacket.
- .2 Hangers and supports for horizontal suspended piping as follows:
  - .1 adjustable steel clevis hanger – MSS Type 1;
  - .2 adjustable swivel ring band hanger – MSS Type 10;

- .3 Special hangers and supports for various applications as follows:
  - .1 for plastic piping – generally as specified above but in accordance with pipe manufacturer's recommendations;
  - .2 for fire protection piping – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of NFPA Standard applicable to piping system;
  - .3 insulation protection shields to and including 40 mm (1-½") dia. – MSS Type 40 galvanized steel shields with ribs to keep shield centred on hanger.
- .4 Hanger rods are to be electro-galvanized carbon steel (unless otherwise specified), round, threaded, to ASTM A36, complete with captive machine nuts with washers at hangers, sized to suit loading in accordance with Table 3 in MSS SP-58, but in any case, minimum 9.5 mm (3/8") diameter.
- .5 Manufacturers:
  - .1 E. Myatt & Co. Inc.;
  - .2 Anvil International Inc.;
  - .3 Empire Industries Inc.;
  - .4 Hunt Manufacturing Ltd.;
  - .5 Unistrut Canada Ltd.;
  - .6 Nibco Inc. "Tolco";
  - .7 Taylor Pipe Supports.

### **3 Execution**

#### **3.01 Installation of Fastening and Securing Hardware**

- .1 Provide fastening and securing hardware required for mechanical work to maintain installations attached to structure or to finished floors, walls, and ceilings in a secure and rigid manner capable of withstanding dead loads, live loads, superimposed dead loads, and any vibration of installed products.
- .2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.
- .3 Where floor, wall or ceiling construction is not suitable to support loads, provide additional framing or special fasteners to ensure proper securement to structure that is to support the products. Provide reinforcing or connecting supports where required to distribute loading to structural components.
- .4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CAN/CSA Z166.1 and CAN/CSA Z166.2.
- .5 Do not attach fasteners to steel deck without written consent from the Consultant.

#### **3.02 Installation of Pipe Hangers and Supports**

- .1 Provide required pipe hangers and supports.

- .2 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from structure only.
- .3 For insulated pipe, size hanger or support to suit diameter of insulated pipe and install hanger or support on outside of insulation and insulation finish.
- .4 Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe less than or equal to 25 mm (1") dia. are to be clevis type or adjustable ring type, and hangers for suspended pipe greater than or equal to 40 mm (1-½") dia. are to be adjustable clevis type.
- .5 Space hangers and supports in accordance with following:
  - .1 cast iron pipe – hang or support at every joint with maximum 2.4 m (8') spacing;
  - .2 plastic pipe – conform to pipe manufacturer's recommended support spacing;
  - .3 copper and steel pipe – hang or support at spacing in accordance with following schedule:

Pipe dia.	Max. Spacing Steel	Max. Spacing Copper
to 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1-½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2-½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3-½")	3.6 m (12')	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')
250 mm (10")	6.0 m (20')	
300 mm (12")	6.7 m (22')	

- .4 flexible grooved pipe/coupling joint piping – as above but with not less than one hanger or support between joints;
- .6 Where pipes change direction, either horizontally or vertically, provide a hanger or support on horizontal pipe not more than 300 mm (12") from elbow, and where pipes drop from tee branches, support tees in both directions not more than 50 mm (2") on each side of tee.
- .7 When pipes with same slope are grouped and a common hanger or support is used, space hanger or support to suit spacing requirement of smallest pipe in group and secure pipes in place on common hanger or support.
- .8 For insulated horizontal piping less than or equal to 40 mm (1-½") diameter, provide galvanized steel insulation protection shields between insulation and hanger or support. Install shields immediately after pipe is insulated.
- .9 Do not support piping from steel deck without written consent from Consultant.

**End of Section**

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## **1 General**

### **1.01 Section Includes**

- .1 Nameplates.
- .2 Tags.
- .3 Pipe Markers.

### **1.02 References**

- .1 ASME A13.1 – Scheme for the Identification of Piping Systems.

### **1.03 Submittals**

- .1 Section 01 33 00: Submittals.
- .2 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.
- .3 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- .4 Product Data: Provide manufacturers catalogue literature for each product required.
- .5 Manufacturer's Installation Instructions: Indicate special procedures, and installation.

### **1.04 Closeout Submittals**

- .1 Section 01 77 00: Project Closeout.
- .2 Record actual locations of tagged valves.

## **2 Products**

### **2.01 Mechanical Work Identification Materials**

- .1 Confirm with the Owner if an existing mechanical work identification system is in place and, if so, match accordingly.
- .2 If an existing mechanical work identification system is not in place, the following is to be used:
  - .1 Equipment nameplates are to be minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2-½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:
    - .1 unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved wording to completely identify equipment and its use with no abbreviations;
    - .2 wording is generally to be as per drawings, i.e. Fan EF-1, and is to include equipment service and building area/zone served, but must be reviewed prior to engraving;
    - .3 supply stainless steel screws for securing nameplates in place;

- .4 nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level.
- .2 Valve tags are to be coloured, 40 mm (1-½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:

VALVE V12 200 mm (8") CHILL. WATER NORMALLY OPEN
---

- .3 Standard pipe identification is to be equal to Smillie McAdams Summerlin Ltd., Brady or Primark Manufacturing Inc. vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:
- .1 for pipe less than or equal to 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around pipe or pipe insulation;
- .2 for pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.
- .4 Identification wording and colours for pipe identification materials are to be as follows:

Pipe Service	Identification Colour	Legend
domestic cold water	green	DOM. COLD WATER
domestic hot water supply	green	DOM. HW SUPPLY
domestic hot water recirculation	green	DOM. HW RECIRC.
sanitary drainage	green	SAN.
plumbing vent	green	SAN. VENT
fire protection sprinklers	red	F.P. SPRINKLER

- .5 Colours for pipe identification legends and directional arrows are to be as follows:

Identification Colour	Legend and Arrow Colour
yellow	black
green	white
red	white

- .6 Duct identification is to be custom made Mylar stencils with 50 mm (2") high lettering to accurately describe duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with lettering background.

### 3 Execution

#### 3.01 Preparation

- .1 Degrease and clean surfaces to receive adhesive for identification materials.

#### 3.02 Installation

- .1 Identify new exposed piping and ductwork as per Part 2 of this Section in locations as follows:
  - .1 at every end of every piping or duct run;
  - .2 adjacent to each valve, strainer, damper and similar accessory;
  - .3 at each piece of connecting equipment;
  - .4 on both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified;
  - .5 at 6 m (20') intervals on pipe and duct runs exceeding 6 m (20') in length;
  - .6 at least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.
- .2 Unless otherwise specified identify new concealed piping and ductwork as per Part 2 of this Section in locations as follows:
  - .1 at points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas;
  - .2 at maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room;
  - .3 at each access door location;
  - .4 at each piece of connected equipment, automatic valve, etc.
- .3 Provide an identification nameplate for equipment provided as part of this project, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate nameplates in the most conspicuous and readable location.
- .4 Tag valves and prepare a valve tag chart in accordance with following requirements:
  - .1 attach a valve tag to each new valve, except for valves located immediately at equipment they control;
  - .2 prepare a digital valve tag chart to list tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed);
  - .3 if an existing valve tag chart is available at site, valve tag numbering is to be an extension of existing numbering and new valve tag chart is to incorporate existing chart;
  - .4 include a copy of valve tag chart in each copy of operating and maintenance instruction manuals.
- .5 Where shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in

ceiling panel material, or stickers equal to Brady "Quick Dot" on ceiling grid material to indicate locations of items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:

- |    |  |        |
|----|--|--------|
| .1 | HVAC piping valves and equipment:      | yellow |
| .2 | fire protection valves and equipment:  | red    |
| .3 | plumbing valves and equipment:         | green  |
| .4 | HVAC ductwork dampers and equipment:   | blue   |
| .5 | control system hardware and equipment: | orange |

**End of Section**



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## **1 General**

### **1.01 Section Includes**

- .1 This Section specifies mechanical system testing, adjusting, and balancing requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

### **1.02 Definitions**

- .1 "Agency" – means agency to perform testing, adjusting, and balancing work.
- .2 "TAB" – means testing, adjusting, and balancing to determine and confirm quantitative performance of equipment and systems and to regulate specified fluid flow rate and air patterns at terminal equipment, e.g., reduce fan speed, throttling, etc.
- .3 "hydronic systems" – includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.
- .4 "air systems" – includes outside air, supply air, return air, exhaust air, and relief air systems.
- .5 "flow rate tolerance" – means allowable percentage variation, minus to plus, of actual flow rate values in Contract Documents.
- .6 "report forms" – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form permanent record to be used as basis for required future testing, adjusting, and balancing.
- .7 "terminal" – means point where controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- .8 "main" – means duct or pipe containing system's major or entire fluid flow.
- .9 "submain" – means duct or pipe containing part of the systems' capacity and serving 2 or more branch mains.
- .10 "branch main" – means duct or pipe servicing 2 or more terminals.
- .11 "branch" – means duct or pipe serving a single terminal.

### **1.03 Submittals**

- .1 Within 30 days of work commencing at site, submit name and qualifications of proposed testing and balancing agency in accordance with requirements of article entitled Quality Assurance below.
- .2 Submit sample test forms, if other than those standard forms prepared by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB), are proposed for use.
- .3 Submit a report by Agency to indicate Agency's evaluation of mechanical drawings with respect to service routing and location or lack of balancing devices. Include set of drawings used and marked-up by Agency to prepare report.

### **1.04 Closeout Submittals**

- .1 Submit a report by Agency after each site visit made by Agency during construction phase of this Project.
- .2 Submit a draft report, as specified in Part 3 of this Section.

- .3 Submit a final report, as specified in Part 3 of this Section.
- .4 Submit a testing and balancing warranty as specified in Part 3 of this Section.
- .5 Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

#### **1.05 Quality Assurance**

- .1 Employ services of an independent testing, adjusting, and balancing agency meeting qualifications specified below, to be single source of responsibility to test, adjust, and balance building mechanical systems to produce design objectives. Agency is to have successfully completed testing, adjusting, and balancing of mechanical systems for a minimum of 5 projects similar to this Project within past 3 years, and is to be certified as an independent agency in required categories by one of following:
  - .1 AABC – Associated Air Balance Council;
  - .2 NEBB – National Environmental Balancing Bureau.
- .2 NBCTA certification in lieu of the above noted organizations is not permitted.
- .3 Testing, adjusting, and balancing of complete mechanical systems is to be performed over entire operating range of each system in accordance with one of following publications:
  - .1 National Standards for a Total System Balance published by Associated Air Balance Council;
  - .2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by National Environmental Balancing Bureau;
  - .3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications.

### **2 Products – Not Used**

### **3 Execution**

#### **3.01 Scope of Work**

- .1 Perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of fluid quantities of mechanical systems as required to meet design specifications and comfort conditions, and recording and reporting results.
- .2 Mechanical systems to be tested, adjusted, and balanced include:
  - .1 TAB of domestic water systems (all piping extended from Municipal main) is to include:
    - .1 domestic hot water recirculation piping;
  - .2 TAB of air handling systems is to include equipment and ductwork air temperatures, capacities, and flows.

#### **3.02 Testing, Adjusting, and Balancing**

- .1 Conform to following:

- .1 as soon as possible after award of Contract, Agency is to carefully examine a set of mechanical drawings with respect to routing of services and location of balancing devices, and is to issue a report listing results of the evaluation;
  - .2 set of drawings examined by Agency is to be returned with evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices;
  - .3 after review of mechanical work drawings and specification, Agency is to visit site at frequent, regular intervals during construction of mechanical systems, to observe routing of services, locations of testing and balancing devices, workmanship, and anything else that will affect testing, adjusting, and balancing;
  - .4 after each site visit, Agency is to report results of site visit indicating date and time of visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing;
  - .5 testing, adjusting, and balancing is not to begin until:
    - .1 building construction work is substantially complete;
    - .2 mechanical systems are complete in all respects, and have been checked, started, adjusted, and then successfully performance tested.
  - .6 mechanical systems to be tested, adjusted and balanced are to be maintained in full, normal operation during each day of testing, adjusting, and balancing;
  - .7 obtain copies of reviewed shop drawings of applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences;
  - .8 Agency is to walk each system from system "head end" equipment to terminal units to determine variations of installation from design, and system installation trades will accompany Agency;
  - .9 Agency is to check valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment;
  - .10 wherever possible, Agency is to lock balancing devices in place at proper setting, and permanently mark settings on devices;
  - .11 Agency is to balance systems with due regard to objectionable noise which is to be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at design conditions, Agency is to immediately report problem and submit data, including sound readings, to permit an accurate assessment of noise problem to be made;
  - .12 Agency is to perform testing, adjusting, and balancing to within  $\pm 5\%$  of design values, and make and record measurements which are within  $\pm 2\%$  of actual values;
- .2 Prepare reports as indicated below.
- .1 Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on AABC or NEBB forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in same manner specified for final reports and submit for review.
  - .2 Upon verification and approval of draft reports, prepare final reports organized and formatted as specified below. Use units of measurement (SI or Imperial) as used on Project Documents.

- .3 Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Report forms complete with schematic systems diagrams and other data are to be consolidated in electronic format as a PDF. PDF file to be indexed and organized into sections, as it applies to the project, as follows:
  - .1 General Information and Summary;
  - .2 Air Systems;
  - .3 Hydronic Systems;
  - .4 Temperature Control Systems;
  - .5 Special Systems.
- .4 Agency is to provide following minimum information, forms, and data in report:
  - .1 inside cover sheet to identify Agency, Contractor, and Project, including addresses, and contact names and telephone numbers and a listing of instrumentation used for procedures along with proof of calibration;
  - .2 remainder of report is to contain appropriate forms containing as a minimum, information indicated on standard AABC or NEBB report forms prepared for each respective item and system;
  - .3 Agency is to include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying equipment, terminals, and accessories;
  - .4 Agency is to include report sheets indicating building comfort test readings for all rooms.
- .3 After final testing and balancing report has been submitted, Agency is to visit site with Contractor and Consultant to spot check results indicated on balancing report. Agency is to supply labour, ladders, and instruments to complete spot checks. If results of spot checks do not, on a consistent basis, agree with final report, spot check procedures will stop and Agency is to then rebalance systems involved, resubmit final report, and again perform spot checks with Contractor and Consultant.
- .4 When final report has been accepted, Contractor is to submit to Owner, in name of Owner, a certificate equal to AABC National Guaranty Certification or a NEBB Quality Assurance Program Bond, and in addition, Contractor is to submit a written extended warranty from Agency covering one full heating season and one full cooling season, during which time any balancing problems which occur, with exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by Agency and reported on to Owner, and if it is determined that problems are a result of improper testing, adjusting, and balancing, they are to be immediately corrected without additional cost to Owner.

**End of Section**

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## **1 General**

### **1.01 Section Includes**

- .1 This Section specifies insulation requirements common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly.

### **1.02 Definitions**

- .1 "concealed" – means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces.
- .2 "exposed" – means exposed to normal view during normal conditions and operations.
- .3 "mineral fibre" – includes glass fibre, rock wool, and slag wool.
- .4 "domestic water" or "potable water" – means piping extended from building Municipal supply main.

### **1.03 Submittals**

- .1 Submit a product data sheet for each insulation system product.

### **1.04 Quality Assurance**

- .1 Mechanical insulation is to be applied by a licensed journeyman insulation mechanic, or by an apprentice under direct, daily, on-site supervision of a journeyman mechanic.
- .2 Do not apply insulation unless leakage tests have been satisfactorily completed.
- .3 Ensure surfaces to be insulated are clean and dry.
- .4 Ensure ambient temperature is minimum 13°C (55°F) for at least 1 day prior to application of insulation, and for duration of insulation work, and relative humidity is and will be at a level such that mildew will not form on insulation materials.
- .5 Insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from site.

## **2 Products**

### **2.01 Fire Hazard Ratings**

- .1 Unless otherwise specified, insulation system materials inside building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

### **2.02 Thermal Performance**

- .1 Unless otherwise specified, thermal performance of insulation is to meet or exceed values given in Tables entitled Minimum Piping Insulation Thickness Heating and Hot Water Systems and Minimum Piping Insulation Thickness Cooling Systems, as stated in ANSI/ASHRAE/IES Standard 90.1 version referenced in Ontario Building Code.

### **2.03 Pipe Insulation Materials**

- .1 Horizontal pipe insulation at hangers and supports are to be equal to Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, pre-moulded, rigid,

sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a captive galvanized steel saddle.

- .2 Pre-moulded mineral fibre is to be rigid, sectional, sleeve type insulation to ASTM C547, with a factory applied vapour barrier jacket.

.1 Manufacturers:

- .1 Johns Manville Inc. "Micro-Lok AP-T Plus";
- .2 Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket;
- .3 Manson Insulation Inc. "ALLEY K APT";
- .4 Owens Corning "Fiberglas" Pipe Insulation.

- .3 Blanket mineral fibre is to be blanket type roll insulation to CGSB 51-GP-11M, 24 kg/m<sup>3</sup> (1-½ lb/ft<sup>3</sup>) density, with a factory applied vapour barrier facing.

.1 Manufacturers:

- .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
- .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
- .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
- .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

#### 2.04 Ductwork System Insulation Materials

- .1 Blanket mineral fibre is to be blanket type roll form insulation to ASTM C553, 24 kg/m<sup>3</sup> (1-½ lb/ft<sup>3</sup>) density, 40 mm (1-½") thick, with a factory applied vapour barrier facing.

.1 Manufacturers:

- .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
- .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
- .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
- .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

#### 2.05 Insulation Fastenings

- .1 Duct Insulation Fasteners – weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1-½") square plastic or zinc plated steel self-locking washers.
- .2 Tape Sealant – equal to MACTac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match surface being sealed.
- .3 Mineral Fibre Insulation Adhesive – clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with type of material to be secured, and WHMIS classified as non-hazardous.
- .4 Screws – No. 10 stainless steel sheet metal screws.

## 2.06 Insulation Jackets and Finishes

- .1 Canvas Jacket Material – ULC listed and labelled, 25/50 fire/smoke rated, roll form, minimum 170 g (6 oz).
- .2 Roll Form Sheet and Fitting Covers – minimum 15 mm (1/2") thick white PVC, 25/50 fire/smoke rated tested in accordance with CAN/ULC-S102, complete with installation and sealing accessories.
  - .1 Manufacturers:
    - .1 Proto Corp. "LoSMOKE";
    - .2 The Sure-Fit System "SMOKE-LESS 25/50";
    - .3 Johns Manville Inc. "Zeston" 300.

## 3 Execution

### 3.01 General Insulation Application Requirements

- .1 Unless otherwise specified, do not insulate following:
  - .1 factory insulated equipment and piping;
  - .2 branch potable water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories;
  - .3 exposed chrome plated potable water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories;
  - .4 factory insulated flexible branch ductwork;
  - .5 piping unions, except for unions in "cold" category piping.
- .2 Install insulation directly over pipes and ducts, not over hangers and supports.
- .3 Install piping insulation and jacket continuous through pipe openings and sleeves.
- .4 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.
- .5 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect insulation jacketing from the action of condensation at its junction with metal.
- .6 Where existing insulation work is damaged as a result of mechanical work, repair damaged insulation work to Project work standards.
- .7 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover exposed end of insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.
- .8 Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.

### 3.02 Insulation for Horizontal Pipe at Hangers and Supports

- .1 At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply insulation sections to piping installers for installation as pipe is erected.

### 3.03 Pipe Insulation Requirements – Mineral Fibre

- .1 Insulate following pipe inside building and above ground with mineral fibre insulation of thickness indicated:
  - .1 domestic cold water piping, less than 100 mm (4") dia. – 25 mm (1") thick;
  - .2 domestic hot water piping, less than 40 mm (1-½") dia. – 25 mm (1") thick;
  - .3 domestic hot water piping, greater than or equal to 40 mm (1½") dia. – 40 mm (1-½") thick;
- .2 Secure overlap flap of the sectional insulation jacket tightly in place. Cover section to section butt joints with tape sealant.
- .3 Insulate fittings with sectional pipe insulation mitred to fit tightly, and cover butt joints with tape sealant, or, alternatively, wrap fittings with blanket mineral fibre insulation to a thickness and insulating value equal to the sectional insulation, secure in place with adhesive and/or wire, and cover with PVC fitting covers.
- .4 Unless otherwise specified, insulate unions, valves, strainers, and similar piping system accessories in "cold" piping with cut and tightly fitted segments of sectional pipe insulation with joints covered with tape sealant, or, alternatively, wrap piping union, valve, strainer, etc., with blanket mineral fibre and cover with PVC covers as for paragraph above.
- .5 Terminate sectional insulation approximately 50 mm (2") from flange or coupling on each side of flange or coupling. Cover flange or coupling with a minimum 50 mm (2") thickness of blanket mineral fibre insulation wide enough to butt tightly to ends of adjacent sectional insulation. Secure blanket insulation in place and cover with a purpose made PVC coupling cover.
- .6 Take special care at concealed water rough-in piping at plumbing fixtures to ensure piping is properly insulated. If necessary due to space limitations, use 12 mm (½") thick sectional pipe insulation in lieu of 25 mm (1") thick insulation.

### 3.04 Ductwork Insulation Requirements – Mineral Fibre

- .1 Insulate following ductwork systems inside building and above ground with mineral fibre insulation of thickness indicated:
  - .1 Outdoor air and combustion air intake ductwork, casings and plenums from fresh air intakes to and including mixing plenums or sections, or, if mixing plenums or sections are not provided, to first heating coil, or if both mixing plenums or sections and heating coil sections are not provided, and fresh air is not tempered, then the fresh air ductwork system complete – minimum 40 mm (1-½") thick as required;
  - .2 mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;



- .3 supply air ductwork outward from fans, except for supply ductwork exposed in area it serves – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
  - .4 exhaust discharge ductwork for a distance of 3 m (10') downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10') distance – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
  - .5 any other ductwork, casings, plenums, or sections specified or detailed on drawings to be insulated – thickness as specified.
- .2 Provide rigid board type insulation for casings, plenums, and exposed rectangular ductwork. Provide blanket type insulation for round ductwork and concealed rectangular ductwork.
- .3 Liberally apply adhesive to surfaces of exposed rectangular ducts and/or casings. Accurately and neatly press insulation into adhesive with tightly fitted butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom and side surfaces. Secure and seal joints with 75 mm (3") wide tape sealant. Additional installation requirements as follows:
- .1 at trapeze hanger locations, install insulation between duct and hanger;
  - .2 provide drywall type metal corner beads on edges of ductwork, casings and plenums in equipment rooms, service corridors, and any other area where insulation is subject to accidental damage, and secure in place with tape sealant.
- .4 Liberally apply adhesive to surfaces of concealed rectangular or oval ductwork, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom surfaces. Secure and seal joints with 75 mm (3") tape sealant. At each trapeze type duct hanger, provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between duct and hanger.
- .5 Accurately cut sections of insulation to fit tightly and completely around exposed and concealed round or oval ductwork. Liberally apply adhesive to surfaces of duct, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Seal joints with tape sealant. At duct hanger locations install insulation between duct and hanger. At each hanger location for concealed ductwork where flexible blanket insulation is used, provide a 100 mm (4") wide full circumference strip of semi-rigid board type duct insulation between duct and hanger.
- .6 Insulation application requirements common to all types of rigid ductwork are as follows:
- .1 at duct connection flanges, insulate flanges with neatly cut strips of rigid insulation material secured with adhesive to side surfaces of flange with a top strip to cover exposed edges of the side strips, then butt the flat surface duct insulation up tight to flange insulation, or, alternatively, increase insulation thickness to depth of flange and cover top of flanges with tape sealant;
  - .2 installation of fastener pins and washers is to be concurrent with duct insulation application;
  - .3 cut insulation fastener pins almost flush to washer and cover with neatly cut pieces of tape sealant;
  - .4 accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers;
  - .5 prior to concealment of insulation by either construction finishes or canvas jacket material, patch vapour barrier damage by means of tape sealant.

### **3.05 Insulation Finish Requirements**

- .1 Unless otherwise shown and/or specified, jacket exposed mineral fibre insulation, and calcium silicate duct insulation work inside building with canvas secured in place with a full covering coat of lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent uninsulated surfaces.
- .2 Jacket exposed pipe insulation work inside building with white sheet PVC and fitting covers. Install sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal joints to produce a neat water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions.

**End of Section**

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**1 General**

**1.01 Submittals**

- .1 Submit shop drawings/product data sheets to regulatory authority for review and approval prior to submitting to the Consultant. Conform to following requirements:
  - .1 submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings;
  - .2 sprinklers shall be referred to on drawings and product submittals, and be specifically identified by the manufacturer's listed model or series designation. Trade names and other abbreviated listings are not allowed;

**1.02 Closeout Submittals**

- .1 Submit a complete sprinkler system test certificate as specified in Part 3 of this Section.

**1.03 Quality Assurance**

- .1 Fire protection sprinkler system work is to be in accordance with following Codes and Standards:
  - .1 NFPA 13-2019 Standard for the Installation of Sprinkler Systems;
  - .2 CSA B137.2, Polyvinylchloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications;
  - .3 CSA B137.3, Rigid Polyvinylchloride (PVC) Pipe for Pressure Applications;
  - .4 ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless;
  - .5 ASTM A135, Standard Specification for Electric-Resistance-Welded Steel Pipe;
  - .6 ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service;
  - .7 ASTM A536, Standard Specification for Ductile Castings;
  - .8 ASTM A795, Standard Specification for Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use;
  - .9 ANSI/ASME B16.4, Grey Iron Threaded Fittings (Classes 125 and 250);
  - .10 CAN/CSA B64.10, Backflow Preventers and Vacuum Breakers.
- .2 Fire protection sprinkler work is to be performed by a sprinkler company who is a member in good standing of the Canadian Automatic Sprinkler Association. Site personnel are to be licensed in jurisdiction of the work and under the continuous supervision of a foreman who is an experienced fire protection system installer and a journeyman pipe fitter licensed in jurisdiction of the work.
- .3 Check and verify dimensions and conditions at site and ensure work can be performed as indicated. Coordinate work with trades at site and accept responsibility for and cost of making adjustments to piping and/or spacing to avoid interference with other building components.
- .4 Verify working condition of existing sprinkler system equipment which has direct interface with project work and is to remain. Replace with new equipment where necessary.

- .5 System components must be ULC listed and labelled.
- .6 All grooved couplings, and fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- .7 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

#### 1.04 Design Requirements

- .1 Fire protection sprinkler work is to be designed in accordance with NFPA 13 and Provincial Standards, and, where required, local building and fire department requirements and standards of Owner's Insurer.
- .2 Sprinkler /System Occupancy – Hazard Design requirements: In accordance with NFPA 13 occupancy-hazard density requirements, unless otherwise specified.

## 2 Products

### 2.01 Pipe, Fittings, and Joints

- .1 Pipe, fittings, and joints are to be as follows, with exceptions as specified in Part 3 of this Section:
  - .1 Schedule 10 Steel – Grooved Coupling Joints
    - .1 Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N, 107H, and 107N QuickVic and 005 rigid coupling joints.
  - .2 Schedule 10 Steel – Screwed Joints
    - .1 Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with mill or site threaded ends, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.
  - .3 "Lightwall" Steel – Grooved Coupling Joints
    - .1 Commercial quality. "Lightwall" rolled mild carbon steel pipe to ASTM A135, Grade A, complete with a galvanized exterior, grooved ends, and fittings and couplings equal to Victaulic "Fire Lock" grooved fittings and Victaulic Style 009N QuickVic or 005 rigid coupling joints.
  - .4 "Lightwall" Steel – Screwed Joints
    - .1 Commercial quality, "Lightwall" rolled mild carbon steel pipe to ASTM A135, Grade A, ULC listed, mill or site threaded, complete with galvanized exterior, Class 125 cast iron screwed fittings to ANSI/ASME B16.4, and screwed joints.

### 2.02 Sprinkler Heads

- .1 Sprinkler heads, unless otherwise specified, are to be as scheduled in Part 3 of this Section.
- .2 Sprinkler body shall be die-cast, with a hex-shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation. Wrenches shall be provided by the sprinkler manufacturer that directly engage the wrench boss.

- .3 For locations where corrosive resistant coatings are required, body shall be coated with UL listed and FM approved anti-corrosion VC-250 coating (silver coloring).
- .4 Sprinkler heads for healthcare facilities are to be quick response type.
- .5 Provide quick response sprinkler heads unless standard response required to suit the hazard class.
- .6 Recessed sprinkler heads in finished areas are to be chrome plated unless otherwise specified. Concealed sprinkler head ceiling plates are to match ceiling colour.
- .7 Sprinkler heads which are exposed in areas where they may be subject to damage are to be complete with wire guards, [chrome plated] where in finished areas.
- .8 Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
- .9 Sprinkler heads located in areas or over equipment where high ambient temperature is present are to be, unless otherwise specified, 74°C (165°F) heads. All other heads, unless otherwise specified or required, are to be 57°C (135°F) rated.
- .10 Manufacturers:
  - .1 The Reliable Automatic Sprinkler Co;
  - .2 The Viking Corporation;
  - .3 Tyco Fire Suppression & Building Products;
  - .4 Victaulic Co.

### **3 Execution**

#### **3.01 Monitoring of Systems**

- .1 Daily monitor and supervise existing sprinkler system serving renovated areas to ensure that each respective system is left in proper operating condition at end of each working day. Include for but not be limited to performing following:
  - .1 Under presence of Owner's representative, check each morning and evening (start and end of work) of each day, sprinkler system to ensure that it is in proper working condition;
  - .2 If portions of sprinkler system is not in proper working order, provide temporary provisions subject to approval of local fire authority or local governing authority, to ensure that proper sprinkler coverage is provided and/or provide supervisory personnel to monitor areas where sprinkler system is not operational;
  - .3 Document and sign off with Owner's representative signing off also, each respective daily check condition;
  - .4 Ensure that work to sprinkler system does not affect portion of system serving areas outside of renovation areas.

#### **3.02 Demolition**

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

### 3.03 Piping Installation Requirements

- .1 Provide required sprinkler system piping.
- .2 Perform piping work in accordance with requirements of NFPA 13, governing regulations, and "Reviewed" shop drawings.
- .3 Piping, unless otherwise specified, is as follows:
  - .1 for piping downstream of "head end" alarm valve(s) and equipment – Schedule 10 or "Lightwall" black steel pipe with Victaulic or equal fittings and coupling joints or screwed fittings and joints;
- .4 Pipe sizes, pipe routing, sprinkler head quantities and locations, and layout of work shown on drawings are to assist during the tendering period. Ensure adequate head coverage, head quantities and pipe sizing as specified in Part 1 of this Section. Do not reduce size of sprinkler main or re-route the main unless approved by Consultant.
- .5 Pipe, fittings, couplings, flanges and similar components are to be clean after erection is complete. Wire brush clean any ferrous pipe, fitting, coupling, flange, hanger, support and similar component which exhibits rust and carefully coat with suitably coloured primer.
- .6 When sprinkler work is complete, test system components and overall system(s) and submit completed test certificate and other documentation in accordance with Chapter 8 of NFPA 13.
- .7 Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks. Gaskets shall be molded and produced by the coupling manufacturer, and shall be verified as suitable for the intended service. A factory-trained field representative of the mechanical joint manufacturer shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed. Contractor shall remove and replace any improperly installed products.

### 3.04 Installation of Sprinkler Heads

- .1 Provide required sprinkler heads in accordance with following schedule:

Application	Sprinkler Head Type
Rooms/areas with a suspended ceiling	Victaulic V38/V39 or Tyco Series RFII "Royal Flush II" concealed pendent

- .2 Sprinkler head manufacturers indicated on schedule are for type indication purposes. Manufacturers are listed in Part 2 of this Section.
- .3 Provide quick response type sprinkler heads for healthcare facilities.
- .4 Coordinate sprinkler head locations with all drawings, including architectural reflected ceiling plan drawings, and, where applicable, electrical drawings. Coordinate sprinkler head locations in areas with suspended ceilings with the location of lighting, grilles, diffusers, and similar items recessed in or surface mounted on the ceiling as per the reflected ceiling plans. In areas with lay-in tile, centre the sprinkler head both ways in the lay-in tile wherever possible. Confirm locations prior to roughing-in.
- .5 Maintain maximum headroom in areas with no ceilings.
- .6 Provide guards for heads where they are subject to damage.

- .7 Provide high temperature heads in equipment rooms and similar areas over heat producing or generating equipment.

**End of Section**

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## **1 General**

### **1.01 References**

- .1 Domestic water piping and valves are to comply with following codes, regulations, and standards (as applicable):
  - .1 applicable local codes and regulations.
  - .2 CAN/CSA B64, Backflow Preventers and Vacuum Breakers.
  - .3 CAN/CSA B125.1, Plumbing Supply Fittings.
  - .4 CAN/CSA B125.3, Plumbing Fittings.
  - .5 CAN/CSA B137 Series, Thermoplastic Pressure Piping Compendium.
  - .6 NSF/ANSI 14, Plastics Piping System Components and Related Materials.
  - .7 NSF/ANSI 61, Drinking Water System Components – Health Effects.
  - .8 NSF/ANSI 372, Drinking Water System Components – Lead Content.

### **1.02 Submittals**

- .1 Submit shop drawings/product data sheets for all products specified in Part 2 of this Section except for pipe, fittings, and chlorine solution.

### **1.03 Closeout Submittals**

- .1 Submit laboratory water purity test results indicating chlorine residual prior to application for Substantial Performance of the Work.

## **2 Products**

### **2.01 Pipe, Fittings, and Joints**

- .1 Copper - Solder Joint
  - .1 Type "L" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints using The Canada Metal Co. Ltd. "SILVABRITE 100" or equal lead-free solder for cold water pipe, and 95% tin / 5% Antimony or "SILVABRITE 100" solder for other services.

### **2.02 Shut-Off Valves**

- .1 Ball Valves
  - .1 Class 600, 4140 kPa (600 psi) WOG rated, lead-free, full port ball type valves, each complete with a forged brass body with solder ends, forged brass cap, blowout-proof stem, 304 stainless steel ball, "Teflon" or "PTFE" seat, and a removable lever handle. Valves in insulated piping are to be complete with stem extensions.
  - .2 Manufacturers:
    - .1 Toyo Valve Co.



- .2 Milwaukee Valve Co.
- .3 Kitz Corporation.
- .4 Apollo Valves.
- .5 Watts Industries (Canada) Inc.

### 2.03 Check Valves

- .1 Horizontal
  - .1 Lead-free, Class 125, bronze, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with solder ends.
  - .2 Manufacturers:
    - .1 Toyo Valve Co. Fig. 237A-LF;
    - .2 Milwaukee Valve Co. #UP1509;
    - .3 Kitz Corporation Code 823;
    - .4 Apollo Valves #61LF Series.

### 2.04 Domestic Hot Water Piping Balancing Valves

- .1 Equal to Victaulic Series 76X Low Lead Balancing Valve, lead-free and compliant with NSF-61 and NSF-372 for use in potable water applications, automatic flow limiting balancing valve ( $\pm 5\%$  over rated operating pressure range), complete with removable flow cartridge. Sizes 12 – 20 mm (1/2 - 3/4") diameter, 2758 kPa (400 psi) rated.

### 2.05 Chlorine

- .1 Sodium hypochlorite to AWWA B300.

## 3 Execution

### 3.01 Demolition

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

### 3.02 Piping Installation Requirements

- .1 Provide required domestic water piping.
- .2 Piping, unless otherwise specified, is as follows:
  - .1 for pipe inside building and aboveground in sizes to 100 mm (4") dia. – Type "L" hard copper with solder joints.
- .3 Lay pipes true to line and grade with bells up grade. Fit sections together so that, when complete, pipe has a smooth and uniform invert. Keep pipe thoroughly clean so jointed compound will adhere. Inspect pipe for defects before being lowered into trench.
- .4 Slope piping so it can be completely drained.

- .5 Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe or equipment.

### **3.03 Installation of Shut-Off and Check Valves**

- .1 Refer to Part 3 of Section 20 05 00 – Common Work Results for Mechanical.
- .2 For shut off valves installed on solder joint copper piping up to and including 75 mm (3") diameter, provide ball type valves, and for flanged joints copper or stainless steel piping larger than 75 mm (3") diameter provide butterfly type valves.

### **3.04 Installation of Domestic Hot Water Piping Balancing Valves**

- .1 Provide balancing valves in domestic hot water recirculation piping where shown or required.
  - .1 for pipe 25 mm (3/4") dia. and less ground – equal to Victaulic Series 76X
- .2 Locate each valve so it is easily accessible.

### **3.05 Flushing and Disinfecting Piping**

- .1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.
- .2 Isolate new piping from existing piping prior to flushing and disinfecting procedures.
- .3 Flush piping until all foreign materials have been removed and flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.
- .4 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with AWWA C601.
- .5 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of test results and fill the systems.

**End of Section**

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**1 General**

**1.01 Submittals**

- .1 Submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings.

**1.02 Closeout Submittals**

- .1 Submit a copy of plumbing inspection certificate prior to application for Substantial Performance of the Work.

**2 Products**

**2.01 Pipe, Fittings, and Joints**

- .1 Copper - Solder Joint
  - .1 Type DWV hard temper to ASTM B306, with forged copper solder type drainage fittings and 50% lead - 50% tin solder joints.
- .2 Cast Iron
  - .1 Class 4000 cast iron pipe, fittings, and mechanical coupling joints to CAN/CSA B70.

**2.02 Cleanouts**

- .1 Horizontal Piping
  - .1 TY pipe fitting with an extra heavy brass plug screwed into the fitting.
- .2 Vertical Piping
  - .1 Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.

**3 Execution**

**3.01 Demolition**

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

**3.02 Drain and Vent Piping Installation Requirements**

- .1 Provide required drainage and vent piping. Pipe, unless otherwise specified, as follows:
  - .1 for pipe inside building and aboveground in sizes less than or equal to 65 mm (2-½") dia. – type DWV copper;
  - .2 for pipe inside building and aboveground in sizes greater than or equal to 75 mm (3") dia. – Class 4000 cast iron;
- .2 Unless otherwise specified, slope horizontal drainage piping aboveground in sizes to and including 75 mm (3") dia. 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") dia. and larger 25 mm (1") in 2.4 m (8').

- .3 Install and slope underground drainage piping to inverts or slopes indicated on drawings to facilitate straight and true gradients between points shown. Verify available slopes before installing pipes.
- .4 Unless otherwise specified, slope horizontal branches of vent piping down to fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4').
- .5 Provide cast brass dielectric unions at connections between copper pipe and ferrous pipe or equipment.

### 3.03 Installation of Cleanouts

- .1 Provide cleanouts in drainage piping in locations as follows:
  - .1 at maximum 15 m (50') intervals in horizontal pipe 100 mm (4") dia. and smaller;
  - .2 at maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") dia.;
  - .3 wherever else shown on drawings.
- .2 Cleanouts are to be same diameter as pipe in piping to 100 mm (4") dia., and not less than 100 mm (4") dia. in piping larger than 100 mm (4") dia.
- .3 Where cleanouts in vertical piping are concealed behind walls or partitions, install cleanouts near floor and so cover is within 25 mm (1") of the finished face of the wall or partition.

**End of Section**

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**1 General**

**1.01 Section Includes**

- .1 Plumbing fixtures and related components.

**1.02 Submittals**

- .1 Submit product data sheets (fixture cuts) for all plumbing fixtures and fittings, including accessories.
- .2 Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
- .3 Wiring Diagrams: Power, signal, and control wiring.

**1.03 Closeout Submittals**

- .1 Operation and maintenance data.

**2 Products**

**2.01 General Re: Plumbing Fixtures and Fittings**

- .1 Fixtures and fittings, where applicable, are to be in accordance with requirements of CAN/CSA-B45 Series, General Requirements for Plumbing Fixtures, including supplements, ASME A112.1.18.1/CSA B125.1, Plumbing Supply Fittings, and CAN/CSA-B125.3, Plumbing Fittings.
- .2 Barrier-free fixtures and fittings are to be in accordance with governing Code requirements.
- .3 Unless otherwise specified, vitreous china, porcelain enamelled, and acrylic finished fixtures are to be white.
- .4 Unless otherwise specified, toilet seats are to be constructed with an anti-microbial compound to inhibit growth of bacteria on seat surface.
- .5 Unless otherwise specified, fittings and piping exposed to view are to be brass, chrome plated and polished.
- .6 Fittings located in areas other than private washrooms are to be vandal-resistant.
- .7 Fixture carriers are to be suitable in all respects for the fixture they support and construction in which they are located.
- .8 Floor flanges for floor mounted water closets are to be cast iron or brass, secured to floor to prevent movement and complete with a wax seal and brass or stainless steel bolts, nuts, and washers. Plastic floor flanges will not be acceptable.
- .9 Proper seal to mate with fixture carrier flange and produce a water-tight installation.
- .10 Exposed traps for fixtures not equipped with integral traps, such as lavatories, are to be adjustable chrome plated cast brass "P" traps with cleanouts, minimum #17 gauge chrome plated tubular extensions, and chrome plated escutcheons, all to suit fixture type and drain connection.
- .11 Concealed traps for fixtures not equipped with integral traps, such as counter sinks, are to adjustable cast brass with cleanout plugs, all to suit fixture type and drain connection.

- .12 Exposed supplies for fixtures which do not have supply trim/fittings with integral stops, i.e. lavatories, are to be solid chrome plated brass angle vales with screwdriver stops for public areas, wheel handle stops for private areas, flexible stainless steel risers, and stainless steel or chrome plated steel escutcheons, all arranged and sized to suit fixture.
- .13 Water piping as specified, complete with ball type shut-off valves as specified with water piping or Dahl Bros. Canada Ltd. ¼ turn Mini Ball Valves.

## **2.02 Plumbing Fixtures and Fittings**

- .1 Refer to Appendix at the end of this section.

## **2.03 WC-1: L-1: Manufacturers**

- .1 Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, following:
  - .1 Flush Valves:
    - .1 Sloan;
    - .2 Delta Commercial;
    - .3 Zurn Industries.
  - .2 Plumbing Brass:
    - .1 Sloan;
    - .2 Acorn Engineering;
    - .3 American Standard;
    - .4 Delta Commercial;
    - .5 Chicago Faucet.
  - .3 Stainless Steel Sinks:
    - .1 Franke Commercial;
    - .2 Novanni Commercial;
    - .3 Aristaline;
    - .4 Arch Metal Ind.
  - .4 Emergency Eye Wash and Emergency Showers:
    - .1 Haws;
    - .2 Speakman;
    - .3 Guardian;
    - .4 Bradley.
  - .5 Drain Fittings, Angle Supplies, and Traps:

- .1 McGuire;
- .2 American Standard;
- .3 Delta Commercial;
- .4 Zurn Industries.
- .6 Fixture Carriers:
  - .1 Watts Industries;
  - .2 Jay R. Smith;
  - .3 Zurn Industries.
- .7 Thermostatic Mixing Valves:
  - .1 Lawler;
  - .2 Delta Commercial;
  - .3 Leonard.
- .8 Electronic "No Touch" Faucets:
  - .1 Sloan;
  - .2 Delta Commercial;
  - .3 Bradley;
  - .4 Zurn Industries.

### 3 Execution

#### 3.01 Demolition

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

#### 3.02 Installation of Plumbing Fixtures and Fittings

- .1 Provide required plumbing fixtures and fittings.
- .2 Where new fixtures and fittings are to be connected to existing piping, include for required piping revisions.
- .3 Connect plumbing fixtures and fittings with piping sized in accordance with drawing schedule. Refer to manufacturer's published connection (rough-in) requirements. Where manufacturer requires piping connection larger than shown below, provide piping accordingly:

Fixture and/or Fitting	Drain Size mm (in)	Vent Size mm (in)	DHW size mm (in)	DCW size mm (in)	Temp Water Size mm (in)
Lavatories	32 (1-¼)	32 (1-¼)	12 (½)	12 (½)	12 (½)

Fixture and/or Fitting	Drain Size mm (in)	Vent Size mm (in)	DHW size mm (in)	DCW size mm (in)	Temp Water Size mm (in)
Hand Hygiene Sinks	38 (1-½)	32 (1-¼)	12 (½)	12 (½)	12 (½)
Counter Sinks	38 (1-½)	32 (1-¼)	12 (½)	12 (½)	-
Emergency Eye Wash	-	-	-	-	12 (½)
Emergency Showers	-	-	-	-	25 (1)
Clinic Service Sinks	100 (4)	38 (1-½)	12 (½)	1 @ 25 (1) 1 @ 12 (½)	-

- .4 Confirm exact location of plumbing fixtures and trim prior to roughing-in. Refer to architectural plan and elevation drawings.
- .5 When installation is complete, check and test operation of each fixture and fitting. Adjust or repair as required.
- .6 For barrier-free fixtures, comply with mounting height and other requirements of governing Code(s).
- .7 Locate control panels for electronic faucets under lavatories and recessed into wall. Coordinate panel installations with electrical trade who will provide 115 volt power wiring to panels. Install flexible conduit (supplied with box) and extend cord from faucet through the flexible conduit to control box. Connect hot and cold water piping to mixing valve in each box, and tempered water piping from each mixing valve to faucet. Set mixing valve maximum temperature limit stops to 43°C (110°F) after domestic water systems (hot and cold) are complete. Ensure each programmable controller is properly programmed and water off after deactivation is set for 3 seconds.
- .8 For emergency showers, install so bottom of shower head is approximately 2 m (82") above floor, and approximately 400 mm (16") out from wall. Wall mount mixing valve approximately 1.5 m (5') above floor and adjacent shower head. Set valve temperature limit stop to 35°C (95°F). Ensure valve is open, and exposed piping is chrome plated or stainless steel.
- .9 Install eye wash fixtures in accordance with manufacturer's instructions. Ensure exposed piping is painted.
- .10 Wall mount mixing valves for emergency fixtures approximately 1.5 m (5') above floor and secure in place. Check and confirm valve operation and temperature of tempered water supply. Provide cabinets where shown. Identify each cabinet and hand 3 identified cabinet keys to Consultant prior to Substantial Performance of the Work.

**End of Section**



**S-1****Basin - Wall Hung - Vitreous China - Gooseneck Spout With Double Foot-Operated Pedal Valve Faucet:**

**American Standard #0955.901EC 'Murro'** Basin with sealed overflow, centre hole, 540 mm x 520 mm x 165 mm (21-1/4"x 20-1/2" x 6-1/2") deep, wall hung, vitreous china, integral back splash, self-draining deck area, sloped front lip, for concealed arm carrier and pedestal support plate. American Standard #0059.020EC Semi-China Pedestal.

**Chicago Faucets #626-FC/834-EP** Gooseneck Spout, C.P. single hole, deck mounted, rigid/swing spout, 248 mm (9-3/4") high, 133 mm (5-1/4") reach with integral 6.0 LPM (1.6 GPM) flow laminar (non-aerating) outlet. Self-Closing Double Foot Pedal Valve, wall mounted, C.P., solid cast brass lead-free body, 356 mm (14") out from wall long pedals, 12.5 mm (1/2") back inlets and top outlet and angle stops with loose key handles.

**Lawler #570-86820.00** Thermostatic Mixing Valve, 9.5 mm (3/8") rough chrome brass body, bronze integral construction with checks, single control round handle adjustment, temperature range 35°C (95°F) to 91°C (180°F), set valve at 46°C (115°F). Capacity 15 LPM (4 GPM) at 69 kPa (10#) drop through valve. (Provide copper tee, adaptors and piping to suit installation.)

**McGuire #155A-LO Basin Drain**, C.P., cast brass 1 pc. top, open grid less overflow holes and 1.5 mm (17ga.), 32 mm (1-1/4") tailpiece.

Provide C.P. flexible copper supply connecting pedal valve to gooseneck, c/w escutcheon.

**McGuire #8872C 'p' Trap**, C.P., polished, cast brass adjustable body, 32 mm (1-1/4") with cleanout plug, seamless brass wall bend and escutcheon. All exposed piping to be chrome plated (for hospital use).

**Watts #TCA-411-HD** Floor Mounted Concealed Arm 'Track' Lavatory Carrier, epoxy coated, heavy duty gauge steel offset uprights with welded feet, steel cross plate with integral mounting brackets, sliding adjustable arm brackets, and adjustable cast iron concealed arms with mounting clips, levelling clips, levelling screws, and basin locking device.

**S-2****MANUAL TWO HANDLES SINK FAUCET**

**Chicago Faucets 786-GN8FCXKABCP Faucet** - Counter mounted, Manual, Two handles, Sink faucet, Chrome-plated finish, 203 mm (8") centerset, Lead Free ANSI/NSF 61 and ANSI/NSF 372 compliant ECAST® brass construction, -377-XKAB ceramic 1/4 turn cartridge, 5.7 LPM (1.5 GPM) maximum flowrate, -FC 5.7 LPM (1.5 GPM) laminar flow control insert in spout inlet, plain end outlet, Rigid/swing Gooseneck spout, 203 mm (8") spout reach, -317-PR vandal-resistant 102 mm (4") metal wrist blade handles with red & blue index, Grid drain included, 13 mm (1/2") NPSM supply inlet for 10 mm (3/8") or 13 mm (1/2") flexible riser.

**Chicago Faucets 834-EPSLOABCP Remote Valve** - Foot operation, ECAST brass construction with less than 0.25% lead content weighted, Polished chrome finish, 13 mm (1/2") NPT female thread inlet, 10 mm (3/8") NPT female thread outlet, 138 - 862 kPa (20 - 125 PSI) operating pressure range, 40°F - 140°F (4°C - 60°C) operating temperature range.

**McGuire LFBV170 Supply** - CONVERTIBLE™ Commercial Faucet Supply kit, consisting of (2) stop valves, (2) risers, (2) flanges (standard), Lead Free Brass body, Chrome-plated finish, 138 - 862 kPa (20 - 125 PSI) operating pressure, 4 to 60 °C (40 to 140 °F) operating temperature, Convertible loose key/triangle handle, Quarter turn ball valve, Angle stop, C.P. wrought steel deep bell wall flange (standard), C.P. prefabricated 127 mm (5") copper sweat tube extension nipple, 305 mm (12") C.P. lavatory flexible copper riser tubes (standard), 13 mm (1/2") Sweat inlet x 10 mm (3/8") O.D. outlet, 82 °C (180 °F) maximum during high-temperature system flush, AB 100 compliant, ASME A112.18.1 compliant, ASME A112.18.2-2 (risers), CSA B125.2 compliant (risers), Certified to NSF/ANSI 372, Certified to NSF/ANSI 61, UPC compliant.

**S-3****WALL-HUNG - - SURGEON SCRUB-UP SINK**

**Franke Commercial SSU1-2020-7MOD Sink** - Single compartment sink, Single hole centerset, Surgeon scrub-up sink, with overall dimension, 508 mm (20") long, 502 mm (19-3/4") wide, 711 mm (28") high, constructed from 16 gauge Type 304 Stainless steel, Bowl dimensions are, 432 mm (17") long, 381 mm (15") wide, 254 mm (10") deep, Antimicrobial, Polished to #4 satin finish, With 130 mm (5-1/8") high backsplash, Radius coved bowl corners, Access panel for service and maintenance, Includes wall hanger brackets, Center waste location, 38 mm (1-1/2"-16) threaded tailpiece with special integral waste design to prevent use of waste plug, Compliances and certifications: ASME A112.19.3 compliant, CSA B45.4 compliant.

**Chicago Faucets 116.104.AB.1 Faucet** - HYTRONIC®, Wall-hung, Automatic no-touch, Hardwired, Sink/lavatory faucet, Polished chrome finish, Single hole centerset, Lead Free ANSI/NSF 61 and ANSI/NSF 372 compliant ECAST® brass construction, Stainless steel hoses included, 1.9 LPM (0.5 GPM) maximum flowrate, Pressure compensating non-aerated laminar spray outlet, includes optional 5.7 LPM (1.5 GPM) insert, Rigid/swing Gooseneck spout, 138 mm (5-3/8") spout reach, 305 mm (12") high, Less handle, Dual infrared sensor, 12 volt AC transformer required (to be ordered separately).

**Chicago Faucets 243.260.00.1/242.340.00.1 Faucet and Flush Valve Power Kit** - Hardwired AC transformer, Transformer and wire.

**Lawler 570-86820 Mixing Valve** - Point of Use and Master controlled fixtures, Thermostatic master water mixing control valve, The temperature is adjusted with the help of Spindle.

## EW-1

### SWING DOWN EYE/FACE WASH WITH DRAIN PAN

**Guardian GBF1735DP-G3600LF Emergency Equipment** - Recessed type mounting, constructed from, 16 Gauge stainless steel, Two FS-Plus spray heads with flip top dust cover each, 13 mm (1/2") Ø I.P.S. brass plug-type valve with O-ring seals, 13 mm (1/2") Ø NPT female inlet supply inlet, In-line strainer, 52 mm (2") Ø NPT female outlet, Thermostatic mixing valve blends hot and cold water, Compliances and certifications: Complies with ADA requirements, ANSI compliant, Notes: 16 Gauge stainless steel Cabinet With Flange With 3/8" (9.5 Mm) Return for Recessed Mounting.

## ESH/EW-1

### COMBINATION EYEWASH AND SHOWER SAFETY STATION

**Guardian G1902-SSH Emergency Equipment** - Floor mounted, constructed from, Stainless Steel Bowl and ABS or Stainless Steel Showerhead, Stainless steel, 283 mm (11-1/8") Ø bowl size, Orange ABS plastic showerhead, Two GS-Plus spray heads with flip top dust cover each, 25 mm (1") Ø I.P.S. chrome-plated brass stay-open ball valve, 13 mm (1/2") Ø I.P.S. chrome-plated brass stay open ball valve, Stainless steel showerhead, 254 mm (10") diameter, 75 LPM (20 GPM) flow control, 32 mm (1-1/4") Ø NPT female top or side inlet supply inlet, Schedule 40, Furnished with orange polyethylene pipe, 32 mm (1-1/4") Ø NPT female outlet, Compliances and certifications: ANSI compliant.

**Lawler 911E/F-Unit 84908 Mixing Valve** - Emergency mixing valve, Thermostatic High-low master water mixing valve, The control mechanism shall employ a liquid-filled thermostatic motor to drive the valve without additional power requirements. The control mechanism shall employ a stainless steel sliding piston control device with reverse seat closure and both fixed and variable cold water bypass.

## FD-1

### FLOOR DRAIN - FOR FINISHED AREA APPLICATION - MEDIUM DUTY (MD)

**Watts FD-100-C-A-7 Floor Drain** - Epoxy coated cast iron, Floor drain, Adjustable Round 6 mm (1/4") thick top, No-hub outlet, Anchor flange, Trap primer tapping, Reversible membrane clamp, Collar with primary and secondary weepholes, 52 cm² (8 sq. in.) free area (for 127 mm (5") diameter strainer), 58 cm² (9 sq. in.) free area (for 152 mm (6") diameter strainer), 77 cm² (12 sq. in.) free area (for 178 mm (7") diameter strainer), 116 cm² (18 sq. in.) free area (for 203 mm (8") diameter strainer), Trap primer tapping, Compliances and certifications: ASME A112.21.1M compliant.

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**1 General**

**1.01 Section Includes**

- .1 HVAC ducts and casings.
- .2 Other duct work accessories.

**1.02 Submittals**

- .1 Submit shop drawings/product data sheets for all products specified in this section except shop fabricated ductwork and fittings.
- .2 Include capacity, throw and terminal velocity, noise criteria, and pressure drops with grille and diffuser shop drawing/product data sheet submission.
- .3 Submit a site inspection and start-up report from fan filter diffuser manufacturer's representative as specified in Part 3 of this section.

**1.03 Quality Assurance**

- .1 Grilles and diffusers are to be tested and performance certified to ANSI/ASHRAE 70, Method of Testing the Performance of Air Outlets and Air Inlets.

**2 Products**

**2.01 Galvanized Steel Ductwork**

- .1 Galvanized steel sheet is to be hot dipped in accordance with requirements of ASTM A653. G60 galvanizing for bare uncovered duct to be finish painted. G90 for all other galvanizing.
- .2 Rectangular
  - .1 Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.
- .3 Round
  - .1 Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings and couplings.

**2.02 Flexible Metallic Ductwork**

- .1 Insulated
  - .1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-I", CAN/ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, supplied in 3 m (10') lengths and factory covered with 40 mm (1-½") thick, 12 kg/m<sup>3</sup> (0.75 lb/ft<sup>3</sup>) density fibreglass insulation with a vinyl jacket meeting 25/50 flame spread and smoke developed requirements tested in accordance with CAN/ULC-S102.

**2.03 Metal Duct System Joint Sealant**

- .1 ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 tested maximum flame spread rating of 5 and smoke developed rating of 0.

- .2 Manufacturers:
  - .1 Johns Manville;
  - .2 Manson Insulation;
  - .3 Knauf Insulation.

#### 2.04 Manual Balancing (Volume) Dampers

- .1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of same material as connecting ductwork unless otherwise specified, each designed to maintain internal free area of connecting duct, and each complete with:
  - .1 hexagonal or square shaft extension through frame;
  - .2 non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers;
  - .3 blade stops for single blade dampers, designed to prevent blade from moving more than 90°;
  - .4 linkage for multiple blade dampers;
  - .5 locking hand quadrant damper operator with, for insulated ducts 50 mm (2") standoff mounting.
- .2 Rectangular Dampers: Nailor Industries Inc. 1800 Series, maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.
- .3 Round Dampers: Nailor Industries Inc. model 1890, maximum 600 mm (24") diameter, equipped with a minimum 200 mm (8") deep frame, and blade stiffeners where required.
- .4 Multiple Rectangular Damper Section Assembly: Rectangular assembly supplied with the dampers or site constructed, of same material as damper and designed for tight and secure mounting of individual dampers.
- .5 Manufacturers:
  - .1 Nailor Industries Inc.;
  - .2 T.A. Morrison & Co. Inc. "TAMCO";
  - .3 Greenheck Fan Corp.;
  - .4 Ruskin Co.

#### 2.05 Fusible Link Dampers

- .1 Curtain blade type, dynamic, galvanized steel (unless otherwise specified) fusible link dampers, ULC classified to CAN/ULC S112 and in accordance with NFPA 90A requirements, factory tested for closure under airflow, 1-1/2 hour or 3 hour rated as required, and complete with a constant force type 301 stainless steel closure spring, a blade lock assembly, a steel sleeve, retaining angles, and, unless otherwise specified, a 74°C (165°F) rated standard fusible link.
- .2 Fusible link dampers are to be Type "B" or Type "C" (as required) with folded curtain blade out of air stream except where damper size or location requires use of type "A" dampers with curtain blade in air stream.
- .3 Manufacturers:

- .1 Nailor Industries Inc.;
- .2 Greenheck Fan Corp.;
- .3 Ruskin Co.;
- .4 Price Industries (E.H. Price).

## 2.06 Grilles and Diffusers

- .1 Grilles and diffusers of type, size, capacity, finish, and arrangement as shown on drawings and in accordance with drawing schedule, each equipped with all required mounting and connection accessories to suit mounting location and application.
- .2 Manufacturers:
  - .1 Price Industries Inc.;
  - .2 Anemostat;
  - .3 Krueger Division of Air System Components Inc.;
  - .4 Titus;
  - .5 Nailor Industries Inc.;
  - .6 Tuttle & Bailey.

## 2.07 Fan Filter Diffusers

- .1 Factory assembled and leakage tested, suspended ceiling mount, modular assemblies, each ULC and CSA or ETL certified and labelled, consisting of a fan-motor and HEPA filter enclosed in a metal plenum, designed for unidirectional vertical flow of filtered air over a cleanroom space. Sound performance of each is not to exceed 50 dBA measured 765 mm (30") from filter face at 0.5 m/s (90 FPM). Units are to be in accordance with the Institute of Environmental Services and Technology Recommended Practices IEST RP CCOO1, HEPA and ULPA Filters, and IEST RP CCOO2, Unidirectional-Flow, Clean-Air Devices. Each unit is to be equipped with:
  - .1 plenum and face frame: airtight low profile design, constructed of type 304 stainless steel with aluminum interior parts including an extruded aluminum filter frame with air by-pass seal, an inlet duct connection collar, sound insulation meeting 25/50 flame spread/smoke developed ratings when tested to CAN/ULC S102, a static pressure port, eyebolts at each corner;
  - .2 fan and motor: removable, consisting of a blower wheel encased in a strategically shaped enclosure a direct connected to a vibration isolated 1/3 HP ECM brushless DC motor with permanent built-in inverter programmed for constant volume airflow and equipped with a 2.4 m (8') length of power cord with plug;
  - .3 filter: HEPA ultra low penetration air (ULPA) filters, 99.9995% efficient on 0.12 µm micron particles, latched into fan plenum and protected by a perforated screen attached with quarter-turn thumb-wheel fasteners, and room side replaceable;
  - .4 diffuser face: perforated, laminar flow face constructed of aluminum with quarter-turn fasteners for removal and access to fan-motor and filter;
  - .5 mounting gasket: roll type gasket material supplied with units for site installation on T-bar ceiling members;

- .6 factory secured seismic restraint connection hardware.

### 3 Execution

#### 3.01 Cleanliness Requirements for Handling and Installation of Ductwork

- .1 Handle and install ductwork in accordance with CSA Z317.2, Special Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Healthcare Facilities and SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.

#### 3.02 Fabrication and Installation of Galvanized Steel Ductwork

- .1 Provide required ductwork, rectangular, round and/or flat oval. Where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.
- .2 It is to be understood that all duct dimensions shown on drawings are clear internal dimensions.
- .3 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit duct pressure class designation of minimum 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so ductwork does not "drum". Flat surfaces of rectangular ductwork are to be cross-broken or beaded per SMACNA standards. Duct system sealing is to meet ANSI/SMACNA Seal Class A requirements.
- .4 Variable air volume ductwork from supply fans to boxes is as above but rectangular duct take-offs are double side straight taper type with a take-off length equal to 0.5 times the branch duct width but minimum 150 mm (6") length, and double taper side is to have an included angle of minimum 60°.
- .5 Confirm routing of all ductwork at site and site measure ductwork prior to fabrication. Duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by the Consultant. Duct routing and/or dimension revisions to suit conditions at site are not grounds for a claim for an extra cost.
- .6 Install (but do not connect) duct system mounted automatic control components supplied as part of the automatic control work.
- .7 Flange connect ductwork to hot water reheat coils in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Coils will be suspended independent of connecting ductwork as part of the heat transfer work.
- .8 Support horizontal rectangular ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with, unless otherwise specified, galvanized steel channels, and galvanized steel hanger rods for exposed ducts and concealed ducts wider than 500 mm (20"). Support hardware constructed of same material as duct for metal duct, and, unless otherwise specified, type 316 stainless steel for non-metal duct. Supports for "heavy" duct such as cementitious core duct is to be suitable in all respects for the application and approved by the Consultant.
- .9 Support round and flat oval ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at top of duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If duct is insulated, size strap to suit diameter of insulated duct. Unless otherwise specified, duct support hardware for metal duct is constructed of same material as duct, and for non-metal duct, type 316 stainless steel.
- .10 Where flanged duct joints are used, do not locate joints in wall or slab openings, or immediately at wall or slab openings. Do not use flanged joints for exposed uninsulated ducts in finished areas.

- .11 Seal all ductwork in accordance with SMACNA Seal Class "A", except for round duct with self-sealing gasketed fittings and couplings which does not require site applied sealant. Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.
- .12 Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.
- .13 Clean exterior exposed (uninsulated) ducts and coat with a heavy full coverage of Bakor #410-02 black metal paint.
- .14 Where dissimilar metal ducts are to be connected, isolate ducts by means of flexible duct connection material.

### **3.03 Installation of Flexible Ductwork**

- .1 For supply air ductwork, provide maximum 1.8 m fully stretched, long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles and diffusers. Do not install flexible ductwork through walls, even if shown on drawings.
- .2 At rectangular galvanized steel duct, accurately cut holes and provide flanged or "Spin-in" round flexible duct connection collars. Seal joints with duct sealer.
- .3 Install flexible ducts as straight as possible and support in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, and secure at each end with nylon or stainless steel gear type clamps, and seal joints. Provide long radius duct bends where they are required.
- .4 Do not penetrate fire barriers with flexible duct.

### **3.04 Installation of Round to Rectangular Duct Connections**

- .1 Cut round holes in rectangular ducts and provide round to rectangular lock-in fittings with dampers for connection of flexible round ductwork.

### **3.05 Installation of Turning Vanes**

- .1 Provide turning vanes in ductwork elbows where shown on drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

### **3.06 Installation of Manual Balancing (Volume) Dampers**

- .1 Provide manual balancing dampers as required to provide a fully balanced system, including but not limited to in all open end ductwork, in all duct mains, and wherever else shown and/or specified.
- .2 Install dampers so operating mechanism is accessible and positioned for easy operation, and so dampers cannot move or rattle. Ensure operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.
- .3 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing 5 additional dampers at no additional cost.

### 3.07 Installation of Fusible Link Dampers

- .1 Provide fusible link dampers. Ensure damper rating (1-½ or 3 hr) is suitable for fire barrier it is associated with.
- .2 Install dampers with retaining angles on all 4 sides of sleeve on both sides of damper and connect with ductwork in accordance with damper manufacturer's instructions and details, and Code requirements.
- .3 Provide expansion clearance between damper or damper sleeve and opening in which damper is required. Ensure openings are properly sized and located, and all voids between damper sleeve and opening are properly sealed to maintain rating of fire barrier.

### 3.08 Installation of Grilles and Diffusers

- .1 Provide grilles and diffusers. Wherever possible, grilles and diffusers are to be product of same manufacturer.
- .2 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .3 Exactly locate grilles and diffusers to conform to final architectural reflected ceiling plans and detailed wall elevations, and to conform to final lighting arrangement, ceiling layout, ornamental and other wall treatment.
- .4 Equip supply diffusers having a basic 4-way or all round air pattern for operation in 1-, 2-, or 3-way pattern where indicated on drawings.
- .5 Provide sheet metal plenums, constructed of same material as connecting duct, for linear grilles and/or diffusers where shown. Construct and install plenums in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible. Where individual sections of linear grilles or diffusers are not equipped with a volume control device, equip duct connection collar(s) with volume control device(s).
- .6 Where linear type diffusers/grilles are installed in suspended T-bar ceilings, clip diffusers/grilles in place using clip supplied by diffuser/grille manufacturer.
- .7 Confirm grille and diffuser finishes prior to ordering.

### 3.09 Installation of Fan Filter Diffusers

- .1 Provide fan filter diffusers.
- .2 Exactly locate fan filter diffusers to conform to final architectural reflected ceiling plans, and to conform to final lighting arrangement and locations of ceiling equipment.
- .3 Install in strict accordance with manufacturer's instructions, including gasket tape on T-bar ceiling members at unit locations. Plug each unit into an adjacent ceiling receptacle.
- .4 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 – Seismic Controls for Mechanical Systems.
- .5 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .6 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.



- .7 Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including, but not limited to, a full operation and maintenance demonstration.

### **3.10 Duct System Protection, Cleaning and Start-Up**

- .1 Temporarily cover all open ends of ducts during construction.
- .2 Include all labour for a complete site walk-through with testing and balancing personnel following route of all duct systems to be tested, adjusted, and balanced for the purpose of confirming proper position and attitude of dampers, location of pitot tube openings, and any other work affecting testing and balancing procedures. Perform corrective work required as a result of this walk-through.

**End of Section**

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## **1 General**

### **1.01 Submittals**

- .1 Submit shop drawings/product data sheets for air terminals. Include following:
  - .1 capacity and pressure drop;
  - .2 sound power data to verify conformance with specified sound power levels;
  - .3 leakage and dimensions;
  - .4 mounting details to suit locations shown, indicating methods and hardware to be used;
  - .5 control components and a control wiring schematic.
- .2 Submit with shop drawings/product data, a test report in accordance with ANSI/AMCA 210 requirements and ISO 3741, published test data on DIN (Direct Internal Noise) made by an independent testing agency for 2.5 m/s and 6 m/s (8.2 ft/min and 19.7 ft/min) branch velocity or inlet velocity, sound power levels with a minimum inlet pressure of 0.25 kPa (0.036 psi) in accordance with ISO 3741 for the 2nd through 7th octave bands, and confirmation pressure loss through a silencer will not exceed 60% of inlet velocity pressure maximum.

### **1.02 Closeout Submittals**

- .1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

### **1.03 Quality Assurance**

- .1 Air terminals manufacturers are to be current members of Air-Conditioning, Heating and Refrigeration Institute (AHRI), and terminals are to be in accordance with requirements of following standards:
  - .1 ANSI/AHRI Standard 880, Performance Rating of Air Terminals;
  - .2 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating;
  - .3 International Organization of Standardization (ISO) Standard 3741, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure-Precision Methods for Reverberation Rooms.

## **2 Products**

### **2.01 Manufacturers**

- .1 Price Industries Inc.;
- .2 Titus;
- .3 Nailor Industries Inc.;
- .4 Krueger Division of Air System Components Inc.

## 2.02 Dual Duct Terminal Units

- .1 Equal to EH Price Model DDQ (direct digital controls) quiet dual duct terminal units in the sizes and configurations as shown on the plans.
- .2 The terminal units shall be factory-assembled, AHRI 880 rated and bearing the AHRI seal for an air volume control terminal with damper assembly and flow sensor, and complete with the following:
  - .1 Unit Casing:
    - .1 The unit casing shall be constructed of a minimum 22 gauge, 0.032 inch (0.81 mm) galvanized steel.
    - .2 The casing shall be assembled with longitudinal lock seam construction.
    - .3 Air Inlet Collar: Manufacturer shall provide round inlet collars, suitable for standard flexible duct sizes.
    - .4 Unit Discharge: Manufacturer shall provide rectangular unit discharges with slip-and-drive connections.
  - .2 Liners:
    - .1 Fiber-Free Foam Insulation - FF.
    - .2 Insulation shall comply with the requirements of UL 181 (erosion, mold growth and humidity) and ASHRAE 62.1, and shall have a maximum flame/smoke spread of 25/50 for both the insulation and the adhesive when tested in accordance with ASTM E84.
    - .3 The insulation shall be secured with adhesive.
    - .4 Insulation thickness shall be 1 inch (25 mm) thick, R-value of 4.0.
  - .3 Sound Attenuator:
    - .1 The manufacturer shall supply an extended discharge sound mixer/attenuator section to reduce discharge sound power levels and to improve mixing efficiency.
    - .2 The integral mixer/attenuator section shall provide an average discharge temperature variation within one degree Fahrenheit for every 10 degrees Fahrenheit temperature differential between the hot and cold ducts.
  - .4 Damper Assembly:
    - .1 The damper assembly shall be heavy-gauge, galvanized steel with a solid shaft rotating in bearings.
    - .2 The damper shaft shall incorporate a visual position indicator etched into the end of the damper shaft to clearly indicate damper position over the full range of 90 degrees.
    - .3 The low leakage 18 gauge damper assembly shall incorporate a peripheral gasket on the damper blades for tight airflow shutoff.
      - .1 Air leakage past the closed damper shall not exceed two percent of the unit maximum airflow at three inch water gauge inlet static pressure, tested in accordance with ASHRAE 130.

- .2 The damper, seal and bearing system shall be tested to 1.25 million cycles, or the equivalent of 100 full open/closures per day for 35 years, with no visible signs of wear, tear, or failure of the damper assembly after such testing.
- .5 Airflow Sensor:
  - .1 The airflow sensor shall be a differential pressure airflow device measuring total, static, and velocity pressures, mounted to the inlet valve.
  - .2 Plastic parts shall be fire-resistant, complying with UL 94.
  - .3 The airflow sensor shall be RoHS (Restriction of Hazardous Substances) compliant. Materials containing polybrominated compounds shall not be acceptable.
  - .4 Control tubing shall be protected by grommets at the wall of the airflow sensor's housing.
  - .5 The airflow sensor shall be furnished with twelve total pressure sensing ports, and include a center averaging chamber that amplifies the sensed airflow signal.
  - .6 The airflow sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.
- .6 Inlet Valve Features:
  - .1 The inlet valve shall be a consistent diameter to retain flex duct and provide a stop for hard duct.
  - .2 The inlet valve shall include a 1/8 inch raised single bead weld for added strength.
  - .3 The gasket seal shall be a low leakage continuous piece with a peripheral gasket for tight airflow shutoff.
  - .4 The inlet valve shall include two heavy duty stop pins to accurately position the damper in the closed position.

### **3 Execution**

#### **3.01 Installation of Terminal Boxes**

- .1 Provide ceiling mounted terminal boxes.
- .2 Secure each box in place from structure by means of galvanized steel angles and hanger rods, independent of connecting ductwork.
- .3 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 – Seismic Controls for Mechanical Systems.
- .4 Coordinate provision of transformers, actuators, and controllers with Controls Contractor.
- .5 Connect each box with ductwork as indicated. Provide straight inlet duct same size as box inlet and of a length equal to a minimum of 4 duct diameters. Refer to drawing detail. Coordinate final box adjustments and settings with personnel doing system testing and balancing work.

#### **3.02 System Startup**

- .1 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

End of Section

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## **1 General**

### **1.01 Submittals**

- .1 Submit shop drawings/product data sheets for following:
  - .1 all control system components;
  - .2 identified schematic control diagrams with component identification, catalogue numbers, and sequence of operation for all systems;
  - .3 certified wiring diagrams for all systems.

### **1.02 Quality Assurance**

- .1 Control systems are to be installed by control component manufacturer or by licensed personnel authorized by control component manufacturer. Submit written confirmation from control component manufacturer.
- .2 Control wiring work is to be performed by licensed journeyman electricians, or under direct daily supervision of journeyman electricians.

## **2 Products**

### **2.01 Local Control Panels**

- .1 NEMA 1 (NEMA 2 in sprinklered areas) wall mounting, enamelled steel barriered enclosures sized to suit the application with 20% spare capacity, a perforated sub-panel, numbered terminal strips for all low and line voltage wiring, hinged door, and slotted flush latch.

### **2.02 Control System Components**

- .1 Components specified below are required for control of equipment and systems in accordance with drawing control diagrams and sequences of operation. Not all required components may be specified.
- .2 Sensor/transmitter input devices must be suitable in all respects for the application and mounting location. Devices are as follows:
- .3 Thermostats:
  - .1 Wall mounting adjustable set-point thermostats, each suitable in all respects for equipment (and operating sequence) they are provided for, equipped with a thermometer, a cover and any required mounting and connection accessories.
  - .2 Low voltage thermostats are to be 24 V electronic type.
  - .3 Set-point adjustment for thermostats in public spaces is to be concealed behind cover. Set-point adjustment for other thermostats is to be accessible through cover.
  - .4 Covers are to be removable, tamper-proof covers with temperature set-point and thermometer displays.
  - .5 Guards for thermostats are to be clear, ventilated acrylic covers with Allen key locking hardware.
- .4 Hardware to permit building automation system control and monitoring of input/output points in accordance with Section 25 05 02 – Building Automation System, points schedule, and drawing control

diagrams and operation sequences. All such hardware is to be suitable in all respects for interface with the building automation system.

## **2.03 System Wiring Materials**

- .1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in appropriate Section(s) of Electrical Work specification.

## **3 Execution**

### **3.01 General Re: Installation of Controls**

- .1 Provide complete systems of control and instrumentation to control and supervise building equipment and systems in accordance with this Section and drawings.
- .2 Control systems are to generally be as indicated on drawing control diagrams and are to have all the elements therein indicated or implied.
- .3 Control diagrams show only the principal components controlling the equipment and systems. Supplement each control system with all relays, transformers, sensors, etc., required to enable each system to perform as specified and to permit proper operation and supervision.

### **3.02 Installation of Thermostats**

- .1 Unless otherwise noted, provide required thermostats.
- .2 Provide a ventilated clear acrylic cover for each thermostat located in finished areas, and a wire type guard for each thermostat located in unfinished areas and in areas such as mechanical rooms where thermostat is subject to damage.
- .3 Unless otherwise indicated, mount room thermostats 1.5 m (5 ft) above finished floor level. Thermostats intended to be used by building occupants in a barrier-free path of travel to be mounted at 1.2 m (4 ft). Confirm exact location of all thermostats prior to roughing-in.
- .4 Provide stand-off mounting and an insulated sub-base for thermostats on outside walls.
- .5 Perform control wiring associated with installation of electric or electric-electronic thermostats.

### **3.03 Installation of Control System Components**

- .1 Provide required control system components and related hardware. Refer to drawing control diagrams and sequences.
- .2 Where components are pipe, duct, or equipment mounted supply components at proper time, coordinate installation with appropriate trade, and ensure components are properly located and mounted.

### **3.04 Control Wiring**

- .1 Perform required control wiring work for control systems except:
  - .1 power wiring connections to equipment and panels, except as noted below;
  - .2 control wiring associated with mechanical plant equipment and systems whose control is not part of work specified in this Section;
  - .3 starter interlock wiring.

- .2 Except as specified below, install wiring in conduit. Unless otherwise specified, final 600 mm (2 ft) connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.
- .3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.
- .4 Wiring work is to be in accordance with certified wiring schematics and instructions, and wiring standards specified in appropriate Sections of Electrical Work Specification.

### **3.05 Identification and Labelling of Equipment and Circuits**

- .1 Refer to identification requirements specified in Section 20 05 00 – Common Work Results for Mechanical.
- .2 Identify equipment as follows:
  - .1 enclosures and components: engraved laminated nameplates with wording listed and approved prior to manufacture of nameplates;
  - .2 wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings.

### **3.06 Testing, Adjusting, Certification, Start-Up, and Training**

- .1 When control work is complete, check installation of components and wiring connections, make any required adjustments, and coordinate adjustments with personnel doing HVAC testing, adjusting, and balancing work.
- .2 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .3 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

**End OF Section**



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## 1 General

### 1.01 Abbreviations and Definitions

.1 Abbreviations used in this Specification are as follows:

- .1 BAS building automation system;
- .2 DDC direct digital controls;
- .3 LAN local area network;
- .4 PC personal computer.

### 1.02 Submittals

.1 Submit shop drawings/product data sheets for BAS components. As a minimum, submit the following:

- .1 BAS network architecture, including modes and interconnections;
- .2 systems schematics, sequences, and flow diagrams;
- .3 points schedule for each point in BAS, including point type, object name, expanded ID, display units, controller type, and address;
- .4 detailed Bill of Materials for each system or application, identifying quantities, part numbers, descriptions, and optional features;
- .5 room schedule including a separate line for each HVAC terminal unit indicating type, location and address;
- .6 details of BAS interfaces and connections to other systems;
- .7 product data sheets or marked catalogue pages including part number, photograph and description for BAS hardware and software.

### 1.03 Quality Assurance

.1 BAS hardware and software is to be installed by experienced personnel employed and trained by manufacturer/supplier of field equipment controllers. System wiring is to be installed by journeyman electricians or under direct on-site supervision of journeyman electricians.

## 2 Products

### 2.01 General Re: Building Automation System

- .1 Control system components (field devices) other than those specified in this Section are generally specified in Section 25 05 01 – Automatic Control Systems. Components factory installed with equipment or supplied with equipment are specified in mechanical work Sections with equipment.
- .2 Building Automation System (BAS) refers to the existing Distech building automation system in place at the facility. It is the intent of this specification that the BAS and controls specified within this section constitute of expansion of this existing BAS. All controls components supplied shall be fully compatible with the existing BAS. Existing BAS graphics shall be updated as required.
- .3

## 2.02 Field Equipment Controllers

- .1 Each field equipment controller is to be a fully user programmable BACnet Testing Labs (BTL) certified and labelled digital controller that communicates via BACnet MS/TP protocol. Each controller is to be housed in a plenum rated plastic housing with removable base to permit pre-wiring of analog and binary input/output field points without controller in place.
- .2 Each controller is to employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences, and is to be factory programmed with a continuous adaptive tuning algorithm that sense changes in physical environment and continually adjusts loop tuning parameters appropriately.
- .3 Each field equipment controller is to:
  - .1 include troubleshooting LED's to identify following conditions:
    - .1 Power On;
    - .2 Power Off;
    - .3 Download or Start-Up In Progress-Not Ready For Normal Operation;
    - .4 No Faults;
    - .5 Device Fault;
    - .6 Field Controller Bus-Normal Data Transmission;
    - .7 Field Controller Bus-No Data Transmission;
    - .8 Field Controller Bus-No Communication;
    - .9 Sensor Actuator Bus-Normal Data Transmission;
    - .10 Sensor Actuator Bus-No Data Transmission;
    - .11 Sensor Actuator Bus-No Communication.
  - .2 support universal inputs, configured to monitor any of following:
    - .1 analog input, voltage mode;
    - .2 analog output, current mode;
    - .3 analog input, resistive mode;
    - .4 binary input, dry contact maintained mode;
    - .5 binary input, pulse counter mode.
  - .3 support binary inputs configured to monitor either of following:
    - .1 dry contact maintained mode;
    - .2 pulse counter mode.
  - .4 support analog outputs configured to output either of following:

- .1 analog output, voltage mode;
- .2 analog output, current mode.
- .5 support binary outputs, 24 VAC Triac;
- .6 support configurable outputs capable of following:
  - .1 analog output, voltage mode;
  - .2 binary output mode.
- .7 have ability to reside on a master-slave/token-passing field controller bus supporting BACnet standard protocol as follows:
  - .1 support communications, including input/output communications between field controllers and network automation engines;
  - .2 support a minimum of one hundred input/output modules and field equipment controllers in any combination;
  - .3 operate at a maximum distance of 4560 m (15,000 ft) between field controller and furthest connected device.
- .8 have ability to monitor and control a network of sensors and actuators over a master-slave/token-passing sensor-actuator bus supporting BACnet standard protocol as follows:
  - .1 bus is to support a minimum of ten devices per trunk;
  - .2 bus is to operate at a maximum distance of 365 m (1200 ft) between field controller and furthest connected device.
- .9 capability of executing complex control sequences involving direct wired input/output points as well as input and output devices communicating over field controller bus or sensor-actuator bus;
- .10 support, but not limited to, following:
  - .1 hot water, chilled water/central plant applications;
  - .2 custom air handling units for special applications;
  - .3 terminal units;
  - .4 special programs as required for systems control.
- .11 support a password protected local controller LCD back-lit display with 6 key keypad as an integral part of field controller or as a remote device communicating over sensor-actuator bus to permit user to view monitored points without logging into system, and to view and change set-points, modes of operation, and parameters.

### 2.03 Input/Output Modules

- .1 Input/output modules to facilitate additional inputs and outputs for use in field equipment controllers are to be similar to field equipment controllers but less display and with a minimum of 4 and a maximum of 17 points.

## **2.04 Wiring Materials**

- .1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in Division 26 – Electrical.

## **3 Execution**

### **3.01 General Re: Installation of the BAS**

- .1 Provide a complete building automation system in accordance with requirements of this Section of the Specification, Section 25 05 01 – Automatic Control Systems, drawings, and the input/output points list(s).
- .2 BAS to include updates to existing BAS graphics to suit new work.
- .3 Unless otherwise specified, perform BAS work in accordance with system manufacturer's instructions.

### **3.02 Installation of Direct Digital Control System Components**

- .1 DDC work is to be performed by skilled technicians, properly trained and are qualified for this work.
- .2 Provide new communications bus as required complete with required ancillaries. Connect and extend existing communications bus.
- .3 Submit Point Data Input forms to Consultant that Owner will fill out with DDC system supplier's assistance. Input this point data into the system.

### **3.03 Control Wiring**

- .1 Perform all required control wiring work for control systems and power wiring connections to controls equipment and panels.
- .2 Except as specified below, install wiring in conduit. Unless otherwise specified, final 600 mm (2') connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.
- .3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.
- .4 Wiring work is to be in accordance with BAS manufacturer's certified wiring schematics and instructions, and wiring standards specified in electrical work Division of this Specification.

### **3.04 Identification and Labelling of Equipment and Circuits**

- .1 Refer to Section 20 05 00 – Common Work Results for Mechanical.
- .2 Identify BAS equipment as follows:
  - .1 enclosures: engraved laminated nameplates with lettering such as BAS Panel CP2, or BAS Relays, or BAS E/P Transformers, with all wording listed and approved prior to manufacture of nameplates;
  - .2 wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings;

**End of Section**