

## **Part 1 - General**

### **1.1 GENERAL**

- .1 This section covers items common to all sections of Divisions 20 through 25.

### **1.2 EXAMINATION OF SITE AND DRAWINGS**

- .1 The Contractor shall examine the site and local conditions affecting the work under this Contract. No additional costs will be considered due to existing conditions.
- .2 The drawings do not show all structural or mechanical details and where accurate dimensions are required these dimensions shall be taken by the Contractor in the field. The Contractor shall confirm to their own satisfaction the accuracy of these field measurements and all necessary minor changes to piping/ducting/equipment to accommodate field conditions shall be approved by the departmental representative and made at no charge to the Owner.
- .3 The departmental representative reserves the right to alter locations of pipes, ducts or equipment without incurring additional costs, provided such alterations are made before the Contractor has begun fabrication of the work in question.
  - .1 The Contractor shall carefully examine the structural, civil, architectural, and electrical drawings and confirm to their own satisfaction that the work under this division can be carried out without changes to the equipment as shown on these drawings. Before commencing the work, the Contractor shall examine the work of other trades and report at once any defect or interference affecting the work of this division.
  - .2 Notes on the drawings are intended to form a part of this specification and must be examined by the Contractor.

### **1.3 SCOPE OF WORK**

- .1 This work includes, but is not limited to, the supply and installation of all supervision, labour, permits, equipment, materials, and consumables necessary to provide this facility with complete and operational systems listed below, as indicated on the drawings, and described in the specifications:
  - .1 The work provided in these tender documents shall be coordinated by the General Contractor for phasing of work.
  - .2 Demolition of all existing main floor plumbing fixtures, and all associated domestic hot and cold water piping, sanitary & vent piping, valves, fittings, and devices. Demolition exclusions are noted on drawings.
  - .3 Supply and installation of new main floor plumbing fixtures, and all associated piping and devices.
  - .4 Demolition of (2) existing exhaust fans located in gable ends, and miscellaneous small fans within the building.
  - .5 Supply and installation of new exhaust fan serving washrooms.

#### **1.4 PRODUCT SPECIFICATIONS AND STANDARDS**

- .1 All equipment and materials specified to conform to an applicable code and/or standard, and shall be listed and/or labelled under the provisions of such code or standard, when available.
- .2 Product description shall take precedence over product model numbers as manufacturers may change numbers during design and tender bid periods.

#### **1.5 EQUIPMENT INSTALLATION**

- .1 Unions or flanges: provide for ease of maintenance and disassembly.
- .2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated.
- .3 Equipment drains: pipe to floor drains.
- .4 Install equipment, rectangular cleanouts and similar items parallel to, or perpendicular to building lines, except where indicated otherwise.

#### **1.6 ANCHOR BOLTS AND TEMPLATES**

- .1 Supply anchor bolts and templates required for the work of this division for installation by other divisions.

#### **1.7 TRIAL USAGE**

- .1 The departmental representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

#### **1.8 PROTECTION OF OPENINGS**

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

#### **1.9 ELECTRICAL**

- .1 Electrical work to conform to Division 26. Supply and installation responsibility is indicated in the mechanical and electrical specifications, and on the mechanical and electrical drawings as appropriate.

#### **1.10 BELT DRIVES**

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 Standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .5 Motor slide rail adjustment plates to allow for centre line adjustment.

#### **1.11 PREPARATION FOR FIRESTOPPING**

- .1 Insulated pipes: ensure integrity of insulation and vapour barrier of fire separation.

### 1.12 ESCUTCHEONS

- .1 On pipes passing through walls, partitions, floors and ceilings in finished areas.
- .2 Chrome plated plastic split ring, pressfit.
- .3 Outside diameter to cover opening or sleeve.
- .4 Inside diameter to fit around finished pipe.
- .5 Standard of Acceptance: Belanger.

### 1.13 TESTS

- .1 Give 24 h written notice of date for tests.
- .2 Insulate or conceal work only after testing and approval by the departmental representative.
- .3 Conduct tests in presence of the departmental representative when requested.
- .4 Bear costs including retesting and making good.
- .5 Piping:
  - .1 General: maintain test pressure without loss for 4 h unless otherwise specified.
  - .2 Test drainage, waste and vent piping to National Plumbing Code and departmental representative. Perform ball test on all underground drainage piping systems.
  - .3 Test domestic hot, cold and recirculation water piping at 1-1/2 times system operating pressure or minimum 860 kPa whichever is greater.
- .6 Equipment: test as specified in relevant sections.
- .7 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

### 1.14 PAINTING

- .1 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work. Outdoor ferrous supports to be painted with two coats of enamel paint in addition to the primer coat.
- .2 Quality and color selection relevant to Section 09 91 23 - Painting.
- .3 Prime and touch up marred manufacturers' finished paintwork to match original.
- .4 Restore to new condition, manufacturers' finishes that have been extensively damaged.

### 1.15 SPARE PARTS

- .1 Furnish spare parts in accordance with Section 01 10 01 – General Requirements.
  - .1 One set of belts for each piece of machinery.
  - .2 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set, for each applicable piece of equipment.
  - .3 As indicated.

### 1.16 DIELECTRIC COUPLINGS

- .1 General:
  - .1 To be compatible with and to suit pressure rating of piping system.
  - .2 Where pipes of dissimilar metals are joined.
- .2 Pipes 50mm and under: isolating unions.
- .3 Pipes 62mm and over: isolating flanges.

### 1.17 DRAIN VALVES

- .1 Locate at low points as required to fully drain and winterize all water systems, and at section isolating valves, unless otherwise specified.
- .2 Minimum 19mm, unless otherwise specified: bronze, with hose end male thread.

### 1.18 OPERATION AND MAINTENANCE MANUAL

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 10 01 – General Requirements.
- .2 Operation and maintenance manual to be reviewed by, and final copies deposited with, the departmental representative before final inspection.
- .3 Operation data to include:
  - .1 Operation instruction for each system and each component.
  - .2 Description of actions to be taken in event of equipment failure.
  - .3 Valves schedule and flow diagram.
  - .4 Colour coding chart.
- .4 Maintenance data shall include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
  - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified elsewhere.
  - .4 Testing, adjusting and balancing reports as specified in Section 20 05 93 - Testing, Adjusting and Balancing.
- .6 Reviews.
  - .1 Submit 3 copies of draft Operation and Maintenance Manual and one electronic copy to the Departmental Representative for review.
  - .2 Submission of individual data will not be accepted unless so directed by the Departmental Representative.
  - .3 Make changes as required and re-submit as directed by the departmental representative.
- .7 Additional data.

- .1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

### **1.19 SHOP DRAWINGS**

- .1 Submit shop drawings and product data in accordance with Section 01 10 01 – General Requirements.
- .2 Shop drawings and product data shall show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances, eg. access door swing spaces.
- .3 Shop drawings and product data shall be accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify as to current model production.
  - .5 Certification of compliance to applicable codes.
  - .6 Electrical requirements.
  - .7 Accessories.

### **1.20 CLEANING**

- .1 Clean mechanical (building) systems in accordance with Section 01 10 01 – General Requirements.
- .2 Clean interior and exterior of all systems including strainers. Vacuum interior of ventilating units.
- .3 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition, including replacement of all filters in all air and piping systems.

### **1.21 RECORD DRAWINGS**

- .1 Site records:
  - .1 The departmental representative will provide 1 set of white prints of mechanical drawings. Mark thereon all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 On a weekly basis, transfer information to prints, to show all work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection at all times.
- .2 Record drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "RECORD DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED"  
(Signature of Contractor) (date).

- .3 Submit to the departmental representative for approval and make corrections as directed.
  - .4 TAB to be performed using record drawings.
  - .5 Submit completed reproducible record drawings with Operating and Maintenance Manuals.
- .3 Submit copies of record drawings for inclusion in final TAB report.

## 1.22 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction waste management plan.
  - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
  - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Requiring Recycled Content".
  - .2 If products within this section are indicated on the "List of Products Requiring Recycled Content", only products with recycled content will be acceptable.
  - .3 For products not identified on list, source products with highest recycled content available when practical.
  - .4 Include following information with product data submission.
    - .1 Percentage of pre-consumer and post-consumer recycled content for each product.
- .3 Regional Materials.
  - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Required to be Locally Sourced".
  - .2 If products within this section are indicated on the "List of Products Required to be Locally Sourced", include following information with Product Data submission:
    - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
- .4 Adhesives and Sealants.
  - .1 Include following information with Product Data submission for materials specified under this section:
    - .1 Submit manufacturer's certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California's SCAQMD #1168.
- .5 Paints and Coatings.
  - .1 Provide low VOC Products as specified herein and complying with local regulations regarding toxic and hazardous materials.

- .2 Ensure primers, paints and coatings used onsite and within building envelope meet or exceed requirements of following standards:
  - .1 Interior and Exterior Paints: GS-11
  - .2 Anti-Corrosive Paint: GS-11
  - .3 Clear Wood Finishes and other coating not covered in GS-11: SCAQMD #1113.
- .3 Submit manufacturer's certification indicating VOC limits of Products.
- .6 If requesting substitute product, ensure proposed substitution achieves above stated goals.

### **1.23 MAX. VOC CONTENT FOR SOLVENT CLEANING ACTIVITIES**

- .1 Following are some of the Maximum allowed VOC Content for following activities, as per SCAQMD Rule 1171-9 (refer to SCAQMD manual for complete list and updates):
  - .1 Product cleaning during onsite surface preparation for coatings or adhesives application, and repair and maintenance cleaning:
    - .1 General maximum VOC 25g/L.
    - .2 Electrical apparatus components and electronic components.
    - .3 Cleaning of coatings or adhesives application equipment max. VOC 25g/L.
  - .2 Refer to SCAQMD for additional information and clarification and complete list of applications.
  - .3 Any discrepancies are to be approved by Departmental Representative. Obtain written approval prior to use on site.

### **1.24 COMMISSIONING**

- .1 Installing trades shall provide site attendance by qualified technicians to assist with the commissioning process, verify in writing that tests and adjustments have been made for each item requiring commissioning, and submit verification to the departmental representative for review. As a minimum, verification shall be a list of each piece of equipment showing the tag # for the equipment, room numbers, date commissioned, personnel's name performing the work and comments indicating the work performed. Report may be hand printed in ink and must be legible. Submit proposed method of commissioning to the departmental representative prior to performing the work, showing all equipment to be commissioned.

**END OF SECTION**

## **Part 1 - General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 22 11 18 - Plumbing Piping Valves and Fittings
- .2 Section 23 31 14 - Ductwork

### **1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.1, Power Piping.
- .2 ASTM International
  - .1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC)

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
  - .2 Submit shop drawings for:
    - .1 Bases, hangers and supports.
    - .2 Connections to equipment and structure.
    - .3 Structural assemblies.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
  - .1 Provide manufacturer's installation instructions.

- .1 The Purchaser will make available 1 copy of systems supplier's installation instructions.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Packaging Waste Management: remove for reuse and return of pallets and crates.

### **Part 2 - Products**

#### **2.1 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
  - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
  - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
  - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

#### **2.2 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58.

#### **2.3 PIPE HANGERS**

- .1 Finishes:
  - .1 Pipe hangers and supports: Galvanized Steel
  - .2 Ensure hangers in contact with copper piping are epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with galvanized steel cup point setscrew, locknut galvanized steel retaining clip.
    - .1 Rod: 13 mm FM approved.
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: galvanized steel beam clamp, eye rod, jaws and extension with galvanized steel retaining clip, tie rod, nuts and washers, to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:

- .1 Cold piping NPS 2 maximum: galvanized steel top-of-beam C-clamp with stainless steel cup point setscrew, locknut and galvanized steel retaining clip, to MSS SP69.
- .2 Cold piping NPS 2 1/2 or greater, galvanized steel top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed or FM approved.
- .4 Upper attachment structural: suspension from lower flange of Steel Joist:
  - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with galvanized steel washer plates with double locking nut galvanized steel.
    - .1 Rod: 13 mm FM approved.
    - .2 Cold piping NPS 2 1/2 or greater, hot piping: galvanized steel washer plates with double locking nut, eye rod, jaws and extension with galvanized steel retaining clip, tie rod, nuts and washers, to MSS-SP58 and MSS-SP69.
- .5 Cold piping NPS 2 1/2 or greater, galvanized steel top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed or FM approved
- .6 Upper attachment to concrete:
  - .1 Ceiling: Galvanized steel welded eye rod, clevis plate, clevis pin and cotter with weldless galvanized steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed or FM approved to MSS SP69.
- .7 Shop and field-fabricated assemblies:
  - .1 Trapeze hanger assemblies.
  - .2 Galvanized Steel brackets.
  - .3 Pre-engineered support systems for pipe trays.
- .8 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
  - .3 Do not use 22 mm or 28 mm rod.
- .9 Pipe attachments: material to MSS SP58:
  - .1 Attachments for stainless steel piping: Galvanized Steel.
  - .2 Attachments for copper piping: Epoxy coated Galvanized Steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .10 Adjustable clevis: material to MSS SP69 UL listed or FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
- .11 Yoke style pipe roll: galvanized steel yoke, rod and nuts to MSS SP69.
- .12 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for stainless steel pipework: galvanized steel.
  - .2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated, with formed portion plastic coated.

- .13 Pipe rollers: galvanized steel roll and roll stand with galvanized steel rod to MSS SP69.

## **2.4 RISER CLAMPS**

- .1 Standard: Galvanized Steel
- .2 Copper pipe: epoxy coated.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

## **2.5 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized steel sheet steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
  - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, galvanized steel to comply with MSS SP69.

## **2.6 CONSTANT SUPPORT SPRING HANGERS**

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

## **2.7 VARIABLE SUPPORT SPRING HANGERS**

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

## **2.8 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

## **2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

- .1 Provide templates to ensure accurate location of anchor bolts.

## **2.10 HOUSE-KEEPING PADS**

- .1 Provide minimum 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 100 mm larger than equipment; chamfer pad edges.
- .2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

## **2.11 OTHER EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports from structural grade steel.
- .2 Submit structural calculations with shop drawings.

## **Part 3 - Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
  - .2 Pre-engineered pipe tray systems to be supplied with manufacturer's installation instructions and layout for each system. A site mock-up of the installation shall be completed for manufacturer's representative to review for compliance.
- .2 Vibration Control Devices:
  - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to industry standards.
  - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:

- .1 Vertical movement of pipework is 13 mm or more,
- .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
  - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
  - .2 Variation in supporting effect does not exceed 25 % of total load.

### 3.3 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code, Provincial Code, authority having jurisdiction and as indicated.
- .2 Fire protection: to applicable fire code, Section 21 13 00 – Sprinkler Systems
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .6 Pre-engineered piping tray systems carrying multiple pipes of various sizes, materials and temperatures shall be supported based on the shortest distance of the hanger supports spacing (listed below) and the pipes within the tray system.
- .7 Within 300 mm of each elbow.
- .8 All storm, sanitary waste and vent PVC DWV pipe hangers to be spaced maximum 1.2 m per NPC or to the Authority Having Jurisdiction.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper	Maximum Spacing Process Sch 80 PVC
up to 1-1/4	2.4 m	1.8 m	1.2 m
1-1/2	3.0 m	2.4 m	1.5 m
2	3.0 m	2.4 m	1.8 m
2-1/2	3.7 m	3.0 m	2.0 m
3	3.7 m	3.0 m	2.1 m
4	3.7 m	3.6 m	2.3 m
6	4.3 m		2.7 m
8	4.3 m		2.9 m
10	4.9 m		3.0 m
12	4.9 m		3.0 m

- .9 Pipework greater than NPS 12: to MSS SP69.

### 3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

### **3.5 HORIZONTAL MOVEMENT**

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

### **3.6 FINAL ADJUSTMENT**

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
  - .1 Hammer jaw firmly against underside of beam.

### **3.7 CLEANING**

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## **Part 1 - General**

### **1.1 GENERAL**

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section.

### **1.2 PURPOSE OF TAB**

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

### **1.3 EXCEPTIONS**

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of the departmental representative.

### **1.4 CO-ORDINATION**

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

### **1.5 PRE-TAB REVIEW**

- .1 Review contract documents before project construction is started and confirm in writing to the departmental representative adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to the departmental representative in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.

### **1.6 START-UP**

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

## **1.7 OPERATION OF SYSTEMS DURING TAB**

- .1 Operate systems for length of time required for TAB and as required by the departmental representative for verification of TAB reports.

## **1.8 START OF TAB**

- .1 Notify the departmental representative 7 days prior to start of TAB.
- .2 Start TAB only when building is essentially completed, including:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
  - .2 Application of weatherstripping, sealing, caulking.
  - .3 All pressure, leakage, other tests specified elsewhere Division 23.
  - .4 All provisions for TAB installed and operational.
  - .5 Start-up, verification for proper, normal and safe operation of all mechanical and associated electrical and control systems affecting TAB including but not limited to:
    - .1 Proper thermal overload protection in place for electrical equipment.
    - .2 Air systems:
      - .1 Filters in place, clean.
      - .2 Duct systems clean.
      - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
      - .4 Correct fan rotation.
      - .5 Fire, smoke, volume control dampers installed and open.
      - .6 Access doors, installed, closed.
      - .7 All outlets installed, volume control dampers open.
    - .3 Liquid Systems:
      - .1 Flushed, filled, vented.
      - .2 Correct pump rotation.
      - .3 Strainers in place, baskets clean.
      - .4 Isolating and balancing valves installed, open.
      - .5 Calibrated balancing valves installed, at factory settings.

## **1.9 APPLICATION TOLERANCES**

- .1 Do TAB to following tolerances of design values:
  - .1 HVAC systems: plus or minus 10%.
  - .2 Plumbing Domestic Hot Water Recirc System: plus or minus 10%.

## **1.10 ACCURACY TOLERANCES**

- .1 Measured values to be accurate to within plus or minus 2% of actual values.

### **1.11 SUBMITTALS**

- .1 Submit, prior to commencement of TAB:
  - .1 Proposed methodology and procedures for performing TAB if different from referenced standard.

### **1.12 PRELIMINARY TAB REPORT**

- .1 Submit for checking and approval of the departmental representative prior to submission of formal TAB report, sample of rough TAB sheets. Include:
  - .1 Details of instruments used.
  - .2 Details of TAB procedures employed.
  - .3 Calculations procedures.
  - .4 Summaries.

### **1.13 TAB REPORT**

- .1 Format to be in accordance with referenced standard.
- .2 TAB report to show all results in Metric units, and to include:
  - .1 Project record drawings.
  - .2 System schematics.
  - .3 Submit 2 hard copies and one electronic of the final TAB Report to the departmental representative for verification and approval, in English, complete with index tabs.

### **1.14 VERIFICATION**

- .1 All reported results subject to verification by the departmental representative.
- .2 Provide manpower and instrumentation to verify up to 100% of all reported results.
- .3 Number and location of verified results to be at discretion of the departmental representative.
- .4 Bear costs to repeat TAB as required to satisfaction of the departmental representative.

### **1.15 SETTINGS**

- .1 After TAB is completed to satisfaction of the departmental representative, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

### **1.16 COMPLETION OF TAB**

- .1 TAB to be considered complete only when final TAB Report received and approved by the departmental representative.

## 1.17 AIR SYSTEMS

- .1 Standard: TAB to be to most stringent of this section or SMACNA or ASHRAE.
- .2 Do TAB of all systems, equipment, components, and controls specified in Division 20 through 25.
- .3 Qualifications: Personnel performing TAB to be current member in good standing of AABC and NEBB.
- .4 Quality Assurance: Perform TAB under direction of supervisor qualified to standards of AABC and NEBB.
- .5 Measurements: To include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
  - .1 Inlet and outlet of exhaust fan.
  - .2 At each controller, controlled device.
  - .3 Locations of systems measurements to include, but not be limited to, following as appropriate: Each main duct, main branch, sub-branch, run-out (or grille, register or diffuser).

## Part 2 - Execution

### 2.1 AIR DISTRIBUTION SYSTEMS

- .1 Test and balance exhaust system. Balancing must be performed by trained personnel who shall keep records on each trial balance.
- .2 Balancing shall be accomplished by means of pitot tube traverse on all main and branch ducts. Fan speeds and dampers shall be adjusted until proper air quantities are obtained.
- .3 Each outlet shall be adjusted by anemometer, voltmeter readings to provide specified air quantities. Each supply outlet shall be adjusted to provide proper throw and distribution in accordance with requirements.
- .4 All necessary equipment including gauges, pitot tubes, anemometers, voltmeters, etc. required for the testing and air balance shall be furnished and of quality and capacity to ensure proper accuracy.
- .5 Upon completion of the balancing, supply three (2) complete records which shall include air quantities at each outlet. Provide if requested, a spot check on each system. If actual quantities do not agree with the balance report, this contractor may be called upon to completely re-balance the systems until satisfactory to the Engineer.
- .6 Balancing to be performed using duct balancing dampers where applicable, grille dampers to be used for fine tuning only.
- .7 Provide the following information as part of the balancing report:

- .1 System No.
- .2 System Location
- .3 Area System Serves
- .4 Specified CFM
- .5 Actual CFM
- .6 Specified Suction S.P.
- .7 Actual Suction S.P.
- .8 Type of Sheave and Location (Motor or Fan)
- .9 Position of Sheave (i.e. Maximum or Minimum RPM)
- .10 Motor HP
- .11 Fan Rated HP
- .12 Amp Draw on each Phase
- .13 Measured voltage
- .14 Motor RPM
- .15 Fan RPM Specified
- .16 Fan RPM Actual
- .17 Individual diffuser reports shall include:
  - .18 Diffuser type
  - .19 Velocity ft/min
  - .20 Diffuser Multiplier
  - .21 Specified CFM
  - .22 Actual CFM
- .8 Provide fan curves for each fan showing plotted design and field conditions, static pressure readings across filter banks, showing design and actual readings.
- .9 Provide a detailed summary of velocity traverses and calculated air quantities for each fan and branch ductwork Provide schematic diagrams for all systems with all outlets numbered. All openings shall be closed using removable gasketed plugs. All balancing shall be done to AABC Standards.

### 1.1 ROOM NUMBERS

- .10 The Contractor is to obtain a set of room numbers from the Consultant for the purposes of labelling systems and equipment where applicable. Construction room numbers from working drawings may not be acceptable.

**END OF SECTION**

## Part 1 - General

### 1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A167-89a, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
  - .2 ASTM C335-89, Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulations.
  - .3 ASTM C411-82(1987), Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .2 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC-S102-M88, Surface Burning Characteristics of Building Materials and Assemblies.
- .3 National Fire Protection Association (NFPA).
  - .1 ANSI/NFPA 90A-1989, Installation of Air Conditioning and Ventilating Systems.
  - .2 ANSI/NFPA 90B-1989, Installation of Warm Air Heating and Air Conditioning Systems.
- .4 Canadian General Standards Board (CGSB).
  - .1 CGSB 51-GP-9M-76, Thermal Insulation, Mineral Fibre, Sleeving for Piping and Round Ducting.
  - .2 CGSB 51-GP-11M-76, Thermal Insulation, Mineral Fibre, Blanket for Piping, Ducting, Machinery and Boilers.
  - .3 CAN/CGSB-51.12-M86, Cement, Thermal Insulating and Finishing.
  - .4 CAN/CGSB-51.40-M80, Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
  - .5 CGSB 51-GP-52Ma-89, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .6 CGSB 51-GP-53M-77, Jacketing, Polyvinyl, Chloride Sheet, for Insulating Pipes, Vessels and Round Ducts.
- .5 Canadian Standards Association (CSA).
  - .1 CSA HA Series-M1980, CSA Standards for Aluminum and Aluminum Alloys.
- .6 Thermal Insulation Association of Canada (TIAC).
  - .1 TIAC, Thermal Insulation Association of Canada, National Insulation Standards.

### 1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 10 01 - General Requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

### 1.3 DEFINITIONS

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.
  - .2 "EXPOSED" - will mean "not concealed" as defined herein.

### Part 2 - Products

#### 2.1 GENERAL

- .1 Components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.
- .2 Materials to be tested in accordance with ASTM C177/C518.

#### 2.2 CLOSED CELL FOAM TO 90°C

- .1 Application: for piping and fittings on:
  - .1 Domestic hot water, temperature 60°C.
  - .2 Domestic hot water recirculation, temperature 60°C.
  - .3 Domestic cold water, temperature 5°C.
  - .4 Existing cold water pipe serving pool equipment.
- .2 Materials:
  - .1 Closed cell polyethylene foam for piping.
  - .2 Thickness: 13mm on cold water piping, 19mm on hot water piping.
  - .3 Thermal Conductivity "k" shall not exceed 0.039 W/m.°C at 24°C mean temperature when tested in accordance with ASTM C177.
  - .4 Standard of Acceptance: Tundra insulation by Armacell.

### Part 3 - Execution

#### 3.1 APPLICATION

- .1 Apply insulation after required tests have been completed and approved by the departmental representative.
- .2 Surfaces shall be clean and dry during application of insulation and finishes.
- .3 Apply insulation materials, accessories and finishes in accordance with TIAC National Insulation Standards and manufacturer's recommendations and as specified herein.
- .4 Terminate insulation and each side of fire wall and seal insulation to all service jacket and to fire wall after fire stopping has been completed.

#### 3.2 INSTALLATION

- .1 Semi-split pipe insulation c/w factory glue strips: Install per manufacturer's instructions.

- .2 At flanges and unions at equipment, expansion joints, valves, circuit balancing and service and other components requiring regular maintenance: omit insulation and bevel away from studs and nuts to permit use of tools without damage to insulation.
- .3 Insulation is not required for:
  - .1 Pipe through floors, valves and fittings.
  - .2 Drain Valves.

### **3.3 FASTENINGS**

- .1 Secure pipe insulation by tape at each joint to prevent separation.

**END OF SECTION**

## **Part 1 - General**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E 202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

### **1.2 POTABLE WATER SYSTEMS**

- .1 When cleaning is completed and system filled:
  - .1 Verify performance of equipment and systems as specified elsewhere in Division 20 through 25.
  - .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
  - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

### **1.3 SANITARY SYSTEMS**

- .1 Perform hydraulic tests to verify grades, and ball test to confirm freedom from obstructions.
- .2 Ensure that traps are full of water.
- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, and/or tank, and operate each fixture to verify drainage and no leakage.

### **1.4 COMMISSIONING**

- .1 Perform commissioning activities in accordance with section 20 04 00 - Mechanical General Requirements.

## **Part 2 - Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 - Execution**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**