

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 increase in Contract Price.
- .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 for phasing of work.
- .2 Demolition consists of removing existing exhaust grilles, plumbing fixtures and associated piping as indicated on the drawings.
- .3 Plumbing consists of the supply and installation of new plumbing fixtures and modifications to the existing plumbing piping as indicated on the drawings.
- .4 Ventilation consists of supply and installation of new exhaust grilles, balancing dampers, modifications to ductwork as required to install new balancing dampers and grilles, and testing, adjusting and balancing the existing exhaust fan as indicated on plans.

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.
- .3 Reference is made in the documents to NPS which is to be understood as Nominal Pipe Size in inches, inside or outside diameter as applicable to the piping or tubing product in question.

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.

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 - Electrical. Supply and installation responsibility is indicated in the mechanical and electrical specifications and on the mechanical and electrical drawings as appropriate.
- .2 Control wiring and conduit, 120V and under, shall be supplied and installed by this trade. Refer to Division 26 - Electrical for quality of materials and workmanship.

1.10 SLEEVES

- .1 Pipe sleeves: provide at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated.
- .2 Schedule 40 steel pipe.
- .3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
 - .2 Where sleeve extends above finished floor.
- .4 Sizes: minimum 6 mm clearance all around, between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 mm above other floors.

- .6 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping.
 - .3 Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.
 - .4 Ensure no contact between copper tube or pipe and ferrous sleeve.
 - .5 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .6 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Amdt-Mar-78.

1.11 PREPARATION FOR FIRESTOPPING

- .1 Uninsulated unheated pipes not subject to movement: no special preparation.
- .2 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe to move without damaging firestopping material.
- .3 Insulated pipes and ducts: 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.

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 domestic hot, cold, recirculation, and heating 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 PERFORMANCE VERIFICATION

- .1 Potable water systems:
 - .1 When cleaning is completed and system filled:
 - .2 Verify performance of equipment and systems as specified elsewhere in Divisions 20 through 25.

- .3 Confirm water quality consistent with supply standards, verify that no residuals remain resulting from flushing and/or cleaning.
- .2 Sanitary drainage systems:
 - .1 Ensure that fixtures are properly anchored, connected to system.
 - .2 Operate flush valves, tanks and operate each fixture to verify drainage and no leakage.
- .3 Heating systems:
 - .1 Ensure that fixtures are properly anchored, connected to system.
 - .2 Operate each fixture to verify no leakage.

1.15 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.

1.16 SPARE PARTS

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals.
 - .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 One set of mechanical seals for each pump.
 - .4 One casing joint gasket for each pump.
 - .5 As indicated.

1.17 ACCESS DOORS

- .1 Supply access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.
- .2 Flush mounted 600 x 600 mm for body entry and 300 x 300 mm for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .3 Material:
 - .1 Special areas such as tiled surfaces: use stainless steel with brushed satin or polished finish as directed by the Departmental Representative.
 - .2 Remaining areas: use prime coated steel.
- .4 Installation:
 - .1 Locate so that concealed items are accessible.
 - .2 Locate so that hand or body entry (as applicable) is achieved.
 - .3 Installation is specified in applicable sections.

1.18 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 NPS 2 and under: isolating unions.
- .3 Pipes NPS 2-1/2 and over: isolating flanges.

1.19 DRAIN VALVES

- .1 Locate at low points and at section isolating valves unless otherwise specified.
- .2 Minimum NPS 3/4 unless otherwise specified: bronze, with hose end male thread and complete with cap and chain.

1.20 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Where specified elsewhere in Division 22 - Plumbing and Division 23 - Heating, Ventilating and Air-Conditioning (HVAC), manufacturers to provide demonstrations and instructions.
- .3 Use operation and maintenance manual, record drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections, and minimum as follows:
 - .1 Plumbing Systems: 1/2 day (site time).
 - .2 Heating: 1/2 day (site time).
- .5 Where deemed necessary, the Departmental Representative may record these demonstrations on video tape for future reference.

1.21 OPERATION AND MAINTENANCE MANUAL

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .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 Control schematics for each system including environmental controls.
 - .2 Description of each system and its controls.
 - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for each system and each component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 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.
- .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.

1.22 SHOP DRAWINGS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .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.

1.23 CLEANING

- .1 Clean mechanical (building) systems in accordance with Section 01 74 11 - Cleaning.
- .2 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and 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.

1.24 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.

1.25 COMMISSIONING

- .1 Perform commissioning.
- .2 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. Commissioning and verification requirements are indicated in detail in the specifications that follow for some equipment/systems, however, 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

1 General

1.1 WORK INCLUDED

- .1 Provide all labour, materials, products, equipment and services to supply and install the basic mechanical materials indicated on the Drawings and specified in Division 20 - Mechanical General Requirements through Division 25 - Integrated Automation of these Specifications.

1.2 IDENTIFICATION OF MECHANICAL SERVICES

- .1 Identify all mechanical services after finish painting is complete.
- .2 Use consistent terminology:
 - .1 With the Drawings and Specifications
 - .2 With the Departmental Representative's requirements and standards.
- .3 Mark valve and equipment identification on Record Drawings.
- .4 Provide typewritten master lists for each Equipment Room. Frame under glass. Insert copies in Operating and Maintenance Instruction Manuals.

1.3 PIPE IDENTIFICATION

- .1 Provide SMS Wrap-Mark on all pipe coverings, using Wrap-Mark pipe markers with alternating flow arrow wording. For outside diameters up to 150 mm, allow marker to completely wrap pipe. For larger outside diameters, secure markers with stainless steel springs. Secure markers on vertical piping and elsewhere where markers could be inadvertently moved.
- .2 Locate identification and flow arrows so they can be seen clearly from floor and service platforms.
 - .1 At least once in each room
 - .2 At each piece of equipment
 - .3 At each branch close to connection point to main piping and ductwork
 - .4 At not greater than intervals of 15 metres on straight runs of exposed piping and ductwork
 - .5 At entry and leaving point to pipe and duct chases, or other concealed spaces
 - .6 Both sides where piping and ductwork passes through walls, partitions and floors
 - .7 On vertical pipes and ducts approximately 1800 mm above floor
 - .8 Behind each access door and panel
 - .9 At valves, identify piping upstream of valves and identify branch, equipment, building part or building serviced downstream of valve.
- .3 Colour code pipes to meet code and the Departmental Representative's requirements. At minimum, colour code pipes with 50 mm wide bands in accordance with the detail shown on the drawings.
- .4 Identify electrical tracing of pipes on pipe insulation.

1.4 VALVE TAGS

- .1 Provide 40 mm dia., 1 mm thick brass tags with 10 mm high die-stamped black letters.
- .2 Attach to valve handles with 100 mm long brass chains through a hole in the handle.

- .3 Tag all valves except for small valves isolating a single piece of equipment such as a unit heater, fan coil unit, terminal reheat coil and radiation section.

1.5 EQUIPMENT NAMEPLATES

- .1 Identify equipment, starters, and, remote control devices in a manner consistent with the Drawings.
- .2 Use solid black capitalized lettering 100 mm high.
- .3 Where equipment size does not permit stencil identification, use lamacoid labels, engraved white on black, mechanically fastened to the equipment. Minimum lettering size 10 mm.

1.6 FLOW DIAGRAMS

- .1 Prepare neat diagrams 1200 mm x 900 mm of piping systems to identify equipment and valves.
- .2 Insert legible page size copies into each Operating and Maintenance Manual.
- .3 Install diagrams, framed under glass, on Equipment Room walls where directed by the Departmental Representative/Contractor.

1.7 COMMISSIONING

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

2 Products

2.1 PIPE HANGERS

- .1 Provide pipe hangers and supports for all piping. Provide hangers in accordance with the following requirements. Provide steel supports in accordance with the subsequent article in this specification section. Provide galvanized steel hangers and supports with galvanized fittings and accessories where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.
- .2 Provide manufactured hangers, accessories and supports in accordance with ANSI B31.1 and MSS SP58, SP69, SP89 and SP90 similar to the Grinnell or Myatt figures numbers below.
- .3 Select products to ensure adequate safety factors under anticipated loads.
- .4 Provide upper attachments as follows:
 - .1 Standard beam clamp for normal service - Grinnell Fig 133 with Fig 290 or Fig 278 or Myatt Fig 500 with Fig 480 or Fig 440.
 - .2 Standard side beam clamp for normal service - Grinnell Fig 225 or Myatt Fig 505.
 - .3 Top beam clamp - Grinnell Fig 92 or Myatt Fig 406.
 - .4 C clamp - Grinnell Fig 86 or Myatt Fig 586.
 - .5 Angle clip for light duty side mounting - Grinnell Fig 202 or Myatt Fig 542.
- .5 For vertical adjustment of hanger rods, provide forged steel turnbuckle - Grinnell Fig 230 or Myatt Fig 475.

- .6 Provide pipe attachments as follows:
 - .1 Adjustable swivel rings for uninsulated fire service piping - ULC approved - Grinnell Fig 69 or Myatt Fig 41.
 - .2 Clevis hanger for copper piping up to and including 100 mm diameter - Grinnell Fig CT-65 plastic coated or Myatt Fig 56 epoxy coated.
 - .3 Swivel ring hanger for copper tubing up to and including 25 mm diameter - Myatt Fig 43 epoxy coated.
 - .4 Standard duty clevis hanger for steel piping - Grinnell Fig 260 or Myatt Fig 124.
 - .5 Standard duty long clevis hanger for steel piping - Grinnell Fig 300 or Myatt Fig 124L.
- .7 Provide vertical pipe supports as follows:
 - .1 Riser clamp for copper pipe - Grinnell Fig CT121C plastic coated or Myatt Fig 186 epoxy coated.
 - .2 Riser clamp for steel or cast iron pipe - Grinnell Fig 261 or Myatt Fig 182 or Fig 183.
- .8 Provide supports for other piping types such as plastic, mechanically fused or packed joint pipe according to the pipe manufacturer's published recommendations. Support piping continuously where required to prevent sagging.
- .9 Provide protection saddles where insulated piping is supported from below.
 - .1 For high temperature insulated pipe - Grinnell Fig 160 or Fig 165 or Myatt Fig 210 or Fig 240.
 - .2 For insulated pipe with vapour barrier for low temperature service, insulate pipe with calcium silicate at hangers and provide Grinnell Fig 167 or Myatt Fig 251.
- .10 Provide roll type supports where shown on the drawings and where longitudinal movement may occur. Provide single pipe rolls - Grinnell Fig 177 or Myatt Fig 262 where supported from below and Grinnell Fig 171 or Myatt Fig 261 where suspended. Provide spring cushions where slight vertical movement is likely and cushioning required - Grinnell Fig 178 or Myatt Fig 880.
- .11 Provide Grinnell or Myatt engineered constant support hangers on piping subject to vertical movement exceeding 40 mm due to vertical pipe expansion.

2.2 SLEEVES, WALL AND FLOOR PLATES

- .1 For pipe sleeves, use machine cut and reamed standard weight steel piping.
- .2 Concealed perimeter risers and runouts may have sleeves of 1.31 mm galvanized steel set around section of insulation to provide freedom of movement of piping. Extend 50 mm above finished floor level.
- .3 For piping through exterior walls, cooperate with the waterproofing trade at all times, and do not break any waterproofing seal without consent of the waterproofing trade. Provide waterproof link seals as detailed on Drawings.
- .4 Provide leak plates where pipe sleeves pass through exterior building walls. Each leak plate shall be a 3.42 mm steel plate, welded to the sleeve, 100 mm diameter greater than sleeve outside diameter.
- .5 Provide 1.31 mm galvanized steel duct sleeves. Provide adequate bracing for support of sleeves during concrete and masonry work. For fire rated floors and walls, build fire damper assemblies into structure to attain fire rated construction, in a manner acceptable to the Departmental Representative.

- .6 Cover pipe sleeves in walls and ceilings of finished areas, other than Equipment Rooms, with satin finish stainless steel, or satin finish chrome or nickel plated brass escutcheons, with non-ferrous set screws. Do not use stamped steel split plates. Split cast plates with screw locks, however, may be used.
- .7 Cover exposed duct sleeves in finished areas with 1.31 mm galvanized steel plates in the form of duct collars. Fix in position with non-ferrous metal screws.

2.3 ACCESS DOORS AND PANELS

- .1 Provide access to concealed mechanical equipment and components, which require inspection, adjustment, repair and preventive maintenance. Install systems and components to result in a minimum number of access doors and panels. Install equipment and components in locations readily accessible through doors and panels.
- .2 Supply for installation by others, doors, panels and frames. Ensure that access doors and panels are properly located.
- .3 Select access doors and panels to suit Architectural finishes and large enough to provide adequate access to equipment and components. Where personnel must pass through, provide 600 mm x 450 mm minimum size doors and panels. Otherwise, provide 300 mm x 300 mm minimum size doors and panels.
- .4 Provide access doors and panels with a fire rating required by the code governing the fire rating of the structure.
- .5 In tile walls, and washroom walls, supply minimum 2.78 mm, Type 304 stainless steel with #4 finish, with recessed frame secured with stainless steel countersunk flush head screws.
- .6 For all other surfaces, supply minimum 2.66 mm welded steel, flush type with concealed hinges, lock and anchor strap, and factory prime coat finish.

3 Execution

3.1 PIPE AND EQUIPMENT INSTALLATION

- .1 Locate distribution systems, equipment and materials for maximum usable space, optimum service clearances and to accommodate current requirements and identified future expansion.
- .2 Coordinate mechanical services installation above typical floor modular ceilings to allow installation and future relocation of lights and air troffers without interfering with or requiring relocation of mechanical, electrical or other services, or removal of ceiling grid.
- .3 Include all pipe offsets required to eliminate interference with the work of other trades.
- .4 Install equipment and materials to present a neat appearance. Run piping parallel to or perpendicular to building planes. Conceal piping in finished areas. Install so as to require a minimum amount of furring.
- .5 Install pipe straight, parallel and close to walls and slab or deck underside, with specified pitch.
- .6 Use standard fittings for all direction changes. Do not use drilled tees and other field fabricated fittings.
- .7 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

- .8 Where pipe sizes differ from connection sizes of equipment, provide reducing fittings between inline components such as valves, strainers and fittings, and equipment. Reducing bushings are not permitted.
- .9 Cap open ends of piping during installation.
- .10 Lay copper tubing so that it is not in contact with dissimilar metal and will not kink or collapse.
- .11 Use non-corrosive lubricant or teflon tape and apply on male thread.
- .12 Provide brass adaptors or dielectric couplings wherever dissimilar metals are joined.
- .13 No pipe to be laid in water or when, in opinion of Departmental Representative conditions are unsuitable.
- .14 Ensure that pipe installation does not transmit vibration to the walls and floors through which they pass.
- .15 Make provisions for neat insulation finish around equipment and materials. Do not mount equipment within insulation depth.
- .16 In electrical rooms and elevator machine rooms, provide drip trays under the entire length of all pipe within the confines of the room. Pipe drip tray to nearest floor drain.
- .17 Perform pipe welding to meet ANSI B31.9.

3.2 CONNECTIONS TO EQUIPMENT

- .1 Provide unions or flanges at all connections to equipment. Ensure that piping adjacent to equipment is readily removable for servicing and/or removal of equipment without shutting down entire system.
- .2 Install unions in piping up to and including 50 mm pipe size. Install flanges in piping 65 mm pipe size and larger.
- .3 Control valves with threaded connections are to have unions at both inlet and outlet.
- .4 Prevent galvanic corrosion by isolating copper and steel. Use red brass adapters, or completely isolate flanges using full-face gaskets with bolts installed through phenolic sleeves with insulating fibre washers. Where the Plumbing Code prohibits the use of red brass adapters, use insulating couplings. Where system valves are required, solid brass isolating valves may be used in lieu of adapters or couplings.
- .5 Provide metallic code rated continuity link between flanges or unions, where pipe mains carry flammable fluids or gases.
- .6 Make all plumbing and sheet metal connections to equipment provided by the Departmental Representative.

3.3 INSERTS

- .1 Size and space for the loads to be supported.
- .2 Properly locate and firmly secure inserts to forms before concrete is poured.
- .3 Place inserts only within main structure and not in any finishing materials.
- .4 When inserts are required in precast concrete, supply inserts and location drawings to the precast concrete supplier for casting into material. Otherwise, include the cost of having the precast concrete supplier install inserts at the site.

- .5 Do not use powder actuated tools.

3.4 HANGERS

- .1 Suspend piping and equipment with all necessary hangers and supports required for a safe and neat installation. Ensure that pipes are free to expand and contract and are graded properly. Adjust each hanger to take its full share of the weight.
- .2 Suspend hanger rods directly from the structure. Do not suspend pipes or equipment from other pipes, equipment, metal work, steel deck or ceilings. Fasten to the bottom rib of structural members only.
- .3 Provide auxiliary structural steel angles, channels and beams where piping and equipment must be suspended between joists or beams.
- .4 Use galvanized rods, steel support angles, channels and beams where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.
- .5 Use space hangers to ensure that structural steel members are not over stressed. In no case shall pipe hangers be further apart than indicated in the tables. When requested, submit detailed drawings showing locations and magnitude of ductwork, piping and equipment loads on the structure. Provide calculations when requested by Departmental Representative. Space hangers so that point load on each hanger is no greater than 45kg. Minimum spacing of hangers to be 1220 mm on center.
- .6 Do not use trapeze type hangers for support of piping, without prior review by Departmental Representative. Where permitted, fabricate from angle or channel frames, and space hangers to suit the smallest pipe size.
- .7 Do not use hooks, chains or straps to support equipment and materials.
- .8 For precast concrete work, pass hanger rods between the members and weld to steel plates resting on the upper surface of the precast material. To prevent raising of the hanger rod, apply a lock nut and 50 mm minimum dia. flat washer tight against the under surface of the precast material.
- .9 Ensure that copper materials are completely isolated from ferrous materials. Use plastic or epoxy coated hangers and clamps. Use lead inserts between copper piping and other ferrous materials.
- .10 If individual point loads are greater than 45kg, provide a signed letter from the steel deck manufacturer confirming the deck is capable of supporting the load.
- .11 Provide round steel threaded rods meeting ASTM A-36. Provide cadmium plated rod and accessories where exposed to direct contact with water or to possible high humidity conditions where condensation can occur.

- .12 The following table establishes minimum standards of rod sizes and hanger spacing for steel and copper piping.

Maximum Horizontal Spacing of Supports			
Pipe Size mm	Rod Size mm	Steel m	Copper m
12	10	1.5	1.5
20	10	1.8	1.8
25	10	1.8	1.8
32	10	2.4	2.1
40	10	2.7	2.4
50	10	2.7	2.7

- .13 In addition to these basic requirements, provide hangers in the following location:
- .1 To eliminate vibration
 - .2 At points of vertical and horizontal change of direction of pipe
 - .3 At inline centrifugal pumps
 - .4 At valves and strainers
 - .5 On mains at branch takeoffs
 - .6 To avoid stress on equipment connections
- .14 Support horizontal cast iron soil pipe at each hub. Where groups of fittings occur, not more than three joints shall be between hangers.
- .15 Refer to applicable articles of the Specification regarding thermal insulation requirements. Unless shown specifically on Drawings, provide the following support methods.
- .1 For insulated domestic hot water piping, for condensate piping and for steam piping up to 65 mm diameter, support with hangers directly on piping.
 - .2 For refrigerant and domestic cold water piping, hangers shall be large enough to fit over specified pipe covering. At each point of support, install specified protection saddles with sufficient length to prevent crushing of insulation.
- .16 Generally, support ducts with 2.7 mm by 25 mm wide galvanized hangers or with 12 mm diameter rods and 40 mm rolled angle saddles to meet SMACNA or ASHRAE Standards.
- .17 Support vertical duct risers at each floor with rolled angle collars bearing on building structure.

3.5 SLEEVES, WALL PLATES, FLOOR PLATES

- .1 Set sleeves for piping and ductwork in conjunction with erection of floors and walls. Locate sleeves accurately in accordance with submittal drawings, and as follows:
- .1 Through interior walls, set sleeves flush with finished surfaces on both sides.
 - .2 Through exterior walls above grade, set sleeves flush with finished surfaces on inside and to suit flashing on outside.
 - .3 For floors in Mechanical Equipment Rooms, Janitors Closets, Kitchens and similar areas where a water dam is required, set sleeves flush to underside of structure and extending 50 mm above finished floor.
 - .4 For other floors, set sleeves flush to both finished surfaces. Refer to Room Finish Schedule.
- .2 Size sleeves to provide 25 mm clearance around insulated piping and ductwork.

- .3 Provide continuous insulation runs through fire separations. Ensure that piping does not touch sleeves or for domestic hot water piping terminate insulation cover on each side of sleeve. For domestic cold water piping, provide same thickness high density insulation with all purpose vapour barrier jacket through fire separation to a point 100 mm on each side of fire separation.
 - .4 Install leak tight seals to meet the manufacturer's requirements. Select the inside diameter of each wall sleeve opening to fit the pipe and leak tight seal, all to ensure watertight joint.
 - .5 Additional sleeving requirements:
 - .1 Provide sleeves for systems not part of Contract, but identified to be required on Drawings.
 - .2 Provide sleeves to accommodate wiring conduits required for Division 20 - Mechanical General Requirements through Division 25 - Integrated Automation work.
 - .3 Provide additional sleeves as required by Drawings to accommodate service requirements. Include for the cost of drilling and setting sleeves.
 - .4 Fill unused sleeves through fire separations with firestop material (see Firestopping article 3.7). Fill other unused sleeves with suitable noncombustible materials.
- 3.6 FIRESTOPPING
- .1 All mechanical penetrations to be firestopped by Section 07 84 00 - Firestopping.
 - .2 Mechanical contractor is responsible for verifying size, type and number of locations required for mechanical systems and advising firestopping contractor.
- 3.7 PAINTING
- .1 Supply ferrous metal work except piping and galvanized and stainless steel ductwork, with at least one factory prime coat, or paint one prime coat on job.
 - .2 Clean and steel brush surfaces with welds. Then prime coat all steel supports and brackets.
 - .3 On uninsulated piping, steel brush and prime coat welds.
 - .4 Touch up or repaint all surfaces damaged during shipment or installation and leave ready for finish painting.
 - .5 Prime coat material shall conform to Canadian General Standards Board Standard No. 1-GP-48.
 - .6 Finish painting will be provided by Division 9 - Finishes.

END OF SECTION

1 General

1.1 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.60-M89, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data to include manufacturer's material description.

2 Products

2.1 MANUFACTURER'S EQUIPMENT PLATES

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

2.2 SYSTEM NAMEPLATES

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

Size #	Dimensions (mm x mm)	No. of Lines	Letter Height (mm)
1	9 x 50	1	3
2	12 x 75	1	5
3	12 x 75	2	3
4	19.0 x 100	1	8
5	19.0 x 100	1	8
6	19.0 x 100	2	5
7	25 x 125	1	12
8	25 x 125	2	8
9	40 x 100	1	19

- .2 Use maximum of 25 letters/numbers per line.

- .3 Terminal cabinets, control panels: Use size #6.
- .4 Equipment in Mechanical Rooms: Use size #9.
- .5 Reheat coils, fans, etc., located above suspended ceilings to be identified via nameplates secured to the room side of the T-bar grid or drywall ceiling access door directly below the applicable equipment: Use size #6.

2.3 IDENTIFICATION OF PIPING SYSTEMS (EXISTING AND NEW SYSTEMS)

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 All other pipes: Pressure sensitive plastic-coated cloth with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.
- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from the Departmental Representative.
 - .2 Colours for legends, arrows: The following table is provided as an example, Contractor shall coordinate with the Departmental Representative to match existing identification used in the existing facility:

Background Color	Legend, Arrows
Yellow	Black
Green	White
Red	White

- .3 Background colour marking and legends for piping systems: The following table is provided as an example. The Contractor shall coordinate with the departmental representative to match existing identification used in the existing facility:

Contents Marking	Background Color	Legend
Domestic hot water	Green	DHW
Domestic hot water return	Green	DHWR
Domestic cold water	Green	DCW
Sanitary	Green	SAN
Sanitary Vent	Green	SAN VENT
Heating Water Supply	Yellow	HWS
Heating Water Return	Yellow	HWR

2.4 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.5 LANGUAGE

- .1 Identification to be in English.

3 Execution

3.1 TIMING

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

3.2 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.

3.3 NAMEPLATES

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

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas, equipment rooms, galleries, tunnels: At not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification to be easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

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

END OF SECTION

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 QUALIFICATIONS OF TAB PERSONNEL

- .1 Names of all personnel it is proposed to perform TAB to be submitted to and approved by Departmental Representative within 60 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.

1.3 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.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.5 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.

1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to 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 Departmental Representative in writing all proposed procedures which vary from standard.
- .3 During construction, coordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Divisions 20 through 25.

1.8 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.9 START OF TAB

- .1 Notify Departmental Representative seven (7) days prior to start of TAB.
- .2 Start TAB only when renovation 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 in Divisions 20 through 25.
 - .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 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 All outlets installed, volume control dampers open.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: $\pm 5\%$.
 - .2 Hydronic systems: $\pm 10\%$.

1.11 ACCURACY TOLERANCES

- .1 Measured values to be accurate to within $\pm 2\%$ of actual values.

1.12 SUBMITTALS

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

1.13 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of 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.

1.14 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 two (2) copies of TAB Report to Departmental Representative for verification and approval, in English, in D-ring binders, complete with index tabs.

1.15 VERIFICATION

- .1 All reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30% of all reported results.
- .3 Number and location of verified results to be at discretion of Departmental Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.16 SETTINGS

- .1 After TAB is completed to satisfaction of 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.

1.17 COMPLETION OF TAB

- .1 TAB to be considered complete only when final TAB Report received and approved by Departmental Representative.

1.18 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 Division 20 - Mechanical General Requirements through Division 25 - Integrated Automation.
- .3 Qualifications: personnel performing TAB to be current member in good standing of AABC.
- .4 Quality assurance: Perform TAB under direction of supervisor qualified to standards of AABC.
- .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, dew point), 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:
- .7 Inlet and outlet of each damper, filter, coil, humidifier, fan, other equipment causing changes in conditions.
- .8 At each controller, controlled device.

- .9 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).

- 2 Products

 - 2.1 NOT USED

 - .1 Not Used.

- 3 Execution

 - 3.1 NOT USED

 - .1 Not Used.

END OF SECTION

1 General

1.1 REFERENCES

- .1 ASTM International (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 33 00 - Submittal Procedures.
- .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.

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 C411.
- .3 Temperatures listed for fluid are approximate. Verify final operating temperatures and apply thicknesses as listed under relevant insulation type.

2.2 P-1 FORMED MINERAL FIBER TO 205°C

- .1 Application: for piping, valves and fittings on:
 - .1 Domestic hot water, temperature 60°C.
- .2 Materials:
 - .1 CGSB 51-GP-9M, rigid mineral fiber sleeving for piping.
 - .2 Thermal Conductivity "k" shall not exceed 0.034 W/m.°C at 24°C mean temperature when tested in accordance with ASTM C335. Thickness:

Fluid Temperature °C	Nominal Pipe Sizes (NPS)thickness (mm)			
	1 and under	1-1/4-2	2-1/2-4	5 & Over
151-200	64	64	76	89
121-150	51	64	64	76
96-120	38	38	51	51
51-95	25	25	38	38
30-50	25	25	25	25
Condensate Returns	25	38	51	51

2.3 P-2 FORMED MINERAL FIBER WITH VAPOUR BARRIER TO 85°C

- .1 Application: for piping, valves and fittings on:
 - .1 Domestic cold water, temperature 4°C.
- .2 Material:
 - .1 CGSB 51-GP-9M, rigid mineral fiber sleeving for piping and CGSB 51-GP-52Ma, vapour barrier jacket and facing material.
 - .2 Thermal Conductivity "k" shall not exceed 0.034 W/m.° C at 24°C mean temperature when tested in accordance with ASTM C335. Thickness:

Fluid Temperature °C	Nominal Pipe Sizes (NPS)thickness (mm)			
	1 and under	1-1/4-2	2-1/2-4	5 & Over
51-85	25	25	38	38
30-50	25	25	25	25
5-29	13	25	25	25
below 5	25	38	38	38

2.4 FASTENINGS

- .1 For insulation systems P-1, P-2.
 - .1 Tape: self adhesive, ULC labelled for less than 25 flame spread and less than 50 smoke developed.
 - .2 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.
 - .3 Lagging adhesive: fire retardant coating.

2.5 INSULATION CEMENT

- .1 To CAN/CGSB-51.12.

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 On piping with insulation and vapour barrier, install high density insulation under hanger shield. Maintain integrity of vapour barrier over full length of pipe without interruption at sleeves, fittings and supports.
- .5 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 Preformed: sectional up to NPS 12, sectional or curved segmented above NPS 12.
- .2 Multi-layered: staggered butt joint construction.
- .3 Vertical pipe over NPS 3: insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter, locate on 4.5 m centres.
- .4 Expansion joints in insulation: terminate single layer and each layer of multiple layers in straight cut at intervals recommended by manufacturer. Leave void of 25 mm between terminations. Pack void lightly with flexible mineral insulation.
- .5 Seal and finish exposed ends and other terminations with insulating cement.
- .6 Expansion joints in piping: provide for adequate movement of expansion joint without damage to insulation or finishes.
- .7 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.
- .8 Insulation is not required for:
 - .1 Chrome plated piping, valves and fittings.
 - .2 Drain Valves.

3.3 FASTENINGS

- .1 Secure pipe insulation by tape at each end and centre of each section, but not greater than 900 mm on centres.

END OF SECTION