

**Part 1            General**

**1.1            ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Product Data:
  - .1    Submit manufacturer's instructions, printed product literature and data sheets for materials of Division 23 and include product characteristics, performance criteria, physical size, finish and limitations.
- .2    Shop Drawings:
  - .1    Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2    Indicate on drawings:
    - .1    Mounting arrangements.
    - .2    Operating and maintenance clearances.
  - .3    Shop drawings and product data accompanied by:
    - .1    Detailed drawings of bases, supports, and anchor bolts.
    - .2    Manufacturer to certify current model production.
    - .3    Certification of compliance to applicable codes.
  - .4    In addition to transmittal letter: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

**1.2            CLOSEOUT SUBMITTALS**

- .1    Operation and Maintenance Data: submit operation and maintenance data for materials of Division 22 for incorporation into manual.
  - .1    Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
  - .2    Operation data to include:
    - .1    Description of systems and their controls.
    - .2    Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .3    Operation instruction for systems and component.
    - .4    Description of actions to be taken in event of equipment failure.
    - .5    Valves schedule and flow diagram.
    - .6    Colour coding chart.
  - .3    Maintenance data to include:
    - .1    Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    - .2    Data to include schedules of tasks, frequency, tools required and task time.
  - .4    Performance data to include:
    - .1    Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
    - .2    Equipment performance verification test results.
    - .3    Special performance data as specified.
  - .5    Approvals:

- .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
- .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
  - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Departmental Representative for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

### 1.3 MAINTENANCE MATERIAL SUBMITTALS

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

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect plumbing materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roof drain installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 PAINTING REPAIRS AND RESTORATION**

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

**3.3 SYSTEM CLEANING**

- .1 Clean interior and exterior of all systems.

**3.4 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

**3.5 DEMONSTRATION**

- .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 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

**3.6 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse and recycling.

**3.7 PROTECTION**

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

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

**1.2            DELIVERY, STORAGE AND HANDLING**

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

**Part 2            Products**

**2.1            MATERIAL**

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
  - .1 Primers, Paints, Coating: In accordance with manufacturer's recommendations for surface conditions.
- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

**Part 3            Execution**

**3.1            APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

**3.2            CLEARANCES**

- .1 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

**3.3            DRAINS**

- .1 Install piping with grade in direction of flow except as indicated.

**3.4            DIELECTRIC COUPLINGS**

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: isolating flanges.

**3.5            PIPEWORK INSTALLATION**

- .1 Screwed fittings jointed with Teflon tape.

- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
  - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

### 3.6

#### SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
  - .2 Other floors: terminate 25 mm above finished floor.
  - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere:
    - .1 Provide space for firestopping.
    - .2 Maintain fire rating integrity.
  - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
  - .4 Ensure no contact between copper pipe or tube and sleeve.

**3.7 PREPARATION FOR FIRE STOPPING**

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

**3.8 EXISTING SYSTEMS**

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval by Departmental Representative 5 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

**3.9 CLEANING**

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1 American Welding Society (AWS)
  - .1 AWS C1.1M/C1.1-2012, Recommended Practices for Resistance Welding.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
  - .2 CSA-W117.2-12, Safety in Welding, Cutting and Allied Processes.
  - .3 CSA W178.1-14, Certification of Welding Inspection Organizations.
  - .4 CSA W178.2-14, Certification of Welding Inspectors.

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

**1.3                QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Welders:
    - .1 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
    - .2 Submit welder's qualifications to Departmental Representative.
    - .3 Each welder to possess identification symbol issued by authority having jurisdiction.
  - .2 Inspectors:
    - .1 Inspectors qualified to CSA W178.2.
  - .3 Certifications:
    - .1 Copy of welding procedures available for inspection.
    - .2 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .1 Packaging Waste Management: remove for reuse.

**Part 2            Products**

**2.1                ELECTRODES**

- .1 Electrodes: in accordance with CSA W48 Series.

**Part 3 Execution**

**3.1 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

**3.2 QUALITY OF WORK**

- .1 Welding: using procedures conforming to AWS C1.1 and applicable requirements of provincial authority having jurisdiction.

**3.3 INSTALLATION REQUIREMENTS**

- .1 Identify each weld with welder's identification symbol.
- .2 Backing rings:
  - .1 Where used, fit to minimize gaps between ring and pipe bore.
  - .2 Do not install at orifice flanges.
- .3 Fittings:
  - .1 NPS 2 and smaller: install welding type sockets.
  - .2 Branch connections: install welding tees or forged branch outlet fittings.

**3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS**

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

**3.5 SPECIALIST EXAMINATIONS AND TESTS**

- .1 General:
  - .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Departmental Representative.
  - .2 To requirements of authority having jurisdiction.
  - .3 Inspect and test 20% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.
- .2 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .3 Failure of visual examinations:
  - .1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative.

**3.6 REPAIR OF WELDS WHICH FAILED TESTS**

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

**3.7 CLEANING**

- .1 Waste Management: separate waste materials for reuse and recycling.

**END OF SECTION**

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**Part 1            General**

**1.1            REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-24.3-92, Identification of Piping Systems.

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
- .2 Product data to include paint colour chips, other products specified in this section.

**1.3            QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

**1.4            DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling.
  - .2 Dispose of unused paint and coating material at official hazardous material collections site approved by Departmental Representative.
  - .3 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

**Part 2            Products**

**2.1            MANUFACTURER'S EQUIPMENT NAMEPLATES**

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

**2.2            SYSTEM NAMEPLATES**

- .1 Colours:
  - .1 Hazardous: red letters, white background.

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

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
5	20 x 100	2	5

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
  - .1 Terminal cabinets, control panels: use size # 5.
- .5 Identification for PWGSC Preventive Maintenance Support System (PMSS):
  - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
  - .2 Sizes: as appropriate.

### 2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

### 2.4 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

### 2.5 LANGUAGE

- .1 Identification in English and French.
- .2 Use one nameplate and label for both languages.

## 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 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Identify systems, equipment to conform to PWGSC PMSS.

**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.

**3.4 CLEANING**

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM B209M-14, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
  - .2 ASTM C335-10e1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .4 ASTM C547-12, Mineral Fiber Pipe Insulation.
  - .5 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .5 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S702-09, Thermal Insulation, Mineral Fibre, for Buildings
  - .3 CAN/ULC-S702.2-10, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

**1.2                DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet. Include product characteristics, performance criteria, and limitations.

- .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .2 Shop Drawings:
  - .1 Submit shop drawings.
- .3 Quality assurance submittals:
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.

**1.4 QUALITY ASSURANCE**

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.
- .3 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling.
  - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
  - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
  - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

**Part 2 Products**

**2.1 FIRE AND SMOKE RATING**

- .1 In accordance with CAN/ULC-S102.
  - .1 Maximum flame spread rating: 25.

- .2 Maximum smoke developed rating: 50.

## 2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to CAN/ULC-S702, ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702, ASTM C547.

## 2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

## 2.4 CEMENT

- .1 Thermal insulating and finishing cement:
  - .1 Air drying on mineral wool, to ASTM C449/C449M.

## 2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

## 2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

## 2.7 JACKETS

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
  - .2 Lagging adhesive: compatible with insulation.
- .2 Aluminum:
  - .1 To ASTM B209.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: smooth.
  - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

**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 PRE-INSTALLATION REQUIREMENT**

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

**3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

**3.4 PIPING INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: C-2 with vapour retarder jacket.
  - .1 Insulation securements: tape
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .3 Thickness of insulation as listed in following table.
  - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
  - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
		Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8
RWL and RWP	C-2	25	25	25	25	25	25

- .4 Finishes:
  - .1 Exposed indoors: aluminum jacket.
  - .2 Concealed, indoors: canvas on valves, fittings. No further finish.
  - .3 Finish attachments: SS bands, at 150 mm on centre. Seals: closed.
  - .4 Installation: to appropriate TIAC code CRF/1 through CPF/5.

**3.5**

**CLEANING**

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**Part 1 General**

**1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for materials of Division 22 and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.2 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect plumbing materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .1 Develop Construction Waste Management Plan related to Work of this Section.
- .2 Packaging Waste Management: remove for reuse.

**Part 2 Products**

**2.1 THERMOSTAT (LINE VOLTAGE)**

- .1 Line voltage wall thermostat:
  - .1 Temperature setting range: 5 degrees C to 25 degrees C.
  - .2 With sub-base.
  - .3 As indicated on drawings.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
  - .1 Waste Management: separate waste materials for reuse and recycling.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASME
  - .1 ANSI/ASME B16.4-2011, Gray-Iron Threaded Fittings Classes 125 and 250.
  - .2 ANSI/ASME B16.15-2013, Cast Copper Alloy Threaded Fittings Classes 125 and 250.
  - .3 ANSI B16.18-2012, Cast Copper Alloy, Solder Joint Pressure Fittings.
  - .4 ANSI/ASME B16.22-2013, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 30- Health and Safety.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
- .2 Submit 2 copies of operation and maintenance manual.

**1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial regulations.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect hydronic materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse.

**Part 2 Products**

**2.1 FITTINGS**

- .1 Cast bronze threaded fittings: to ANSI/ASME B16.15.
- .2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.
- .3 Cast iron threaded fittings: to ANSI/ASME B16.4.
- .4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roof drain installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 MANUFACTURER'S INSTRUCTIONS**

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

**3.3 PIPING INSTALLATION**

- .1 Assemble piping using fittings manufactured to ANSI standards.

**3.4 FIELD QUALITY CONTROL**

**3.5 CLEANING**

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse and recycling.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.1-2010, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
  - .2 ASME B16.3-2011, Malleable Iron Threaded Fittings: Classes 150 and 300.
  - .3 ASME B16.5-2013, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.
  - .4 ASME B16.9-2012, Factory-Made Wrought Buttwelding Fittings.
- .2 ASTM International
  - .1 ASTM A47/A47M-99(2014), Standard Specification for Ferritic Malleable Iron Castings.
- .3 CSA International
  - .1 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3                CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect hydronic materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse.

**Part 2 Products**

**2.1 PIPE JOINTS**

- .1 NPS 2 and under: screwed fittings with PTFE tape.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

**2.2 FITTINGS**

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
  - .1 Cast iron: to ASME B16.1, Class 125.
  - .2 Steel: to ASME B16.5.
- .3 Butt-welding fittings: steel, to ASME B16.9.
- .4 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roof drain installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 CLEANING**

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse and recycling.

**3.3 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by hydronic systems installation.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International
  - .1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
  - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Test and Evaluation Reports:
  - .1 Certification of Ratings:
    - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect plumbing materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse.

**Part 2 Products**

**2.1 SEAL CLASSIFICATION**

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C

- .2 Seal classification:
  - .1 Class C: transverse joints and connections made air tight with gaskets, sealant, tape, or combination thereof. Longitudinal seams unsealed.
  - .2 Unsealed seams and joints.

## 2.2 SEALANT

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

## 2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

## 2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

## 2.5 FITTINGS

- .1 Fabrication: to SMACNA.

## 2.6 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to ASHRAE.
- .3 Joints: to ASHRAE.

## 2.7 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
  - .1 Maximum size duct supported by strap hanger: 500.
- .2 Hanger configuration: to SMACNA.
- .3 Hangers: black steel angle with black steel rods to ASHRAE:
- .4 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts.
  - .2 For steel joist: manufactured joist clamp.
  - .3 For steel beams: manufactured beam clamps:

## Part 3 Execution

### 3.1 EXAMINATION

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

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 GENERAL**

- .1 Do work in accordance with ASHRAE and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
  - .1 Insulate strap hangers 100 mm beyond insulated duct.

**3.3 HANGERS**

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: as indicated.

**3.4 SEALING AND TAPING**

- .1 Apply sealant in accordance to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

**3.5 CLEANING**

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse and recycling.

**END OF SECTION**

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**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 23 09 33 - Electric and Electronic Control System for HVAC.

**1.2 REFERENCES**

- .1 CSA Group
  - .1 CSA C22.2 No.46-13, Electric Air-Heaters.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for cabinet convector heaters and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Include:
    - .1 Mounting methods.
    - .2 kW rating, voltage, phase.
    - .3 Cabinet material thicknesses.
    - .4 Colour.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for cabinet convector heaters for incorporation into manual.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect convectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .3 Develop Construction Waste Management Plan related to Work of this Section.
- .4 Packaging Waste Management: remove for reuse.

**Part 2 Products**

**2.1 CABINET CONVECTOR HEATERS**

- .1 Wall mounted cabinet: to CSA C22.2 No.46, surface-mount:
  - .1 Front inlet/front outlet.

- .2 Front panel: 1.2 mm thick, steel.
- .3 Finish: phosphatized and finished with 2 coats powder coated finish, white.
- .2 Elements: mineral insulated with steel sheath and welded fins, secured and free-floating for expansion.

## 2.2 CONTROLS

- .1 Wall mounted thermostats: type electronic digital, line voltage to Section 23 09 33 - Electric and Electronic Control System for HVAC.

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roof drain installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### 3.2 INSTALLATION

- .1 Install cabinet convectors as indicated.
- .2 Install wall mounted thermostats in locations indicated.
- .3 Make power and control connections.

### 3.3 FIELD QUALITY CONTROL

- .1 Tests:
  - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

### 3.4 CLEANING

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse and recycling.

**END OF SECTION**