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**PART 1        GENERAL**

**1.1            RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .3      Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .4      Section 23 05 53.01 – Mechanical Identification.

**1.2            REFERENCES**

- .1      American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1      ANSI/ASHRAE/IESNA 90.1 SI, Energy Standard for Buildings except Low-Rise Residential Buildings.
- .2      American Society for Testing and Materials (ASTM International)
  - .1      ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
  - .2      ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3      ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4      ASTM C449/C449M, Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5      ASTM C533, Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  - .6      ASTM C547, Specification for Mineral Fiber Pipe Insulation.
  - .7      ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .8      ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .9      ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .10     ASTM C921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3      Canadian General Standards Board (CGSB)
  - .1      CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2      CGSB 51-GP-53M, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

- .4 Thermal Insulation Association of Canada (TIAC)
  - .1 National Insulation Standards.
- .5 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .6 Model National Energy Code of Canada for Buildings (MNECB).

### **1.3 PRODUCT DATA**

- .1 Submit Product Data in accordance with Section 01 33 00 - Submittal Procedures.

### **1.4 SAMPLES**

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

### **1.5 MANUFACTURER'S INSTRUCTIONS**

- .1 Submit manufacturer's installation instructions in accordance with 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

### **1.6 QUALIFICATIONS**

- .1 Installer to be certified in performing work of this section, and have at least 5 years successful experience in this size and type of project, qualified to standards of TIAC.

### **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions recommended by manufacturer.

## **1.8 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by Owner's Representative.
- .5 Divert unused adhesive materials from landfill to official hazardous material collections site approved by Owner's Representative.
- .6 Do not dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

## **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: includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.
  - .1 Mineral fibre: ASTM C547.
  - .2 Maximum "k" factor: ASTM C547.
- .4 TIAC Code A-2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
  - .1 Insulation: ASTM C533.
  - .2 Maximum "k" factor: ASTM C533.
  - .3 Design to permit periodic removal and re-installation

- .5 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: ASTM C547.
- .6 TIAC Code A-6: Flexible unicellular tubular elastomer.
  - .1 Insulation: with vapour retarder jacket to ASTM C534.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: C534.
  - .4 Certified by manufacturer free of potential stress corrosion cracking corrodants.
  - .5 Flame spread index less than 25, and smoke developed index less than 50.
- .7 TIAC Code C-1: Rigid mineral fibre board, unfaced.
  - .1 Mineral fibre: ASTM C612.
  - .2 Maximum "k" factor: ASTM C612.
- .8 TIAC Code C-2: Mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: ASTM C553.
- .9 TIAC Code C-4: Rigid mineral fibre board faced with factory applied vapour retarder jacket.
  - .1 Mineral fibre: ASTM C612.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: ASTM C612.

## **2.3 CEMENT**

- .1 Thermal insulating and finish
  - .1 To: ASTM C449/C449M.
  - .2 Hydraulic setting or air drying on mineral wool, to ASTM C449.

## **2.4 JACKETS**

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.
  - .2 Colours: to match adjacent finish paint. Confirm with Owner's Representative.
  - .3 Minimum service temperatures: -20°C.
  - .4 Maximum service temperature: 65°C.

- .5 Moisture vapour transmission: 0.02 perm.
- .6 Thickness: 0.56 mm.
- .7 Fastenings:
  - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks.
  - .3 Pressure sensitive vinyl tape of matching colour.
- .8 Special requirements:
  - .1 Indoor: flame spread rating 25. Smoke developed 50.
  - .2 Outdoor: UV rated material at least 0.5 mm thick.
- .9 Covering adhesive: Compatible with insulation.
- .2 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.
- .3 Aluminum:
  - .1 To ASTM B209.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: Stucco embossed or corrugated.
  - .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.
- .4 Stainless steel:
  - .1 Type: 304 or 316.
  - .2 Thickness: 0.25 mm.
  - .3 Finish: Smooth, corrugated or stucco embossed.
  - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.50 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.

## **2.5 REMOVABLE INSULATION COVERS**

- .1 General:
  - .1 All Covers shall be sewn, stapled or "hog-ringed" covers shall not be acceptable.
  - .2 Covers shall conform to the configuration of the items being insulated.

- .3 Covers shall include openings for all protrusions such as pipes, packing glands on valves and expansion joints, hangers, supports, instrument lines, and other appurtenances.
- .4 Covers shall be designed so that no force bending or folding of the cover is necessary for installation.
- .5 Minimum 50mm wide flaps at terminal ends are to be provided to overlap adjacent covers to ensure a good heat seal.
- .6 Parting seems shall be at the installed low points (gravitational bottom) of the cover to allow drainage without the use of weep tubes or grommets.
- .7 Valve bonnets are to be covered, but packing glands shall remain exposed.
- .8 Valve covers are to be designed such that the bonnet section is sewn to the body section. For larger valves, the cover may be fabricated in two sections, each section containing one half of the valve body and bonnet.
- .9 Covers with a weight of 18.1 Kg or less are to be fabricated in one piece.
- .10 Covers with a weight of more than 18.1 Kg are to be fabricated in more than one piece.
- .2 Insulation Core:
  - .1 The insulation core shall be fabricated in one piece, wherever possible.
  - .2 To prevent insulation settlement, the insulation core shall be secured within the jacket through the weather barrier (outer jacketing), the insulation, and the liner (inner jacketing).
  - .3 Insulating cores with more than one piece shall have staggered joints to prevent hot spots and heat loss. The joint edges shall be butted together and extra securement provided at those edges.
  - .4 Insulation core shall be comprised of 50mm thick fiberglass insulation of non-combustible wool with resilient inorganic glass fibers bonded with a thermosetting resin. Insulation density to be 38 Kg/m<sup>3</sup>. Insulation thermal conductivity to be 0.044W/m.°C at a mean temperature of 100°C.
- .3 Jacket:
  - .1 The jacket shall be fabricated in one piece, wherever possible.
  - .2 Gusset walls shall be required for covers with core insulation thickness in excess of 25mm.
  - .3 All seams, except the final closing seam, shall be inside seams. The jackets are to be sewn inside out, then turned correct side out before inserting the insulation core. The final closing seam shall be sewn on the exterior of the jacket. Seams shall be sewn with Teflon® coated fiberglass thread or Kevlar® coated stainless steel thread.
  - .4 Machine stitching shall be used for all sewing. Sewing shall be 6-8 stitches per centimeter.
  - .5 Draw cords are to be placed along the outer edge of the flap and the outer edge of the flap then rolled back inside and double stitched.

- .6 Draw cords are to be of sufficient length to allow 150mm of cord to protrude from each side of the flap.
- .7 The inner and outer jacket shall be comprised of a fiberglass fabric impregnated with silicone rubber. The silicone rubber shall be flame retardant and suitable for high temperature usage. Outer jacket density shall be 595 gms/m<sup>2</sup>.
- .4 Securement devices:
  - .1 The securement belts and D-ring belts shall be of the same material as the weather barrier (exterior jacket).
  - .2 The belts shall be placed 50mm back from the parting seams and on 150mm centers.
  - .3 Fire retardant Velcro® shall be used to fasten the securement belt to the weather barrier after the belt passed through the Stainless Steel D-rings.
- .5 Identification tags:
  - .1 Each cover shall be identified by a permanently attached stainless steel tag.
  - .2 An identification legend shall be mechanically embossed into the tag.
  - .3 The tags shall be located in the same areas on similar type covers.
  - .4 Should a cover require more than one piece for its construction, each piece to be identified and numbered (i.e. 1 of 3).
  - .5 Each tag shall include at least the following information, but may also include any pertinent information required by the end user.
    - .1 Type of item being covered.
    - .2 Location of item.
    - .3 Recording and tracking information.
- .6 Warranty:
  - .1 Provide a 5-year product Warranty
- .7 Acceptable manufacturers:
  - .1 Advanced Industrial Systems Inc., Thermo Help Canada Inc., Advanced Thermal Corp.

## 2.6 INSULATION SECUREMENTS

- .1 Tape: Self-adhesive, aluminum, reinforced, 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.
- .6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation.

- .7 Fasteners: 4 mm diameter pins with 35 mm diameter or square clips. Length of pin to suit thickness of insulation.

## **2.7 VAPOUR RETARDER LAP ADHESIVE**

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

## **2.8 INDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.

## **2.9 OUTDOOR VAPOUR RETARDER MASTIC**

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.

# **PART 3 EXECUTION**

## **3.1 PRE- INSTALLATION REQUIREMENTS**

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

## **3.2 INSTALLATION**

- .1 Install in accordance with TIAC National Standards
  - .1 Hot equipment: To TIAC code 1503-H.
  - .2 Cold equipment: to TIAC code 1503-C or 1503-CA.
- .2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.
- .3 Provide vapour retarder as recommended by manufacturer.
- .4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.
- .5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports outside vapour retarder jacket.



.7 Supports, Hangers:

- .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

**3.3 EQUIPMENT INSULATION SCHEDULES**

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 Hot Equipment:

- .1 TIAC code A-1 or C-1 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
- .2 TIAC code A-2 with 25 mm air gap, mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
- .3 TIAC code C-2 unfaced with wire or bands and 13 mm cement precede by one layer of reinforcing mesh.
- .4 Thicknesses:
  - .1 Domestic hot water storage tanks 25 mm
  - .2 Shell and tube heat exchangers 50 mm
  - .3 Steam condensate receivers 50 mm
  - .4 Deaerator-feedwater heaters 50 mm
  - .5 Chilled and hot water buffer tanks

.3 Breechings, engine exhausts and mufflers:

- .1 TIAC code A-2 with 25 mm air gap, mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
- .2 Cement reinforced with one layer of reinforcing mesh.

.4 Cold equipment:

- .1 TIAC A-3 or C-4 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.
- .2 TIAC C-2 faced with vapour retardant jacket and with wire or bands and 13 mm cement preceded by one layer of reinforcing mesh.
- .3 TIAC A-6 or C-4 with mechanical fastenings or wire or bands, adhesive.
  - .1 Thicknesses: Chillers (except factory insulated) 50 mm A-3, A-6 or C-4.

.5 Finishes:

- .1 Engine exhaust piping and muffler: To TIAC code CEF-4.
- .2 Equipment in mechanical rooms: TIAC code CEF/1 with aluminum jacket.
- .3 Equipment elsewhere: TIAC code CEF/2 with 13 mm cement and canvas jacket.

**3.4 REMOVABLE INSULATION COVERS**

- .1 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

- .2 Removable insulation covers shall be provided for the following:
  - .1 Domestic water service entrance backflow preventer.
  - .2 Domestic water service entrance pressure reducing valve assembly.
  - .3 Domestic water service entrance O.S. & Y gate valve.
  - .4 Domestic water service entrance copper connection butterfly valves NPS 2½ and larger.
  - .5 Domestic water service entrance wye –strainer.
  - .6 Domestic hot water service pump assemblies.
  - .7 Hydronic heating and chilled water system pump assemblies:-pumps, suction diffusers, triple duty valves.
  - .8 Hydronic heating and chilled water system valves NPS 2½ and larger -gate, globe and butterfly.
  - .9 Hydronic heating and chilled water system flex connections, expansion joints.
  - .10 Hydronic heating and chilled water system expansion tanks.
  - .11 Hydronic heating and chilled water system air separators.
  - .12 Hydronic heating and chilled water system plate and frame heat exchangers.
  - .13 Hydronic heating and chilled water system shell and tube heat exchangers removable heads.
  - .14 Balancing valves NPS 2½ and above.
  - .15 Two-Way Control valves NPS 2½ and larger.
  - .16 Three-Way Control valves NPS 2½ and larger.

**END OF SECTION**