.1 Appendix C.1 - Thermal Insulation for Piping

Use this Section to specify requirements for Piping and Equipment Insulation. This Master Specification Section contains:

.1 This Cover Sheet

.2 Specification Section Text:

1. General

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1.3 Product Options and Substitutions
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2. Products

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3.4 Engine Exhaust Insulation Application
3.5 Cold Pipe Insulation Application
3.6 Cold Equipment Insulation Application
3.7 Insulation Type Thickness Schedule

Consider carefully all requirements relating to recovering of exposed insulation surfaces. Specify recovering materials as follows:

.1 Canvas: if surfaces are to be painted.
.2 PVC: if surfaces are subject to damage or abuse.
.3 Aluminum: if surfaces are subject to damage or abuse or where appearance is important.

END OF DATA SHEETS

GENERAL

1.1 RELATED REQUIREMENTS

1. Mechanical General Requirement

1.2 REFERENCE DOCUMENTS

1. American Society for Testing and Materials (ASTM):

.1	ASTM C411 05	Hot Surface Performance of High Temperature Thermal Insulation
.2	ASTM E84 10b	Surface Burning Characteristics of Building Materials

2. American Society of Testing and Materials (ASTM)

C549	Specification for Perlite Loose Fill Insulation
C578	Specification for Rigid, Cellular Polystyrene Thermal Insulation
E90	Standard Test Method for Laboratory measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
E119	Test Method for Fire Tests of Building Construction and Materials
E136	Test Method for Behavior of Material in a Vertical Tube Furnace at 750 Degrees C.

3. Underwriters Laboratories, Inc. (UL)

   Fire Resistance Directory

4. National Fire Protection Association (NFPA):

.1	NFPA 255 2006	Method of Test of Surface Burning Characteristics of Building Materials Underwriter Laboratories Canada (ULC)
.2	CAN/ULC S102 10	Surface Burning Characteristics of Building Materials and Assemblies

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

1. Refer to Division 01 for requirements pertaining to product options and substitutions.

1.4 SHOP DRAWINGS AND PRODUCT DATA

1. Comply with requirements of Section 20 00 13.
2. Submit an insulation schedule. For each application include the following information:
   - .1 Materials
   - .2 "k" value
   - .3 Thickness
   - .4 Density
   - .5 Finish
   - .6 Jacketing
3. Submit product data and test reports when requested to substantiate that insulation and recovery assemblies meet flame/smoke development ratings and performance requirements for the assembly and thickness used.

1.5 DEFINITIONS

1. For the purposes of this Section, the following definitions apply:
   - .1 Concealed: piping systems and equipment in trenches, shafts, furring, and suspended ceilings.

.2 Exposed: piping systems and equipment in mechanical rooms or otherwise not "concealed".

.3 "k" Value: thermal conductivity of insulating material per unit of thickness (W/m°C).

1.6 FLAME/SMOKE DEVELOPMENT RATINGS

1. Pipe insulations, recovery materials, tapes, vapour retarder facings and adhesives shall have maximum flame spread rating of 25 and maximum smoke developed rating of 100 except in plenum spaces and air handling systems where maximum smoke development rating shall be 50, when tested in accordance with CAN/ULC-S102, NFPA 255, or ASTM E84.

SPEC NOTE: Specify smoke development of 50 when a building is classified as a "high rise".

2. Insulating materials and accessories shall withstand service temperatures without smoldering, glowing, smoking or flaming when tested in accordance with ASTM C411.

2. Products

2.1 HOT PIPE INSULATION

1. Hot Pipe Insulation - Mineral Fibre:

   .1 Material: formed rigid mineral fibre insulation sleeving.

   .2 "k" Value: maximum 0.035 W/m°C at 24°C mean temperature.

   .3 Service Temperature: up to 150°C.

   .4 Jacket: factory applied general purpose jacket.

2. Hot Pipe Insulation - Black Rubber:

   .1 Material: flexible elastomeric unicellular preformed pipe covering.

   .2 "k" Value: 0.04 W/m. °C at 24°C mean temperature.

   .3 Service Temperature: up to 100°C.

   .4 Maximum Allowable Thickness: 25 mm.

2.2 HOT EQUIPMENT INSULATION

1. Hot Equipment Insulation - Flat Surfaces:

   .1 Material: rigid mineral fibre.

   .2 "k" Value: maximum 0.035 W/m°C at 24°C mean temperature.

   .3 Service Temperature: 20°C to 120°C.

2. Hot Equipment Insulation - Curved Surfaces:

   .1 Material: mineral fibre blanket.

   .2 "k" Value: maximum 0.035 W/m°C at 24°C mean temperature.

   .3 Service Temperature: 20°C to 120°C.

2.3 ENGINE EXHAUST INSULATION

1. Material: formed rigid hydrous calcium silicate for piping (however where extremely high temperatures are required it may be necessary to consider refactory fibre).

2. "k" Value: maximum 0.059 W/m°C at 93°C mean temperature.

3. Service Temperature: up to 750°C.

2.4 COLD PIPE INSULATION

1. Cold Pipe Insulation: Mineral Fibre:

   .1 Material: formed mineral fibre rigid insulation sleeving.

   .2 "k" Value: maximum 0.035 W/m°C at 24°C mean temperature.

   .3 Service Temperature: -14°C to 100°C.

   .4 Jacket: factory applied vapour barrier jacket.

2. Cold Pipe Insulation - Black Rubber:

   .1 Material: flexible elastomeric unicellular preformed pipe covering.

   .2 "k" Value: 0.04 W/m. °C at 24°C mean temperature.

   .3 Service Temperature: -4°C to 100°C.

   .4 Maximum Allowable Thickness: 25 mm.

2.5 COLD EQUIPMENT INSULATION

1. Cold Equipment Insulation - Flat Surfaces:

   .1 Materials: rigid mineral fibre.

   .2 "k" Value: maximum 0.035 W/m°C at 24°C mean temperature.

   .3 Service Temperature: -14°C to 100°C.

   .4 Jacket: factory applied vapour barrier jacket.

2. Cold Equipment Insulation - Curved Surfaces:

   .1 Material: mineral fibre blanket.

   .2 "k" Value: maximum 0.035 W/m°C at 24°C mean temperature.

   .3 Service Temperature: -14°C to 100°C.

   .4 Jacket: factory applied vapour barrier jacket.

2.6 ACCESSORIES

1. For mineral fibre insulation materials:

   .1 FSK Tape: vapour barrier tape consisting of laminated aluminum foil, glass fibre scrim and paper, with pressure sensitive self adhesive.

   .2 ASJ Tape: vapour resistant tape consisting of all service jacket material with pressure sensitive self adhesive.

   .3 Adhesive: quick setting adhesive for joints and lap sealing.

2. Black Rubber Insulation Adhesive: manufacturers recommended contact cement.

3. Finishing Cement: mineral fibre hydraulic setting thermal insulating and finishing cement for use up to 650°C.

4. Insulating Cement: mineral fibre thermal insulating cement for use up to 870°C.

Type 1: Mineral fibre hydraulic setting thermal **insulating and finishing cement** for use up to 650°C.

Type 2: Mineral fibre thermal **insulating cement** for use up to 870°C.

Type 3: Expanded or exfoliated vermiculite thermal **insulating cement** for use up to 980°C.

2.7 RECOVERY MATERIALS

1. Canvas: ULC listed, 220 g/m^2 plain weave cotton fabric.
2. Aluminum: to 0.5 mm thick with longitudinal slip joints and 50 mm end laps, 0.4 mm thick die shaped fitting covers with factory attached protective liner on interior surface.
3. PVC: [0.38] or [ ] mm thick for interior use [and [ ] mm thick for exterior use], off-white in colour with one-piece premoulded fitting covers.
4. Black Rubber Finish: insulation manufacturers recommended vinyl lacquer type coating.

3. Execution

3.1 INSTALLATION, GENERAL

1. Apply insulation after required piping system tests have been completed and inspected.
2. Ensure insulation is continuous through walls and floor penetrations.
3. Ensure piping surface is clean and dry before insulating.
4. Locate cover seams in least visible locations.
5. Stagger butt joints where multi-layered insulation is used.
6. On vertical piping with diameters 25 mm and larger, use insulation supports welded or bolted to pipe directly above lowest pipe fitting. Repeat supports on 4.5 m centers and at each valve and flange.

7. Tightly fit insulation sections to pipe to make smooth and even surfaces. Cut insulation for proper fit where weld beads protrude. Bevel away from studs and nuts to allow their removal without damage to insulation. Trim closely and neatly around extending parts of pipe saddles, supports, hangers, clamp guides and seal with insulating/finishing cement.

3.2 HOT PIPE INSULATION APPLICATION

1. Apply mineral fibre insulation when pipe surface temperatures are 50°C to 60°C.
2. Apply mineral fibre insulation and recovery over full length of pipe without penetration of hangers, interruption at sleeves and fittings. Seal butt joints with 100 mm wide ASJ tape.
3. Terminate mineral fibre insulation at each end of unions and flanges. Trowel finishing cement into bevel.
4. Cover fittings and valves with equivalent thickness of finishing cement. Apply finishing cement over exposed fittings and valves before applying canvas recovering.
5. Cut mineral fibre insulation layers straight on 10 m centers with 25 mm gap to allow for expansion between terminations. Pack void tightly with insulation and protect joints with aluminum sleeves.
6. Seal black rubber insulation butt joints and seams with black rubber insulation adhesive.
7. Recover exposed mineral fibre insulated piping with [canvas] [PVC] [aluminum].
8. Recover mineral fibre insulated piping exposed to outdoors with aluminum.
9. Coat exposed black rubber insulation with two coats of black rubber finish material.
10. Do not insulate the following piping system components:
    - .1 Hot water heating piping in radiation cabinets.
    - .2 Unions, flanges, strainers, expansion joints, flexible piping connectors.
    - .3 Condensate trap assemblies and drip legs.
    - .4 Chrome plated or stainless steel piping.
    - .5 Valve bonnets on domestic water systems.

3.3 HOT EQUIPMENT INSULATION APPLICATION

1. Use rigid fibreboard for flat surfaces and blanket for curved surfaces.
2. Tightly butt edges and stagger joints. Weld mechanical fastener pins to equipment where necessary.
3. Cover insulation with 25 mm galvanized hexagonal mesh and 12 mm coat of insulating cement. Finish with a final 12 mm coat of finishing cement and recover with canvas.

3.4 ENGINE EXHAUST INSULATION APPLICATION

1. Ensure insulation is continuous through the wall or roof to point of termination.
2. Cover elbows and fittings with equivalent thickness of insulating cement.
3. Recover all piping, including muffler, with aluminum.

3.5 COLD PIPE INSULATION APPLICATION

1. Insulate 2 m portion of plumbing vents measured from roof outlet back. Do not insulate remaining vent piping.
2. Insulate storm sewer piping throughout. Insulate final 2 m portion from outlet drain back with 25 mm insulation.
3. Apply mineral fibre insulation and recovery over full length of pipe without penetration of hangers, interruption at sleeves and fittings. Apply adhesive to ends of butt joints and seal joint seams with 100 mm wide strips of joint tape.
4. Insulate complete system including valves, unions, flanges, strainers. Cover fittings and valves with equivalent thickness of finishing cement. Cover finishing cement with open mesh glass cloth and adhesive. Seal lap joints with 100% coverage of joint tape and seal the assembly with adhesive.
5. Seal black rubber insulation butt joints and seams with black rubber insulation adhesive.
6. Recover exposed mineral fibre insulated piping with [canvas] [PVC] [aluminum].
7. Recover mineral fibre insulated piping exposed to outdoors with [aluminum] [PVC].

8. Coat exposed black rubber insulation with two coats of black rubber finish material.

3.6 COLD EQUIPMENT INSULATION APPLICATION

1. Tightly butt edges and stagger joints. Seal joints with 100 mm wide FSK tape.
2. Cover insulation with 25 mm galvanized hexagonal mesh and 12 mm coat of finishing cement. Finish with a final 12 mm coat of finishing cement and recover with canvas.

3.7 INSULATION TYPE AND THICKNESS SCHEDULE

SPEC NOTE: Insulation thicknesses generally conform to ASHRAE recommendations. See Table 6.8.2B in ASHRAE 90.1 Standard or Table C-10 in ASHRAE 189.1 Standard (latest edition) for current thickness requirements.

Service Type and Nominal Pipe Diameter (mm)	Insulation Type	Insulation Thickness Range (mm)
Hot water heating		
50 and smaller	Hot pipe	25 to 50
65 and larger	Hot pipe	40 to 75
Low pressure steam		
50 and smaller	Hot pipe	40 to 75
65 and larger	Hot pipe	50 to 75
Condensate		
25 and smaller	Hot pipe	25 to 50
30 to 50	Hot pipe	40 to 75
65 and larger	Hop pipe	50 to 75
Domestic hot water and recirculation		
40 and smaller	Hot pipe	12 to 25
50 and larger	Hot pipe	25 to 50
Chilled water		
25 and less	Cold pipe	12 to 25
30 to 50	Cold pipe	20 to 40
65 and larger	Cold pipe	25 to 50

Continued next page

3.7 INSULATION TYPE AND THICKNESS SCHEDULE (Cont'd)

Service Type and Nominal Pipe Diameter (mm)	Insulation Type	Insulation Thickness Range (mm)
Refrigerant & Chilled glycol		
25 and smaller	Cold pipe	25 to 50
30 and larger	Cold pipe	40 to 75
Domestic cold water		
40 and smaller	Cold pipe	12 to 25
50 and larger	Cold pipe	25 to 50
Condenser water,		
All sizes	Cold pipe	25 to 50
External sprayed coil		
All sizes	Cold pipe	12 to 25
Condenser water piping indoors		
25 and smaller	Cold pipe	25 to 50
30 and larger	Cold pipe	40 to 75
Plumbing vents		
All sizes	Cold pipe	25 to 50
Storm sewer piping,		
All sizes	Cold pipe	12 to 25
Final 2 m section	Cold pipe	25 to 50

SPEC NOTE: Specify insulation for "Condenser water piping indoors" only when free cooling chillers or exchangers are specified.

END OF SECTION