

1.1. REFERENCE STANDARDS

- 1.1.1. Meet NFPA 90A-2006. Maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with NFPA 255-2006 and CAN4-S102-M83.
- 1.1.2. Materials tested in accordance with ASTM C411-82 shall not flame, smoulder, glow or smoke at temperature to which exposed in service.

1.2. BUILDING SERVICES REQUIRING INSULATION**1.2.1. Pipe Services**

- 1.2.1.1. All domestic cold water pipes
- 1.2.1.2. All domestic hot water and recirculation pipes
- 1.2.1.3. All horizontal sections of storm and sanitary drains
- 1.2.1.4. All heating hot water pipes
- 1.2.1.5. All chilled water pipes
- 1.2.1.6. All refrigerant pipes

1.2.2. Ductwork Services

- 1.2.2.1. All ductwork conveying air with a temperature of less than 20°C or higher than 28°C.
- 1.2.2.2. All exhaust ductwork 3m prior to the point of leaving the building.

1.2.3. Equipment

- 1.2.3.1. All domestic hot water storage tanks
- 1.2.3.2. All chilled water piping
- 1.2.3.3. All under-bodies of roof drains
- 1.2.3.4. All intake or exhaust plenums
- 1.2.3.5. All headers of chillers
- 1.2.3.6. All expansion tanks
- 1.2.3.7. All heat exchangers where fluids temperatures are less than 15°C or higher than 28°C.
- 1.2.3.8. Chemical treatment filter cartridges where fluids temperatures are less than 15°C

1.2.4. Elements not to be insulated

- 1.2.4.1. Hot water unions
- 1.2.4.2. Hot water pumps
- 1.2.4.3. Hot water valves (isolation, check, balancing, control)
- 1.2.4.4. Any equipment label or identification tag
- 1.2.4.5. Flexible pipe or duct connectors
- 1.2.4.6. Safety relief valves



1.3. GENERAL

- 1.3.1. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

1.4. PIPING INSULATION (EXCEPT REFRIGERANT)

- 1.4.1. Rigid molded fibreglass insulation in compliance with ASTM C547, Class 1, minimum density 56.1 kg/m³ (3.5 pounds/cubic foot), K-factor of approximately 0.035 W/mK (0.24 BTU-in/sq.ft-h-F) at 24 deg.C (75 degrees F), suitable for temperatures from minus 29 deg.C (minus 20 degrees F) to plus 232 deg.C (450 degrees F).

- 1.4.2. Vapor barrier jacket: laminated white kraft paper, aluminum foil, glass fiber reinforcement, permeance of 0.29 mg/MPA-s-m (0.2 perms-inch) , and puncture resistance of 50 units.

1.4.3. Thickness

- 1.4.3.1. Minimum insulation thickness in inches, shall comply with the table below for the associated piping system and pipe sizes.

Fluid	Insulation Thickness for Pipe Size Listed				
	Temp. Range (°C)	Pipe 25mm	Pipe 50mm	Pipe 100mm	Pipe 150mm
Heating Hot Water	38 - 95	25 mm	25 mm	38 mm	38 mm
Domestic Cold Water	5 - 15	12 mm	12 mm	25 mm	25 mm
Domestic Hot Water	40 - 60	25 mm	25 mm	38 mm	38 mm
Horizontal Storm/Sanitary	5 - 35	12 mm	12 mm	12 mm	12 mm
Chilled Water	2 - 15	25 mm	25 mm	38 mm	38 mm

1.4.4. Jacket – Indoors

- 1.4.4.1. PVC pre-moulded fittings that meet 25 flame spread and 50 smoke developed ratings may be applied in mechanical rooms as follows:

- 1.4.4.1.1. 1/12" thick minimum.
 1.4.4.1.2. Fitting covers, one piece, pre-moulded to match.
 1.4.4.1.3. Fastenings standard to manufacturer.

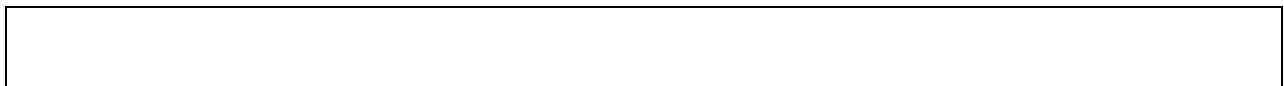
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1.4.5. Jacket - Outdoors

- 1.4.5.1. Jacketing shall be aluminum complying with ASTM C1729, Type I, Grade 1 or 2, Class A. Jacketing shall have a 3 mil thick polysurlyn moisture barrier heat laminated to the interior surface.
- 1.4.5.2. Typical thickness is 0.016”.
- 1.4.5.3. Aluminum jacketing for elbows/fittings shall be pre-fabricated two-piece pressed elbows complying with ASTM C1729, Type III, Grade 3, Class D. Sectional, factory contoured, or field-fabricated gores shall be an alternative for elbows/fittings. All elbows/fittings shall fit closely around insulation.
- 1.4.5.4. Aluminum jacketing for all fittings, tees, elbows, valves, caps, etc. shall have a 3 mil polysurlyn or painted moisture barrier on the interior surface.
- 1.4.5.5. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 20 mm (0.75 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.
- 1.4.5.6. Aluminum protective jacketing shall not be considered a vapor retarder.
- 1.4.5.7. Neither rivets, screws, staples nor any other fastener capable of penetrating the underlying vapor retarder shall be used to secure the aluminum jacketing.

1.5. REFRIGERANT PIPING

- 1.5.1. Flexible Elastomeric Insulation: Cellular closed cell in compliance with ASTM C534, Type 1, minimum density 80.1 kg/m³ (5 pounds/cubic foot), K-factor of approximately 0.042 W/m-K (0.29 BTU-in/sq.ft.-hr-deg.F) at 24 deg.C (75 degrees F), suitable for temperatures up to 105 deg.C (220 degrees F).
- 1.5.2. Valve and fitting covers: Same as pipe insulation, cut to fit.
- 1.5.3. Outdoor Weather Resistant Protective Finish: Acrylic latex enamel paint.
- 1.5.4. Thickness:
 - 1.5.4.1. 25mm for pipes 25mm diam and less
 - 1.5.4.2. 38mm for pipes 32mm diam and larger



1.6. DUCTWORK INSULATION

1.6.1. Indoor, Exposed, Rectangular

1.6.1.1. In mechanical equipment rooms and all other areas where visible without removing ceilings or opening access panels, insulate ductwork with 38 mm (1½") thick rigid, fiberglass insulation board with factory-applied vapor barrier. Insulation: ASTM C612 Class 2, conductivity of 0.0375 W/m-K (0.26 BTU-in/hr-sq.ft-F), density of 48 kg/m³ (3.0 lbs/cu.ft). Vapor barrier: laminated white kraft paper, aluminum foil, glass fiber reinforcement, 0.29 mg/MPA-s-m (0.2 perms-inch), and puncture resistance of 50 units.

1.6.1.2. Canvas Jacket: Apply where rigid insulation is applied indoors: compact, firm ULC listed heavy plain weave, cotton fabric at 220 g/m².

1.6.2. Indoor, Concealed, All Shapes

1.6.2.1. In ceiling spaces, building shafts, and other locations where not visible, insulate ductwork with 38 mm (1½") thick, blanket-type, fiberglass insulation with factory-applied vapor barrier, and 50 mm (2") stapling and taping flange along one edge. Insulation: ASTM C553, density of 12 kg/m³ (0.75 lbs/cu.ft), conductivity of 0.046 W/m-K (0.32 BTU-in/hr-sq.ft.-F). Vapor barrier: laminated white kraft paper, aluminum foil, glass fiber reinforcement, 0.29 mg/MPA-s-m (0.2 perms-inch), and puncture resistance of 50 units.

1.6.3. Outdoor Ductwork

1.6.3.1. Closed Cell Flexible Elastomeric Insulation, 50 mm (2") thick with a service temperature range from - 29 deg.C (-20 degrees F) to 82 deg.C (180 deg F). Meets ASTM C 177 or C518; conductivity 0.038 W/m-K (0.27 Btu-in. / hr-ft²- F), density 48 kg/m³ (3 lb/cu ft).

1.6.3.2. The insulation and outside surface must be protected with a white Thermo Plastic Rubber Membrane formulated to:

1.6.3.2.1. Be resistant to UV, and ozone, acid rain, and physical elements produced from outdoor weather per ASTM E 96 Procedure A.

1.6.3.2.2. Show no evidence of continued erosion, delaminating, cracking, flaking, or peeling when tested in accordance with the test method for erosion resistance in UL181.

1.6.3.2.3. Be resistant to mold growth resistance, ASTM G 21/C 1338 resistant to fungi, and resistant to bacteria growth per ASTM G 22.

1.6.3.2.4. Top layer: Stucco-embossed, UV-resistant aluminum weathering surface

1.6.3.2.5. Middle Layer: Double layer of high-density polyethylene reinforcement

1.6.3.2.6. Bottom Layer: Uniform layer of rubberized asphalt adhesive, protected by disposable silicone release paper

1.6.3.2.7. Heat Aging, ASTM D 794: No visible blistering or deterioration.

1.6.3.2.8. Tear Resistance, ASTM D 1424, Average: 660 grams.

- 1.6.3.2.9. Elongation, ASTM D 412, Minimum: 450 percent.
- 1.6.3.2.10. Water Vapor Transmission, ASTM E 96: 0.009 perms.
- 1.6.3.2.11. Wind-Driven Rain, SFBC TAS-110-95, 160 km/h (100 mph): No leakage or failure.

1.7. EQUIPMENT INSULATION

1.7.1. Hot Equipment

- 1.7.1.1. Insulate all equipment with surface temperature over 38 deg.C (100 deg.F), using rigid fiberglass insulation board. Insulation: ASTM C612 Class 2, conductivity of 0.0375 W/m-K (0.26 BTU-in/hr-sq.ft.F), density of 96 kg/m³ (6.0 lbs/cu.ft). Vapor barrier: laminated white kraft paper, aluminum foil, glass fiber reinforcement, permeance of 0.2, and puncture resistance of 50 units.
- 1.7.1.2. Apply insulation in thickness as follows: 38 mm (1½") for operating temperature up to 65 deg.C (150 deg.F), 50 mm (2") for operating temperature of 65 deg.C (150 deg.F) to 93 deg.C (200 deg.F), 75 mm (3") for operating temperature over 93 deg.C (200 deg.F).
- 1.7.1.3. Cut, score, or miter insulation to fit contour of equipment and secure with galvanized steel bands or wire, or weld pins. Stagger joints where possible and fill voids with insulating cement. Apply 25 mm (1") galvanized wire mesh over entire exterior surface and finish with two coats of insulating cement troweled to a hard finish.

1.7.2. Cold Equipment

- 1.7.2.1. Insulate all equipment with surface temperature below 15 deg.C (60 deg.F) with 25 mm (1") thick, flexible, closed cell, elastomeric foam insulation sheet. Insulation: ASTM C534, conductivity of 0.042 W/m-K (0.30 BTU-in/hr-sq.ft.F), 0.29 mg/MPA-s-m (0.2 perms-inch).
- 1.7.2.2. Apply elastomeric foam insulation sheet with contact adhesive. Seal all butt joints with adhesive.

