METROLINX

Capital Projects Group

# Mechanical Insulation Specification

Specification 20 05 25

Revision 1
Date: September 2018

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Publication Date: September, 2018


an Agency of the Government of Ontario

## Amendment Record Sheet

| Amendment in Clause No. | Date of Amendment | Description of Changes |
|---|---|---|
| Various | Sept. 20, 2018 | Revised to coordinate with corresponding specifications. |
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**LIST OF CONTENT**

## 1. GENERAL

### 1.1. SCOPE OF WORK

1.1.1. Provide mechanical insulation products as required, scheduled and specified herein.

1.1.2. This Section specifies insulation requirements common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly.

### 1.2. RELATED WORKS

1.2.1. Section 20 05 05 - Mechanical Work General Instructions.

1.2.2. Section 20 05 10 - Basic Mechanical Materials and Methods.

### 1.3. REFERENCE STANDARDS

1.3.1. Standards and codes to be latest editions adopted by and enforced by local governing authorities.

1.3.2. ANSI/ASHRAE/IES Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.3.3. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

1.3.4. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

1.3.5. ASTM C240 Standard Test Methods for Testing Cellular Glass Insulation Block.

1.3.6. ASTM C449 - 07(2013) Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

1.3.7. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation.

1.3.8. ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

1.3.9. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

1.3.10. ASTM C1393 Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks.

1.3.11. CGSB 51-GP-11M Thermal Insulation, Mineral Fiber, Blanket, for Piping, Ducting, Machinery and Boilers.

1.3.12. ISO 6944-1 Fire Containment – Elements of Building Construction – Part 1: Ventilation Ducts.

1.3.13. NFPA-96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

1.3.14. Ontario Building Code.

1.3.15. Thermal Insulation Association of Canada National Insulation Standards.

1.3.16. ULC-S101 Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.3.17. ULC S102 Standard Method of Test for Surface Burning Characteristics of building Materials and Assemblies.

1.3.18. ULC S115 Standard Method of Fire Tests of Firestop Systems.

## 1.4. WARRANTY

1.4.1. Products to be guaranteed by manufacturer, for a minimum of 2 years after acceptance by Metrolinx.

## 1.5. DELIVERY, STORAGE AND HANDLING

1.5.1. Handle and store products in accordance with manufacturer's instructions, in locations approved by Metrolinx. Include one copy of these instructions with product at time of shipment.

1.5.2. Insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from site.

## 1.6. SUBMITTALS

1.6.1. Refer to submittal requirements in Section 20 05 05.

1.6.2. Submit a sample of each type of insulation (and insulation accessories and finish), in applied form, for review. Mount samples on a plywood board. Identify each product with manufacturer's name and insulation type, and proposed use of insulation. When sample board has been approved by Metrolinx, mechanical insulation work is to conform to approved sample board.

1.6.3. Submit a fabrication drawing for each custom-made cover to indicate material and fabrication details, and a 300 mm (12") square sample of proposed cover material.

1.6.4. In accordance with Part 3 of this Section, submit a letter from fire rated duct wrap supplier to certifying duct wrap has been properly installed.

1.6.5. Submit a colour chart for coloured lagging adhesive for canvas jacketed insulation.

1.6.6. Product Data

a) Submit product data sheets for products specified in this Section indicating:

1) technical data, supplemented by bulletins, component illustrations, detailed views, technical descriptions of items, and parts lists;

2) performance criteria, compliance with appropriate reference standards, characteristics, limitations, and troubleshooting protocol;

3) product transportation, storage, handling, and installation requirements;

4) Product identification in accordance with Metrolinx requirements.

1.6.7. Shop Drawings

a) Submit shop drawings for products specified in this Section indicating:

1) type, purpose and ratings;

2) mounting details to suit locations shown, indicating methods and hardware to be used.

## 1.7. QUALITY ASSURANCE

1.7.1. Manufacturers Qualifications

a) Manufacturer shall be ISO 9000, 9001 or 9002 certified. Manufacturer of product shall have produced similar product for a minimum period of five years. When requested by Consultant, an acceptable list of installations with similar product shall be provided demonstrating compliance with this requirement.

b) Where manufacturers provide after installation onsite inspection of product installations, include for manufacturer's authorized representative to perform onsite inspection and certificate of approvals.

1.7.2. Installers Qualifications

a) Mechanical insulation is to be applied by a licensed journeyman insulation mechanic, or by an apprentice under direct, daily, on-site supervision of a journeyman mechanic.

b) Installers to be fully qualified and experienced installers of respective products and work in which they are installing.

c) Installer to be manufacturer trained and certified on specific product. Submit copy of training certificate with shop drawings.

1.7.3. Regulatory Requirements

a) Products and work to comply with applicable local governing authority regulations, bylaws and directives.

b) Include for required inspections and certificate of approvals of installation work from local governing authorities.

## 1.8. DEFINITIONS

1.8.1. "concealed" – means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces.

1.8.2. "exposed" – means exposed to normal view during normal conditions and operations.

1.8.3. "mineral fibre" – fibreglass or glass fibre.

1.8.4. "domestic water" or "potable water" – means piping extended from building Municipal supply main.

## 2. PRODUCTS

## 2.1. FIRE HAZARD RATINGS

2.1.1. Unless otherwise specified, insulation system materials inside building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.

## 2.2. THERMAL PERFORMANCE

2.2.1. Unless otherwise specified, thermal performance of insulation is to meet or exceed values given in Tables entitled Minimum Piping Insulation Thickness Heating and Hot Water Systems and Minimum Piping Insulation Thickness Cooling Systems, as stated in ANSI/ASHRAE/IES Standard 90.1 version referenced in Ontario Building Code.

## 2.3. PIPE INSULATION MATERIALS

2.3.1. Horizontal pipe insulation at hangers and supports are to be Belform Insulation Ltd. "Koolphen K-Block" or approved equivalent, insulated pipe support inserts consisting of minimum 150 mm (6") long, pre-moulded, rigid, sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a captive galvanized steel saddle.

2.3.2. Flexible foam elastomeric is to be closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation with a water vapour transmission rating of 0.10 in accordance with ASTM E96, Procedure B, and required installation accessories. Standard of quality acceptance products are:

a) Armacell AP/Armaflex SS;

b) IK Insulation Group K-Flex "LS" Self-Seal Pipe Insulation;

c) or approved equivalent.

2.3.3. Closed cell foamed glass is to be Pittsburgh Corning "FOAMGLASS" or approved equivalent, expanded, sectional, rigid sleeve type insulation with a liquid or vapour permeability rating (as per ASTM C240) of 0.00, and a factory applied "PITTWRAP SSII" or approved equivalent, self-sealing jacket.

2.3.4. Premoulded mineral wool is to be rigid, sectional, sleeve type, non-combustible, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket. Standard of acceptance products are:

a) Roxul "Techton 1200";

b) IIG (Johns Manville Inc.) MinWool-1200;

c) Paroc 1200;

d) or approved equivalent.

2.3.5. Fire rated pre-moulded mineral wool is to be non-combustible, fire-rated, rigid, sectional, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket and compatible with ULC S115 and ULC-S101 firestopping. Standard of acceptance products are:

a) Roxul "Techton 1200";

b) IIG (Johns Manville Inc.) MinWool-1200;

c) Paroc 1200;

d) or approved equivalent.

2.3.6. Pre-moulded fibreglass is to be rigid, sectional, sleeve type insulation to ASTM C547, with a factory applied vapour barrier jacket. Standard of acceptance products are:

a) Johns Manville Inc. "Micro-Lok AP-T Plus";

b) Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket;

c) Manson Insulation Inc."ALLEY K APT";

d) Owens Corning "Fiberglas" Pipe Insulation;

e) or approved equivalent.

2.3.7. Blanket fibreglass is to be blanket type roll insulation to CGSB 51-GP-11M, 24 kg/m$^3$ (1-½ lb/ft$^3$) density, with a factory applied vapour barrier facing. Standard of acceptance products are:

a) Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

b) Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

c) Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

d) CertainTeed Corporation;

e) or approved equivalent.

2.3.8. Pre-moulded weatherproof jacketed fibreglass is to be Knauf Insulation "Redi-Klad 1000" or approved equivalent, sectional, sleeve type pipe insulation with a self-sealing weather-proof jacket and a 100 mm (4") butt joint sealing strip with each section.

## 2.4. BARRIER-FREE LAVATORY PIPING INSULATION KITS

2.4.1. Removable, flexible, reusable, white moulded plastic insulation kits for barrier-free lavatory drain piping and potable water supplies exposed under lavatory.

2.4.2. Standard of acceptance products are:

a) Truebo "Lav-Guard 2" E-Z Series;

b) Zeston "SNAP-TRAP";

c) McGuire Manufacturing Co. Inc. "ProWrap";

d) or approved equivalent.

## 2.5. EQUIPMENT INSULATION MATERIALS

2.5.1. Blanket fibreglass is to be blanket type roll form insulation to ASTM C553, 24 kg/m$^3$ (1-½ lb/ft$^3$) density, with a factory applied vapour barrier facing. Standard of acceptance products are:

a) Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

b) Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

c) Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

d) Certainteed Corporation Softtouch FSK Duct Wrap Type 150;

e) or approved equivalent.

2.5.2. Semi-rigid fibreglass board is to be roll form, moulded insulation to ASTM C1393, with a factory applied vapour barrier facing consisting of laminated aluminum foil and kraft paper. Standard of acceptance products are:

a) Knauf Fiber Glass Pipe and Tank Insulation;

b) Manson Insulation Inc. "AK FLEX";

c) Johns Manville Inc. Pipe and Tank Insulation “Micro-Flex”;

d) Multi-Glass Insulation Ltd. "MULTI-FLEX MF";

e) Owens Corning Pipe and Tank Insulation;

f) Glass-Cell Fabricators Ltd. "R-Flex";

g) or approved equivalent.

2.5.3. Semi-rigid mineral wool blanket is to be Roxul "Enerwrap MA 960" or approved equivalent, flexible, black fibrous scrim faced mineral wool blanket insulation to ASTM C553.

2.5.4. Closed cell foamed glass is to be Pittsburgh Corning "FOAMGLAS" or approved equivalent, expanded, rigid board and block type insulation with a liquid or vapour permeability rating (as per ASTM C240) of 0.00.

## 2.6. REMOVABLE/REUSABLE INSULATION COVERS

2.6.1. Valve, etc. covers are to be NO SWEAT or approved equivalent, reusable insulation wraps with vapour barrier jacket and self-sealing ends and longitudinal seam, with a length to suit the application and an insulation thickness equal to adjoining insulation.

2.6.2. Custom manufactured equipment covers conforming to shape of item to be insulated, designed to be easily removable and replaceable to suit use and maintenance procedures of particular item, and to provide adequate personnel protection. Covers are to be complete with minimum 95 kg/m$^3$ (6 lb/ft$^3$) density ceramic fibre insulation sewn between minimum 542.5 g/m$^2$ (1.8 oz/ft$^2$) weight silicone impregnated fibreglass fabric in a quilted pattern using double stitches made with Kelvar or Teflon coated fibreglass thread. Overlap flaps are to be secured using laces, snaps, or Velcro double stitched in place. Standard of acceptance manufacturers are:

a) Crossby Dewar Inc.;

b) Insufab Systems Inc.;

c) ADL Insulflex Inc.;

d) Firwin Corp.;

e) GlassCell Isofab Inc;

f) or approved equivalent.

## 2.7. DUCTWORK SYSTEM INSULATION MATERIALS

2.7.1. Rigid fibreglass board is to be pre-formed board type insulation to ASTM C612, 48 kg/m$^3$ (3 lb/ft$^3$) density, with a factory applied reinforced aluminum foil and kraft paper facing. Standard of acceptance products are:

a) Knauf Fiber Glass Insulation Board with FSK facing;

b) Manson Insulation Inc. "AK BOARD FSK";

c) Johns Manville Inc. Type 814 "Spin-Glas";

d) Owens Corning 703;

e) or approved equivalent.

2.7.2. Semi-rigid fibreglass board is to be roll form insulation to ASTM C1393, consisting of cut strips of rigid mineral board insulation glued to an aluminium foil and kraft paper facing. Standard of acceptance products are:

a) Multi-Glass Insulation Ltd. "Multi-Flex MKF";

b) Glass-Cell Fabricators Ltd. "R-FLEX";

c) Owens Corning Pipe and Tank Insulation;

d) Johns Manville Inc. Pipe and Tank Insulation;

e) or approved equivalent.

2.7.3. Blanket fibreglass is to be blanket type roll form insulation to ASTM C553, 24 kg/m$^3$ (1½ lb/ft$^3$) density, 40 mm (1-½") thick, with a factory applied vapour barrier facing. Standard of acceptance products are:

a) Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

b) Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

c) Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

d) Certainteed Corporation Softtouch FSK Duct Wrap Type 150;

e) or approved equivalent.

2.7.4. Pre-moulded calcium silicate is to be rigid block and sheet insulation. Standard of acceptance products are:

a) Johns Manville Inc. "Thermo-12 Gold";

b) Industrial Insulation Group "Thermo-12 Gold";

c) or approved equivalent.

2.7.5. Flexible foam elastomeric sheet is to be sheet form, CFC free, closed cell, self-adhering elastomeric nitrile rubber insulation with a water vapour permeability rating of 0.08 in accordance with ASTM E96 Procedure A. Standard of acceptance products are:

a) Armacell "AP/Armaflex SA";

b) IK Insulation Group "K-Flex Duct Wrap", S2S;

c) or approved equivalent.

## 2.8. FIRE RATED DUCT WRAP

2.8.1. Flexible, non-combustible, blanket type fibreglassfibreglass duct wrap completely encapsulated in reinforced foil, suitable for installation with zero clearance to combustibles (for grease ducts), and ULC tested and listed (ULC Designs FRD-17 & 23 for ventilation ducts, ULC Design FRD-19 for kitchen exhaust/grease duct) to facilitate a 2 hour fire resistance rating (76 mm [3"] thick) to kitchen grease exhaust duct in accordance with requirements of NFPA-96, and/or a 1 or 2 hour fire resistance rating (38 mm [1-½"] thick) to ventilation or pressurization ductwork in accordance with requirements of ISO 6944-1.

2.8.2. Standard of acceptance manufacturers are:

a) 3M Fire Barrier Duct Wrap 615;

b) CL4 Inc. "CL4Fire";

c) Unifrax Corp. "FyreWrap Elite 1.5";

d) Morgan Thermal Ceramics "FireMaster FastWrap XL";

E) or approved equivalent.

## 2.9. INSULATING COATINGS

2.9.1. Robson Thermal Manufacturing Ltd. or approved equivalent, insulating coatings as follows:

a) anti-condensation coating, "No Sweat-FX";

b) thermal insulating coating, "ThermaLite";

c) or approved equivalent.

## 2.10. INSULATION FASTENINGS

2.10.1. Wire – minimum #15 gauge galvanized annealed wire.

2.10.2. Wire with Mesh – minimum #15 gauge galvanized annealed wire factory woven into 25 mm (1") hexagonal mesh.

2.10.3. Aluminium Banding –ITW Insulation Systems Canada "FABSTRAPS" or approved equivalent, minimum 12 mm (½") wide, 0.6 mm (1/16") thick aluminium strapping.

2.10.4. Stainless Steel Banding –ITW Insulation Systems Canada "FABSTAPS" or approved equivalent, 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.

2.10.5. Duct Insulation Fasteners – weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1-½") square plastic or zinc plated steel self-locking washers.

2.10.6. Tape Sealant –MACtac Canada Ltd. or approved equivalent, self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match surface being sealed.

2.10.7. FibreglassFibreglass Insulation Adhesive – clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20 °C to 82 °C (-4 °F to 180 °F), compatible with type of material to be secured, and WHMIS classified as non-hazardous.

2.10.8. Flexible Elastomeric Insulation Adhesive – Armacell "Armaflex" #520 or approved equivalent, air-drying contact adhesive.

2.10.9. Closed Cell Foamed Glass Insulation Adhesive – Pittsburgh Corning PC88 or approved equivalent, multi-purpose 2-component adhesive.

2.10.10. Lagging Adhesive – white, brush consistency, ULC listed and labelled, 25/50 fire/smoke rated lagging adhesive for canvas jacket fabric, suitable for colour tinting, complete with fungicide and washable when dry.

2.10.11. Screws – No. 10 stainless steel sheet metal screws.

## 2.11. INSULATION JACKETS AND FINISHES

2.11.1. Canvas Jacket Material or approved equivalent – ULC listed and labelled, 25/50 fire/smoke rated, roll form, minimum 170 g (6 oz.).

2.11.2. Roll Form Sheet and Fitting Covers – minimum 15 mm (1/2") thick white PVC, 25/50 fire/smoke rated tested in accordance with ULC S102, complete with installation and sealing accessories. Standard of acceptance products are:

a) Proto Corp. "LoSMOKE";

b) The Sure-Fit System "SMOKE-LESS 25/50";

c) Johns Manville Inc. "Zeston" 300;

d) or approved equivalent.

2.11.3. Rigid Aluminium Jacket –ITW Insulation Systems Canada "Lock-on" or approved equivalent, 0.406 mm (0.016") thick embossed aluminum jacket material to ASTM B209, factory cut to size and complete with polysurlyn moisture barrier and continuous modified Pittsburgh Z-Lock or approved equivalent, butt straps with "Fabstraps" to weatherproof the end to end joints, and 2-piece epoxy coated pressed aluminum fittings with weather locking edges.

2.11.4. Stainless Steel Jacket –ITW Insulation Systems Canada "Lock-on" or approved equivalent, 0.254 mm (0.010") thick type 304 embossed stainless steel jacket material to ASTM A240, factory cut to size and complete with moisture barrier and continuous modified Pittsburgh Z-Lock or approved equivalent, butt straps with "Fabstraps" to cover end to end joints, and 2-piece pressed stainless steel fittings with weather locking edges.

2.11.5. Adhesive backed flexible aluminium is to be MFM Building Products Corp. "Flex-Clad 400" or approved equivalent, roll form sheet material with an aggressive rubberized asphalt adhesive backing, high density polyethylene reinforcement, and an embossed aluminum facing.

2.11.6. Heat resistant, trowel consistency thermal insulating and finishing cement to ASTM C 449, and suitable for the application.

2.11.7. Foamed glass insulation protective coating is to be Pittsburgh Corning "PITTCOTE 404" or approved equivalent, flexible acrylic latex weather barrier coating, white unless otherwise specified.

2.11.8. Flexible foam elastomeric insulation protective coating equal to Armacell "WB Armaflex" or approved equivalent, weatherproof, water-based latex enamel finish.

## 3. EXECUTION

### 3.1. GENERAL INSULATION APPLICATION REQUIREMENTS

3.1.1. Do not apply insulation unless leakage tests have been satisfactorily completed.

3.1.2. Ensure surfaces to be insulated are clean and dry.

3.1.3. Ensure ambient temperature is minimum 13 °C (55 °F) for at least 1 day prior to application of insulation, and for duration of insulation work, and relative humidity is and will be at a level such that mildew will not form on insulation materials.

3.1.4. Unless otherwise specified, do not insulate following:

a) factory insulated equipment and piping;

b) heating piping within radiation unit enclosures, including blank filler sections of enclosures;

c) heating piping in soffits and/or overhang spaces and connected to bare element radiation in spaces;

d) branch potable water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories;

e) exposed chrome plated potable water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories;

f) heated liquid system pump casings, valves, strainers and similar accessories;

g) heating system expansion tanks;

h) fire protection pump casings;

i) manufactured expansion joints and flexible connections;

j) acoustically lined ductwork and/or equipment;

k) factory insulated flexible branch ductwork;

l) fire protection system water storage tanks;

m) piping unions, except for unions in "cold" category piping.

3.1.5. Install insulation directly over pipes and ducts, not over hangers and supports.

3.1.6. Install piping insulation and jacket continuous through pipe openings and sleeves.

3.1.7. Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.

3.1.8. When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect insulation jacketing from the action of condensation at its junction with metal.

3.1.9. Insulate, vapour seal, and finish seismic restraints, braces, anchors, hanger rods, and similar hardware directly connected to "cold" piping and/or equipment, for a distance of 300 mm (12") clear of adjacent pipe or equipment finish, to match piping and/or equipment insulation.

3.1.10. When insulating vertical piping risers 75 mm (3") diameter and larger, use insulation support rings welded directly above lowest pipe fitting, and thereafter at 4.5 m (14.7') centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.

3.1.11. Where piping and/or equipment is traced with electric heating cable, ensure cable has been tested and accepted prior to application of insulation, and ensure cable is not damaged or displaced during the application of insulation.

3.1.12. Where existing insulation work is damaged as a result of mechanical work, repair damaged insulation work to Project work standards.

3.1.13. Where fibreglass rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover exposed end of insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.

3.1.14. Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.

3.1.15. Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in insulation and provide a suitable grommet in the opening.

## 3.2. INSULATION FOR HORIZONTAL PIPE AT HANGERS AND SUPPORTS

3.2.1. At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply insulation sections to piping installers for installation as pipe is erected.

3.2.2. For 100 mm (4") diameter and larger heating system piping where roller type hangers and supports are provided, a steel saddle will be tack welded to pipe at each roller hanger or support location. Pack saddle voids with loose mineral wool insulation.

## 3.3. PIPE INSULATION REQUIREMENTS – FIBREGLASS

3.3.1. Insulate following pipe inside building and above ground with fibreglass insulation of thickness indicated:

a) domestic cold-water piping, less than 100 mm (4") dia. – 25 mm (1") thick;

b) domestic cold-water piping, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;

c) domestic hot water piping, less than 40 mm (1-½") dia. – 25 mm (1") thick;

d) domestic hot water piping, greater than or equal to 40 mm (1½") dia. – 40 mm (1-½") thick;

e) tempered domestic water piping, supply and return, less than 40 mm (1-½") dia. – 25 mm (1") thick;

f) tempered domestic water piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;

g) storm drainage piping from roof drains to the point where main vertical risers extend straight down, without offsets, and connect to horizontal underground mains – 25 mm (1") thick;

h) condensate drainage piping from fan coil unit or any other air conditioning system/unit drain pans to main vertical drain risers or to indirect drainage point – 25 mm (1") thick;

i) drainage piping from refrigerated drinking fountains to nearest 75 mm (3") dia. or larger drain pipe – 25 mm (1") thick;

j) chilled water piping, supply and return, less than 100 mm (4") dia. – 25 mm (1") thick;

k) chilled water piping, supply and return, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;

l) chilled glycol solution piping, supply and return, less than 100 mm (4") dia. – 25 mm (1") thick;

m) chilled glycol solution piping, supply and return, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;

n) hot water heating piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;

o) hot water heating piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;

p) glycol solution heating or heat reclaim piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;

q) glycol solution heating or heat reclaim piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;

r) low pressure (to 140 kPa [20 psi]) steam piping, less than 100 mm (4") dia. – 65 mm (2-½") thick;

s) low pressure (to 140 kPa [20 psi]) steam piping, greater than or equal to 100 mm (4") dia. – 80 mm (3") thick;

t) medium pressure (140 to 415 kPa [20 to 60 psi]) steam piping, less than 40 mm (1-½") dia. – 100 mm (4") thick;

u) medium pressure (140 to 415 kPa [20 to 60 psi]) steam piping, greater than or equal to 40 mm (1-½") dia. – 112 mm (4-½") thick;

v) low pressure condensate piping, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;

w) low pressure condensate piping, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;

x) medium pressure condensate piping, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;

y) medium pressure condensate piping, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;

z) boiler feedwater piping complete – 25 mm (1") thick;

aa) boiler blowdown piping complete – 40 mm (1-½") thick;

bb) chilled domestic cold-water piping from remote water cooler(s) to drinking fountain(s) – 40 mm (1-½") thick;

cc) piping indicated to be traced with electric heating cable – minimum 50 mm (2") thick;

dd) drum drip(s) in dry zone standpipe and/or sprinkler system piping – 50 mm (2") thick;

ee) refrigerant suction piping (between compressor and evaporator coil) inside building – 25 mm (1") thick;

ff) refrigerant hot gas piping (between compressor and condenser) inside building – 25 mm (1") thick;

gg) refrigerant hot gas by-pass piping (between compressor discharge and evaporator coil) inside building – 25 mm (1") thick;

hh) air compressor set fresh air intake piping – 25 mm (1") thick.

3.3.2. Secure overlap flap of the sectional insulation jacket tightly in place. Cover section to section butt joints with tape sealant.

3.3.3. Insulate fittings with sectional pipe insulation mitred to fit tightly, and cover butt joints with tape sealant, or, alternatively, wrap fittings with blanket fibreglass insulation to a thickness and insulating value equal to the sectional insulation, secure in place with adhesive and/or wire, and cover with PVC fitting covers.

3.3.4. Unless otherwise specified, insulate unions, valves, strainers, and similar piping system accessories in "cold" piping with cut and tightly fitted segments of sectional pipe insulation with joints covered with tape sealant, or, alternatively, wrap piping union, valve, strainer, etc., with blanket fibreglass and cover with PVC covers as for paragraph above.

3.3.5. Terminate sectional insulation approximately 50 mm (2") from flange or coupling on each side of flange or coupling. Cover flange or coupling with a minimum 50 mm (2") thickness of blanket fibreglass insulation wide enough to butt tightly to ends of adjacent sectional insulation. Secure blanket insulation in place and cover with a purpose made PVC coupling cover.

3.3.6. Drum drips in dry zone sprinkler and/or standpipe system piping will be traced with electric heating cable as part of electrical work, and are generally not shown on drawing(s). Confirm number and size of drum drips required with trade providing piping and include for insulation to suit. Wherever possible drum drips will be located in heated areas.

3.3.7. Take special care at concealed water rough-in piping at plumbing fixtures to ensure piping is properly insulated. If necessary due to space limitations, use 12 mm (½") thick sectional pipe insulation in lieu of 25 mm (1") thick insulation.

3.3.8. Insulate seismic restraint hardware such as hanger rods, braces, anchors, etc., directly connected to "cold" category piping and equipment for a distance of 300 mm (12") from piping or equipment with insulation and finish to match pipe or equipment insulation. Coat seismic restraint hardware for a distance of 300 mm (12") from the termination of insulation with Robson Thermal "NO-SWEAT-FX" or approved equivalent, water based anti-condensation coating.

## 3.4. PIPE INSULATION REQUIREMENTS – MINERAL WOOL

3.4.1. Insulate following pipe inside building and above ground with high temperature mineral wool insulation of thickness indicated:

a) high pressure (above 415 kPa [60 psi]) steam piping, less than 40 mm (1-½") dia. – 100 mm (4") thick;

b) high pressure (above 415 kPa [60 psi]) steam piping, greater than or equal to 40 mm (1-½") dia. – 115 mm (4-½") thick;

c) high pressure condensate piping – 50 mm (2") thick;

d) engine-generator set exhaust system piping – 75 mm (3") thick.

3.4.2. Generally, install insulation on piping as specified above for fibreglass insulation.

3.4.3. Generally, install insulation on fittings as specified above for fibreglass insulation but cover with canvas, not PVC fitting covers.

## 3.5. PIPE INSULATION REQUIREMENTS – FLEXIBLE FOAM ELASTOMERIC

3.5.1. Install flexible elastomeric pipe insulation in strict accordance with manufacturer's published instructions to suit the application, and using adhesive, joint sealants and finish to produce a water-tight installation. Insulate refrigerant suction and hot gas piping outside building with 25 mm (1") thick flexible elastomeric pipe insulation.

## 3.6. PIPE INSULATION REQUIREMENTS – CLOSED CELL FOAMED GLASS

3.6.1. Install closed cell foamed glass insulation in strict accordance with manufacturer's published instructions to suit the application, and using adhesive, joint sealants, and jacketing to produce a water-tight installation. Insulate piping located outside building and indicated to be heat traced with minimum 50 mm (2") thick with closed cell foamed glass.

## 3.7. PIPE INSULATION REQUIREMENTS – FIRE RATED INSULATION

3.7.1. Where pipe (inside building and above ground) which is to be insulated as specified above penetrates fire rated construction, provide fire-rated, non-combustible sectional insulation on portion of pipe in fire barrier and for a distance of 50 mm (2") on either side of fire barrier. Insulation thickness is to be as noted, but in any case, minimum 25 mm (1").

## 3.8. INSTALLATION OF WEATHER-PROOF JACKETED INSULATION

3.8.1. Install sectional weather-proof jacketed pipe insulation in strict accordance with manufacturer's instructions to produce a water-tight weather-proof installation. Insulate fittings with blanket type glass fibre insulation of a thickness and insulating value equal to the sectional insulation and secured in place with adhesive and wire. Jacket fittings with manufactured aluminium fitting covers sealed water-tight. As per design requirements, insulate required pipe with weather-proof jacketed insulation.

## 3.9. INSTALLATION OF BARRIER FREE LAVATORY INSULATION KITS

3.9.1. Provide manufactured insulation kits to cover exposed drainage and water piping under barrier free lavatories.

## 3.10. EQUIPMENT INSULATION REQUIREMENTS – BLANKET TYPE FIBREGLASS

3.10.1. Insulate following equipment with fibreglass blanket type insulation of thickness indicated:

a) chilled water and/or domestic cold-water pump casings – 40 mm (1-½") thick;

b) roof drain sumps where inside the building – 25 mm (1") thick;

c) water meter(s) – 40 mm (1-½") thick;

d) top of radiant ceiling panels – 50 mm (2") thick.

3.10.2. Unless otherwise noted, wrap equipment to a thickness and insulating value equal to an equivalent thickness of rigid sectional pipe insulation. Laminate insulation in place with a full coverage of adhesive and secure with wire. Apply a jacket of insulation vapour barrier material secured in place with adhesive or sealant tape.

3.10.3. Cover roof drain sumps with purpose made PVC fitting covers.

3.10.4. Lay fibreglass blanket on radiant ceiling panels after testing is complete.

## 3.11. EQUIPMENT INSULATION REQUIREMENTS – SEMI-RIGID FIBREGLASS

3.11.1. Insulate following equipment with semi-rigid fibreglass board insulation of thickness indicated:

a) refrigeration machine water chiller(s) and suction elbow(s) – 50 mm (2") thick;

b) uninsulated domestic hot water storage tank(s) – 40 mm (1-½") thick;

c) shell and tube type heat exchangers – 40 mm (1-½") thick;

d) condensate receiver(s) – 40 mm (1-½") thick;

e) flash tanks – 40 mm (1-½") thick;

f) hot well tank – 40 mm (1-½") thick;

g) deaerating feedwater heater – 40 mm (1-½") thick;

h) blow-down tank – 40 mm (1-½") thick;

i) chilled water or chilled glycol solution storage tank – 50 mm (2") thick;

j) heating main air separator – 40 mm (1-½") thick;

k) chilled water expansion tank – 40 mm (1-½") thick.

3.11.2. Install insulation as required to fit shape and contour of equipment. Secure insulation in place with adhesive, and with aluminum straps on 450 mm (18") centres. Apply a 6 mm (¼") thick skim coat of insulating cement, then, when insulating cement has dried, apply a 6 mm (¼") thick coat of cement trowelled smooth.

3.11.3. For "cold" equipment, prime insulation with suitable sealer and apply a jacket of glass thread reinforced foil and kraft paper vapour barrier jacket material laminated in place with a full coverage of adhesive.

3.11.4. Provide removable and replaceable insulated metal covers for equipment with removable heads to permit heads to be removed and replaced without damaging adjacent insulation work.

## 3.12. EQUIPMENT INSULATION REQUIREMENTS – SEMI-RIGID MINERAL WOOL

3.12.1. Insulate following equipment with calcium silicate equipment insulation of thickness indicated:

a) engine-generator set exhaust system silencer(s) – 75 mm (3") thick;

b) uninsulated boiler breeching where inside the building – 75 mm (3") thick.

3.12.2. Cut or mitre insulation (or use factory scored type insulation) to fit shape and contour of equipment and secure insulation in place with aluminum straps on 450 mm (18") centres. Point joints, mitres, scores and gaps with insulating cement. Apply a 12 mm (½") thick coat of insulating cement and trowel smooth.

## 3.13. EQUIPMENT INSULATION REQUIREMENTS – CLOSED CELL FOAMED GLASS

3.13.1. As per design requirements, insulate equipment with closed cell foam glass insulation of required thickness.

3.13.2. Install insulation in strict accordance with manufacturer's published instructions using adhesive, wrap, sealant, etc., to secure insulation in place, to secure and seal joints, and to produce a 100% water-tight installation.

## 3.14. EQUIPMENT INSULATION REQUIREMENTS – REMOVABLE/REUSABLE TYPE

3.14.1. Provide custom designed and manufactured removable and reusable insulation covers for following:

a) plate type heat exchanger(s);

b) 150 mm (6") dia. and larger piping strainers, backflow preventers, etc.;

c) diesel engine exhaust manifolds;

d) 150 mm (6") dia. and larger steam traps and similar equipment.

3.14.2. Provide "wrap type" removable and reusable insulation covers for "cold" circuit balancing valves, backflow preventers, and similar items, and for steam traps and similar items requiring service in piping less than 150 mm (6") dia.

## 3.15. DUCTWORK INSULATION REQUIREMENTS – FIBREGLASS

3.15.1. Insulate following ductwork systems inside building and above ground with fibreglass insulation of thickness indicated:

a) outside air intake ductwork, casings and plenums from fresh air intakes to and including mixing plenums or sections, or, if mixing plenums or sections are not provided, to first heating coil, or if both mixing plenums or sections and heating coil sections are not provided, and fresh air is not tempered, then the fresh air ductwork system complete – minimum 40 mm (1-½") thick as required;

b) mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

c) supply air ductwork outward from fans, except for supply ductwork exposed in area it serves – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

d) exhaust discharge ductwork for a distance of 3 m (10') downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10') distance – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

e) any other ductwork, casings, plenums or sections specified or detailed on drawings to be insulated – thickness as specified.

3.15.2. Provide rigid board type insulation for casings, plenums, and exposed rectangular ductwork. Provide blanket type insulation for round ductwork and concealed rectangular ductwork.

3.15.3. Liberally apply adhesive to surfaces of exposed rectangular ducts and/or casings. Accurately and neatly press insulation into adhesive with tightly fitted butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom and side surfaces. Secure and seal joints with 75 mm (3") wide tape sealant. Additional installation requirements as follows:

a) at trapeze hanger locations, install insulation between duct and hanger;

b) provide drywall type metal corner beads on edges of ductwork, casings and plenums in equipment rooms, service corridors, and any other area where insulation is subject to accidental damage, and secure in place with tape sealant.

3.15.4. Liberally apply adhesive to surfaces of concealed rectangular or oval ductwork, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom surfaces. Secure and seal joints with 75 mm (3") tape sealant. At each trapeze type duct hanger, provide a 100 mm (4") wide full length piece of rigid fibreglass board insulation between duct and hanger.

3.15.5. Accurately cut sections of insulation to fit tightly and completely around exposed and concealed round or oval ductwork. Liberally apply adhesive to surfaces of duct, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Seal joints with tape sealant. At duct hanger locations install insulation between duct and hanger. At each hanger location for concealed ductwork where flexible blanket insulation is used, provide a 100 mm (4") wide full circumference strip of semi-rigid board type duct insulation between duct and hanger.

3.15.6. Insulation application requirements common to all types of rigid ductwork are as follows:

a) at duct connection flanges, insulate flanges with neatly cut strips of rigid insulation material secured with adhesive to side surfaces of flange with a top strip to cover exposed edges of the side strips, then butt the flat surface duct insulation up tight to flange insulation, or, alternatively, increase insulation thickness to depth of flange and cover top of flanges with tape sealant;

b) installation of fastener pins and washers is to be concurrent with duct insulation application;

c) cut insulation fastener pins almost flush to washer and cover with neatly cut pieces of tape sealant;

d) accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers;

e) prior to concealment of insulation by either construction finishes or canvas jacket material, patch vapour barrier damage by means of tape sealant.

## 3.16. DUCTWORK INSULATION REQUIREMENTS – FLEXIBLE ELASTOMERIC

3.16.1. Insulate exposed exterior ductwork (except fresh air intake ductwork) and associated plenums and/or casings outside building with minimum 40 mm (1-½") thick flexible elastomeric sheet insulation as required, applied in 2 minimum 20 mm (¾") thick layers with staggered tightly butted joints.

3.16.2. Install with adhesive in strict accordance with manufacturer's instructions to produce a weather-proof installation. Ensure sheet metal work joints are sealed watertight prior to applying insulation.

## 3.17. DUCTWORK INSULATION REQUIREMENTS – CALCIUM SILICATE

3.17.1. Insulate following kitchen exhaust ductwork with minimum 40 mm (1-½") thick calcium silicate block insulation:

a) kitchen exhaust ductwork from exhaust hood to masonry shaft – 2 hour rating;

b) stairwell pressurization ductwork from fan to stairwell – 1 hour rating.

3.17.2. Secure insulation in place with adhesive and with wire on 450 mm (18") centres. Point gaps and joints with insulating cement. Where ductwork is exposed, cover insulation with wire mesh secured to wire and with edges laced together and apply a coat of finishing cement trowelled smooth. Use drywall type metal corner bead for duct edges where finishing cement is applied.

## 3.18. DUCT WRAP REQUIREMENTS – FIRE RATED MATERIAL

3.18.1. Provide blanket type fire rated duct wrap system material for following ductwork to produce fire rating indicated:

a) kitchen exhaust ductwork from exhaust hood to masonry shaft – 2 hour rating;

b) stairwell pressurization ductwork from fan to stairwell – 1 hour rating.

3.18.2. Install duct wrap material in accordance with ULC design requirements and supplier's/manufacturer's instructions.

3.18.3. Coordinate installation of duct wrap with installation of ductwork.

3.18.4. Arrange and pay for duct wrap supplier to examine completed duct wrap system at site. Submit a letter from supplier to certifying duct wrap system has been properly installed.

## 3.19. APPLICATION OF INSULATING COATINGS

3.19.1. Apply, in accordance with manufacturer's instruction, insulating coatings to following bare metal surfaces:

a) paint bare metal surfaces clear of "cold" piping and/or equipment insulation for a distance of from 300 mm (12") to 600 mm (24") clear of pipe or equipment insulation, with "No Sweat-FX" or approved equivalent, anti-condensation coating;

b) paint bare metal surfaces associated with mechanical systems with an operating temperature 60 °C (140 °F) with "ThermaLite" or approved equivalent, insulating coating.

3.19.2. Apply coatings with a brush. Remove any splatter or excess coating from adjacent surfaces.

## 3.20. INSULATION FINISH REQUIREMENTS

3.20.1. Unless otherwise shown and/or specified, jacket exposed fibreglass insulation, and calcium silicate duct insulation work inside building with canvas secured in place with a full covering coat of lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent uninsulated surfaces.

3.20.2. Unless otherwise shown or specified, jacket exposed fibreglass insulation listed below with canvas jacket secured in place with a full covering coat of coloured lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent surfaces. Insulate services to receive coloured lagging adhesive as required.

3.20.3. Jacket exposed pipe insulation work inside building with white sheet PVC and fitting covers. Install sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal joints to produce a neat water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions.

3.20.4. Install rigid aluminum jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with the jacket. Provide aluminum jacket for insulation as required.

3.20.5. Install adhesive backed flexible aluminum to cleaned and primed metal surfaces which are between -23 °C and 74 °C (-10 °F and 165 °F) in strict accordance with manufacturer's published instructions and details, including shingle type overlap joints to shed water, and use of a hand roller to concentrate pressure on seams. Provide adhesive backed flexible aluminum jacket for insulation as required.

3.20.6. Install rigid stainless steel jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with jacket. Provide stainless steel jacket for applications as required.

3.20.7. Apply 2 heavy coats of "PITTCOTE 404" or approved equivalent, coating with 24 hr. between coats to foamed glass insulation exposed above grade.

3.20.8. Apply 2 coats (with 24 hr. between coats) of specified coating to flexible elastomeric insulation outside building.

**END OF SECTION**