



## **THERMAL INSULATION SPECIFICATION GUIDE FOR REFRIGERATION SYSTEMS**

This specification guide is based on the format recommended by MICA (Section VI Specification Writing, Specification Format Section 15250 Thermal Insulation General and Section 15253 Refrigerant Piping Systems).

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***Items in bold/italics must be completed by the specifying Engineer.***

### THERMAL INSULATION – GENERAL

#### Part I: General Provisions

##### A. General

This specification covers the materials, methods, and installation of thermal insulation for applications within a temperature range of -70°F to 220°F (-57°C to 104°C) for the purpose of condensation control and energy savings on the following:

1. All liquid and suction lines shall be insulated continuously from a point 6" (150mm) inside the display case to the suction service valve at the compressor except the high pressure liquid line coming from the evaporative condensers to the thermosyphon tank.
2. Hot gas defrost supply lines shall be insulated.
3. Heat traced condensate water drain piping shall be insulated.
4. Chilled water piping shall be insulated.
5. Heating hot water piping not located under the floor slab shall be insulated.
6. Low pressure ammonia piping and associated equipment shall be insulated.
7. Brine piping and associated equipment shall be insulated.
8. Miscellaneous piping subject to sweating under normal operating conditions shall be insulated.
9. ***Other applications which shall be insulated are listed below:***

*Note: Do not use FlexTherm Sheet, FlexTherm, FlexTherm White or FlexTherm Seam Seal Insulation on stainless steel components when the operating temperature exceeds 90°F (33°C).*

## B. Quality Assurance

All insulation recommendations/design criteria are based on products manufactured by Nomaco Insulation. Exceptions or additions to this specification shall be submitted for written approval by the specifying engineer prior to the bid date. Supporting technical data and samples must be submitted for comparison. Changes in specified work shall be made only by the issuance of a signed change order by the purchaser. Any alternate, recommended as an equivalent or equal must be validated by a third party based on having equivalent performance for the application being specified.

## C. Codes, Regulations and Standards

1. Insulation systems, repairs, additions and alterations shall be furnished and installed in accordance with industry standards and such statutory provisions as apply to the work under contract. All systems shall be installed according to the manufacturer's recommended practices.
2. All material shall conform to specified ASTM Standards where applicable, principally ASTM C534.
3. Contractors shall conform to all OSHA and other published practices for the installation of insulation.

## D. Definitions

***Any special terms or definitions should be inserted in this section.***

## Part 2. Materials and Products

### A. General

Insulation systems are based on utilization of flexible closed cell elastomeric insulation in tubular or sheet form.

### B. Materials – Physical Properties

1. Shall conform to the minimum requirements specified in ASTM C534.
2. Shall have a maximum thermal k factor of 0.28 BTU – in./hr. – sqft. – deg F (0.04W/mK) when tested according to ASTM C177 or C518 at 75°F (24°C) mean temperature.
3. Shall have a water vapor transmission rate of 0.10 perm – inch or less when tested according to ASTM E96 (dry cup method).
4. Material shall have a flame spread of 25 or less and a smoke development rating of 50 or less when tested according to ASTM E84 in thickness of 1" (25mm) and below.

In addition, the product shall not melt or drip flaming particles when subjected to a flame.

5. Materials shall be selected for proper size, fit and thickness. Tubing and/or piping shall be identified as such for correct insulation I.D. and wall.
6. All materials, including accessories (i.e. Adhesive, coatings etc.) shall be shipped to the job site in marked, unopened containers as received from the manufacturer. All boxes shall be identified with a manufacturing lot number allowing traceability back to the manufacturing date.
7. Materials shall be manufactured under the supervision of an independent third party testing program verifying the properties of k (thermal conductivity), wvt (water vapor transmission) and fire performance.
8. Elastomeric insulation may lose some resilience where directly exposed to operating temperatures below 20°F (-29°C), however, this hardness change does not effect the material's insulating performance.

#### C. Products – Approved for Use

1. FlexTherm Tubular Insulation supplied in wall thickness of 3/8" (10mm) to 1-1/2" (38mm) and ID's up to 4" IPS.
2. FlexTherm White, FlexTherm Seam Seal Elastomeric Tubular Insulation supplied in wall thickness of 3/8" (10mm) to 1" (25mm) and ID's up to 4" IPS.
3. FlexTherm Sheet Insulation supplied in thickness up to 2" (51mm).
4. Insulation Tape supplied in thickness of 1/8" (3mm) x 2" (50mm) wide x 30' (11m) long.
5. Type R-320, R-620, R-373 Contact Adhesive for adhering all seams, butts and ends.
6. Type R-374 Protective Coating for protection against degradation of ultraviolet rays in outdoor applications.

#### D. Materials Fabrication

All products should be installed according to manufacturer's recommendations.

1. Tubular applications requiring greater than 1-1/2" (38mm) wall insulation can be sleeved according to manufacturer's schedule.
2. All piping larger than 4" IPS should be insulated with sheet formed around the pipe with the seams and butt joints adhered with Approved Contact Adhesive.

### Part 3. Execution/Installation

#### 3.1 General

- A. All insulation work shall be performed by trained installers regularly engaged in the insulation trade.
- B. Progressive testing of systems to be insulated shall have been completed, inspected and approved by owner's representative before insulation is applied.
- C. Insulation shall not be applied until all surfaces are clean, dry and free of dirt, grease, moisture or other impurities such as corrosive cleaners and building dust. Insulation should not be applied to surfaces that are wet or frosted. Insulation should not be applied to a system which is in operation. Refrigerant pipe openings shall be sealed while slipping on insulation to prevent foreign matter from entering the tube.
- D. Suitable application use temperatures and conditions shall be provided by the Owner and in compliance with the installers design criteria.

- E. Insulation shall be protected from moisture and weather during storage and installation.
- F. All seams, butts and ends shall be completely sealed to retard moisture vapor from entering the system.
- G. All insulation shall be installed according to the manufacturer's recommended procedures and practices.
- H. At least 36 hours should be allowed after insulating for the adhesive to set before equipment is used.
- I. Apply foam tape by spirally wrapping with a 50% overlap. Remove the release liner to expose the adhesive on one side. Apply multiple layers until the desired thickness is reached. Do not stretch the tape during application.

### 3.2.1 Piping (New/Existing) Single Layer (1-1/2" (38mm) wall or less)

- A. On new installations, slide unslit tubular insulation over the open ends of the pipe and sleeve along the pipework for straight runs and long radius drawn bends (this method eliminates the longitudinal seam). Insulation installed in this manner should be pushed on, never pulled. Stretching the insulation may result in open seams and joints. Powder is applied at the factory to the I.D. of the product, to aid in sliding the product in place.  
On existing systems, install pipe insulation by slitting the six foot tubular sections and applying it onto the piping. All seams and butt joints shall be adhered and sealed using Contact Adhesive. Apply contact adhesive to both surfaces. Adhesive shall be tack dry prior to pressing the joint together.
- B. Sheet insulation shall be used on pipes larger than 4" IPS. Care shall be taken not to stretch the sheet insulation when covering the piping. Approved Contact Adhesive should be used to secure the seams and butt joints. The seam should be positioned to the bottom of the pipe. On 12" IPS and larger, adhere the insulation to the pipe on the lower 1/3 of the pipe.
- C. All exposed ends should be coated with Approved Contact Adhesive and the open ID's secured to the pipe by applying adhesive to the pipe surface and the insulation in an effort to maintain a vapor barrier for the system. This is required for low temperature and refrigeration lines.
- D. When brazing pipe joints or fittings, ease the insulation back along the pipe 8" (200mm) on each side of joint and retain with clamps. When brazed joint has fully cooled, apply a brush coat of contact adhesive to each butt joint; when set, press joints together.

### 3.2.2 Piping (New/Existing) Double Layer (over 1-1/2" (38mm) wall)

- A. On systems requiring greater than 1-1/2" wall insulation, sleeving can be used. Refer to manufacturer's recommended sleeving schedule.
- B. All seams should be staggered when applying multiple layers of insulation.
- C. The contact adhesive on the inner layer joint shall be completely cured prior to installing the outer layer of insulation.

### 3.2.3 Fittings, Elbows, Tees and Small Valves

- A. All fittings and small valves shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered and sealed with Approved Contact Adhesive. Screwed fittings, typically found on iron pipe, shall be sleeved by using oversize insulation tube or sheet to cover the fitting with a minimum one inch overlap onto the adjacent insulation.

- B. All elbows shall be insulated with mitered tubular sections or sheet insulation of equal thickness to the adjacent piping. All seams shall be adhered and sealed with contact adhesive.
- C. All Tees shall be insulated with the same insulation thickness as the adjacent piping. Tees shall be insulated from fabricated tubular insulation.
- D. All large valves (gated strainer), flanges and couplings shall be insulated with sheet material, fabricated according to the manufacturer's recommended practices. Insulate valves to the bonnet flange, to a point below the packing gland. Seal around the bonnet flange with contact adhesive.

#### 3.2.4 Pipe Hangers

- A. Where piping is directly supported by hangers, the hanger rods shall be insulated with the same thickness of insulation as the adjacent piping. Oversized tubular insulation or insulation tape can be used for this purpose. All seams, joints and terminated ends shall be sealed with Approved Contact Adhesive.
- B. Properly sized saddles shall be used wherever the insulation may be compressed due to the weight of the pipe. Wooden or polyethylene dowels or wooden or calcium silicate blocks inserted between the pipe and the saddle can be used to relieve the weight on the insulation. For all cold and refrigeration systems, the dowels or blocks must be adhered to the insulation and the surface sealed with Approved Contact Adhesive.

#### 3.2.5 Outdoor Applications (Protective Coatings)

- A. Insulation installed outdoors shall have the seams longitudinal located on the lower half of the pipe for added protection from UV degradation and seam failure.
- B. Type R-374 Protective Coating should be applied to the insulation when it is installed outdoors for ultraviolet protection. The insulation must be free of contaminants such as dirt. If the insulation is not clean, it should be wiped down with a cleaning solution such as denatured alcohol. To insure good adhesion, the temperature should be above 50°F (10°C) during application and drying. Two coats are recommended for best performance. Four hours should be allowed between coats for drying. Periodic refinishing may be required to prolong the lifespan of the insulation.
- C. As an alternative to the Type R-374 Protective Coating, waterproofing mastics (i.e. as supplied by Fosters, Childers or Mon Eco), PVC, metal or aluminum jacketing may be used and should be applied according to the manufacturer's recommendations.

#### 3.2.6 Thickness Schedule to Prevent Condensation on Refrigerant Piping Systems

***Note: Insulation recommendations are based on data generated using Nomaco Insulation Products. Design criteria used to prevent condensation for cold piping systems were for normal conditions of 85°F (29°C) Ambient and 70% Relative Humidity. More severe conditions would require additional insulation. Insulation thicknesses must comply with all applicable code provisions.***

***Design criteria used for energy savings on hot piping systems were based on typical energy costs and operating conditions. These may not reflect actual conditions and should be verified for each application.***

Piping System	Up to 2"	Over 2" to 4"	Over 4" to 6"	Over 6"
	(50mm)	(50mm-100mm)	(100mm-150mm)	(150mm)
Chilled water:				
Chilled water (40°F) (4°C)	½" (13mm)	½" (13mm)	½" (13mm)	¾" (19mm)
Condensate Drain	½" (13mm)	½" (13mm)	½" (13mm)	¾" (19mm)
Refrigeration:				
Above 25°F (-4°C)	¾" (19mm)	¾" (19mm)	¾" (19mm)	¾" (19mm)
10°F to 25°F (-12°C to -4°C)	¾" (19mm)	1" (25mm)	1" (25mm)	1" (25mm)
-10°F to 10°F (-23°C to -12°C)	1" (25mm)	1" (25mm)	1-¼" (32mm)	1-¼" (32mm)
-30°F to -10°F (-34°C to -23°C)	1-¼" (32mm)	1-¼" (32mm)	1-3/8" (35mm)	1-½" (38mm)
Below -30°F (-34°C)	Contact Nomaco Insulation for recommendation.			

### 3.3 Vessels and Equipment Insulation

#### 3.3.1 General Recommendations

- A. Insulation Sheet shall be used to insulate equipment.
- B. All surfaces shall be clean and free of dirt, grease and other contaminants. If necessary, surfaces should be cleaned with a cleaner such as denatured alcohol to ensure good adhesion.
- C. Insulation shall be adhered to the surfaces with full coverage of contact adhesive.
- D. All seams, butt joints and exposed end cuts shall be adhered with contact adhesive. All joints between sheets should be made under compression.
- E. When multiple layers are applied, seams shall be staggered.

#### 3.3.2 Vessels and Equipment Insulation Schedule

**Note: Insulation Recommendations are based on data generated using Nomaco Insulation Insulation Products. Design criteria used to prevent condensation were for normal conditions of 85°F (29°C) and 70% Relative Humidity. More severe conditions would require additional insulation. Insulation thicknesses must comply with all applicable code provisions.**

**Design Conditions used for energy savings on hot systems were based on typical energy costs and operating conditions. Energy calculations were based on thickness recommendations which would typically achieve between 20 – 40 BTU loss per hour per square foot. These may not reflect actual conditions and should be verified for each application.**

System Temperature	Thickness Recommendation
Below -20°F	Contact Nomaco Insulation for recommendation
-20°F to 0°F	(-29°C to -18°C) 2" (50mm)
0°F to 20°F	(-18°C to -7°C) 1-½" (38mm)
20°F to 40°F	(-7°C to 4°C) 1" (25mm)

40°F to 60°F	(4°C to 16°C)	$\frac{3}{4}$ " (19mm)
60°F to 100°F	(16°C to 38°C)	$\frac{1}{2}$ " (13mm)
100°F to 120°F	(38°C to 49°C)	1" (25mm)