

GUIDE SPECIFICATION: REFRIGERATION SYSTEMS

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. This specification covers the materials, methods, and installation of thermal insulation for refrigeration piping and equipment, including but not limited to, refrigeration suction, sub-cooled liquid piping, and evaporator coil condensate piping, for the purpose of condensation control, freeze prevention, and energy savings.

1.02 REFERENCES

- A. ASTM (American Society for Testing and Materials)
- B. ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers)
- C. NSF (National Sanitation Foundation)
- D. OSHA (Occupational Safety & Health Administration)

1.03 DEFINITIONS

- A. Thermal Conductivity (K-value): The time rate of steady state heat flow through a unit area of a homogeneous material induced by a unit temperature gradient in a direction perpendicular to that unit area. Typically expressed in units of Btu-inch / hour per square foot per degree F. The lower the K-value, the higher the insulating value.
- B. Water Vapor Transmission Rate: The steady water vapor flow in unit time through unit area of a body, normal to specific parallel surfaces, under specific conditions of temperature and humidity at each surface.

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

1.04 QUALITY ASSURANCE

- A. All insulation recommendations/design criteria are based on products manufactured by K-Flex USA.
- B. Material shall be delivered in non-broken, factory-furnished packaging and stored in a clean, dry indoor space that provides protection against the weather.
- C. Insulation shall be applied by qualified personnel skilled in this trade.

1.05 SUBMITTALS FOR INFORMATION



- A. Product data: To include product description, manufacturer's installation instructions, types of insulation and recommended thicknesses for each application, and location of materials.
- B. Samples of systems shall be provided upon engineer's request.

1.06 CODES, REGULATIONS & STANDARDS

- A. Insulation systems, repairs, additions and alterations shall be furnished and installed in accordance with industry standards (ASHRAE) and such statutory provisions (national, state and local codes) as apply to the work under contract. All systems shall be installed according to the manufacturer's recommended practices.
- B. All material shall conform to specified ASTM Standards where applicable, principally ASTM E84 and ASTM C534.
- C. When applicable all materials shall conform to NSF or other requirements that are mandated for the application or equipment.
- D. Contractors shall conform to all OSHA and other published practices for the installation of insulation.

PART 2 – PRODUCTS

2.01 INSULATION MATERIALS

- A. Physical Properties:
 - 1. Insulation shall have a maximum thermal k value of 0.25 BTU - in./hr. - ft² - °F (0.036 W/mK) when tested according to ASTM C177 or C518 at 75°F (24°C) mean temperature.
 - 2. Insulation shall have a water vapor transmission rate of 0.01 perm - inch or less when tested according to ASTM E96 (dry cup method).
 - 3. Insulation shall have a flame spread of 25 or less and a smoke development rating of 50 or less when tested according to ASTM E84 at the installed thickness for applications inside the building envelope.
 - 4. Insulation materials shall be manufactured without the use of CFCs, HFCs, or HCFCs and also be free of formaldehyde, fibers and dust.
 - 5. Insulation materials shall be UL GREENGUARD® Gold Certified for VOC content.
 - 6. Insulation shall be UL Validated as Mold Resistant per UL 2824 / ASTM D6329.
 - 7. Insulation materials installed indoors that are exposed to food prep or wash down areas shall be NSF-certified to Standard 169, "Special Purpose Food Equipment and Devices".
 - 8. Insulation materials shall be manufactured under the supervision of an independent third party testing program verifying the properties of K-value (thermal conductivity), wvt (water vapor transmission) and fire performance.



B. Flexible Elastomeric: Closed Cell Flexible Elastomeric Foam Insulation that complies with ASTM C 534, Type I for tubular material and Type II for sheet material.

1. Products: Subject to compliance with requirements, available products that may be incorporated include, but are not limited to, the following:

a. K-Flex USA; Insul-Tube, Insul-Lock DS, K-Fit Fittings

2. *Product Recommendations: Recommendations for different applications are as follows:*

a. *Pipe and Equipment Insulation: Insul-Tube, Insul-Lock DS tubular insulation supplied up to 2" wall thickness.*

b. *Factory Fabricated Fittings (Elbows, Tees): K-Fit*

2.02 ADHESIVES

A. Flexible Elastomeric Adhesives: For adhering all seams, butts and ends, and adhering sheet insulation to substrates.

1. Products: Subject to compliance with requirements, available products that may be incorporated include, but are not limited to, the following:

a. K-Flex USA; K-Flex Contact Adhesive (373, 320, 420, 620, 720 LVOC, or 1120)

2. *Product Recommendations: Recommendations for different applications are as follows:*

a. *Fast Dry Adhesives: K-Flex 320 (Amber Color) or 620 (Black Color)*

b. *Comply with MIL-A-24179: K-Flex 373 (Blue Color)*

c. *LEED Projects: K-Flex 720 LVOC and K-Flex 1120. These adhesives meet the VOC requirements of South Coast Air Quality Management District (SCAQMD) Regulation 1168.*

d. *Water Based: K-Flex 1120*

e. *Comply with ASTM C916 Type 1: K-Flex 1120*

2.03 FACTORY OR FIELD APPLIED JACKETS AND FINISHES

A. Jacketing shall be a PVC Composite Jacket (PCJ) in lieu of metal or PVC jacketing:



B. PCJ shall have a maximum permeance of 0.001 perms when tested according to ASTM E 96 (dry cup method), shall be puncture and dent resistant, shall have a minimum thickness of 0.012", shall have a flame/smoke rating of 25/50 or less when tested according to ASTM E 84 for indoor applications, and shall be NSF-certified for use in food prep or wash down areas.

1. Products: Subject to compliance with requirements, available products that may be incorporated include, but are not limited to, the following:

a. K-Flex USA; K-Flex Clad WT, K-Flex Clad AL, K-Flex Titan

2. *Products Recommendations: Recommendations for different applications are as follows:*

a. *Indoor NSF certified applications: K-Flex Clad WT or WT NS*

b. *Outdoor Jacket: K-Flex Clad AL or AL NS, K-Flex Titan*

c. *Outdoor Finish (UV Protection Only): K-Flex 374 Protective Coating*

2.04 INSULATED PIPE SUPPORTS

A. Insulated pipe supports shall be used at pipe hanger locations to prevent insulation compression, and shall be comprised of a load-bearing rigid foam insert (high-density urethane or equivalent) with elastomeric foam collars, and shall have a minimum compressive strength of 72 psi.

1. Products: Subject to compliance with requirements, available products that may be incorporated include, but are not limited to, the following:

a. K-Flex USA; K-Flex 360 Insulated Pipe Support

PART 3 – EXECUTION

3.01 EXAMINATION AND PREPARATION

A. All insulation work shall be performed by trained personnel 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 imperfections. Insulation should not be applied to surfaces that are wet or frosted. Insulation should not be applied to a system that is in operation.



- D. All refrigerant copper lines must be free of extraneous chemicals, such as corrosive cleaners or building material's dust, prior to installation.
- E. Suitable application temperatures and conditions shall be provided by the Owner and in compliance with the installers design criteria.
- F. 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.
- G. All insulation materials shall comply with specification requirements (material type, thickness and ID).
- H. Insulation shall be protected from moisture and weather during storage and installation. Insulation must be clean and dry prior to installation.
- I. The use of an independent inspection agency to determine that insulation materials have been installed correctly is optional. Where so required, it is recommended that the inspection agencies be certified under the National Insulation Association certified thermal insulation inspector program (TIIP).

3.02 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Install refrigeration piping insulation in accordance with ASTM C1710 and manufacturer's recommendations.
- B. Install insulation using the following general guidelines:
 - 1. Install pipe insulation by sliding non-slit sections over the open ends of pipe.
 - 2. Refrigerant pipe shall be sealed while slipping on insulation to prevent foreign matter from entering the tube. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.
 - 3. Do not slit tubes for straight pipe sections unless unavoidable.
 - 4. Longitudinal seams shall be installed facing down in order to reduce weight and pressure on the seam.
 - 5. All seams, butts and ends shall be completely sealed to retard moisture vapor from entering the system using K-Flex contact adhesive. Do not tape insulation joints.
 - 6. All fittings (elbows, tees) shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with K-Flex contact adhesive.



7. Insulation shall be adhered directly to the pipe using a two-inch strip of K-Flex contact adhesive on the ID of the insulation and on the pipe at the following locations: high end of the pipe run, every termination point (supports, valves, flanges, end of pipe run), and every 18 feet of the pipe run.
8. K-Flex 360 Insulated Pipe Supports, comprised of high-density rigid foam inserts with elastomeric foam collars, shall be installed at all pipe hanger locations to prevent the insulation from compressing. The pipe support shall have with the same insulation thickness as the pipe insulation. All joints shall be sealed with K-Flex contact adhesive. Saddles shall be installed under all insulated lines at locations where the hanger may move due to movement in the piping from expansion and contraction.
9. All outdoor piping exposed to sunlight and weather shall be covered with a PCJ field or factory applied, or shall be painted with two coats of K-Flex 374 Protective Coating (where allowed by code). Prior to applying 374 Protective Coating, the insulation shall be wiped clean with denatured alcohol. All outdoor exposed piping seams shall face downward.

C. Piping Insulation Thickness Schedule:

*Note: Insulation thickness recommendations are based on data generated using K-Flex USA Insulation Products. Design criteria used to prevent condensation for cold piping systems were for **normal conditions of 85°F Ambient Temperature and 70% Relative Humidity**. More severe conditions require additional insulation. Insulation thicknesses must comply with all applicable code provisions. Recommendations below comply with ASHRAE 90.1 – 2010 requirements.*

1. All liquid and suction lines shall be insulated continuously from a point 6" inside the display case to the suction service valve at the compressor.
2. Pipes to be insulated include, but may not be limited to, domestic water, roof drain, condensate drain, evaporator condensate, liquid / suction refrigerant, ammonia, glycol secondary loop, and CO2 secondary loop.
3. Miscellaneous piping subject to sweating under normal operating conditions shall be insulated.
4. Piping design must allow for adequate spacing of insulation thickness and cross ventilation around the insulation. Do not crowd the insulation.

Refrigeration Piping System	≤1½"	1½" to 4"	>4" to 6"
Above 25°F	¾"	1"	1"
11°F to 25°F	¾"	1"	1"
-9°F to 10°F	1"	1"	1½"
-30°F to -10°F	1½"	1½"	1½"
<-30°F (-34°C)	Contact K-Flex USA for recommendation.		

END OF SECTION

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

