

GUIDE SPECIFICATION: DUCT LINER

This specification guide includes internal thermal & acoustical insulation for ductwork and air handling systems. This section is based on the format recommended by MICA (Midwest Insulation Contractors Association) and has been revised to include K-Flex USA products and installation recommendations. When a project requires more detailed specification statements, one should consult Section 230716 – HVAC Equipment Insulation, 230713 – Duct Insulation, or 233113 – Metal Ducts.

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. This specification covers the materials, methods, and installation of internal thermal and acoustical insulation for ductwork, equipment and air handling applications within a temperature range of -40°F to +220°F for the purpose of condensation control, energy savings and noise reduction.

1.02 REFERENCES

- A. ASTM (American Society of Testing Materials)
- B. ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers)
- C. SMACNA (Sheet Metal and Air Conditioning National Association)
- D. UL (Underwriter's Laboratories)
- E. UL GREENGUARD®
- F. USDA (US Department of Agriculture)
- G. RoHS (Restriction of the use of Hazardous Substances)

1.03 DEFINITIONS

- A. UL GREENGUARD® Environmental Institute: Independent testing of products for emissions of Volatile Organic Compounds (VOCs). Provides independent, third-party certification of IAQ performance. Certification is based upon criteria used by EPA, OSHA and WHO.
- B. IAQ: Indoor Air Quality
- C. EPA: Environmental Protection Agency
- D. WHO: World Health Organization
- E. OSHA: Occupational Safety and Health Administration
- F. Thermal Conductivity (K-Value): The amount of heat in BTU's transferred in one hour through one square foot of homogenous material one inch in thickness when there is a temperature difference of 1°F. The lower the K Value, the higher the insulating value.
- G. 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.



- H. Noise Reduction Coefficient (NRC): A single number rating that is the arithmetic average of the individual sound absorption coefficients at 250, 500, 1000 and 2000 Hz to the nearest 0.05.

1.04 QUALITY ASSURANCE

- A. All insulation recommendations/design criteria are based on products manufactured by K-Flex USA. 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 and review.
- 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 should be applied by qualified personnel skilled in this trade.
- D. Products for installation in air handling systems shall have a flame-spread index of 25 or less and a smoke-developed index of 50 or less when tested to ASTM E84, latest revision.

1.05 SUBMITTALS FOR INFORMATION

- A. Product data: To include product description, manufacturer's installation instructions, types 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 / SMACNA) 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 E2231, and ASTM C534 and C1534.
- C. When applicable, all materials shall conform to UL, USDA, GREENGUARD®, RoHS 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 ACOUSTIC DUCT LINER INSULATION MATERIALS

A. Physical Properties:

1. Insulation shall have a maximum thermal k value of 0.25 BTU - in./hr. - ft² - °F when tested according to ASTM C177 or C518 at 75°F mean temperature.
2. Insulation shall have a water vapor transmission rate of 0.06 perm - inch or less when tested according to ASTM E96 (dry cup method).
3. Insulation shall have a maximum water absorption rate of 0.2% (% by volume), when tested in accordance with ASTM C209.
4. 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.
5. Insulation materials shall be manufactured without the use of CFCs, HFCs, or HCFCs and also be free of formaldehyde, fibers and dust.
6. Insulation materials shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411 at a temperature of 250°F.
7. Insulation materials shall meet the requirements of UL 181 for mildew and air erosion, NFPA 90A, and NFPA 90B.
8. Insulation materials shall have a minimum NRC of 0.55 when tested to ASTM C423 at a nominal 1" thickness when used to line ducts.
9. Insulation materials shall be UL GREENGUARD Gold Certified for VOC content.
10. Materials shall be UL validated for resistance to mold growth.
11. Insulation 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.

B. Flexible Elastomeric: Closed Cell Flexible Elastomeric Foam Acoustical Duct Liner that complies with ASTM C534, Type II for sheet material and ASTM C1534 for duct liner.

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 Duct Liner Gray, K-Flex Duct Liner Gray with PSA

2.02 ADHESIVES

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



1. Products: Subject to compliance with project 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 Adhesive. 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: K-Flex 1120*

2.03 PROTECTIVE FINISH

- A. When duct liner is used in conjunction with UV sterilization lights a protective finish shall be applied to the duct liner every 2-3 years
 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 374 Protective Coating

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. Suitable application temperatures and conditions shall be provided by the contractor and in compliance with the installer's design criteria. Installation work shall be performed at the temperatures recommended by the product manufacturer.
- E. All materials, including accessories (i.e. adhesive, coatings, etc.) shall be shipped to the fabrication 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.
- F. All insulation materials shall comply with specification requirements (material type, thickness).
- G. Insulation shall be protected from moisture and weather during storage and installation. Insulation must be clean and dry prior to installation.
- H. 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 insulation inspector program (TIIP).

3.02 GENERAL INSTALLATION GUIDELINES

- A. Install insulation in accordance with SMACNA guidelines and manufacturer's instructions.

3.03 INSTALLATION OF FLEXIBLE ELASTOMERIC ACOUSTIC DUCT LINER

- A. Acoustic Duct Liner Installation on Square, Rectangular or Round Ductwork:
 - 1. Ductwork shall be insulated (lined) using K-Flex Duct Liner Gray Sheet Insulation, and installed according to manufacturer recommendations.
 - 2. Sheet shall be adhered directly to the duct using a minimum of 90% coverage of K-Flex contact adhesive. All surfaces shall be clean and free of dirt, rust, grease, or other impurities. If the surface is not clean, it should be wiped down with a cleaner such as denatured alcohol to ensure good adhesion. Use of K-Flex Duct Liner Gray with PSA (pressure sensitive adhesive) is an acceptable option in lieu of contact adhesive.
 - 3. Provide mechanical fastening per SMACNA or ASHRAE recommendations. The use of adhesive backed "stick pins" is not acceptable. Mechanical fasteners shall be installed perpendicular to the duct surface, and in no instance shall the pin compress the liner more than 1/8" relative to the nominal thickness of the insulation.



4. All internal duct areas shall be covered with duct liner. Longitudinal corner joints shall be overlapped and compressed. Length of duct should allow for reaching in to apply 100% pressure to all interior surfaces.
5. For rectangular or square ductwork, installation shall be with fabricated pieces, not wrapped. The bottom and top pieces shall be cut to the full width plus ¼". The sides shall be cut ¼" oversized and compression fit.
6. For round duct, inside diameter of the duct should allow for adequate pressure to be applied to all surfaces.
7. Duct systems with internal air velocities above 4,000 fpm shall have metal nosing applied to every leading edge.

NOTE: When TDC (flanged) connections are used, minimize the thickness of the gasket or sealant between duct sections to minimize any gap in the insulation between duct sections.

B. Duct Liner Acoustic Insulation Thickness Schedule:

*Note: Insulation recommendations are based on data generated using K-Flex USA Elastomeric Insulation Products. Design criteria used to prevent condensation were for normal **conditions of 85°F Ambient Temperature and 70% Relative Humidity**, unless noted otherwise. More severe conditions would require additional insulation. Insulation thicknesses must comply with all applicable code provisions.*

Design criteria 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.

ASHRAE 90.1-2010 and most state and local codes determine thickness recommendations (min. R value) based on climate zone and location of the duct i.e. exterior, unconditioned space attic, etc. Minimum R values will range from 1.9 to 8.0 depending on the climate zone and the location of the duct.

Duct System: (Supply and Return, Outside and Exhaust Air)

System Temperature	Sheet Thickness Recommendation	
Below 0°F	2"	R = 8
0°F to 20°F	1.5"	R = 6
20°F to 40°F	1"	R = 4.2
40°F to 60°F	0.75"	R = 3
60°F to 100°F	0.5"	R = 2
100°F to 120°F	0.75"	R = 3
120°F to 140°F	1"	R = 4.2
140°F to 160°F	1.5"	R = 6

END OF SECTION

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

