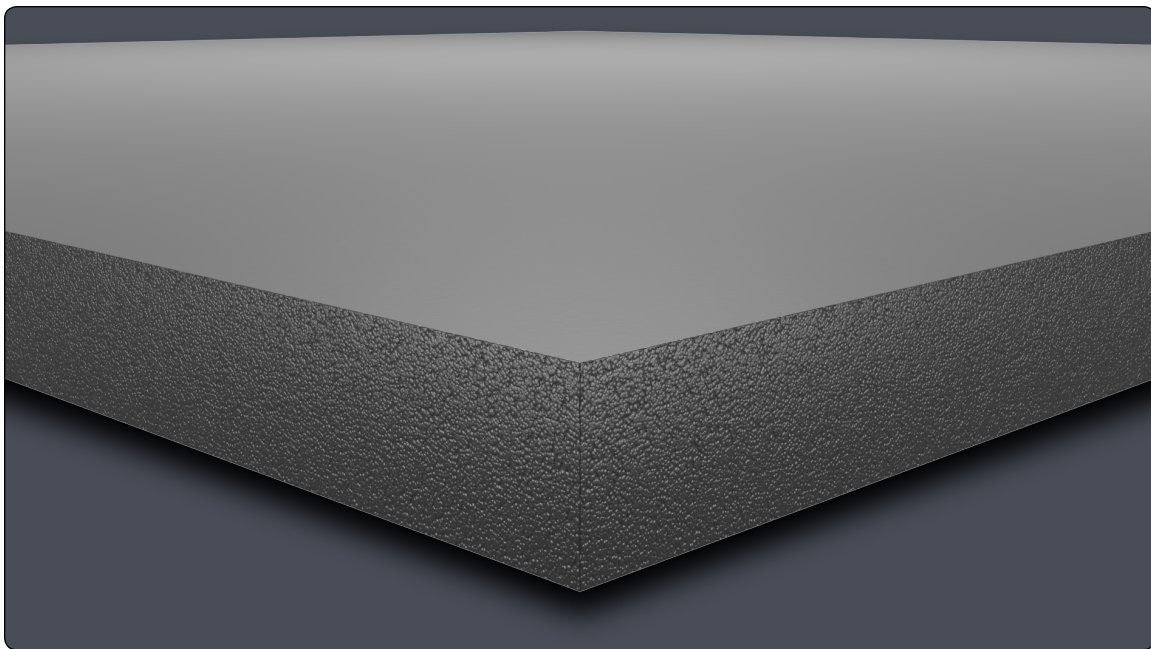




# Duct Liner Insulation

---

Product Performance for Lining HVAC Ducts





# K-FLEX

## ABOUT K-FLEX USA



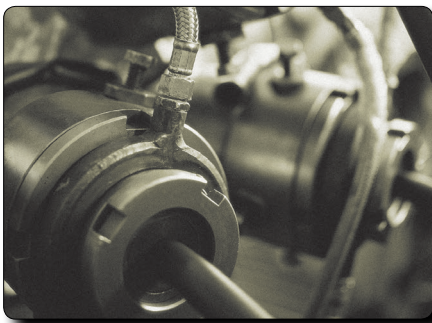
Youngsville, NC Headquarters

**K-FLEX USA IS A LEADING MANUFACTURER** of closed cell flexible elastomeric foam insulation products for mechanical piping, air handling units and vessels.

Designed for ease of installation and reliable performance, K-FLEX® products provide excellent thermal and acoustical performance, including inherent resistance to moisture intrusion.

In April 2012, K-FLEX USA was awarded with ISO 9001:2008 certification by FM Approvals. The independent certification demonstrates the company's commitment to quality.

K-FLEX products have proven performance in the Plumbing, HVAC/R, Commercial/Industrial, Marine, Oil & Gas, Acoustic and OEM Markets.



K-FLEX USA prides itself on being responsive to the market, providing dependable service to customers throughout North America, bringing an innovative approach to product offerings, and having products that are 3rd party tested and certified.

As a member of the IK Insulation Group, K-Flex USA delivers state-of-the-art levels of technical knowledge and customer support to the global mechanical insulation market.

**ISO 9001  
CERTIFIED**



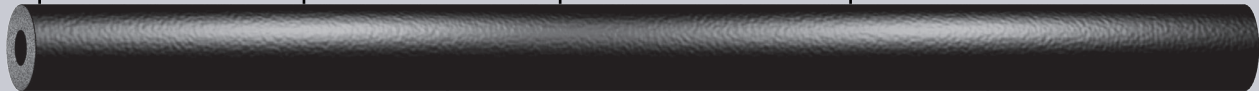
### COMPANY HISTORY

**1965**  
Rubatex was formed.

**1989**  
L'Isolante K-FLEX was formed.

**2001**  
Nomaco Insulation and L'Isolante K-FLEX joined to form Nomaco K-FLEX (NKF).

**2004**  
NKF acquired RBX's mechanical insulation business.



**1975**  
Halstead was formed and INSUL-TUBE® became a well-known product brand.

**1999**  
Rubatex acquired Halstead to form RBX Industries.

**2002**  
NKF entered into a Sales & Marketing Agreement with RBX Industries.

**2008**  
L'Isolante K-FLEX and Nomaco split. K-FLEX USA was formed.

### K-FLEX USA BENEFITS

- Designed for lasting performance
- Easy-to-Use Products
- Responsive to market
- Industry & Product expertise
- 3rd Party Certified Products
- Broad Product Range
- Systems Approach
- Factory-applied PSA & Cladding to Insulation
- Full line of accessories (tapes, adhesives, etc)

### GLOBAL PRESENCE



#### L'ISOLANTE K-FLEX:

- 11 Production Facilities in 9 Countries
- Worldwide Commercial Distribution
- Headquartered in Italy

# DUCT LINER APPLICATION CONSIDERATIONS

## Conditions

A key design objective of modern residential, commercial and industrial facilities is to incorporate a concern for energy consumption, as well as occupant comfort and safety. A healthier, more productive and more attractive environment depends in large part on well-designed and properly-insulated HVAC duct systems, which carry air to conditioned spaces inhabited by people, sensitive equipment, or a combination of both.

The advent of enhanced Indoor Air Quality (IAQ) has influenced engineers to 1) keep interior ducts free of foreign materials that bring fibers into the air stream, absorb moisture, or support mold growth, and 2) address sound reduction mechanically through deflection and other methods. However, not using interior insulation results in increased transferred noise, energy loss, and higher cost solutions. Using a fiber-free, closed cell elastomeric liner provides a solution for all of these issues.

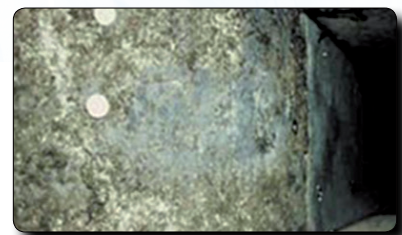
## Critical Factors to Consider

Using the proper insulation material, thickness, installation procedure and maintenance has many benefits, including:



## Causes of Insulation Failure

Attenuating noise carried through ductwork is a vital function of a duct liner insulation material to help create productive living, work and learning environments. Additional purposes for duct insulation are energy conservation and IAQ control. For both of these functions, moisture vapor intrusion is the single-most destructive factor, with studies showing that for every 1% moisture gain, the insulation efficiency drops 7.5%. This gain takes place as moisture-laden air migrates through the insulation system to the duct surface and forms moisture on the duct. A closed cell structure of the insulation is critical as moisture inevitably accumulates in permeable insulation even with a facing. Further, costly and dangerous mold growth on the insulation surface inside the duct (pictured top right) and outer surface of the duct (pictured bottom right) can result when the insulation has failed.





## INSULATION OPTIONS

The purpose of these technical notes is to offer designers and those working in the field a thorough overview of insulation materials commonly used for

the purpose of lining HVAC ducts. For an understanding of the analysis carried out, we will refer both to the most commonly used materials (table 1) and to the

headings and sources of data presented in table 2.

**Table 1**

<b>A</b>	K-FLEX FLEXIBLE CLOSED CELL ELASTOMERIC FOAM
<b>B</b>	FIBROUS-BASED LINERS
<b>C</b>	SEMI-CLOSED CELL FOAMS

**Table 2**

	TOPIC	SOURCE OF DATA
<b>1</b>	Performance	average values gathered from manufacturer and industry resources
<b>2</b>	Installation	manufacturer and industry recommendations regarding use and installation of product

## TECHNICAL PROPERTIES

	K-FLEX Duct® Liner Gray Closed Cell Elastomeric	Fibrous	Semi-Closed Cell Elastomeric Foam
Closed Cell Structure	Yes	No	No
Flexible	Yes	Yes	Yes
Thermal k (75°F mean)	0.25	0.23	0.25
Water vapor permeability without jacketing (perm-in)	<0.06	75.00	Info not available
Water Absorption (lbs/ft²) (ASTM D1667)	0.091	2.673	Info not available
Requires additional facing	No	Yes	No
25/50 flammability rating	Yes (2")	Yes	Yes (1")
Service Temperature (°F)	-297°F to + 220°F	0°F to + 250°F	-297°F to + 180°F
Density (pcf)	3 - 4	1.5 - 3	3 - 6
Available with PSA	Yes	No	No
Fiber-free	Yes	No	Yes
Non-porous	Yes	No	No
Resists Dirt Accumulation	Yes	No	Yes
NRC Value (1")	0.55	0.70	0.60
GREENGUARD	Yes	Yes	Yes
GREENGUARD Gold	Yes	Yes	Yes
UL Validated Mold Resistance	Yes	Yes	No

# NOISE REDUCTION

Effective noise reduction in ducts requires an integrated strategy of good mechanical layout, vibration isolation and insulation with noise absorbing properties. Acoustic performance can be categorized into two functions: noise reduction (absorption) and sound barrier. For duct lining applications, the primary acoustical goal of the insulation is to achieve noise reduction through the absorption of air-borne and structure-borne sound waves and the subsequent conversion of sound energy into heat. The insulation absorbs noise from the air handler (fan) and room, and prevents it from traveling down the duct and exiting at the vent openings.

Noise reduction, quantified by the Noise Reduction Coefficient (NRC), measures the percentage of sound

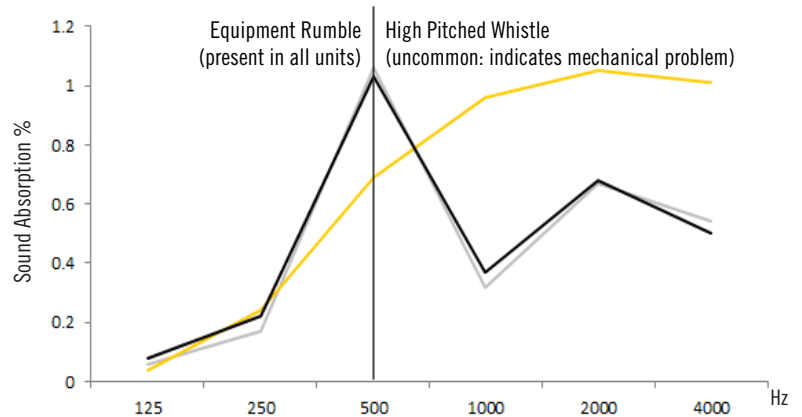
absorption in a reverberation room by determining noise decay rate. K-FLEX Duct Liner Gray outperforms fibrous, and is comparable to semi-closed cell elastomeric, in absorbing noise at low frequencies associated with equipment rumble (125 - 500 Hz), which is the #1 target for acoustical treatment. Noise from higher frequencies, i.e. high pitched screeching, is the result of a mechanical problem downstream and is not usually a consideration.

Sound barriers, quantified by the Sound Transmission Loss (STL), reduce the amount of noise that pass through an area, by reflecting the sound waves back to its source. STL values are defined as the difference in decibels (dB) between the average sound pressure levels in the source and receiving rooms before

and after acoustic treatment which are then used to determine the Sound Transmission Class (STC) of the product. Sound barrier properties are generally related to the mass of the material in that the higher the mass, the higher (better) the STC value. In the case of metal air ducts, the metal duct itself is a good barrier material and the insulation is not a major contributor as a sound barrier. When STC values are given for duct lining materials, they are often tested as a composite (insulation and metal together) as this provides a more accurate measure of the STL of the application and if the insulation were tested by itself, it would not provide a very high value. It should be noted however, that insulation, when adhered to the duct will reduce noise created by vibration from the duct.

## Sound Performance Comparison

- K-FLEX DUCT LINER GRAY
- Fiberglass
- Semi-Closed Cell Elastomeric Foam



Sound Absorption	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
1" K-FLEX Duct Liner Gray	0.06	0.17	1.06	0.32	0.67	0.54	0.55
1" Fibrous*	0.08	0.19	0.69	0.94	0.99	0.98	0.70
1" Semi-Closed Cell Foam*	0.08	0.22	1.00	0.37	0.68	0.50	0.60

Sound Barrier (dB)	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	STC
1.5" K-FLEX Duct Liner Gray**	12	10	13	14	22	31	16
1" K-FLEX Duct Liner Gray**	3	8	10	10	14	23	12
1" K-FLEX Duct Liner Gray***	15	22	22	26	38	50	27

Sound Insertion Loss (dB)	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
1" K-FLEX Duct Liner Gray	1	3	20	7	12	12	12

\*Manufacturer's published data.

\*\*Tested as insulation only.

\*\*\*Tested with insulation attached to metal duct.



## ENERGY CONSERVATION

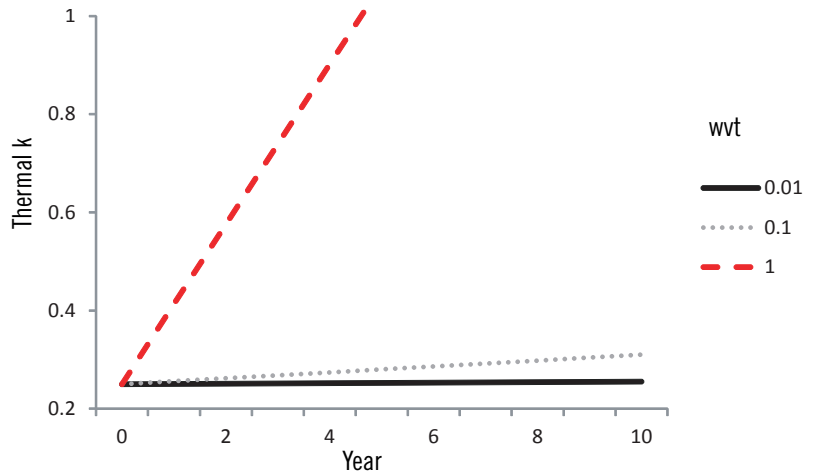
Thermal insulation is commonly used to reduce energy consumption of HVAC systems and equipment. If improper insulation is used, potential threats include heat loss through duct walls and moisture intrusion into the interior structure of the insulation. Since water is a very good conductor, the capability of an insulation material to slow water vapor from penetrating into its interior structure is fundamental for the long-term efficiency of the application.

SMACNA allows 5% moisture intrusion for fiberglass liner, **BUT:** For every 1% moisture gain, the insulation effectiveness drops 7.5%. As indicated below, if the permeability of the insulation is less than 0.10 perm-in, there will be minimal long-term effects on the k-value.

	k-value (75°F mean)	Permeability (perm-in) unjacketed
Closed Cell Elastomeric	0.25	<0.06
Fibrous	0.23	75.00
Semi-Closed Cell Foam	0.25	not published

### Thermal k performance over time with moisture gain (10 years)

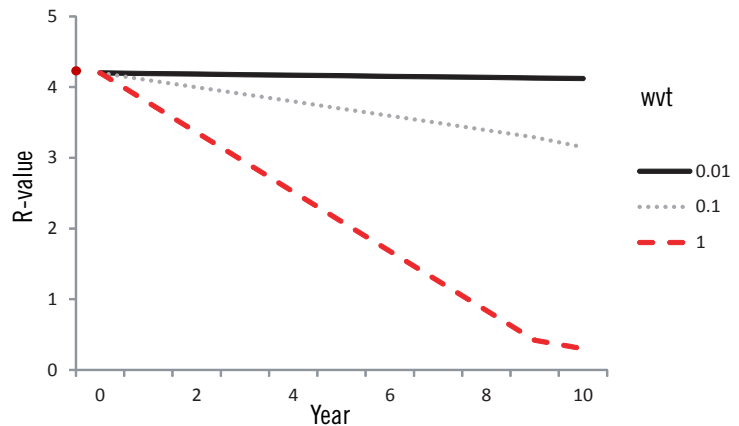
Permeability (perm-in)	.01	.10	1.00
k-value (start)	.250	.250	.250
k-value (10 years)	.255	.310	1.88



### R-value performance over time with moisture gain (10 years)

An R-value of 4.2 is required by IECC, ASHRAE and nearly every state building code.

Permeability (perm-in)	.01	.10	1.00
R-value (start)	4.2	4.2	4.2
R-value (10 years)	4.12	3.15	0.55



# IAQ CONTROL MOLD RESISTANCE / LOW VOC / FIBER-FREE

For an insulation material to defend against indoor air quality (IAQ) problems, it must resist condensation and moisture intrusion that can lead to mold, and ensure that the air passing over it does not contain fibers or dust. In ductwork that functions using conditioned air, the formation of condensation on the surface of the insulating material, within it, or on the outside of the metal is a negative factor.

Condensation forms as a result of the direct contact of warm humid air with a cold surface if the temperature of the surface is lower than the Dew Point of the humid air. The surface temperature of a duct and of the insulation depends on the application conditions and the R-value of the insulation material. If the insulation material is vapor permeable, moisture can move inside the insulation to reach areas where the temperature is low enough to have condensation, even if the surface temperature of the insulation is high enough to prevent surface condensation. An insulation material

with low permeability would prevent this situation from occurring.

In the southern half of the US, where warm humid summers are the norm, schools with central HVAC systems either shut down the system or run it minimally to save energy. The resulting warm, humid environment with little airflow is a good breeding ground for mold.

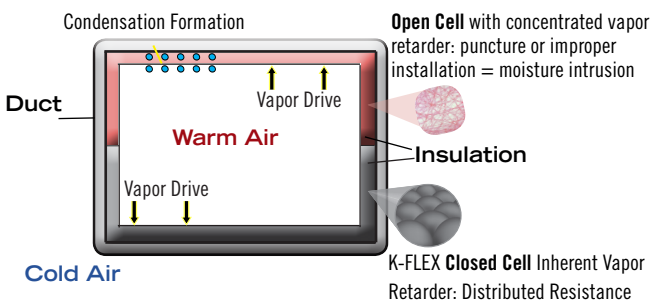
K-FLEX Duct Liner Gray has tested as mold resistant to ASTM G21 and D 6329/UL2824 standards. This is a result of a closed cell structure that inherently resists moisture and wicking, an added anti-microbial agent, a smooth surface skin that resists dirt accumulation, and a fiber-free composition that makes it non-particulating and non-eroding. K-FLEX Duct Liner Gray is GREENGUARD® certified as a low VOC material, meeting the requirements of the GREENGUARD

and GREENGUARD Gold classifications, and is UL Validated for Mold Resistance. In contrast, fibrous or open cell liners rely on a concentrated moisture vapor barrier (surface-applied coating). If the barrier is damaged (even a pinhole) or the edges are not properly sealed, they are susceptible to moisture intrusion and subsequent mold growth. Once moisture penetrates, it can wick and involve large areas in the mold growth process. The EPA & NAIMA recommend the immediate removal of wet fiberglass to prevent mold. Mold remediation, even for small elementary schools, can cost around \$200k.

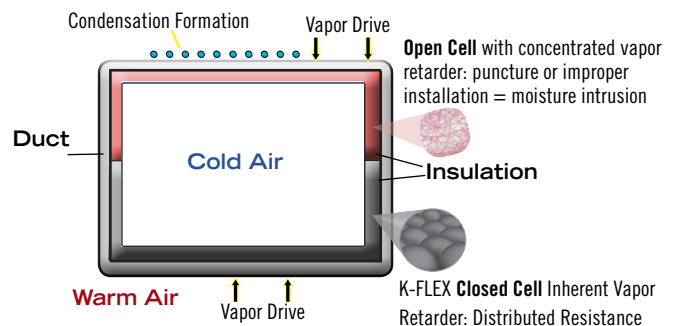
Further, a study in the April 2004 issue of ASHRAE Journal revealed that in an inspection, 92% of 150 office buildings with fiberglass duct liner had fungal growth. Semi-closed cell elastomeric insulation would also be susceptible to moisture intrusion. Often times, insulation can have moisture issues before a building is enclosed or commissioned.



Winter: Cold air outside duct, warm air inside duct



Summer: Warm air outside duct, cold air inside duct



Result w/ Fibrous: Mold growth on insulation



Result w/ Fibrous: Mold growth on ceiling from water drip (corrosion on duct also possible)



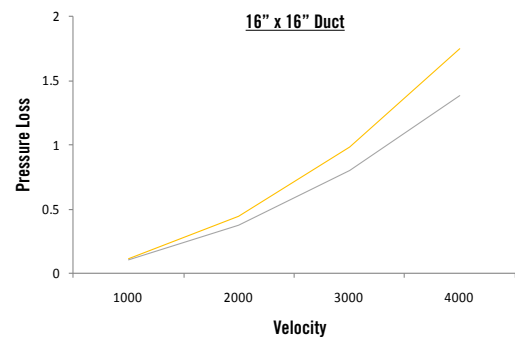


## PERFORMANCE K-FLEX DUCT LINER GRAY

- Proven Sustainable Performance: Lasts the life of the system
- Temperature Range: -297°F to +220°F
- Low perm (<0.06 perm-in) without jacketing = No vapor barrier facing / edge treatment needed
- Available with or without factory-applied PSA
- Inherently high mold & mildew resistance
- Fiber-free & Low VOC = IAQ
- GREENGUARD® Certified - GREENGUARD & GREENGUARD Gold Classification for low VOC
- UL Validated Microbial Resistance
- Contains an EPA-registered antimicrobial agent for added protection
- No erosion, cracking or delamination at high velocity air flow rates
- Low pressure loss (values comparable to fiberglass)\*\*
- Available up to 2" thickness and 60" width

PROPERTY	RATING	CRITERIA
NRC 1"	0.55	ASTM C423
STC 1.5" (insulation only)	16	ASTM E90
Permeability	<0.06 perm-in	ASTM E96
Water Absorption	<0.2%	ASTM C209
Thermal k	0.25 (Btu-in/h-ft <sup>2</sup> -°F)	ASTM C177 & C518
R-value	1" = 4.2, 2" = 8	
Fire Rating	25/50 up to 2" thick Pass	ASTM E84 NFPA 90 A / 90 B
Air Erosion	4,000 fpm rating	UL 181 (tested to 10,000 fpm)
Mold	Pass	ASTM G21
Energy Rating	Complies	ASHRAE 90.1
Elastomeric Duct Lining Requirements	Pass	ASTM C1534
Water Vapor Sorption	Pass	ASTM C1104

**PRESSURE LOSS (H <sub>2</sub> O/100 ft): K-FLEX DUCT LINER GRAY vs. Fiberglass			
Velocity (ft/m)	10" x 10"	16" x 16"	24" x 24"
1000	.311 / .207	.102 / .114	.052 / .068
2000	1.007 / .806	.377 / .443	.207 / .266
3000	2.021 / 1.797	.799 / .988	.473 / .594
4000	3.467 / 3.179	1.386 / 1.748	.849 / 1.050



### SPECIFICATION COMPLIANCE

- ASTM C534 Type 2 (Sheet), Grade 1
- ASTM C1534 Type 1
- ASTM D1056-00-2C1
- New York City MEA 186-86-M Vol. V
- USDA & RoHS Compliant
- ASTM E84: 25/50 at 2" and below
- Meets requirements of NFPA 90A Sect. 2.3.3 for Supplementary Materials for Air Distribution Systems up to 2" thickness
- Meets requirements of UL 181 Sections 11.0 and 16.0 (Mold Growth/Air Erosion)
- Meets requirements of ASTM C411 (Test Method for Hot Surface Performance of High Temperature Thermal Insulation)
- GREENGUARD GOLD certified under the "Indoor Air Quality" classifications



# INSTALLATION & MAINTENANCE K-FLEX DUCT LINER GRAY

- No Double Wall required to prevent air erosion or airborne fibers  
On average, double wall is 60% more expensive than single wall, is heavier and takes longer to install  
No need to wrap in mylar  
No need to finish (seal) exposed edges
- Easy to fabricate & install (use SMACNA guidelines)  
No issues using weld pins or impact-applied fasteners (via automated or manual pin spotting equipment)  
(K-FLEX recommends pins & adhesives to fasten liner to metal)  
Easy to cut manually or with an automated machine\*  
Works well with automated, semi-automated, and handheld equipment
- Flexible: non-rigid, non-breakable
- No protective clothing required during installation
- Safe: Non-dusting, Non-wicking, Non-abrasive, Non-itching
- Low Maintenance
- Easy to Clean – Smooth and Durable Surface, Resists Tearing
- Available with factory-applied pressure sensitive adhesive (PSA)
- Available up to 60” width (in all thicknesses, including 2”)
- Can be installed using K-Flex 1120 Water Based Adhesive; non-flammable, no VOCs, allows repositioning of the liner.

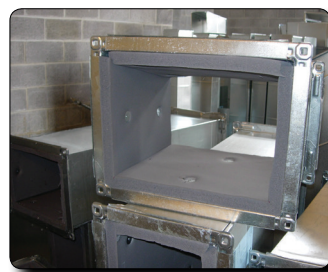
\*Cutting Options:

## Automated Cutting

- Easily cuts using a water-jet machine (i.e. Lockformer Vulcan 1600) - Doesn't pick up moisture along cut edges
- Cuts well with rotary blade cutters (DuroDyne or Multi-Cam) - Gear-driven blades perform better than drag blades

## Manual Cutting

- Cuts well with electric cutters (i.e. Bosch Foam Rubber Cutter Model 1575A) or sharp knives

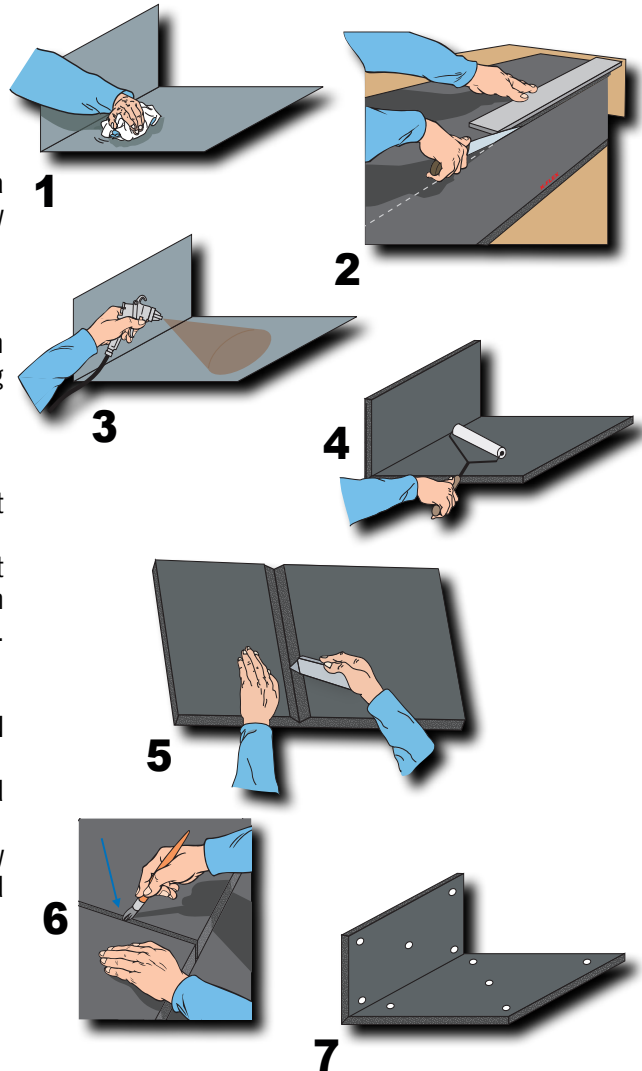




## INSTALLATION K-FLEX DUCT LINER GRAY

### Rectangular / Square Duct

1. Thoroughly clean the surface to be insulated.
  2. Cut K-Flex Duct Liner Gray to the correct size (refer to installation guidelines available on our website). Always cut oversize (1/8") to provide a slight compression fit. Avoid stretching the material. Because of its flexibility and ease of cutting, elastomeric sheet is ideal for insulating irregular shapes.
  3. Apply approved contact or hot melt adhesive (refer to technical bulletins available on our website) to both surfaces by brush, roller or spray. Minimum coverage rate should be 90%. Allow adhesive to become tacky before mating surfaces. Note: some spray adhesives provide acceptable adhesion with a one sided application (to the sheet metal only). We recommend testing to determine acceptability of this method.
  4. For best results, use a roller to apply uniform pressure to ensure full contact to the sheet metal after the insulation has been applied.
  5. On some coil lines, the insulation material can be bent along with the sheet metal. As an alternative, a v-groove cut one half the depth of the insulation can be made where the bend occurs, to avoid overcompressing the insulation.
  6. Where liner is installed to individual sections compression fit seams, adjoining adjacent liner sections using approved adhesive is optional.
  7. Apply mechanical fasteners in accordance with HVAC DUCT CONSTRUCTION STANDARDS, METAL AND FLEXIBLE, published by SMACNA (second edition). Note: Use caution when using weld pins with solvent based adhesives.
- \* **For PSA:** Follow cleaning and cutting procedures as outlined above. Partially remove the release liner, exposing 8-10" of the adhesive. Carefully align and install the liner on the sheet metal. Remove remaining release liner and install liner. Follow procedures as outlined in items 4 thru 7 above.



### Round Duct: Double-Wall Construction

1. Thoroughly clean the surface to be insulated.
2. Gauge K-FLEX Duct Liner Gray to ensure that, when installed, the OD of the inner duct is less than the ID of the outer duct layer. This allows the two layers to fit over each other.
3. Duct lengths may have to be shortened to 4' or 6' maximum lengths to allow for insertion into the outer shell.
4. Cut the insulation to fit around the inner duct such that the ends meet to make a seam (no overlap).
5. Apply adhesive (hot melt or solvent-based) to both ends of the insulation sheet.
6. Adhere the inner duct to the insulation sheet and roll the insulation onto the duct.
7. Mate the ends of the insulation. The seams should be glued.
8. Slide the inner duct (with insulation) into the outer duct. A slight gap between the two layers is acceptable.

### Round Duct: Single-Wall Construction

Double-wall construction is not mandatory when using K-FLEX Duct Liner Gray.

1. Follow cleaning procedures as outlined above.
2. Adhere the insulation to the inner wall using approved contact adhesives. The length of the duct sections may have to be shortened to 4' or 6' maximum lengths to allow the liner to adhere to the duct. Ideally, the liner seam should run longitudinally along the duct as this limits the duct length to a maximum of 5 feet, which is the maximum width of the liner.
3. Seal the longitudinal seam with solvent-based contact adhesive.
4. Apply mechanical fasteners per item 7 above.

## PROJECT REFERENCE LIST K-FLEX DUCT LINER GRAY

- Bellefonte High School, Pennsylvania
- City Of Doral Courthouse, Florida
- Washington State University Veterinary Science Building, Washington
- Finn Hill School, Washington
- Allegheny College, Pennsylvania
- Pine Richland High School, Pennsylvania
- Taunton Courthouse, Massachusetts
- University of Massachusetts, Massachusetts
- Massachusetts Department of Transportation, Massachusetts
- Kelowna General Hospital, British Columbia, Canada
- Bloomsburg University, Pennsylvania
- Woodward Elementary School, British Columbia
- George Mason University, Virginia
- Miami-Dade County Courthouse, Florida



### **Bellefonte High School, Bellefonte, PA**

For the expansion of Bellefonte High School, Center Point Engineering specified 65,000 sf of 1” thick K-Flex Duct Liner Gray flexible elastomeric foam insulation for its uniquely excellent noise reduction and moisture control properties.

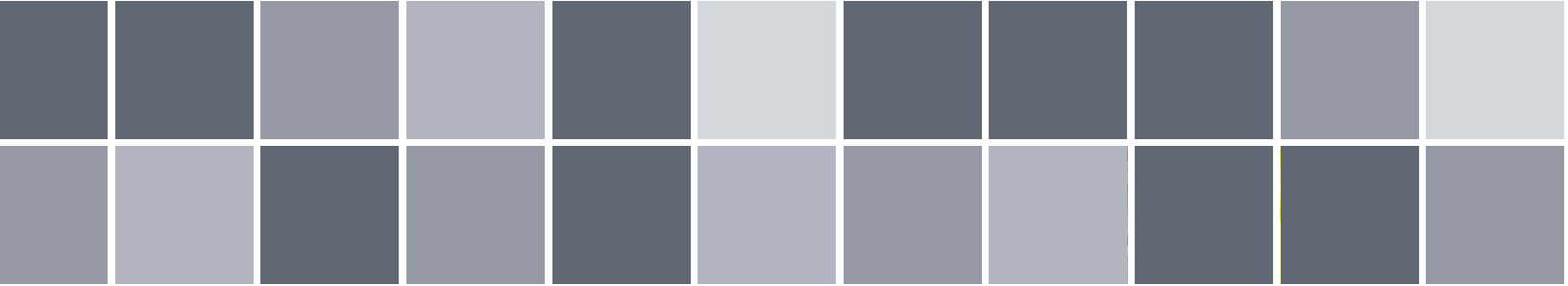
S.P. McCarl & Company, the winning bidder on the project, is not a full coil line shop, so duct liner has to be installed manually, making any ease-of-use advantages helpful. “We did both TDC and slip and drive duct on this project, so it was very convenient that K-Flex Duct Liner Gray came in 56-1/4” and 59” widths and 100’ lengths,” stated Daren Lewis, sheet metal superintendent. Following SMACNA guidelines, S.P. McCarl & Company used S2S (“skin-two-side”) liner adhered with a spray-applied contact adhesive and mechanically fastened with weld pins. Lewis and Bill Scully, construction manager, had their original labor take-off based on their experience with installing fiberglass liner. “When we first started out, there was a significant difference in installation rates. We were a little nervous,” admitted Lewis. “But as the guys got used to the product, we have been able to close the gap significantly. It was a combination of learning curve and other things, like using the Bosch foam rubber cutter. By the end of the project, we had the same production rates.”

As a flexible, non-itching material with a tough outer skin on both sides, K-Flex Duct Liner Gray is more manageable and tear-resistant than fiberglass. Bill Scully was also impressed with how well K-Flex Duct Liner Gray held up on the jobsite. Because of the logistics of working around occupied classrooms, storage space on site was at a premium and rain and roof leaks were unavoidable. In these tough conditions K-Flex Duct Liner Gray held up where fiberglass would have been replaced. It also held up well during actual installation, with no fear of damage to exposed edges.

Scully and Lewis plan to install more K-Flex Duct Liner Gray in the future. “Elastomeric liner is growing,” explained Scully. “Cleanliness of buildings and duct cleaning are becoming more important, and specifiers are concerned with fiberboard erosion. We try to stay on the cutting edge and evaluate new products. We think K-Flex Duct Liner Gray is a winner.”



**K-FLEX**



*The HVAC Inspection, Maintenance  
and Restoration Association*



**K-FLEX**

www.kflexusa.com | 800-765-6475 | 100 Nomaco Drive | Youngsville, NC 27596