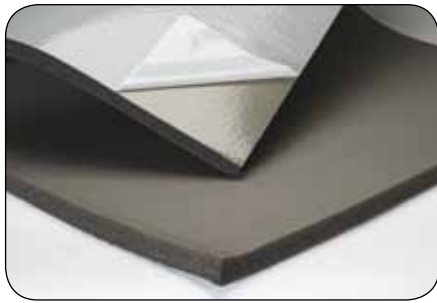




K-FLEX DUCT[®] LINER GRAY



Flexible, Closed Cell Elastomeric Foam Insulation
Responsive to Market
Industry & Product Expertise
3rd Party Certified Products
25/50-rated up to 2" thick
Systems Approach
Factory-applied Options
11 Production Facilities Worldwide





DUCT LINER BENEFITS

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.



TECHNICAL PROPERTIES

COMPARISON BETWEEN MATERIALS

	K-FLEX Duct® Liner Gray Closed Cell Elastomeric	Fibrous	Semi-Closed Cell Elastomeric
Closed Cell Structure	Yes	No	No
Flexible	Yes	Yes	Yes
Thermal k (75°F mean)	0.25	0.23	0.25
water vapor transmission (wvt) without jacketing (perm-in)	<0.06	75.00	Info not available
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")	0.50	0.70	0.60

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 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

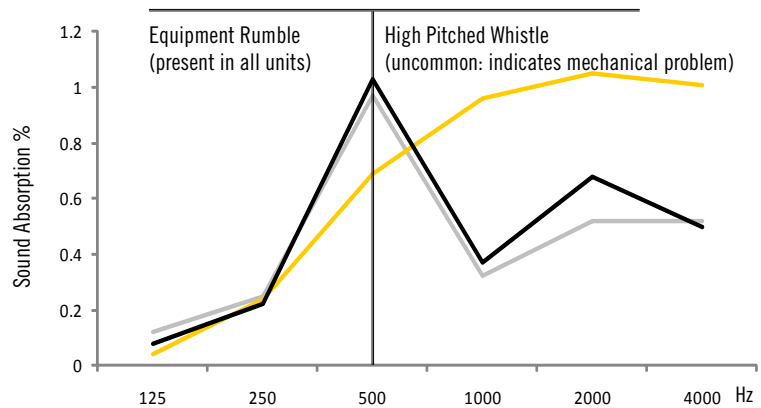
determining noise decay rate. K-FLEX Duct® Liner Gray outperforms fibrous, and is comparable to semi-closed cell elastomeric, in absorbing noise at low frequencies associated with equipment rumble (125 - 500 Hz), which is the #1 target for acoustical treatment. Noise from higher frequencies, i.e. high 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 being 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



Sound Absorption	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
1" K-FLEX Duct® Liner Gray	0.12	0.25	0.97	0.32	0.52	0.52	0.50
1" Fibrous*	0.08	0.19	0.69	0.94	0.99	0.98	0.70
1" Semi-Closed Cell Elastomeric*	0.08	0.22	1.03	0.37	0.68	0.50	0.60

Sound Barrier	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

*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

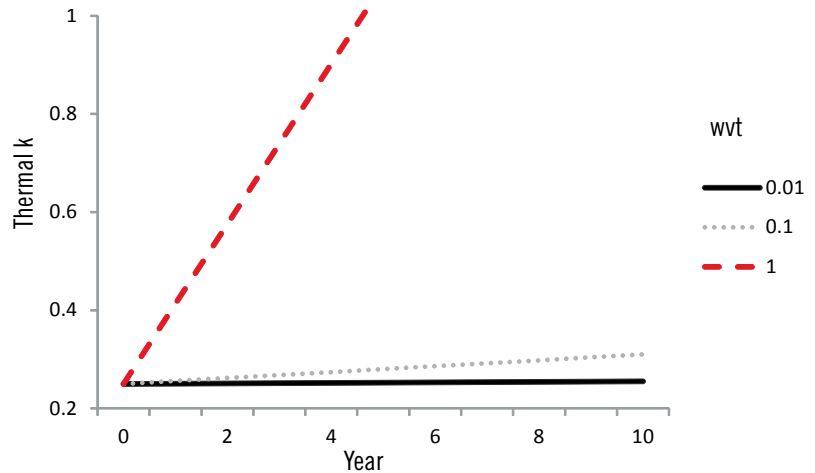
structure is fundamental for the long-term efficiency of the application.

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 wvt 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)	wvt (perm-in) unjacketed
Closed Cell Elastomeric	0.25	<0.06
Fibrous	0.23	75.00
Semi-Closed Cell Elastomeric	0.25	not published

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

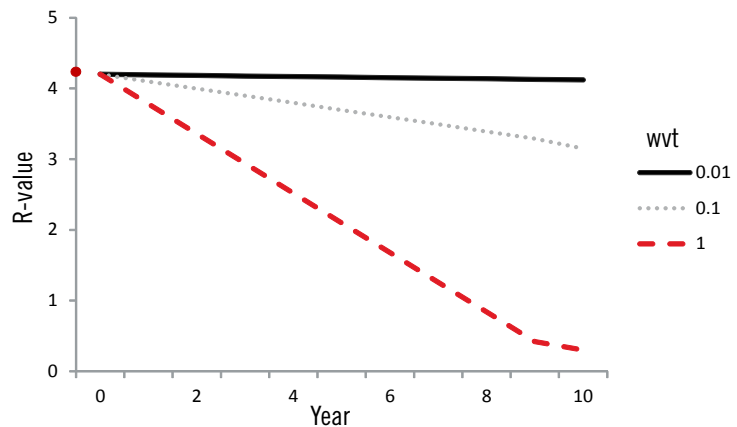
wvt (perm-in)	.01	.10	1.00
k-value (start)	.250	.250	.250
k-value (10 years)	.255	.310	1.88



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.

wvt (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 / NON-FIBROUS

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 wvt 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.

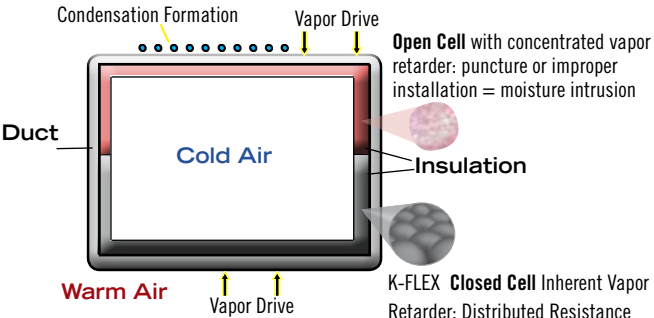
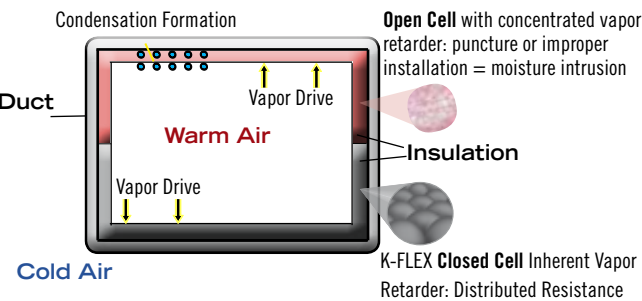
K-FLEX Duct® Liner Gray has tested as mold resistant to ASTM G 21 standards. This is a result of a closed cell structure that inherently resists moisture and wicking, an added anti-microbial agent, a smooth surface skin that resists dirt accumulation, and a fiber-free composition that makes it non-particulating and non-eroding. K-FLEX Duct® Liner Gray is **GREENGUARD® certified** as a low VOC material, meeting the requirements of the “Children & Schools” and “Indoor Air Quality” classifications.

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)





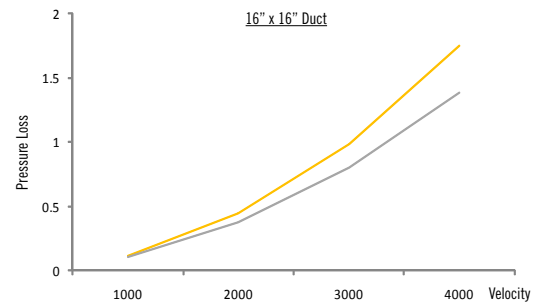
PERFORMANCE

- Proven Reliable Performance
- 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 - Children & Schools™ Classification for low VOC & Microbial Resistance Listing
- 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)**
- Sustainable: Lasts the life of the system

PROPERTY	RATING	CRITERIA
NRC 1"	0.50	ASTM C 423
STC 1.5" (insulation only)	16	ASTM E 90
wvt	<0.06 perm-in	ASTM E 96
Water Absorption	<.2%	ASTM C 209
Thermal k	0.25 (Btu-in/h-ft ² -°F)	ASTM C 177 & C 518
R-value	1" = 4.2, 2" = 8	
Fire Rating	25/50 up to 2" thick Pass	ASTM E 84 NFPA 90 A / 90 B
Air Erosion	4,000 fpm rating	UL 181 (tested to 10,000 fpm)
Mold	Pass	ASTM G 21
Energy Rating	Complies	ASHRAE 90.1
Elastomeric Duct Lining Requirements	Pass	ASTM C 1534

****PRESSURE LOSS (H₂O/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
- ASTM D1056-00-2C1
- ASTM C423/E795 NRC=0.50 at 1" thickness
- New York City MEA 186-86-M Vol. V
- USDA & RoHS Compliant
- UL 94-5V Flammability Classification (Recognition No. E300774)
- 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 certified under the "Children & Schools" and "Indoor Air Quality" classifications



INSTALLATION & MAINTENANCE

- No Double Wall required to prevent air erosion or airborne fibers
On average, double wall is 60% more expensive than single wall
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 (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)



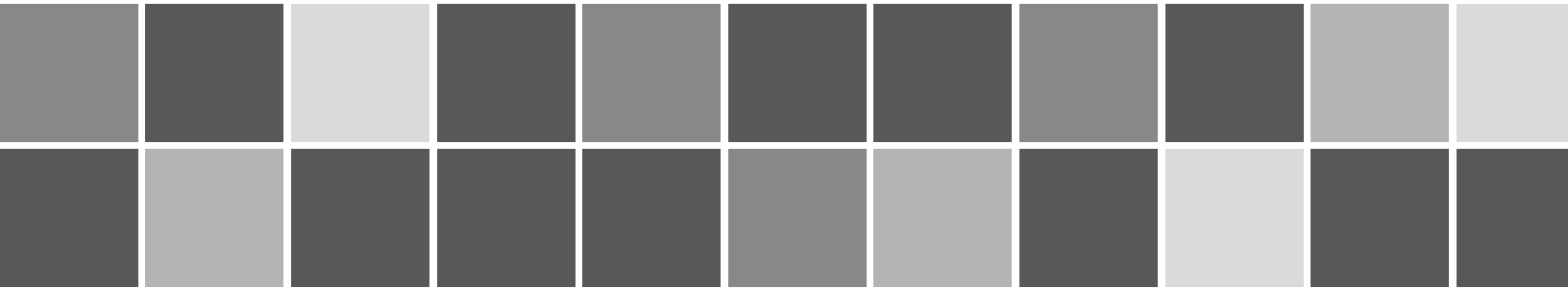
PROJECT REFERENCE LIST

- 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





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