



Fibrous Glass Duct Liner Standard

Design, Fabrication and Installation Guide

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Preface

The North American Insulation Manufacturers Association (NAIMA) presents this Standard as a recommended guideline for the selection, fabrication, and installation of fibrous glass duct liner insulations in sheet metal air handling ducts as defined herein. Fibrous glass duct liner insulations are designed for use in air duct systems operating at air velocities not exceeding 6,000 feet per minute (30.5 m/s), or not to exceed rated air velocities for product types as listed by their manufacturers.

This voluntary Standard has been prepared to meet the need for detailed information regarding materials, specification, fabrication, and installation of fibrous glass liners. Additionally, brief recommendations are offered regarding the commissioning, operation, and maintenance of fibrous glass lined duct systems so that they may more dependably provide desired acoustical, thermal, and indoor air comfort performance for the system's design service life.

This Standard is intended to expand references to fibrous glass materials and installation methods in *HVAC Duct Construction Standards - Metal and Flexible*, second edition, 1995, eighth printing (2004), published by the Sheet Metal & Air Conditioning Contractors' National Association (SMACNA), in particular, pages 2-25 through 2-30.

This Standard was developed using reliable engineering principles and research plus consultation with and information obtained from manufacturers, contractors, testing laboratories, and others having specialized experience. It is subject to revision as further experience and investigation may show is necessary or desirable. Constructions and products which comply with this Standard will not necessarily be considered acceptable if, when examined and tested, they are found to have other features which impair the result contemplated by this Standard.

NAIMA assumes no responsibility and accepts no liability for the application of the principles or techniques contained in this manual. **In particular, NAIMA makes no warranty of any kind, express or implied, regarding merchantability or fitness for any particular purpose in connection with the information supplied herein.** Authorities considering adoption of this Standard should review all Federal, State, local, and contractual regulations applicable to specific installations.

This Standard is not intended to preclude alternate methods and materials of fabrication when such methods and materials can be documented as providing equivalent performance.

This Standard is not intended to address issues related to thermal or acoustical insulation within and furnished as integral parts of HVAC equipment such as air handling units, coils, air cleaners, silencers, humidifiers, and terminal devices. Manufacturers of such equipment are responsible for design, specification, and installation of appropriate insulation components in their products so that thermal, acoustical, and indoor air quality requirements are met.

NAIMA extends its thanks to the member companies of its Air Handling Committee who contributed their time and talents in the development of this Standard.

NAIMA Air Handling Committee Member Companies:

CertainTeed

www.certainteed.com • 800-233-8990

Johns Manville

www.jm.com • 800-654-3103

Knauf Insulation

www.knaufnorthamerica.com • 800-825-4434

Owens Corning

www.owenscorning.com • 800-GET-PINK

References

The following may be used as references when working with information in this Standard. NOTE: Current editions of some references may differ from editions of listed date.

ASHRAE

180 Technology Parkway, Peachtree Corners, GA 30092

- 2017 ASHRAE Handbook - Fundamentals
- 2019 ASHRAE Handbook - Heating, Ventilating, and Air-Conditioning Applications
- 2020 ASHRAE Handbook - Heating, Ventilating, and Air-Conditioning Systems and Equipment
- A Practical Guide to Noise and Vibration Control for HVAC Systems: Mark E. Schaffer
- ANSI/ASHRAE Standard 52.2-2017, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
- ANSI/ASHRAE Standard 62-2019, Ventilation for Acceptable Indoor Air Quality
- ANSI/ASHRAE/IESNA Standard 90.1-2019, Energy Standard for Buildings Except Low Rise Residential Buildings
- ASHRAE/IES 90.1-1989, Energy Efficient Design of New Buildings Except Low Rise Residential Buildings
- ASHRAE Humidity Control Design Guide For Commercial and Institutional Buildings, ISBN 1-B83413-98-2

ASTM - American Society for Testing and Materials

100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

- ASTM C 167 - Test Methods for Thickness and Density of Blanket or Batt Thermal Insulation
- ASTM C 177 - Test Method for Steady-State Heat Flux Measurement and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
- ASTM C 390 - Criteria for Sampling and Acceptance of Preformed Thermal Lots
- ASTM C 411 - Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
- ASTM C 423 - Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
- ASTM C 518 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- ASTM C 665 - Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
- ASTM C 916 - Standard Specification for Adhesives for Duct Liner Insulation

- ASTM C 1071 - Standard Specification for Duct Lining Insulation (Thermal and Sound Absorbing Material)
- ASTM C 1104/C - 1104M Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
- ASTM C 1338 - Test Method for Determining Fungi Resistance of Insulation Materials and Facings
- ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials
- ASTM E 795 - Practices for Mounting Test Specimens During Sound Absorption Tests
- ASTM G 21-96 - Practice for Determining Resistance of Synthetic Polymer Materials to Fungi

EPA - Environmental Protection Agency

1200 Pennsylvania Ave., Washington, DC 20460

- Building Air Quality: A Guide for Facility Owners and Building Managers

NAIMA - North American Insulation Manufacturers Association

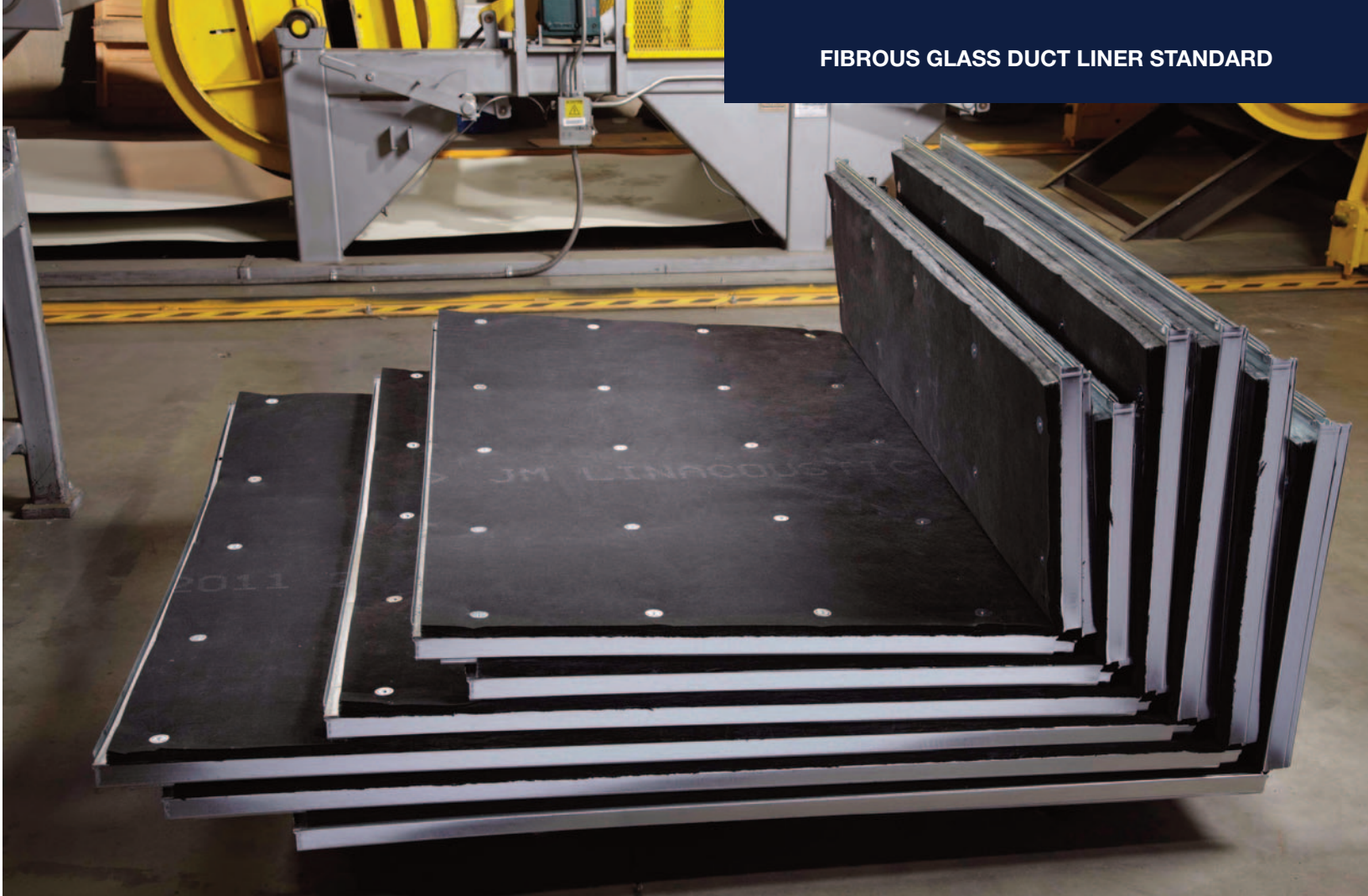
P.O. Box 1906, Alexandria, VA 22313

- Pub. # AH-106, The Benefits and Recommended Use of Fibrous Glass Duct Liners
- Pub. # AH-110, Fiber Glass HVAC Insulations: An Essential Component of Indoor Environmental Quality
- Pub. # AH-113, The Facts About Mold Growth
- Pub. # AH-114, The Facts About Airborne Fibers
- Pub. # AH-122, Cleaning Fibrous Glass Insulated Air Duct Systems, Recommended Practice
- Pub. # AH-125, Facts About Using Sealants in Fiber Glass Air Handling Systems

NFPA - National Fire Protection Association

1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269

- NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems, 1999 Edition
- NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems, 1999 Edition
- NFPA 259 - Standard Test Method for Potential Heat of Building Materials, 1993 Edition



SMACNA - Sheet Metal & Air Conditioning Contractors' National Association

4201 Lafayette Center Drive, Chantilly, Virginia 20151-1219

- ANSI/SMACNA 006-2006 HVAC Duct Construction Standards
- Ducted Electric Heater Guide for Air Handling Systems, Second Edition, 1994
- Fire, Smoke & Radiation Damper Guide for HVAC Systems, Fifth Edition, 2002
- HVAC Systems Applications, Second Edition, 2010
- HVAC Systems Duct Design, Fourth Edition, 2006
- Indoor Air Quality - A Systems Approach, Third Edition, 1998

ICC - International Code Council, Inc.

500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001

- International Building Code, 2021
- International Energy Conservation Code, 2021
- International Mechanical Code, 2021
- International Residential Code, 2021

Refer to area codes and municipal ordinances for additional specific local requirements for ducted heating and air conditioning systems.

ADDITIONAL REFERENCES

AIA - American Institute of Architects

- Guidelines for Design and Construction of Hospital and Health Care Facilities (ISBN I-57165-002-4), 2001

AIHA - American Industrial Hygiene Association

- American Industrial Hygiene Association Journal, August 1971, Volume 32, Number 8: Fibrous Glass-Lined Air Transmission Systems: An Assessment of Their Environmental Effects. J. LeRoy Balzer, W. Clark Cooper, M.D., and Douglas P. Fowler, Environmental Health Sciences, School of Public Health, University of California, Berkeley, California 94720

AMA - American Medical Association

- Archives of Environmental Health, February 1971, Volume 22: Erosion of Fibers From Installed Fibrous-Glass Ducts: Jacob Cholak, ChE, and Lawrence J. Schafer, BSE(ChE), Cincinnati

For product design and performance reference data, refer to manufacturers' catalogs and/or data sheets.

Section I: Design Criteria

A. BACKGROUND

Introduction of forced air heating, ventilating, and air conditioning systems established the need for duct insulation. A forced air duct system is designed to be a conduit for supply and return of conditioned air to and from occupied spaces of a building. It is insulated to control duct-borne noise, to reduce heat loss or gain through metal duct walls, and to minimize water vapor condensation. An internally lined duct system conveys conditioned air quietly to occupied spaces at design temperature and humidity.

B. BENEFITS

A sealed sheet metal duct system with fibrous glass duct liner provides outstanding performance in these ways:

- Fibrous glass duct liners attenuate the noises generated by HVAC equipment, air velocity, and occupant cross-talk.
- Fibrous glass duct liners reduce heat loss or gain through sheet metal duct surfaces.
- Fibrous glass duct liner thermal performance, in combination with sealed sheet metal duct surfaces acting as an air and vapor retarder, helps to prevent the formation of water vapor condensation inside the duct as well as on its outside surface.
- Exterior surfaces of metal duct systems with fibrous glass liners protect the insulation from abuse.
- Fibrous glass duct liners may be fabricated along with the sheet metal ductwork in the shop, allowing for quality workmanship under controlled conditions.

C. PROPERTIES OF MATERIALS

1. Fibrous Glass Duct Liners

TYPES: Fibrous glass duct liners are manufactured of glass fibers bonded with thermosetting resin. They are dimensionally stable, withstand abuse, and provide a cleanable, fire-resistant interior surface designed to minimize friction loss. This interior treatment may be in the form of a coating and/or a mat facing. Two forms are available: (1) flexible blankets supplied in rolls; and (2) rigid boards supplied in sheet form.

PROPERTIES: Fibrous glass duct liners are designed to meet the physical property requirements of ASTM C1071 - *Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)*. This specification defines the two types of duct liner described above: Type I - Flat, in roll form; and Type II - Flat, in sheet form.

ACOUSTICAL PERFORMANCE: When tested in accordance with ASTM C 423 (Mounting A), duct liner insulation shall have sound absorption coefficients not less than those set out in Table 2: Sound Absorption Coefficients (Min) Using a Type "A" Mounting.

TABLE 2. SOUND ABSORPTION COEFFICIENTS (MIN) USING A TYPE "A" MOUNTING

Thickness inches (mm)	Sound Absorption Coefficients at Octave Band Center Frequencies, Hz						
	125	250	500	1000	2000	4000	NRC
TYPE I							
½ (13)	.02	.07	.18	.37	.52	.67	.30
1 (25)	.04	.19	.35	.55	.69	.72	.45
1½ (38)	.08	.31	.58	.75	.82	.81	.60
2 (51)	.16	.42	.76	.85	.85	.83	.70
TYPE II							
1 (25)	.02	.20	.52	.72	.82	.84	.55
1½ (38)	.05	.40	.77	.88	.88	.86	.75
2 (51)	.12	.57	.90	.95	.95	.92	.85



Fig. I-1: Flexible fibrous glass duct liner - Type I



Fig. I-2: Rigid fibrous glass duct liner - Type II

OTHER PROPERTIES DEFINED BY ASTM C 1071: ASTM C 1071 also establishes the following property requirements and methods of testing for fibrous glass duct liner:

- Corrosiveness - When tested in accordance with ASTM C 665 or ASTM C 1617, the metal plate in contact with the back side (non-air surface side) of the insulation shall show no corrosion greater than the comparative plates in contact with sterile cotton which has been tested in the same manner.
- Water vapor sorption - When tested in accordance with ASTM C 1104/1104M, the water vapor sorption of the insulation shall not be more than 3% by weight.
- Fungi resistance - When tested in accordance with ASTM C 1338, the insulation shall be observed as having no fungal growth.
- Temperature resistance - When tested in accordance with ASTM C 411, the air stream surface shall have no evidence of flaming, glowing, smoldering, visible smoke, delamination, cracking, deformation, or reduction of thickness.
- Erosion resistance - The erosion resistance shall be determined by using the erosion test of UL 181.
- Odor emission - When tested in accordance with ASTM C 1304, a detectable odor of objectionable nature recorded by more than two of the five panel members shall constitute failure of the material.
- Surface burning characteristics - When tested in accordance with ASTM E 84,* the air stream surface of the insulation shall have a maximum flame spread index of 25* and a maximum smoke developed index of 50. (NOTE: Adhesive used to adhere the insulation to the interior of the sheet metal duct shall have flame spread and smoke developed ratings no greater than 25/50.)
- Combustion characteristics - When tested in accordance with NFPA Standard 259, the material shall have a potential heat value not exceeding 3,500 Btu/lb (8,141 kJ/kg).
- Apparent thermal conductivity - When tested in accordance with ASTM C 177 or ASTM C 518, the apparent thermal conductivity of the insulation at the specified thickness shall not exceed the following values when measured at a mean temperature of 75°F (24°C):

Type I - 0.28 Btu·in/hr·ft²·°F ($\lambda=0.040$ W/m·°C)

Type II - 0.25 Btu·in/hr·ft²·°F ($\lambda=0.036$ W/m·°C)

*This Standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire-hazard or fire-risk assessment of the materials, products, or assemblies under actual fire conditions. Values are reported to the nearest 5 rating.

2. Duct Liner Adhesives

Adhesives complying with ASTM C 916 for use with fibrous glass duct liners are either solvent-based or water-based. Adhesives are classified according to their flammability in both wet and dry states. Designers shall specify only those adhesives that meet construction and code requirements and shall assure themselves that adhesives specified possess acceptable fire hazard classification values under installed conditions. Installers should carefully follow ventilation, storage, and other precautions published by manufacturers of these adhesives. More detailed information on duct liner adhesives can be found in Section II Part C of this Standard.

3. Duct Liner Fasteners

In addition to adhesives, mechanical fasteners are required when installing fibrous glass duct liners. Two types of fasteners are in general use:

- Mechanically secured (see Fig. I-3) - These hardened steel fasteners form positive mechanical attachments to the sheet metal; they are impact-driven into the duct.
- Weld-secured (see Figs. I-4 and I-5) - These are attached to the duct by resistance or capacitance discharge welding processes. Correct adjustment of welding equipment, especially timing devices, is necessary to obtain a solid weld without burn-through.

Fastener heads or washers shall have a minimum area of 0.75 in.² (480mm²) and a minimum thickness of 0.010" (0.25 mm), and shall have either cupped or beveled heads as shown in Figure I-6. When installed, they shall not compress the insulation more than 1/8" (3mm) based on the nominal insulation thickness.

Adhesive fasteners are also available. These have a large base for use with an adhesive. Due to uncertain long-term adhesive aging characteristics, before being specified for use with fibrous glass duct liners, adhesive fasteners should be carefully evaluated for long term performance in the intended application. More detailed information on duct liner fasteners can be found in Section II Part D of this Standard.

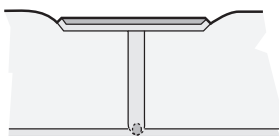


Fig. I-3: Clinched pin, impact applied, integral head

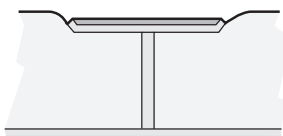


Fig. I-4: Welded pin, integral head

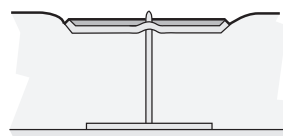


Fig. I-5: Welded pin, press-on head

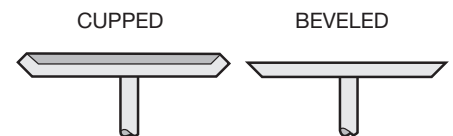


Fig. I-6: Head types



D. SYSTEM ACOUSTICAL PERFORMANCE

Fibrous glass duct liners have been proven to be among the most efficient and cost-effective ways to reduce duct-borne noise. The sound-absorbing property of fibrous glass duct liners provides attenuation of noise from HVAC equipment, air flow, and cross-talk.

Sheet metal ductwork can act as speaker tubes transmitting noise throughout the duct system and into the occupied spaces. The direction of air flow has little to do with the direction of noise transmitted. Sound can be transmitted both upstream and downstream from the source.

HVAC equipment is a major source of unwanted noise in a building. Noise generated by mechanical equipment, as well as by other sources, must be considered in relation to the overall indoor environmental quality of a building. A proper acoustical environment is as important for occupant comfort as are other environmental factors controlled by air-conditioning systems.

Selection of duct liner thickness depends on the duct dimensions, predominant frequencies, and the amount of sound attenuation required. Providing basic noise control principles are understood, adequate noise control in a duct system with fibrous glass duct lining materials is not difficult to achieve during the design of the system.

Detailed information can be found in ASHRAE's *Handbook of Fundamentals and HVAC Applications Handbook*, and in SMACNA's *HVAC Systems Duct Design Manual*.

Definitions

The following definitions are related to the determination of acoustical performance of fibrous glass duct liners:

Frequency - The number of cycles per second measured in units of Hertz (Hz). A frequency of 1,000 Hz means 1,000 cycles per second.

Insertion loss - Of a silencer or other sound-reducing element, in a specified frequency band, the decrease in sound power level, measured at the location of the receiver, when a sound insulator or a sound attenuator is inserted in the transmission path between the source and the receiver.

Noise reduction coefficient (NRC) - A single number rating derived from measured values of sound absorption coefficients in accordance with Test Method ASTM C 423. It provides an estimate of the sound absorptive property of an acoustical material.

Octave band - A frequency band with an upper frequency limit equal to twice the lower limit.

Sound absorption - (1) the process of dissipating sound energy, (2) the property possessed by materials, objects and structures such as rooms of absorbing sound energy.

Sound absorption coefficient (dimensionless) - Of a surface in a specified frequency band, the measure of the absorptive property of a material as approximated by Test Method ASTM C 423. Ideally, it is the fraction of the randomly incident sound power absorbed or otherwise not reflected.

Sound attenuation - The reduction of the intensity of sound as it travels from the source to a receiving location. Sound absorption is often involved as, for instance, in a lined duct.

ASTM C 423 Type A mounting - Test specimen laid directly against the test surface.

E. SYSTEM THERMAL PERFORMANCE

Fibrous glass duct liners applied to sheet metal ducts contribute to energy efficiency by controlling heat loss or gain through duct walls, as well as helping to control moisture condensation.

1. ANSI/ASHRAE/IESNA 90.1-2019, *Energy Standard for Buildings Except Low Rise Residential Buildings*

This National Voluntary Consensus Standard was developed under the auspices of ASHRAE; it was co-sponsored by both the

American National Standards Institute (ANSI) and the Illuminating Engineering Society of North America (IESNA). It supersedes ASHRAE/IES 90.1-1989. Minimum duct system R-values are keyed to building envelope criteria tables found in Chapter 6 of the Standard and to climate zone conditions found in Annex 1. Minimum R-values are given in Table 6.8.2.

TABLE 6.8.2. MINIMUM DUCT INSULATION R-VALUE^(a)

Climate Zone	Duct Location		
	Exterior ^(b)	Unconditioned Space and Buried Ducts	Indirectly Conditioned Space ^(c,d)
Supply and Return Ducts for Heating and Cooling			
0 to 4	R-8	R-6	R-1.9
5 to 8	R-12	R-6	R-1.9
Supply and Return Ducts for Heating Only			
0 to 1	None	None	None
2 to 4	R-6	R-6	R-1.9
5 to 8	R-12	R-6	R-1.9
Supply and Return Ducts for Cooling Only			
0 to 6	R-8	R-6	R-1.9
7 to 8	R-1.9	R-1.9	R-1.9

(a) Insulation R-values, measured in $\text{h} \cdot \text{ft}^2 \cdot ^\circ\text{F} / \text{Btu}$, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Where portions of the building envelope are used as a plenum enclosure, building envelope insulation shall be as required by the most restrictive condition of Section 6.4.4.1 or Section 5, depending on whether the plenum is located in the roof, wall, or floor. Insulation resistance is measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 75°F at the installed thickness.

(b) Includes attics above insulated ceilings, parking garages and crawl spaces.

(c) Includes return air plenums with or without exposed roofs above.

(d) Return ducts in this duct location do not require insulation.

2. International Code Council, 2021 International Energy Conservation Code

This national model energy code was developed by the membership of the International Code Council (ICC).

The first International Energy Conservation Code (IECC), introduced in 1998, continues the leadership role in energy codes that the ICC legacy organizations started over 20 years before. The IECC addresses energy efficiency on several fronts, including cost

savings, reduced energy usage, conservation of natural resources, and the impact of energy usage on the environment.

The ICC performs periodic revisions through an established process, allowing stakeholder participation from industry, the public, and governmental entities. Once the revision process is completed, a new edition of the model code is published, thereby allowing for the adoption of the updated codes by states and localities.

SECTION R403.3.1 MINIMUM DUCT INSULATION - RESIDENTIAL CONSTRUCTION

Duct Location	Duct Diameter	
	≥ 3 inches (76mm)	< 3 inches (76mm)
Attic	R-8	R-6
Other Areas	R-6	R-4.2

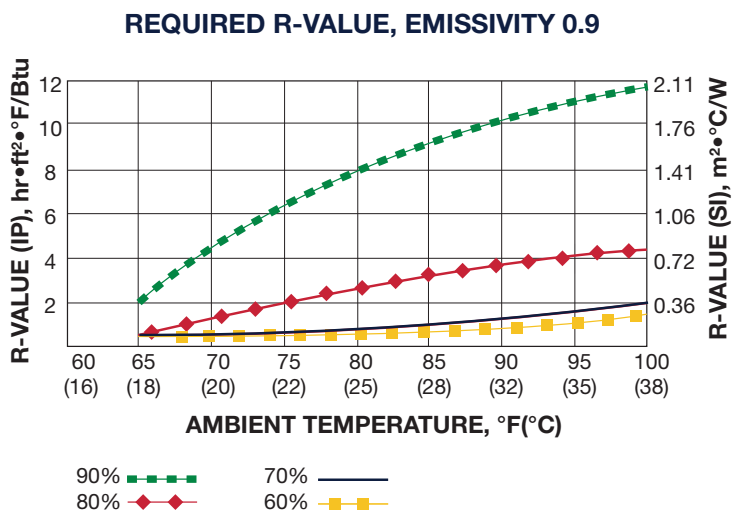
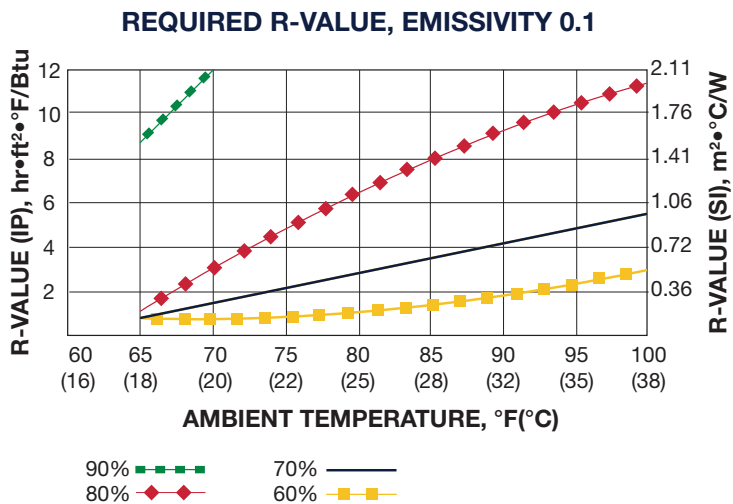
Exception: Ducts or portions thereof located completely inside the thermal envelope do not require duct insulation.

Section I: Design Criteria

F. CONDENSATION CONTROL PERFORMANCE

Fibrous glass duct liners are effective in helping to control moisture condensation on both interior and exterior surfaces of sheet metal ductwork. This helps the insulation to stay dry, maintaining its full thermal efficiency. It also helps to prevent damage to ceilings and other building components caused by condensation dripping from ductwork.

The charts below show installed R-values of fibrous glass duct liner required to prevent moisture condensation on the outside surface of the duct under varying conditions of ambient temperature and relative humidity. Curves are based on cold duct internal temperature of 55°F (13°C), no wind.



G. INDOOR ENVIRONMENTAL QUALITY AND DUCT INSULATION

When properly designed, installed, operated, and maintained, air transmission systems with fibrous glass duct liners can enhance indoor environmental quality by controlling heat loss or gain while reducing condensation and providing control of duct-borne noise.

Tests on fibrous glass duct liners have not indicated significant fiber contribution to the occupied space. In fact, test samples contained fewer fibers than values reported for outdoor ambient air. Reviewing a number of major studies, the World Health Organization's International Programme on Chemical Safety (1988) concluded: "The contribution of fibrous-glass-lined air transmission systems to the fibre content of indoor air is insignificant."

It is vital that HVAC systems be properly designed, installed, operated, and maintained, to minimize moisture carry-over from humidifiers and/or cooling coils by the air stream into the duct system. High efficiency filtration should be selected and regularly maintained to reduce dirt accumulation in the duct system and the possibility of microbial contamination. Condensate drains must also be inspected to assure that they are operating properly.

H. FIRE SAFETY CONSIDERATIONS

This section consists of excerpts from NFPA Standard 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*, 2018 Edition

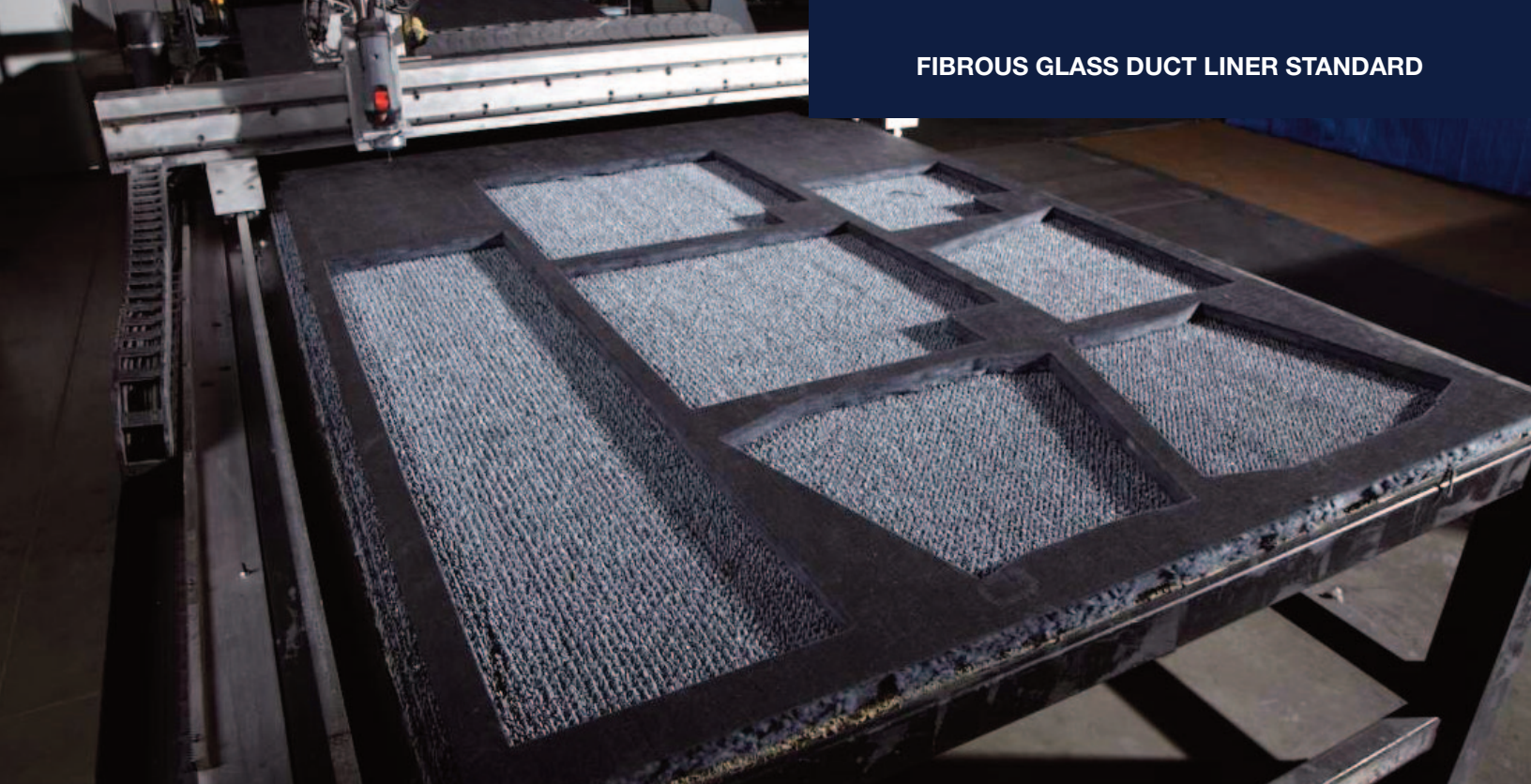
Definitions:

Air duct lining - Air duct lining includes materials such as adhesive, insulation, coating, and film used to line the inside surface of an air duct, fan casing, or duct plenum. Air ducts shall be constructed of materials, reinforced, and sealed to satisfy the requirements of use of the air duct system such as supply air systems, return or exhaust air systems, and variable volume/pressure air systems.

Limited combustible material - A building construction material not complying with the definition of noncombustible material which, in the form in which it is used, has a potential heat value not exceeding 3,500 Btu/lb (8,141 kJ/kg) where tested in accordance with NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, and complies with (a) or (b):

(a) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 1/8" (3.2 mm), that has a flame spread index not greater than 50.

(b) Materials, in the form and thickness used, other than as described in (a), having neither a flame spread index greater than 25 nor evidence of continued progressive combustion, and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame spread index greater than 25 nor evidence of continued progressive combustion.



Material Considerations

Materials subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition shall be considered combustible.

When supplementary materials such as duct coverings, duct linings, vapor barrier facings, fasteners, tapes, and core materials added to air ducts, plenums, panels, and duct silencers are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state.

Air duct, panel and plenum linings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe coverings, ASTM C 411, *Standard Test Method for Hot-Surface Performance of High Temperature Thermal Insulation*, at the temperature to which they are exposed in service. In no case shall the test temperature be below 250°F (121°C).

Air duct linings shall be interrupted at fire dampers so as not to interfere with the operation of these devices. (See page 17 for installation details.)

I. DESIGN CONSIDERATIONS

When determining the application of fibrous glass duct liner in an air duct system, the designer should consider:

1. Uses Subject to Indicated Precautions

- Duct liner should only be used in systems where operating temperatures will not exceed 250°F (121°C).

- To avoid contact with liquid water, duct liner shall be protected by use of a sheet metal sleeve and drip pan adjacent to such equipment as evaporative coolers, humidifiers, cooling coils, and outside air intakes.
- When duct systems run through unconditioned space and are used for cooling only, register openings must be tightly sealed during the heating season to prevent accumulation of water vapor in the duct system.
- To avoid damage to the duct liner due to the physical abuse caused by maintenance personnel working in accessible plenums, some means of duct liner protection must be considered.
- Lined ductwork supplying clean rooms should have terminal filtration of the efficiency required for the particular class of clean rooms.

2. Application Limitations

The use of fibrous glass duct liner is not recommended for the following applications:

- With equipment of any type which does not include automatic maximum temperature controls and where an operating temperature of 250°F (121°C) may be exceeded.
- In kitchen or fume exhaust ducts or ducts conveying solids or corrosive gases.
- With coal or wood-fueled equipment.
- In any application where the duct liner may come in direct contact with liquid water (such as cooling coils, humidifiers, evaporative coolers) unless protected from the water source.
- Inside fire damper sleeves. (See page 17 for details of duct liner interruption at fire dampers.)
- Immediately adjacent to high temperature heating coils without radiation protection.
- In systems supplying operating rooms, delivery rooms, recovery rooms, nurseries, isolation rooms, and intensive care.

Section I: Design Criteria

J. SHORT FORM SPECIFICATIONS

All heating, cooling, and ventilation supply and return ducts operating at a maximum air velocity of 6,000 FPM (30.5 m/sec) and service temperature not exceeding 250°F (121°C) or lower than 40°F (4°C) shall be lined with duct liner having an airstream surface treatment. The duct liner shall meet the requirements for life safety as set forth in NFPA 90A and 90B and shall conform to the requirements of ASTM Specification C 1071.

Duct liner shall be installed in accordance with the latest edition of NAIMA *Fibrous Glass Duct Liner Standard* (hereinafter referred to as NAIMA FGDLS) or SMACNA *HVAC Duct Construction Standard, Metal & Flexible* (hereinafter referred to as SMACNA HVAC DCS). Liner shall be installed with the labeled or printed surface exposed to the air stream. Subject to the specified application limitations, duct liner shall cover the interior metal surfaces of duct sections and fittings except where required by codes (as in areas of fire dampers or electric heaters). A minimal gap is permitted at the transverse joints between duct sections.

Adhesive shall be applied to the sheet metal with a minimum coverage of 90%. All transverse edges not receiving sheet metal nosing shall be coated. Longitudinal joints in duct liner should occur at the corners of ducts. However, duct size and standard duct liner product dimensions may make exposed longitudinal joints necessary. In such cases, the exposed joints shall be coated with an adhesive or coating designed for duct liner application and additionally secured with mechanical fasteners in accordance with NAIMA FGDLS as if it were a transverse joint. Adhesive shall meet the requirements of ASTM C 916.

Joints shall be butted. A minimal gap is permitted at the transverse joints between duct sections. All rips and tears on the air stream surface shall be repaired by coating damaged areas with approved adhesive or coating or damaged duct liner shall be replaced. Longitudinal corner joints may be folded and/or overlapped and compressed.

Mechanical fasteners shall be used to secure the duct liner to the sheet metal and shall be spaced in accordance with NAIMA FGDLS or SMACNA HVAC DCS. These may be either impact-driven or weld-secured.

Mechanical fasteners shall be installed perpendicular to the duct surface and shall not compress the insulation more than 1/8" (3mm) based on the nominal insulation thickness.

Metal nosings (either channel or zee profile) shall be securely installed over transverse liner edges facing the air stream at fan discharge and any interval of lined duct preceded by unlined duct. In addition, where velocities exceed 4,000 FPM (20.3 m/sec), metal nosing shall be installed on upstream edges of lined duct sections.

K. CSI 3-PART MASTERFORMAT® SPECIFICATION

SECTION 23 07 13

Sheet Metal Ducts - Acoustical Lining Insulation Commercial/Residential Duct Systems

PART 1.00 - GENERAL

1.01 Scope

A. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required for correct fabrication and installation of commercial or residential air duct systems of sheet metal lined with fibrous glass duct liner in accordance with applicable project drawings and specifications, subject to terms and conditions of the contract:

1. All air duct systems operating at internal air velocities not exceeding rated duct liner limitations and internal air temperature not exceeding 250°F (121°C) nor below 40°F (4°C).
2. Duct liner products shall conform to the requirements of ASTM C 1071.
3. The manufacturer's product identification shall appear on the air stream surface.
4. Duct liner adhesive shall conform to the requirements of ASTM C 916.
5. The finished duct system shall meet the requirements of NFPA 90A and 90B including:
 - It shall be rated for maximum operating temperature of 250°F (121°C) per ASTM C 411.
 - It shall have a flame spread index not greater than 25 and a smoke developed index not greater than 50 per ASTM E 84 or CAN/ULC S102.
 - It shall have a potential heat value not greater than 3,500 Btu/lb (8,141 kJ/kg) per NFPA 259.
 - It shall have no microbial growth when tested per ASTM C 1338, ASTM G 21-96 (fungus test).

Marking on the airstream surface of the duct liner shall provide evidence of compliance.

B. Dimensions shown on the plans are finished inside dimensions.

C. Fabrication and installation shall conform to the manufacturer's recommendations and to the requirements of the latest edition of NAIMA FGDLS or SMACNA HVAC DCS.

1.02 Delivery and Storage of Materials

A. Deliver all materials and/or fabricated, insulated duct sections and fittings to the job site and store in a safe, dry place.

B. Protect materials from dust, dirt, moisture, and physical abuse before and during installation. Replace wet, contaminated duct liner.

PART 2.00 - PRODUCTS

2.01 Insulated Duct System

A. Insulate all supply ducts, return ducts, and related fittings with duct liner meeting the requirements of ASTM C 1071 as follows:

1. Type I - Flat, in roll form, in thicknesses of 1/2" to 2" (13mm to 51mm) in 1/2" (13mm) increments. Maximum thermal conductivity at 75°F (24°C) mean temperature: 0.31 Btu-in/hr-ft²·°F (λ = 0.045 W/m·°C).
2. Type II - Flat, in sheet form, in thicknesses of 1", 1 1/2", and 2" (25mm, 38mm, and 51mm). Maximum thermal conductivity at 75°F (24°C) mean temperature: 0.27 Btu-in/hr-ft²·°F (λ = 0.039 W/m·°C). The duct liner shall have an airstream surface treatment.

PART 3.00 - EXECUTION

3.01 Inspection

A. Verify that the duct liner product may be installed in accordance with project drawings, operating performance parameters and limitations, and provisions of NAIMA FGDLS or SMACNA HVAC DCS.

3.02 Insulation of Straight Ducts and Fittings

A. Duct liner shall cover the interior metal surfaces of duct sections and fittings. Joints shall be butted. A minimal gap is permitted at the transverse joints between duct sections.

B. Adhere duct liner to sheet metal with 90% (minimum) coverage of adhesive complying with requirements of ASTM C 916.

C. Coat all transverse edges not receiving sheet metal nosing. Longitudinal joints in duct liner should occur at the corners of ducts. However, duct size and standard duct liner product dimensions may make exposed longitudinal joints necessary. In such cases, coat exposed joints with adhesive designed for duct liner application. Adhesive shall meet requirements of ASTM C 916. Additionally, secure such joints with mechanical fasteners in accordance with NAIMA FGDLS as if they were transverse joints.

D. Secure duct liner with mechanical fasteners, either weld-secured or impact-driven. Mechanical fasteners shall not compress the insulation more than 1/8" (3 mm) based on nominal insulation thickness and shall be installed perpendicular to the duct surface. Spacing of mechanical fasteners with respect to interior duct dimensions shall be in accordance with NAIMA FGDLS or SMACNA HVAC DCS. Fastener heads or washers shall have a minimum area of 0.75 in.² (480mm²) with beveled or cupped edges.

E. Securely install metal nosings (either channel or zee profile) over transverse liner edges facing the airstream at fan discharge and at any point where lined duct is preceded by unlined duct. In addition, where air velocities exceed 4,000 FPM (20.3 m/sec), install metal nosing on upstream edges of lined duct sections.

F. Fold duct liner in roll form and compress in the corners of rectangular duct sections or cut and fit to assure a lapped, compressed corner joint.

G. Cut and fit duct liner in sheet form to assure tight, overlapped corner joints. Install so top pieces of rigid duct liner are supported at the edges by the side pieces.

H. Installation of two layers of duct liner is not recommended. If the specification forces the use of multiple layers, the following steps shall be taken:

1. Adhere first layer of duct liner to the sheet metal in the usual manner.
2. Adhere top layer of duct liner to bottom layer using a minimum of 90% adhesive coverage.
3. Use mechanical fasteners of the proper length for the double layer of duct liner.
4. Treat the leading edges of double layer duct linings to prevent separation of the two layers in accordance with requirements for single layer applications (determined by service air velocity).

3.03 Inspection

A. Upon completion of installation of lined duct and before HVAC system start-up, visually inspect the ductwork and verify that duct liner has been correctly installed. Confirm that the duct system is free from construction debris.

3.04 Commissioning

A. After the lined duct system is completely installed and ready for service, conduct a final inspection of the entire system. This inspection should include, at minimum, the following steps:

1. Check all registers, grilles, and diffusers to ensure that they are clean and free from construction debris.
2. Check all filters in accordance with their manufacturers' instructions. Use specified grade of filters at all times system is operating.
3. Cover supply openings with filter media prior to system start-up to catch any loose material that may remain inside the ductwork.
4. Turn the HVAC system on and allow it to run until steady state operation is reached.
5. Remove the temporary filter media from supply openings and, along with it, any loose material blown downstream and caught by the filter media.
6. Check to ensure that air delivery performance meets all requirements and complies with SMACNA leakage specifications.

3.05 Safety Precautions

A. Conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, NAIMA's Product Stewardship Program, and all state and/or local safety and health codes and regulations that may apply to the work. Consult the manufacturer's Safety Data Sheet (SDS) when appropriate.

Section II: Fabrication Standards

A. APPLICATION CONSIDERATIONS

This Standard is based on the presumption that the duct system designer has:

1. Clearly designated on contract drawings the sections of ductwork to be lined;
2. Specified the type and thickness of duct liner to be installed and adhesive to be used;
3. Determined that the specified duct liner has the thermal, acoustical, friction loss, and other performance characteristics required for the application;
4. Provided for condensation control where interruptions of lined ductwork might cause a problem.

B. CUTTING FIBROUS GLASS DUCT LINER

Fibrous glass duct liner may be cut:

1. By hand with a utility knife or other suitable sharp knife. Knives specifically designed for cutting duct liner are available from several manufacturers.
2. By machines, such as automated coil line equipment (see Fig. II-1). Many different types of coil line equipment exist; follow cutting recommendations of the equipment manufacturers.
3. By computerized equipment which can be programmed to cut rectangular shapes for straight duct sections or special shapes for fittings such as ells, tees, offsets, and transitions (see Fig. II-2).

For appropriate work practices when cutting fibrous glass duct liner, refer to the manufacturer's Safety Data Sheet (SDS).

C. DUCT LINER ADHESIVES

Adhesives shall comply with the property requirements of ASTM C 916. These may be either water-based or solvent-based. Water-based duct liner adhesives may not develop fast tack and early bond strength as quickly as solvent-based adhesives. In situations where fittings have tight radii and the duct liner shows a tendency to separate from the sheet metal before the adhesive has had time to set, additional mechanical fasteners should be applied to ensure that the duct liner will remain in contact with the sheet metal while the adhesive dries.

Vapor emanating from some solvent-based adhesives may be explosive. Adhesives should be applied in well-ventilated areas away from open flames, welding operations, or other potential ignition sources. Follow adhesive label instructions.

Adhesives may be applied by roller coating, spraying, or brushing. Application instructions and precautions provided by adhesive manufacturers should be carefully followed.

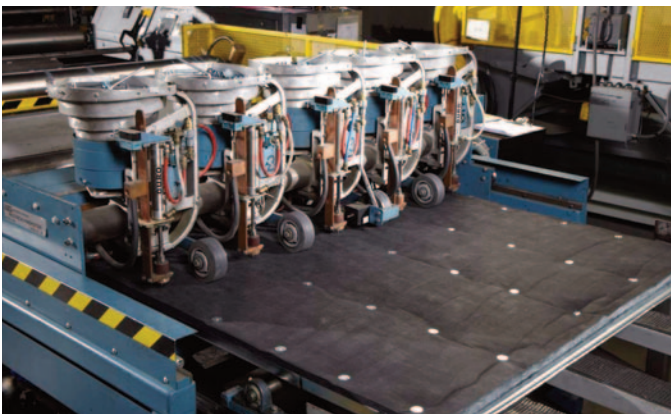


Fig. II-1. Cutting and processing fibrous glass duct liner on an automatic coil line

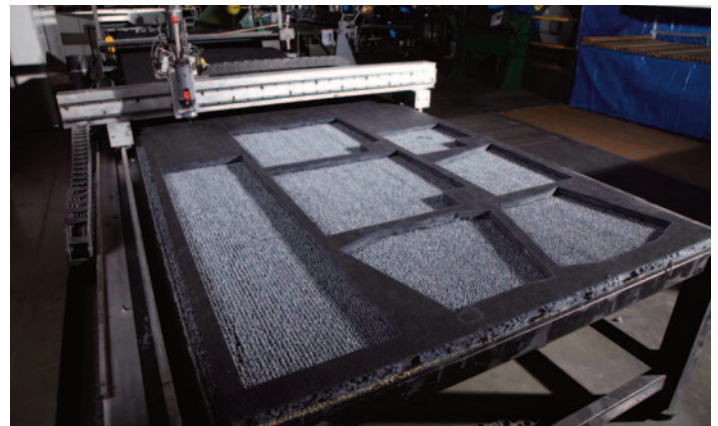


Fig. II-2. Example of computer-guided cutting and fabrication

D. MECHANICAL FASTENING

Mechanical fasteners shall be located with respect to interior duct dimensions regardless of air flow direction. See Fig. II-4.

See page 5 for types of mechanical fasteners.

Mechanical fasteners also must:

1. Be as corrosion-resistant as G60 galvanized steel when installed.
2. Indefinitely sustain a 50 pound (22.7 Kg) tensile dead load test perpendicular to the duct wall.

3. Not adversely affect the fire hazard classification of the duct liner and adhesive.
4. Not damage the duct liner when applied as recommended.
5. Not cause leakage in the duct.
6. Be installed perpendicular to the duct surface.
7. Be the correct length for the specified duct liner thickness.
8. Not compress the duct liner insulation more than 1/8" (3mm).
9. Not project more than nominally into the air stream.

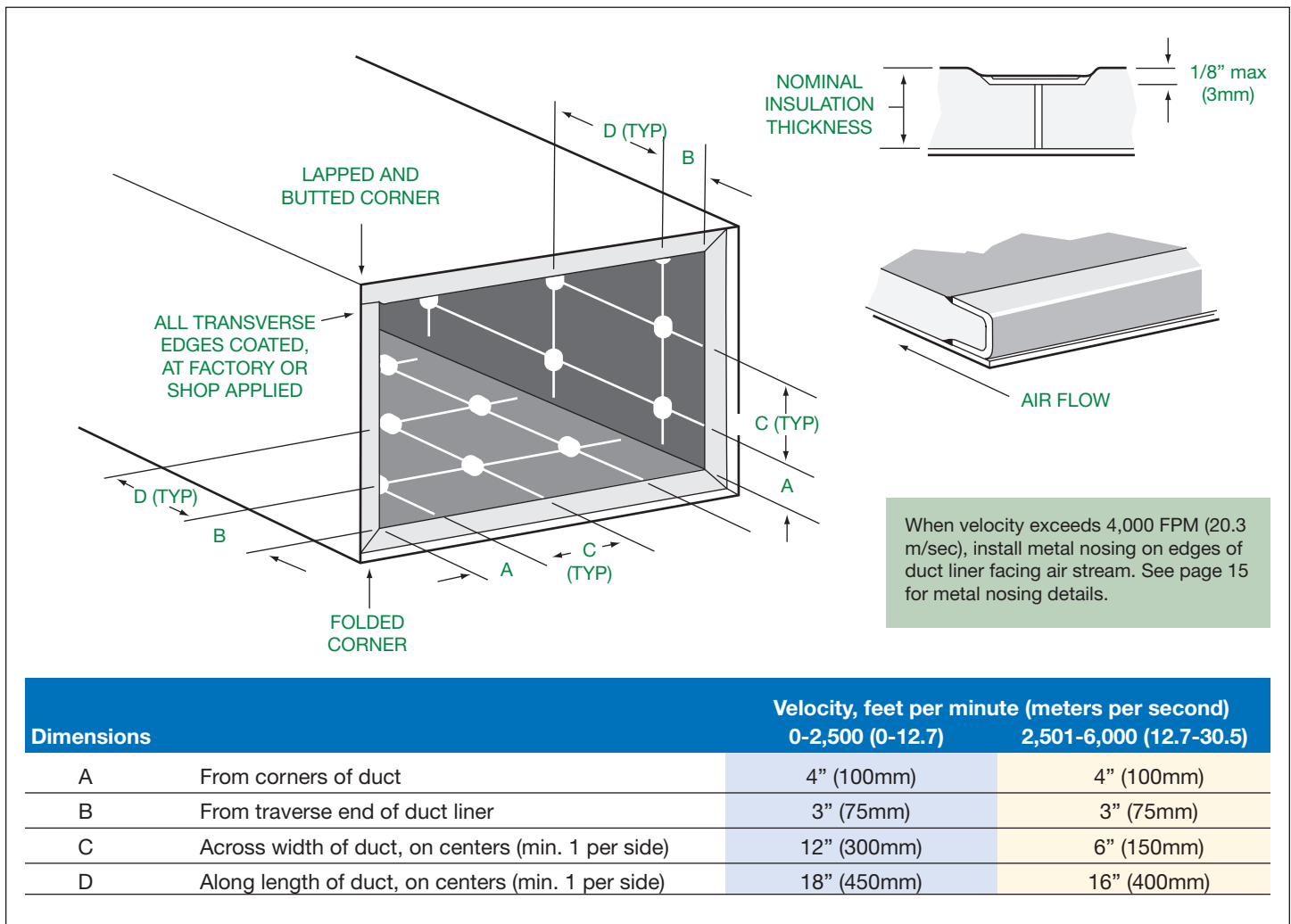


Fig. II-4. Mechanical fastener spacing

Section II: Fabrication Standards

E. GENERAL FABRICATION AND INSTALLATION PRINCIPLES

1. Unless otherwise indicated, the inside dimensions of the duct shown on contract drawings shall be maintained (see Fig. II-5). Duct dimensions shall be increased as necessary to compensate for liner thickness.

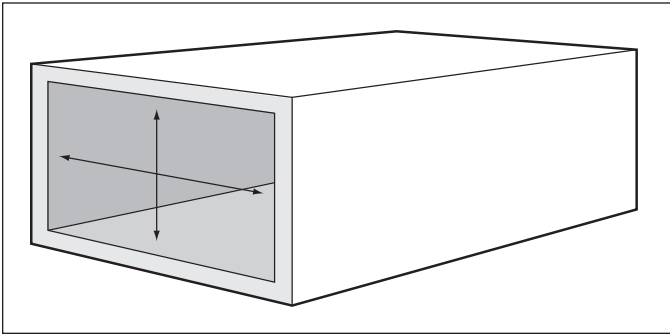


Fig. II-5. Net free area

2. Duct liner shall cover the interior metal surfaces of duct sections and fittings. A minimal gap is permitted at the transverse joints between duct sections. Liner should not be patched in fittings, except that seams may be allowed at break points. Allowance for sheet metal add-on dimensions must be made when cutting duct liner.
3. The duct liner shall be installed with the labeled or printed surface exposed to the air stream.
4. The duct liner shall be adhered with a minimum of 90% coverage of adhesive of the liner contact surface area. Adhesive shall conform to ASTM C 916.
5. All transverse edges not receiving metal nosing shall be fully coated with adhesive conforming to ASTM C 916 or coating approved (or applied) by the duct liner manufacturer. Joints shall be butted. A minimal gap is permitted at the transverse joints between duct sections.
6. Liner shall be folded and compressed at corners of rectangular duct sections or cut and fit to assure lapped, compressed joints (see Figs. II-6a, b, c, page 15). Longitudinal joints in duct liner should occur at the corners of ducts. However, duct size and standard duct liner product dimensions may make exposed longitudinal joints necessary. In such cases, the exposed joints shall be coated with adhesive and additionally secured with mechanical fasteners in accordance with NAIMA FGDLS as if it were a transverse joint.
7. Metal nosings (either channel or zee profile) shall be securely installed over transversely oriented liner edges facing the air stream at fan discharge and at any point where lined duct is preceded by unlined duct (see Figs. II-7a, b, c, page 15). In addition, where air velocities exceed 4,000 fpm (20.3 m/sec), metal nosing shall be applied to upstream edges of lined duct sections. When installing duct system components with nosings, make sure they are properly oriented with respect to the direction of air flow.



8. Where dampers, turning vanes, or other devices are placed inside of lined duct or fittings, the installation must not damage the airstream surface. The use of metal hat sections or other “build-out” means is optional; when used, “build-outs” shall be mechanically secured to the duct wall. (See Fig. II-8, page 16.)
9. Duct liners shall be interrupted at fire dampers to avoid interference with damper operation and at heat sources to meet minimum clearance specified as a condition of equipment listing. (See Fig. II-9, page 17)
10. Installation of two layers of duct liner to meet a minimum specified thickness is not recommended. When specifications require two layers, minimum adhesive coverage of 90% for each layer shall be applied. Fasteners of sufficient length for both layers must be used. In addition, special attention to leading-edge nosings is required (See Fig. II-7c, page 15).

DUCT LINER CORNER TREATMENTS

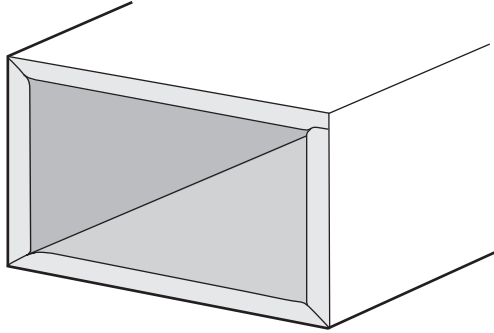


Fig. II-6a. Type I duct liner, corners folded

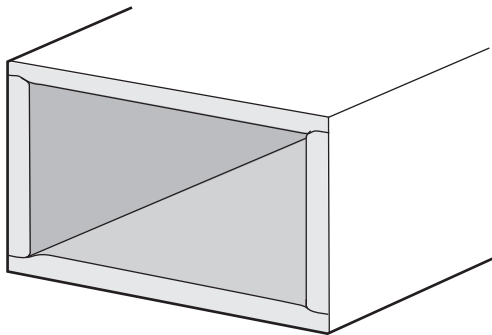


Fig. II-6b. Type I duct liner, corners lapped and compressed

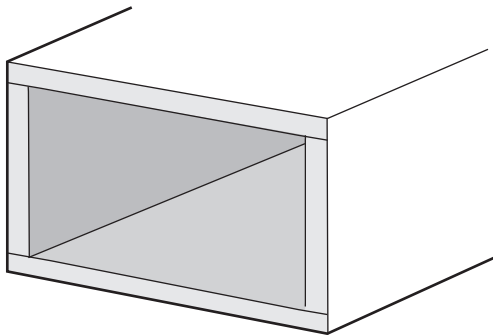


Fig. II-6c. Type II duct liner, corners lapped, side pieces supporting top piece

Longitudinal seams shall occur only at the corners of the duct unless duct size and standard duct liner product dimensions make it impossible to do so.

NOSING TREATMENTS

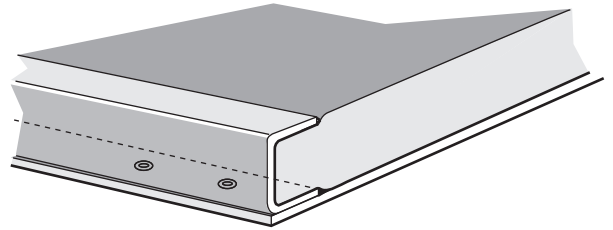


Fig. II-7a. Channel nosing, 1" (25mm) x liner thickness x 1" (25mm), mechanically secured to sheet metal duct

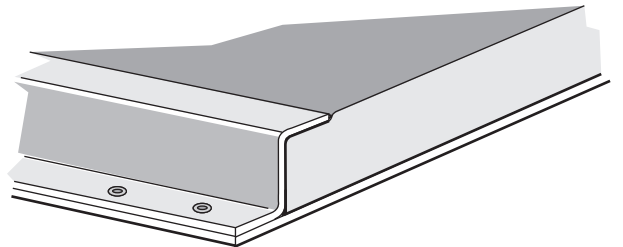


Fig. II-7b. Zee nosing, 1" (25mm) x liner thickness x 1" (25mm), mechanically secured to sheet metal duct

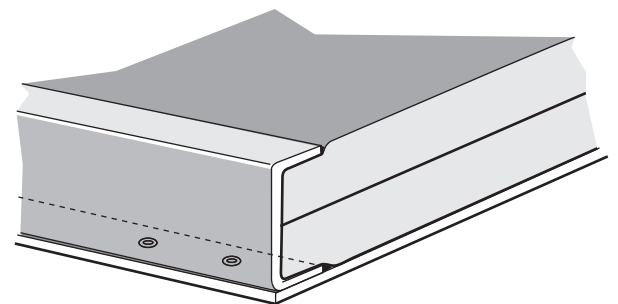


Fig. II-7c. Nosing in two-layer duct liner installations, 1" (25mm) x thickness of both layers x 1" (25mm). Second layer of duct liner shall also be adhered to first layer with 90% (minimum) coverage of adhesive complying with ASTM C 916. Duct liner fasteners must be sufficient length for both layers of duct liner.

Section II: Fabrication Standards

Build-out for Installing Turning Vanes and Accessories

Hat section, 3" (75mm) (min.) wide x duct liner thickness, with 1" (25mm) flanges mechanically secured to duct. Inside of hat section shall also be insulated. Wider hat sections shall be used if required for adequate support of accessories installed within duct.

If air velocity range is between 4,000 and 6,000 fpm (20.3 to 30.5 m/sec), nosing must be applied to upstream exposed edges of duct liner. See page 15 for nosing details.

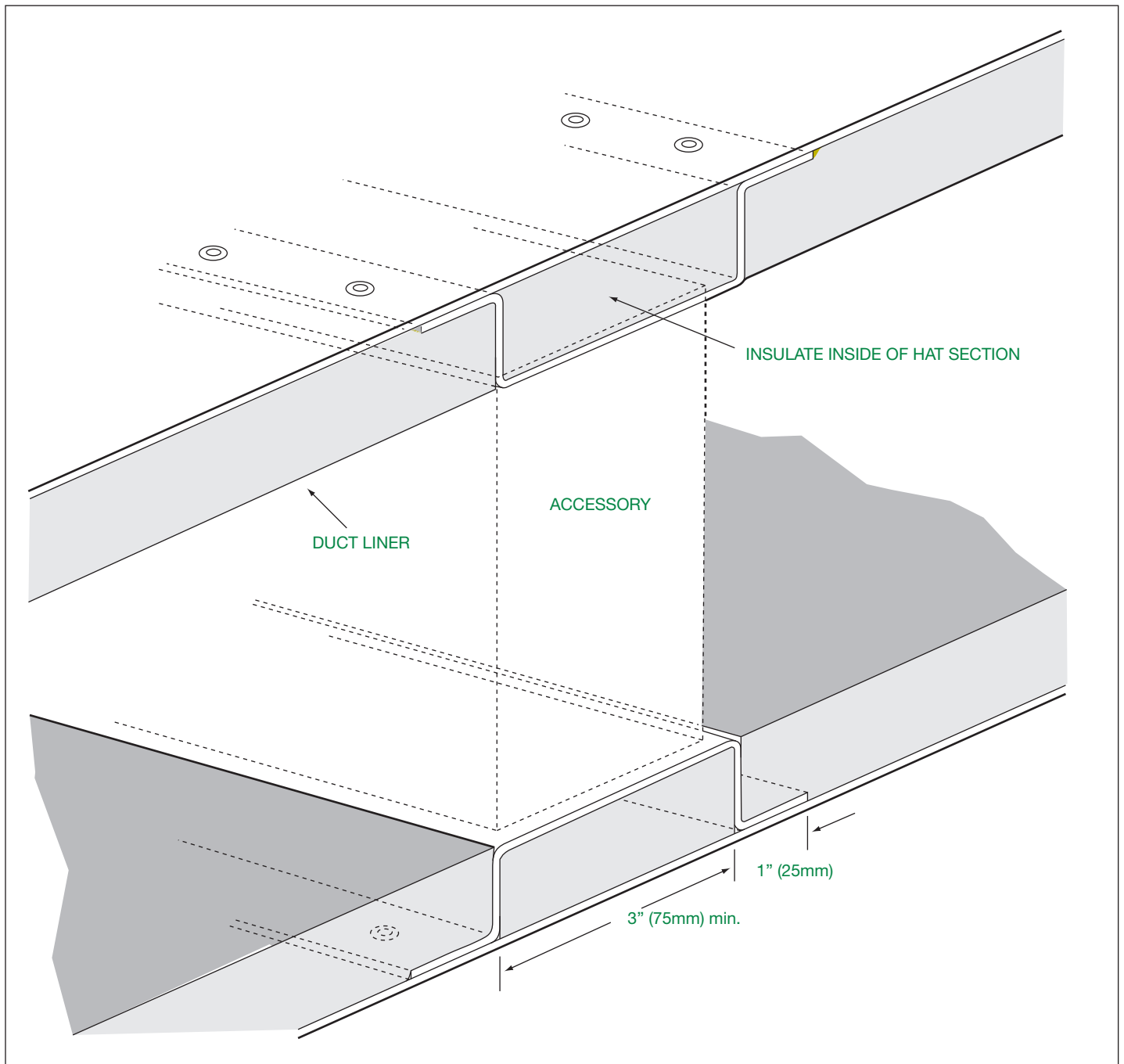


Fig. II-8. Build-out for installation of turning vanes or other equipment

Fabrication Standard - Interruptions of Duct Liner (as at Fire Dampers)

Sleeve assembly installed through fire wall, secured to wall with retaining angle, per damper manufacturer's listing. Duct shall be attached to sleeve assembly with "S" connectors. Exposed sleeve surfaces shall be insulated with duct wrap. Nosing is required on upstream exposed edges of duct liner.

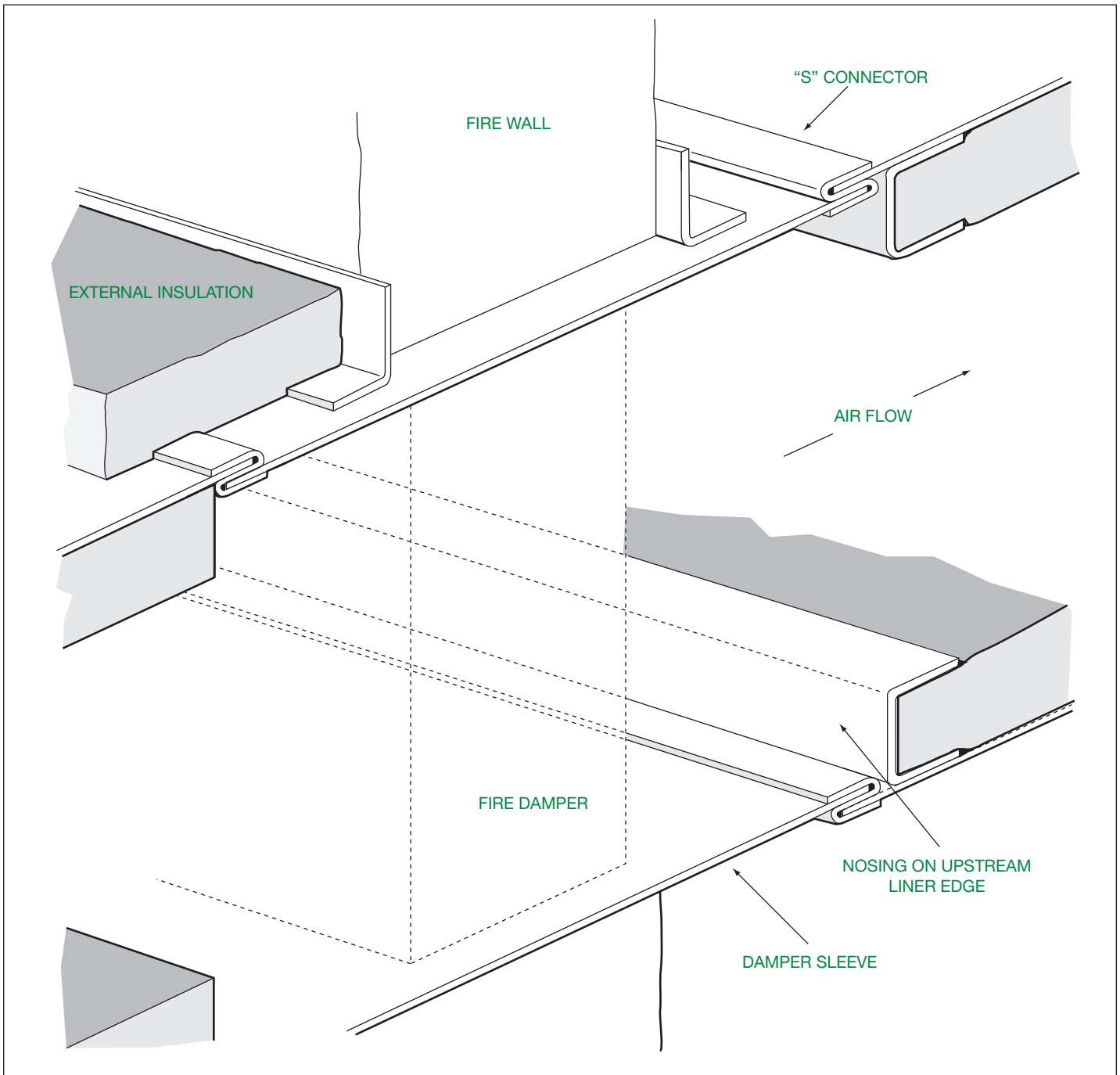


Fig. II-9. Interruption of duct liner, as at fire dampers

Section III: System Operation

A. INSTALLATION

Application of fibrous glass duct liner insulation is normally a shop-fabrication process. After each duct system component has been completed and duct liner installed with adhesives, fasteners, and (where required) nosings applied in accordance with this Standard, all components should be carefully cleaned and inspected to make sure all seams and joints are neatly butted, all fasteners secure, and all interior metal surfaces of duct sections and fittings are covered. A minimal gap is permitted at the transverse joints between duct sections.

Care should be taken at the jobsite to ensure that fibrous glass duct linings are not damaged during jobsite storage, handling, and installation. If damage occurs, apply adhesive conforming to ASTM C 916 (or coating approved by the duct liner manufacturer) to repair as required. If damage is sufficiently severe, carefully replace the damaged area with a patch, coating edges with adhesive. In extreme cases, remove and replace liner.

Lined duct components should be kept clean and dry at all times. Discard any material which has become contaminated during storage.

B. COMMISSIONING

After the lined duct system is completely installed and ready for service, conduct a final inspection of the entire system. This inspection should be conducted before testing and should include at minimum the following steps:

1. Check all registers, grilles, and diffusers to ensure that they are clean and free from construction debris.
2. Check all filters in accordance with their manufacturers' instructions. Use the specified grade of filters at all times the system is operating.
3. Cover supply openings with filter media prior to system start-up to catch any loose material that may remain inside the ductwork.
4. Turn the HVAC system on and allow it to run until steady state operation is reached.
5. Remove the temporary filter media from supply openings and, along with it, any loose material blown downstream and caught by the filter media.
6. Check to ensure that air delivery performance of the duct system meets all requirements and complies with SMACNA leakage specifications.

C. OPERATION AND MAINTENANCE

Operation of any duct system includes preventive maintenance which should follow certain basic principles whether or not the system is lined with fibrous glass insulation materials. These include:

1. Operating within system design operating temperatures and air velocities.
2. Maintaining filtration equipment in good, clean condition throughout the system and following manufacturers' recommendations for maintenance, cleaning, and replacement.
3. Controlling condensation and other sources of moisture to prevent the duct liner from becoming wet. The system should be operated and maintained so as to avoid moisture carry-over from humidifiers and/or coils by the air stream into the duct system. Condensate drains must be inspected to assure proper operation. When duct systems run through unconditioned space and are used for cooling only, register openings must be tightly sealed during the heating season to prevent accumulation of water vapor in the duct system.
4. Fibrous glass duct liner that has become wet in service should be removed and replaced to reduce the risk of mold growth and to restore thermal and acoustical performance levels. The source of the water must be identified and eliminated prior to replacement of the liner.

D. PREVENTIVE MAINTENANCE

Careful maintenance of the HVAC system, including the ductwork, is important in preventing accumulation of dirt, dust, and moisture which can restrict air flow, impair the ability of fibrous glass duct linings to perform satisfactorily, and jeopardize the quality of the indoor air.

SMACNA recommends system design and maintenance procedures in its publication *Indoor Air Quality*. These procedures include inspection, detection, and repair of probable sources of moisture and are consistent with those recommended in ASHRAE 62.1-2019, *Ventilation for Acceptable Indoor Air Quality*, and the Environmental Protection Agency (EPA) publication *Building Air Quality: A Guide for Facility Owners and Building Managers*.

E. ACCESSING FIBROUS GLASS LINED DUCTS FOR CLEANING

In some cases, when preventive maintenance has been inconsistent, system cleaning may become necessary. Fibrous glass duct liners can be cleaned successfully. Proper cleaning practices will ensure that the insulated duct system's structural and functional integrity is maintained. The entire air distribution system needs to be opened, cleaned, closed, and returned to service with all its thermal, acoustical, and air-tightness properties intact.

Care must be taken in the selection and application of the cleaning process. Several viable methods are available which have proven effective in cleaning insulated duct systems, and professional duct cleaning services are widely available.

Refer to the NAIMA handbook, *Cleaning Fibrous Glass Insulated Air Duct Systems*, Pub. No. AH-122, for details. It is recommended that an independent expert be consulted before committing to proceed with duct cleaning, especially if introduction of "sanitizing" antimicrobial agents into the system is under consideration.

1. Opening Ductwork

1. Determine location and dimensions of openings.
2. Draw straight lines the size of the opening plus 1/2" (15mm) on all four sides. These lines will establish the size of a sheet metal patch that will be required when closing the duct.
3. Drill two overlapping holes through the duct only at one corner, staying 1/2" (15mm) inside drawn lines. Do not drill into duct liner. See Fig. III-1.
4. Cut along opening lines with shears, staying 1/2" (15 mm) inside drawn lines.
5. Carefully loosen the sheet metal piece from the duct liner inside and discard it.
6. Cut through the insulation with a knife around three sides of the opening at a 45° angle, leaving the upstream end uncut. See Fig. III-2.
7. Carefully pull the insulation out through the opening, bending it at the upstream side so that the surface opposite the airstream surface is the most tightly folded. Tape it out of the way.

2. Opening Ducts Lined with Rigid Duct Liner Board

If the duct is lined with Type II rigid duct liner board rather than Type I flexible duct liner, the insulation must be cut away on all four sides and removed (see Fig. III-3). Rigid duct liner board can be distinguished from flexible duct liner by its uniform thickness and rigidity. It also has a black airstream surface. Most duct liners have dark-colored base material; airstream surfaces are either smooth black coatings or dark-colored mats.

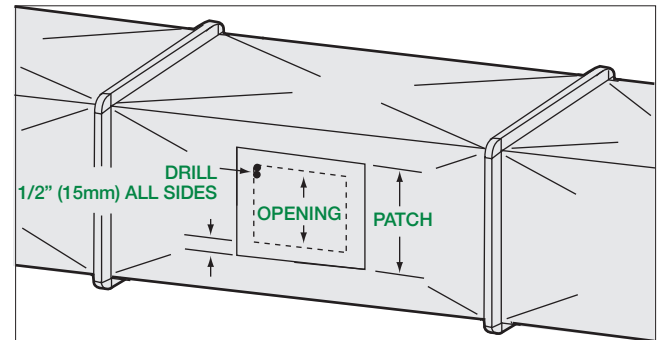


Fig. III-1. Laying out location for opening in duct

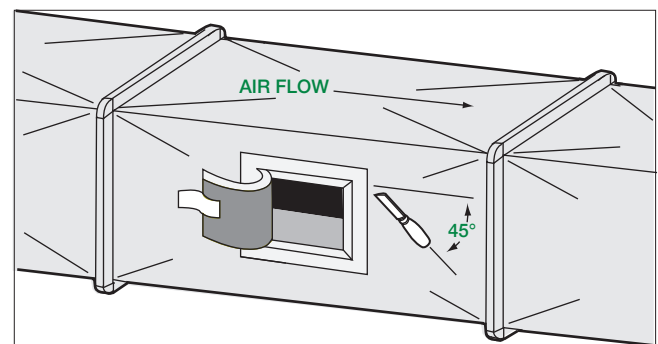


Fig. III-2. Cutting into flexible duct liner at 45° angle

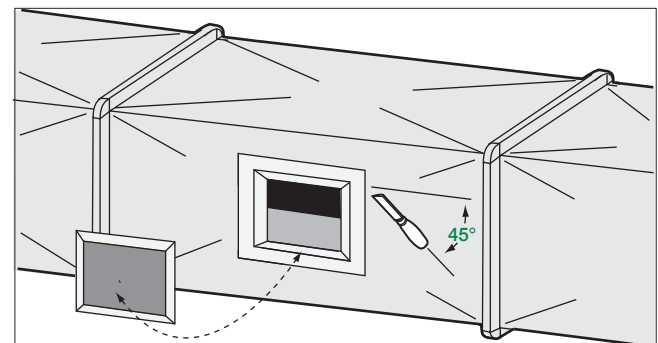


Fig. III-3. Opening duct lined with rigid duct liner board

Section III: System Operation

3. Closing Cleaned Ductwork

When closing openings made for cleaning sheet metal ducts lined with fibrous glass duct liners, the insulation must be secured in its original position before the sheet metal is patched.

1. Coat edges of flexible duct liner flap (or cut-out piece of rigid duct liner board) with adhesive complying with ASTM C 916.
2. Replace the flap or cut-out piece in its original position so the hole in the duct liner is tightly plugged (See Fig. III-4).
3. Cut a sheet metal patch to dimensions drawn on duct when opening (see page 19). The patch should be about 1" (25mm) larger in both dimensions than the hole in the sheet metal which it must cover.
4. Apply a bead of sealant around the opening (see Fig. III-5). Sealant must be suitable for use on sheet metal ducts.
5. Apply adhesive to the duct liner flap or cut-out piece of duct liner board and press the sheet metal patch in place over it.
6. Screw the sheet metal patch to the duct with sheet metal screws on 8" (200mm) centers (approx.) so the patch will overlap the opening by 1/2" (15mm), on all four sides (see Fig. III-6).

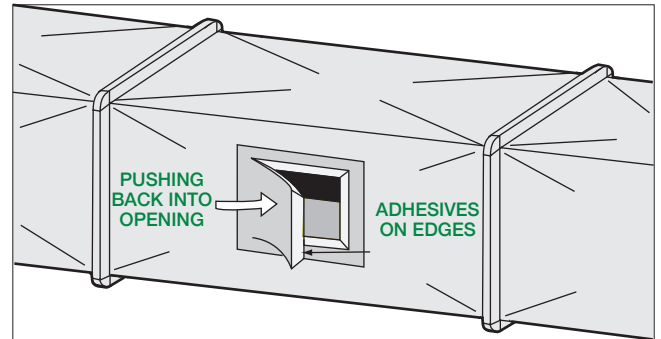


Fig. III-4. Replacing duct liner insulation after cleaning

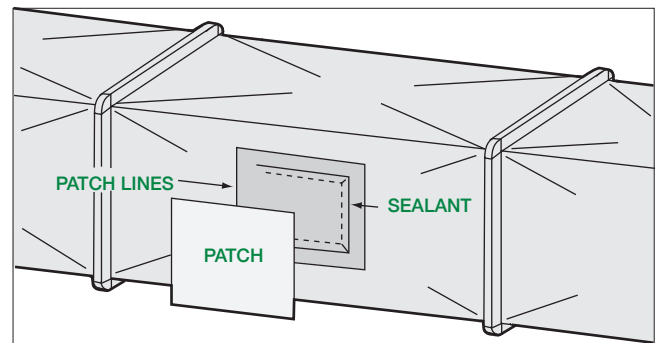


Fig. III-5. Sealing around opening and placing patch

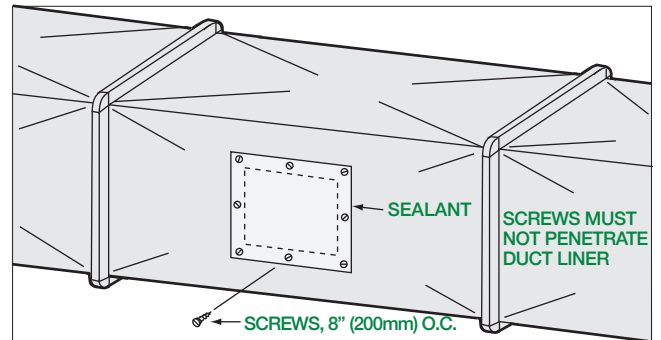


Fig. III-6. Fastening metal patch in place over opening



INSPECTION CHECK LIST FOR FIBROUS GLASS DUCT LINER INSTALLATION

All check-marks should be in the YES column. If a check-mark appears in the NO column, it should be brought to the duct system contractor's attention.

Project Name and Number _____

Duct System Contractor _____

Mechanical Contractor _____

General Contractor _____

Engineer _____

Inspected by _____ Date _____

DOCUMENTATION

- ___ Current edition, NAIMA Fibrous Glass Duct Liner Standard
- ___ SMACNA Duct Construction Standards - Metal and Flexible
- ___ Duct Liner Manufacturer's Installation Recommendations
- ___ Submittal Drawings
- ___ Plans and Job Specifications
- ___ Applicable Building / Energy Codes

PRODUCT

	YES	NO
___ Does duct liner comply with NFPA 90A as stated on product data sheet?	()	()
___ Does duct liner R-value conform to code requirements?	()	()
___ Is duct liner thickness in accordance with job plans and specifications?	()	()

INSTALLATION

___ Has duct liner been correctly installed with labeled or printed surface visible?	()	()
___ Has duct liner been adhered to sheet metal with at least 90% coverage of adhesive?	()	()
___ Does duct liner cover the inside surfaces of the system including fittings? A minimal gap is permitted at the transverse joints between duct sections.	()	()
___ Is the duct liner free of visible damage (tears, punctures, abrasions)?	()	()
___ Are fasteners of the proper type and properly installed?	()	()
___ Are fastener washers, cupped or beveled, installed so they will not cut into duct liner?	()	()
___ Are fasteners spaced at the correct intervals for system air velocity?	()	()
___ Are fasteners correctly installed so they are perpendicular to the sheet metal?	()	()
___ Do fastener heads or washers compress duct liner no more than 1/8" (3mm)?	()	()
___ Are transverse joints factory coated or field coated with adhesive meeting ASTM C 916?	()	()
___ Are all leading edges finished with sheet metal nosing if air velocity requires it?	()	()
___ Are transverse joints neatly butted? A minimal gap is permitted at transverse joints between duct sections.	()	()
___ Are all corner joints compressed and either overlapped or folded?	()	()
___ Are longitudinal joints at corners unless duct size or product dimensions prohibit?	()	()
___ Are top panels of duct liner board supported by side panels?	()	()
___ If installation is 2-layer, are layers bonded together with adhesive?	()	()

COMMISSIONING

___ Are all sheet metal joints sealed per project specifications to prevent air leakage?	()	()
___ Has all construction debris been blown or physically removed from the duct system?	()	()
___ Are all registers, grilles, and diffusers free from construction debris?	()	()
___ Have all filters been installed in accordance with manufacturers' instructions?	()	()
___ Are all sources of potential moisture installed or treated so duct liner won't become wet?	()	()
___ Is the system operating within design temperatures, air velocities, and static pressures?	()	()

Facts on Fibrous Glass Duct Insulation

Fiber glass has been commercially manufactured for more than 75 years. Today, fiber glass is an important component of the nation's economy, providing energy-conserving products that help reduce pollution and preserve the environment.

One of the world's most useful materials, fiber glass can absorb sound, help control heat flow, diminish impurities from liquids and gases, reinforce other materials and, with a vapor retarder, help control condensation. Fiber glass duct insulation will not support the growth of mold or bacteria when tested in accordance with specifications of the American Society for Testing and Materials (ASTM C 1338) or Underwriters Laboratories Inc. UL 181. In addition, fiber glass duct insulation materials installed internal to the duct system are tested per ASTM G 21.

Commitment to Product Stewardship

In May 1999, the North American Insulation Manufacturers Association (NAIMA) implemented a comprehensive voluntary work practice partnership with the U. S. Occupational Safety and Health Administration (OSHA). This Health and Safety Partnership Program (HSPP) will train workers to keep airborne exposures below 1 fiber-per-cubic-centimeter (1 f/cc). After completion of the HSPP, NAIMA converted the program into NAIMA's Product Stewardship Program with essentially the identical recommendations.

NAIMA has produced a pamphlet entitled "*Working Smart with Fiber Glass, Rock Wool and Slag Wool Products*," that describes the recommended work practices. Included in the pamphlet are recommendations for minimizing dust generation, maintaining adequate ventilation, wearing appropriate clothing and personal protective equipment, and removing fibers from skin and eyes. It also details specific work practices for blowing insulation in attics, installing cavity fill, batt, blanket, and roll insulation, fabricating pipe and board, installing ceiling tiles and spray-applied fireproofing and handling bulk unbonded products, and removing previously installed products. These recommendations were endorsed by OSHA as part of the HSPP and are now incorporated into the NAIMA Product Stewardship Program. The pamphlet, along with a video describing the work practice recommendations, is available free is available free online at www.insulationinstitute.org.

NAIMA and its member companies are committed to ensuring that fiber glass products can be safely manufactured, installed and used. NAIMA member companies have funded tens of millions of dollars of research at leading independent laboratories and universities in the United States and abroad. The weight of the scientific research shows no association between exposure to glass fibers and respiratory disease or cancer in humans.

In October 2001, an international expert review by the International Agency for Research on Cancer (IARC) re-evaluated the 1988 IARC assessment of glass fibers and removed glass wools from its list of possible carcinogens by downgrading the classification of these fibers from Group 2B (possible carcinogen) to Group 3 (not classifiable as to carcinogenicity in humans). All fiber glass wools that are commonly used for thermal and acoustical insulation are included in this classification. IARC noted specifically:

"Epidemiologic studies published during the 15 years since the previous IARC Monographs review of these fibers in 1988 provide no evidence of increased risks of lung cancer or mesothelioma (cancer of the lining of the body cavities) from occupational exposures during manufacture of these materials, and inadequate evidence overall of any cancer risk."

U.S., California, and international authorities have all agreed that biosoluble and inhalable glass fibres should not be labeled as a possible cancer hazard. The U.S. National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment (OEHHA) actions mean that a cancer warning label for biosoluble fiber glass is no longer required under Federal or California law. NAIMA and its member companies are committed to the safe manufacture, installation, and use of fiber glass insulation products.

The NTP in June 2011 removed from its Report on Carcinogens (RoC) all biosoluble glass wool used in home and building insulation and for non-insulation products.

Also in 2011, California's OEHHA published a modification to its Proposition 65 listing to include only "Glass wool fibers (inhalable and biopersistent)."

Fiber glass is now the most thoroughly evaluated insulation material in the market. The data from these evaluations demonstrate that:

(1) No causal association has been found between either cancer or non-malignant pulmonary disease and human exposure to glass fibers.

(2) Inhalation exposures of animals to massive amounts of biosoluble glass wool fibers, hundreds and even thousands of times greater than human exposures, have not shown a relationship between glass wool fibers and disease.

(3) Glass wool fibers are biosoluble and, therefore, dissolve more rapidly in body fluids than other fibers that have been associated with human disease.

(4) Workplace levels of respirable glass fibers in most settings are less than 1 fiber/cc, and airborne levels in insulated buildings are not significantly different than levels outside or in uninsulated buildings.

NAIMA member companies continue to support ongoing scientific investigations into the health and safety aspects of glass wools as part of their comprehensive Product Stewardship Program. NAIMA is dedicated to providing up-to-date information on the results of these studies as they become available.

Safety of In-Place Duct Products

When properly designed and installed, fiber glass products for air handling systems improve the indoor environment by controlling heat loss or gain while reducing condensation and providing acoustical insulation.

The results of several more recent scientific studies demonstrate that fiber glass insulated HVAC systems have no adverse effects on indoor environmental quality.

- The IPCS Environmental Health Criteria 77 on man-made mineral fibers has stated: "it has generally been concluded that the contribution of fibrous glass lined air transmission systems to the fibre content of indoor air is insignificant."
- Duke University – A 1997 study showed that mold is no more likely to grow on fiber glass than on any other surface in the duct system. Mold grows in the presence of water. By helping to reduce condensation, fiber glass insulated ducts actually help minimize microbial growth.
- University of Nevada Las Vegas – A 1996 study confirmed the results of numerous earlier studies showing that fiber content in the indoor air from fiber glass lined systems is insignificant and does not adversely affect the health of building occupants.

Conclusion

NAIMA members believe fiber glass is safe to manufacture, install and use when recommended work practices are followed. Complete details on work practices and exposure guidelines are contained in NAIMA's Product Stewardship Program and can be obtained in written or video form by contacting NAIMA at the following address:

P.O. Box 1906
Alexandria, VA 22313
Phone: (703) 684-0084
Or visit us at www.insulationinstitute.org.

Notes

About NAIMA

NAIMA is the association for North American manufacturers of fiber glass, rock wool, and slag wool insulation products. Its role is to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool, and slag wool insulation, and to encourage the safe production and use of these materials.

In May 1999, NAIMA began implementing a comprehensive voluntary work practice partnership with the U.S. Occupational Safety and Health Administration (OSHA). The program, known as the Health and Safety Partnership Program, or HSPP, promotes the safe handling and use of insulation materials and incorporates education and training for the manufacture, fabrication, installation and removal of fiber glass, rock wool and slag wool insulation products.

The HSPP was completed and is now known as the NAIMA Product Stewardship Program, with the elements of the HSPP included.

For more information, contact:



P.O. Box 1906
Alexandria, VA 22313
Tel: 703-684-0084
www.insulationinstitute.org

For additional information on fibrous glass duct systems, contact one of the manufacturers listed below.

CertainTeed

www.certainteed.com • 800-233-8990

Johns Manville

www.jm.com • 800-654-3103

Knauf Insulation

www.knaufnorthamerica.com • 800-825-4434

Owens Corning

www.owenscorning.com • 800-GET-PINK