NADCA White Paper:
Interior Insulation Applications in HVAC Systems

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Introduction

As the industry's leading global advocate and trusted resource for reliable information, the National Air Duct Cleaners Association (NADCA) is uniquely qualified to provide guidance for consumers and the industry on the best practices for inspecting, maintaining and restoring HVAC systems.

One of the critical aspects of HVAC systems is the insulation used inside metal ductwork, air handlers, mixing boxes, and other components of HVAC systems. Insulation materials need to be understood and handled properly to ensure optimum system performance and compliance with regulations.

This paper covers the specific topic of internally insulated sheet metal ductwork and HVAC system components. Related topics, such as flex duct and ductboard, may be discussed in future papers.

Currently a broad range of information exists regarding cleaning and restoration of interior insulation in HVAC systems. In working with a wide spectrum of parties associated with the HVAC and insulation industries, NADCA recognizes the need to provide direction in this area.

Disclaimer

Although the following information reflects the current state of the art for interior insulation applications in HVAC systems, readers should recognize that new developments regularly occur and should familiarize themselves with the most current information when determining the appropriate steps to take.

NADCA recognizes that differences in opinion exist as to how to manage interior insulation in HVAC systems. NADCA also recognizes that industry professionals will decide whether or not various interior insulation applications are appropriate for a given HVAC system, based on the unique circumstances surrounding that system.

This document was written in the United States of America and is intended primarily for use in that country. This material may also prove useful for industry professionals and others operating outside the USA. All users of this document are encouraged to refer to applicable federal, state/provincial, and local authorities having jurisdiction over the subjects addressed within this document.

Technical Aspects of Interior Insulation

Heating and cooling an indoor space with an HVAC system requires costly energy consumption.

One method of reducing these costs is to insulate metal ducts and air handlers. Insulating materials are placed on the outside or inside to reduce the transfer of heat through the walls of the HVAC system.

Without insulation, a process called *conduction* occurs. Heat is conducted through the metal walls of the system. If the system is cooling, the temperature of the cool air will rise as it goes through the air handler and ductwork because the heat outside the ductwork will conduct through the metal and warm the cool air. This warming effect will cause the unit to stay on longer, using more energy as it tries to cool the building to the desired temperature.

If the system is warming and no insulation exists, the heat will conduct through the metal walls to outside the system, once again requiring more energy consumption to achieve the chosen temperature.

Insulation dramatically reduces conduction, allowing air that is heated or cooled at the air handler to better maintain its temperature as it travels through the duct system.

Insulation is typically made of material that is a poor heat conductor. These include fiberglass, rubber, cotton, polyester, plastic and other materials. It also commonly is filled with air pockets which further reduce the conduction of heat through the material. Insulation that is flattened or compressed – reducing the thickness and air pockets – will be less effective, that is, it will conduct more heat than if it is left in its non-compressed state.

Insulation used inside an HVAC system is known as “liner” or “interior insulation.” Ductwork with interior insulation is often referred to as “lined ductwork.”

As of this writing, the most common material used in new lined HVAC systems is fiberglass. However, other materials are used as well. Sometimes fiberglass or other liner in a system needs to be replaced or repaired. In this case, a variety of materials are sometimes used.

Insulation Standards and Regulatory Requirements

Interior HVAC insulation must meet specific regulatory requirements and industry standards. A number of organizations have published guidelines, standards, or codes governing its use.

These organizations include:

- ASHRAE, formerly known as the American Society of Heating, Refrigerating, and Air Conditioning Engineers.
- SMACNA, the Sheet Metal and Air Conditioning Contractors' National Association.
- NAIMA, the North American Insulation Manufacturers Association
- NFPA, the National Fire Protection Association
- ASTM, formerly known as the American Society for Testing and Material
- IMC, the International Mechanical Code
- UMC, the Universal Mechanical Code
- IECC, International Energy Conservation Code
- EPA, Environmental Protection Agency
- UL, Underwriters Laboratories
- NADCA

Using materials that fail to comply with regulatory requirements or industry standards increases the risk of equipment failure and legal liability. Products advertised by the manufacturer for use in HVAC interiors should be in compliance with regulations and standards.

Standards include:

- ASTM C 1071, *Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).*
- ASTM C 1338, *Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings*.
- ASTM C 916, *Standard Specification for Adhesives for Duct Thermal Insulation*. Note: This includes data on adhesives used to coat exposed edges of insulation, such as when access holes are cut.
- ASHRAE 62.1, *Ventilation for Acceptable Air Quality*, requiring that materials with surfaces in airstreams have documented resistance to microbial growth and erosion.
- NFPA 90A – *Standard for the Installation of Air-Conditioning and Ventilating Systems* – and 90B – *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*, minimizing fire risks and setting thresholds for limiting flammability and smoke generation.

The International Mechanical Code and other building codes include further requirements that must be met by insulation manufacturers and installers.

R-Values

The ability of an insulating material to resist heat transfer is known as its thermal resistance or R-value. As a material's R-value number increases, the thermal resistance becomes greater. Thus, a material with an R-value of 10 will permit less heat loss than a material with an R-value of 1.

A typical R-value for 1" insulation is 4.2. This will vary depending on the material. R-value increases with the thickness of the material.

Internationally, R-values are converted to a metric value and the converted number is called the RSI (R-value Systeme International).

ASHRAE, fire codes and building codes help set the standards for minimum R-values for the insulation that is to be used in ductwork and air handlers.

When insulation is replaced in a system, it must meet or exceed the required R-values for that system. Additionally, changes in building codes or other governing regulations may have occurred since the original insulation was installed, so it cannot be assumed that matching the original R-value will be sufficient. Current regulations must be followed.

Sound Attenuation

A primary reason for HVAC insulation to be used in sheet metal ductwork and HVAC components is for its sound absorption characteristics. This is known as sound attenuation.

Just as air pockets reduce heat transfer, they do the same with sound. The sound of the fan running, wind noises from air turbulence in an HVAC system, and sound transfer between rooms can be absorbed to a great degree by some insulation materials.

Sound attenuation is measured, not in R-value, but by Noise Reduction Coefficient (NRC) with a range from zero to one.

When replacing or repairing interior insulation in an HVAC system, attention must be paid to matching or exceeding the NRC values of the original insulation. Regional regulations may require that new insulation meet current codes.

Weight

In some applications, the weight of the liner may be a factor in determining which type of liner to use.

Microbial Growth

Interior insulation materials for HVAC systems and their adhesives are typically inorganic and usually do not support or act as nutrient for microbial growth. Some materials may additionally be chemically treated to resist microbial growth.

Cost

While cost is usually a factor when determining the type of liner used, issues such as operating conditions, acoustic needs, or safety concerns may indicate that a more costly material is preferred. Also, although fiberglass liner is the least expensive per square foot, other cost factors such as thermal protection and durability are also considered when determining overall or long-term expense.

Lined ductwork can save the cost of adding exterior insulation at the job site so this may be a factor in selecting it for an HVAC system.

Preventive Maintenance

The manner in which an HVAC system is used has a direct impact on the life of the liner. Operation of any HVAC system includes preventive maintenance which should follow certain basic principles, regardless of the type of liner used. 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 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.

4. For information on wet fiberglass liner, see Fiberglass section below. Rubber, plastic, or polyester duct liner materials that have become wet must be dried before returning to service in order to restore thermal and acoustical performance levels and reduce the risk of microbial growth. If the material has become contaminated with microbial growth or polluted liquid, such as flood water or gray water, it must be removed and replaced. The source of the moisture must be identified and eliminated prior to replacement of the liner. In severe situations, such as sewage contamination, the ductwork may need to be replaced.

5. Per SMACNA guidelines, duct liner shall not be used in applications where moisture would collect in the duct.

Fire and Water Damage

All insulation materials can be made unusable by fire, smoke and soot. Water or liquid infiltration may or may not make the material unusable (see No. 4 above), depending on the material, water source, and degree of damage.

When to Replace

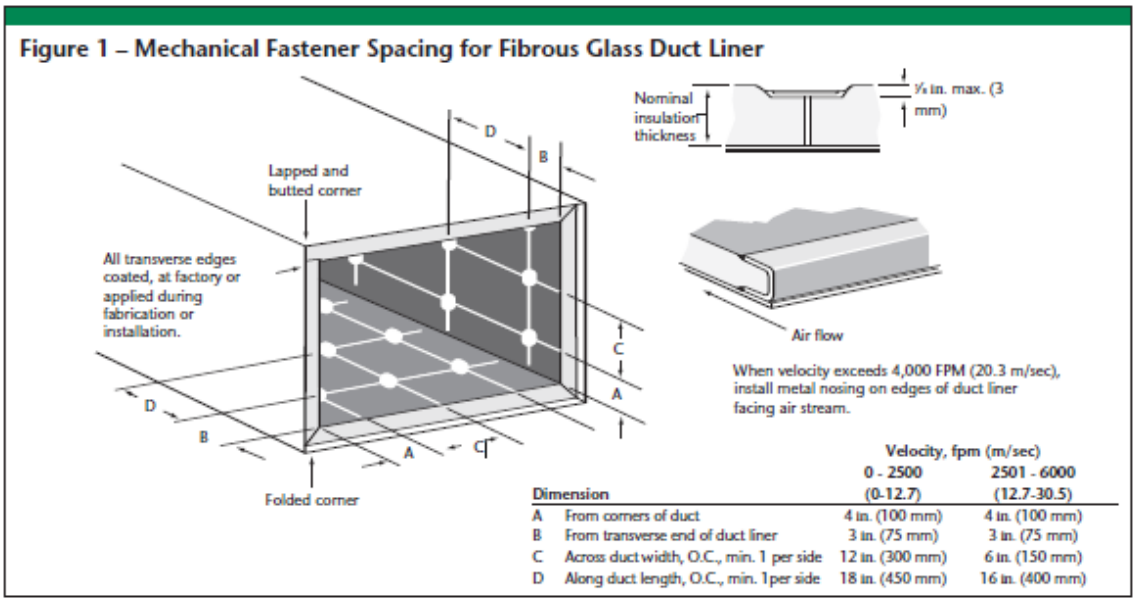
A liner should be replaced if it cannot be restored to:

- Meet the thermal and acoustical needs of the system
- Withstand the physical forces of the HVAC airstream over the long term
- Meet the indoor air quality standards expected

Installing Insulation

Duct liner is installed with liner adhesives and mechanical liner fastener pins in accordance with the latest version of SMACNA HVAC Duct Construction Standards (HVAC DCS). See Figure 1 from NAIMA, which applies to fiberglass and most liner materials.

Duct linings must be interrupted at fire dampers (to avoid adverse effects on damper operation) and at heat sources (to meet minimum clearances specified in an equipment listing).



(Acknowledge NAIMA for the image)

Installation of Duct Access Doors and Panels in Lined Ducts

When duct access doors or duct access panels are provided in openings of lined metal ducts, they shall be insulated. Access door and panel construction shall be in conformance with the latest version of SMACNA HVAC Duct Construction Standards, Metal and Flexible.

Options and general installation procedures:

- Locate, measure and cut the opening in the metal wall of the duct. Next, using a cutting instrument, reach through the cut duct wall and cut the duct liner free from the duct and remove the “patch” of metal with insulation attached.
- If using factory fabricated access doors, use insulated type. Install per manufacturer’s installation instructions. A continuous gasket shall be provided between the access door and duct wall to effectively seal.
- If using fabricated sheet metal access panels, the sheet metal gage shall be no less than the duct gage and the panel shall be sized 1 ½ in. larger (width and height) than the cut duct opening. Liner shall be installed with the use of liner adhesive and liner fastener pins. A continuous gasket shall be provided between the access panel and duct wall to effectively seal. Fasten the access panel to the duct with #10 screws at 8 in. maximum spacing.
- If the removed “patch” is to be reused, combine with a cut sheet metal piece (min. duct gage thickness) sized 1 ½ in. larger (width and height) than the “patch”. Center the new sheet metal piece over the non-insulated side of the “patch” and fasten the two pieces together with #10 screws at 8 in. maximum spacing. Fasten the access panel to the duct with #10 screws at 8 in. maximum spacing. A continuous gasket shall be provided between the access panel and the duct wall to effectively seal.
- To prevent insulation fibers from separating, apply adhesive to all exposed edges of duct liner at access panels and at the cut duct opening. This is not required at the cut duct opening if access doors are installed using sheet metal installation tabs (aka dovetail tabs).

Mechanical access doors shall not be installed in the following locations:

- Where ductwork internal or external reinforcements or stiffeners are located.
- At ductwork transverse or longitudinal joints and seams. Maintain 4 inches clearance where possible.
- Within 4 inches of ductwork end panels or caps.
- Within 4 inches of ductwork accessories or specialties. Accessories can include turning vanes, splitter vanes, volume dampers, coils, duct mounted controls and sensors, etc.
- Where ductwork hangers or supports are located. Specifically, ductwork hanger and support upper attachments, hangers, lower attachments and riser supports, etc., shall not be modified or removed.
- At casings or housings of factory or built- up equipment.
- Outdoors without mechanical and/or weather protection.

Types of Interior Insulation

Fiberglass

Description

Fiber (or fibrous) glass duct liner insulations are manufactured from glass fibers bonded with resin. They hold their shape, resist abuse, and provide a cleanable, fire-resistant interior surface designed to minimize air friction loss. The interior air surface treatment may be in the form of a coating and/or an erosion-resistant covering known as a mat facing. Two forms of duct liner are available.

- **Type I - Flexible blankets**, supplied in roll form; thicknesses of 1⁄2 to 2 in. (13 mm to 51 mm) in 1⁄2 in. (13 mm) increments.
- **Type II - Rigid boards**, used when denser insulation is specified, supplied in sheet form; thicknesses of 1 to 2 in. (25 mm to 51 mm) in 1⁄2 in. (13 mm) increments.

Applications and Features

- Thermal: Specified R-values will be met when installed in accordance with manufacturers' instructions.

- Acoustic: Duct liner helps to attenuate noise generated by central air handling equipment, air movement within the ducts, and occupant cross-talk. Fiberglass has generally better acoustic-attenuating properties than other duct lining materials.

- Surface: Fibrous glass duct liner has a mat-faced and/or coated surface that minimizes air friction loss while enabling the insulation to withstand the duct cleaning process when NAIMA recommendations are followed.

- May have an antimicrobial additive

Fabrication of Lined Ductwork and Installation

For additional information on fabrication, operation, and maintenance, see the NAIMA Fibrous Glass Duct Liner Standard, and SMACNA HVAC Duct Construction Standards.

Causes of Material Degradation

Any failure to follow Preventive Maintenance practices 1to 5 stated earlier in the "Technical Aspects of Interior Insulation" section of this document could result in material degradation.

Repair or Replacement

Fiberglass is the most common liner that has been used in HVAC systems for decades. As technology has improved, liner facings have become more resistive to erosion, but in some systems, particularly older ones, depending on conditions, liner facing may become brittle and flake off, requiring repair or replacement. Additionally, small cuts, tears, or abrasions may need repair.

Small repairs can be made with fire retardant adhesive designed for this purpose. More extensive repairs may require a coating designed for interior HVAC insulation.

For wet fiberglass, NAIMA Standard AH-122 states:

"NAIMA recommends that fibrous glass insulations that have become wet in service should be removed and replaced to reduce the risk of mold growth and to restore design thermal and acoustical performance levels. These insulations may be very difficult to dry under normal operating conditions."[1]

NAIMA Recommendations for Fibrous Glass Duct Liner Removal and Repair

These general guidelines are provided for technicians considering removing and/or replacing fibrous glass duct liner. Because there are many possible situations one may encounter when removing and replacing fibrous glass duct liner (FGDL) materials this guidance is only a list of issues to consider when performing this task and may not address all the issues one may encounter:

1. Because the materials are attached to the inside of the duct with mechanical pins and adhesive, removal and replacement may be labor-intensive and costly. Therefore it may be more cost-effective to replace the entire duct with new lined duct. This will likely depend on the amount of FGDL being repaired and/or replaced.

2. If the decision is made to remove and replace the FGDL, be sure to follow NAIMA's recommended work practices when working with these materials. Removal may generate airborne or loose particles so the technician should consider using recommended work practices for improved ventilation.

3. Consider using heavy wire cutters to remove the mechanical fasteners or another option is to use pliers to grasp the washer and twist the fastener loose.

4. After the fasteners are removed, the next step will be to remove the FGDL. Depending on the quality of the adhesive and installation this could vary from an easy job of pulling the liner out in sheets to a very difficult job of scraping the old material from the entire interior surface. Note: NAIMA recommends replacing the FGDL as the interior of the duct must meet the mechanical code requirements which include flame spread and smoke developed index requirements. This testing would be impractical to do for metal duct with varying amounts of residual material left on the interior of the duct.

5. The next step will be to prepare the interior duct surface so it is clean and the new FGDL can be properly attached with adhesive and pinned. Refer to the adhesive manufacturer's instructions for guidance on surface preparation.

6. Finally, install the new duct liner materials in accordance with NAIMA's Fibrous Glass Duct Liner Standard (AH124).

Safety

Fiberglass is a potential mechanical irritant to the upper respiratory tract, eyes, nose, throat and skin.

The United States Occupation Safety and Health Administration (OSHA) states, "Mineral fibers [including fibrous glass] are currently only regulated as nuisance dust."[2] Accepted exposure limits are available from OSHA.

NAIMA recommends the following safety practices:

1. Minimize fiberglass dust generation.
2. Maintain adequate ventilation.
3. Wear appropriate clothing and personal protective equipment.

For more extensive safety instructions, visit the NAIMA web site.[3]

Elastomeric (Rubber)

Closed cell insulation – also called "foam" - has foam cells or bubbles with intact membranes that encapsulate air and reduce or eliminate passageways for airflow. An elastomeric is a material with the elastic properties of natural rubber. Elastomeric closed cell insulation is a rubber-based product used to insulate pipe and ducts. It is available in sheet or prefabricated tube form. When using elastomeric insulation in HVAC applications, it is necessary to use products designed for use in HVAC systems.

Applications and Features

Two forms of elastomeric insulation are used in the interior of ducts. Both products have a smooth skin which will not trap dirt and dust, making them easy to clean. One is a non-closed-cell product used in manufacturing lined ductwork. It is conformable to the duct interior and will tolerate 90-degree bending. It is used in manufactured lined ductwork and will absorb liquids.

The second product:

- Has closed cells
- Comes in rolls of sheets
- Is installed in flat sections
- Is used in new or existing ductwork
- Has a very low WVT (water vapor transmission – amount of water that can go through the product)
- Does not particulate over time in the airstream, according to manufacturers, unless exposed to factors that can cause degradation (see below)
- Weighs approximately twice as much as fiberglass liner

Some elastomeric foam is manufactured with an antimicrobial additive which will help prevent mold growth.

Causes of Material Degradation

Both types of elastomeric insulation will likely last the life of the system and retain their thermal integrity over time unless they are:

- Installed improperly
- Directly exposed to UV light or pool chorine
- Mechanically scraped or cut
- Exposed to heat in excess of 180 degrees for a long period of time

Installation and Removal

Closed cell elastomeric insulation, sometimes referred to as elastomeric foam, is installed using simple straight knives and adhesives or is available with a self-adhering backing with a removable plastic sheeting. Pins are required according to SMACNA guidelines but are not always required by the manufacturer.

Remove existing interior insulation by peeling sheets off and razor scraping if necessary. If necessary, remove insulation remnants and glue residue with a grinding wire wheel and bag debris.

Non-closed-cell elastomeric insulation is only installed by the manufacturer of the lined duct.

Safety

According to the manufacturer, elastomeric insulation does not flake, break apart, or off-gas during installation so no special breathing or other safety equipment is needed when installing elastomeric foam.

Adhesives may require adequate ventilation or other safety procedures as outlined in safety data sheets.

Cutting Access Holes

Because of the cellular nature of elastomeric liner, the manufacturer does not require adhesive on exposed edges because no particles are released from the cut section.

Repair or Replacement

The material normally only needs replacing if has been structurally damaged by abrasion or similar mechanical means, but repair can be done using an adhesive designed for the product. Non-closed cell elastomeric liner should be repaired or replaced in a similar manner to fiberglass.

Cleaning with standard soft bristle brushes will not damage the foam.

Polyolefin (Plastic) Closed Cell Insulation

Polyolefin is a category of plastics. When manufactured with closed cells, similar to elastomeric, it is used as insulator.

Applications and Features

- Low thermal conductivity and a very low water vapor transmission rate
- Chemical-resistant properties
- Lightweight and flexible
- Smooth air stream side
- Does not particulate in the air stream
- Most formulations are UV-resistant though not UV-proof

Causes of Material Degradation

- Severe UV exposure
- Improper installation
- Mechanical cutting or scraping

Removal, Installation and Adhesion

Remove by peeling polyolefin sheets off and razor scraping as needed. If necessary, remove insulation remnants and glue residue with a grinding wire wheel and bag.

Install using the manufacturer's recommended solvent-based contact adhesive with a roller, brush or sprayer with appropriate ventilation and safety measures.

Polyolefin sheet must be adhered to the duct using mechanical pins/fasteners in addition to adhesive.

Repair or Replacement

Polyolefin liner cannot be repaired. Liner that is compromised must be replaced.

Safety:

- Non-irritating to skin
- Dust may cause irritation to the nose, throat and lungs
- Fumes/vapors generated during hot-wire cutting may cause respiratory irritation. According to the manufacturer, concentrations of the isobutane agent incidental to proper handling of the product are expected to be well below the American Conference of Governmental and Industrial Hygienists (ACGIH) recommended exposure limit of 800 ppm. For exposures above 800 ppm, take into consideration the type of application, environmental concentrations and materials being used concurrently when selecting a respirator. Observe OSHA regulations for respirator use (29 CFR 1910.134). Take any other safety precautions.
- Standard job site PPE for handling
- Eye Protection: Wear tight fitting safety goggles if there is a potential for exposure to flying particles.

Polyester

Esters are chemical compounds that make up naturally-occurring fats and oils, including butter. Polyester is a synthetic compound composed mostly of esters. It is frequently used in the form of thread that has multiple uses, including the manufacture of fabrics and insulation.

When used as an HVAC insulation, polyester is woven or webbed into a blanket and can be bonded to a foil facing, similar to fiberglass liner construction.

Applications and Features

The following are typical features. They may vary with different manufacturers.

- High Noise Reduction Coefficient (NRC) value, similar to or greater than fiberglass
- Similar weight to fiberglass
- As of this writing, typically costs more than fiberglass and less than elastomeric
- Generally non-irritating to skin
- Weighs less than elastomeric

Installation and Removal

A polyester liner should be replaced if:

- The facing shows degradation from wetting
- There is product degradation due to improper installation
- There is visible degradation, rips, tears, or separation of layers
- It shows any sign of mold or other microbial growth

Remove existing polyester liner by razor scraping. Bag debris.

Liner is installed using common duct liner installation methods and materials. Insulation should be applied using a water or solvent-based duct liner adhesive and pinned with metal fasteners in accordance with *SMACNA HVAC Duct Construction Standards, Metal and Flexible*.

Safety

No special requirements are needed; use standard PPE (personal protective equipment) for handling. Although dust exposure is unlikely with this product, any dust that is generated should be avoided.

Cutting Access Holes

To install access doors, follow the same procedures used for fiberglass liner.

Polyester liner can be repaired with coatings in a manner similar to fiberglass. It typically has a foil facing that can be repaired with FSK tape.

Causes of Degradation

Water and any event that damages the foil facing may degrade polyester liner.

Asbestos

Asbestos-containing materials are no longer used for interior insulation but may be found in older HVAC systems. These should be dealt with in accordance with local, state, and federal laws governing asbestos handling and removal.

Reflective

Reflective insulation is made of material similar to plastic bubble wrap. It has a facing of foil or metallized polyester. Some contractors have used reflective insulation on the interior of HVAC systems as a liner or as a covering over existing damaged liner.

However, as of this writing, reflective insulation has not been fully tested for use inside HVAC systems and is, therefore, not sold for this application.

Double-Wall Duct

Double-wall duct is ductwork that is fabricated from two layers of metal with a layer of insulation in between. The inner wall may be perforated for sound attenuation or solid to reduce thermal loss.

The double-wall style of lined duct – sometimes referred to as double duct – is also used where increased resistance to liner damage is desired.

The outer shell is the structural (pressure) shell and is the basis of construction. Metal wall inner lining is available for all conventional duct shapes; typically it is of 22 gauge galvanized steel with 3/32 inch diameter holes when perforated.

Installation of Duct Access Doors and Panels in Double-Wall Ducts

It must be recognized that the installation of access doors and access panels in double-wall duct differs from the installation of access doors and access panels in lined single-wall ducts. Liner installation in double-wall ducts does not require liner adhesive or mechanical liner fastener pins. Instead, the liner is fit in place between the outer metal wall and the inner metal wall which securely holds the liner in place. It is therefore critical that access door and access panel construction in double-wall duct not only provides for securing the access door assembly or the access panel to the outer duct wall but that provisions are also made to secure the inner duct wall. Additionally, access door and access panel construction in double-wall ducts must provide for partitioning cut liner edges in the duct opening from the airstream.

When duct access doors or duct access panels are provided in openings of double-wall metal duct, they shall be insulated. Access door and panel construction shall be in conformance with the latest version of SMACNA HVAC Duct Construction Standards, Metal and Flexible.

Options and general installation procedures:

- Locate, measure and cut an opening in the outer metal wall (pressure shell) of the duct. Then cut the duct liner free and remove the insulation. Next, cut an opening in the inner metal wall of the duct.
- If using factory-fabricated access doors, provide insulated type with the airside construction matching the inner metal wall construction of the duct (e.g. = perforated inner metal wall or solid inner metal wall). Observe the access door manufacturer's installation instructions. The access door frame shall recess into the duct opening and fasten to the inner metal wall of the duct. As an option to the access door frame fastening to the inner metal wall of the duct, the duct opening shall be fit with a double-wall flanged duct sleeve of the same gage as the outer metal wall of the duct. The duct sleeve shall be fastened at the outer and inner metal walls of the duct and sealed at the outer metal wall of the duct. A continuous gasket or sealer shall be provided at the access door frame and the outer wall of the duct to effectively seal.
- If using fabricated sheet metal access panels, access panel construction shall be double-wall and match the duct construction where installed (e.g., perforated inner metal wall or solid inner metal wall). Prior to installing the access panel, to secure the inner metal wall of the duct and to partition-off cut liner edges from the airstream, the duct opening shall be fit with a double-wall flanged duct sleeve of the same gage as the outer metal wall of the duct. The duct sleeve shall be fastened at the outer and inner metal walls of the duct and sealed at the outer metal wall of the duct. The access panel outer metal wall shall be sized 1 ½ in. larger (width and height) than the framed duct opening. A continuous gasket shall be provided between the access panel outer wall and the duct outer wall to effectively seal. Fasten the access panel to the duct with #10 screws at 8 in. maximum spacing.

Similar to lined single-wall metal ducts, mechanical access doors or panels shall not be installed in the following locations:

- Where ductwork internal or external reinforcements or stiffeners are located.
- At ductwork transverse or longitudinal joints and seams. Maintain 4 inches clearance where possible.
- Within 4 inches of ductwork end panels or caps.
- Within 4 inches of ductwork accessories or specialties. Accessories can include turning vanes, splitter vanes, volume dampers, coils, duct mounted controls and sensors, etc.
- Where ductwork hangers or supports are located. Specifically, ductwork hangers and supports upper attachments, hangers, lower attachments and riser supports, etc., shall not be modified or removed.
- At casings or housings of factory or built- up equipment.
- Outdoors without mechanical and/or weather protection.

Technical Resources

Fiberglass: www.naima.org

Reflective Insulation: www.rimainternational.org

For all other insulation materials, contact the manufacturer.

Standards and texts governing duct liner:

SMACNA HVAC Duct Construction Standards, Metal and Flexible

ASHRAE Handbook: Fundamentals:

- Chapter 21 – Duct Design
- Chapter 23 – Insulation

ASHRAE Handbook: Systems and Equipment

- Chapter 19 – Duct Construction

NFPA Standard 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems

NFPA Standard 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems

NAIMA Standard AH-122: Cleaning Fibrous Glass Insulated Duct (Ductboard/Duct Board) Systems – Recommended Practices

NAIMA: "Insulated Duct Cleaning and Maintenance" http://www.naima.org/insulation-knowledge-base/duct-hvac-insulation/insulated-duct-cleaning-and-maintenance.html

NADCA Standard for Assessment, Cleaning, and Restoration of HVAC Systems

ASHRAE: www.ashrae.org

SMACNA: www.smacna.org

NFPA: www.nfpa.org

Frequently Asked Questions

1. Can liner be removed without replacing it?

   No. If a liner is removed, the result will be increased energy consumption and possibly increased noise output. Operating an HVAC system without insulation also violates HVAC design standards established by ASHRAE and other organizations.

2. How do I clean lined ductwork?

   Information on cleaning lined ductwork can be found in the NADCA Standard for Assessment, Cleaning, and Restoration of HVAC Systems and, for fiberglass liner, NAIMA Standard AH-122: Cleaning Fibrous Glass Insulated Duct (Ductboard/Duct Board) Systems – Recommended Practices.

3. What do I do if liner is contaminated with mold?

   Per the NADCA Standard for Assessment, Cleaning, and Restoration of HVAC Systems, Section 4.17, "It is *recommended* that porous materials with mold growth (Condition 3) be properly removed and replaced." Condition 3 is defined in the standard as "An indoor environment
   contaminated with the presence of actual mold growth and associated spores. Actual growth includes growth that is active or dormant, visible or hidden."

4. Can a liner be removed and replaced with exterior insulation?

   Possibly. An HVAC design professional should be consulted to ensure such a change will not impair the thermal and sound attenuation properties required of the system.

5. Where can a person get training or get questions answered on how to install or remove interior insulation?

   As of this writing, little formal training exists on this topic other than in HVAC technician courses that broadly cover HVAC installation, service, and repair. In addition to the data in this paper, information on liner installation and replacement can be obtained from the liner manufacturer's instructions, by contacting the manufacturer, and from the standards listed above in the "Technical References" section.

6. How do I determine if a liner can be used again after fire, flood, or similar damage?

   This information is found in the NADCA Standard for Assessment, Cleaning, and Restoration of HVAC Systems, sections 4.14 through 4.24. If further clarification is needed, consult an HVAC design professional or industrial hygienist.

7. How do I make a determination if a liner can be repaired or needs to be replaced?

   This information can be found in the NADCA Standard for Assessment, Cleaning, and Restoration of HVAC Systems, sections 4.14 through 4.24 and, for fiberglass liner, the NAIMA document "Insulated Duct Cleaning and Maintenance."

8. Is a special license needed to replace or repair liner?

   Consult with your state contractors license board and/or authorities having jurisdiction to determine if a license is required for HVAC liner replacement or repair.

Endnotes

[1] NAIMA Standard AH-122: "Cleaning Fibrous Glass Insulated Duct (Ductboard / Duct Board) Systems - Recommended Practices," p. 4.
[2] https://www.osha.gov/SLTC/syntheticmineralfibers/table.html
[3] http://www.naima.org/insulation-knowledge-base/health-and-safety-aspects/safe-handling-recommendations.html

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