

THERMAL INSULATION OF H & V DUCTWORK

TIMSA's recommendations for installing thermal insulation to the outer surface of H&V ductwork.

It is not applicable to the installation of sound absorbent linings or for the installation of fire protection insulation.

TGN 3

GENERAL INSULATION PRINCIPLES

Thermal insulation should be applied to all H&V ductwork unless specified otherwise by the purchaser.

Ductwork conveying warm air should be insulated to conserve energy.

Ductwork conveying chilled air or cold supply air should be insulated to conserve energy and control condensation at the external surface.

Boiler exhaust ductwork should be insulated to reduce the external surface temperature to a safe level and prevent condensation of exhaust gases inside the ductwork.

Recommendations for the specification and installation of thermal insulation and finishes are given in BS 5422: 1990 and BS 5970: 1992.

Thermal insulation materials used should be manufactured and tested under an approved ISO-9002 Quality management System and comply with the relevant British Standard specification if available. (See TIMSA's Insulation Industry Handbook.) They should be suitable for continuous use without degradation throughout the range of operating temperatures and should provide proof against rotting, mould, fungal growth and attack by vermin. Products containing CFCs in their manufacture should not be used.

The required fire behaviour properties of insulating materials and finishes will depend on the location where they are to be installed and should conform to the relevant section of BS 5422: 1990, the Building Regulations Approved Document B or other requirements if specified by the purchaser.

On chilled air and cold air supply ducting a fully sealed vapour barrier should be applied to the external warm face of the insulation to prevent ingress of moisture vapour. The permeance of the vapour barrier should not exceed 0.01g/(s.MN) when tested by the approved method in either BS 3177 or BS 4370. The vapour barrier should not reduce the fire rating of the complete insulation assembly as above. (See BS 5422: 1990 Section 5.17.3.)

For systems operating between -10°C to 0°C, a permeance rating not exceeding 0.002g/s.MN) should be used.

Insulation should be selected and installed in accordance with the recommendations given in BS 5970: 1992 and at thickness complying with BS 5422: 1990.

Ductwork should be tested for air leakage as specified prior to the application of thermal insulation.

THERMAL INSULATION PRODUCTS

A wide range of types of thermal insulation products is available for use on rectangular, circular or flat-oval ducting. These comprise rigid preformed slabs or boards and flexible rolls, blankets, mats and mattresses. Most are available with a factory applied finish of reinforced aluminium foil or are suitable for the application of site applied finishes.

Initially, the suitability of a product will be decided by certain key properties such as thermal performance, operating temperature, fire safety and economic considerations. However, the final choice of product may involve the consideration of numerous other properties which are pertinent to that particular project. Examples are mechanical strength, durability, compatibility, resistance to chemicals, oil and moisture. Manufacturers will readily supply all this information but the table below lists the key properties for several types of thermal insulation products which are used on H&V ductwork.

Table of key properties

	Density (kg/m ³)	Thermal conductivity (W/mK @ 10°C)	Operating temperature (°C)
Glass mineral wool	10 - 80	0.030 @ 48kg	Cryo to 230
Rock mineral wool	45 - 80	0.033 @ 45kg	Up to 800
Expanded polystyrene	15 - 30	0.035 @ 20kg	-100 to 80
Calcium silicate	240	0.054	Ambient to 1000
Cellular Glass	120 and 136	0.04 @ 120kg	-260 to 430
Polyurethane foam	35, 40, 50	0.023 @ 40kg	-180 to 110
Polyisocyanurate foam	32, 40, 50	0.021 @ 40kg	-180 to 140
Phenolic foam	35 - 60	0.018 @ 40kg	-180 to 120
Polyethylene	30	0.041	-50 to 105
Nitrile rubber	60 and 90	0.035 @ 60kg	-40 to 105

Note : thermal conductivity measured to BS 874 for mineral wools, BS 5608 for polyurethane and polyisocyanurate.

METHODS OF APPLICATION

Fixing methods should minimise the occurrence of direct metal paths where thermal bridging may cause localised high temperatures at the aluminium foil surface. The full insulating effect should be maintained at connections and access openings and panels including the edges of such openings. The insulation should cover all forms of flanged joints, fasteners or stiffeners either by means of purpose-made covers or by increasing the general thickness of insulation to give appropriate cover.

Where multiple-layer insulation is applied, the joints in each layer should be staggered.

The insulation outer covering and, where applicable, the vapour seal, should be continuous and should not be pierced or fouled by any of the supports. Insulation at supports should be with a product of suitable compressive strength to carry the loads transmitted to the supports. Such load-bearing insulation should be extended by a minimum of 50mm each side of such locations in order to facilitate sealing the vapour barrier.

Where slab insulation products are used on rectangular ductwork, they should be applied so that product on the horizontal face overlaps that on the vertical face to maintain thickness at corners. They should be installed securely with adhesive which may be supplemented by insulation hangers and washers or bands of reinforced adhesive foil tape when recommended by the insulation manufacturer. Such fasteners may be rustproof metal studs, split prongs, plastic studs or other approved devices fixed to the duct surface and should be suitable for the thickness and weight of insulation and its finishings to be applied. Fastenings should be spaced at approximately 300mm centres and should finish flush with or below the surface of the insulation. Adhesives should be compatible with the ductwork, insulation and vapour seal. All joints and fixings should be sealed with tape of the same material as the insulation facing.

When flexible roll or compression resistant mineral wool products are used, the insulation can be secured to the ductwork with 150mm wide bands of suitable adhesive tape first applied to the ductwork surface at 300mm centres. Circumferential and longitudinal joints should be sealed with tape of the same material as the insulation facing. If no protective finish or cladding system is to be installed, the external surface of the insulation should be wrapped with galvanised wire netting of 25mm mesh and 1mm thickness, complying with BS 1485 and the netting joints should be secured with a lacing of 1mm galvanised wire. Care should be taken to ensure that the insulating material is not compressed during application.

TYPES OF INSULATION FINISHES

Insulation finishes are applied over the insulation itself to provide, depending upon type used, a vapour barrier, weather protection, chemical resistance, protection from mechanical damage or improved aesthetics. The choice of finish may be dependent upon the type of insulation used and vice versa. Wet applied finishes will usually require a firmer base than self-supporting metal coverings which can be used with softer insulation materials.

Indoor finishes

Aluminium Foil

Reinforced to minimise tearing and factory applied to the insulation product during manufacture. All joints should be secured with matching self adhesive foil tape. Generally applied to provide a vapour barrier or for aesthetic reasons and in areas where there is little risk of mechanical damage.

Mastic and coating finishes

A variety of different types are available and are applied on-site over insulation. Choice will depend upon factors such as whether they are to be applied directly to the insulant or onto reinforcing fabrics, method and conditions of application and specific resistance properties required. Woven fabrics, e.g. woven glass cloth, may be used to reinforce the films. Typically the first coat is applied and the fabric immediately embedded into the wet material, with longitudinal and circumferential overlaps being a minimum of 50mm. After drying a second coating is applied. All such jointing, sealing materials and methods of application should follow the recommendations of the relevant manufacturer. Generally used to provide a more robust vapour barrier or to provide an appropriate surface for decorative purposes. The manufacturers recommended application temperature and conditions should be strictly adhered to, especially with water based coatings which may be unsuitable for application in cold or damp conditions (e.g. coldrooms or external winter conditions).

Flexible plastic sheet or elastomer sheet

Applied directly to the external surface of the insulation and all joints lapped “weatherwise” and secured and sealed by adhesive together with, if required, a waterproof tape. All longitudinal and circumferential overlaps should be a minimum of 50mm. All such jointing, sealing materials and methods of application should follow the recommendations of the sheet material manufacturer. Generally used to provide a vapour barrier and in areas where there is little risk of mechanical damage.

Rigid PVC sheet

The sheet material not less than 0.35mm thick, together with preformed fittings should be applied directly to the external surface of the insulation and all joints should be lapped “weatherwise” and secured with plastic rivets at 150mm centres. Alternatively, joints may be continuously solvent welded in lieu of rivets. All longitudinal and circumferential overlaps should be a minimum of 50mm. Matching PVC tape may be used to finish the joints. All such jointing, sealing materials and methods of application should follow the recommendations of the sheet material manufacturer. Generally used to provide a vapour barrier and some resistance to mechanical damage.

Sheet metal cladding

Comprising either aluminium sheeting of, typically, 1mm thickness or galvanised mild steel sheeting of 0.8mm thickness. The sheet material and preformed fittings should be applied directly to the external surface of the insulation and all joints should be lapped “weatherwise” then secured with metal rivets at 150mm centres. Reference to BS 5970 should be made with regard to compatibility between screws/rivets and cladding. All longitudinal and circumferential

overlaps should be a minimum of 40mm. On ductwork carrying fluids or gases at sub-ambient temperatures, metal straps at 225mm centres should be used in lieu of metal rivets. All such jointing, sealing materials and methods of application should follow the recommendations of the sheet material manufacturer. Generally used in plant rooms to protect the insulation from mechanical damage, water or oil. Under certain circumstances, stainless steel cladding can be used.

Outdoor finishes

All air handling plant, ductwork and associated equipment located outside buildings should be finished in one of the following ways

Polyisobutylene sheet material

Minimum thickness 0.8mm, should be adhered to the external surface of the insulation and all joints should be lapped “weatherwise”, secured and sealed by adhesive or solvent welding. All longitudinal and circumferential overlaps should be a minimum of 50mm. All such jointing, sealing materials and methods of application should follow the recommendations of the sheet material manufacturer. To prevent bellying, particularly on large ducts wrap with galvanised wire netting of 25mm mesh complying with BS 1485. The netting joints should be secured with a lacing of 1mm galvanised wire.

Roofing felt

Applied directly to the external surface of the insulation with all joints lapped “weatherwise”, secured and sealed by suitable adhesive. All longitudinal and circumferential overlaps should be a minimum of 50mm. Finish with two coats of black bituminous paint. All such jointing, sealing materials and methods of application should follow the recommendations of the sheet material manufacturer. Secure in position with galvanised wire netting of 25mm mesh complying with BS 1485. The netting joints should be secured with a lacing of 1mm galvanised wire.

Mastic and coating finishes

A variety of different types are available and are applied on-site over insulation. Choice will depend upon factors such as whether they are to be applied directly to the insulant or onto reinforcing fabrics, method and conditions of application and specific resistance properties required. Woven fabrics, e.g. woven glass cloth, may be used to provide the reinforcement in films required to have a high degree of weather resistance. Typically the first coat is applied and the fabric immediately embedded into the wet material, with longitudinal and circumferential overlaps being a minimum of 50mm. After drying a second coating is applied. All such jointing, sealing materials and methods of application should follow the recommendations of the relevant manufacturer. The manufacturers recommended application temperature and conditions should be strictly adhered to, especially with water based coatings which may be unsuitable for application in cold or damp conditions (e.g. coldrooms or external winter conditions).

Sheet metal cladding

Installation and thicknesses of metal cladding should be in accordance with BS 5970: 1992 sections 26, 27 and Table 5. The sheet material and preformed fittings should be applied directly to the external surface of the insulation and all joints should be lapped “weatherwise”, secured with metal rivets at 150mm centres. Reference to BS 5970 should be made with regard to compatibility between screws/rivets and cladding. All longitudinal and circumferential overlaps should be a minimum of 40mm. On ductwork carrying fluids or gases at sub-ambient temperatures, metal straps at 225mm centres should be used in lieu of metal rivets. All such jointing, sealing materials and methods of application should follow the recommendations of the sheet material manufacturer. Under certain circumstances, stainless steel cladding may be used.

Vapour Barriers

A vapour barrier must be used over the insulation on all ductwork operating at temperatures below the ambient air. The vapour barrier should be applied such that it is continuous and gives protection to the whole surface of the insulation which it covers. It should not be pierced or otherwise damaged. Means of load distribution must be provided at points of support as necessary. The material selected for use as a vapour barrier must be compatible with the thermal insulation which it is to protect.

Typical examples of vapour barriers are

- a) Wet applied systems such as solvent based polymers, vinyl emulsions and bitumen emulsions with or without elastomeric latex. Frequently, these are reinforced with cotton scrim or glass mesh fabrics.
- b) Elastomer sheets with all joints overlapped and continuously vapour sealed. Good at accommodating movement due to contraction.
- c) Polyvinyl chloride, polyethylene, polyisobutylene or other suitable plastics tape or sheet. Used for wrapping small irregular shaped areas or where a coloured decorative finish is required.
- d) Epoxy and polyester resins. Used to provide a multi-purpose barrier to water vapour, weather and chemicals.
- e) Reinforced aluminium foils, building sheet or plastics film with all joints adequately overlapped and continuously vapour sealed.

Where the operating temperature of the equipment cycles above and below the temperature of the ambient air, it will be necessary to design a vapour barrier/breather system.

For further information refer to BS 5970 sections 5 and 8.

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