STIFERITE ISOCANALE SYSTEM

Introduction
Since 1968 Stiferite has been the constant leader in the production of rigid polyurethane and polyiso (PIR) foam panels with aluminium facers.

Stiferite’s has been the pioneer of PIR panels with aluminium facing designed specifically to be used in the fabrication of ventilation ducts.

Based on the exceptional insulation properties of PIR aluminium foam panels and the simple fabrication and installation process, pre-insulated ductwork systems have been recognize by the HVAC industry as a significant innovative alternative to the classical sheet metal (GI) ductwork.

The construction of a pre-insulated duct generally follows a standard procedure regardless of the shape of the duct:
• Tracing
• Cutting
• Gluing
• Folding
• Taping
• Flanging and reinforcement if required
• Sealing
**Technical Notebook**

**Isocanale Pre-Insulated Ductwork System - Fabrication Guide**

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**Ductwork Fabrication**

**Tracing**
Using a teflon pencil which can be supplied by STIFERITE, an outline of the duct shape can be scribed on the PIR panel. All measurements refer to a duct's internal dimension. This means the area of air passage or opening of the duct. All tracing and/or plotting is done on the internal side of the duct.

**Cutting**
45° miter cuts are made along the edge of the duct, while “V” cuts or grooves of the same angle are made for folding of the panel into shape. Other special purpose angles can be made including 22.5°. All the cuts are made using Jack Planes made available by STIFERITE.

**Gluing**
The glue is contact adhesive and can be applied evenly to the cut surfaces with a glue spreader or a simple all-purpose paint brush. The “V” grooves must be cleaned off of any PIR foam particles or dust. Generally the curing period of the adhesive is between 10 to 20 minutes or when the glue is dry to the touch.

**Folding**
After the glue is cured, the sides are folded to each other and the duct is formed. When the outer sides of the duct are joined, use the internal surface of the cuts for aligning purposes. The rigid spatulas supplied by STIFERITE should then be used to crease well the edges of the duct in the glued grooves.

**Taping**
The special double cured reinforcement aluminium tape is available from STIFERITE and is applied for the purpose of: sealing PIR foam material from the area, as a vapour barrier in the folded seams of the duct, to repair or cover any damages to the panel and for aesthetic appearance of the duct.

Before applying the tape, make sure that the surfaces are dry and clean. Ideally the tape should be applied at temperatures above 10°C, it should not be applied when temperatures are below 0°C.

The tape is applied only to the external seams of the duct where the sides of the panel were joined, and not on the folded “V” grooves. Use a tape marker to scribe a reference line on the panel for applying the tape. A soft spatula is used to brush along the surface of the tape and eliminate trapped air bubbles.

**Flanging and Reinforcement**
STIFERITE offers two types of flanging systems for joining ducts together:

1. Invisible Flange with hidden “I” bayonet in PVC
2. Teeth Connector

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The invisible flange is convenient in limited access areas and where the ducts are mounted in sight and aesthetics is a priority.

The “teeth connector” is designed for use with small ductwork and low air pressure systems.

Duct reinforcement is required to protect against negative and positive pressure of systems based on two parameters: Duct size and total system pressure.

**Sealing**
After the duct has been assembled, all internal joints must be hermetically sealed with silicon. Apply a bead of silicon to all the joints and then using a radius tool or a wet finger run it along the length of the silicone to spread the sealant along the side of duct wall. Besides sealing the joints, the silicon also prevents any foam particles from entering the flow of air.

The STIFERITE’S PIR ISOCANALE panel is 1200 x 4000mm in dimensions. The standard thickness is 20mm, +/- 2mm. (30mm thickness is also available upon request).

- h=height
- w=width
- l=length

Refer to internal duct dimensions.
The duct panels may be cut in either width or length direction taking in consideration the duct's dimensions and the material usage. In order to optimize the duct's mechanical characteristics and fully utilize the panel (minimal waste), four different cutting methods may be employed, each with its own limiting dimension. See table 1:

<table>
<thead>
<tr>
<th>Method</th>
<th>Duct side dimensions</th>
<th>Max length of duct segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2x (w+h) &lt; 1040 mm</td>
<td>4000 mm</td>
</tr>
<tr>
<td></td>
<td>The sum of 4 sides</td>
<td></td>
</tr>
<tr>
<td>2a</td>
<td>(h+w+h) &lt; 1080 mm</td>
<td>4000 mm</td>
</tr>
<tr>
<td></td>
<td>The sum of 3 sides</td>
<td></td>
</tr>
<tr>
<td>2b</td>
<td>(w+h) &lt; 1120 mm</td>
<td>4000 mm</td>
</tr>
<tr>
<td></td>
<td>The sum of 2 sides</td>
<td></td>
</tr>
<tr>
<td>2c</td>
<td>w and h &lt; 1160 mm</td>
<td>4000 mm</td>
</tr>
<tr>
<td></td>
<td>Any single side</td>
<td></td>
</tr>
<tr>
<td>3a, 3b</td>
<td>(h+w+h) &lt; 3880 mm</td>
<td>3600 mm</td>
</tr>
<tr>
<td></td>
<td>The sum of any 3 sides</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>w and h &lt; 3960 mm</td>
<td>1200 mm</td>
</tr>
<tr>
<td></td>
<td>Any single side</td>
<td></td>
</tr>
</tbody>
</table>

**Method 1**

In this method the entire duct can be fabricated using a single panel based on the duct side dimensions listed on table: xx. Considering the off-cuts of the grooves: 20+40+40+40+20 = 160mm subtracted from the panel width of 1200 mm = 1040 mm

The cuts are made in the lengthwise direction and the duct is fabricated as shown below:

**Method 2**

This method is for larger ducts and constructed using more than one panel that are joined together to form the duct. The dimensions of the duct determines if the joining pieces are of equal or unequal size as shown in method 2b and 2c.

This method is used, when the sum of three sides is less than or equal to 1,080 as shown on the table and cannot be constructed using only one panel as in method 1.

The grooves are again cut in the lengthwise direction.
Method 2a:

\[ h + w + h < 1,080 \text{ mm or } w + h + w < 1,080 \]

If the duct is larger than method 2a and the sum of two sides is less or equal to 1120 mm as shown on the table, method 2b is used. The grooves are again cut in the lengthwise direction.

Method 2b:

\[ w + h < 1120 \text{ mm} \]

If the duct is yet larger than method 2b, the dimensions would be limited to the width of the panel: 1200mm minus the 45° cuts on each side. 1200mm-40mm=1160mm. The cuts are again made in the lengthwise direction and the duct length is limited by the length of the panel: 4000mm.

Method 2c:

\[ w \text{ and } h < 1160 \text{ mm} \]
**Method 3**

This method is applied for even larger ducts still, where the length of the duct is determined by the limits of the panel width minus the groove: 1200-20=1180. The V grooves in this case are made in the width-wise direction and the panel is folded lengthwise in a "U" shaped segment.

Duct construction method 3:

In the case where it is desirable to increase the length beyond the limit of 1180, it is acceptable to join three individual modules together and have a maximum combined length of 3600mm. (3 modules x 1200mm) with a cover width less than 1160mm as shown:

**Method 3a**

Where the cover width is more than 1600mm, the orientation of the cover is in the width-wise direction and the seams must not align with the three segments joined on the duct body as shown:

**Method 3b**

**Method 4**

This method is for the largest of duct sizes, where an entire panel can be used for a single side and allow a maximum length of 3960 mm. The V grooves are cut along the width-wise direction of the panel, and the segments are made in lengths of 1200mm.
Among the many fittings in a duct system, elbows are perhaps the most common. Below are a few types of elbows:

Radiused Elbow

Square Elbow

A Radiused Elbow is one in which the air flows smoothly along the radiused path with minimal noise or drag. In a Square Elbow the air is abruptly deviated which causes more drag and noise, this is the reason why in this type of elbow the use of turning vanes is required.

Symmetric Elbow

Asymmetric Elbow

A Symmetric Elbow is one in which the inlet and outlet dimensions are the same, unlike the Asymmetric Elbow where the inlet and outlet dimensions are not the same.

Fabrication Terminology

Elbow Construction

Construction of an elbow begins with cutting of four separate pieces from a PIR panel based on the inlet and outlet dimensions, neck lengths and radius requirements. The minimum length of any neck and internal radius shall be 200mm. The distance between the creases on the inner and outlet strips shall not be less than 50mm. All the cuts are made using the appropriate Jack Plane (45°, 90° etc..)

The four pieces are the inner, outer and sides pieces as shown below:

Elbow Components

All measurements should be made on the internal side of the duct. When measuring the inlet and outlet strips, an nominal amount should be added to compensate for the bending creases that will be made on the strips later. Use a bending machine to crease the inlet/outlet strips. Note that the bending creases on the inner strip are made on the external surface and on the internal surface for the outer strip.

The assembly procedure is as follows:

1. After having followed the fabrication procedure including the gluing process, lay the outer strip onto the table and starting at the end of the neck of each side strip properly align and join both pieces to the outer strip. Continue along the outer radius until all three pieces are glued together.

2. The inner strip is glued onto the inner side of the elbow using the same alignment procedure as previously.
Elbow Assembly Procedure

Using the rigid spatula gently crease the glued edges to ensure proper adhesion. Please follow the sealing and taping process as described on the ductwork fabrication procedure previously described.

Turning Vanes

When there is lack of space and/or the design specifies it, the use of square elbows is employed. In this case, all square elbows shall have “turning vanes” installed inside them. The turning vanes are aerodynamically designed to assist the airflow and limit the amount of noise and drag. Normally the turning vanes are fastened to an aluminium strip mounted externally to the elbow.
Reducers may have a taper on one side of the duct only, this is classified as an “eccentric” reducer, while one with tapers on both sides is classified as “concentric”.

The assembly begins with the connecting the side pieces to the bottom piece followed by the creased cover. The cover shall have a minimum of 3 creases per bend made with a bending machine.

Reducer Construction
Construction of a reducer begins with cutting of four separate pieces from a PIR panel based on the inlet and outlet dimensions, and a minimum neck length of 200mm before and after the taper. The taper angle shall not exceed 20°. The four pieces are the two sides, the bottom side and the cover as shown:

Components of a Reducer
Offsets are often used to deviate around an obstacle or connect to a differently aligned duct. Jack Planes of various angles can be used for cutting of the V grooves and other cuts. The curving of the offset pieces is achieved by the bending of creases made with a bending machine and spaced at least 50mm apart as previously mentioned.

**Offset Construction**

Again like elbows and reducers, offsets are constructed beginning with the cutting of four separate pieces from a PIR panel based on the inlet and outlet dimensions. Neck size is the same as in a reducer: minimum of 200mm and the angle no greater than 30 degrees. The four pieces are then glued together, taped and sealed.

Static take-off branches are typically made in Straight Branch, Angle Branch and Boot Branch.
Static branches can be connected to a supply duct as Male/Female for short and light weight branches or they may be Flanged when connected to a large and long branch with heavy diffusers, grilles and dampers.

The male/female connection is made by cutting the end of the take-off duct and the opening of the supply duct at 45° angles using a small male/female Jack Plane. Glue is then applied to both surfaces and after the curing period they are joined together. Silicon is then applied along the outer seam, and tape on the inner.

The flanged connection is made by using "U" profiles on the branch duct and "F" profiles on the supply duct. Rivets are inserted into the profiles to join the two ducts together. Self adhesive gasket is recommended in the assembly.

**Static Boot Branches Take-off**
Improved aerodynamics is the main reason for the use of a Static Boot Branch design. They are constructed the same way as reducers, the only difference is that the taper on the cover is cut by using both a 45° and 22.5° angle Jack Plane.

**Dynamic Branches**
Dynamic branches are used to direct the air stream velocity pressure to the branches. The general norms apply to dynamic branches: the neck length must be at least 200mm, the internal radius is minimum 200mm, creases on curved strips must be at least 50mm apart.
**Construction of Dynamic Branches**
The same procedure and steps used for fabrication of elbows and reducers is used for dynamic branches, though they are perhaps the most complex pieces to construct.

Assembly of two-way dynamic branch begins with the left and right sides attached to the base piece, followed by the assembly of the taper strip, outer strip and finally the inner strip.

The sequence for assembling the two-way tee begins with attaching the both creased inner strips to one of the side tees, followed by the attachment of the other side piece to the two inner strips. Then attach both outer creased strips to both of the sides to complete the tee.

**Connection to aluminium spiral fittings**
A circular hole equal to the diameter of the fitting is made on the duct using the round hole cutter tool, or by first scribing the perimeter circle around the fitting and then cutting the hole with a standard utility knife. The fitting then is inserted in the hole and the tabs then bent back against the inner surface of the panel. Silicon shall be applied around the groove between the fitting and supply duct's outer surface.
Duct reinforcement is required against deformation due to negative and positive pressure or both. Careful observation of the reinforcement details in this section and proper application is a must.

**Duct Reinforcement application**

Whether reinforcement is required or not is determined by two parameters: Duct size, and Total System Pressure (A/C system static pressure).

<table>
<thead>
<tr>
<th>Duct Side Measurement (mm)</th>
<th>Pressure (Pa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>300</td>
<td>200</td>
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<tr>
<td>400</td>
<td>300</td>
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<td>500</td>
<td>400</td>
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<tr>
<td>1900</td>
<td>1800</td>
</tr>
<tr>
<td>2000</td>
<td>1900</td>
</tr>
</tbody>
</table>

**Table:**

- **One Bar at 600 mm**
- **Two Bars at 600 mm**
- **Three Bars at 600 mm**
- **No Reinforcement Required**

**Installation of Duct Reinforcement**

There are three components in an aluminium reinforcement system: the aluminium stiffener bar, discs, and mounting screws. The bar is inserted vertically in combination with the reinforcing discs inside the duct. Four discs total are installed for every bar, two on the inside of the duct and two on the outside surface of the duct. The self-threading mounting screws are inserted from the top of the outside disc to the stiffener bar in combination with the inside disc. As shown:
In case of multiple reinforcement bars as shown above, the distance between bars is 50% of the step distance as indicated on the reinforcement chart. When an horizontal bar is also required, the bars shall be tied together at the point of intersection with cable ties.

**Aluminium Flanges**

STIFERITE suggests two different types of flanging systems for joining duct segments together.

- Invisible Flange
- Teeth Connectors

Determination of the type used is based on the application. The one generally used is the invisible flange, where the “H” shaped bayonet in PVC joining the two segments together is hidden (invisible) inside the two aluminium profiles. Two of the main features of the invisible flange is the easy installation in limited access areas and when the duct is in-view and aesthetics are a prime consideration. It provides a tight joint without the use of adhesive or gasket.

The Teeth Connector is a very economical alternative only in small and low pressure ductwork applications. Small is defined as maximum size of any duct side to 500mm and maximum pressure of 500 Pascals. It is an aluminium plate with prone points (teeth) in each end.

**Installation of Invisible Flange**
**Teeth Connector Flange**

Aluminium tape is applied to the ends of the two duct segments followed by a continuous bead of silicone around the end of only one segment. Then, the two duct segments are joined together and a Tooth Connector for duct sides up to 300mm is pressed in the middle of all four sides of the duct and centered over the seams. For ducts between 300 and 500mm, two Teeth Connectors evenly spaced are applied. Aluminium tape is then wrapped around the joint of the two ducts which consequently covers the Teeth Connectors and the seams.

![Installation of Teeth Connectors](image)

**Connection to HVAC machines and components**

The Stiferite’s ISOCANALE system is compatible with all standard Air-Handling Units (AHU) and components including dampers, flex duct, grilles, diffusers, galvanized sheet metal etc… A full range of aluminium profiles are available for connection to virtually any type of surface. Components generally have flanged or spigotted connections, below is an example of proper installation for the two different connections using aluminium profiles: “h”, “F” and “U”.

![Connections to flanged and spigotted surfaces](image)
Ductwork made of PIR panels is a very light weight system, and therefore the support and hanging system does not have to be as strong as a sheet metal system. Attachment of the ductwork to the building frame may be made of beam clamps, spring clips, wall clamps and screw anchors.

**Installation of duct support and hangers**

The most common types of duct support system are uni-strut or steel channel combined with a threaded bar or hanger strap. The duct support bars shall be at least 50mm in width and 22 gauge minimum thickness. Alternatively, a duct support bracket may be used for a maximum of any duct side of 700mm. The suspension for a duct support bracket is generally a threaded bar. Spacing recommendations between supports are reported in table 2 below:

**Table: 2 Maximum Hanger Spacing**

<table>
<thead>
<tr>
<th>4 m 13 ft Segments</th>
<th>4,000 mm 12 ft Max</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2 m 4 ft Segments</td>
<td>2,400 mm 8 ft Max</td>
<td>1,400 mm 6 ft Max</td>
</tr>
<tr>
<td></td>
<td>750</td>
<td>1100</td>
</tr>
</tbody>
</table>

Largest Duct Side Dimension

Hangers and Support

Duct Support Bracket
When evaluating the cost of Polyiso (PIR) ducting versus sheet metal, generally the comparison focuses only on the savings in fabrication and installation of PIR ducts. However, the comparison should not stop here, in-fact the annual savings in energy costs due to the insulation properties and air leakage of PIR systems is substantially significant and must be taken into account. The insulation comparison of a duct system using PIR panels versus other insulants used in the industry illustrates clearly the superiority of PIR panels. Due to the thermal conductivity coefficient of PIR foam, it takes almost twice the thickness of other panels to reach the same thermal insulation performance as PIR as shown below.