



The Kingspan **KoolDuct**® System

METRIC FABRICATION MANUAL



*Low Energy –
Low Carbon Buildings*

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Introduction

Overview

The heating, ventilation and air-conditioning (HVAC) industry is in the midst of a dynamic era. However, air-distribution ductwork, a critical component of HVAC systems, has remained virtually unchanged since the early 1900s.

Several factors have introduced the need to revolutionise HVAC ductwork. Energy use has continued to escalate, and thus the demand for energy reducing solutions has intensified. Requirements for clean air are becoming increasingly prevalent. Speed of construction has become a valuable asset. Floor space and headroom are under constant pressure.

Traditionally, HVAC ductwork is constructed from galvanised sheet steel, which is installed first and then insulated separately as a second operation. The **Kingspan KoolDuct® System** however, is an advanced and innovative pre-insulated rectangular HVAC ductwork system, which is installed in a single-fix.

The **Kingspan KoolDuct® System** eliminates virtually all of the problems associated with galvanised sheet steel, mineral fibre duct board and pre-insulated rigid polyisocyanurate (PIR) ductwork systems whilst, at the same time, offering additional advantages to the specifying engineer, the architect, the M&E contractor, the fabricator, the facilities manager, the property developer and the building owner.

Ductwork fabricated from The **Kingspan KoolDuct® System** is the only premium performance pre-insulated ductwork, in a thickness of up to 45 mm, in the world to be UL Listed as a Class 1 Air Duct, to Standard for Safety UL 181 (Underwriters Laboratories: Factory Made Air Ducts & Air Connectors), when fabricated to a specification clearly defined by UL.

In addition, ductwork fabricated from The **Kingspan KoolDuct® System** can reduce air-leakage rates to a fraction of those typical of rectangular sheet metal ductwork. This cutting edge System thus offers the triple benefits of cutting energy use, cutting operational carbon dioxide (CO₂) emissions and cutting costs.

As a result, The **Kingspan KoolDuct® System** should be considered the ductwork system of choice, where low embodied environmental and low operational environmental impacts are key requirements.

Applications

The **Kingspan KoolDuct® System** is designed for use in building services / HVAC applications. It is suitable for both new build and refurbishment projects in the residential, commercial, public, light industrial and leisure sectors.

Ductwork fabricated from The **Kingspan KoolDuct® System** can be installed indoors, outdoors, visibly mounted, concealed above false ceilings, concealed below raised floors or within confined enclosures such as pre-fabricated modules. Furthermore, its versatility enables individual system components, such as plenum boxes, risers and straight sections, to be integrated with sheet metal ductwork, whilst larger sized ducts, with a cross-sectional dimension greater than 2 m, are easily fabricated.

Operational Limits

It is recommended that ductwork fabricated from The **Kingspan KoolDuct® System** is used for operation as supply, return, exhaust and fresh air ductwork, for heating, ventilation and air-conditioning systems, within the following limits:

Mean Air Velocity (Max.)	25.4 m/s
Design Pressure (Max.)*	Positive: 1000 Pa Negative: 750 Pa
Temperature	Internal air temperature of -20°C to +80°C during continuous operation.
Size	Unlimited (provided that Kingspan KoolDuct® System fabrication techniques and procedures are strictly observed).

Table: Operating Limits for Ductwork Fabricated from The **Kingspan KoolDuct® System**

* These are maximum values and vary depending upon both the coupling system and the size of the ductwork.

NB 'Mean Air Velocity' refers to the design air flow rate related to the cross-sectional area of the ductwork. 'Design Pressure' relates to the actual total pressure of the relevant section of ductwork and not the fan static pressure. 'Total Pressure' is a combination of both static and dynamic pressures.

Ductwork fabricated from The **Kingspan KoolDuct® System** should not be used in the following applications:

- conveyance of solids;
- fire resistant ductwork;
- kitchen / grease hood exhaust systems;
- chemical, fume or smoke exhaust systems;
- where combustible matter readily collects inside the ductwork;
- adjacent to any mechanical / electrical sources of extreme heat;
- outdoor / underground use without mechanical and / or weather protection;
- where the failure of automatic control equipment may give rise to extreme temperatures; and
- with equipment of any type that does not include automatic maximum temperature controls.

Introduction

Information about this Manual

This manual is intended to provide the Trained Fabricator / Installer with a clear understanding of the standard of fabrication and installation required, in order to comply with current building regulations, standards and codes. It is also intended to provide the specifying engineer / design professional with an appreciation of the System's fabrication methods and installation procedures.

Some fabrication processes can be carried out either manually or by using CNC controlled machinery. This manual deals with manual fabrication only, but where the use of CNC controlled machinery is possible, this is made clear. Please note that a list of CNC controlled machinery manufacturers is supplied in Appendix A, for reference.

This manual is not to be used as the sole reference material for the fabrication and installation of *Kingspan KoolDuct® System* ductwork, nor as the sole basis of a project specification. For fabrication and installation techniques, reference should always be made to The *Kingspan KoolDuct® System* Training Manual (latest edition), and comprehensive training should be undertaken through The *Kingspan KoolDuct® System* Training Course. For specification details, reference should always be made to The *Kingspan KoolDuct® System* Specifier's Guide (latest edition). For further information, please contact Kingspan Insulation.

This manual deals specifically with ductwork fabricated from 22 mm, 30 mm and 42 mm *Kingspan KoolDuct®* panels, and uses metric measurements throughout, but similar guidelines are applicable to other thicknesses; It is applicable to both panel lengths of 2950 mm and 3930 mm. Please note that when figures differ between panel lengths, that which is applicable to the 2950 mm panel will be listed first followed by that which is applicable to the 3930 mm panel (e.g. 2906 / 3886 mm).

Fabrication Standards

The fundamental function of HVAC ductwork is the conveyance of supply, return, or exhaust air. Its effectiveness at performing this function is determined by its ability to satisfy specific theoretical performance criteria, which is a direct function of the materials used and the system's design, fabrication and installation. As energy usage becomes increasingly regulated in worldwide building standards, it is crucial that actual system performance matches specified design performance in terms of:

- heat loss / gain;
- air-leakage; and
- legislative compliance.

As a result, Kingspan Insulation places specific importance on the following.

Quality of Materials

Kingspan Insulation offers a complete product line, providing all materials, tools and accessories necessary for the effective fabrication of ductwork from The *Kingspan KoolDuct® System*. Each component has been rigorously tested in the field, in a variety of ductwork applications, to the highest performance standards. Under no circumstances are unapproved components to be used in place of the coupling systems, adhesive, silicone sealant and aluminium tape supplied by Kingspan Insulation. Prior approval, in writing, should be obtained from Kingspan Insulation for the use of alternative materials.

Fabrication & Installation

All personnel responsible for the fabrication of ductwork from The *Kingspan KoolDuct® System* should, prior to being engaged in the work, have successfully completed The *Kingspan KoolDuct® System* Training Course. The list of Trained Fabricators / Installers is continuously updated in order to ensure the maintenance of high standards.

Trained Fabricators / Installers are bound to use the fabrication methods outlined in this manual, and those detailed in The *Kingspan KoolDuct® System* Training Manual. If an alternative fabrication method or procedure is to be used for any step in this process, prior approval in writing, should be obtained from Kingspan Insulation.

Workmanship

This manual provides all of the information necessary to fabricate ductwork, from The *Kingspan KoolDuct® System*, to the highest standards. However, it remains the sole responsibility of the Trained Fabricator / Installer to self-certify the quality of its workmanship. Kingspan Insulation cannot be held responsible for issues arising from the incorrect application of the methods outlined in this manual.

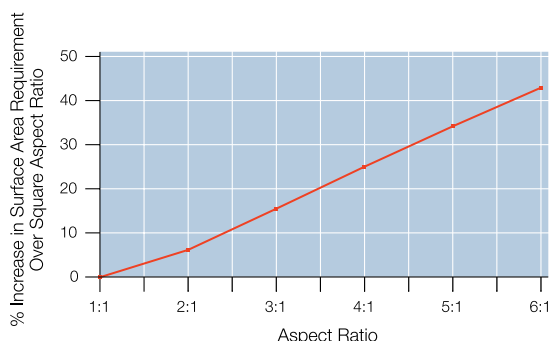
Economy of Duct Design

A ductwork system accounts for a substantial portion of the overall cost of a building's HVAC system – potentially in excess of one-third of the total cost. Careful and attentive planning during the design stage of a ductwork system can yield a significant reduction in its overall cost. There are two factors in particular that can have a considerable impact:

- the total number of special pieces / fittings (pieces other than straight sections); and
- the aspect ratio of the ductwork sections.

Special pieces such as elbows, reducers, and offsets, etc. require considerably more labour (and material to a certain extent) to construct than straight sections. While all ductwork systems will require a certain quantity of special fittings, their usage should be minimised. Ideally, the system should follow the straightest possible route.

The other point which is less intuitively obvious is the aspect ratio of ductwork sections. This ratio is defined as the length of a section of ductwork's longer side divided by its shorter side. As the aspect ratio increases, the corresponding surface area increases dramatically. The figure below illustrates this relationship for six duct sizes of identical cross sectional area with different aspect ratios. In addition, higher aspect ratio ducts also exhibit increased frictional resistance and noise. As can be seen, a square aspect ratio (1:1) (example: duct size 300 x 300 mm) is the most economical. However, while smaller aspect ratios are more desirable from a material requirement and aerodynamic standpoint, the trade-off is in space utilisation, as small aspect ratio ducts require more clearance for installation. Based on all of these considerations, it is not recommended that aspect ratios exceed 4:1 (example: duct size 600 x 150 mm).



UL Listing

Ductwork fabricated from The *Kingspan KoolDuct® System* is the only premium performance pre-insulated ductwork, in a thickness of up to 45 mm, in the world to be UL Listed as a Class 1 Air Duct, to Standard for Safety UL 181 (Underwriters Laboratories: Factory Made Air Ducts & Air Connectors). The UL Listing requires that ductwork is fabricated using:



- 20–45 mm *Kingspan KoolDuct®* panels, faced with silver aluminium foil autohesively bonded to the insulation core, on both sides, during their manufacture at Kingspan Insulation's Pembridge, UK, manufacturing facility;
- either, or a combination of, the aluminium grip, the Tiger Clip and / or the 4-bolt coupling systems;
- an aluminium foil vapour barrier tape that is UL Listed A-P to Standard for Safety UL 181 A (Underwriters Laboratories: Standard for Closure Systems for use with Rigid Air Ducts); and
- Kingspan High Performance Silicone Sealant / Caulk.

Further details of the UL Listing for ductwork fabricated from The *Kingspan KoolDuct® System* are published at: www.ul.com in the 'Online Certifications Directory'. To view the listing, type 'Kingspan Insulation' under the search parameter 'Company Name', followed by 'MH25124' under the search parameter 'UL File Number'.

1. Terminology

1.1 Kingspan KoolDuct® Panels

Kingspan KoolDuct® panels are supplied in the following dimensions: 2950 / 3930 mm x 1200 mm. In the interests of clarity, the 2950 / 3930 mm dimension is considered their length, the 1200 mm dimension their width. Kingspan KoolDuct® panels are available in thicknesses of 20, 22, 30, 42 and 45 mm.

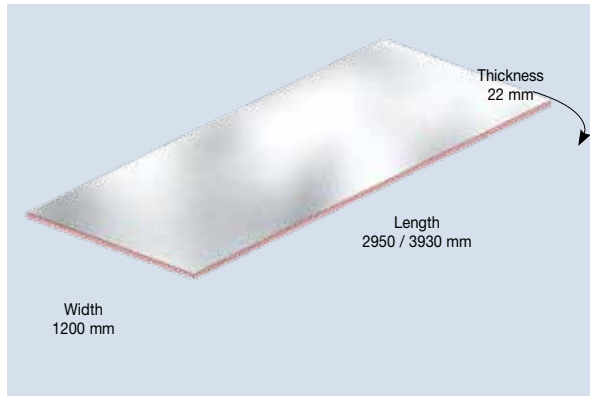


Figure 1.1 Kingspan KoolDuct® Panels

1.2 Ductwork Sections

The cross-sectional measurements specified on technical drawings of ductwork systems usually refer to their internal dimensions. These measurements reflect the cross-sectional area of the air passage necessary to satisfy the designed airflow requirements. Accordingly, all measurements in this manual will follow this convention unless otherwise stated, and it is strongly recommended that the Trained Fabricator / Installer adopts this convention.

To this end, when a ductwork section's dimensions are referred to, the following conventions are used:

- 'w' refers to the ductwork section's internal width;
- 'h' refers to the ductwork section's internal height; and
- 'l' refers to the ductwork section's length.

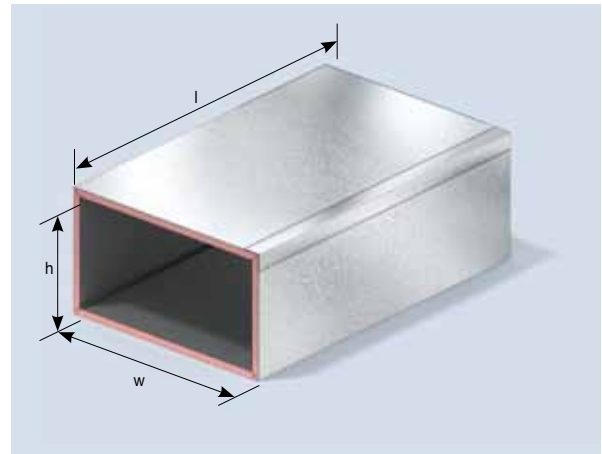


Figure 1.2 Ductwork Section Terminology

2. Fabrication Procedure

2.1 General

The fabrication of ductwork from The *Kingspan KoolDuct® System* is accomplished by following a standardised procedure. The process is generally the same, regardless of the size or shape of the ductwork section:

- tracing;
- cutting;
- assembly;
- taping;
- reinforcement;
- sealing;
- coupling; and
- fabrication inspection.

Where the process differs from that laid out above, it will be discussed in the relevant section.

Please note that when fabricated correctly, finished ductwork sections will have no exposed insulation internally or externally.

2.2 Tracing

The tracing of the ductwork section's outline onto the surface of the panel is the first step of the fabrication procedure. It is accomplished by lightly marking (rather than scribing) lines, using a marking tool, such as one of the plastic pencils supplied in The *Kingspan KoolDuct® System* Tool Box. Care should be taken not to pierce the aluminium facing.

When tracing straight sections, it is possible to skip this step and proceed directly to the cutting phase, provided that the long and short clamping rules are used as a guide. When fabricating all other types of ductwork sections, however, the outline should be marked out in full before cutting takes place.

Please note that, as the cross-sectional measurements specified on technical drawings of ductwork systems normally refer to their internal dimensions, all tracing is performed on the internal face of *Kingspan KoolDuct®* panels.

2.3 Cutting

Jack planes are employed to cut 45° bevelled edges along an outline, which has been previously traced onto the panel's surface. When the ductwork section is put together, in the subsequent assembly step in the fabrication procedure, these bevelled edges fit together to form a mitre joint. There are two types of mitre joint, the folded mitre joint and the butted mitre joint. The type of mitre joint used, is dependent on the type and size of the ductwork section being fabricated, and each type of mitre joint necessitates the use of different jack planes.

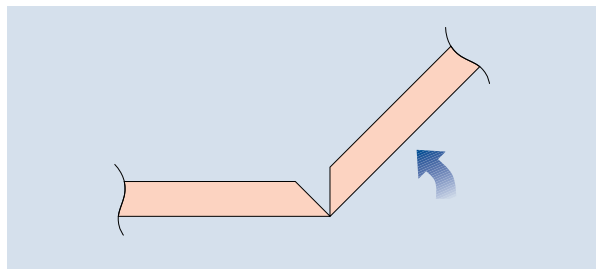


Figure 2.1 Folded Mitre Joints

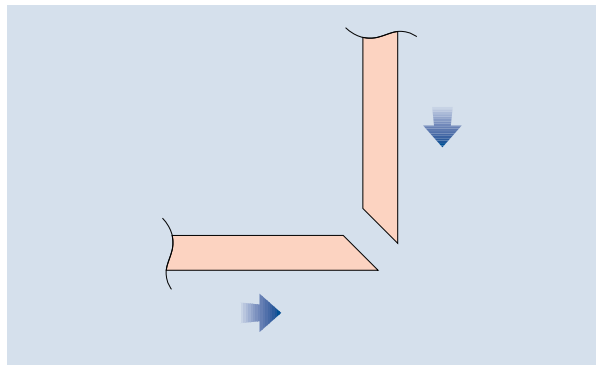


Figure 2.2 Butted Mitre Joints

2. Fabrication Procedure

Regardless of what kind of cut is being made into the panel, it is paramount, in the interest of system integrity, that it is done as accurately as possible. For this reason, it is recommended that the section of panel being cut is clamped into position using the long and / or short clamping rules supplied by Kingspan Insulation. When cutting straight lines, clamping rules can also be used as a cutting guide (as shown in Figure 2.3), to help to ensure that the edge is cut as straight and as accurately as possible.

It is good practice to check the dimension of each duct side once it has been cut.



Figure 2.3 The Cutting Procedure

2.3.1 Folded Mitre Joints

When a ductwork section's dimensions are such that at least two sides of it can be fabricated from a single panel, then the corner between the two sides can be cut using the dual blade jack plane. This jack plane has two 45° blades in a 'V' formation and simultaneously cuts two complimentary bevelled edges down the panel, whilst leaving the foil facing between them intact. This 'V' groove allows the panel to be folded to form a folded mitre joint, and thus the 90° corner between the two sides.

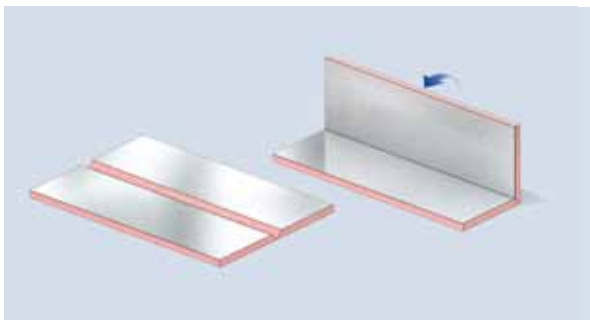


Figure 2.4 Folded Mitre Joint

Some ductwork sections, such as boot branches and mitred offsets, require folded mitre joints at angles greater or lesser than 90°. Such mitre joints therefore require bevelled edges at angles greater or lesser than 45°, which can be cut using the universal jack plane (the dual blades of which can be altered such that almost any angle of V groove can be cut) or the 22.5° jack plane.

2.3.2 Butted Mitre Joints

In instances where a folded mitre joint is not possible, such as where there is insufficient space to cut adjacent sides from the same panel, then a single bevelled edge is cut using one of the two single bladed small jack planes. These jack planes have one blade at a 45° angle, cut a single bevelled edge and, unlike the dual angle jack plane, they also cut through the aluminium foil facing. This bevelled edge allows one side of the ductwork section to be butted up to another, also cut with the 45° small jack plane, to form a butted mitre joint, and thus the 90° corner between the two sides.

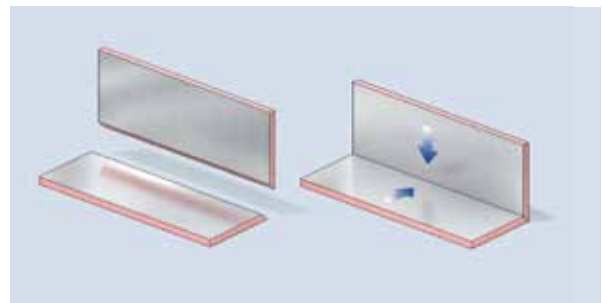


Figure 2.5 Butted Mitre Joint

2.3.3 Automatic Cutting

Please note that the cutting process can be achieved using CNC machinery. Details of manufacturers can be found in Appendix A.

The use of CNC machinery is particularly indicated to cut thicker Kingspan **KoolDuct**® panels such as 42mm and 45 mm, which are more difficult to cut manually.

2.4 Assembly

In the assembly process, those pieces which have been cut out are put together and secured, using either adhesive or Tiger Clips. Adhesive can always be used in the same manner, regardless of the size of the ductwork section and the static pressure to which it is to be exposed. Tiger Clips, however, should always be used in accordance with the parameters discussed below.

2.4.1 Assembly with Adhesive

Prior to use, the adhesive is shaken well, to ensure uniform consistency, and the bevelled edges are swept clean of any remaining insulation dust. Adhesive is then applied to all bevelled edges using a glue spreader (such as that supplied in The *Kingspan KoolDuct® System Tool Box*) or a brush, such that it covers all of the exposed insulation.

Suitable spray adhesives are also available, that typically require a prime coat and then a second coat. Spray adhesive should always be applied in accordance with the recommendations of its manufacturer.

Depending on the temperature and relative humidity of the application environment, the adhesive will require approximately 10 to 20 minutes to cure, at which point it should be dry to the touch. Once dry, the sides can be folded to form a folded mitre joint (see Figure 2.4), or connected to form a butted mitre joint (see Figure 2.5). The cut foil edges on the internal side of the ductwork section are used for alignment purposes. Please note that, when a ductwork section comprises several individual pieces, the assembly process for each joint is initiated from the same end of the ductwork section, such that the subsequent trimming of any excess length is only required at one end.

Finally, a rigid spatula (such as that supplied in The *Kingspan KoolDuct® System Tool Box*) is used to firmly press along the newly formed corners of the ductwork section, to ensure maximum adhesion in the joints.

2.4.2 Assembly with Tiger Clips

Tiger Clips are patented mechanical closures (see Figure 2.6), which have been specifically designed to aid the assembly and coupling of ductwork fabricated from The *Kingspan KoolDuct® System* (see Section 10 for coupling). During assembly, they are used instead of adhesive to secure joints, and can speed up the assembly process by eliminating the time required for the adhesive to cure.

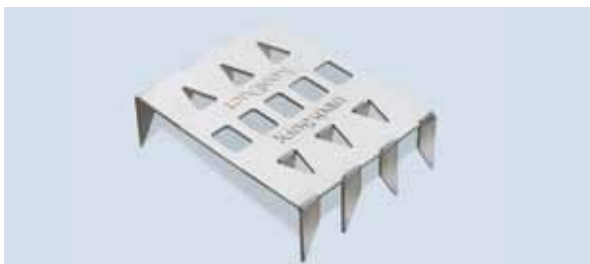


Figure 2.6 Tiger Clips

Prior to their application, a rigid spatula is used to firmly press along the edges of the ductwork section. Tiger Clips are then fitted by bending them through 90° whilst pushing the spikes into the panel, such that the bevelled edges are held tightly together (see Figure 2.7).



Figure 2.7 Assembly with Tiger Clips

When using Tiger Clips it is critical that the static pressure and ductwork size limitations shown in Table 2.1 are strictly observed. In all cases, Tiger Clips are installed not more than 50 mm from each end of the joints, and additional clips are installed between, at centres detailed in Table 2.1.

Please note that when fabricating elbows and radius fittings, Tiger Clips should be installed on all 4 corners joints, and the maximum allowed spacing between Tiger Clips is 100 mm on the inner corner joints and 250 mm on the outer corner joints, regardless of the ductwork section's size and the static pressure to which it is to be exposed (up to a limit of 1000 Pa).

Pressure (Pa)	Maximum Size (mm)	Tiger Clip Centres (mm)	Application
≤ 500	Any size	500	Only on butted joints*
> 500 but ≤ 1000	Any size	250	Only on butted joints*

Table 2.1 Tiger Clip Limitations (Other than Elbows)

Tiger Clips should also be used on folded joints if the outer foil facer is penetrated during the process of cutting the mitre. A single clip should be installed over a small cut in the foil. If the cut is large, then Tiger Clips should be installed along the whole joint per butted joints.

2. Fabrication Procedure

2.4.2.1 Example 1

Figure 2.8 illustrates the use of Tiger Clips in the fabrication of a ductwork section with dimensions of 450 mm (w) x 300 mm (h), for use in a system with a static pressure of 500 Pa. Referring to Table 2.1, it can be seen that, as the static pressure to which it is to be exposed is 500 Pa, Tiger Clips are used only on the butted joints, at centres not exceeding 500 mm, with the first and last not more than 50 mm from their respective ductwork section ends.

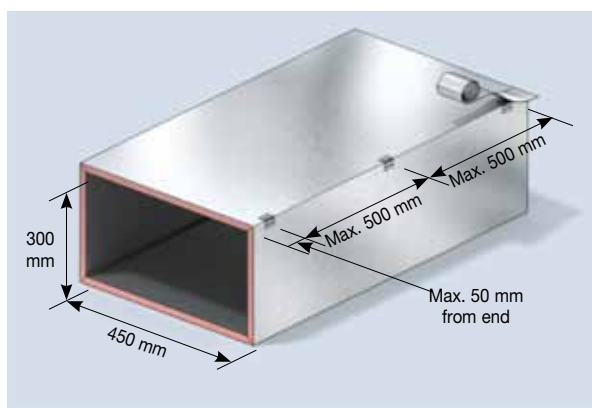


Figure 2.8 Example 1: 450 mm (w) x 300 mm (h), 500 Pa

2.4.2.2 Example 2

Figure 2.9 illustrates the use of Tiger Clips in the fabrication of a transition with inlet dimensions of 450 mm (w) x 300 mm (h), but this time for use in a system with a static pressure of 1000 Pa. Referring to Table 2.1, it can be seen that the static pressure to which it is to be exposed is such that Tiger Clips are placed at centres not exceeding 250 mm, with the first and last not more than 50 mm from their respective ductwork section ends.

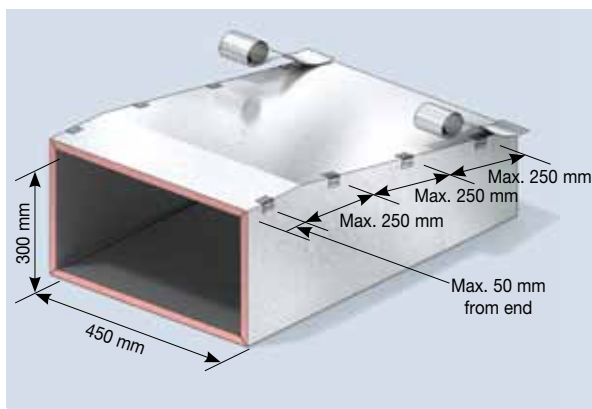


Figure 2.9 Example 2: 450 mm (w) x 300 mm (h), 1000 Pa

2.5 Taping

For butted joints, after the ductwork section has been assembled and regardless of whether adhesive or Tiger Clips are used in its assembly, a protective and durable aluminium vapour barrier tape, at a recommended width of 75 mm (min.), is applied to the external foil facing of the joints, such that the joints are fully covered (see Figure 2.12).

For folded joints using adhesive based assembly, no tape is required unless the outer facing is penetrated during the process of cutting the mitre. If the outer facing has been penetrated, the whole cut should be covered with tape.

For folded joints using Tiger Clip assembly, however, it is necessary to apply tape to cover the Tiger Clips. The tape only needs to cover the Clips and not the whole joint unless the outer facing is penetrated during the process of cutting the mitre. If the outer facing has been penetrated, the whole cut should be covered with tape.

The taping of joints serves four purposes:

- to re-establish the vapour barrier at butted mitre joints;
- to repair and cover any damage to the panel, both externally and internally;
- to seal and isolate the insulation material from its surroundings; and
- to improve the ductwork's aesthetic appearance.

Prior to applying the tape, ensure that the panel surface is clean, dry, free of grease, dust and silicone, and devoid of foreign matter and contaminants. If the surface cannot be thoroughly cleaned, a light coat of adhesive can be applied to the area where the tape is to be placed. Please note that an adhesive should be used which is fit for the purpose intended, such as the adhesive supplied by Kingspan Insulation.



Figure 2.10 The Taping Procedure

The tape marker supplied in The *Kingspan KoolDuct®* System Tool Box is used to mark, rather than scribe, a line on the external foil surface of the panel. This line serves as a reference during the application of the tape. The tape should extend 25 mm min. either side of joints or penetrations through the outer facing, and from the perimeter of Tiger Clips.

To apply the tape, exert the amount of pressure necessary for it to fully adhere, and smooth down using a flexible spatula (such as that supplied in The *Kingspan KoolDuct®* System Tool Box), to ensure maximum adhesion, a wrinkle-free finish and to expel any air bubbles trapped underneath. In order to ensure a good bond, the tape should always be applied in accordance with the recommendations of its manufacturer. Please note that when taping transitions or elbows, the tape is applied to the concave or creased side first, and the supplemental directions within the relevant sections of this manual should be observed.

2.6 Reinforcement

Depending on the system pressure, the ductwork section's dimensions and the coupling system used, the installation of a reinforcement system may be necessary. Please see Section 9 of this manual for more information.

2.7 Sealing

Following the assembly and taping of the ductwork section, the internal seams of all mitre joints, regardless of whether they have been folded or butted, are sealed with silicone sealant. The application of silicone sealant serves three purposes:

- to increase air-tightness by sealing the internal surface of the ductwork;
- to impart greater strength and rigidity to the ductwork; and
- to prevent any insulation particles from entering the airstream.

A generous and continuous bead of silicone sealant (with no gaps) (see Figures 2.11 and 2.12) is applied along the entire length of each internal joint seam, and subsequently pressed into the corners using a smooth radiused tool. Please note that the silicone sealant should be fully cured before any transportation or installation of ductwork sections is carried out. Correct application is crucial in ensuring 'clean air' and minimal air-leakage.

To this end, and in order to ensure a good bond, the silicone sealant should always be applied in accordance with its manufacturer's recommendations. Please note that it is recommended that silicone sealant is not applied at temperatures $\leq 4^{\circ}\text{C}$ or when frost or moisture is present on the surfaces to be sealed.



Figure 2.11 The Sealing Procedure

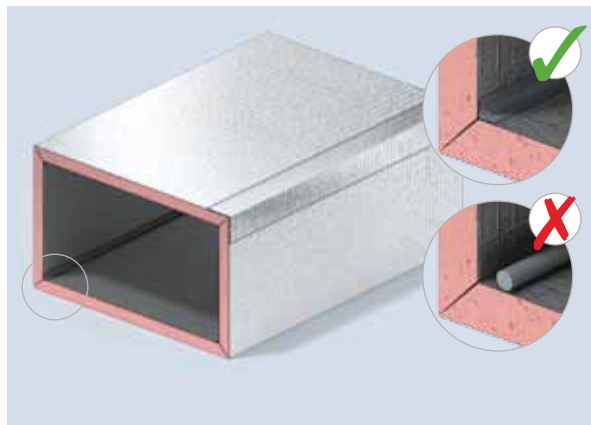


Figure 2.12 Model Application of Silicone Sealant

2.8 Coupling

'Coupling' refers to the act of joining ductwork sections to each other. This is commonly referred to as 'jointing'. However, to distinguish it from the act of creating joints during the cutting and assembly phase, this will be referred to as 'coupling' throughout. There are several coupling systems available. A full discussion of each, complete with instructions, is provided in Section 10 of this manual.

2.9 Fabrication Inspection

Once the ductwork has been fabricated, it is essential for its long term performance to check that the whole fabrication procedure has been followed and that the completed ductwork is fit for the purpose intended. Particular attention should be paid to the application of the tape, silicone sealant, and reinforcement. The inside of ductwork sections should be free from any fabrication debris. For a sample inspection checklist, please see Appendix B of this manual.

When correctly fabricated, following the procedure above, the finished ductwork section will have no exposed insulation – internally or externally.

3A. Straight Ductwork: 22 mm Panel

3A.1 General

Ductwork systems comprise many different kinds of ductwork section, from elbows and offsets to transitions and branches. However, the most common sections, which make up the majority of most systems, are straight. In general, it can be advantageous to design ductwork systems with as much straight ductwork as possible, as not only can straight sections be fabricated with greater ease and speed than other sections, but also, due to their relative simplicity, they should be more air-tight.

3A.2 Straight Ductwork Fabrication

There are eight standard fabrication methods, which can be divided into two groups: Group 1, comprising Methods 1–4; and Group 2, comprising Methods 5–8.

Methods in Group 1 can only be used when both of the ductwork section’s cross-sectional dimensions are ≤ 1156 mm. This enables the bevelled edges to be cut along the length of the panel, thus giving a maximum ductwork section length of 2950 mm / 3930 mm – i.e. the length of the panel.

When either w or h is > 1156 mm, a method from Group 2 is used. For these methods, the orientation of the panel is altered and the bevelled edges are cut along its width (i.e. perpendicular to its length). This increases the maximum possible w or h to 2906 / 3886 mm, but restricts the maximum ductwork section length to 1200 mm (i.e. the width of the panel). Table 3A.1 summarises all of the available methods, while Figure 3A.1 provides a method selector. In addition, all eight methods are discussed below in Sections 3A.3 and 3A.4.

Choosing the most appropriate method will minimise both fabrication time and panel wastage.

Group	Method	Side Dimensions (mm)	Max. Length (mm)
1	1	Sum of 4 sides ≤ 1024	2950 / 3930
	2	Sum of 3 sides ≤ 1068	
	3	Sum of 2 sides ≤ 1112	
	4	Both w & h individually ≤ 1156	
2	5	Sum of 4 sides $\leq 2774 / 3754$	1200
	6	Sum of 3 sides $\leq 2818 / 3798$	
	7	Sum of 2 sides $\leq 2862 / 3842$	
	8	Both w & h individually $\leq 2906 / 3886$	
Multiple duct		Unlimited (see Section 13)	2950 / 3930

Table 3A.1 Summary of Methods

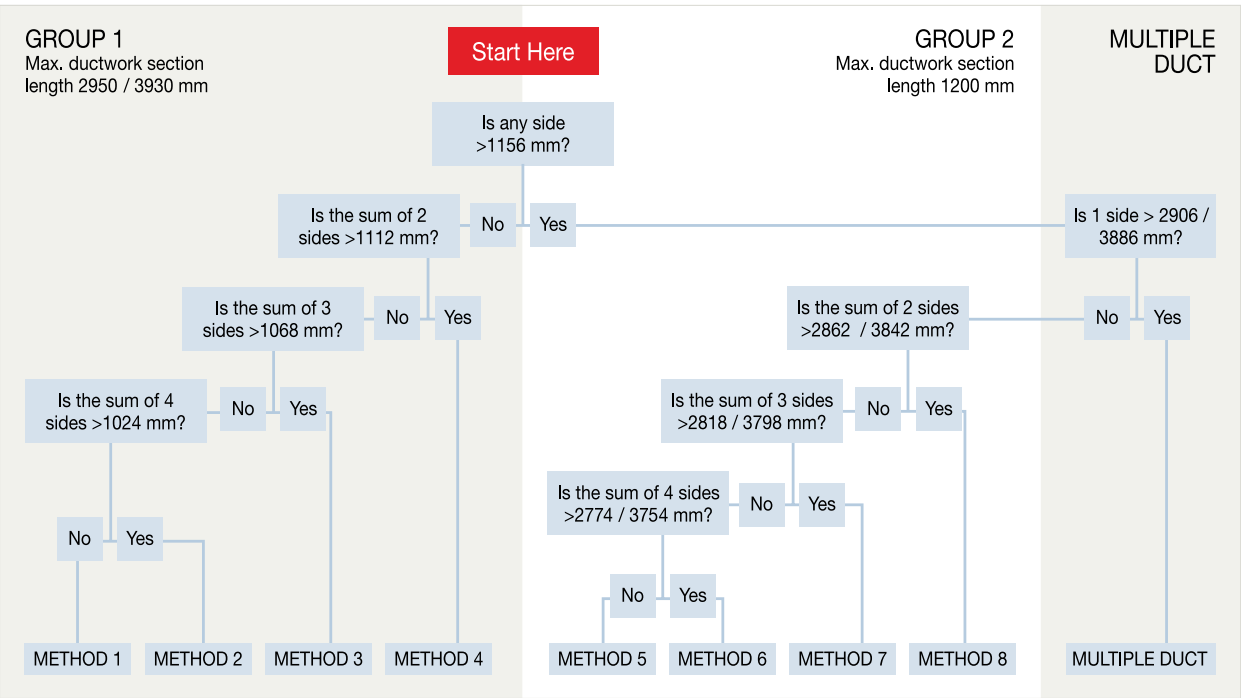


Figure 3A.1 Method Selector

3A.3 Group 1: Both w & $h \leq 1156$ mm

The choice between methods in Group 1 is determined by the precise dimensions of the ductwork section, and therefore the number of panels required in its fabrication. The maximum ductwork section length of all methods is 2950 / 3930 mm.

3A.3.1 Method 1 ($w+h+w+h \leq 1024$ mm)

Method 1 is used when the dimensions of a ductwork section are such that it can be fabricated from a single *Kingspan KoolDuct®* panel, orientated along its length. The maximum internal perimeter of a ductwork section fabricated using this method is 1024 mm. This figure is derived by subtracting the combined widths of the bevelled edges from the total width of the panel. As every bevelled edge in a straight ductwork section is cut at 45° (to enable a 90° mitre joint) each one will remove 22 mm (from a 22 mm thick panel). The dual angle jack plane, which simultaneously cuts two bevelled edges (to form a V groove) will therefore remove 44 mm from the panel. An entire ductwork section, fabricated from a single panel, requires three V grooves (44+44+44 mm) and two individual bevelled edges (22+22 mm), thus removing 176 mm from the panel, and hence giving a maximum internal perimeter of 1024 mm.

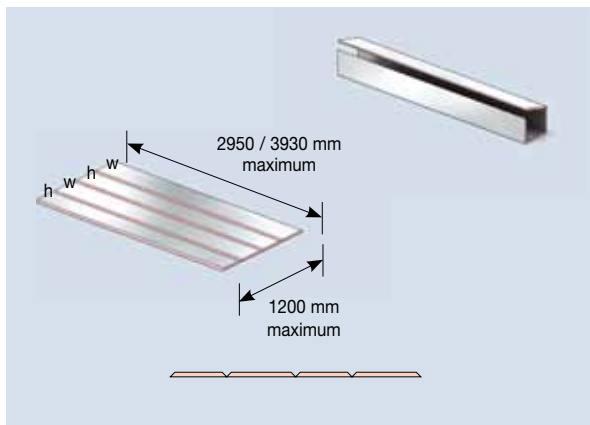


Figure 3A.2 Method 1: $w+h+w+h \leq 1024$ mm

3A.3.2 Method 2 (Sum of Three Sides ≤ 1068 mm)

Method 2 is used when the dimensions of the a ductwork section are such that two panels are required, but where the internal lengths of three sides can be cut from a single panel (to form a U shaped piece), leaving only one side to be cut from another (to form a cover). Thus, the sum of the internal lengths of three sides is ≤ 1068 , as a total of two V grooves and two single bevelled edges are required (1200–44–44–22–22 mm).

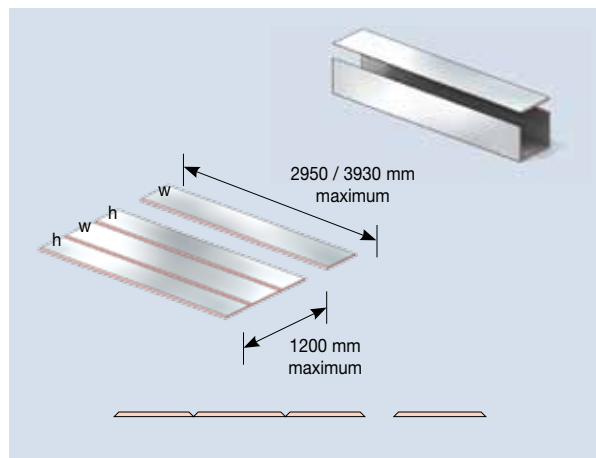


Figure 3A.3 Method 2: Sum of Three Sides ≤ 1068 mm

3A.3.3 Method 3 ($w+h \leq 1112$ mm)

Method 3 is used when the dimensions of a ductwork section are such that the internal lengths of three sides cannot be cut from a single panel, but where only two panels are still required. Two sides are cut from each panel, and the sum of the internal lengths of two sides is ≤ 1112 mm, as a total of one V groove and two single bevelled edges are required (1200–44–22–22 mm).

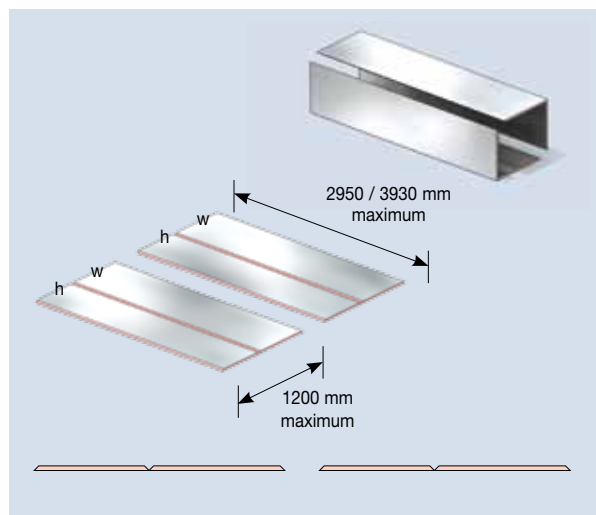


Figure 3A.4 Method 3: $w+h \leq 1112$ mm

3A. Straight Ductwork: 22 mm Panel

3A.3.4 Method 4 ($w + h \leq 1156 \text{ mm}$)

Method 4 is used when the dimensions of a ductwork section are such that the internal lengths of two sides cannot be cut from a single panel, but where all sides can be cut from a separate panel. Thus, both w & h are $\leq 1156 \text{ mm}$, as a total of two single bevelled edges are required (1200–22–22 mm).

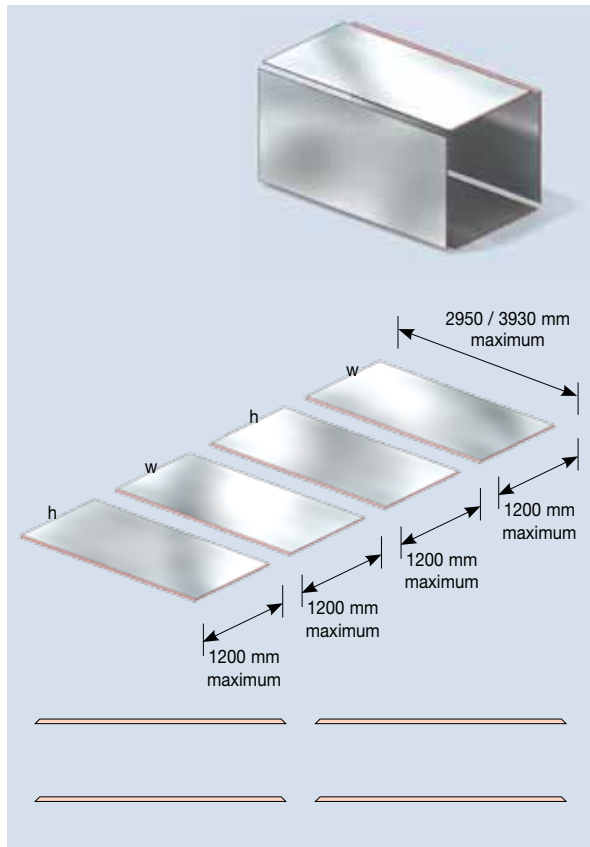


Figure 3A.5 Method 4: $w + h \leq 1056 \text{ mm}$

3A.4 Group 2: w and/or $h > 1156 \text{ mm}$

The choice between methods in Group 2 is determined in largely the same way as with Group 1 – by the cross-sectional dimensions of the ductwork. In addition to the methods below, the multiple duct method (see Section 13) should also be considered and, when the pressure is $> 500 \text{ Pa}$, should be regarded as preferable.

3A.4.1 Method 5 ($w + h + w + h \leq 2774 / 3754 \text{ mm}$)

Method 5 is used when the internal length of any one side is greater than that which can be fabricated from a single panel, orientated with its length parallel to the length of the final ductwork section (1156 mm), but where the internal length of all four sides can be fabricated from a single panel, orientated with its length perpendicular to the length of the final ductwork section. Thus the sum of the internal length of all four sides must be $\leq 2774 / 3754 \text{ mm}$, as a total of three V grooves and two single bevelled edges are required (2950 / 3930–44–44–22–22 mm).

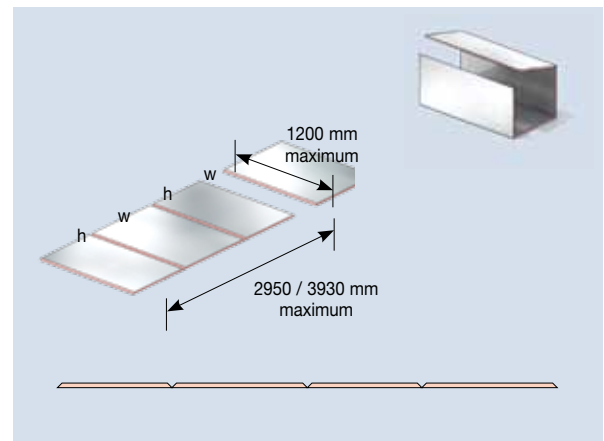


Figure 3A.6 Method 5: $w + h + w + h \leq 2774 / 3754 \text{ mm}$

3A.4.2 Method 6

(Sum of Three Sides $\leq 2818 / 3798$ mm)

Method 6 is used when the dimensions of a ductwork section are such that two panels are required, but where the internal lengths of three sides can be cut from a single panel (to form a U shaped piece), leaving only one side to be cut from another (to form a cover). Thus the sum of the internal lengths of three sides is $\leq 2818 / 3798$ mm, as a total of two V grooves and two individual bevelled edges are required (2950 / 3930–44–44–22–22 mm).

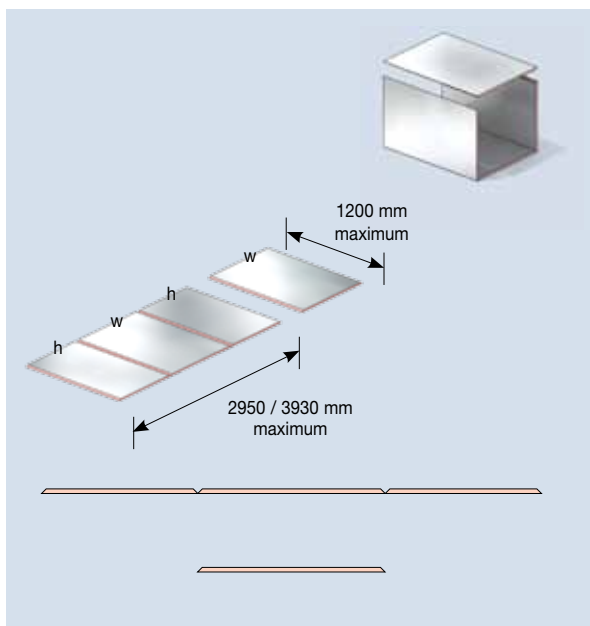


Figure 3A.7 Method 6: Sum of Three Sides $\leq 2818 / 3798$ mm

3A.4.3 Method 7

($w+h \leq 2862 / 3842$ mm)

Method 7 is used when the dimensions of a ductwork section are such that the internal lengths of three sides cannot be fabricated from a single panel but where only two panels are still required. Two sides are cut out of each panel, and the sum of the internal lengths of two sides is $\leq 2862 / 3842$ mm, as a total of one V groove and two bevelled edges are required (2950 / 3930–44–22–22 mm).

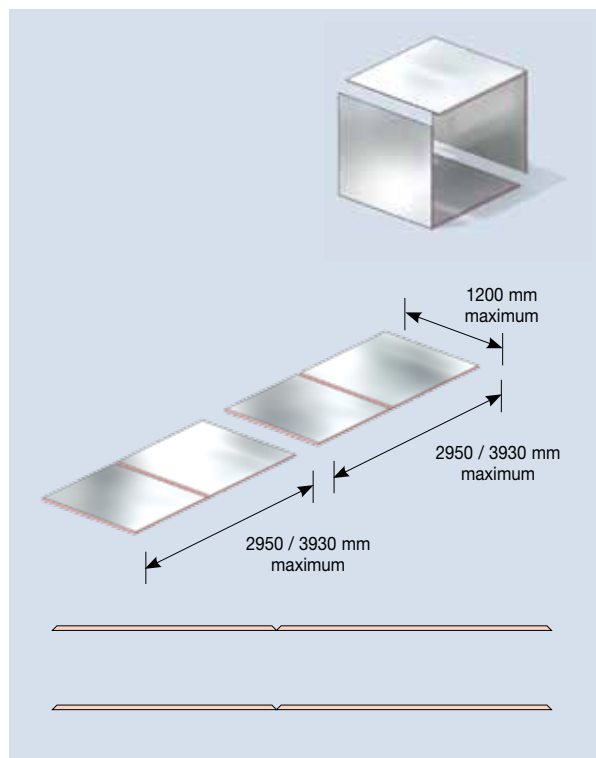


Figure 3A.8 Method 7: Sum of Two Sides $\leq 2862 / 3842$ mm

3A. Straight Ductwork: 22 mm Panel

3A.4.4 Method 8 ($w \text{ \& } h \leq 2906 / 3886 \text{ mm}$)

Method 8 is used when the dimensions of a ductwork section are such that the internal lengths of two sides cannot be cut from a single panel, but where all sides can be cut from a separate panel. Thus, both w & h are $\leq 2906 / 3886 \text{ mm}$, as a total of two single bevelled edges are required (2950 / 3930–22–22 mm).

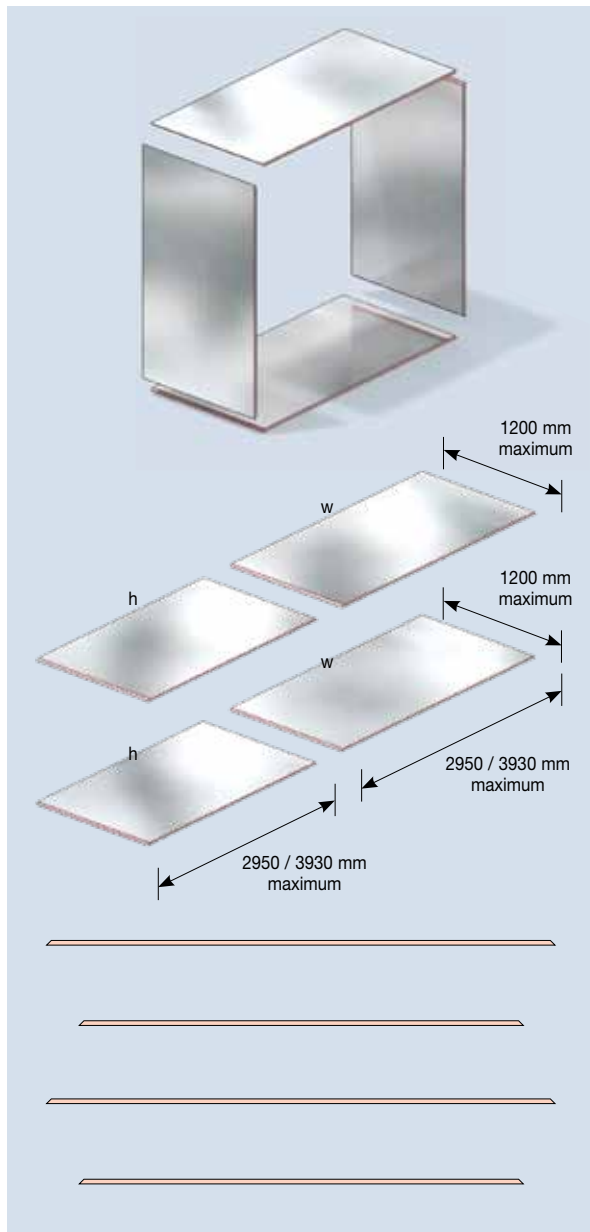


Figure 3A.9 Method 8: $w \text{ \& } h \leq 2906 / 3886 \text{ mm}$

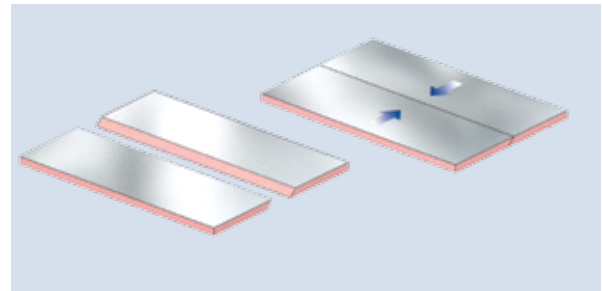


Figure 3A.10 Butted Lateral Bevelled Joint

3B. Straight Ductwork: 30 mm Panel

3B.3 Group 1: Both w & $h \leq 1140$ mm

The choice between methods in Group 1 is determined by the precise dimensions of the ductwork section, and therefore the number of panels required in its fabrication. The maximum ductwork section length of all methods is 2950 / 3930 mm.

3B.3.1 Method 1 ($w+h+w+h \leq 960$ mm)

Method 1 is used when the dimensions of a ductwork section are such that it can be fabricated from a single *Kingspan KoolDuct*® panel, orientated along its length. The maximum internal perimeter of a ductwork section fabricated using this method is 960 mm. This figure is derived by subtracting the combined widths of the bevelled edges from the total width of the panel. As every bevelled edge in a straight ductwork section is cut at 45° (to enable a 90° mitre joint) each one will remove 30 mm (from a 30 mm thick panel). The dual angle jack plane, which simultaneously cuts two bevelled edges (to form a V groove) will therefore remove 60 mm from the panel. An entire ductwork section, fabricated from a single panel, requires three V grooves (60+60+60 mm) and two individual bevelled edges (30+30 mm), thus removing 240 mm from the panel, and hence giving a maximum internal perimeter of 960 mm.

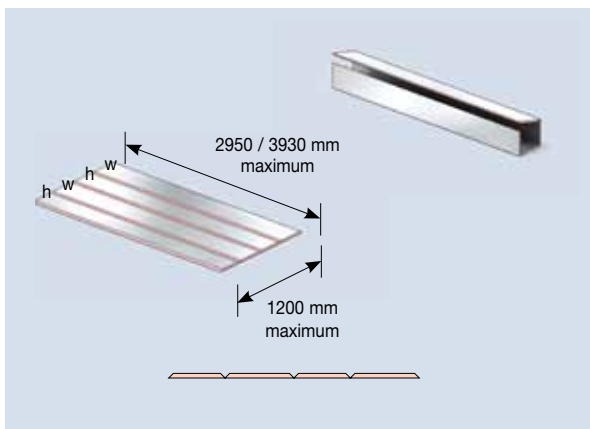


Figure 3B.2 Method 1: $w+h+w+h \leq 960$ mm

3B.3.2 Method 2 (Sum of Three Sides ≤ 1020 mm)

Method 2 is used when the dimensions of the a ductwork section are such that two panels are required, but where the internal lengths of three sides can be cut from a single panel (to form a U shaped piece), leaving only one side to be cut from another (to form a cover). Thus, the sum of the internal lengths of three sides is ≤ 1020 , as a total of two V grooves and two single bevelled edges are required (1200–60–60–30–30 mm).

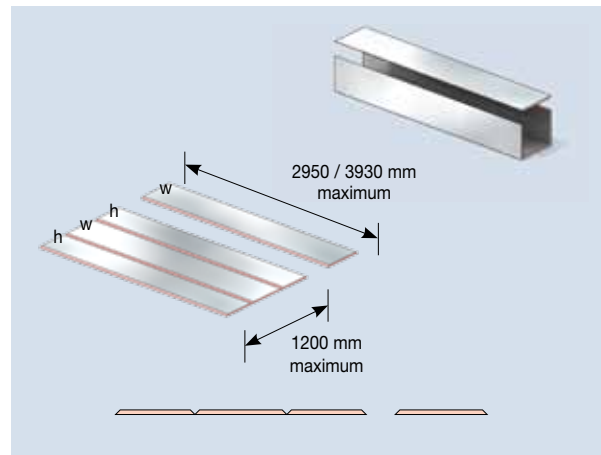


Figure 3B.3 Method 2: Sum of Three Sides ≤ 1020 mm

3B.3.3 Method 3 ($w+h \leq 1080$ mm)

Method 3 is used when the dimensions of a ductwork section are such that the internal lengths of three sides cannot be cut from a single panel, but where only two panels are still required. Two sides are cut from each panel, and the sum of the internal lengths of two sides is ≤ 1080 mm, as a total of one V groove and two single bevelled edges are required (1200–60–30–30 mm).

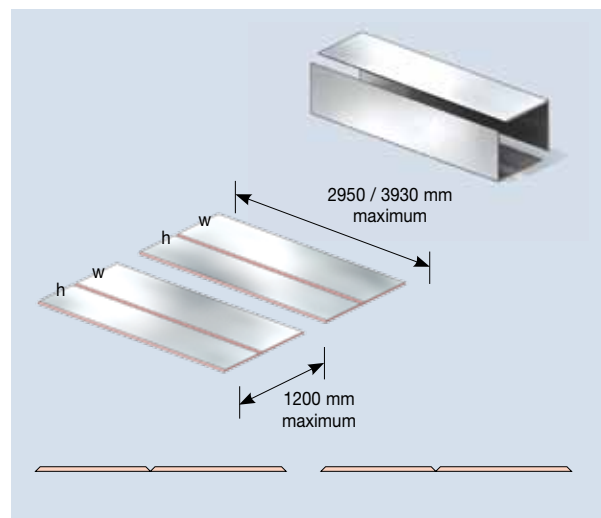


Figure 3B.4 Method 3: $w+h \leq 1080$ mm

3B.3.4 Method 4 ($w \text{ \& } h \leq 1140 \text{ mm}$)

Method 4 is used when the dimensions of a ductwork section are such that the internal lengths of two sides cannot be cut from a single panel, but where all sides can be cut from a separate panel. Thus, both w & h are $\leq 1140 \text{ mm}$, as a total of two single bevelled edges are required (1200–30–30 mm).

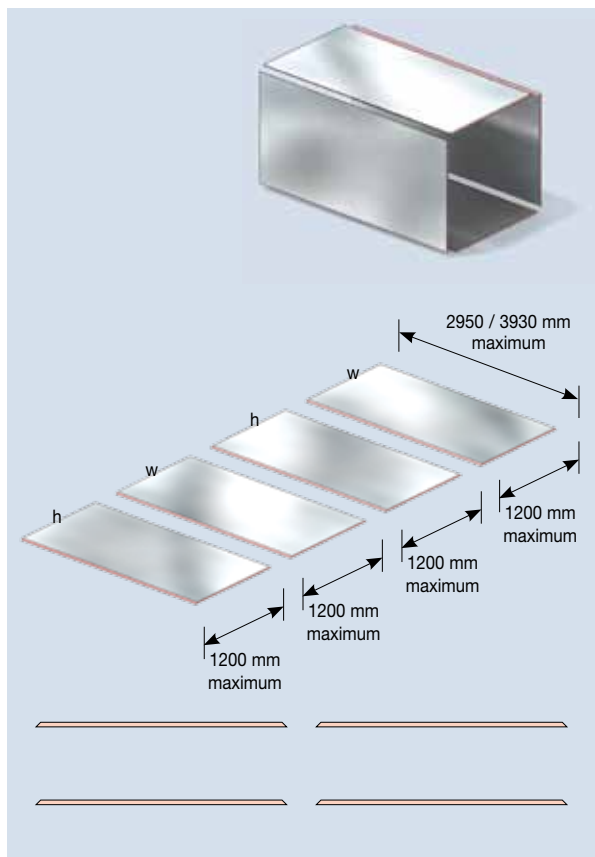


Figure 3B.5 Method 4: $w+h \leq 1140 \text{ mm}$

3B.4 Group 2: w and/or $h > 1140 \text{ mm}$

The choice between methods in Group 2 is determined in largely the same way as with Group 1 – by the cross-sectional dimensions of the ductwork. In addition to the methods below, the multiple duct method (see Section 13) should also be considered and, when the pressure is $> 500 \text{ Pa}$, should be regarded as preferable.

Please note that when a ductwork section's dimensions (w and / or h) are $> 2000 \text{ Pa}$ and a method from Group 2 is to be used then reference should be made to the Kingspan Insulation Technical Service Department (see rear cover) in order to determine the appropriate reinforcement. Alternatively the multiple duct method can be used.

3B.4.1 Method 5 ($w+h+w+h \leq 2710 / 3690 \text{ mm}$)

Method 5 is used when the internal length of any one side is greater than that which can be fabricated from a single panel, orientated with its length parallel to the length of the final ductwork section (1140 mm), but where the internal length of all four sides can be fabricated from a single panel, orientated with its length perpendicular to the length of the final ductwork section. Thus the sum of the internal length of all four sides must be $\leq 2710 / 3690 \text{ mm}$, as a total of three V grooves and two single bevelled edges are required (2950 / 3930–60–60–60–30–30 mm).

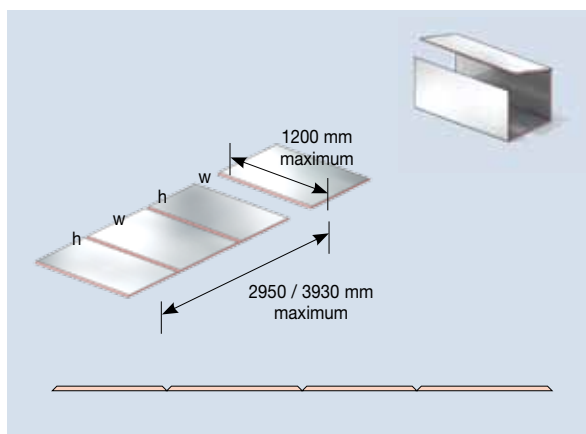


Figure 3B.6 Method 5: $w+h+w+h \leq 2710 / 3690 \text{ mm}$

3B. Straight Ductwork: 30 mm Panel

3B.4.2 Method 6

(Sum of Three Sides $\leq 2770 / 3750$ mm)

Method 6 is used when the dimensions of a ductwork section are such that two panels are required, but where the internal lengths of three sides can be cut from a single panel (to form a U shaped piece), leaving only one side to be cut from another (to form a cover). Thus the sum of the internal lengths of three sides is $\leq 2770 / 3750$ mm, as a total of two V grooves and two individual bevelled edges are required (2950 / 3930–60–60–30–30 mm).

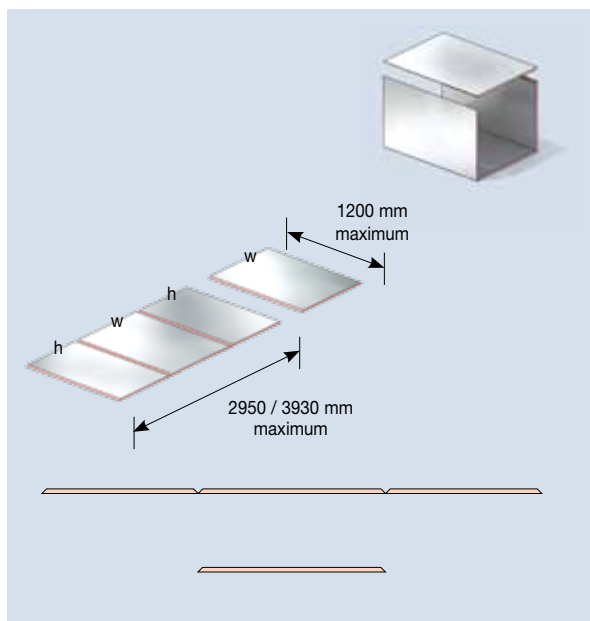


Figure 3B.7 Method 6: Sum of Three Sides $\leq 2770 / 3750$ mm

3B.4.3 Method 7

($w+h \leq 2830 / 3810$ mm)

Method 7 is used when the dimensions of a ductwork section are such that the internal lengths of three sides cannot be fabricated from a single panel but where only two panels are still required. Two sides are cut out of each panel, and the sum of the internal lengths of two sides is $\leq 2830 / 3810$ mm, as a total of one V groove and two bevelled edges are required (2950 / 3930–60–30–30 mm).

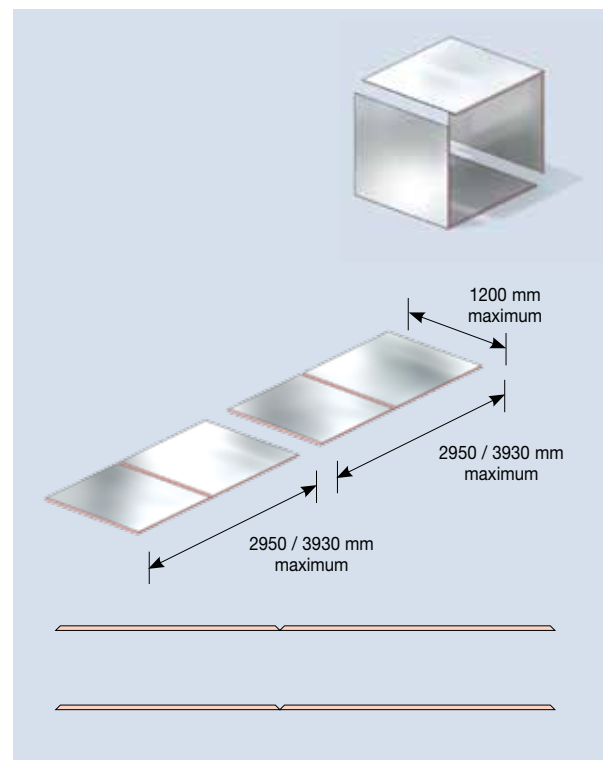


Figure 3B.8 Method 7: Sum of Two Sides $\leq 2830 / 3810$ mm

3B.4.4 Method 8 ($w \text{ \& } h \leq 2890 / 3870 \text{ mm}$)

Method 8 is used when the dimensions of a ductwork section are such that the internal lengths of two sides cannot be cut from a single panel, but where all sides can be cut from a separate panel. Thus, both w & h are $\leq 2890 / 3870 \text{ mm}$, as a total of two single bevelled edges are required ($2950 / 3930-30-30 \text{ mm}$).

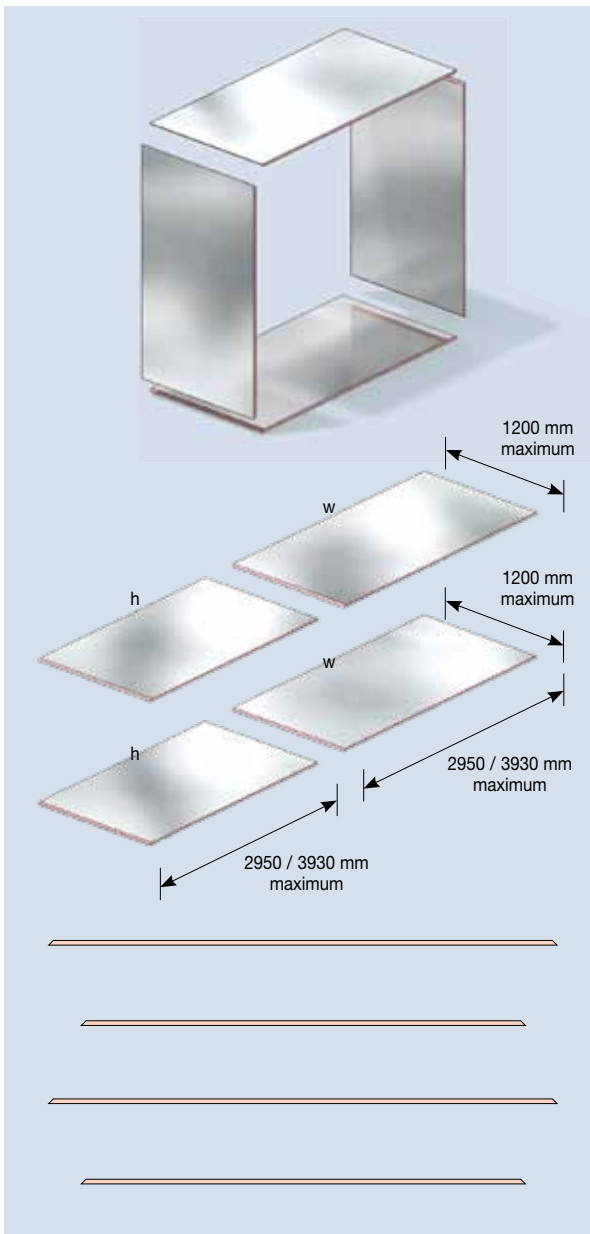


Figure 3B.9 Method 8: $w \text{ \& } h \leq 2890 / 3870 \text{ mm}$

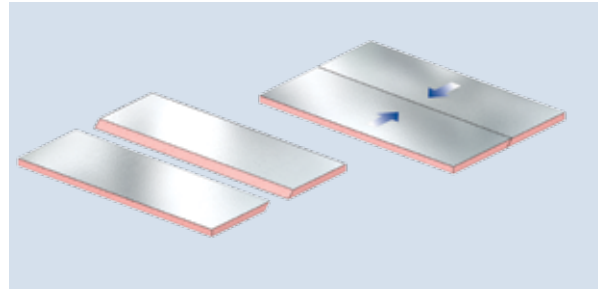


Figure 3B.10 Butted Lateral Bevelled Joint

3C. Straight Ductwork: 42 mm Panel

3C.1 General

Ductwork systems comprise many different kinds of ductwork section, from elbows and offsets to transitions and branches. However, the most common sections, which make up the majority of most systems, are straight. In general, it can be advantageous to design ductwork systems with as much straight ductwork as possible, as not only can straight sections be fabricated with greater ease and speed than other sections, but also, due to their relative simplicity, they should be more air-tight.

3C.2 Straight Ductwork Fabrication

There are eight standard fabrication methods, which can be divided into two groups: Group 1, comprising Methods 1–4; and Group 2, comprising Methods 5–8.

Methods in Group 1 can only be used when both of the ductwork section's cross-sectional dimensions are ≤ 1116 mm. This enables the bevelled edges to be cut along the length of the panel, thus giving a maximum ductwork section length of 2950 mm / 3930 mm – i.e. the length of the panel.

When either w or h is > 1116 mm, a method from Group 2 is used. For these methods, the orientation of the panel is altered and the bevelled edges are cut along its width (i.e. perpendicular to its length). This increases the maximum possible w or h to 2890 / 3870 mm, but restricts the maximum ductwork section length to 1200 mm (i.e. the width of the panel). Table 3C.1 summarises all of the available methods, while Figure 3C.1 provides a method selector. In addition, all eight methods are discussed below in Sections 3C.3 and 3C.4.

Choosing the most appropriate method will minimise both fabrication time and panel wastage.

Group	Method	Side Dimensions (mm)	Max. Length (mm)
1	1	Sum of 4 sides ≤ 864	2950 / 3930
	2	Sum of 3 sides ≤ 948	
	3	Sum of 2 sides ≤ 1032	
	4	Both w & h individually ≤ 1116	
2	5	Sum of 4 sides $\leq 2614 / 3594$	1200
	6	Sum of 3 sides $\leq 2698 / 3678$	
	7	Sum of 2 sides $\leq 2782 / 3762$	
	8	Both w & h individually $\leq 2866 / 3762$	
N/A	Multiple duct	Unlimited (see Section 13)	2950 / 3930

Table 3C.1 Summary of Methods

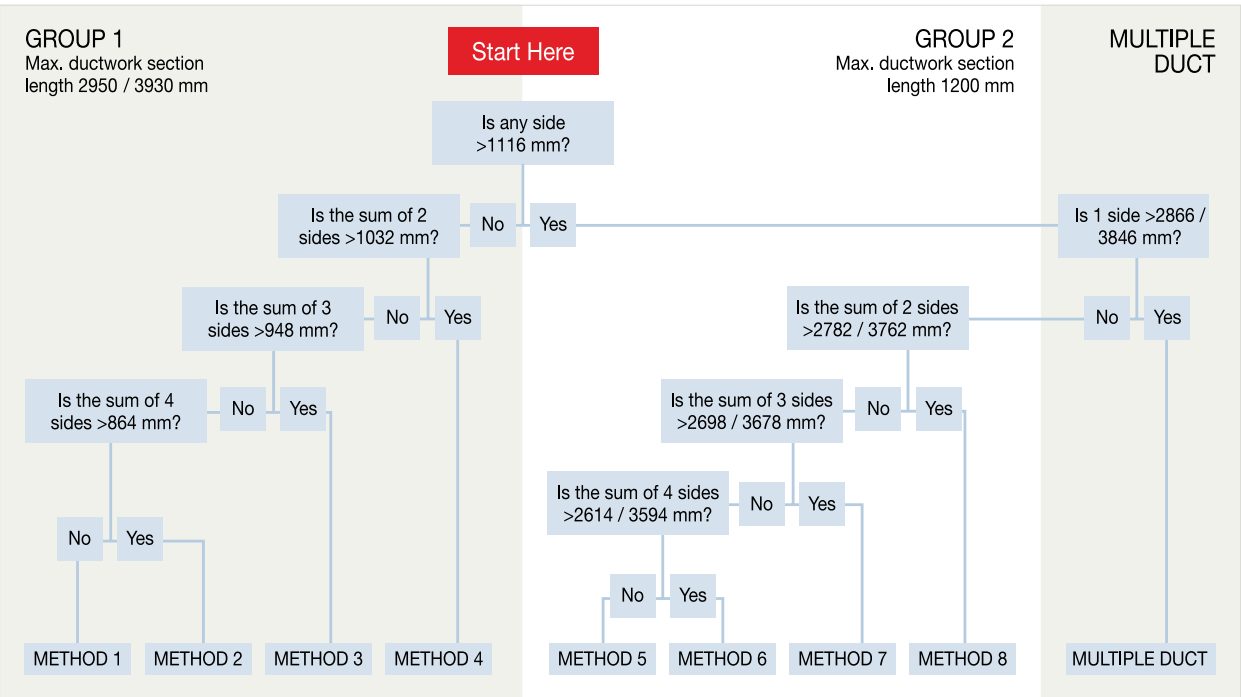


Figure 3C.1 Method Selector

3C.3 Group 1: Both w & $h \leq 1116$ mm

The choice between methods in Group 1 is determined by the precise dimensions of the ductwork section, and therefore the number of panels required in its fabrication. The maximum ductwork section length of all methods is 2950 / 3930 mm.

3C.3.1 Method 1 ($w+h+w+h \leq 864$ mm)

Method 1 is used when the dimensions of a ductwork section are such that it can be fabricated from a single *Kingspan KoolDuct®* panel, orientated along its length. The maximum internal perimeter of a ductwork section fabricated using this method is 864 mm. This figure is derived by subtracting the combined widths of the bevelled edges from the total width of the panel. As every bevelled edge in a straight ductwork section is cut at 45° (to enable a 90° mitre joint) each one will remove 42 mm (from a 42 mm thick panel). The dual angle jack plane, which simultaneously cuts two bevelled edges (to form a V groove) will therefore remove 84 mm from the panel. An entire ductwork section, fabricated from a single panel, requires three V grooves (84+84+84 mm) and two individual bevelled edges (42+42 mm), thus removing 336 mm from the panel, and hence giving a maximum internal perimeter of 864 mm.

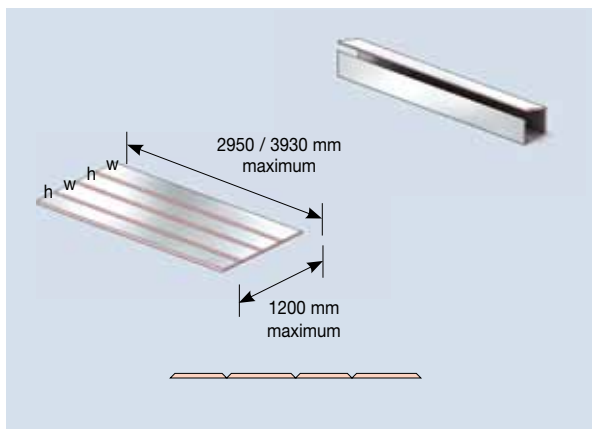


Figure 3C.2 Method 1: $w+h+w+h \leq 864$ mm

3C.3.2 Method 2 (Sum of Three Sides ≤ 948 mm)

Method 2 is used when the dimensions of the a ductwork section are such that two panels are required, but where the internal lengths of three sides can be cut from a single panel (to form a U shaped piece), leaving only one side to be cut from another (to form a cover). Thus, the sum of the internal lengths of three sides is ≤ 948 mm, as a total of two V grooves and two single bevelled edges are required (1200–84–84–42–42 mm).

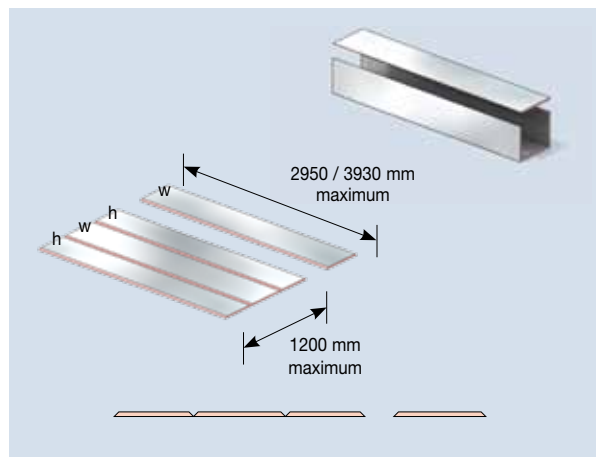


Figure 3C.3 Method 2: Sum of Three Sides ≤ 948 mm

3C.3.3 Method 3 ($w+h \leq 1032$ mm)

Method 3 is used when the dimensions of a ductwork section are such that the internal lengths of three sides cannot be cut from a single panel, but where only two panels are still required. Two sides are cut from each panel, and the sum of the internal lengths of two sides is ≤ 1032 mm, as a total of one V groove and two single bevelled edges are required (1200–84–42–42 mm).

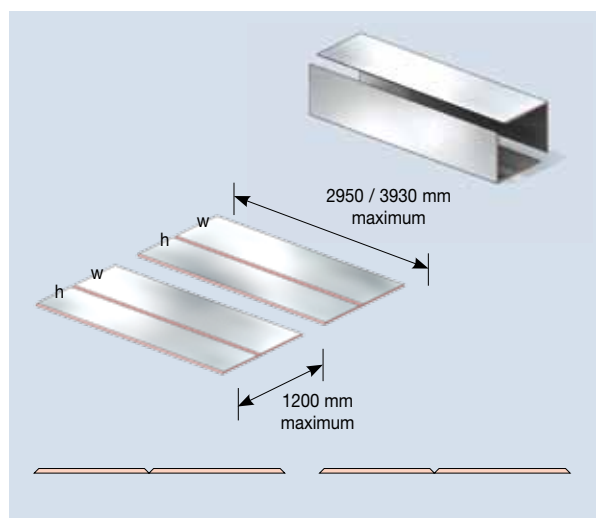


Figure 3C.4 Method 3: $w+h \leq 1032$ mm

3C. Straight Ductwork: 42 mm Panel

3C.3.4 Method 4 ($w \text{ \& } h \leq 1116 \text{ mm}$)

Method 4 is used when the dimensions of a ductwork section are such that the internal lengths of two sides cannot be cut from a single panel, but where all sides can be cut from a separate panel. Thus, both w & h are $\leq 1116 \text{ mm}$, as a total of two single bevelled edges are required (1200–42–42 mm).

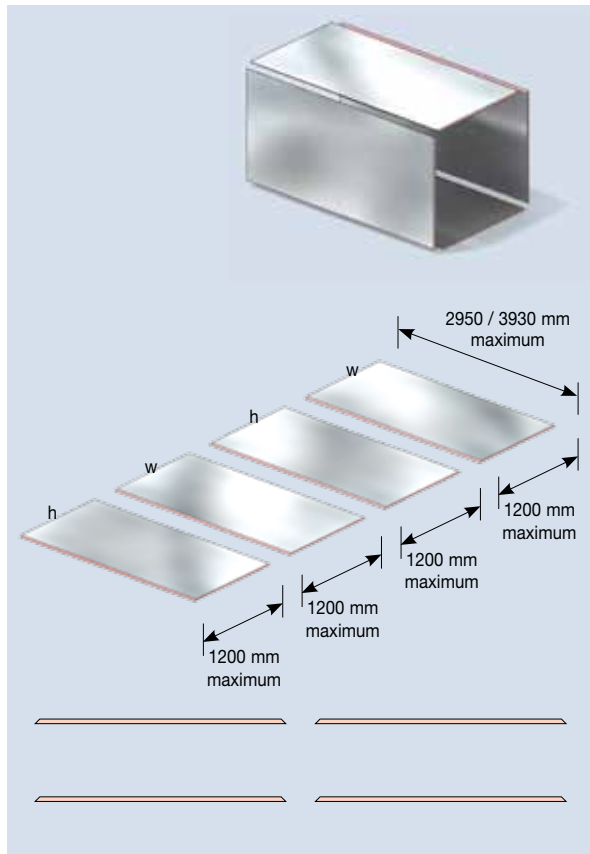


Figure 3C.5 Method 4: $w+h \leq 1116 \text{ mm}$

3C.4 Group 2: w and/or $h > 1116 \text{ mm}$

The choice between methods in Group 2 is determined in largely the same way as with Group 1 – by the cross-sectional dimensions of the ductwork. In addition to the methods below, the multiple duct method (see Section 13) should also be considered and, when the pressure is $> 500 \text{ Pa}$, should be regarded as preferable.

3C.4.1 Method 5 ($w+h+w+h \leq 2614 / 3594 \text{ mm}$)

Method 5 is used when the internal length of any one side is greater than that which can be fabricated from a single panel, orientated with its length parallel to the length of the final ductwork section (1116 mm), but where the internal length of all four sides can be fabricated from a single panel, orientated with its length perpendicular to the length of the final ductwork section. Thus the sum of the internal length of all four sides must be $\leq 2614 / 3594 \text{ mm}$, as a total of three V grooves and two single bevelled edges are required (2950 / 3930–84–84–84–42–42 mm).

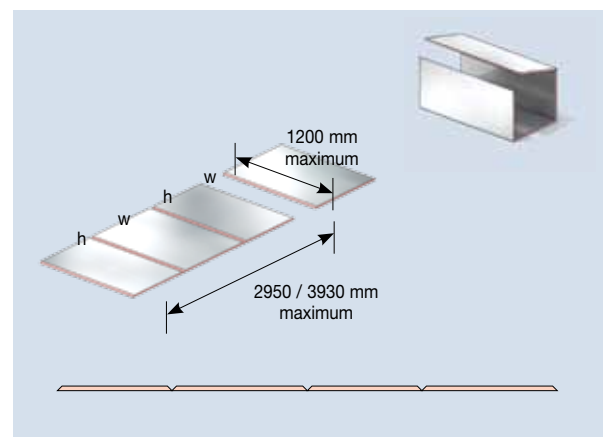


Figure 3C.6 Method 5: $w+h+w+h \leq 2614 / 3594 \text{ mm}$

3C.4.2 Method 6

(Sum of Three Sides $\leq 2698 / 3678$ mm)

Method 6 is used when the dimensions of a ductwork section are such that two panels are required, but where the internal lengths of three sides can be cut from a single panel (to form a U shaped piece), leaving only one side to be cut from another (to form a cover). Thus the sum of the internal lengths of three sides is $\leq 2698 / 3678$ mm, as a total of two V grooves and two individual bevelled edges are required (2950 / 3930–84–84–42–42 mm).

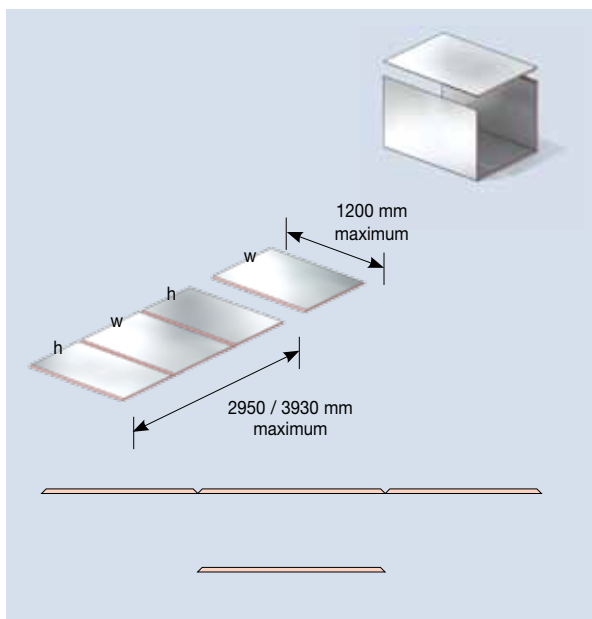


Figure 3C.7 Method 6: Sum of Three Sides $\leq 2698 / 3678$ mm

3C.4.4 Method 7

($w+h \leq 2782 / 3762$ mm)

Method 7 is used when the dimensions of a ductwork section are such that the internal lengths of three sides cannot be fabricated from a single panel but where only two panels are still required. Two sides are cut out of each panel, and the sum of the internal lengths of two sides is $\leq 2782 / 3762$ mm, as a total of one V groove and two bevelled edges are required (2950 / 3930–84–42–42 mm).

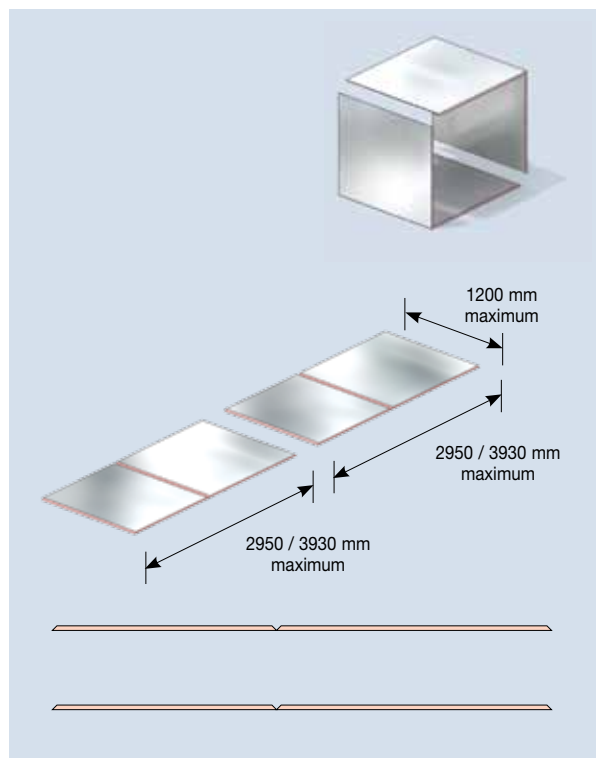


Figure 3C.8 Method 7: Sum of Two Sides $\leq 2782 / 3762$ mm

3C. Straight Ductwork: 42 mm Panel

3C.4.5 Method 8 ($w \text{ \& } h \leq 2866 / 3762 \text{ mm}$)

Method 8 is used when the dimensions of a ductwork section are such that the internal lengths of two sides cannot be cut from a single panel, but where all sides can be cut from a separate panel. Thus, both w & h are $\leq 2866 / 3846 \text{ mm}$, as a total of two single bevelled edges are required ($2950 / 3930 - 42 - 42 \text{ mm}$).

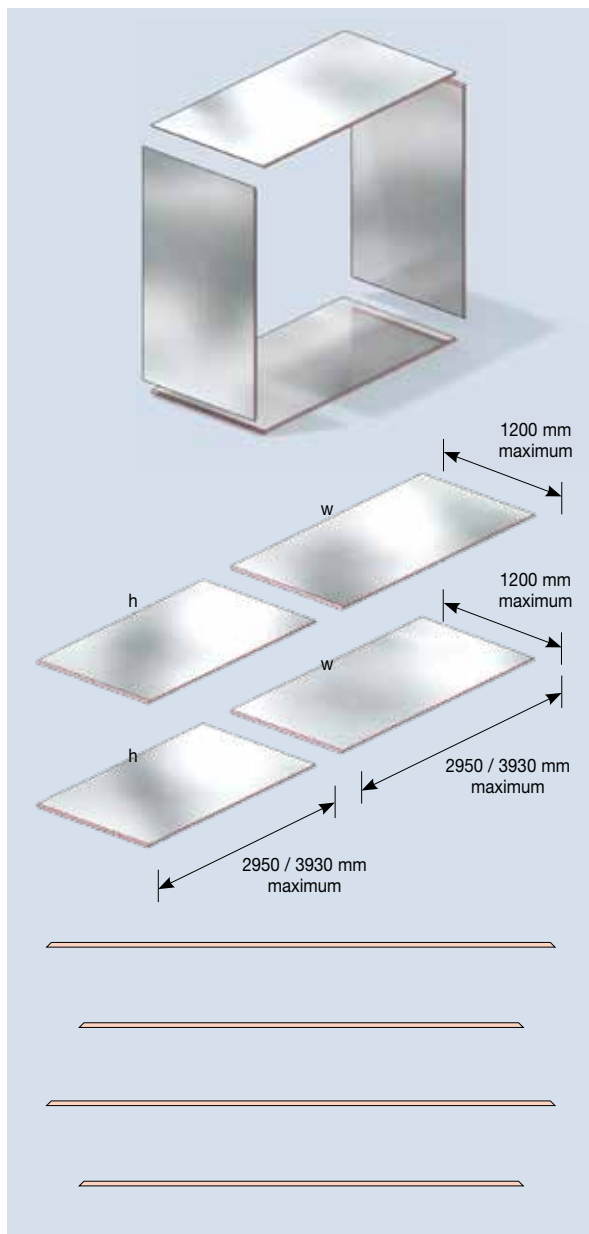


Figure 3C.9 Method 8: $w \text{ \& } h \leq 2866 / 3846 \text{ mm}$

3D Connecting Panels

3D.1 General

When fabricating rectangular ductwork sections, it is acceptable to connect two *Kingspan KoolDuct*® panels together using butted lateral bevel joints (see Figure 3C.10), as long as the limits below are strictly observed. The joint can either be longitudinal (along the length of the ductwork section and parallel to the direction of the air flow) or transverse (along the height or width of the ductwork section and perpendicular to the direction of the air flow), depending on the static pressure to which the ductwork section is to be exposed.

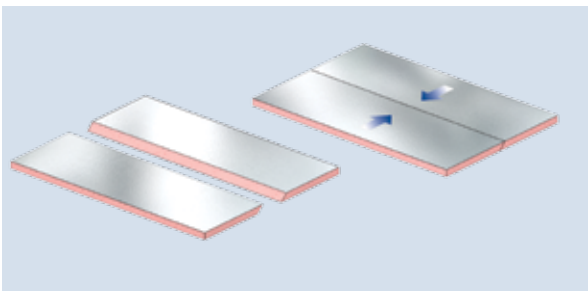


Figure 3D.1 Butted Lateral Bevelled Joint

3D.1.1 Static Pressures ≤ 250 Pa

For static pressures ≤ 250 Pa, it is possible to use either a transverse (see Figure 3C.11) or a longitudinal bevel joint (see Figure 3C.12), with no restriction on joint length. Please note that ductwork sections with a w and/or $h > 1000$ mm may require reinforcement. This should be installed in accordance with the recommendations detailed in Section 9.

3D.1.2 Static Pressures Between 251 & 1000 Pa

For static pressures between 251 and 1000 Pa, only a transverse bevel joint can be used. At these pressures the maximum joint length is limited to 600 mm. Please note that ductwork sections with a w and/or $h > 500$ mm may require reinforcement. This should be installed in accordance with the recommendations detailed in Section 9.

3D Connecting Panels

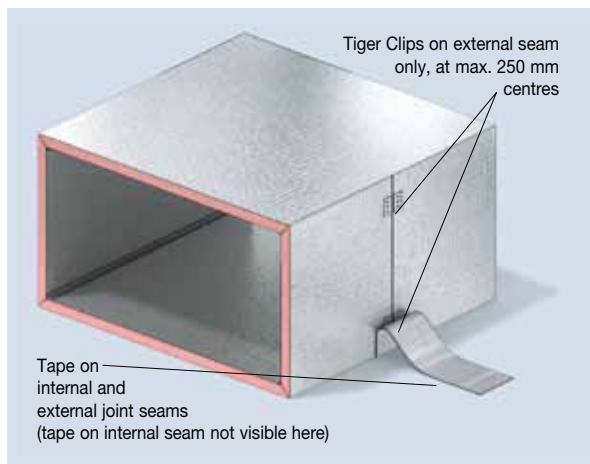


Figure 3D.2 Transverse Bevel Joint

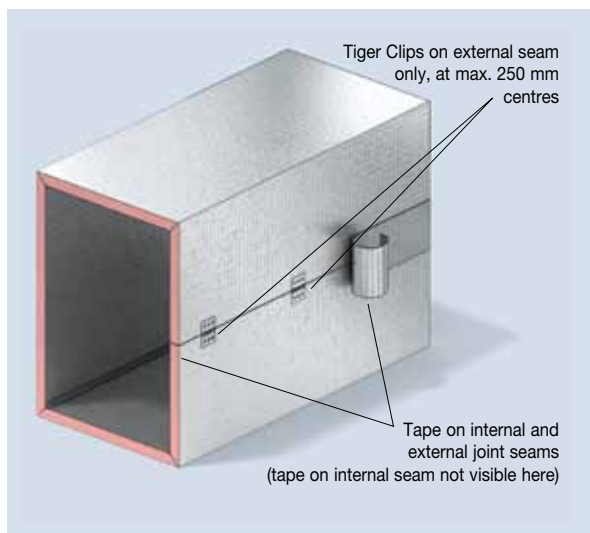


Figure 3D.3 Longitudinal Bevel Joint

3D.1.3 Fabrication Guidance

When fabricating butted lateral bevel joints, the following instructions should be strictly observed:

- the bevelled edges of the two panels to be jointed, should accurately match one another;
- when a transverse butted lateral bevel joint is used, it should be cut such that the bevelled edge on the inside of the ductwork section is pointing in the direction of the air flow (see Figure 3C.13);
- all butted lateral bevel joints should be glued (see Section 2.4.1);
- Tiger Clips should be applied evenly spaced at a maximum of 250 mm centres, all along the external side of the butted lateral bevel joint, to add additional strength; and
- all butted lateral bevel joints should be covered with tape on both sides (see Section 2.5).

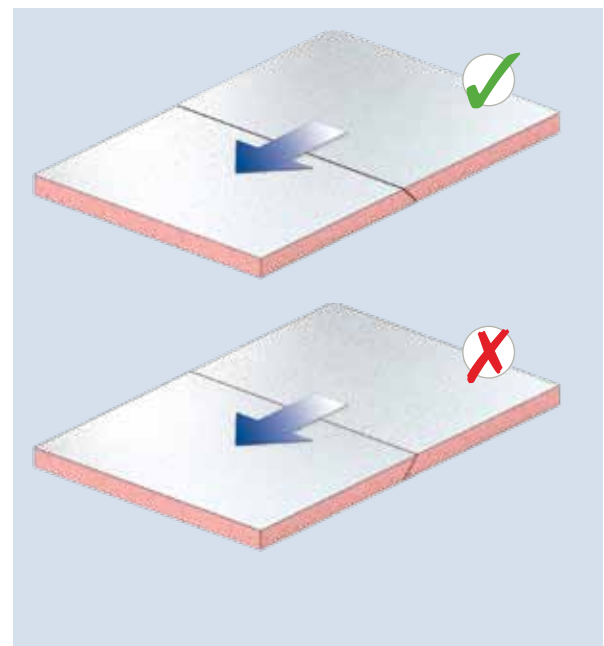


Figure 3D.4 Transverse Butted Lateral Bevel Joints

Please note that when connecting panels, it is critical that the static pressure and ductwork size limitations are strictly observed. When reinforcement is required (see Section 9), extra reinforcement should be installed along the joint in addition to the standard reinforcement. 1 bar should be installed at the same centres as the standard reinforcement; e.g. if the standard reinforcement required is 2 bars at 600 mm centres then 1 bar should be installed at 600 mm centres along the joint. For more information, please contact Kingspan Insulation.

4. Elbows

4.1 General

Elbows or bends are used to change the direction of the airflow in a ductwork system and are one of the most common fittings in ductwork fabricated from The *Kingspan KoolDuct®* System. They can be classified in four ways.

4.1.1 Radius or Square

Firstly, elbows can be classified as 'radius' or 'square'. A radius elbow is one where the air changes direction smoothly along a radial path, thereby minimising both noise and drag. A square bend has no radius and the abrupt change in air direction generally requires the use of turning vanes. Examples of each are shown in Figure 4.1.



Figure 4.1 Radius or Square Elbow

4.1.2 Hard or Easy

Secondly, elbows can be classified as 'hard' or 'easy'. A hard elbow signifies that rotation occurs in the plane of the longer side of the ductwork's cross-section, whereas an easy elbow signifies that rotation occurs in the shorter side of the ductwork's cross-section. When an elbow is orientated in a vertical plane (as illustrated in Figure 4.2) a hard elbow will have $w < h$ and an easy elbow $w > h$.



Figure 4.2 Hard or Easy Elbow

4. Elbows

4.1.3 Symmetric or Asymmetric

Thirdly, elbows can be classified as 'symmetric', or 'asymmetric'. A symmetric elbow has an inlet and an outlet of identical dimensions. Accordingly, the outlet on an asymmetric elbow is not the same size as the inlet. Figure 4.3 shows the difference.

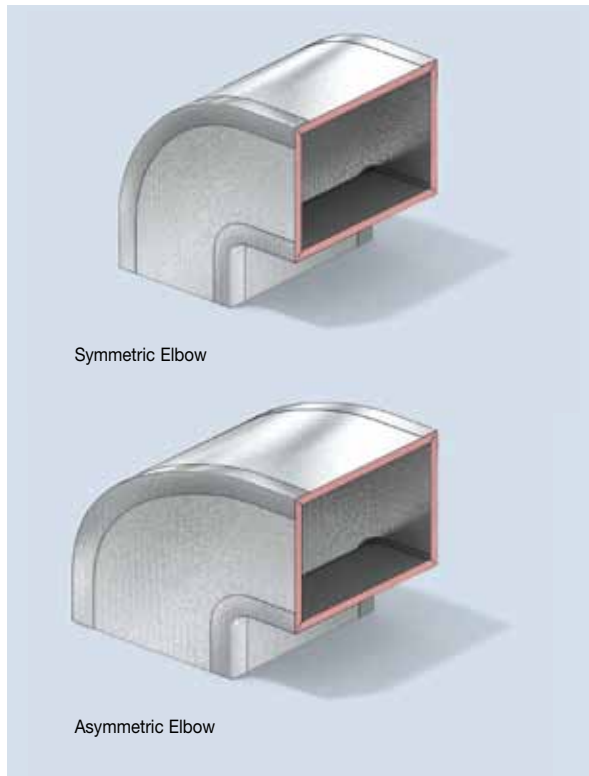


Figure 4.3 Symmetric or Asymmetric Elbow

4.1.4 Long, Medium or Short Radius

Finally, radius elbows can be classified by the size of their internal radius in relation to their width. A long radius elbow has a radius greater than, or equal to, its width. A medium radius elbow has a radius greater than, or equal to, half its width but less than its total width, and a short radius elbow has a radius less than half of its width.

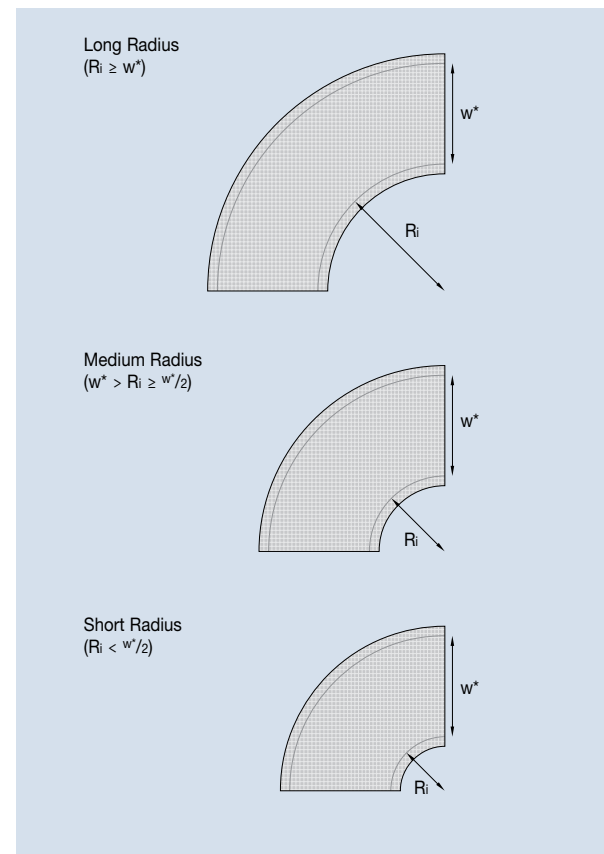


Figure 4.4 Long, Medium or Short Radius Elbow

* or h depending on the orientation of the elbow. For convenience, this manual will assume that w is the length of the elbow in the plane of the bend.

4.2 Elbow Design

When designing an elbow, to be fabricated from The *Kingspan KoolDuct®* System, it is essential to observe the following:

- the standard length of any neck should be ≥ 100 mm;
- for radius elbows the internal radius (R_i) should be ≥ 200 mm; and
- for radius elbows, the distances between the creases on the inner and outer strips should be ≥ 75 mm for 22 mm thick panels and ≥ 100 for 30 mm thick panels.

Because thicker panels are much more difficult to bend with the bending machine, alternative elbow design should be considered for the 42 and 45mm thick panels (e.g. square elbows instead of radius elbows).

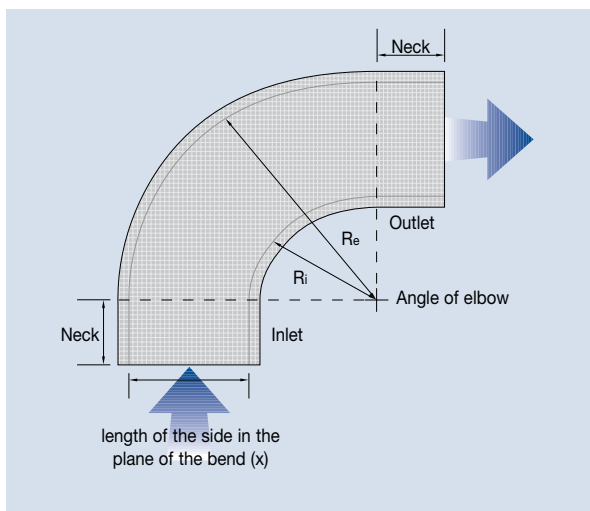


Figure 4.5 Dimensions of an Elbow

In order to properly construct an elbow, the following information should ideally be supplied:

- dimensions of the inlet (w & h);
- dimensions of the outlet (w & h);
- lengths of the outlet and inlet dimensions in the plane of the bend;
- internal (R_i) or external (R_e) radius (radius elbows only); and
- lengths of inlet and outlet neck.

4.3 Elbow Fabrication

The precise method of fabrication is dependent on whether the elbow is radius or square.

4.3.1 Radius Elbows

Radius elbows are typically fabricated from four separate pieces of *Kingspan KoolDuct®* panel: the two sides, and the inner and outer strips (see Figure 4.6). The fabrication procedure follows that detailed in Section 2, with the addition of the bending process for the inner and outer strips.

Please note that some radius elbows require the installation of splitters (see Section 4.4).

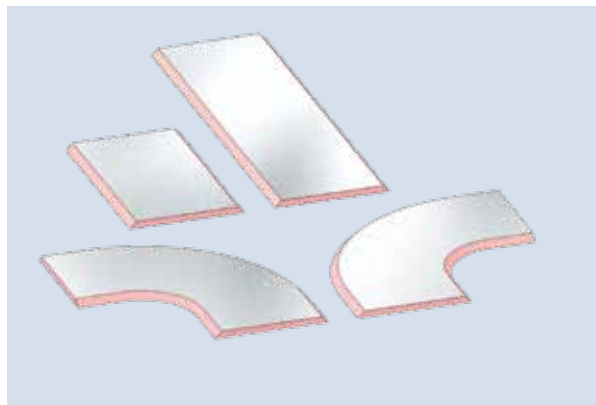


Figure 4.6 Components of a Radius Elbow

4.3.1.1 Tracing & Cutting

As with all ductwork components, tracing and measuring is performed on the internal surface of the ductwork section. For some common radius elbows, special templates can be made available to speed up the measuring process (see Figure 4.7). Once one side of an elbow has been traced, it can be cut out using small jack planes with a 45° angle (such as those supplied in The *Kingspan KoolDuct®* System Tool Box), and, by turning it upside down, used as a template to trace the second side.



Figure 4.7 Elbow Template

4. Elbows

The lengths of the inner and outer strips can be obtained by bending a folding ruler (such as that supplied in The *Kingspan KoolDuct® System* Tool Box) along the curved perimeter of the sides. A nominal amount should be added to compensate for the subsequent creasing process. Any excess length can be trimmed off following complete assembly.

4.3.1.2 Bending

Parallel lines or dots are marked on the inner and outer strips, in preparation for creasing on the manual bending machine. The bending of the inner strip is performed by creasing its external surface, and the bending of the outer strip is performed by creasing its internal surface. Please note that the bending process can also be achieved using an automatic bending machine. For details of the manufacturers of such machines, please see Appendix A.

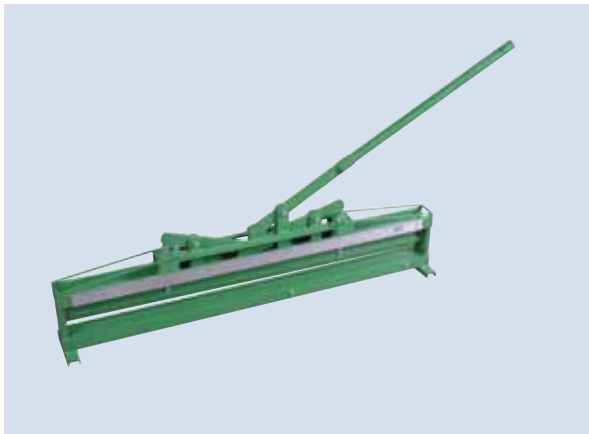


Figure 4.8 Manual Bending Machine

4.3.1.3 Assembly

The assembly process begins by placing one side onto a flat surface. The outer strip is then attached to it, starting at the end of one of the necks. Care should be taken to ensure that the internal aluminium foil edges of the two pieces are properly aligned. Next, the other side is attached to the outer strip in the same manner as the first. Then, the inner strip is fitted to both sides from the same end as the outer strip.

Finally, a rigid spatula should be used to firmly press along the outside of the edges of the elbow to ensure maximum adhesion in the joints. The procedure is shown in Figure 4.9.

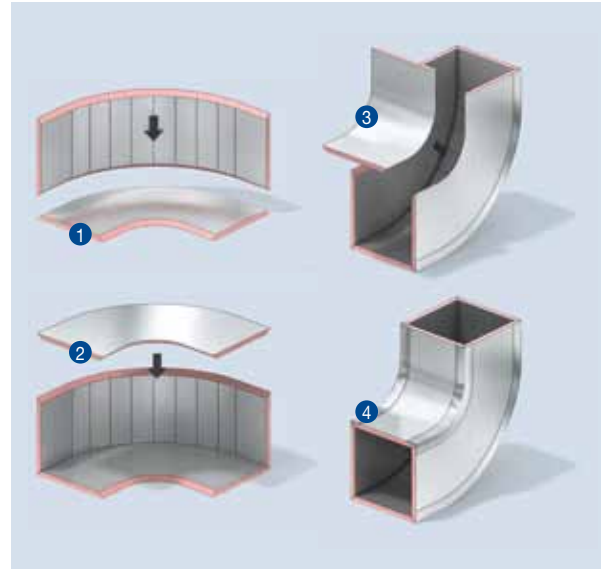


Figure 4.9 Radius Elbow Fabrication Procedure

Adhesive or Tiger Clips can be used in accordance with the instructions detailed in Section 2.4.

4.3.1.4 Taping, Sealing & Reinforcement

The taping, sealing & reinforcement process is as described in Sections 2.5 and 2.7. Please note that the tape is always applied first to the inner and outer creased strips, rather than the elbow's flat sides. As the surface to be taped is curved, the edge of the tape to be folded over is slit intermittently in order to prevent wrinkling, the entrapment of air and a poor application as a result.

4.3.2 Square Elbows

Square elbows are typically fabricated from four pieces.

The fabrication procedure follows that detailed in Section 2.

Please note that most square elbows require the installation of turning vanes (see Section 4.5).

4.4 Splitters in Radius Elbows

Splitters are used in radius elbows, when necessary, in order to reduce turbulence in the airstream and the associated pressure drop.

4.4.1 Splitter Design

Splitters are required in all short radius elbows (see Section 4.1.4), with an angle $\geq 45^\circ$ (see Section 4.2) and the length of the side in the plane of the bend ≥ 500 mm.

The ends of splitters should stop 25 mm short of the opening at either end of the elbow.

The number and placement of splitters is dependent on the length of the side in the plane of the bend (w^*) of the elbow, and is shown in Table 4.1 and Figure 4.10, both of which are based on the requirements of B&ES (HVCA) DW/144.

* or h depending on the orientation of the elbow. For convenience, this manual will assume that w is the length of the elbow in the plane of the bend.

Please note that the number and spacing of splitters can also be determined in accordance with Chart 4-1 in SMACNA (Sheet Metal & Air Conditioning Contractors' National Association) HVAC Duct Construction Standards: Sheet Metal and Flexible.

Width (mm)	No. of Splitters	Splitter Position		
		A	B	C
0-499	0	—	—	—
500-800	1	$w/3$	—	—
801-1600	2	$w/4$	$w/2$	—
1601-2000	3	$w/8$	$w/3$	$w/2$

Table 4.1 Splitter Placement (Short Radius Elbows)

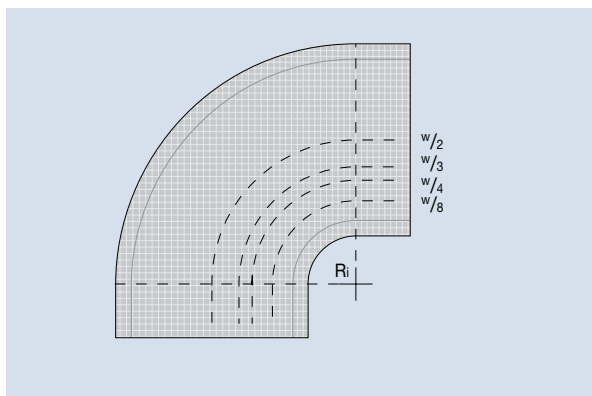


Figure 4.10 Splitter Placement for Short Radius Elbows

4.4.2 Splitter Fabrication

Splitters are fabricated from *Kingspan KoolDuct*® panels. Splitters are bent in the same manner as described for elbow covers, in Section 4.3.1.2. The front end of the splitter (that which faces the inlet) is cut in a 'V' shaped manner, in order to ensure minimal disruption to the airstream. This is best achieved by using a small jack plane with a 45° angle (such as that supplied in The *Kingspan KoolDuct*® System Tool Box) on both sides of the panel, to cut a 'V' shaped protrusion in the manner shown in Figure 4.11. Prior to installation, all exposed insulation should be covered with tape.

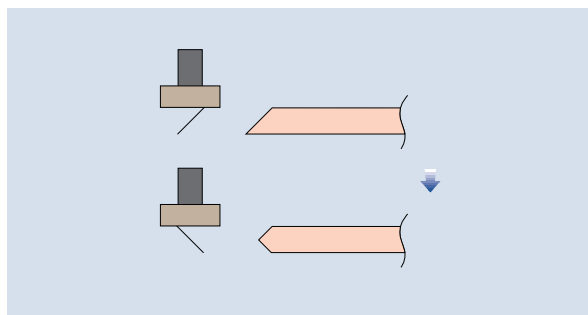


Figure 4.11 Splitter Fabrication

The splitters are then attached in position with adhesive or Tiger Clips, perpendicular to the two sides of the elbow, as shown in Figure 4.12, and a generous and continuous bead of silicone sealant is applied to all corners, formed by the intersection of the splitter and the sides of the elbow.

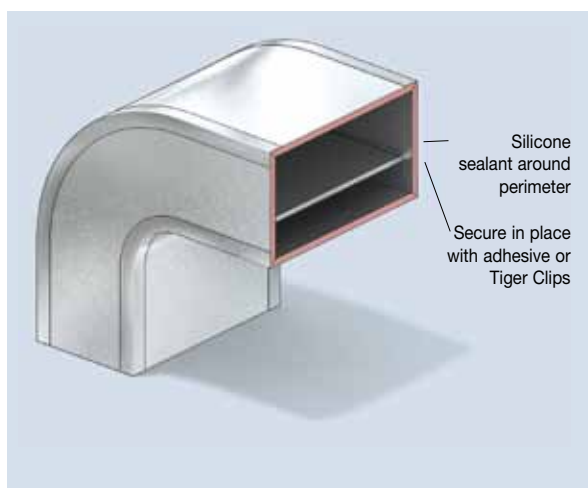


Figure 4.12 Splitter Installation

4. Elbows

4.5 Turning Vanes in Square Elbows

Turning vanes are required in square elbows with dimensions (w and/or h) > 200 mm. It is recommended that aerodynamically designed metal turning vanes, also known as 'double skin' turning vanes, are used.

4.5.1 Turning Vane Installation

The method of turning vane installation is dependent on both the dimensions of the square elbow and the static pressure to which it is to be exposed.

4.5.1.1 Method 1: Small, Low Pressure Elbows

For square elbows with both dimensions (w and h) ≤ 600 mm and exposed to static pressures of ≤ 500 Pa, only silicone sealant is required. In these instances a generous and continuous bead of silicone sealant is applied around the perimeter of the turning vane track to secure the assembly to the ductwork.

4.5.1.2 Method 2: Larger or Higher Pressure Elbows

For square elbows with one or both dimensions (w and/or h) > 600 mm and/or exposed to static pressures of > 500 Pa, mechanical fixings (comprising either inner reinforcing bars, reinforcing discs and speed clips, or metal strips and rivets / screws) are required in addition to silicone sealant. These are installed as illustrated in Figure 4.13 and Figure 4.14.

Please note that turning vanes are not a substitute for proper reinforcement. Square elbows should be reinforced in the same manner as any other ductwork section, as detailed in Section 9.

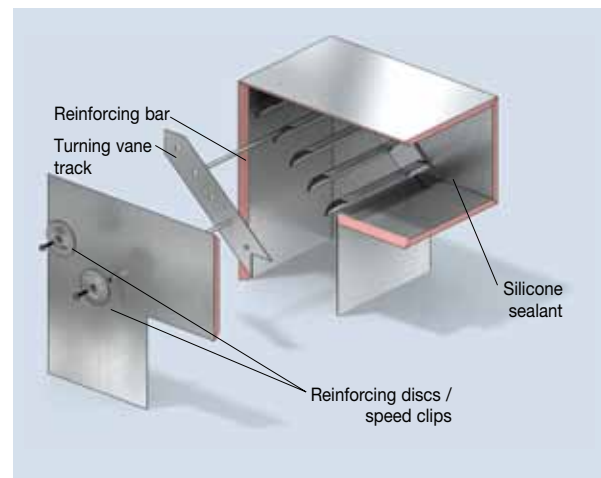


Figure 4.13 Turning Vane Installation – Reinforcing Bar System

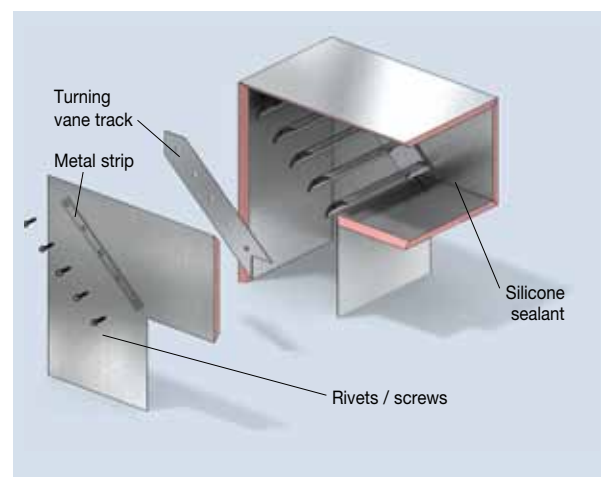


Figure 4.14 Turning Vane Installation – Aluminium Strips

5. Transitions

5.1 General

Transitions, or reducers as they are sometimes known, are used to change the cross-sectional dimensions of the ductwork system and can be classified as either eccentric or concentric.

Eccentric transitions have a taper on one side of the ductwork section, whereas concentric transitions have a taper on both sides, thus maintaining the centre line in both cross-sections. Both are shown in Figure 5.1.

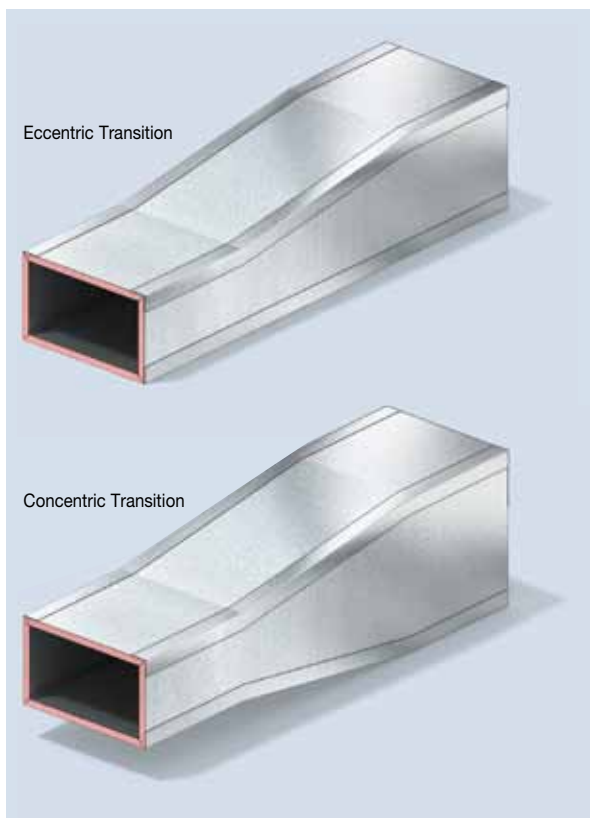


Figure 5.1 Eccentric or Concentric Transitions

5.2 Transition Design

Abrupt changes in cross-sectional area can induce turbulence and therefore increase friction loss and noise. A well designed transition will have:

- a taper angle $\leq 22.5^\circ$ (it may sometimes be necessary to design a transition with a taper angle $> 22.5^\circ$ – such instances require the use of splitters and are discussed in Section 5.4); and
- a neck length ≥ 100 mm, both before and after the taper.

5. Transitions

5.3 Transition Fabrication

Most transitions are fabricated using four separate pieces of *Kingspan KoolDuct*® panel, as shown in Figure 5.2. Please note that it is sometimes possible to fabricate eccentric transitions from as few as two pieces, resulting in improved structural rigidity and reduced fabrication time. This is generally accomplished by forming the two sides and the base from a single piece.

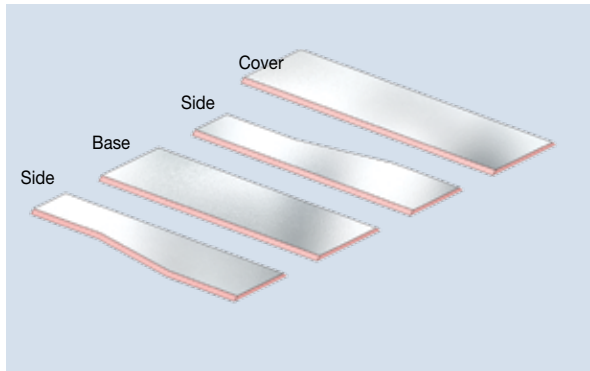


Figure 5.2 Components of a Transition

5.3.1 Tracing & Cutting

The tracing and cutting procedure is similar to that discussed in Section 4.3.1. As with elbows, once the first side has been marked and cut, it can be turned over and used as a template for the second.

5.3.2 Bending

The bending process is very similar to that discussed in Section 4.3.1.2. Please note that the parallel lines or dots should be marked on the cover for eccentric transitions, and on both cover and base for concentric transitions, in preparation for creasing or the manual bending machine. Each bend can be created with one crease and, depending on the direction, is performed on either the internal or external face of the base or cover.

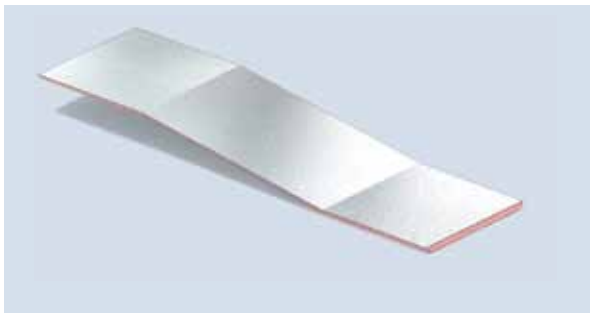


Figure 5.3 Transition Cover

5.3.3 Assembly

The assembly process is as previously described in Section 4.3.1.3.

5.3.4 Taping, Sealing & Reinforcement

The taping, sealing and reinforcement process is as previously described in Section 4.3.1.4.

5.4 Splitters in Transitions

Whilst a gentle taper is preferable in the interests of aerodynamics, a more abrupt taper is sometimes unavoidable. Transitions which have a taper angle $> 22.5^\circ$ require the addition of splitters.

5.4.1 Splitter Design

Splitters in transitions are always spaced proportionally, as illustrated in Figure 5.4.

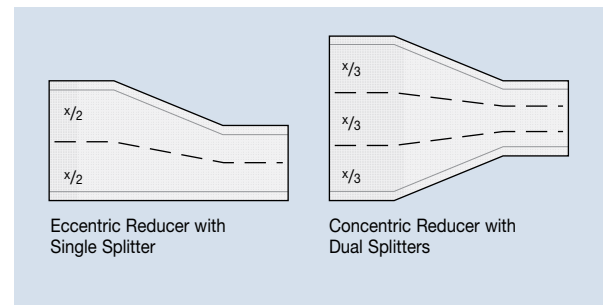


Figure 5.4 Splitter Placement

The ends of splitters should stop 25 mm short of the opening at either end of the transition.

5.4.2 Splitter Fabrication

Splitters are fabricated from *Kingspan KoolDuct*® panels. Splitters are bent in the same manner as described for transition covers, in Section 5.3.2. The front end of the splitter (that which faces the inlet) is cut in a 'V' shaped manner, in order to ensure minimal disruption to the airstream. This is best achieved by using a small jack plane with a 45° angle (such as that supplied in The *Kingspan KoolDuct*® System Tool Box) on both sides of the panel, to cut a 'V' shaped protrusion in the manner shown in Figure 4.11. Prior to installation, all exposed insulation should be fully covered with tape.

6. Offsets & Easements

6.1 General

Offsets are frequently required in order to either design ductwork around fixed obstructions, or, to connect differently aligned ductwork sections. Offsets can be classified as either angled, radius or mitred.

Angled offsets are those where the dimension in which the offset is taking place (w or h) is reduced slightly at the beginning of the offset and restored at its completion.

Mitred and radius offsets are those in which the cross-sectional dimensions of the ductwork are maintained throughout the length of the offset.

6.2 Offset Design

The same general design rules apply to all offsets. However, the specific details vary between types.

6.2.1 Angled Offsets

With angled offsets:

- the cover and base of the offset should have one crease per bend (performed using the manual bending machine);
- necks should be ≥ 100 mm in length;
- the maximum recommended angle of inclination should be 15° due to aerodynamic considerations;
- the diagonal should therefore be $\geq 3.87 \times$ the length of the offset depth; and
- splitters and reinforcement should be installed as required.

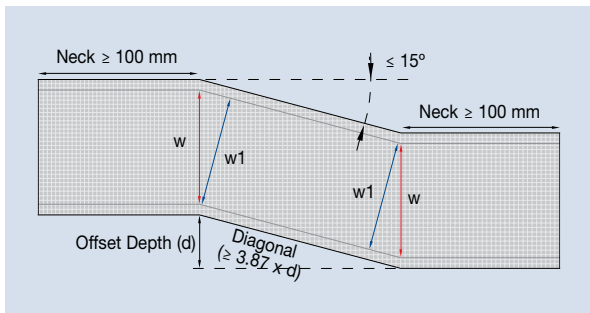


Figure 6.1 Angled Offsets

6.2.2 Mitred Offsets

With mitred offsets:

- the cover and base of the offset should have one crease per bend (performed using the manual bending machine);
- necks should be ≥ 100 mm in length;
- the maximum recommended angle of inclination should be 30° due to aerodynamic considerations;
- the diagonal should therefore be $\geq 2 \times$ the length of the offset depth; and
- splitters and reinforcement should be installed as required.

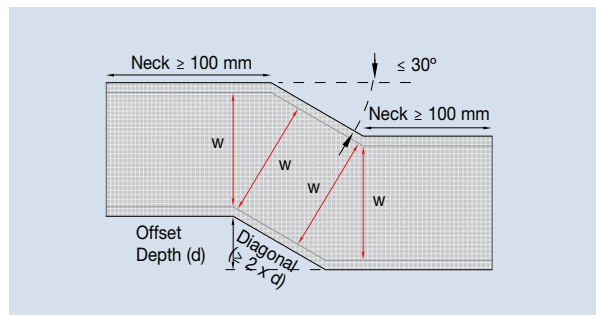


Figure 6.2 Mitred Offsets

6.2.3 Radius Offsets

With radius offsets:

- the cover and base of the offset should have at least one crease per bend (performed using the manual bending machine);
- necks should be ≥ 100 mm in length;
- the maximum recommended angle of inclination should be 30° due to aerodynamic considerations;
- the radius of the offset should be ≥ 200 mm; and
- splitters and reinforcement should be installed as required.

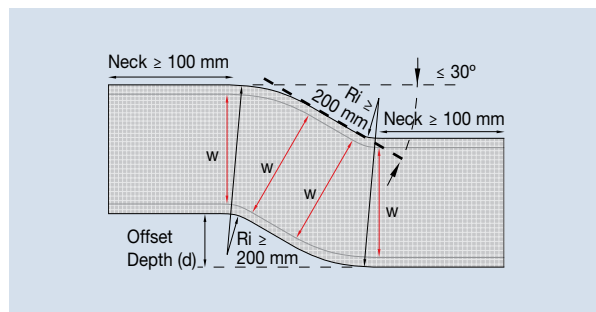


Figure 6.3 Radius Offsets

6. Offsets & Easements

6.3 Offset Fabrication

Like elbows and transitions, all offsets are typically fabricated using four separate pieces of *Kingspan KoolDuct*® panel. The fabrication procedure follows that detailed in Sections 4.3 and 5.3.

6.4 Easements

Easements are required within ductwork systems to encase obstacles, which cannot be avoided using offsets. Their accommodation may necessitate altering the dimensions and shape of the ductwork section in which they are found.

Designers should seek to avoid locating pipes, electrical conduits, structural members and other obstacles inside ductwork and, where possible, offsets should be used. However, in cases where this is unavoidable, the following rules should be adhered to:

- any pipe, or other obstruction, passing through a ductwork section should be encased in an easement, in order to ensure minimum disruption to the airstream;
- where the area of the obstruction reduces the cross-sectional area of the ductwork section by > 20%, the shape of the section should be modified accordingly in order to maintain the original cross-sectional area (see Figure 6.4); and

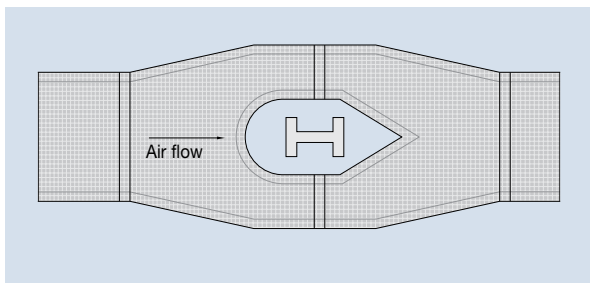


Figure 6.4 Accommodating Easements with Ductwork Sections

- when a section is transformed in order to accommodate an obstruction, the rules governing the maximum angles of the taper for a transition discussed in Section 5.1 are still applicable.

7. Branches

7.1 General

Branches or take-offs are used to convey air from one part of a ductwork system to another and connect the main duct to the air-distribution points. They can be classified in a number of ways.

7.1.1 Rectangular or Circular

Branches can be classified as either rectangular or circular.

Rectangular branches are fabricated from The *Kingspan*

KoolDuct® System. Circular branches are generally only used at the distribution points of a ductwork system, in order to connect it to components such as plenum boxes (which are usually supplied with a round fitting). As circular ductwork sections are not fabricated from The *Kingspan* **KoolDuct® System**, only their connection is dealt with below.

7.1.2 Static or Dynamic

Branches can also be classified as either static or dynamic.

A static branch is designed such that air will be directed into it by the 'static' pressure in the supply duct. Static pressure is the pressure of the airstream at a particular point regardless of its motion, and can be thought of simply as the pressure of the air on the ductwork section's walls. A high static pressure will obviously direct more air into a static branch than a low static pressure. There are three types of static branch, as illustrated below.

In general, as a result of the abrupt change in direction, a straight branch can induce severe turbulence, which can contribute to increased pressure loss and noise. However, the inherent design of angle branches and boot branches make them far more adept at reducing localised friction losses, and they are therefore preferable.

A dynamic branch is designed such that air will be directed into it by the 'dynamic' pressure in the supply duct. Dynamic pressure (or velocity pressure as it is sometimes known) is the pressure of the airstream in motion and is a function of both its velocity and density. In a dynamic branch the ductwork divides into two or three parts, and it is the motion of the airstream that causes a portion of it to enter into the branch.

See Figure 7.1.

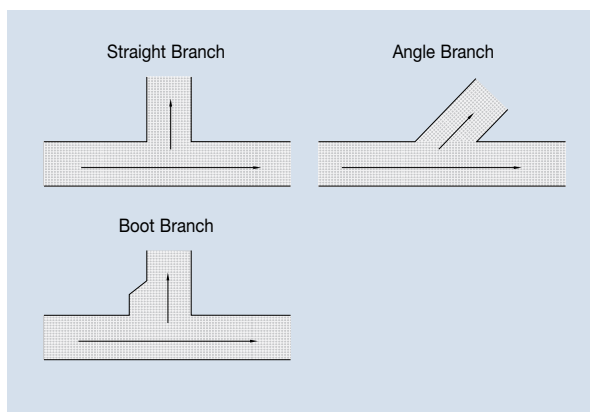


Figure 7.1 Types of Static Branches

7. Branches

7.2 Boot Branch Design

When designing a boot branch, to be fabricated from The *Kingspan KoolDuct® System*, it is essential to observe the following:

- the cover should have one mitre cut per bend;
- the taper angle should be $\leq 45^\circ$;
- the neck on the larger end of the boot branch should be ≥ 50 mm in length if a flanged connection is used (there may be no neck if an un-flanged connection is used);
- the neck on the smaller end of the boot branch should be ≥ 100 mm in length; and
- the larger end of the boot branch should be sized in accordance with relevant guidance (see Figure 7.2).

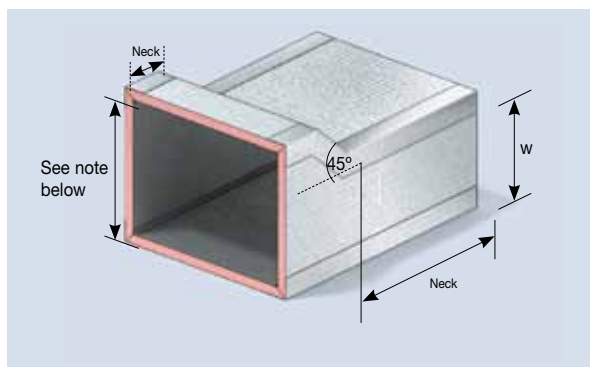


Figure 7.2 Boot Branch Design

NB SMACNA recommends that this dimension be $5/4w$ and 100 mm minimum. B&ES. DW/144 recommends that this dimension be $4/3w$ to $5/4w$ depending on the size of the duct.

7.3 Boot Branch Fabrication

Boot branches are typically fabricated in the same manner as that discussed for elbows, transitions and offsets (see Sections 4.3 and 5.3). Please note that the 45° angle necessitates the use of the 22.5° jack plane. The first mitre is cut on the external surface of the cover, whilst the second is cut on the internal surface (see Figure 7.3). Angles $< 45^\circ$ will require the use of the universal jack plane which has a variable blade angle. In general, a taper angle of x° will require a jack plane angle of $x^\circ/2$.

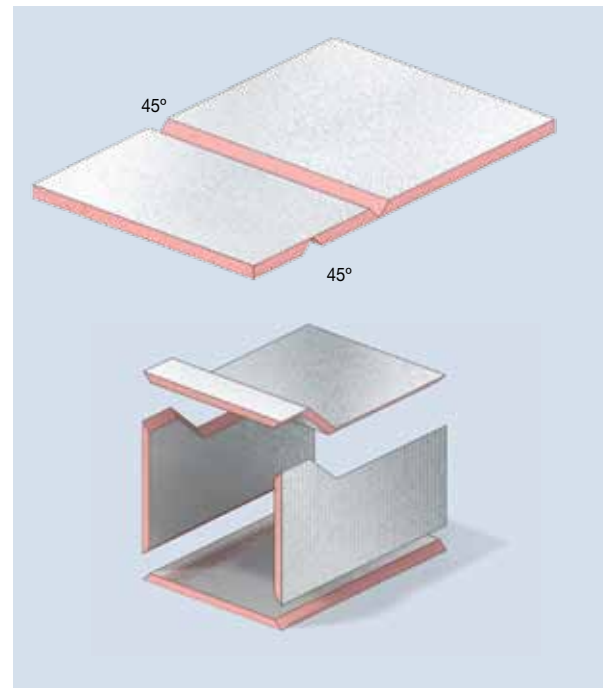


Figure 7.3 Boot Branch Fabrication

7.4 Boot Branch Attachment

There are three methods of attaching a boot branch to supply ductwork, the choice of which is dependent on its size and pressure. Regardless of which method is used, support on the branch duct is positioned as close as possible to its connection to the supply duct. Please note that if heavy diffusers, grills or dampers are to be installed in the branch duct, then, Method 2: Flanged Connections' is always used, and the load of such accessories on the ductwork is neutralised by additional support.

7.4.1 Method 1: Un-flanged Connections

When the larger end of a boot branch has dimensions (w and h) ≤ 600 mm, the whole branch comprises a single ductwork section (i.e. is max. 2950 / 3930 mm in length), and the static pressure is limited to 500 Pa max., it can be attached without the need for a flanged connection. When using this method, it is critical that these static pressure and size limitations are strictly observed.

There are two variations, the first, which uses a butted mitre joint, and a second, which uses a butted square end joint.

7.4.1.1 Method 1a: Butted Mitre Joint Connection

This is the preferred method of un-flanged connection. Both the boot branch and the supply duct are cut with complimentary bevelled edges, using the appropriate 45° small jack plane. Both bevelled edges are glued, allowed to cure, and brought together as shown in Figure 7.4. Finally, a generous and continuous bead of silicone sealant is applied around the external seam of the joint, and tape applied around the internal seam, such that there is no exposed insulation.

Please note that Tiger Clips can be used in place of adhesive. These are fitted on the internal side of the joint to secure the bevelled edges together, and then covered with tape such that it seals both the Tiger Clips and the insulation.

The number of Tiger Clips required per side is detailed in Table 7.1. The Tiger Clips are evenly spaced around the perimeter of the opening, whilst respecting the required number of Tiger Clips per side.

Opening w or h (mm)	No. Tiger Clips per Side
100–150	1
151–300	2
301–500	3
501–600	4

Table 7.1 Tiger Clip Placement

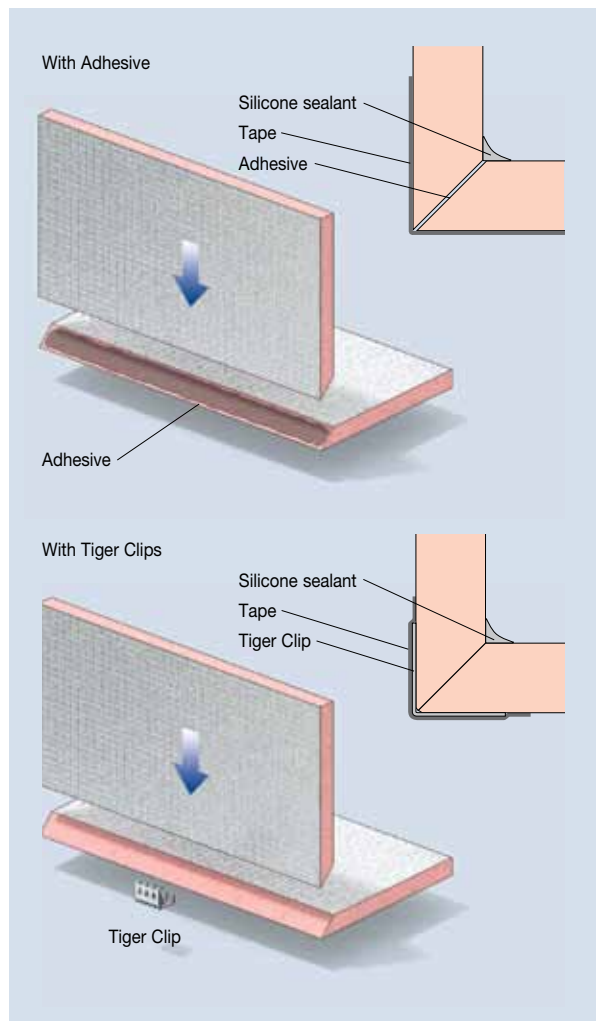


Figure 7.4 Method 1a: Butted Mitre Joint Connection

7.4.1.2 Method 1b: Butted Square End Joint Connection

First, both the boot branch and the supply duct are cut with complimentary straight edges, using the 90° small jack plane. Next, the exposed insulation on both the boot branch and the supply duct are covered with tape. A generous amount of silicone sealant is applied to the cut and taped straight edges of the boot branch, and Tiger Clips, bent through 90°, are fitted to the external side of the boot branch, such that the protruding base plates of the Tiger Clips are parallel to, and flush with, the taped face of the boot branch opening.

7. Branches

The number of Tiger Clips required per side is detailed in Table 7.1. The Tiger Clips are evenly spaced around the perimeter of the opening, whilst respecting the required number of Tiger Clips per side.

The boot branch is then aligned with the opening in the supply duct and pressed into place such that the teeth on the protruding Tiger Clip base plates, penetrate the insulation panel around the opening in the supply duct, and both taped edges fully contact the silicone sealant.

Tape over the Tiger Clips, making sure that the Tiger Clips are completely covered, then apply a bead of silicone sealant around the external seam of the joint.

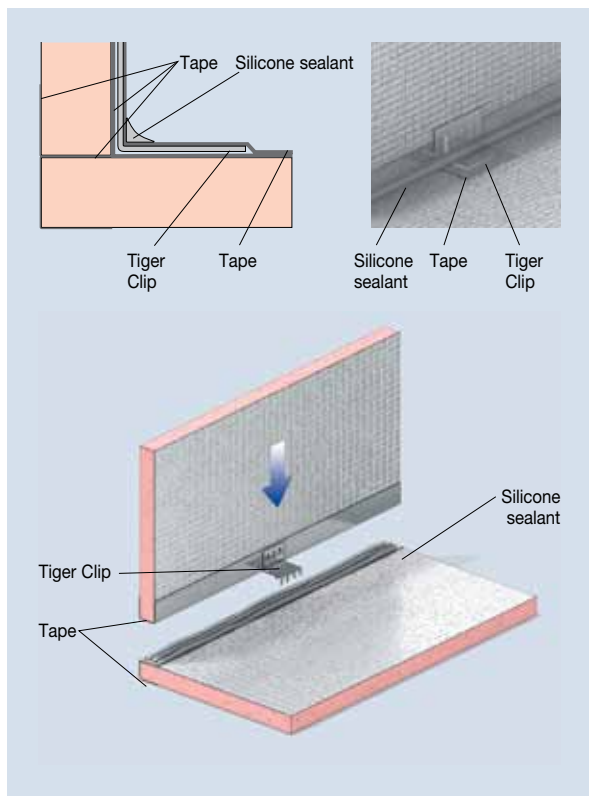


Figure 7.5 Method 1b: Butted Square End Joint Connection

7.4.2 Method 2: Flanged Connections

When the larger end of a boot branch has dimensions (w and/or h) > 600 mm, the whole branch comprises more than one ductwork section (i.e. is $> 2950 / 3930$ mm in length), and/or the static pressure is > 500 Pa, it should be connected to the supply duct using a flanged connection.

First, the boot branch is fitted with either the aluminium grip U profile (formed by inserting the aluminium grip internal profile into the aluminium grip external U profile), or the aluminium structural U profile, and the supply duct with either the aluminium grip F profile (formed by inserting the aluminium grip internal profile into the aluminium grip external F profile), or the aluminium structural F profile.

Next, a strip of self-adhesive gasket is affixed to the underside of the U profile, around the perimeter of the boot branch opening. Finally, the boot branch and supply duct can be coupled together, using rivets or screws, as shown in Figure 7.6.

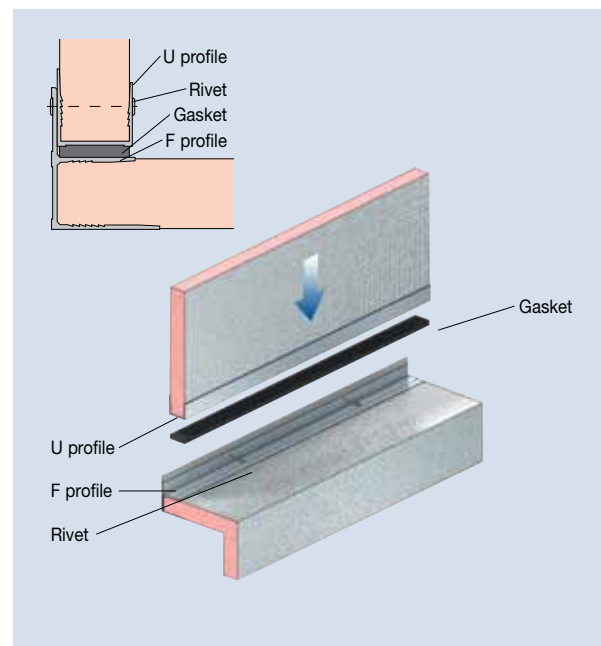


Figure 7.6 Method 2: Flanged Connection

7.4.3 Method 3: All in One Connection

In situations where at least one cross-sectional dimension of the supply duct and the boot branch is the same, a third option with increased strength can be used. In this method, each side wall of the boot branch is combined with one side of the supply duct and cut from the same *Kingspan KoolDuct*® panel. This eradicates two panel joints and increases the strength of the section.

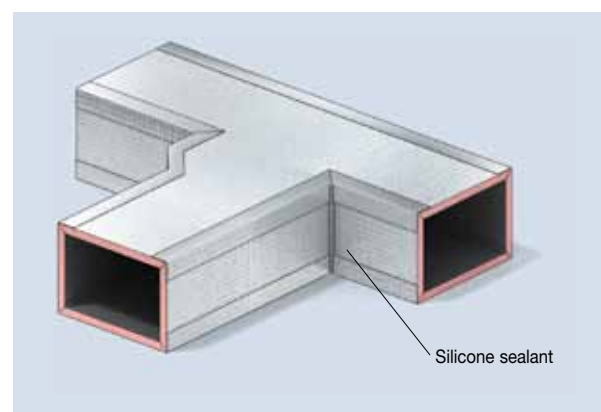


Figure 7.7 Method 3: All in One

7.5 Circular Branches

The connection of both rigid and flexible circular ductwork to ductwork fabricated from The *Kingspan KoolDuct® System* is made by means of either a shoe branch (see Figure 7.8) or a round fitting (see Figure 7.9), both of which may be tabbed or untabbed. The method of attachment is dependent on both the type and size of the fitting.



Figure 7.8 Shoe Branch Fitting: Untabbed

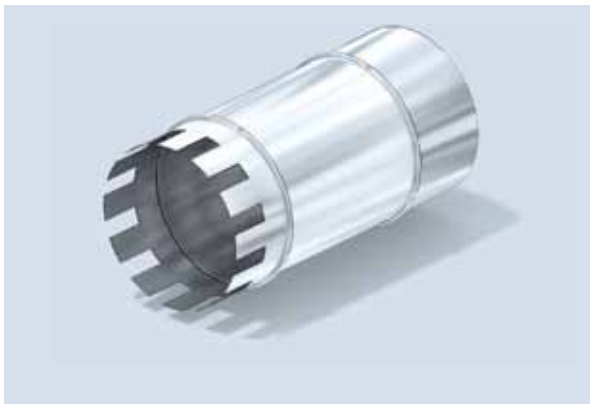


Figure 7.9 Round Fitting: Tabbed

Regardless of the method used, a hole, matching the dimensions (external dimensions if tabbed and internal dimensions if untabbed) of the fitting, is cut into the supply duct using a round hole cutter (such as that supplied by Kingspan Insulation Ltd).

7.5.1 Small Fittings

For small shoe branch fittings (diameters ≤ 300 mm) exposed to static pressures of ≤ 500 Pa, the following methods should be used. Please note that for small branch fittings exposed to static pressures of > 500 Pa, the procedure detailed below for large fittings should be used. Regardless of the type of small fitting used, the exposed insulation resulting from the cutting of the hole is fully sealed, using tape, prior to the fitting's installation.

7.5.1.1 Shoe Branch: Untabbed

First, a generous and continuous bead of silicone sealant is applied to the underside of the lap of the shoe branch, around its entire perimeter. Next, the fitting is placed over the hole in the supply duct. Small pieces of tape are then applied inside the hole, to secure the shoe branch to the supply duct whilst the silicone sealant cures. If desired, these can be subsequently removed.

Finally, a generous and continuous bead of silicone sealant is applied around the perimeter of the fitting, at the point where the lap abuts the external surface of the supply ductwork.

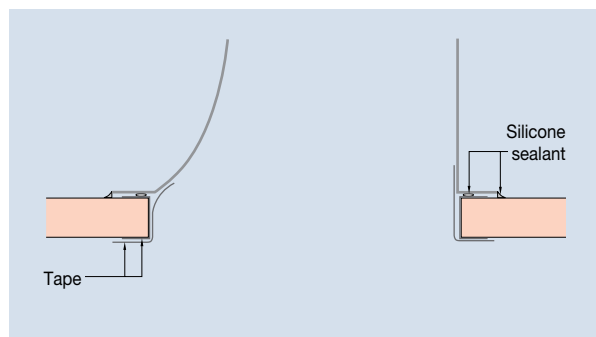


Figure 7.10 Installing a Shoe Branch: Untabbed

7.5.1.2 Shoe Branch: Tabbed

The method of attachment for small tabbed shoe branches is the same as that for untabbed, with the exception that the shoe branch's tabs are bent back inside the supply duct, to secure it in place. Please note that there is no need to tape the fitting to the supply duct when tabbed fittings are used.

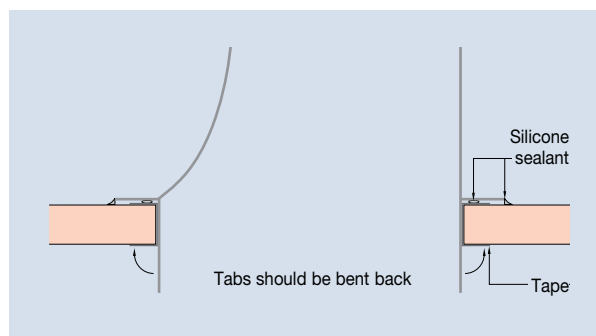


Figure 7.11 Installing a Shoe Branch: Tabbed

7.5.1.3 Round Fittings: Untabbed

First, the round fitting is inserted into the hole in the supply duct, such that the lap (sometimes called a knurl) is flush with its external surface. Next, a generous and continuous bead of silicone sealant is applied, as shown in Figure 7.12, around

7. Branches

the perimeter of the fitting, at the point where the lap abuts the external surface of the supply ductwork. Finally, small pieces of tape are applied inside the hole, to secure the round fitting to the supply duct whilst the silicone sealant cures. If desired, these can be subsequently removed.

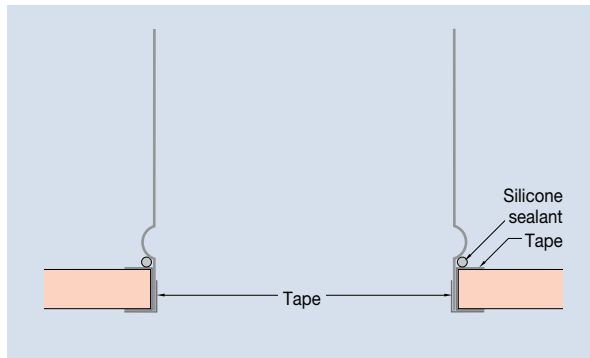


Figure 7.12 Installing a Round Fitting: Untabbed

7.5.1.4 Round Fittings: Tabbed

The procedure for attaching tabbed round fittings is the same as that for untabbed, with the exception that the round fitting's tabs are bent back inside the supply duct, to secure it in place. Please note that there is no need to tape the fitting to the supply duct when tabbed fittings are used.

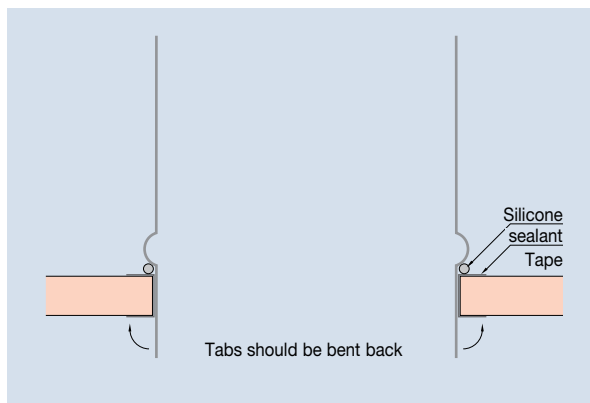


Figure 7.13 Installed a Round Fitting: Tabbed

7.5.2 Large Fittings

For larger fittings (diameters > 300 mm) and small fittings exposed to static pressures of > 500 Pa, mechanical fixings are required.

7.5.2.1 Shoe Branch: Untabbed

First, four or more pieces of the aluminium structural U profile, or the aluminium grip U profile (formed by inserting the aluminium grip internal profile into the aluminium grip external U profile), are cut to approximately 40 mm in length, and then secured around the taped hole in the supply duct. Next, the fitting is placed over the hole in the supply duct. The shoe branch can then be secured in place, as shown in Figure 7.14, using rivets

or screws, which should pass through both the lap of the fitting and the 'U' profile. Finally, a generous and continuous bead of silicone sealant is applied around the perimeter of the fitting, at the point where the lap abuts the external surface of the supply ductwork.

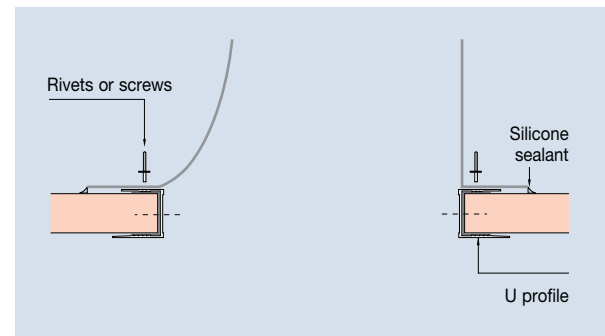


Figure 7.14 Installing a Large Shoe Branch: Untabbed

7.5.2.2 Shoe Branch: Tabbed

The procedure for attaching a tabbed shoe fitting is the same as for untabbed, except that the shoe fitting's tabs are bent back inside the supply ductwork.

7.5.2.3 Round Fitting: Untabbed

First, four pieces of the aluminium structural U profile, or aluminium grip U profile (formed by inserting the aluminium grip internal profile into the aluminium grip external U profile), are cut to approximately 40 mm in length, and then secured around the taped hole in the supply duct. Next, the fitting is placed over the hole in the supply duct. The round fitting can then be secured in place, as in Figure 7.15, using rivets or screws, which should pass through both the fitting and the U profile. Finally, a generous and continuous bead of silicone sealant is applied around the perimeter of the fitting, at the point where the lap abuts the external surface of the supply ductwork.

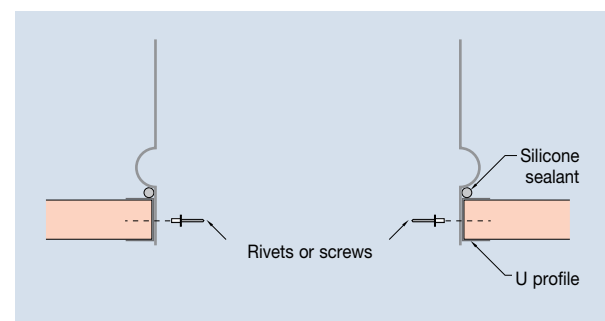


Figure 7.15 Installing a Large Round Fitting: Untabbed

7.5.2.4 Round Fitting: Tabbed

The procedure for attaching a tabbed round fitting is the same as for untabbed, except that the round fitting's tabs are bent back inside the supply ductwork.

7.6 Dynamic Branch Design

Dynamic branches can be fabricated as either two way or three way, and the elbows in a dynamic branch can be radius or square. Figure 7.16 provides an example of a two way dynamic 'Y' branch with radius elbow. The following design rules apply to all dynamic branch ductwork sections:

- necks should be ≥ 100 mm;
- the internal radius of any radius elbow should be ≥ 200 mm;
- creases on curved strips should be ≥ 75 mm apart for 22 mm thick panels and ≥ 100 mm apart for 30 mm thick panels; and
- reinforcement bars and/or splitters should still be used as specified (see Section 9 for more information).

Because thicker panels are much more difficult to bend with the bending machine, alternative design should be considered for the 42 and 45mm thick panels (e.g. dynamic branches with square elbows instead of radius elbows).



Figure 7.16 Two Way Dynamic Branch

7.7 Dynamic Branch Fabrication

Although dynamic branches are the most complex ductwork sections to fabricate, the procedure is the same as that described for elbows and transitions (see Sections 4.3 and 5.3). The same steps are followed for tracing, cutting, assembly, taping, and sealing, in that order. Figure 7.17 below illustrates all the component pieces that make up a two way dynamic 'Y' branch with radius elbow.

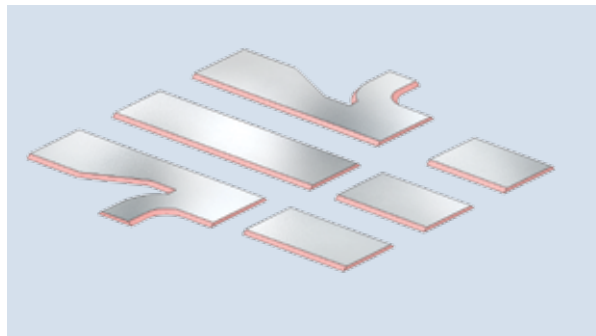


Figure 7.17 Component Pieces of a Two Way Dynamic 'Y' Branch with Radius Elbow

8. End Caps

8.1 General

End caps are used to close off ductwork systems at their termination points – usually at the end of branch ducts.

8.2 End Cap Fabrication

There are two methods available for capping ductwork sections, the selection of which is dependent on the length of the section.

8.2.1 Method 1: $l \leq 1000$ mm

For ductwork sections with a length ≤ 1000 mm, where silicone sealant can be easily applied on the internal side of the end caps, the preferred method of attachment is to use a butted mitre joint. Firstly, complimentary bevelled edges are cut around the perimeter of both the cap and the opening in the ductwork section, using a 45° jack plane (such as that supplied in The *Kingspan KoolDuct®* System Tool Box). Next, adhesive is applied to the bevelled edges and allowed to cure. The cap can then be fitted and taped into position. Finally, the internal seams of the mitre joints are sealed with silicone sealant. Please note that Tiger Clips can be used instead of adhesive, if desired. At all stages, the fabrication instructions laid out in Section 2 should be strictly adhered to.

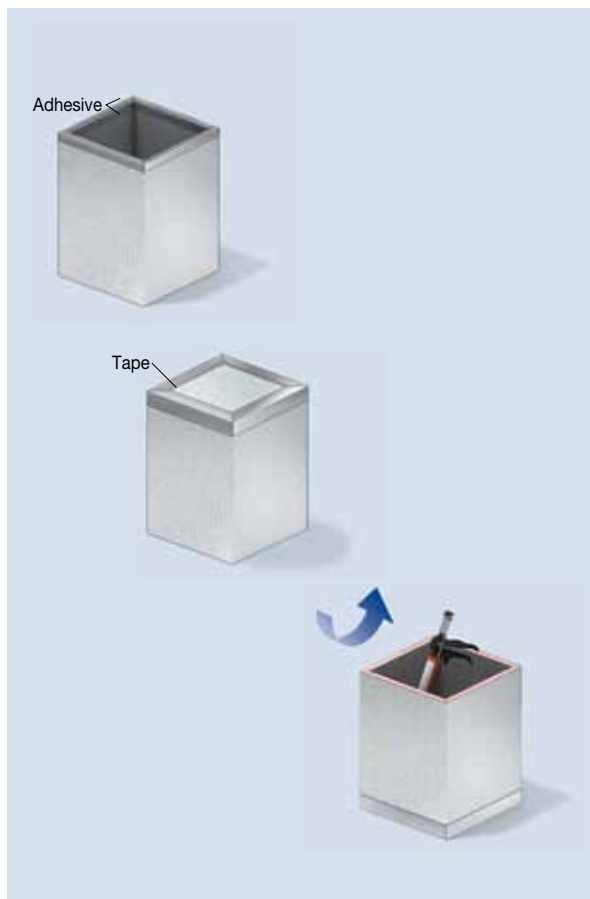


Figure 8.1 Method 1: $l \leq 1000$ mm

8.2.2 Method 2: $l > 1000$ mm

For ductwork sections with a length > 1000 mm, the preferred method of attachment is to simply butt the end cap against the end of the ductwork section, and secure it in position. Prior to attachment of the end cap, the exposed insulation, around the perimeter of the opening in the ductwork section, is sealed with tape, and a generous and continuous bead of silicone sealant is applied to the taped surface that will abut the end cap. The end cap can then be butted against the ductwork section, and secured in place using Tiger Clips and tape. At all stages, the fabrication instructions laid out in Section 2 should be strictly adhered to.

NB Method 2 is only suitable for *Kingspan KoolDuct®* panels that are 22 mm thick.

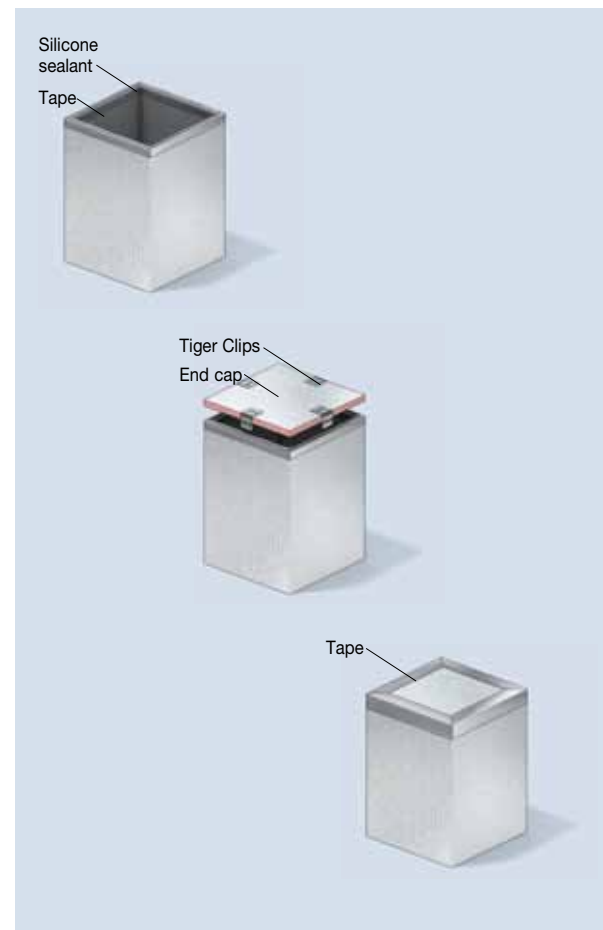


Figure 8.2 Method 2: $l > 1000$ mm

9A. Ductwork Reinforcement: 22 mm Panel

9A.1 General

The reinforcement of ductwork is required, to ensure that the specified rectangular cross-section of the ductwork is always maintained. Reinforcement is therefore used, when required, to protect against positive pressure (i.e. where the air in the ductwork is at a higher pressure than that outside), and negative pressure (i.e. where the air in the ductwork is at a lower pressure than that outside). Surface deformation, as a result of internal air pressure, can potentially have a serious impact on both the integrity of the ductwork and, in the case of The *Kingspan KoolDuct® System*, on the integrity of *Kingspan KoolDuct®* panels themselves. It is therefore imperative that the recommendations for reinforcement in Section 9A.2 are strictly adhered to. Please note that only internal reinforcement is described, and external bracing is not covered by the scope of this manual.

9A.2 Reinforcement Design

The determination of the nature and quantity of reinforcement is based on three parameters:

- the coupling system used;
- the size of the ductwork section (both w and h should be evaluated); and
- the total pressure inside the section (static plus dynamic) – please note that the highest of design, commissioning and testing pressures should always be used as the reference for reinforcement.

Please note that the method of fabrication is largely irrelevant when determining reinforcement. All ductwork should be reinforced in accordance with the reinforcement chart which corresponds to the coupling system that has been used.

Figures 9A.1, 9A.2, 9A.3, and the tables in Appendix E., should always be used to determine whether reinforcement is necessary, and if so, its nature. The reinforcement charts identify the spacing required between reinforcing bars, for a certain w or h of ductwork, at a specific pressure.

Figures 9A.1, 9A.2 and 9A.3 apply equally to negative and positive pressures. However, please note that the maximum allowable negative pressure is 750 Pa (negative).

All ductwork sections (including elbows, transitions, offsets etc.) should be reinforced, if required by Figures 9A.1, 9A.2 and 9A.3.

For ductwork sections with dimensions larger than those covered by Figures 9A.1, 9A.2 and 9A.3, the multiple duct method of construction, as discussed in Section 13, can be used. In this case, each of the smaller ductwork sections that make up the multiple duct should be reinforced individually, in accordance with Figures 9A.1, 9A.2 and 9A.3.

There will be occasional circumstances, where the geometry of the ductwork means that standard reinforcement can not be installed, e.g. where a large branch splits from a large duct, or for a large end cap. In these circumstances, reinforcement solutions can be provided by Kingspan Insulation.

9A. Ductwork Reinforcement: 22 mm Panel

9A.2.1 Reinforcement with the Aluminium Grip & Invisible Coupling Systems

When either the aluminium grip coupling system or the invisible coupling system is used, reference should be made to Figure 9A.1 and the tables in Appendix E. For ductwork sections over 2 m (w and/or h), the multiple duct method of construction, as discussed in Section 13, can be used. In this case, each of the smaller ductwork sections that make up the multiple duct should be reinforced individually.

Where Figure 9A.1 indicates ‘no reinforcement’, this means that no reinforcement is required and that the ductwork section can be used ‘as is’.

Where Figure 9A.1 indicates ‘1 bar centred’, this means that a single bar is installed in the centre of the ductwork section, equidistant from both ends of the ductwork section, and at the centre of the cross-sectional dimension in question.

Where Figure 9A.1 indicates ‘1 bar every 900 mm’, this means that a single bar is installed at the centre of the cross-sectional dimension in question. The first and last reinforcing bars are installed at a maximum of 450 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 900 mm centres.

Where Figure 9A.1 indicates ‘1 bar every 600 mm’, this means that a single bar is installed at the centre of the cross-sectional

dimension in question. The first and last reinforcing bars are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 600 mm centres.

Where Figure 9A.1 indicates ‘2 bars every 600 mm’, this means that two bars are installed as a pair, 600 mm apart, with an equal distance between reinforcing bars should be approximately the same as the space between each bar and its adjacent ductwork section side. The first and last pairs are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening pairs are installed at a maximum of 600 mm centres.

Where Figure 9A.1 indicates ‘3 bars every 600 mm’, this means that three bars are installed as a trio, with a 600 mm spacing between the central bar and each of the two lateral bars, and with an equal distance between the two most lateral bars and their adjacent ductwork section sides. The first and last trios are installed at a maximum of 300 mm either end of the ductwork section, and the intervening trios are installed at a maximum of 600 mm centres.

Please note that where the dimensions and pressure of a ductwork section are such that it falls directly on a line between two specifications on the chart, the more stringent reinforcement requirement is always followed.

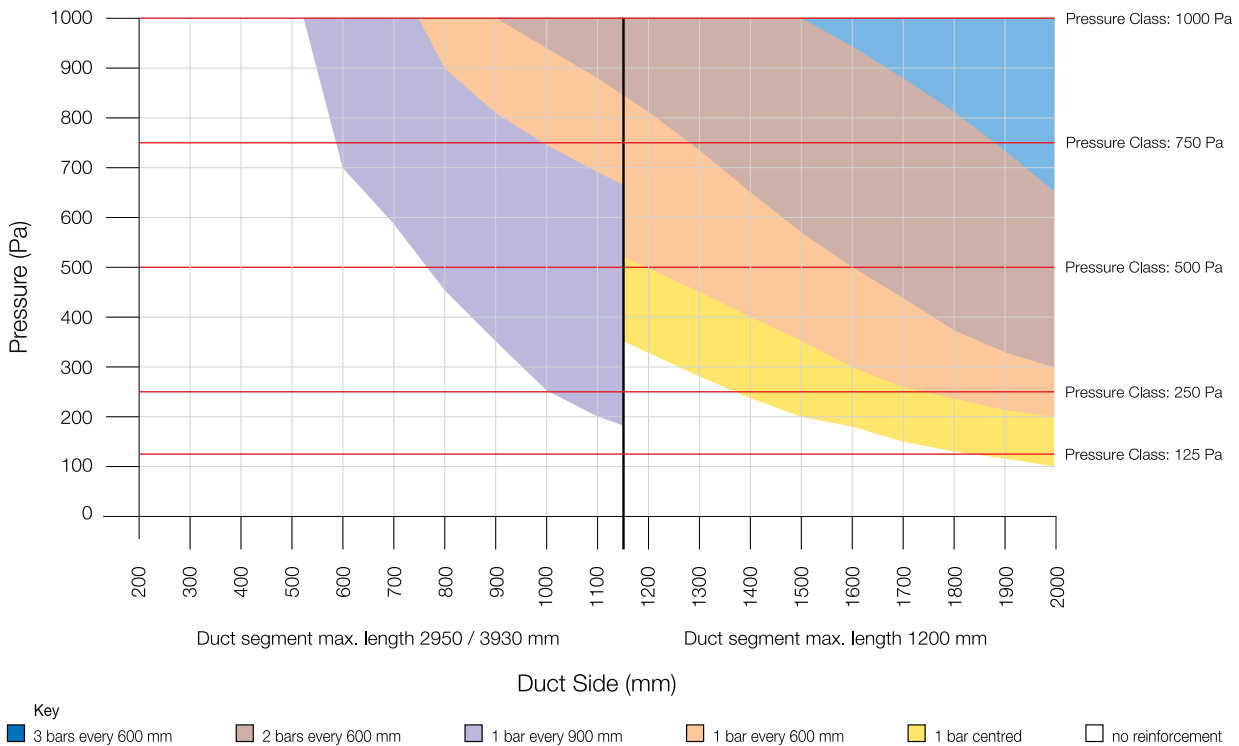


Figure 9A.1 Reinforcement Chart: Aluminium Grip & Invisible Coupling Systems – 22 mm Panel
Please see also reinforcement table in Appendix E.

9A.2.2 Reinforcement with the 4-bolt Flange Coupling System

When the 4-bolt coupling system is used, reference should be made to Figure 9A.2 and the tables in Appendix E. For ductwork sections over 2 m (w and/or h), the multiple duct method of construction, as discussed in Section 13, can be used. In this case, each of the smaller ductwork sections that make up the multiple duct should be reinforced individually.

Where Figure 9A.2 indicates ‘no reinforcement’, this means that no reinforcement is required and that the ductwork section can be used ‘as is’.

Where Figure 9A.2 indicates ‘1 bar every 900 mm’, this means that a single bar is installed at the centre of the cross-sectional dimension in question. The first and last reinforcing bars are installed at a maximum of 900 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 900 mm centres.

Where Figure 9A.2 indicates ‘1 bar every 600 mm’, this means that a single bar is installed at the centre of the cross-sectional dimension in question. The first and last reinforcing bars are installed at a maximum of 600 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 600 mm centres.

Where Figure 9A.2 indicates ‘1 bar centred’, this means that a single bar is installed, equidistant from both ends of the two ductwork section, and at the centre of the cross-sectional dimension in question.

Where Figure 9A.2 indicates ‘2 bars centred’, this means that two bars are installed as a pair, equidistant from both ends of the ductwork section, and distributed evenly across the cross-sectional dimension in question. The space between reinforcing bars should be approximately the same as the space between each bar and its adjacent ductwork section side.

Where Figure 9A.2 indicates ‘2 bars every 600 mm’, this means that two bars are installed as a pair, 600 mm apart, with an equal distance between each bar and its adjacent ductwork section side. The first and last pairs are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening pairs are installed at a maximum of 600 mm centres.

Where Figure 9A.2 indicates ‘3 bars every 600 mm’, this means that three bars are installed as a trio, with a 600 mm spacing between the central bar and each of the two lateral bars, and with an equal distance between the two most lateral bars and their adjacent ductwork section sides. The first and last pairs are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening pairs are installed at a maximum of 600 mm centres.

Please note that where the dimensions and pressure of a ductwork section are such that it falls directly on a line between two specifications on the chart, the more stringent reinforcement requirement is always followed.

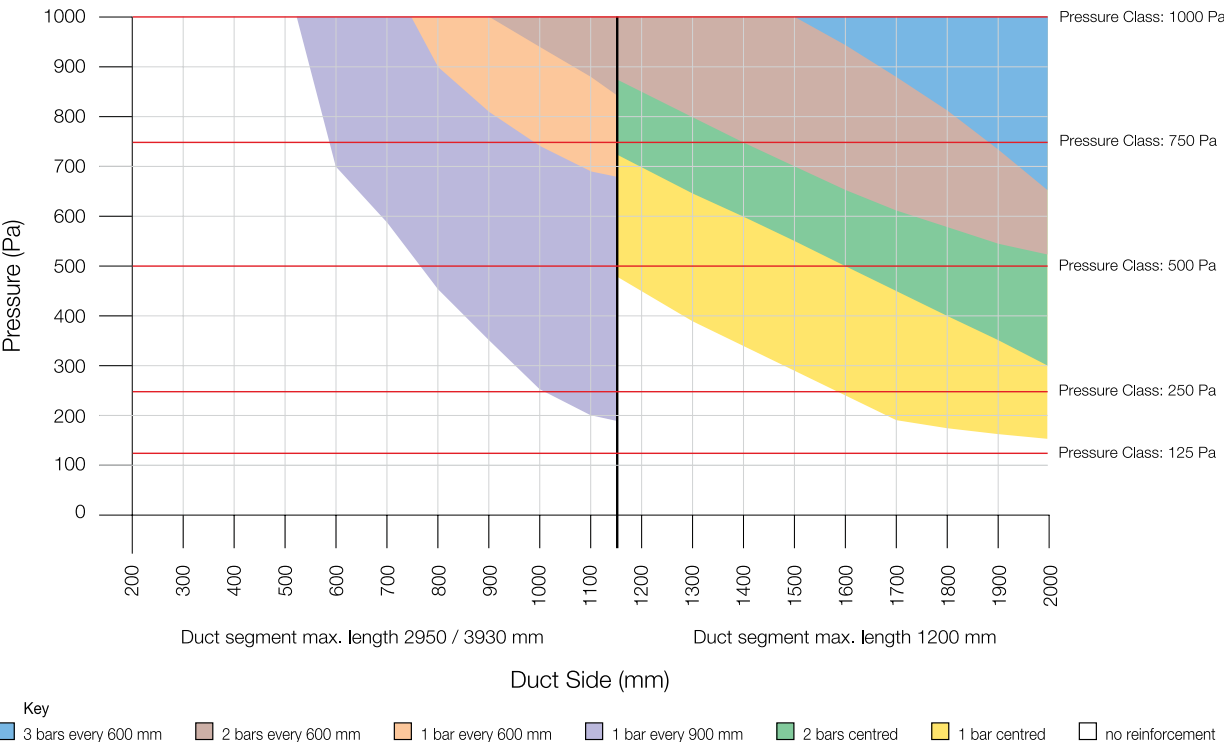


Figure 9A.2 Reinforcement Chart: 4-bolt Flange Coupling System – 22 mm Panel

Please see also reinforcement table in Appendix E.

9A. Ductwork Reinforcement: 22 mm Panel

9A.2.3 Reinforcement with the Tiger Clip Coupling System

When the Tiger Clip coupling system is used, reference should be made to Figure 9A.3 and the tables in Appendix E.

Where Figure 9A.3 indicates ‘no reinforcement’, this means that no reinforcement is required and that the ductwork section can be used ‘as is’.

Where Figure 9A.3 indicates ‘1 bar at joint’, this means that a single bar is installed at the centre of the cross-sectional dimension in question. One bar only is installed at each coupling seam at a maximum of 300 mm from the end of one of the ductwork sections that make up the coupling seam.

Where Figure 9A.3 indicates ‘1 bar every 900 mm’, this means that a single bar is installed at the centre of the cross-sectional dimension in question. The first and last reinforcing bars are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 900 mm centres.

Where Figure 9A.3 indicates ‘1 bar every 600 mm’, this means that a single bar is installed at the centre of the cross-sectional dimension in question. The first and last reinforcing bars are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 600 mm centres.

Where Figure 9A.3 indicates ‘not applicable’, ductwork fitted with the Tiger Clip coupling system is unsuitable for use at these sizes and pressures.

Please note that where dimensions and pressure of a ductwork section are such that it falls directly on a line between two specifications on the chart, the more stringent reinforcement requirement is always followed.

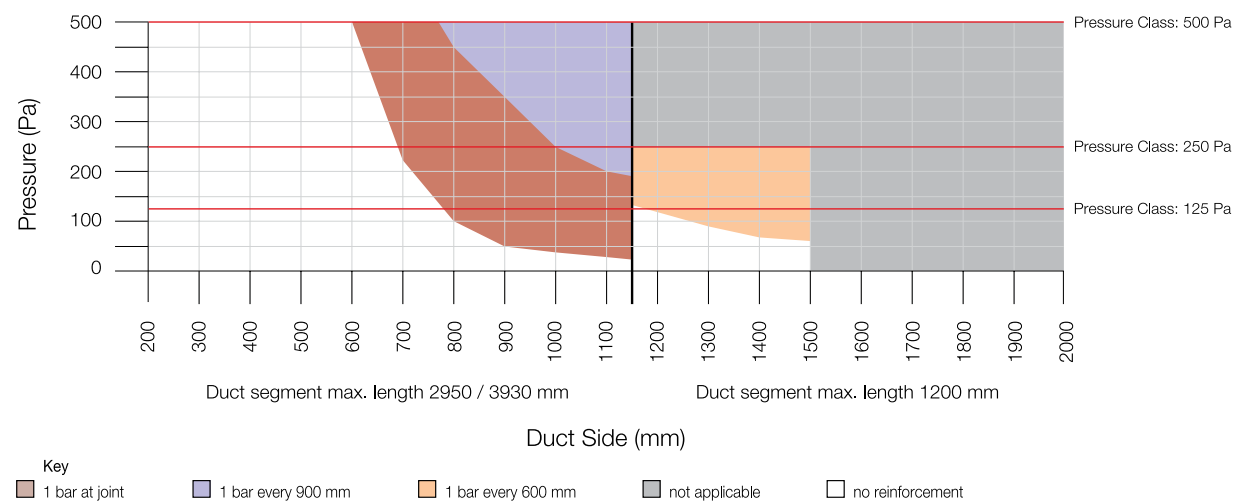


Figure 9A.3 Reinforcement Chart: Tiger Clip Coupling System – 22 mm Panel

Please see also reinforcement table in Appendix E.

9B. Ductwork Reinforcement: 30 / 42 mm Panel

9B.1 General

The reinforcement of ductwork is required, to ensure that the specified rectangular cross-section of the ductwork is always maintained. Reinforcement is therefore used, when required, to protect against positive pressure (i.e. where the air in the ductwork is at a higher pressure than that outside), and negative pressure (i.e. where the air in the ductwork is at a lower pressure than that outside). Surface deformation, as a result of internal air pressure, can potentially have a serious impact on both the integrity of the ductwork and, in the case of The *Kingspan KoolDuct® System*, on the integrity of *Kingspan KoolDuct®* panels themselves. It is therefore imperative that the recommendations for reinforcement in Section 9B.2 are strictly adhered to. Please note that only internal reinforcement is described, and external bracing is not covered by the scope of this manual.

9B.2 Reinforcement Design

The determination of the nature and quantity of reinforcement is based on three parameters:

- the coupling system used;
- the size of the ductwork section (both w and h should be evaluated); and
- the total pressure inside the section (static plus dynamic) – please note that the highest of design, commissioning and testing pressures should always be used as the reference for reinforcement.

Please note that the method of fabrication is largely irrelevant when determining reinforcement. All ductwork should be reinforced in accordance with the reinforcement chart which corresponds to the coupling system that has been used.

Figures 9B.1, 9B.2, 9B.3, and the tables in Appendix F, should always be used to determine whether reinforcement is necessary, and if so, its nature. The reinforcement charts identify the spacing required between reinforcing bars, for a certain w or h of ductwork, at a specific pressure.

Figures 9B.1, 9B.2 and 9B.3 apply equally to negative and positive pressures. However, please note that the maximum allowable negative pressure is 750 Pa (negative).

All ductwork sections (including elbows, transitions, offsets etc.) should be reinforced, if required by Figures 9B.1, 9B.2 and 9B.3.

For ductwork sections with dimensions larger than those covered by Figures 9B.1, 9B.2 and 9B.3, the multiple duct method of construction, as discussed in Section 13, can be used. In this case, each of the smaller ductwork sections that make up the multiple duct should be reinforced individually, in accordance with Figures 9B.1, 9B.2 and 9B.3.

There will be occasional circumstances, where the geometry of the ductwork means that standard reinforcement can not be installed, e.g. where a large branch splits from a large duct, or for a large end cap. In these circumstances, reinforcement solutions can be provided by Kingspan Insulation.

9B. Ductwork Reinforcement: 30 / 42 mm Panel

9B.2.1 Reinforcement with the Aluminium Grip & Invisible Coupling Systems

When either the aluminium grip coupling system or the invisible coupling system is used, reference should be made to Figure 9B.1 and the tables in Appendix F. For ductwork sections over 2 m (w and/or h), the multiple duct method of construction, as discussed in Section 13, can be used. In this case, each of the smaller ductwork sections that make up the multiple duct should be reinforced individually.

Where Figure 9B.1 indicates 'no reinforcement', this means that no reinforcement is required and that the ductwork section can be used 'as is'.

Where Figure 9B.1 indicates '1 bar centred', this means that a single bar is installed in the centre of the ductwork section, equidistant from both ends of the ductwork section, and at the centre of the cross-sectional dimension in question.

Where Figure 9B.1 indicates '1 bar every 900 mm', this means that a single bar is installed at the centre of the cross-sectional dimension in question. The first and last reinforcing bars are installed at a maximum of 450 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 900 mm centres.

Where Figure 9B.1 indicates '1 bar every 600 mm', this means that a single bar is installed at the centre of the cross-sectional

dimension in question. The first and last reinforcing bars are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 600 mm centres.

Where Figure 9B.1 indicates '2 bars every 600 mm', this means that two bars are installed as a pair, 600 mm apart, with an equal distance between reinforcing bars should be approximately the same as the space between each bar and its adjacent ductwork section side. The first and last pairs are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening pairs are installed at a maximum of 600 mm centres.

Where Figure 9B.1 indicates '3 bars every 600 mm', this means that three bars are installed as a trio, with a 600 mm spacing between the central bar and each of the two lateral bars, and with an equal distance between the two most lateral bars and their adjacent ductwork section sides. The first and last trios are installed at a maximum of 300 mm either end of the ductwork section, and the intervening trios are installed at a maximum of 600 mm centres.

Please note that where the dimensions and pressure of a ductwork section are such that it falls directly on a line between two specifications on the chart, the more stringent reinforcement requirement is always followed.

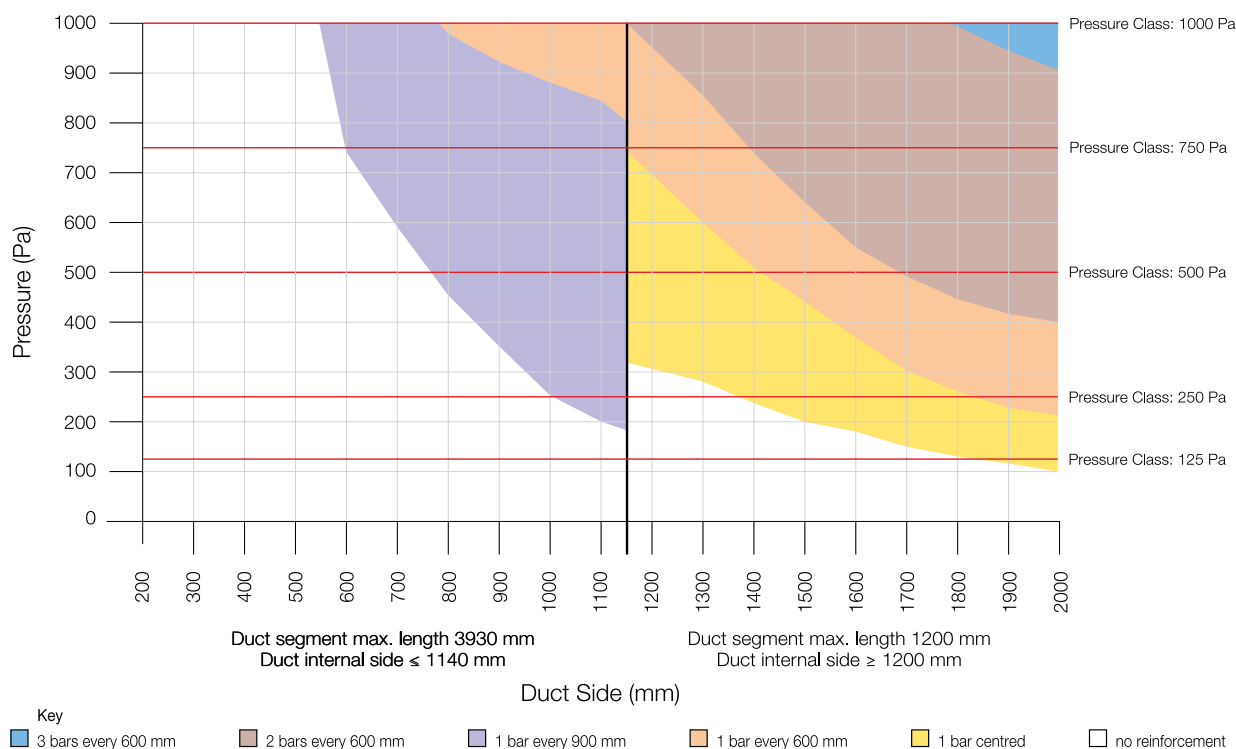


Figure 9B.1 Duct Reinforcement + Grip and Bayonet Coupling – 30 / 42 mm Panel

Please see also reinforcement table in Appendix F.

9B.2.2 Reinforcement with the 4-bolt Flange Coupling System

When the 4-bolt coupling system is used, reference should be made to Figure 9B.2 and the tables in Appendix F. For ductwork sections over 2 m (w and/or h), the multiple duct method of construction, as discussed in Section 13, can be used. In this case, each of the smaller ductwork sections that make up the multiple duct should be reinforced individually.

Where Figure 9B.2 indicates 'no reinforcement', this means that no reinforcement is required and that the ductwork section can be used 'as is'.

Where Figure 9B.2 indicates '1 bar every 900 mm', this means that a single bar is installed at the centre of the cross-sectional dimension in question. The first and last reinforcing bars are installed at a maximum of 900 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 900 mm centres.

Where Figure 9B.2 indicates '1 bar every 600 mm', this means that a single bar is installed at the centre of the cross-sectional dimension in question. The first and last reinforcing bars are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 600 mm centres.

Where Figure 9B.2 indicates '1 bar centred', this means that a single bar is installed, equidistant from both ends of the two ductwork section, and at the centre of the cross-sectional dimension in question.

Where Figure 9B.2 indicates '2 bars centred', this means that two bars are installed as a pair, equidistant from both ends of the ductwork section, and distributed evenly across the cross-sectional dimension in question. The space between reinforcing bars should be approximately the same as the space between each bar and its adjacent ductwork section side.

Where Figure 9B.2 indicates '2 bars every 600 mm', this means that two bars are installed as a pair, 600 mm apart, with an equal distance between each bar and its adjacent ductwork section side. The first and last pairs are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening pairs are installed at a maximum of 600 mm centres.

Where Figure 9B.2 indicates '3 bars every 600 mm', this means that three bars are installed as a trio, with a 600 mm spacing between the central bar and each of the two lateral bars, and with an equal distance between the two most lateral bars and their adjacent ductwork section sides. The first and last pairs are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening pairs are installed at a maximum of 600 mm centres.

Please note that where the dimensions and pressure of a ductwork section are such that it falls directly on a line between two specifications on the chart, the more stringent reinforcement requirement is always followed.

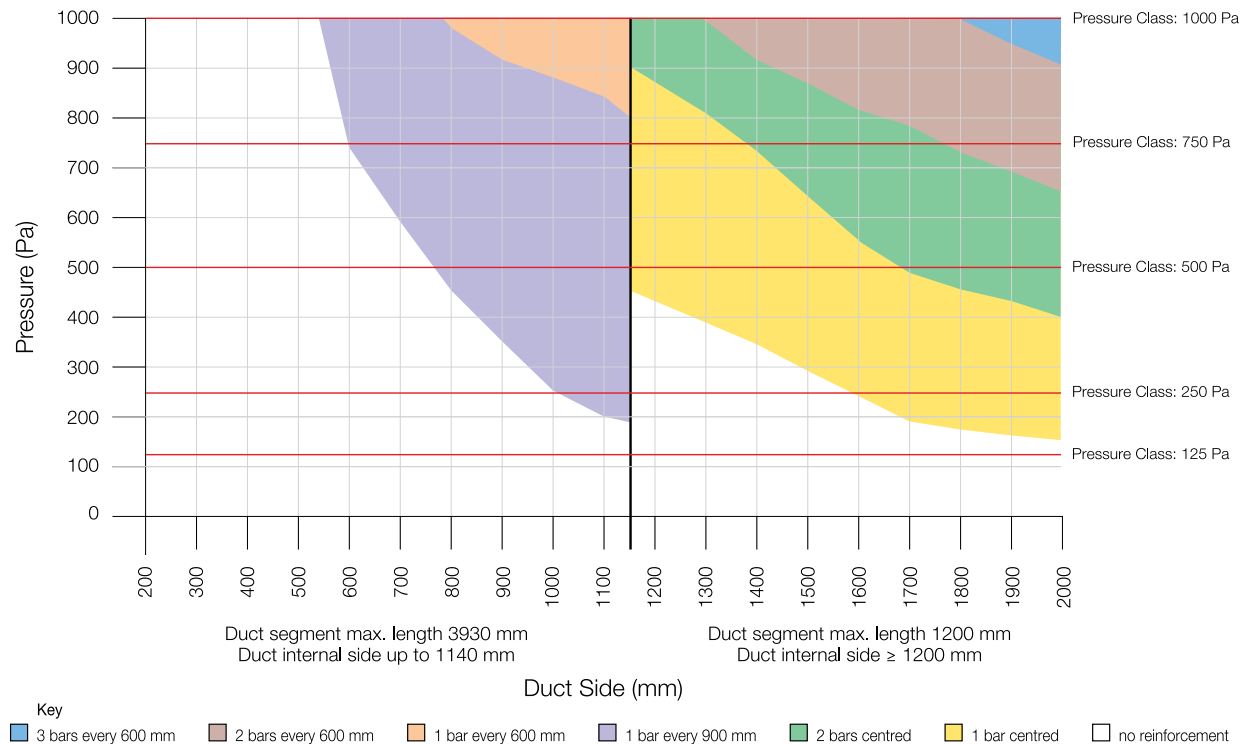


Figure 9B.2 Duct Reinforcement + 4 Bolt Coupling - 30 / 42 mm Panel
Please see also reinforcement table in Appendix F.

9B. Ductwork Reinforcement: 30 / 42 mm Panel

9B.2.3 Reinforcement with the Tiger Clip Coupling System

When the Tiger Clip coupling system is used, reference should be made to Figure 9B.3 and the tables in Appendix F.

Where Figure 9B.3 indicates ‘no reinforcement’, this means that no reinforcement is required and that the ductwork section can be used ‘as is’.

Where Figure 9B.3 indicates ‘1 bar at joint’, this means that a single bar is installed at the centre of the cross-sectional dimension in question. One bar only is installed at each coupling seam at a maximum of 300 mm from the end of one of the ductwork sections that make up the coupling seam.

Where Figure 9B.3 indicates ‘1 bar every 900 mm’, this means that a single bar is installed at the centre of the cross-sectional dimension in question. The first and last reinforcing bars are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 900 mm centres.

Where Figure 9B.3 indicates ‘1 bar every 600 mm’, this means that a single bar is installed at the centre of the cross-sectional dimension in question. The first and last reinforcing bars are installed at a maximum of 300 mm from either end of the ductwork section, and the intervening bars are installed at a maximum of 600 mm centres.

Where Figure 9B.3 indicates ‘not applicable’, ductwork fitted with the Tiger Clip coupling system is unsuitable for use at these sizes and pressures.

Please note that where dimensions and pressure of a ductwork section are such that it falls directly on a line between two specifications on the chart, the more stringent reinforcement requirement is always followed.

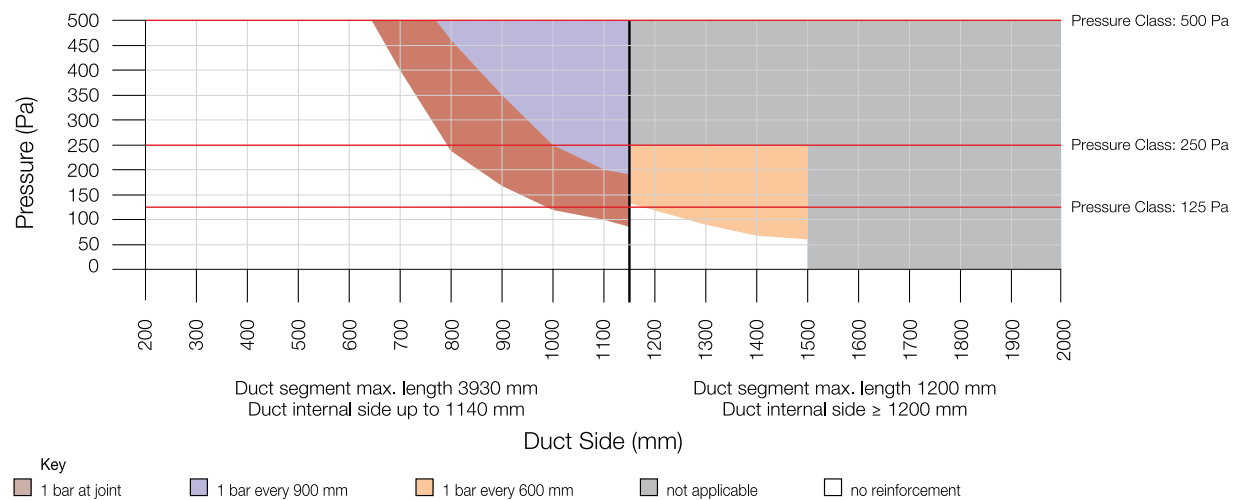


Figure 9B.3 Duct Reinforcement + Tiger Clip Coupling – 30 / 42 mm Panel

Please see also reinforcement table in Appendix F.

9C. Ductwork Reinforcement

9C.1 Ductwork Reinforcement Installation

There are two methods that can be used to reinforce ductwork fabricated from The *Kingspan KoolDuct®* System:

- The *Kingspan KoolDuct®* reinforcing bar system; and
- *Kingspan KoolDuct®* panels.

The *Kingspan KoolDuct®* reinforcing bar system can be used in all circumstances, regardless of pressure or the ductwork section's dimensions, and is considered the preferred method. *Kingspan KoolDuct®* panels, in contrast, can only be used to reinforce ductwork against negative pressure, and their use is limited to small ductwork (h and/or $w \leq 600$ mm) subject to static pressures ≤ 500 Pa.

9C.1.1 Reinforcing Bar System

The *Kingspan KoolDuct®* reinforcing bar system comprises:

- aluminium inner reinforcing bars;
- aluminium outer reinforcing bars;
- aluminium reinforcing discs; and
- speed clips.

The inner reinforcing bar, and reinforcing discs on the external surface of the ductwork section, protect against deformation resulting from positive air pressure.

The outer bar, which fits over the inner bar, and the reinforcing discs on the internal side of the ductwork section, protect against deformation resulting from negative air pressure. Whenever The *Kingspan KoolDuct®* reinforcing bar system is used, both the inner and outer bars are always installed.

Please note that the inner reinforcing bar and speed clips can be replaced with an 8 mm non-corrodible threaded bar and nut respectively.

To install The *Kingspan KoolDuct®* reinforcing bar system, first, a hole 10 mm in diameter (the diameter of the inner reinforcing bar) is cut in both sides of the ductwork section, at the reinforcement location.

Next, the inner reinforcing bar is cut to the length of the external dimension of the ductwork section plus the depth of the two reinforcing discs and the two speed clips (15 mm), and the outer reinforcing bar is cut to the length of the internal dimension of the ductwork section.

Then, one end of the inner reinforcing bar is pushed through the hole in a reinforcing disc, and a speed clip is fitted to stop the disc from falling off the end of the bar. The other end of the inner reinforcing bar can then be pushed through one of the holes in the ductwork section, from the outside, and a second reinforcing disc slotted over it from the inside.

9C. Ductwork Reinforcement

As the inner reinforcing bar is pushed towards the opposite side of the ductwork section, the outer reinforcing bar is slotted over it and another reinforcing disc fitted before the end of the inner bar is pushed through the hole in the opposite side of the ductwork section.

A bead of silicone sealant should be applied between the two internal reinforcing discs and the inner surfaces of the ductwork section, and between the hole in these discs and the inner reinforcing bar, to avoid unwanted air-leakage.

Finally, one more reinforcing disc and speed clip is placed on the inner reinforcing bar on the opposite side of the ductwork section, thus securing the whole assembly in place.

Please note that if a ductwork section has both vertical and horizontal reinforcing bars at the same reinforcement centres, these are securely fixed together, using a non-corrodible wire which is fit for the purpose intended, at their point of intersection.

This process is repeated at every reinforcement centre.

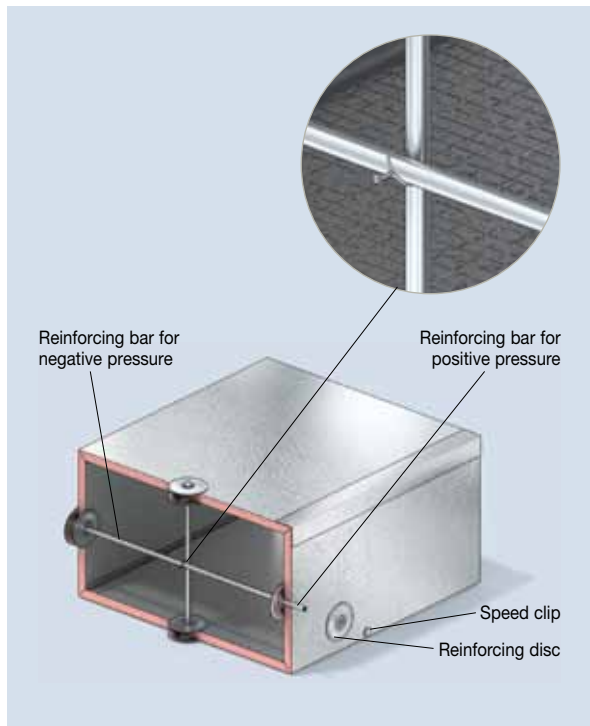


Figure 9C.1 Reinforcing Bar System

9C.1.2 Kingspan KoolDuct® Panels

Bearing in mind the limitations set in 9C.1, *Kingspan KoolDuct®* panels are installed in accordance with the reinforcement charts in Section 9A.1 and 9B.1. They are fabricated and installed in the same way that splitters in radius elbows are fabricated and installed (see Section 4.4.2), and are a minimum of 300 mm in length at each centre.

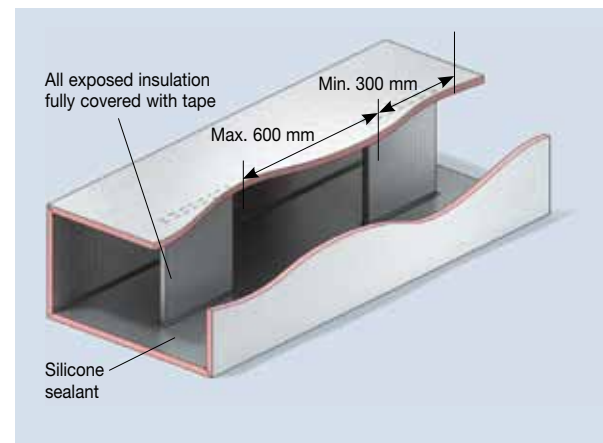


Figure 9C.2 Kingspan KoolDuct® Panel Reinforcement

9C.2 Reinforcement Examples

The following examples work through the reinforcement required for two differently sized ductwork sections at different pressures, for the different coupling systems. Both cross-sectional dimensions (w and h) should be assessed independently and reinforced accordingly. Although the charts may specify the same spacing for different coupling systems (e.g. '1 bar every 600 mm') the exact number of reinforcing bars may vary. This is because the maximum distance that the first (and last) reinforcing bar can be placed from the end of the ductwork section, is dependent on the coupling system used.

9C.2.1 Example 1

Dimensions (w x h x l): 1000 mm x 500 mm x 2500 mm.

Pressure: 250 Pa. Panel thickness: 22mm

9C.2.1.1 Aluminium Grip & Invisible Coupling Systems

With a ductwork section height of 500 mm, Figure 9A.1 indicates that reinforcement is not required, when the aluminium grip coupling system is used.

With a ductwork section width of 1000 mm, Figure 9A.1 indicates that reinforcement is required in this cross-sectional dimension at '1 bar every 900 mm'. When '1 bar every 900 mm' is specified, the first (and last) reinforcing bars are installed at a maximum of 450 mm from the ductwork section ends (and intervening bars at maximum 900 mm centres).

In this example, with a ductwork section length of 2500 mm, a total of three reinforcing bars are required (two, no less than 450 mm from the ends, and one to bridge the intervening distance). The exact spacing can vary, as long as the limits above are strictly observed. In Figure 9C.3, the first and last bars are installed 350 mm from the ductwork section ends and the intervening bar half way between the two.

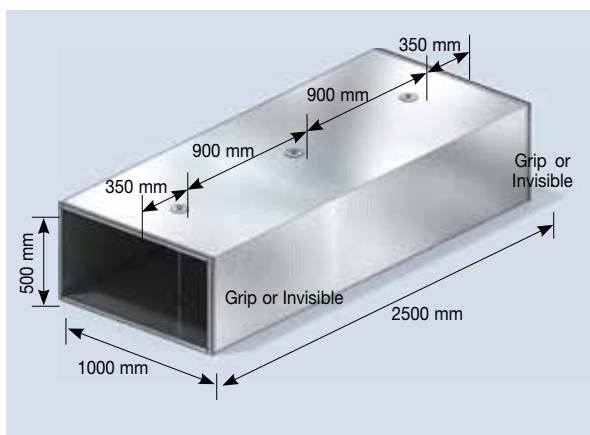


Figure 9C.3 Example 1: Aluminium Grip or Invisible Coupling System, 250 Pa

9C.2.1.2 4-bolt Coupling System

With a ductwork section height of 500 mm, Figure 9A.2 indicates that reinforcement is not required, when the 4-bolt coupling system is used.

With a ductwork section width of 1000 mm, Figure 9A.2 indicates that reinforcement is required in this cross-sectional dimension at '1 bar every 900 mm'. When '1 bar every 900 mm' is specified, the first (and last) reinforcing bars are installed at a maximum of 900 mm from the ductwork section ends (and intervening bars at maximum 900 mm centres).

In this example, with a ductwork section length of 2500 mm, a total of two reinforcing bars are required. The exact spacing can vary, as long as the limits above are strictly observed. In Figure 9C.4, the first and last bars are installed 800 mm from the ductwork section ends. As the distance between them is 900 mm, an intervening bar is not required.

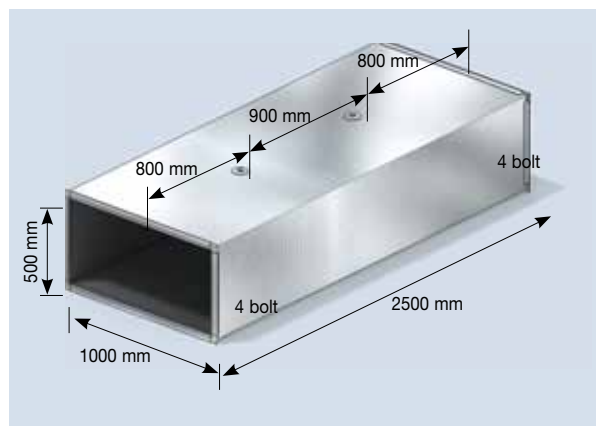


Figure 9C.4 Example 1: 4-bolt Coupling System

9C. Ductwork Reinforcement

9C.2.1.3 Tiger Clip Coupling System

With a ductwork section height of 500 mm, Figure 9A.3 indicates that reinforcement is not required, when the Tiger Clip coupling system is used.

With a ductwork section width of 1000 mm, Figure 9A.3 indicates that reinforcement is required in this cross-sectional dimension at '1 bar every 900 mm'. When '1 bar every 900 mm' is specified, the first (and last) reinforcing bars are installed at a maximum of 300 mm from the ductwork sections ends (and intervening bars at maximum 900 mm centres). In this example, with a ductwork section length of 2500 mm, a total of four reinforcing bars are required.

The exact spacing can vary, as long as the limits above are strictly observed. In Figure 9C.5, the first and last bars are installed 200 mm from the ductwork section ends and the intervening bars at 700 mm centres.

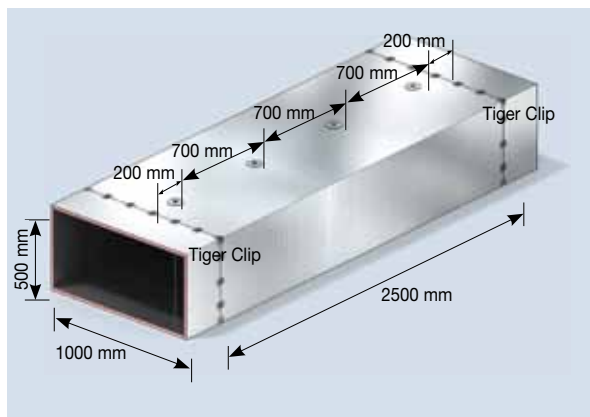


Figure 9C.5 Example 1: Tiger Clip Coupling System

9C.2.2 Example 2

Dimensions (w x h x l): 1700 mm x 1200 mm x 1200 mm.

Pressure: 500 Pa. Panel thickness: 22mm

9C.2.2.1 Aluminium Grip & Invisible Coupling Systems

With a ductwork section height of 1200 mm, Figure 9A.1 indicates that reinforcement is required in this cross-sectional dimension at '1 bar every 600 mm'. When '1 bar every 600 mm' is specified, the first (and last) reinforcing bars are installed at a maximum of 300 mm from the ductwork sections ends (and intervening bars at maximum 600 mm centres).

In this example, with a ductwork section length of 1200 mm, a total of two reinforcing bars are required. In Figure 9C.6, the first and last bars are installed 300 mm from the ductwork section ends.

With a ductwork section width of 1700 mm, Figure 9A.1 indicates that reinforcement is required in this cross-sectional dimension at '2 bars every 600 mm'. When '2 bars every 600 mm' is specified, the first (and last) pairs are installed at a maximum of 300 mm from the ductwork section ends (and intervening bars at maximum 600 mm centres). In this example, with a ductwork section length of 1200 mm, a total of four reinforcing bars (arranged as two pairs) are required. In Figure 9C.6, the first and last pairs of bars are installed 300 mm from the ductwork section ends.

Please note that, as the bars installed in the height dimension coincide with the bars in the width dimension, they should be connected together at the point of intersection, as described in Section 9C.1.1.

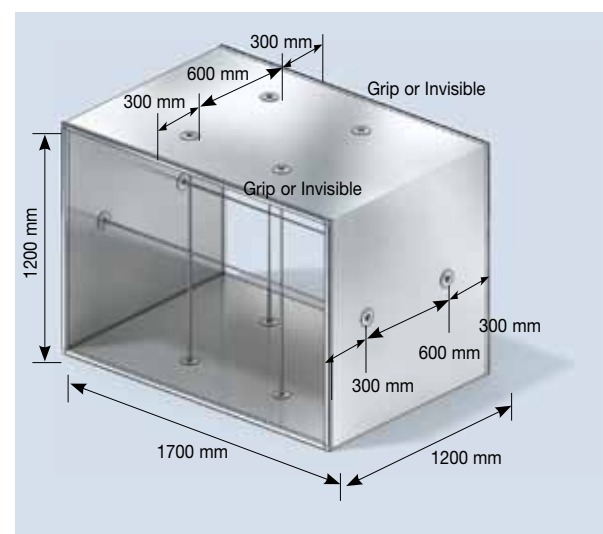


Figure 9C.6 Example 2: Aluminium Grip & Invisible Coupling Systems, 500 Pa

9C.2.2.2 4-bolt Coupling System

With a ductwork section height of 1200 mm, Figure 9A.2 indicates that reinforcement is required in this cross-sectional dimension at '1 bar centred'. When '1 bar centred' is specified, a single reinforcing bar is placed equidistant from both ductwork section ends and at the centre of the cross-sectional dimension in question.

With a ductwork section width of 1700 mm, Figure 9A.1 indicates that reinforcement is required in this cross-sectional dimension at '2 bars centred'. When '2 bars centred' is specified, two reinforcing bars are installed as a pair, equidistant from both the ductwork section ends, and such that the space between reinforcing bars is approximately the same as the space between each bar and its adjacent ductwork section side.

Please note that, as the bars installed in the height dimension coincide with the bars in the width dimension, they should be connected together at the point of intersection, as described in Section 9C.1.1.

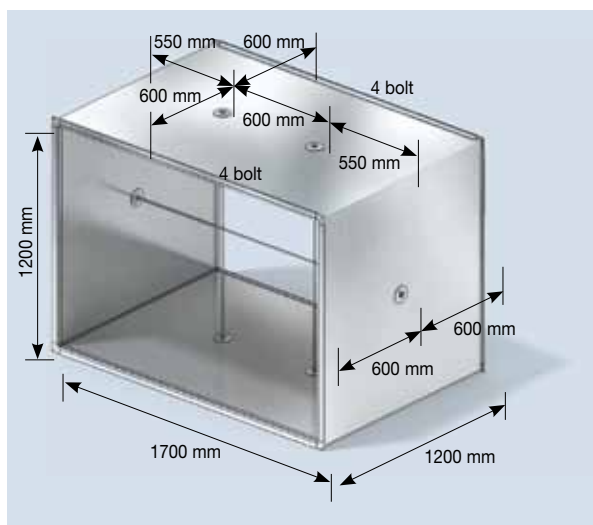


Figure 9C.7 Example 2: 4-bolt Coupling System

9C.2.2.3 Tiger Clip Coupling System

With a ductwork section height of 1200 mm and width of 1700 mm, Figure 9A.3 indicates that it is unsuitable for coupling with the Tiger Clip coupling system.

9C.3 Over-pressure

Ductwork should be designed such that the operating pressure is always less than, or equal to, the design pressure. To eradicate the risk of over-pressure that might exceed the design pressure, and consequently may compromise the integrity of the ductwork system, the installation of a pressure relief damper (PRD) and bypass duct is recommended. During normal operation, the PRD is closed. If the maximum design pressure is exceeded, the PRD will open and redirect some of the airflow back into the fan intake, so maintaining the system pressure inside the ductwork at an acceptable pressure.

10. Coupling Systems

10.1 General

'Coupling' refers to the act of joining ductwork sections to each other. This is commonly referred to as 'jointing'. However, to distinguish it from the act of creating joints during the cutting and assembly phase, this will be referred to as 'coupling' throughout.

Coupling systems are required in all ductwork systems, to connect the individually fabricated ductwork sections, in order to form the complete system. There are four coupling systems currently approved for use with The *Kingspan KoolDuct®* System, the selection of which is dependant upon the intended application:

- the aluminium grip coupling system;
- the 4-bolt coupling system;
- the invisible coupling system; and
- the Tiger Clip coupling system.

There may be some instances where the intended location of *Kingspan KoolDuct®* System ductwork cannot be facilitated by the available coupling systems. In these instances, it may be possible to construct a hybrid coupling system, using a combination of those shown in this section. No such system, however, should be attempted without seeking guidance from Kingspan Insulation.

The integrity of a ductwork system at its coupling points is of paramount importance in achieving lower air-leakage. With this in mind, the following procedures should be adhered to in full.

10.2 The Aluminium Grip Coupling System

The aluminium grip coupling system comprises a two piece assembly, as shown in Figure 10.1, complete with an integral male-female locking mechanism. The external profile can be distinguished from the aluminium grip internal profile by the additional lip for the attachment of the bayonet cleat. It has been specifically designed to complement the unique features of ductwork fabricated from The *Kingspan KoolDuct®* System. It can provide a permanent, minimal air-leakage connection, without the use of adhesive, fastening hardware or corner pieces, whilst also improving rigidity.

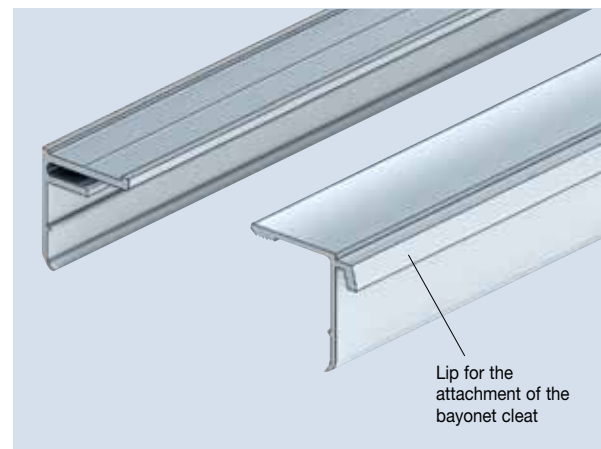


Figure 10.1 Components of the Aluminium Grip Coupling System

10.2.1 Assembly & Attachment

10.2.1.1 Fitting the Aluminum Grip External Profile

One piece of the aluminium grip external profile is required for the end of each ductwork sections being coupled. Only one length is required for each end, as it can be installed as a single piece, by bending it around the perimeter of the ductwork section using the following method.

First, four 'V' shaped, 90° notches are cut out of the profile, in the places indicated in Figure 10.2, using the *Kingspan KoolDuct®* Grip Notcher. Next, a saw is used to cut through the bayonet cleat lip, opposite the apex of the 'V'. Finally, the profile can be bent into the required shape, around the end of the ductwork section.

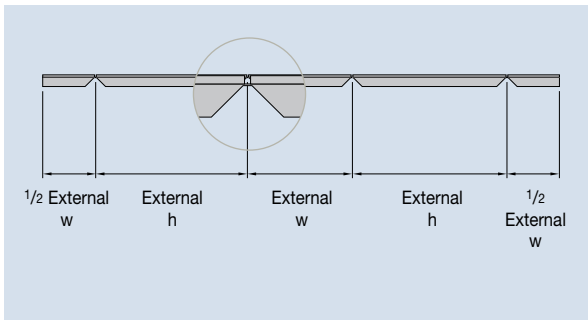


Figure 10.2 Cutting the Aluminium Grip External Profile



Figure 10.3 Bending the Aluminium Grip External Profile

10.2.1.2 Fitting the Aluminum Grip Internal Profile

In order to complete the assembly and to secure the external profile in place, four pieces of the aluminium grip internal profile are required for the end of each ductwork section. Each piece is cut to 5 mm less than the corresponding internal dimension of the ductwork section. The four pieces can then be inserted into the external profile, one on each of the ductwork sections' cross-sectional dimensions, starting with the bottom, followed by the two sides and top (designated as the side where the two ends of the external grip profile meet). They can be gently tapped into position using a rubber hammer (such as that supplied in The *Kingspan KoolDuct®* System Tool Box).

10.2.1.3 Sealing

Finally, a generous bead of silicone sealant is applied, to prevent undesired air-leakage in the following areas (see Figure 10.4):

- in the small gap where the two cut ends of the aluminium grip external profile meet (A);
- in the four internal corners where the sections of aluminium grip internal meet each other (B);
- in the four external corners of the aluminium grip external profile where the two cut edges of the 'V' shaped notches meet (C); and
- if required, behind the lip of the aluminium grip external profile, where it has been bent and meets the external surface of the ductwork section (D).

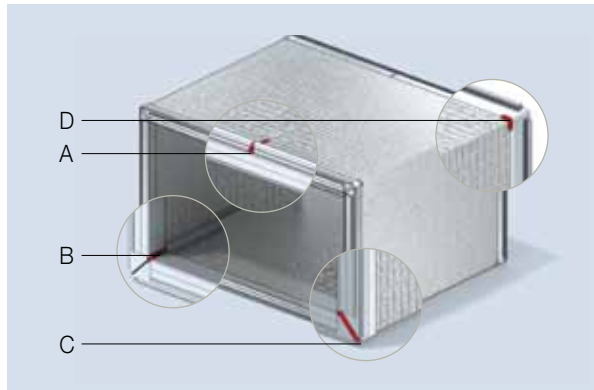


Figure 10.4 Sealing with Silicone Sealant

10.2.2 Coupling

10.2.2.1 Affixing Gasket

Once the aluminium grip profiles have been fully fitted, a strip of self-adhesive gasket is affixed around the end surface of the flanged ductwork section, on one of the two ductwork sections to be coupled, ensuring that the two cut ends of the gasket overlap. The preferred gasket comprises 15 mm wide, and minimum 15 mm thick, polyurethane foam, such as that supplied by Kingspan Insulation.



Figure 10.5 Affixing Self-Adhesive Gasket

10. Coupling Systems

10.2.2.2 Fitting Bayonet Cleats

Bayonet cleats can now be used to couple the ductwork sections together. If they have been accurately fabricated, the bayonet cleat should simply slide into position. However, if required, self-locking pliers (such as the Kool Clamp supplied by Kingspan Insulation), lubricant and a rubber hammer (such as that supplied in The *Kingspan KoolDuct® System Tool Box*) can be used to assist in the process. In order to ensure that the bayonet cleat does not loosen over time, it is important to observe the following:

- the bayonet cleats for the vertical sides of the ductwork should be cut to the same length as the corresponding external cross-section, and should be fitted first; and
- the bayonet cleats for the horizontal sides of the ductwork should be cut to a length equivalent to the external cross-section plus 15 mm, and should be fitted after those for the vertical sides.

These simple safeguarding measures ensure that the vertical bayonet cleats are locked into position.

A generous bead of silicone sealant can also be applied to the ends of each of the bayonet cleats, where they meet the external profile, in order to maximise air-tightness (see Figure 10.7).



Figure 10.6 Fitting Bayonet Cleats

10.2.2.3 Fitting End Caps

Finally, plastic end caps can be fitted to the bayonet cleats, to improve the aesthetics of the ductwork and cover any sharp edges that may be present, as shown in Figure 10.7. Please note that, if silicone sealant has been applied to the ends of the bayonet cleats, then plastic end caps cannot be used.

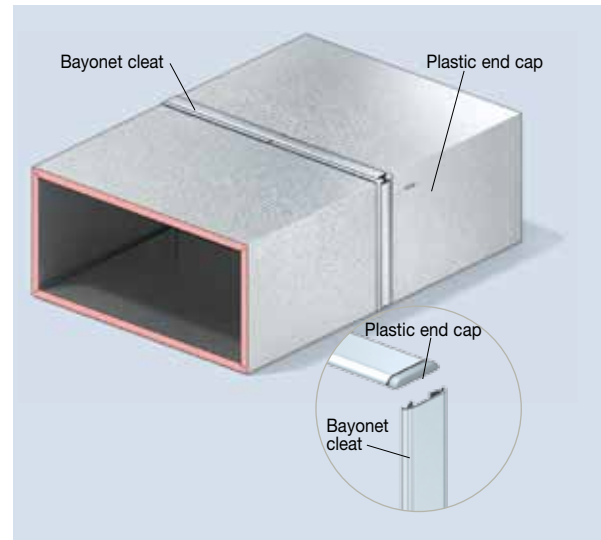


Figure 10.7 Fitting End Caps

10.2.3 High Humidity Environments

In high humidity environments, there is a possibility that cold bridging may result in the formation of condensation on the aluminium grip profiles.

In order to reduce the risk of this occurring, externally insulate the coupling points with strips of *Kingspan KoolDuct®* panel. Carefully tape all joints and exposed insulation, in order to ensure that a continuous vapour seal is maintained on the outside of the *Kingspan KoolDuct®* panel strips. See Figure 10.16.

10.3 The 4-bolt Coupling System

The 4-bolt coupling system utilises special 4-bolt profiles and 4-bolt corner pieces, in conjunction with commercially available mechanical fixings. It has been specifically designed to match the traditional coupling systems commonly used on galvanised sheet metal ductwork systems, and is characterised by its ease of installation and use.

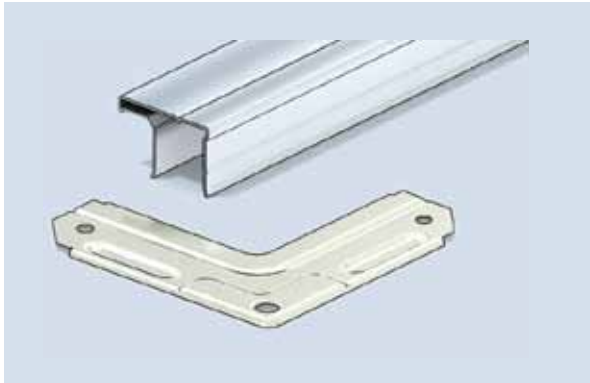


Figure 10.8 Components of the 4-bolt Coupling System

10.3.1 Assembly & Attachment

10.3.1.1 Preparation of the Ductwork Section Ends

Prior to assembling the 4-bolt coupling system, the exposed insulation at the end of both of the ductwork sections being coupled, should be fully sealed with tape, as shown in Figure 10.9. At the ends of the ductwork sections that are to be coupled, a 20 mm wide band of insulation is then gently compressed, as shown in Figure 10.9, using a rigid spatula (such as that supplied in The Kingspan **KoolDuct**® System Tool Box), to enable easy fitting of the 4-bolt profile.

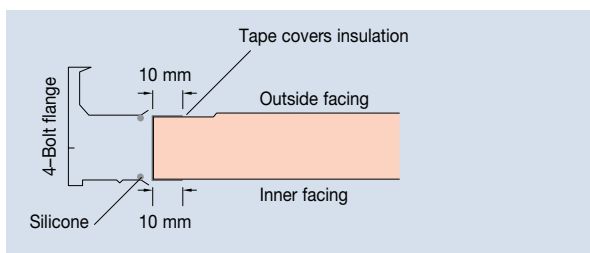


Figure 10.9 Preparation of the Ductwork Section Ends

10.3.1.2 4-bolt Profile Preparation

Four pieces of 4-bolt profile are required for the end of each ductwork section being coupled. Each piece is cut to 20 mm less than the corresponding internal dimension of the ductwork section. The exposed area of bare steel at the cut edges is too small to cause significant corrosion, however we would advise that the cut edges of the 4-bolt profile should be treated with zinc spray, or equivalent, to prevent any corrosion occurring.

The four pieces of 4-bolt profile and the four 4-bolt corner pieces, are combined to make up a rectangular frame of the correct dimensions to fit the ductwork cross-section.

10.3.1.3 Sealing

A generous and continuous bead of silicone sealant is applied to prevent undesired air-leakage in the following areas (see Figure 10.10):

- prior to installation – around the perimeter of the rectangular frame, on the two parts which will be in contact with the surfaces of the panel;
- after installation – around the perimeter of the rectangular frame, where it meets the internal surface of the ductwork section (A);
- after installation – in the four internal corners of the rectangular frame, at the point inside the ductwork where the lengths of the 4-bolt flange meet each other (B);
- after installation – at the point where the lengths of the 4-bolt profile meet the 4-bolt corner pieces (C);
- after installation – on the groove in the 4-bolt corner pieces where they are exposed at the ductwork section's corners (D); and
- after installation – on the rear of the 4-bolt corner pieces where they meet the external surface of the ductwork section (E).

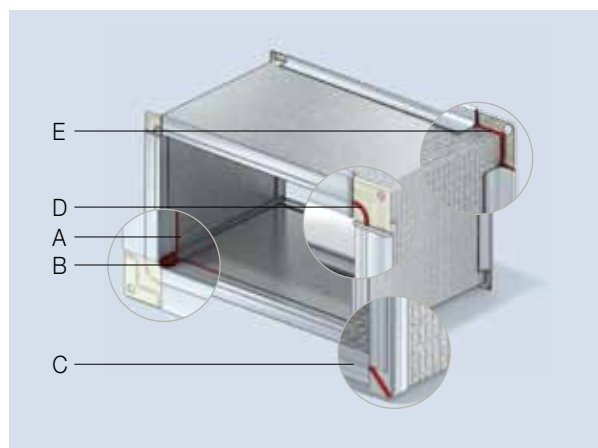


Figure 10.10 Sealing with Silicone Sealant

10. Coupling Systems

10.3.1.4 Fitting the 4-bolt Profile

The completed frame is tapped into position using a rubber hammer (such as that supplied in The *Kingspan KoolDuct®* System Tool Box) (see Figure 10.11). Rivets are optional, and may be used where required. If used, they should pass through both sides of the 4-bolt profile and the insulation. Rivet holes must be pre-drilled.



Figure 10.11 Fitting the 4-bolt Profile

10.3.2 Coupling

10.3.2.1 Affixing Gasket

Once the rectangular frame has been fully attached to the ends of both of the ductwork sections being coupled, a strip of self-adhesive gasket is affixed to one of them, as described in Section 10.2.2.1. Other varieties of gasket can be fit for the purpose intended.

10.3.2.2 Bolting & Clamping

The ductwork sections are then aligned, and appropriately sized bolts loosely fitted through the pairs of aligned holes in each of two diagonally opposite corners (see Figure 10.12).

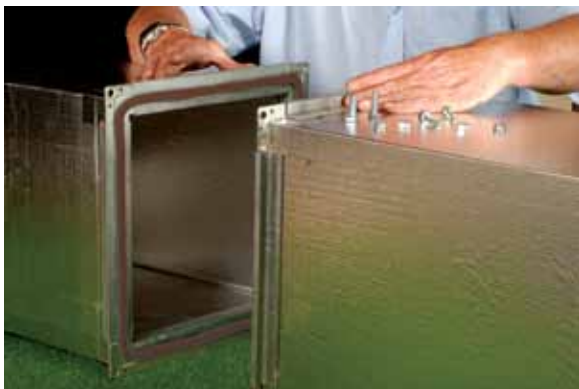


Figure 10.12 Coupling Two Ductwork Sections Together

Fixing clamps are used on all four sides, to secure the two ductwork sections together. They are used in sufficient numbers to ensure that there are no gaps in the seam. The first and last clamps along a side are fitted 75 mm from the corners, and the intervening clamps are fitted at a maximum of 300 mm centres. The bolts are tightened securely.



Figure 10.13 Fixing Clamps

10.3.3 High Humidity Environments

In high humidity environments, there is a possibility that cold bridging may result in the formation of condensation on the 4-bolt profiles. In order to reduce the risk of this occurring, externally insulate the coupling points with strips of *Kingspan KoolDuct®* panel. Carefully tape all joints and exposed insulation, in order to ensure that a continuous vapour seal is maintained on the outside of the *Kingspan KoolDuct®* panel strips. See Figure 10.16.

10.4 The Invisible Coupling System

The invisible coupling system uses aluminium grip profiles, and has been specifically designed for use in situations where ductwork is installed in confined spaces, or where it is visibly mounted and aesthetics are a prime consideration.

10.4.1 Assembly & Attachment

The procedure for attaching an invisible coupling system using aluminium grip profiles is the same as described in Section 10.2.1, except that, in this instance, on one of the two ductwork sections to be coupled, the aluminium grip h profile is used in place of the aluminium grip external profile, and on the other, the aluminium grip U profile is used in place of it.



Figure 10.14 Components of the Invisible Coupling System

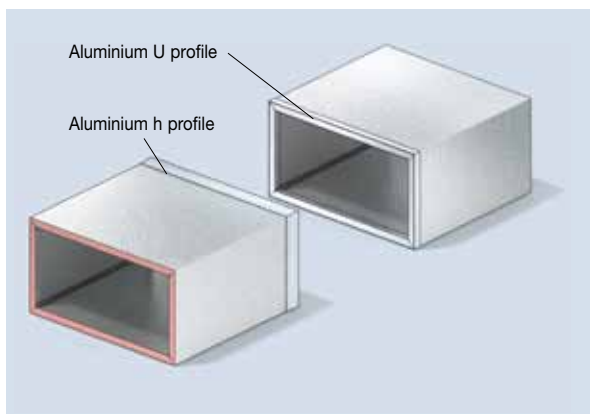


Figure 10.15 Attachment of the Aluminium Grip Profiles

10.4.2 Coupling

10.4.2.1 Affixing Gasket

Gasket is affixed to the end of one of the ductwork sections, as described in Section 10.2.2.1.

10.4.2.2 Riveting

The ductwork sections are aligned and pushed together such that the gasket is fully compressed. They are then permanently fastened together using 35 mm rivets, driven through the flange of the h profile into the U profile.

10.4.3 High Humidity Environments

In high humidity environments, there is a possibility that cold bridging may result in the formation of condensation on the profiles. In order to reduce the risk of this occurring, externally insulate the coupling points with strips of **Kingspan KoolDuct®** panel. Carefully tape all joints and exposed insulation, in order to ensure that a continuous vapour seal is maintained on the outside of the **Kingspan KoolDuct®** panels.

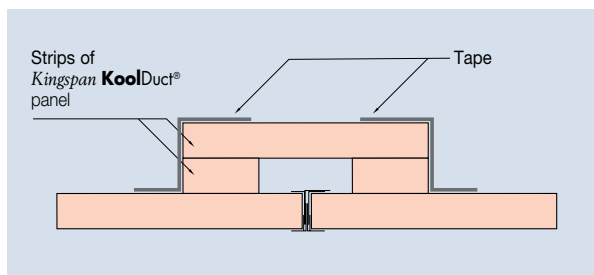


Figure 10.16 External Insulation of Coupling Points

10. Coupling Systems

10.5 The Tiger Clip Coupling System

The Tiger Clip coupling system is an alternative system specifically designed for small, low pressure ductwork. It can, however, be used in specific circumstances with larger, low pressure ductwork. It is critical that, in all circumstances, the static pressure and ductwork size limitations laid out in Table 10.1 are strictly observed. Using the Tiger Clip coupling system can be a highly cost-effective solution for small ductwork, both in terms of material and labour savings.

w or h (mm)	No. Tiger Clips per Side in Addition to Those at Corners	Max. Pressure (Pa)
100–150	0	500
151–300	1	
301–500	2	
501–1000	3	
1001–1156	4	250
1157–1250	4	
1251–1500	5	

Table 10.1 Tiger Clip Placement

Although the fitting of Tiger Clips is straightforward, the procedure detailed below should be strictly adhered to, in order to ensure that they function properly.

Tape is applied to the ends of both of the ductwork sections being coupled, such that all exposed insulation is fully covered.



Figure 10.17 Application of Tape

A generous and continuous bead of silicone sealant is then applied around the end surface, of one of the two ductwork sections.



Figure 10.18 Application of Silicone Sealant

The ductwork sections are aligned, brought together, and one Tiger Clip is fitted and bent round each corner, orientated parallel to the coupling seam. Tiger Clips are then fitted in accordance with Table 10.1, perpendicular to the coupling seam.

The Tiger Clips (including those at the corners) are evenly spaced around the perimeter of the opening, whilst respecting the required number of Tiger Clips per side.



Figure 10.19 Fitting Tiger Clips

Finally, tape is applied around the coupling seam, such that it, and the Tiger Clips, are fully covered.



Figure 10.20 Sealing with Tape

11. Components & HVAC Equipment

11.1 General

Ductwork fabricated from The *Kingspan KoolDuct® System* is extremely versatile, and fully compatible with virtually all standard ductwork components and HVAC equipment.

11.2 Coupling

Components and plant machines are typically manufactured with either a flanged or spigotted connection. The *Kingspan KoolDuct® System* offers a full range of profiles, which enable ductwork fabricated from the System to be coupled to either type of connection.

The methods discussed in Sections 11.2.1 and 11.2.2 can be used for all pressures and sizes of ductwork. For small, low pressure ductwork, an alternative method using Tiger Units is available, which can yield both time and cost savings (see Section 11.2.3).

Please note that when coupling to fans that create substantial vibration, the installation of an anti-vibration flexible joint is recommended.

Also note that the installation of fire dampers and their connection to ductwork should always be carried out in accordance with existing Standards, such as BS 9999 - 2008 (Code of practice for fire safety in the design, management and use of buildings).

11.2.1 Flanged Coupling Methods

11.2.1.1 Method 1: Aluminium U Profile

In this method, the end of the ductwork section is first fitted with either the aluminium grip U profile (formed by fitting the aluminium grip internal profile to the aluminium grip external U profile), or the aluminium structural U profile (using the respective procedures discussed in Sections 10.2.1 and 10.4.1). Next, a strip of self-adhesive gasket is affixed around the entire perimeter of the profile (using the procedure discussed in Section 10.2.2). Finally, the ductwork section is coupled to the component or plant machine, using either rivets or self-tapping screws, in the manner shown in Figure 11.1.

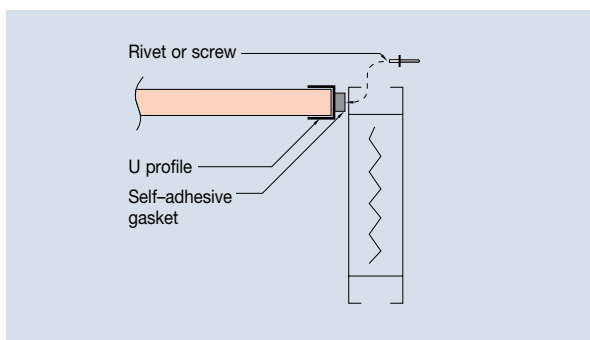


Figure 11.1 Method 1: Aluminium U Profile

11.2.1.2 Method 2: Aluminium F Profile

In this method, the end of the ductwork section is first fitted with either the aluminium grip F profile (formed by fitting the aluminium grip internal profile to the aluminium grip external F profile), or the aluminium structural F profile (using the respective procedures discussed in Section 10.2.1 and 10.4.1). Next, a strip of self-adhesive gasket is affixed around the entire perimeter of the profile (using the procedure discussed in Section 10.2.2). Finally, the ductwork section is coupled to the component or plant machine, using either rivets or self-tapping screws, in the manner shown in Figure 11.2.

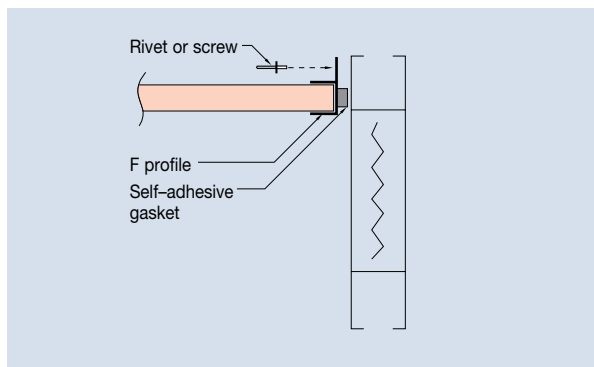


Figure 11.2 Method 2: Aluminium F Profile

11.2.1.3 Method 3: Bolt Coupling Using Aluminium h Profile & Sheet Metal Flange

In this method, the end of the ductwork is fitted with either the aluminium grip h profile (formed by fitting the aluminium grip internal profile to the aluminium grip external h profile), or the aluminium structural h profile. Next, the flange of the aluminium h profile is fitted with a standard sheet metal flange. Finally, a strip of self-adhesive gasket is affixed around the entire perimeter of the sheet metal flange (using the procedure discussed in Section 10.2.2), and the ductwork sections securely coupled together using bolts, as shown in Figure 11.3.

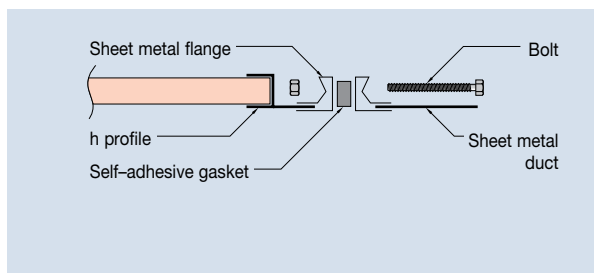


Figure 11.3 Bolt Coupling Using Aluminium h Profile & Sheet Metal Flange

11. Components & HVAC Equipment

11.2.1.4 Method 4: 4-bolt Coupling System

In this method the end of the ductwork section is first fitted with the 4-bolt coupling system, in the manner discussed in Section 10.3.1. Next, a strip of self-adhesive gasket is affixed around the entire perimeter of the 4-bolt profile (using the procedure discussed in Section 10.3.2). Finally, the ductwork section is coupled to the component or plant machine, with bolts and clamps.

Please ensure that the depth of the 4-bolt profile is taken into account for alignment purposes, and care should be taken to ensure that the external dimensions of the 4-bolt assembly match the external dimensions of the flange on the component, such that the 4 bolts and clamps can be used.

11.2.2 Spigotted Coupling Methods

11.2.2.1 Method 1: Aluminium h Profile

In this method, the end of the ductwork section is first fitted with either the aluminium grip h profile (formed by fitting the aluminium grip internal profile to the aluminium grip external h profile), or the aluminium structural h profile (using the respective procedures discussed in Sections 10.2.1 and 10.4.1). The ductwork is coupled to the component or plant machine, using rivets or self-tapping screws, in the manner shown in Figure 11.4. Please note that gasket is not required when using this method.

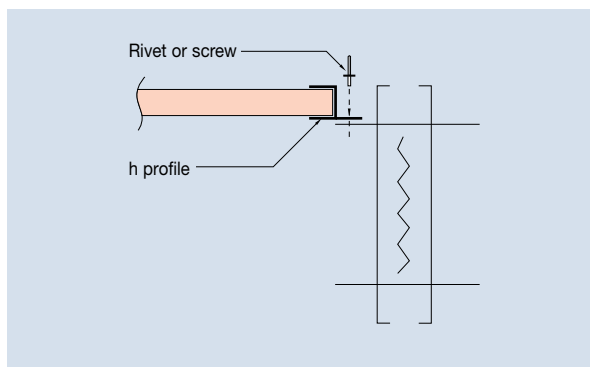


Figure 11.4 Method 1: Aluminium h Profile

11.2.2.2 Method 2: Aluminium U Profile

In this method, the end of the ductwork section is first fitted with either the aluminium grip U profile (formed by fitting the aluminium grip internal profile to the aluminium grip external U profile), or the aluminium structural U profile (using the procedures discussed in Sections 10.2.1 and 10.4.1). Next, a strip of self-adhesive gasket is affixed around the entire perimeter of the profile (using the procedure discussed in Section 10.2.2). Finally, the ductwork is coupled to the component or plant machine, using rivets or self-tapping screws, in the manner shown in Figure 11.5.

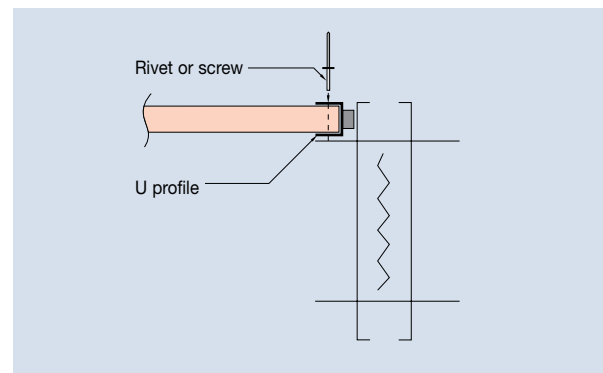


Figure 11.5 Method 2: Aluminium U Profile

11.2.2.3 Method 3: 4-bolt Coupling System

This method is performed in the same manner as Method 2, with the exception that the ductwork section is fitted with the 4-bolt coupling system (using the procedure discussed in Section 10.3.1).

11.2.2.4 Method 4: Conversion to Flanged Coupling System

A rectangular spigot can be converted into a flange by affixing a sheet metal flange to the spigot, as shown in Figure 11.6, and then any of the flanged coupling methods described in 11.2.1 can be used.

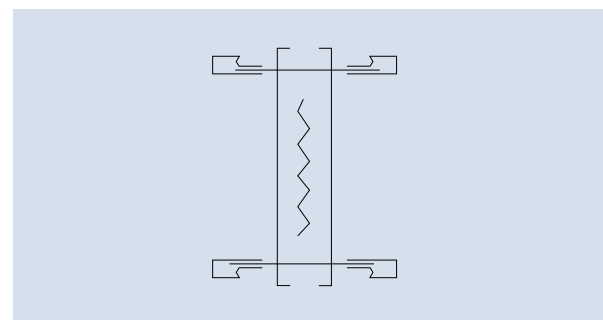


Figure 11.6 Method 4: Conversion to Flanged Coupling System

11.2.2.5 Alternative Method: Fire Dampers Only

In addition to the above methods, there is an alternative that can be used to couple ductwork fabricated from The **Kingspan KoolDuct® System** to fire dampers. In this method, the end of the ductwork section is first fitted with either the aluminium grip h profile (formed by fitting the aluminium grip internal profile to the aluminium grip external h profile), or the aluminium structural h profile. It can then be coupled to the fire damper using an 'S' support connector as shown in Figure 11.7. Please note that gasket is not required when using this method.

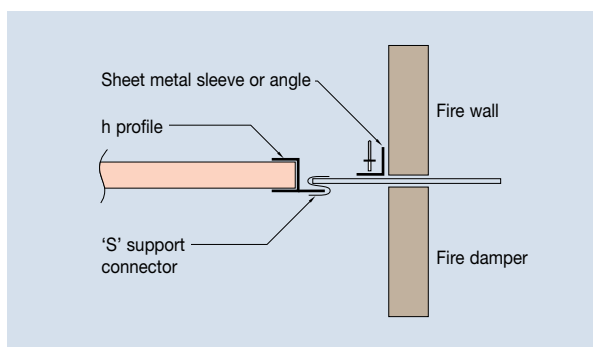


Figure 11.7 Alternative Method: Fire Dampers Only

The installation of fire dampers and their connection to ductwork should always be carried out in accordance with existing Standards, such as BS 9999 - 2008 (Code of practice for fire safety in the design, management and use of buildings).

11.2.3 Tiger Unit Coupling Methods

The Tiger Unit (see Figure 11.8) is an alternative coupling system, which can be used to couple ductwork sections fabricated from The **Kingspan KoolDuct® System** to any flanged or spigotted component, or plant machine. Its use is confined to smaller ductwork (maximum perimeter of 2000 mm) and lower pressures (≤ 250 Pa). Like the Tiger Clip coupling system, it can be a highly cost-effective solution, both in terms of materials and labour.

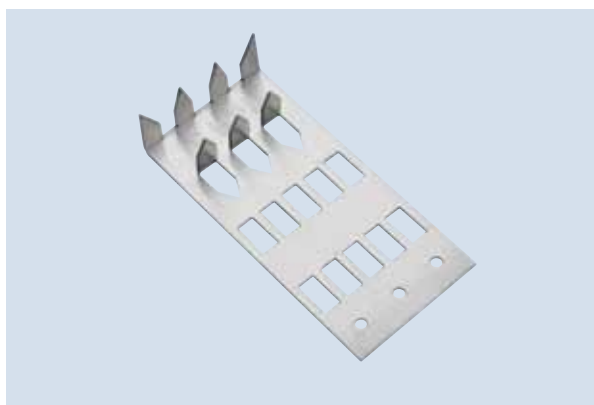


Figure 11.8 Tiger Unit

11.2.3.1 Use with Flanged Components / Plant

When coupling ductwork sections fabricated from The **Kingspan KoolDuct® System** to components or plant machines with a flanged connection, the Tiger Unit should first be bent through an angle of 90° , to create a complimentary flange through which connection can take place. Next, and prior to attaching the Tiger Unit, the exposed insulation at the end of the ductwork section is fully covered with tape. Then, the Tiger Unit is pushed into place and secured in position with tape. Finally, the ductwork section can then be coupled to the component or plant machine, using either rivets or self-tapping screws, in the manner shown in Figure 11.9.

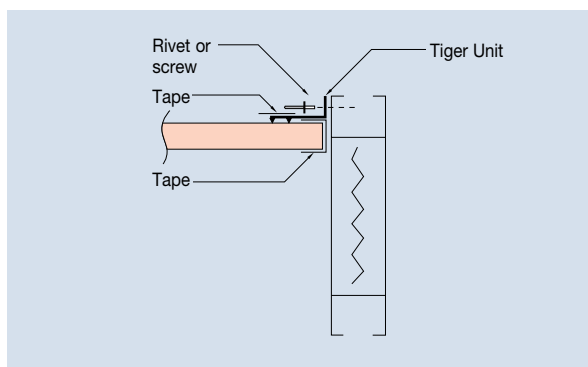


Figure 11.9 Use of the Tiger Unit with Flanged Components / Plant

11.2.3.2 Use with Spigotted Components / Plant

When coupling ductwork sections fabricated from The **Kingspan KoolDuct® System** to components or plant machinery with a spigotted connection, the Tiger Unit is used as supplied (i.e. not bent), to provide a surface through which mechanical fixings can be driven. The exposed insulation at the end of the ductwork section is fully covered with tape. Then, the Tiger Unit is pushed into place, such that one of its ends is flush with the end of the ductwork section, and secured in position with tape. Finally the ductwork section can be coupled to the component or plant machinery, using rivets or self-tapping screws, in the manner shown in Figure 11.10.

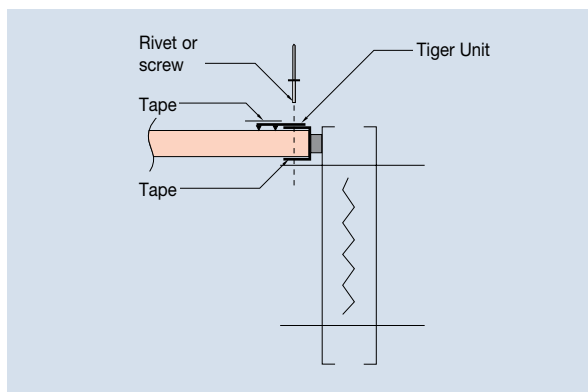


Figure 11.10 Use with Spigotted Components / Plant

12. Access Doors

12.1 General

Access doors are required in HVAC ductwork systems for visual control, cleaning and maintenance. Ductwork fabricated from The *Kingspan KoolDuct® System* offers the flexibility of cutting access doors before or after the ductwork is installed.

12.2 Access Door Design

The intended purpose of an access door should be taken into account when deciding its size.

There are two types of access door which can be fitted to The *Kingspan KoolDuct® System*:

- access doors fabricated from *Kingspan KoolDuct®* panel; and
- insulated pre-fabricated doors (either square or oval).

12.3 Access Door Fabrication / Installation

Regardless of the type of access door, the preparatory work performed on the ductwork is the same. The outline of the access door is marked on to the ductwork section's external surface, then cut out using a jack plane with a 90° angle (such as that supplied in The *Kingspan KoolDuct® System* Tool Box). Finally, to give rigidity and to provide an anchor point for the access door, the perimeter of the door opening is fitted with the aluminium grip U profile (formed by fitting the grip internal profile to the grip external U profile), or the aluminium structural U profile.

12.3.1 *Kingspan KoolDuct®* Panel Access Doors

When an access door is to be fabricated from *Kingspan KoolDuct®* panel, the piece that was cut out of the ductwork to form the opening can be used as the door. The cut out piece is trimmed by 25 mm on both width and height, and the perimeter of the door is fitted with the aluminium grip h profile (formed by fitting the grip internal profile to the grip external h profile), or the structural h profile. Then, a strip of self-adhesive gasket is affixed to the flange of the h profile, on the side which will be in contact with the door frame.

Finally, the door is placed into position and fixed to the door frame through the flange of the profile, using self-tapping screws, such that it can be removed when required. Care should be taken to ensure that the gasket is fully compressed in order to provide a tight seal.

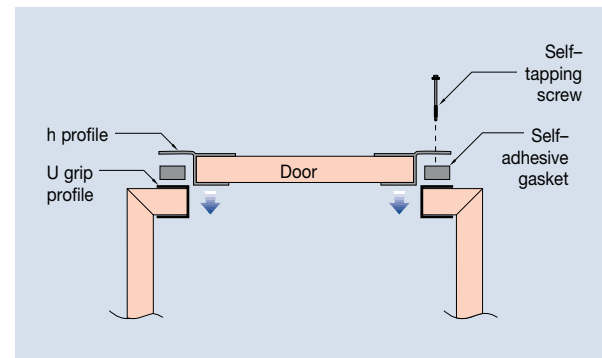


Figure 12.1 *Kingspan KoolDuct®* Panel Access Door

12.3.2 Insulated Pre-fabricated Access Doors

Insulated pre-fabricated access doors are available in a variety of sizes to suit many different applications, and are fitted using the following method.

First, the door frame is placed in position, and fixed to the U profile as shown in Figure 12.2, using rivets or self-tapping screws. Care should be taken to ensure that the gasket is fully compressed, in order to provide a tight seal. Finally, a generous and continuous bead of silicone sealant is applied around the perimeter of the access door frame, at the seam between it and the external surface of the ductwork section. Please note that when an oval access door is used, it will be extremely difficult to fit the entire perimeter of the access door with a profile. It is therefore acceptable to fit it with four or more smaller pieces of profile, in the manner discussed for shoe branches in Section 7.5.2.1. Fixing and sealing is performed as above, and all exposed insulation should be fully covered in tape.

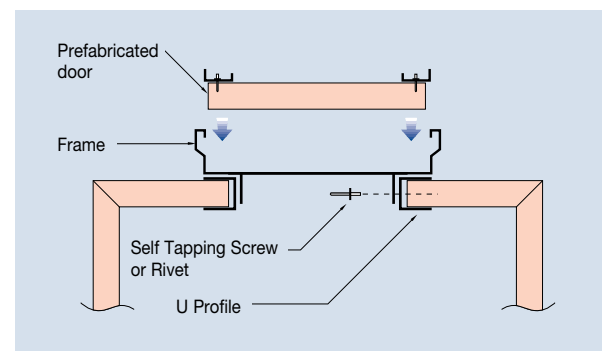


Figure 12.2 Fitting Insulated Pre-fabricated Access Doors

13. Multiple Ducts

13.1 General

A multiple duct consists of two or more dimensionally similar ductwork sections, connected together to perform the same function as a much larger single section. Multiple ducts comprising two ductwork sections (dual ducts) are the most common, but multiple ducts containing any number of sections (see Figure 13.1) can be fabricated, provided the guidelines below are followed.

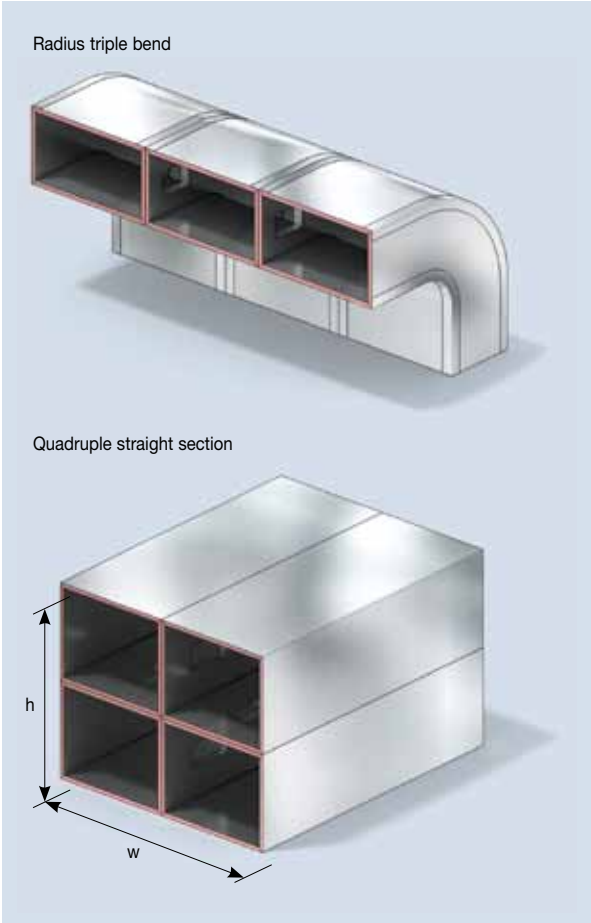


Figure 13.1 Multiple Ducts

13.2 Multiple Duct Design

The multiple duct method should be considered as an alternative to Methods 5–8 (see Straight Ductwork Section), for the following dimensions:

Thickness (mm)	Dimensions w and/or h (mm)
22	> 1156
30	> 1140
42	> 1116

Please note that with multiple ducts, the shared walls can be treated as if they were not there when determining the internal dimensions of the duct. It is the internal dimensions of the outside walls of the combined duct that must match the ductwork dimensions in the project specification.

13.3 Multiple Duct Fabrication

The component ductwork sections of a multiple duct, are fabricated using the appropriate method as detailed in previous sections.

Once the component ductwork sections of a multiple duct have been assembled, they should be mechanically fixed together using, for example, the inner reinforcing bar, reinforcing disc and speed clips, as illustrated in Figure 13.2.

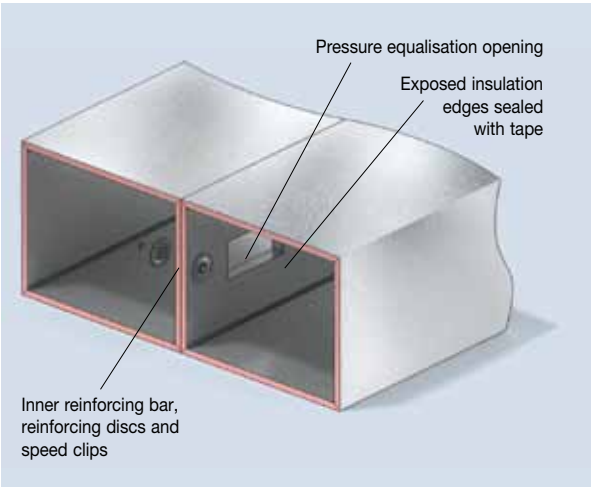


Figure 13.2 Multiple Duct Fabrication

In order to ensure an equivalent and balanced pressure in all of the ductwork sections, circular or rectangular openings are cut in their shared walls. This is an absolute requirement where multiple ducts feed branch ductwork. The openings should be sized such that they take up approximately 5% of the area of the shared walls. For example, for a ductwork section with shared wall dimensions 1000 mm (h) x 2000 mm (l), two openings 300 mm x 300 mm each are required. The exposed insulation around the perimeter of the hole should be fully covered with tape.

13. Multiple Ducts

13.4 Multiple Duct Coupling

Multiple ducts are coupled together in a similar manner to that discussed in Section 10 for standard ductwork fabricated from The *Kingspan KoolDuct® System*. Multiple ducts are treated as a single ductwork section, and the coupling system is installed around the perimeter of the whole multiple duct, as shown in Figure 13.3. At those points where the shared walls of the component ductwork sections meet the perimeter of the combined duct, and therefore interrupt where the coupling system will be placed, a slit is cut into the insulation, using a sharp edge (such as the knife supplied in the *Kingspan KoolDuct® System Tool Box*), to allow the flange of the profile to be inserted.

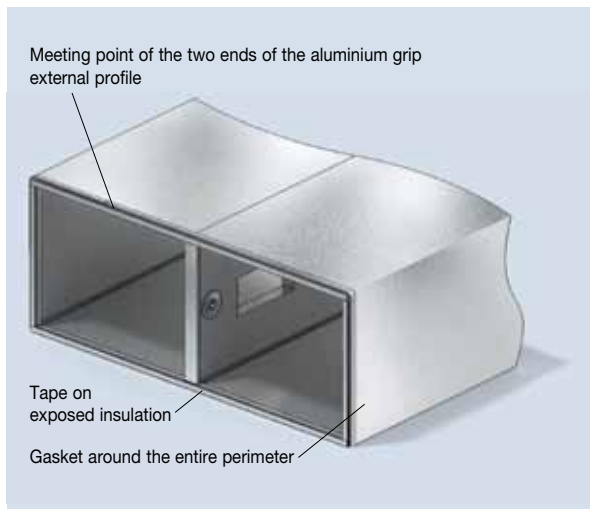


Figure 13.3 Multiple Duct Coupling

Please note that when the aluminium grip coupling system is used, care should be taken to ensure that the place where the two ends of the aluminium grip external profile meet, when it is folded round the duct perimeter, does not coincide with the junction between two component ductwork sections.

Any exposed insulation on the shared walls which has not been flanged should be fully covered with tape.

13.5 Multiple Duct Reinforcement

The rules discussed for ductwork section reinforcement in Section 9, is applicable to multiple ducts. When considering reinforcement, each component ductwork section is separately assessed.

Please note that reinforcement is generally added after the component ductwork sections have been fastened together.

14. Protective & Decorative Finishes

14.1 General

Ductwork sections fabricated from The *Kingspan KoolDuct® System* do not generally require any additional protection, for conventional indoor installations. This is because the panels from which the ductwork is fabricated are faced on both sides with a protective and durable reinforced aluminium foil. This facing, however, is not suitable for outdoor or underground applications, certain chemical environments, and some special indoor applications where the risk of mechanical damage is high. In such instances, an additional protective layer should be employed.

Sometimes it can be desirable, for aesthetic purposes, to paint the ductwork to allow it to blend in, or stand out, in a particular location. If this is the case, please refer to the guidelines in Section 14.5.

Please check that the recommendations below meet the requirements of the project specification, and any locally applicable laws and regulations.

14.2 Protection of Indoor Ductwork

14.2.1. Design

Care should always be taken to locate ductwork in areas where it will be at little risk of physical damage. Where this is unavoidable, such as in plant rooms, a protective finish of metal cladding should be employed. These include:

- aluminium sheet; and
- aluminium–zinc alloy coated steel sheet.

14.2.2 Fabrication of Clad Ductwork Sections

There are a wide variety of methods which can be used to clad ductwork, both during fabrication and in situ. However, the following method is preferable, as it produces robust, fully integrated and highly aesthetic ductwork. In addition, ductwork sections fabricated using this method can still be installed in a single-fix.

First, an oversized shell is fabricated from the cladding material. Remember that quoted ductwork section sizes are always for the internal dimensions, so, for example, a 200 mm x 300 mm ductwork section fabricated from 22 mm *Kingspan KoolDuct®* panels will require a shell with internal dimensions of 244 mm x 344 mm.

Next, *Kingspan KoolDuct®* panels are used to internally line the shell, and are glued into position, using an appropriate adhesive. Please note that mitred edges are not necessary, the panel is used purely as a liner.

Then, the aluminium grip coupling system, or 4-bolt coupling system, is attached to the composite product, in the same manner as described for standard ductwork in Sections 10.2.1 and 10.3.1.

Next, aluminium rivets are used, to secure the coupling system to the ductwork. They are positioned at max. 300 mm centres around the perimeter of the profiles, with no fewer than two per side.

Finally, all internal seams between panels are sealed in the same manner as described in Section 2.7, with a generous and continuous bead of silicone sealant.

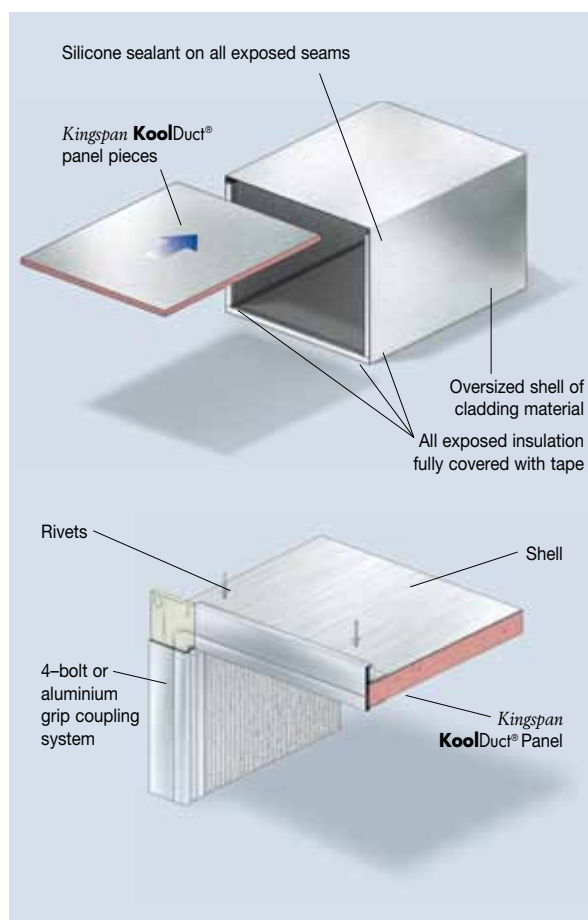


Figure 14.1 Protection of Internal Ductwork

14. Protective & Decorative Finishes

14.3 Protection of Outdoor Ductwork

14.3.1 Design

Ductwork that is installed outdoors, and exposed to the elements, should be adequately weather-protected. There are a number of cladding systems available, that provide a protective finish, and are compatible with ductwork fabricated from The *Kingspan KoolDuct®* System.

These include:

- aluminium sheet;
- aluminium–zinc alloy coated steel sheet;
- heavy–duty self–adhesive laminate;
- synthetic elastomeric jacketing;
- reinforcing glass / synthetic cloth embedded between two coats of appropriate coating; or
- UV resistant glass reinforced polyester / epoxy (GRP / GRE).

Protective finishes which have a tenting effect and lack long term durability are to be avoided. For resistance to bird attack, please refer to the cladding manufacturers' guidelines.

Please note that it is the responsibility of the ductwork system designer to specify the protective finish, and any special construction requirements, prior to the fabrication process. In the interests of system integrity, all protective finishes should be applied in a factory controlled environment, prior to installation of the ductwork.

14.3.2 Installation

All protective weatherproof finishes should be installed in accordance with the relevant manufacturer's instructions.

Regardless of the type of finish installed, all coupling points must be fully weatherproofed, to help to prevent any moisture ingress into the ductwork system. This can be achieved by applying the same protective weatherproof finish, as used for the ductwork sections, at these coupling points.

Please note that cladding overlaps on all seams shall be sufficient and all joints shall be sealed water-tight. Where practical, horizontal flat cladding shall have a fall or slope to shed water and avoid pooling.

14.4 Protection Against Chemical Attack

When ductwork fabricated from The *Kingspan KoolDuct®* System is specified for environments in which it could come under chemical attack, details of the chemicals involved, concentration and application, should be submitted, prior to use, to Kingspan Insulation for advice on the product's suitability.

14.4.1 Swimming Pools

The ambient air in swimming pools does not affect the integrity of ductwork fabricated from The *Kingspan KoolDuct®* System, when an aluminium coupling system (such as the aluminium grip or tiger clip coupling systems) is used.

Ductwork fabricated from the *Kingspan KoolDuct®* System can usually be installed in swimming pools, without the need for additional protection. However, in rare instances, staining can occur on untreated aluminium surfaces, and, where this an aesthetic concern, painting (see Section 14.5) should be considered.

14.5 Decorative Finishes

Ductwork fabricated from The *Kingspan KoolDuct®* System can be painted for aesthetic purposes. When selecting paint, it should be suitable for use on aluminium surfaces, and consideration should be given to any effect that it might have on the thermal and fire performance of the insulation and its factory applied aluminium foil vapour barrier facing.

Although the application of a primer coat is generally recommended, this may not be required for certain polyurethane based paints. For further details please contact Kingspan Insulation.

Please note that paint is not an acceptable weatherproofing solution for outdoor installations.

15. Hangers & Supports

15.1 General

Hangers and supports are essential components of any ductwork system, regardless of the material from which it is manufactured. As a result of the low weight nature of ductwork fabricated from The *Kingspan KoolDuct®* System, hangers and supports need not be as heavy, or as numerous, as those required for sheet metal ductwork.

15.2 Hanger & Support Design

Hanger and support systems should be designed such that they are fit for the purpose intended. Due to the large variety of support systems available, and the wide range of materials used to fix the systems to structures, the Trained Fabricator / Installer should assume full responsibility for hanging and supporting ductwork fabricated from The *Kingspan KoolDuct®* System in accordance with the project specification.

Please note that the strength of hangers and supports required, is dependent on the weight of the ductwork section being hung. The weight of a ductwork section fabricated from The *Kingspan KoolDuct®* System is dependant not only on its dimensions, but also the coupling system and finish used. For information only, three tables of estimated weights for straight ductwork are included in Appendix C and Appendix D. The actual weight of the ductwork section should always be independently determined by the Trained Fabricator / Installer, and the appropriate gauge of hanger chosen, in accordance with the relevant manufacturer's guidelines. In all instances, the support structure should be appropriate for the specific design, and the sequence of installation.

When fixing ductwork fabricated from The *Kingspan KoolDuct®* System to building structures, the principles laid out in B&ES DW/144 Part 6: Hangers and Supports, or equivalent guidance, should be followed, whilst bearing in mind the lower weight of the System.

15.3 Conventional Hangers & Supports

The most common types of hangers used with ductwork fabricated from The *Kingspan KoolDuct®* System are:

- threaded steel rods;
- wire ropes;
- chains; and
- flat straps.

The most common type of supports used with ductwork fabricated from The *Kingspan KoolDuct®* System are metal angles or channels (e.g. Unistrut channel or equivalent). Metal angles and channels can be used with ductwork of any dimensions.

Note that the couplings used with The *Kingspan KoolDuct®* System are not designed to carry the load of vertically orientated ductwork.



Figure 15.1 Conventional Hangers & Supports for Vertical Ductwork

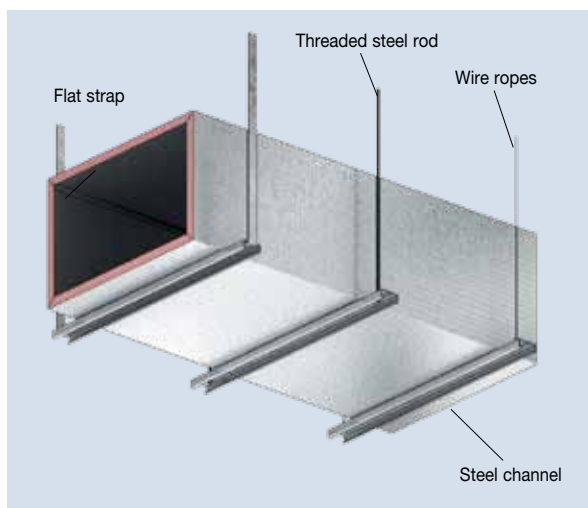


Figure 15.2 Conventional Hangers & Supports for Horizontal Ductwork

15. Hangers & Supports

15.4 Tiger Supports

Tiger Supports have been specifically designed to complement the low weight nature of ductwork fabricated from The **Kingspan KoolDuct® System**, and they can be a highly cost-effective solution, both in terms of materials and labour. When used in conjunction with vertically orientated ductwork, or with wire support systems (see section 15.5), they can be used with ductwork of any dimensions. When using Tiger Supports in conjunction with horizontally orientated ductwork, they should only be used up to a maximum ductwork section size (w and/or h) of 700 mm.

15.4.1 Vertically Orientated Ductwork

When used to support vertically orientated ductwork, Tiger Supports are used in conjunction with 6–8 mm threaded steel rods. Four Tiger Supports are installed at each support centre (one on each corner), by pushing the metal spikes into the ductwork and applying tape as shown in Figure 15.3. Each threaded steel rod passes through the attachments of two Tiger Supports, one on either side of the ductwork section, and is secured in place with an appropriately sized washer and nut. A more robust support can be created by applying silicone sealant, as an adhesive, between the Tiger Supports and the external surface of the ductwork.

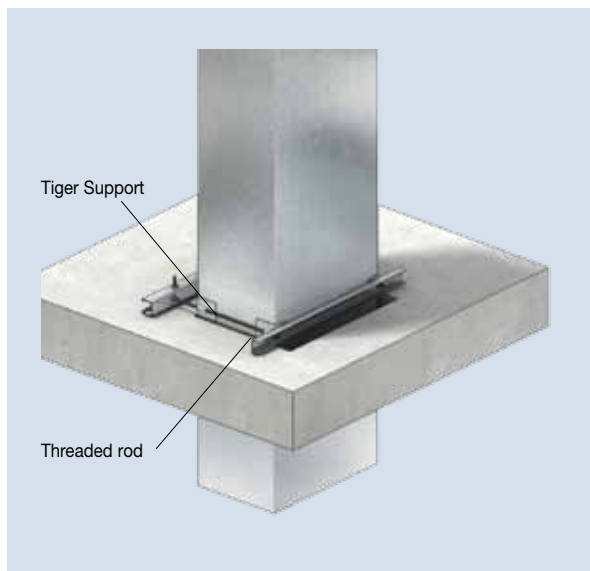


Figure 15.3 Tiger Supports on Vertically Orientated Ductwork

15.4.2 Horizontally Orientated Ductwork

When used to support horizontally orientated ductwork, Tiger Supports can be used in conjunction with either 6–8 mm threaded steel rods or wire ropes. Regardless of which is used, two Tiger Supports are first installed at each support centre, by pushing the metal spikes into the underside of the ductwork and applying tape as shown in Figure 15.4, such that no part of the Tiger Support is visible underneath the ductwork section. When threaded steel rods are used, they pass through the attachment on the side of the Tiger Support, and are secured in position with an appropriately sized washer and nut. When wire ropes are used, it should be threaded through the attachment on the side of the Tiger Support, and secured to the Tiger Support in accordance with the wire manufacturer's recommendations.

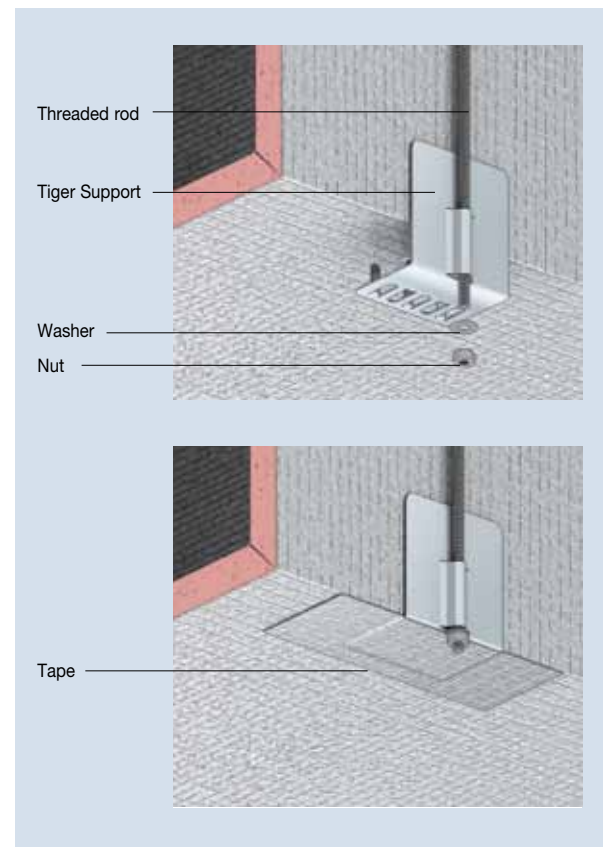


Figure 15.4 Tiger Supports on Horizontally Orientated Ductwork: Threaded Bar

15.5 Wire Support Systems

Wire support systems, which feature a wire that wraps around the ductwork, can also be used, but should be installed in accordance with the recommendations of its manufacturer and with additional protection at ductwork corners, to prevent the wires cutting into the insulation panels.

Tiger Supports can be used for this protection, with the added benefit that, if the wire is threaded through the tubular attachment on the side of the Tiger Support, as shown in Figure 15.5, it can not slip off the protection. If Tiger Supports are used, they should be installed as described in Section 15.4.2.

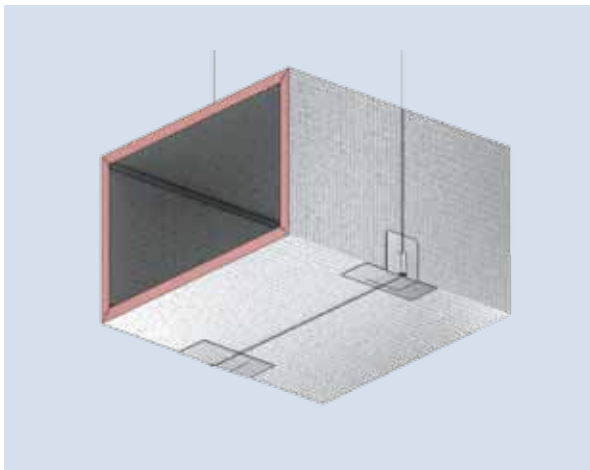


Figure 15.5 Wire Support System

15.6 Hanger & Support Placement & Spacing (excl. Wire Hangers / Support Systems)

It is the sole responsibility of the Trained Fabricator / Installer to accurately determine both the placement and spacing of hangers and supports. However, general information and recommendations are given below, in accordance with the principles of B&ES DW/144.

15.6.1 Vertically Orientated Ductwork

For vertically orientated ductwork, supports should be anchored at each floor slab level, but if the floor slab spacing exceeds four metres, the ductwork system designer should specify any additional support requirements.

When supporting vertically orientated ductwork, each riser and downstand should have at least one support centre.

Where possible, supports should be installed underneath the base of vertically oriented ductwork that is not supported on a load bearing substrate.

15.6.2 Horizontally Orientated Ductwork

Supports on horizontal ductwork should be positioned as per the recommendations in Table 15.1. Please note that narrower spacing may be required, due to the limitations of the building structure or to achieve the necessary rigidity.

Table 15.1 is applicable to hangers such as threaded bars and metal straps, and supports such as metal channels, metal angles and Tiger Supports. It may not be applicable to wire hangers or wire support systems.

Largest Cross-Sectional Dimension (mm)	Recommended Maximum Hanger & Support Centres (mm)
≤ 1156	2950 / 3930 i.e. the maximum length of the ductwork section
1157–2000	1800
> 2000	Special analysis required. Please contact Kingspan Insulation

Table 15.1 Recommended Hanger & Support Centres

15. Hangers & Supports

15.6.3 Components / HVAC Equipment

All components, such as fire dampers, volume control dampers (VCDs), mixing boxes, humidifiers etc, should be fully and independently supported.

15.6.4 Branch Connections

Supports on branch connections should be placed as close to the main ductwork as possible.

15.6.5 Changes in Direction

Support is required at every change of direction, such as elbows, offsets and branches. Care should be taken to ensure that heavier fittings, such as square elbows fitted with turning vanes, are sufficiently supported.

15.6.6 Noise & Vibration

If noise and vibration generated by the fan is likely to cause an issue, they can be reduced by placing strips of *Kingspan KoolDuct®* panel in between the supports and the ductwork itself (as shown in Figure 15.6). These should be cut to measure any exposed insulation fully covered with tape.

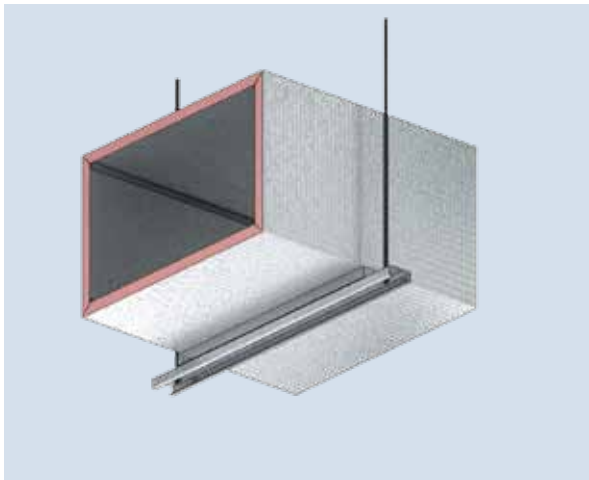


Figure 15.6 Reducing Noise & Vibration

15.6.7 Supporting Outdoor Ductwork

Support systems for outdoor ductwork should be individually designed to suit the particular circumstances. Designers should specify supports which are appropriate for the intended application. In particular, it is recommended that outdoor ductwork is fully restrained.

If a ductwork system is to be installed on a roof, it should be designed to withstand the wind and snow loads laid out in the latest edition of the relevant building design standard or code. All ancillary pieces, attachments and access panels that could potentially work loose, should be securely fastened with a locking device approved by the equipment manufacturer.

If this is not practical, then it is recommended that ductwork systems should be located within the building, or in a concrete block enclosure.

15.7 Wire Ropes / Support System Placement & Spacing

The spacing required for wire ropes / support systems, depends upon the gauge and strength of the proposed wire cable / support system and the ductwork size and weight. Please refer to the wire ropes / support system manufacturer for guidance on spacings.

16. Damage Repair

16.1 General

Localised damage to ductwork fabricated from The *Kingspan KoolDuct® System* can be repaired in-situ in an efficient and economical manner, as opposed to replacing an entire ductwork section, which could be the case with some other ductwork systems.

Completed ductwork sections fabricated from The *Kingspan KoolDuct® System* should be free from any punctures and tears in the facing. Any damage should be repaired using the procedures below.

16.2 Repair Procedure

The precise method of repair will depend on the extent of the damage.

16.2.1 Superficial Damage

Superficial damage such as small tears, punctures and indentations in the facing can be repaired simply, by using tape to cover the damage and restore the vapour barrier.

16.2.2 Substantial Damage

More substantial damage, than that which can be repaired simply with tape, should be cut out and replaced.

First, an outline, fully encompassing the damaged area, is marked on the ductwork section.

Next, a small jack plane with a 45° angle is used to cut out the damaged piece, such that the resulting exposed insulation has a bevelled edge. Once removed, the damaged piece can be used as a template to trace the outline of an identical replacement piece. The identical replacement piece is cut out with the same jack plane.

Then, tape is applied to the exposed bevelled edges on both the ductwork section and the replacement piece, such that all exposed insulation is fully covered with tape, prior to fitting.

Next, a generous and continuous bead of silicone sealant is applied to the taped bevelled edge on the ductwork section, and the replacement piece is fitted with the assistance of Tiger Clips around the perimeter.

Finally, all exterior seams are fully covered with tape.

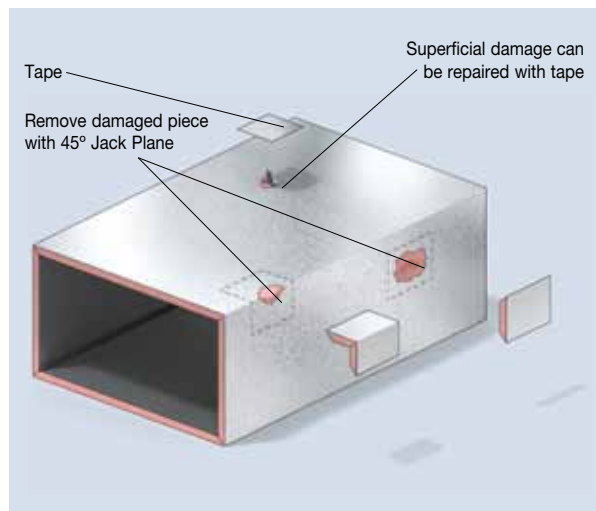


Figure 16.1 Damage Repair Procedure

17. Cleaning

17.1 General

When required, ductwork fabricated from The *Kingspan KoolDuct® System* should be cleaned in accordance with the principles of BS EN 15780: 2011, BS EN 13403: 2003, NADCA ACR: 2006 or B&ES (HVCA) TR/19, using many of the dry and non-abrasive cleaning methods offered through professional HVAC ductwork cleaning specialists.

Standard	Title
BS EN 15780: 2011	Ventilation for buildings – Ductwork – Cleanliness of ventilation
BS EN 13403: 2003	Ventilation for Buildings. Non-metallic ducts. Ductwork made from insulation duct boards
NADCA ACR: 2006	National Air Duct Cleaners Association: Assessment, Cleaning & Restoration of HVAC Systems
B&ES (HVCA) TR/19	Building & Engineering Services Association (formerly known as the Heating & Ventilation Contractors' Association) – Guide to Good Practice – Internal Cleanliness of Ventilation Systems, 2005 Edition

Table 17.1 Ductwork Cleaning Standards

17.2 Cleaning Methods

It is recommended that ductwork fabricated from The *Kingspan KoolDuct® System* is cleaned by the following dry cleaning methods only:

- an air nozzle, comprising a perforated plastic ball placed on the end of a flexible hose, which uses low or high volume compressed air;
- an air lance, which directs low volume compressed air locally through an airgun with a trigger;
- mechanical brushing with a soft and non-abrasive rotary brush to brush the surface of the ductwork;
- hand wiping and manual brushing with soft and non-abrasive materials; and
- electric / manual vacuuming to gently remove dust and debris through suction.

Other methods, depending upon the nature of the deposit to be removed, may be also suitable. For verification of cleaning methods not listed above, please contact Kingspan Insulation prior to usage.

NB Ductwork fabricated from The Kingspan KoolDuct® System is unsuitable for wet cleaning methods and any techniques considered as being abrasive e.g. hard brushing, scraping or compressed air systems using metal balls. Dust, debris and particulates should be collected using an air movement and containment device with appropriate filtration for contaminants.

18. Noise Control

18.1 General

As per sheet metal ductwork, noise generated by HVAC equipment and transmitted through the ductwork system can sometimes be an issue for a particular system. If this is considered to be the case, there are two solutions available.

18.1.1 Attenuators / Silencers

Sound attenuators / silencers are components that are fabricated with an internal acoustic absorption material. They are connected to ductwork fabricated from The *Kingspan KoolDuct®* System in the same way as any other ductwork component.

18.1.2 Acoustic Duct Liner

An acoustic duct liner is a material designed for installation inside ductwork, for the absorption of noise. Depending upon the nature of the duct liner required, it should be adhered to the inner walls of ductwork fabricated from The *Kingspan KoolDuct®* System in accordance with the recommendations of its manufacturer, for example secured in place with mechanical fixings in a manner similar to that for sheet metal ductwork. For product specific fixing instructions, and to ensure that fixings and adhesives are compatible with *Kingspan KoolDuct®* panels, please contact the manufacturer of the lining and fixings. For further information, please contact Kingspan Insulation.

Due to cleaning considerations, and the increased risk of loose particles / fibres entering the system when using a liner, the installation of an appropriately sized attenuator is the preferred method of sound abatement.

19. Plenum Boxes

19.1 General

Plenum boxes are square or rectangular ductwork sections designed to allow an even air distribution through air diffusers installed at their outlets. Plenum boxes are typically connected to flexible circular ductwork. The air flows in through the circular fitting and goes through the box to the other side, where the diffuser is fitted.

Kingspan KoolDuct® panels can be used in the fabrication of pre-insulated plenum boxes (see Figure 19.1). Whilst standard *Kingspan KoolDuct*® panels, faced with silver aluminium foil on both sides, can be used, *Kingspan KoolDuct*® panels are also available with black coated aluminium foil on one side (and the standard silver facing on the other). This black facing can be used on the inside of the plenum box, to avoid reflected glare. Like many other elements of the System, pre-insulated plenum boxes can be fully integrated with insulated sheet metal ductwork, as a weight and cost saving measure.

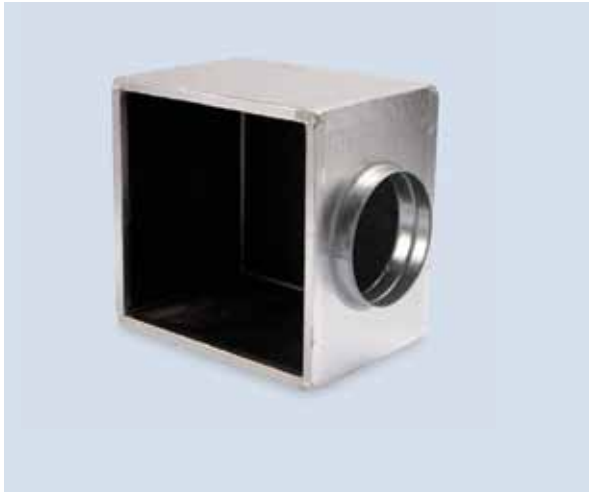


Figure 19.1 Pre-insulated Plenum Box

19.2 Plenum Box Fabrication

Plenum boxes are fabricated in accordance with the methods discussed in Section 2. Please note, however, that as a result of the extremely low pressures experienced in a plenum box, only silicone sealant and tape are required in their fabrication. Adhesive or Tiger Clips are not necessary. Round fittings, which can be either tabbed or untabbed, are attached in the manner described in Section 7.4, and flexible ductwork is attached in accordance with the flexible ductwork manufacturers' recommendations. The plenum opening is typically completely framed, using the U profile, to facilitate the connection of grilles and diffusers.

Please note that *Kingspan KoolDuct*® panels can also be used in the manufacture of plenum boxes for linear slot diffusers. For further information, please contact Kingspan Insulation.

20. Underground Applications

20.1 General

Ductwork fabricated from The *Kingspan KoolDuct®* System can be suitable for use in underground applications, provided that the considerations detailed below are fully addressed.

20.2 Considerations

Ductwork fabricated from The *Kingspan KoolDuct®* System should:

- be installed in a weather-tight enclosure or be fully weatherproofed;
- not be submerged in any kind of liquid or be at risk of being submerged;
- be installed in a trench which is not directly backfilled (backfilling should never be allowed to compromise the integrity of the ductwork);
- be non-load bearing;
- not be contaminated with any material or be at risk of being contaminated;
- be at no risk from aggressive chemical attack;
- be sat on non-wicking bearers to protect it from ground moisture;
- be laid to a fall;
- be fabricated using only non-corrodible elements such as the aluminium grip coupling system or Tiger Clip coupling system.

For more information, please contact Kingspan Insulation.

21. Storage, Handling & Transportation

21.1 General

To prevent physical damage, care should be exercised in the storage, handling and transportation, of both *Kingspan KoolDuct*® panels, and ductwork sections fabricated from the System. Please note that the factory applied packaging is not weatherproof. Any panels or sections which have been allowed to get wet or damaged should not be used.

21.2 Storage Inside

Wherever possible, both *Kingspan KoolDuct*® panels, and ductwork sections fabricated from the System, should be stored inside, under cover, clear of the ground and away from direct heat sources. The open ends of the ductwork sections should be fully sealed with a protective sheet to prevent the ingress of foreign matter. Please allow the Kingspan KoolDuct High Performance Silicone Sealant to dry before applying a covering to the open ends.

21.3 Storage Outside

Where storage inside a building is not possible, *Kingspan KoolDuct*® panels, and ductwork sections fabricated from the System, should be stored clear of the ground, protected and secured against all weather, including wind, rain, and sunlight, by an opaque light coloured weatherproof material, suitable for the climate in which it is to be stored. The open ends of the ductwork should be fully sealed with a weatherproof sheet to prevent the ingress of foreign matter. Please allow the Kingspan KoolDuct High Performance Silicone Sealant to dry before applying a covering to the open ends.

22. Health & Safety

22.1 General

Kingspan KoolDuct® panels have a non-fibrous insulation core and are odourless, non-tainting, non-deleterious, chemically inert and safe to use. They are exempt from the requirements of Article 57 and 59(1) of REACH Regulation (EC) No. 1907 / 2006 and do not require a Safety Data Sheet (SDS) when used in the EU. However, Kingspan Insulation has produced a Safety Information Data Sheet, covering the details that one would expect of an SDS, copies of which can be obtained from Kingspan Insulation.

The adhesive and silicone sealant supplied by Kingspan Insulation are not exempt from REACH regulations and as such require a published SDS when used in the EU. Copies can be obtained from Kingspan Insulation.

22.2 Health & Safety Considerations

The principal safety considerations for both *Kingspan KoolDuct®* panels and ancillaries are laid out below, for information.

22.2.1 *Kingspan KoolDuct®* Panels & Finished Ductwork

The reflective surfaces on this product are designed to enhance its thermal performance. As such they will reflect light as well as heat, including ultraviolet (UV) light. Therefore, if this product is being installed during very bright or sunny weather, it is advisable to wear UV protective sunglasses or goggles, and if the skin is exposed for a significant period of time, to protect the bare skin with a UV block sun cream.

The reflective facings on this product can be slippery when wet. Therefore it is recommended that any excess material should be contained to avoid a slip hazard.

Warning – do not stand, or otherwise support your weight, on *Kingspan KoolDuct®* Panels unless they are fully supported by a load bearing surface. Do not, under any circumstances stand, or otherwise support your weight, on completed ductwork sections fabricated from The *Kingspan KoolDuct®* System.

Stickers to this effect, such as those supplied by Kingspan Insulation, should be affixed to the outside of each finished ductwork section.

22.2.2 *Kingspan KoolDuct®* System Ancillaries

Silicone sealant and adhesive should only be used in a well-ventilated area. Impervious gloves, such as those made from nitrile rubber, should be worn. There should be no sources of ignition close to a work area where adhesive is being used.

When hand tools with blades are used in the fabrication process, they should be handled with the precautions normally required when working with exposed blades.

Dust is not normally a hazard when hand tools are used. However, when an automatic cutting machine is used, and there is the potential for dust to be generated in a confined space, it is recommended that extraction be used. With all cutting procedures, it is advisable to wear eye protection and a disposable dust mask where appropriate. Machinery should always be used in accordance with the relevant machine manufacturer's guidelines.

Appendix A:

Manufacturers of Automatic Cutting Machines

Please note that this list is not intended to be exhaustive.

AXYZ Automation (UK) Ltd.

Telford 54 Business Park
Nedge Hill
Telford
TF3 3AL,
UK

Phone: +44 (0)1952 291600
www.axyz.co.uk

CGM Progetti

Via dell'Industria, n°19
28924 Verbania Fondotoce (VB)
Italy

Tel: +39 0323 586 778
Fax: +39 0323 586 778

(note: 0323 even for international calls)

www.cgmprogetti.it

GoMech Ltd.

GoMech Ltd.
26610 Eckel Rd
Perrysburg
Ohio
43551
USA

Toll Free: +1 (800) 471 7871
Tel: +1 (419) 419 4446
Fax: +1 (419) 893 3742
www.gomech.com

Kingspan Insulation LLC

P.O. Box 113826, Dubai Investment Park 2, Dubai, U.A.E.

Tel: +971 4 889 1000
Fax: +971 4 883 8515
info@kingspaninsulation.ae
www.kingspaninsulation.ae

Pathfinder Australia Ltd Pty

12 Dib Court
Tullamarine
Victoria 3043
Australia

Tel: +61 (0) 3 9338 3471
Fax: +61 (0) 3 9338 6936
www.pathfinderaus.com.au

Pippin Building Products Ltd

Presthayes Farm
Eccliffe
Gillingham
Dorset
SP8 5RE
UK

Tel: +44 (0) 7778 161337
www.pippinbp.co.uk

Appendix B:

Fabrication & Installation Checklist

General

The following fabrication and installation checklist is included for reference only. Not every question will be applicable to every ductwork installation. Common sense should be exercised in its use, and attention should be given to the appropriate reference materials. Please note that all fabrication and installation should be self-certified by the Trainer Fabricator / Installer.

Fabrication Checklist

Panel Thickness Checks

1. Is the thickness of *Kingspan KoolDuct*® panel appropriate for the application?

Ductwork Design Checks

2. Has all measuring and tracing been performed on the internal side of the ductwork section?
3. Do all radius fittings (such as radius elbows) have internal radiuses of at least 200 mm?
4. Are all splitters installed in radius fittings in accordance with the information provided in this manual?
5. Are square elbows fitted with turning vanes in accordance with the information provided in this manual?
6. Is the taper angle of all tapers and offsets in accordance with specification?
7. Are the necks of all tapers, elbows and offsets at least 100 mm long?
8. Do all boot branches have a maximum inclination of 45°?

Fabrication Checks

9. Have all Tiger Clips been used in accordance with the information provided in this manual?
10. When adhesive has been used, has it been applied to all mitre joints?
11. Has the 75 mm aluminium tape approved by Kingspan Insulation been used?
12. Has the tape been applied everywhere that the external surface of the aluminium facing has been cut and is it properly adhered?
13. Has the silicone sealant approved by Kingspan Insulation been used?
14. Have all ductwork sections been sealed inside, with a continuous and appropriately sized bead of silicone sealant?

Coupling System Checks

15. Are all ductwork section ends fitted with the appropriate coupling system?
16. Are all cut edges of the 4-bolt profile treated with zinc spray or equivalent to prevent atmospheric corrosion?
17. Are all coupling points properly sealed for minimum air-leakage?

End Cap Checks

18. Are all end caps fitted and sealed in accordance to the information provided in this manual?

Reinforcement Checks

19. Has all ductwork been fabricated to resist the highest of the design, commissioning and testing pressures?
20. Is the number of reinforcements in accordance with the information provided in this manual?
21. Is the spacing between reinforcements in accordance with the information provided in this manual?
22. Are all ductwork sections reinforced in accordance with the information provided in this manual?

Finish / Weatherproofing Checks

23. Where ductwork has been painted, is the paint fit for purpose (it must not compromise the aluminium facing, insulation, thermal performance or fire classification)?
24. Has all ductwork that is subjected to the elements been weatherproofed in accordance with the information provided in this manual, and, has the weatherproofing been installed in accordance with the weatherproofing manufacturer's instructions.

Storage Checks

25. Have all completed ductwork sections been stored in accordance with the information provided in this manual?

Final Checks

26. Are all ductwork sections free from damage, punctures and tears to the facing?
27. Do the completed fabricated ductwork sections demonstrate good workmanship?
28. Are all ductwork sections clean – has all fabrication debris been removed from the inside of the ductwork section.

Appendix B:

Fabrication & Installation Checklist

Installation Checklist

Visual Checks

- 29. Is all ductwork free from visual damage?
- 30. Is all ductwork free from sagging and visible misalignment?

Pressure Checks

- 31. Is the ductwork system operating within the designed pressure limits?

Coupling System Checks

- 32. Have ductwork sections been coupled in accordance with the information provided in this manual?
- 33. Have Tiger Clips been installed in accordance with the information provided in this manual?
- 34. Are all relevant ductwork sections correctly coupled to all plant machinery and components in accordance with the information provided in this manual?

Branch / Take-Off Checks

- 35. Have all boot branches been fabricated and attached to the ductwork system in accordance with the methods in this manual?

Round Metal Fitting Checks

- 36. Have all round metal fittings been fabricated and attached to the ductwork system in accordance with the methods in this manual?

Shoe Branch Checks

- 37. Have all shoe branches been fabricated and attached to the ductwork system in accordance with the methods in this manual?

Access Doors / Inspection Opening Checks

- 38. Are access doors installed in accordance with the information provided in this manual?

Hanger & Support Checks

- 39. Is the maximum spacing between supports in accordance with the information provided in this manual?
- 40. Is the load of any accessories / components neutralised by appropriate accessory support?
- 41. Is the support structure free from vibration and noise that could affect the ductwork?
- 42. Is the aluminium facing of the ductwork sections which is in contact with the supports free from damage?
- 43. Is the support of all ductwork sections in accordance with the information provided in this manual?
- 44. Is ductwork supported at every change of direction e.g. elbows, offsets and branches.
- 45. Are the type of hangers and supports in accordance with the information provided in this manual?

Vertical Ductwork Checks

- 46. Is all vertical ductwork supported in accordance with the information provided in this manual?

Outdoor Ductwork Checks

- 47. Is all ductwork which has been installed outdoors and subject to the elements properly weatherproofed?

Health & Safety Checks

- 48. Have stickers warning personnel not to support their weight, or walk, on ductwork sections been affixed.

Appendix C:

Table of Weights for 22 mm Thick Panels

Aluminium Grip & Invisible Coupling Systems

The table below shows the weight per linear metre of differently sized ductwork sections fabricated from The **Kingspan KoolDuct®** System, when fitted with the aluminium grip coupling system or the invisible coupling system at both ends. The table is based on the following assumptions:

- that the length of the ductwork sections is the maximum possible given its cross-sectional dimensions, i.e. 2950 mm / 3930 mm when both w & h are ≤ 1156 mm and 1200 mm when either w or h is > 1156 mm; and
- that the pressure is 500 Pa and that The **Kingspan KoolDuct®** reinforcing bar system has been installed in accordance with Table 9A.1.

Please note that this table is included solely for reference purposes. The weights of individual ductwork sections must always be verified by the Trained Fabricator / Installer, which will retain the responsibility for determining the appropriate nature and number of hangers and supports.

		Width (mm)																				
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000		
Height (mm)	200	2.2 / 2.1	2.5	2.9	3.3	3.7	4.1	4.6	5.0	5.4	5.8	8.0	8.5	9.0	9.5	10.3	10.8	11.3	11.8	12.3	200	Height (mm)
	300	2.6	3 / 2.9	3.3	3.7	4.1	4.4	5.0	5.5	5.8	6.2	8.6	9.1	9.6	10.1	10.9	11.4	11.9	12.4	13.0	300	
	400	3.0	3.4	3.8 / 3.7	4.1	4.4	4.8	5.5	5.9	6.3	6.7	9.1	9.6	10.2	10.7	11.5	12.0	12.5	13.1	13.6	400	
	500	3.4	3.8	4.2	4.6 / 4.4	4.8	5.2	5.9	6.3	6.7	7.1	9.7	10.2	10.7	11.2	12.1	12.6	13.2	13.7	14.2	500	
	600	3.8	4.2	4.6	5.0	5.5 / 5.2	5.6	6.3	6.7	7.1	7.5	10.3	10.8	11.3	11.8	12.7	13.3	13.8	14.3	14.8	600	
	700	4.2	4.6	5.0	5.5	5.9	6.3 / 6.0	6.8	7.2	7.5	7.9	10.8	11.3	11.9	12.4	13.4	13.9	14.4	14.9	15.4	700	
	800	4.8	5.3	5.7	6.2	6.6	7.1	7.8 / 7.4	7.9	8.3	8.7	11.5	12.0	12.5	13.0	14.0	14.5	15.1	15.6	16.1	800	
	900	5.2	5.7	6.1	6.6	7.0	7.5	8.2	8.7 / 8.3	8.7	9.1	12.0	12.5	13.0	13.5	14.6	15.1	15.7	16.2	16.7	900	
	1000	5.7	6.1	6.5	7.0	7.4	7.9	8.6	9.1	9.5 / 9.1	9.5	12.6	13.1	13.6	14.1	15.2	15.8	16.3	16.8	17.3	1000	
	1100	6.1	6.5	6.9	7.4	7.8	8.3	9.1	9.5	10.0	10.4 / 9.9	13.1	13.6	14.2	14.7	15.9	16.4	16.9	17.4	17.9	1100	
												13.8	14.3	14.8	15.3	16.5	17.0	17.6	18.1	18.6	1200	Height (mm)
													14.8	15.3	15.9	17.1	17.7	18.2	18.7	19.2	1300	
														15.9	16.4	17.8	18.3	18.8	19.3	19.8	1400	
															17.0	18.4	18.9	19.4	19.9	20.4	1500	
																19.1	19.6	20.1	20.6	21.1	1600	
																	20.2	20.7	21.2	21.7	1700	
																		21.3	21.8	22.4	1800	
																			22.5	23.0	1900	
																				23.6	2000	

All weights in kg per linear metre

Weights based on 2950 mm long ductwork sections

Weights based on 3930 mm long ductwork sections

Weights based on 1200 mm long ductwork sections

Appendix C:

Table of Weights for 22 mm Thick Panels

4-bolt Coupling System

The table below shows the weight per linear metre of differently sized ductwork sections fabricated from The *Kingspan*

KoolDuct® System, when fitted with the 4-bolt coupling system at both ends. The table is based on the following assumptions:

- that the length of the ductwork sections is the maximum possible given its cross-sectional dimensions, i.e. 2950 mm / 3930 mm when both w & h are ≤ 1156 mm and 1200 mm when either w or h is > 1156 mm; and
- that the pressure is 500 Pa and that The *Kingspan* **KoolDuct®** reinforcing bar system has been installed in accordance with Table 9A.2.

Please note that this table is included solely for reference purposes. The weights of individual ductwork sections must always be verified by the Trained Fabricator / Installer, which will retain the responsibility for determining the appropriate nature and number of hangers and supports.

		Width (mm)																				
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000		
Height (mm)	200	2.3 / 2.2	2.6	3.0	3.4	3.8	4.2	4.8	5.2	5.6	6.0	8.7	9.3	9.8	10.4	11.0	11.6	12.2	12.7	13.3	200	Height (mm)
	300	2.8	3.2 / 3.0	3.4	3.8	4.2	4.6	5.2	5.6	6.0	6.4	9.3	9.8	10.4	11.0	11.7	12.2	12.8	13.3	13.9	300	
	400	3.2	3.6	4.0 / 3.8	4.2	4.6	5.0	5.7	6.1	6.5	6.9	9.9	10.4	11.0	11.5	12.3	12.8	13.4	13.9	14.5	400	
	500	3.6	4.0	4.5	4.9 / 4.6	5.0	5.5	6.1	6.5	6.9	7.3	10.4	11.0	11.6	12.1	12.9	13.4	14.0	14.5	15.1	500	
	600	4.0	4.5	4.9	5.3	5.8 / 5.5	5.9	6.5	6.9	7.3	7.7	11.0	11.6	12.2	12.7	13.5	14.0	14.6	15.2	15.7	600	
	700	4.5	4.9	5.3	5.8	6.2	6.6 / 6.3	7.0	7.4	7.8	8.2	11.6	12.2	12.7	13.3	14.1	14.6	15.2	15.8	16.3	700	
	800	5.0	5.5	6.0	6.4	6.9	7.3	8.1 / 7.7	8.1	8.6	9.0	12.2	12.8	13.3	13.9	14.7	15.3	15.8	16.4	16.9	800	
	900	5.5	5.9	6.4	6.8	7.3	7.7	8.5	9.0 / 8.6	9.0	9.4	12.8	13.3	13.9	14.5	15.3	15.9	16.4	17.0	17.5	900	
	1000	5.9	6.3	6.8	7.3	7.7	8.2	9.0	9.5	9.9 / 9.4	9.9	13.4	13.9	14.5	15.0	15.9	16.5	17.0	17.6	18.1	1000	
	1100	6.3	6.8	7.2	7.7	8.1	8.6	9.5	9.9	10.4	10.8 / 10.3	13.9	14.5	15.1	15.6	16.5	17.1	17.6	18.2	18.7	1100	
												14.9	15.5	16.1	16.6	17.6	18.2	18.8	19.3	19.9	1200	Height (mm)
													16.1	16.6	17.2	18.2	18.8	19.4	19.9	20.5	1300	
														17.2	17.8	18.8	19.4	20.0	20.5	21.1	1400	
															18.4	19.4	20.0	20.6	21.2	21.7	1500	
																20.5	21.1	21.7	22.3	22.9	1600	
																	21.7	22.3	22.9	23.5	1700	
																		22.9	23.5	24.1	1800	
																			24.1	24.7	1900	
																				25.4	2000	

All weights in kg per linear metre

Weights based on 2950 mm long ductwork sections

Weights based on 3930 mm long ductwork sections

Weights based on 1200 mm long ductwork sections

Tiger Clip Coupling System

The table below shows the weight per linear metre of differently sized ductwork sections fabricated from The **Kingspan KoolDuct®** System, when fitted with the Tiger Clip coupling system at both ends. The table is based on the following assumptions:

- that the length of the ductwork sections is the maximum possible given its cross-sectional dimensions, i.e. 2950 mm / 3930 mm when both w & h are ≤ 1156 mm and 1200 mm when either w or h is > 1156 mm; and
- that the pressure is 500 Pa when both w and h are ≤ 1156 mm and 250 Pa when either w or h is > 1156 mm, and that The **Kingspan KoolDuct®** reinforcing bar system has been installed in accordance with Table 9A.3.

Please note that this table is included solely for reference purposes. The weights of individual ductwork sections must always be verified by the Trained Fabricator / Installer, which will retain the responsibility for determining the appropriate nature and number of hangers and supports.

		Width (mm)															
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500		
Height (mm)	200	1.9 / 1.9	2.2	2.6	2.9	3.3	3.6	4.1	4.4	4.8	5.1	5.6	5.9	6.3	6.6	200	Height (mm)
	300	2.2	2.6 / 2.6	2.9	3.2	3.6	4.0	4.5	4.8	5.2	5.5	6.0	6.3	6.7	7.0	300	
	400	2.6	2.9	3.2 / 3.2	3.6	4.0	4.3	4.9	5.2	5.5	5.9	6.4	6.7	7.1	7.4	400	
	500	2.9	3.3	3.6	3.9 / 3.9	4.3	4.7	5.2	5.6	5.9	6.2	6.8	7.1	7.5	7.8	500	
	600	3.3	3.6	4.0	4.3	4.8 / 4.7	5.1	5.7	6.0	6.4	6.7	7.2	7.5	7.9	8.2	600	
	700	3.6	4.0	4.3	4.7	5.1	5.5 / 5.4	6.1	6.4	6.7	7.1	7.6	7.9	8.3	8.6	700	
	800	4.1	4.5	4.9	5.3	5.7	6.1	6.8 / 6.8	7.1	7.5	7.9	8.3	8.7	9.1	9.4	800	
	900	4.4	4.8	5.2	5.6	6.1	6.5	7.2	7.6 / 7.5	7.9	8.3	8.7	9.1	9.5	9.8	900	
	1000	4.8	5.2	5.6	5.9	6.4	6.8	7.6	8.0	8.3 / 8.2	8.6	9.1	9.5	9.9	10.2	1000	
	1100	5.1	5.5	5.9	6.3	6.8	7.2	8.0	8.3	8.7	9.1 / 9.0	9.9	10.3	10.7	11.1	1100	
												10.3	10.7	11.1	11.5	1200	
													11.1	11.5	11.9	1300	
														11.8	12.2	1400	
															12.6	1500	

All weights in kg per linear metre

Weights based on 2950 mm long ductwork sections

Weights based on 3930 mm long ductwork sections

Weights based on 1200 mm long ductwork sections

Appendix D:

Table of Weights for 30 mm Thick Panels

Aluminium Grip & Invisible Coupling Systems

The table below shows the weight per linear metre of differently sized ductwork sections fabricated from The *Kingspan KoolDuct® System*, when fitted with the aluminium grip coupling system or the invisible coupling system at both ends. The table is based on the following assumptions:

- that the length of the ductwork sections is the maximum possible given its cross-sectional dimensions, i.e. 2950 mm / 3930 mm when both w & h are ≤ 1140 mm and 1200 mm when either w or h is > 1140 mm; and
- that the pressure is 500 Pa and that The *Kingspan KoolDuct®* reinforcing bar system has been installed in accordance with Table 9B.1.

Please note that this table is included solely for reference purposes. The weights of individual ductwork sections must always be verified by the Trained Fabricator / Installer, which will retain the responsibility for determining the appropriate nature and number of hangers and supports.

		Width (mm)																				
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000		
Height (mm)	200	2.9 / 2.8	3.3	3.8	4.3	4.8	5.3	5.9	6.4	6.9	7.4	9.6	10.2	10.8	11.5	12.1	13.0	13.6	14.2	14.8	200	Height (mm)
	300	3.4	3.9 / 3.8	4.3	4.8	5.3	5.8	6.5	7.0	7.5	7.9	10.2	10.8	11.4	12.2	12.8	13.7	14.3	14.9	15.5	300	
	400	3.9	4.4	4.9 / 4.8	5.3	5.8	6.3	7.0	7.5	8.0	8.5	10.8	11.4	12.0	12.8	13.4	14.4	15.0	15.6	16.2	400	
	500	4.4	4.9	5.5	6.0 / 5.8	6.3	6.7	7.5	8.0	8.5	9.0	11.5	12.1	12.7	13.5	14.1	15.1	15.7	16.3	16.9	500	
	600	4.9	5.5	6.0	6.5	7.0 / 6.7	7.2	8.1	8.5	9.0	9.5	12.1	12.7	13.3	14.1	14.8	15.8	16.4	17.0	17.6	600	
	700	5.5	6.0	6.5	7.0	7.5	8.0 / 7.7	8.6	9.1	9.6	10.0	12.7	13.3	14.0	14.8	15.4	16.5	17.1	17.7	18.3	700	
	800	6.2	6.7	7.3	7.8	8.4	8.9	9.7 / 9.4	9.9	10.4	10.9	13.4	14.0	14.6	15.5	16.1	17.3	17.9	18.5	19.1	800	
	900	6.7	7.2	7.8	8.3	8.9	9.4	10.3	10.8 / 10.4	10.9	11.4	14.1	14.7	15.3	16.2	16.8	18.0	18.6	19.2	19.8	900	
	1000	7.2	7.7	8.3	8.8	9.4	9.9	10.8	11.3	11.9 / 11.4	11.9	14.7	15.3	15.9	16.8	17.4	18.7	19.3	19.9	20.5	1000	
	1100	7.7	8.2	8.8	9.3	9.9	10.4	11.3	11.9	12.4	13.0 / 12.5	15.3	15.9	16.5	17.5	18.1	19.4	20.0	20.6	21.2	1100	
												16.0	16.6	17.2	18.1	18.8	20.1	20.7	21.3	21.9	1200	Height (mm)
													17.2	17.8	18.8	19.4	20.8	21.4	22.0	22.6	1300	
														18.4	19.5	20.1	21.5	22.1	22.7	23.3	1400	
															20.2	20.8	22.3	22.9	23.5	24.1	1500	
																21.4	23.0	23.6	24.2	24.8	1600	
																	23.8	24.4	25.0	25.6	1700	
																		25.1	25.7	26.3	1800	
																			26.4	27.1	1900	
																				27.8	2000	
All weights in kg per linear metre																						
Weights based on 2950 mm long ductwork sections																						
Weights based on 3930 mm long ductwork sections																						
Weights based on 1200 mm long ductwork sections																						

4-bolt Coupling System

The table below shows the weight per linear metre of differently sized ductwork sections fabricated from The *Kingspan*

KoolDuct® System, when fitted with the 4-bolt coupling system at both ends. The table is based on the following assumptions:

- that the length of the ductwork sections is the maximum possible given its cross-sectional dimensions, i.e. 2950 mm / 3930 mm when both w & h are ≤ 1140 mm and 1200 mm when either w or h is > 1140 mm; and
- that the pressure is 500 Pa and that The *Kingspan* **KoolDuct®** reinforcing bar system has been installed in accordance with Table 9B.2.

Please note that this table is included solely for reference purposes. The weights of individual ductwork sections must always be verified by the Trained Fabricator / Installer, which will retain the responsibility for determining the appropriate nature and number of hangers and supports.

		Width (mm)																				
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000		
Height (mm)	200	3.0 / 2.9	3.4	3.9	4.4	4.9	5.4	6.0	6.5	7.0	7.5	10.3	11.0	11.6	12.3	12.9	13.7	14.4	15.0	15.7	200	Height (mm)
	300	3.5	4.1 / 3.9	4.4	4.9	5.4	5.9	6.6	7.1	7.6	8.1	11.0	11.7	12.3	13.0	13.6	14.4	15.1	15.7	16.4	300	
	400	4.1	4.6	5.1 / 4.9	5.4	5.9	6.4	7.1	7.6	8.1	8.6	11.7	12.3	13.0	13.7	14.3	15.1	15.8	16.4	17.1	400	
	500	4.6	5.1	5.6	6.1 / 5.9	6.4	6.9	7.6	8.1	8.6	9.1	12.4	13.0	13.7	14.3	15.0	15.8	16.5	17.1	17.8	500	
	600	5.1	5.6	6.1	6.7	7.2 / 6.9	7.4	8.2	8.6	9.1	9.6	13.0	13.7	14.4	15.0	15.7	16.5	17.2	17.8	18.5	600	
	700	5.6	6.1	6.7	7.2	7.7	8.2 / 7.9	8.7	9.2	9.7	10.2	13.7	14.4	15.0	15.7	16.3	17.2	17.9	18.5	19.2	700	
	800	6.3	6.8	7.4	7.9	8.5	9.0	9.9 / 9.5	10.1	10.6	11.1	14.4	15.1	15.7	16.4	17.0	17.9	18.6	19.2	19.9	800	
	900	6.8	7.4	7.9	8.5	9.0	9.6	10.5	11.0 / 10.6	11.1	11.6	15.1	15.7	16.4	17.0	17.7	18.6	19.3	20.0	20.6	900	
	1000	7.3	7.9	8.4	9.0	9.5	10.1	11.0	11.6	12.1 / 11.6	12.2	15.8	16.4	17.1	17.7	18.4	19.3	20.0	20.7	21.3	1000	
	1100	7.9	8.4	9.0	9.5	10.1	10.6	11.6	12.1	12.7	13.2 / 12.7	16.4	17.1	17.8	18.4	19.1	20.1	20.7	21.4	22.0	1100	
												17.5	18.2	18.8	19.5	20.2	21.2	21.9	22.6	23.3	1200	Height (mm)
												18.8	19.5	20.2	20.9	21.9	22.6	23.3	24.0		1300	
												20.2	20.9	21.6	22.7	23.4	24.0	24.7			1400	
												21.6	22.2	23.4	24.0	24.7	25.4				1500	
												22.9	24.1	24.7	25.4	26.1					1600	
												25.3	26.0	26.7	27.4						1700	
												26.7	27.4	28.1							1800	
												28.1	28.8								1900	
												29.5									2000	

All weights in kg per linear metre

Weights based on 2950 mm long ductwork sections

Weights based on 3930 mm long ductwork sections

Weights based on 1200 mm long ductwork sections

Appendix D:

Table of Weights for 30 mm Thick Panels

Tiger Clip Coupling System

The table below shows the weight per linear metre of differently sized ductwork sections fabricated from The **Kingspan KoolDuct® System**, when fitted with the Tiger Clip coupling system at both ends. The table is based on the following assumptions:

- that the length of the ductwork sections is the maximum possible given its cross-sectional dimensions, i.e. 2950 mm / 3930 mm when both w & h are ≤ 1140 mm and 1200 mm when either w or h is > 1140 mm; and
- that the pressure is 500 Pa when both w and h are ≤ 1140 mm and 250 Pa when either w or h is > 1140 mm, and that The **Kingspan KoolDuct®** reinforcing bar system has been installed in accordance with Table 9B.3.

Please note that this table is included solely for reference purposes. The weights of individual ductwork sections must always be verified by the Trained Fabricator / Installer, which will retain the responsibility for determining the appropriate nature and number of hangers and supports.

		Width (mm)															
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500		
Height (mm)	200	2.6 / 2.6	3.0	3.4	3.9	4.3	4.8	5.3	5.8	6.2	6.7	7.2	7.7	8.1	8.6	Height (mm)	200
	300	3.0	3.4 / 3.4	3.9	4.3	4.7	5.2	5.8	6.3	6.7	7.1	7.7	8.2	8.6	9.0		300
	400	3.4	3.9	4.3 / 4.3	4.7	5.2	5.7	6.3	6.7	7.2	7.6	8.2	8.7	9.1	9.5		400
	500	3.9	4.3	4.7	5.2 / 5.2	5.6	6.1	6.8	7.2	7.6	8.1	8.7	9.1	9.6	10.0		500
	600	4.3	4.7	5.2	5.6	6.1 / 6.0	6.5	7.2	7.7	8.1	8.5	9.2	9.6	10.1	10.5		600
	700	4.8	5.2	5.7	6.1	6.6	7.1 / 7.1	7.8	8.2	8.7	9.1	9.7	10.1	10.6	11.0		700
	800	5.4	5.9	6.3	6.8	7.3	7.9	8.7 / 8.6	9.1	9.5	10.0	10.2	10.6	11.1	11.5		800
	900	5.8	6.3	6.8	7.2	7.7	8.3	9.1	9.6 / 9.5	10.0	10.5	11.0	11.5	12.0	12.4		900
	1000	6.2	6.7	7.2	7.7	8.1	8.7	9.6	10.1	10.5 / 10.5	10.9	11.5	12.0	12.4	12.9		1000
	1100	6.7	7.2	7.6	8.1	8.6	9.2	10.1	10.6	11.0	11.5 / 11.4	12.4	12.9	13.4	13.9		1100
												12.9	13.4	13.8	14.3		
													13.9	14.3	14.8		
														14.8	15.3		
															15.8		

All weights in kg per linear metre

Weights based on 2950 mm long ductwork sections

Weights based on 3930 mm long ductwork sections

Weights based on 1200 mm long ductwork sections

Appendix E:

Table of Weights for 42 mm Thick Panels

4-bolt Coupling System

The table below shows the weight per linear metre of differently sized ductwork sections fabricated from The *Kingspan*

KoolDuct® System, when fitted with the 4-bolt coupling system at both ends. The table is based on the following assumptions:

- that the length of the ductwork sections is the maximum possible given its cross-sectional dimensions, i.e. 3930 mm when both w & h are ≤ 1116 mm and 1200 mm when either w or h is > 1116 mm; and
- that the pressure is 500 Pa and that The *Kingspan* **KoolDuct®** reinforcing bar system has been installed in accordance with Table 9B.2.

Please note that this table is included solely for reference purposes. The weights of individual ductwork sections must always be verified by the Trained Fabricator / Installer, which will retain the responsibility for determining the appropriate nature and number of hangers and supports.

Width (mm)																				Height (mm)
200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000		
4.2	4.9	5.6	6.2	6.9	7.6	8.4	9.1	9.7	10.4	14.4	15.2	16.1	17.0	17.9	18.9	19.7	20.6	21.5	200	
	5.6	6.2	6.9	7.6	8.2	9.1	9.7	10.4	11.1	15.3	16.1	17.0	17.9	18.8	19.8	20.6	21.5	22.4	300	
		6.9	7.6	8.2	8.9	9.8	10.4	11.1	11.8	16.2	17.0	17.9	18.8	19.7	20.7	21.6	22.4	23.3	400	
			8.2	8.9	9.6	10.5	11.1	11.8	12.5	17.1	17.9	18.8	19.7	20.6	21.6	22.5	23.4	24.2	500	
				9.6	10.2	11.2	11.8	12.5	13.2	18.0	18.8	19.7	20.6	21.4	22.5	23.4	24.3	25.2	600	
					10.9	11.9	12.5	13.2	13.8	18.9	19.7	20.6	21.5	22.3	23.5	24.3	25.2	26.1	700	
						12.9	13.6	14.3	15.0	19.8	20.6	21.5	22.4	23.2	24.4	25.3	26.1	27.0	800	
							14.3	15.0	15.7	20.7	21.5	22.4	23.3	24.1	25.3	26.2	27.0	27.9	900	
								15.7	16.4	21.5	22.4	23.3	24.2	25.0	26.2	27.1	28.0	28.8	1000	
									17.0	22.4	23.3	24.2	25.1	25.9	27.1	28.0	28.9	29.8	1100	
										23.7	24.6	25.5	26.4	27.3	28.6	29.5	30.4	31.3	1200	
											25.5	26.4	27.3	28.2	29.5	30.4	31.3	32.2	1300	
												27.3	28.2	29.1	30.4	31.3	32.2	33.1	1400	
													29.1	30.0	31.3	32.2	33.1	34.0	1500	
														30.9	32.3	33.1	34.0	34.9	1600	
															33.7	34.6	35.5	36.4	1700	
																35.5	36.4	37.4	1800	
																	37.4	38.3	1900	
																		39.2	2000	
All weights in kg per linear metre																				
Weights based on 3930 mm long ductwork sections																				
Weights based on 1200 mm long ductwork sections																				

All weights in kg per linear metre

Weights based on 3930 mm long ductwork sections

Weights based on 1200 mm long ductwork sections

Appendix E:

Table of Weights for 42 mm Thick Panels

Tiger Clip Coupling System

The table below shows the weight per linear metre of differently sized ductwork sections fabricated from The **Kingspan KoolDuct® System**, when fitted with the Tiger Clip coupling system at both ends. The table is based on the following assumptions:

- that the length of the ductwork sections is the maximum possible given its cross-sectional dimensions, i.e. 3930 mm when both w & h are ≤ 1116 mm and 1200 mm when either w or h is > 1116 mm; and
- that the pressure is 500 Pa when both w and h are ≤ 1116 mm and 250 Pa when either w or h is > 1116 mm, and that The **Kingspan KoolDuct®** reinforcing bar system has been installed in accordance with Table 9B.3.

Please note that this table is included solely for reference purposes. The weights of individual ductwork sections must always be verified by the Trained Fabricator / Installer, which will retain the responsibility for determining the appropriate nature and number of hangers and supports.

Width (mm)														Height (mm)
200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	
3.7	4.3	4.8	5.4	6.0	6.6	7.3	7.9	8.5	9.1	9.8	10.4	11.0	11.5	200
	4.8	5.4	6.0	6.6	7.2	8.0	8.5	9.1	9.7	10.4	11.0	11.6	12.2	300
		6.0	6.6	7.1	7.8	8.6	9.1	9.7	10.3	11.1	11.6	12.2	12.8	400
			7.1	7.7	8.4	9.2	9.8	10.3	10.9	11.7	12.3	12.9	13.5	500
				8.3	9.0	9.8	10.4	1.0	11.5	12.3	12.9	13.5	14.1	600
					9.6	10.5	11.1	11.7	12.2	13.0	13.6	14.1	14.7	700
						11.4	12.1	12.7	13.3	13.6	14.2	14.8	15.4	800
							12.7	13.3	13.9	14.6	15.2	15.8	16.4	900
								13.9	14.5	15.2	15.9	16.5	17.1	1000
									15.1	16.3	16.9	17.5	18.2	1100
										16.9	17.5	18.1	18.8	1200
											18.2	18.8	19.4	1300
												19.4	20.1	1400
													20.7	1500

All weights in kg per linear metre

Weights based on 3930 mm long ductwork sections

Weights based on 1200 mm long ductwork sections

Appendix F: Pressure Class & Reinforcement Reference Table for 22 mm Thick Panels

Pressure Class: 125 Pa (limited to 125 Pa positive & 125 Pa negative)

Max. w or h (mm)	200	300	400	500	600	700	800	900	1000	1100
Coupling System	Reinforcement Specification									
Aluminium Grip & Invisible	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.
4-bolt	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.
Tiger Clip	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@Joint	1@Joint	1@Joint	1@Joint
Duct segment max. length: 2950 / 3930 mm										

Pressure Class: 250 Pa (limited to 250 Pa positive & 250 Pa negative)

Max. w or h (mm)	200	300	400	500	600	700	800	900	1000	1100
Coupling System	Reinforcement Specification									
Aluminium Grip & Invisible	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900
4-bolt	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900
Tiger Clip	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@Joint	1@Joint	1@Joint	1@900	1@900
Duct segment max. length: 2950 / 3930 mm										

Pressure Class: 500 Pa (limited to 500 Pa positive & 500 Pa negative)

Max. w or h (mm)	200	300	400	500	600	700	800	900	1000	1100
Coupling System	Reinforcement Specification									
Aluminium Grip & Invisible	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@900	1@900
4-bolt	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@900	1@900
Tiger Clip	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@Joint	1@Joint	1@900	1@900	1@900	1@900
Duct segment max. length: 2950 / 3930 mm										

1200	1300	1400	1500	1600	1700	1800	1900	2000
Reinforcement Specification								
No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1 Bar Centred	1 Bar Centred
No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.
1@600	1@600	1@600	1@600	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Duct segment max. length: 1200 mm								

1200	1300	1400	1500	1600	1700	1800	1900	2000
Reinforcement Specification								
No Reinf.	No Reinf.	1 Bar Centred	1 Bar Centred	1 Bar Centred	1 Bar Centred	1@600	1@600	1@600
No Reinf.	No Reinf.	No Reinf.	No Reinf.	1 Bar Centred	1 Bar Centred	1 Bar Centred	1 Bar Centred	1 Bar Centred
1@600	1@600	1@600	1@600	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Duct segment max. length: 1200 mm								

1200	1300	1400	1500	1600	1700	1800	1900	2000
Reinforcement Specification								
1@600	1@600	1@600	1@600	2@600	2@600	2@600	2@600	2@600
1 Bar Centred	1 Bar Centred	1 Bar Centred	1 Bar Centred	2 Bars Centred	2 Bars Centred	2 Bars Centred	2 Bars Centred	2 Bars Centred
Not Applicable								
Duct segment max. length: 1200 mm								

Appendix F: Pressure Class & Reinforcement Reference Table for 22 mm Thick Panels

Pressure Class: 750 Pa (limited to 750 Pa positive & 750 Pa negative)

Max. w or h (mm)	200	300	400	500	600	700	800	900	1000	1100
Coupling System	Reinforcement Specification									
Aluminium Grip & Invisible	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@900	1@900	1@600	1@600
4-bolt	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@900	1@900	1@600	1@600
Tiger Clip	Not Applicable									
Duct segment max. length: 2950 / 3930 mm										

1200	1300	1400	1500	1600	1700	1800	1900	2000
Reinforcement Specification								
1@600	2@600	2@600	2@600	2@600	2@600	2@600	3@600	3@600
2 Bars Centred	2 Bars Centred	2@600	2@600	2@600	2@600	2@600	3@600	3@600
Not Applicable								
Duct segment max. length: 1200 mm								

Pressure Class: 1000 Pa (limited to 1000 Pa positive & 750 Pa negative)

Max. w or h (mm)	200	300	400	500	600	700	800	900	1000	1100
Coupling System	Reinforcement Specification									
Aluminium Grip & Invisible	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@600	2@600	2@600	2@600
4-bolt	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@600	2@600	2@600	2@600
Tiger Clip	Not Applicable									
Duct segment max. length: 2950 / 3930 mm										

1200	1300	1400	1500	1600	1700	1800	1900	2000
Reinforcement Specification								
2@600	2@600	2@600	3@600	3@600	3@600	3@600	3@600	3@600
2@600	2@600	2@600	3@600	3@600	3@600	3@600	3@600	3@600
Not Applicable								
Duct segment max. length: 1200 mm								

Notes

1@Joint Reinforcing bars should be placed at a maximum of 300 mm from ductwork section end on one side of the coupling seam only.

1@900 Reinforcing bars should be placed at a maximum of 900 mm centres, and:

- Aluminium Grip & Invisible – the first and last bars should be placed at max. 450 mm from their respective ductwork section ends;
- 4-bolt – the first and last bars should be placed at max. 900 mm from their respective ductwork section ends; or
- Tiger Clip – the first and last bars should be placed at max. 300 mm from their respective ductwork section ends.

1@600 Reinforcing bars should be placed at a maximum of 600 mm centres, and:

- Aluminium Grip & Invisible – the first and last bars should be placed at max. 300 mm from their respective ductwork section ends;
- 4-bolt – the first and last bars should be placed at max. 600 mm from their respective ductwork section ends; or
- Tiger Clip – the first and last bars should be placed at max. 300 mm from their respective ductwork section ends.

2@600 Reinforcing bars should be placed as a pair at a maximum of 600 mm centres, and the first and last pairs of the bars should be placed at max. 300 mm from their respective ductwork section ends.

3@600 Reinforcing bars should be placed as a trio at a maximum of 600 mm centres, and the first and last trios of the bars should be placed at max. 300 mm from their respective ductwork section ends.

Appendix G: Pressure Class & Reinforcement Reference Table for 30 / 42 mm Thick Panels

Pressure Class: 125 Pa (limited to 125 Pa positive & 125 Pa negative)

Max. w or h (mm)	200	300	400	500	600	700	800	900	1000	1100
Joint Type	Reinforcement Specification									
Aluminium Grip & Bayonet	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.
4-bolt	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.
Tiger Clip	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@Joint	1@Joint
Duct segment max. length: 3930 mm										

Pressure Class: 250 Pa (limited to 250 Pa positive & 250 Pa negative)

Max. w or h (mm)	200	300	400	500	600	700	800	900	1000	1100
Joint Type	Reinforcement Specification									
Aluminium Grip & Bayonet	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900
4-bolt	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900
Tiger Clip	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@Joint	1@Joint	1@Joint	1@900	1@900
Duct segment max. length: 3930 mm										

Pressure Class: 500 Pa (limited to 500 Pa positive & 500 Pa negative)

Max. w or h (mm)	200	300	400	500	600	700	800	900	1000	1100
Joint Type	Reinforcement Specification									
Aluminium Grip & Invisible	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@900	1@900
4-bolt	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@900	1@900
Tiger Clip	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@Joint	1@Joint	1@900	1@900	1@900
Duct segment max. length: 2950 / 3930 mm										

1200	1300	1400	1500	1600	1700	1800	1900	2000
Reinforcement Specification								
No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1 Bar Centred	1 Bar Centred
No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.	No Reinf.
1@600	1@600	1@600	1@600	1@600	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Duct segment max. length: 1200 mm								

1200	1300	1400	1500	1600	1700	1800	1900	2000
Reinforcement Specification								
No Reinf.	No Reinf.	1 Bar Centred	1 Bar Centred	1 Bar Centred	1 Bar Centred	1 Bar Centred	1@600	1@600
No Reinf.	No Reinf.	No Reinf.	No Reinf.	1 Bar Centred	1 Bar Centred	1 Bar Centred	1 Bar Centred	1 Bar Centred
1@600	1@600	1@600	1@600	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Duct segment max. length: 1200 mm								

1200	1300	1400	1500	1600	1700	1800	1900	2000
Reinforcement Specification								
1 Bar Centred	1 Bar Centred	1 Bar Centred	1@600	1@600	2@600	2@600	2@600	2@600
1 Bar Centred	1 Bar Centred	1 Bar Centred	1 Bar Centred	2 Bars Centred	2 Bars Centred	2 Bars Centred	2 Bars Centred	2 Bars Centred
Not Applicable								
Duct segment max. length: 1200 mm								

Appendix G: Pressure Class & Reinforcement Reference Table for 30 / 42 mm Thick Panels

Pressure Class: 750 Pa (limited to 750 Pa positive & 750 Pa negative)

Max. w or h (mm)	200	300	400	500	600	700	800	900	1000	1100
Joint Type	Reinforcement Specification									
Aluminium Grip & Bayonet	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@900	1@900	1@900	1@900
4-bolt	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@900	1@900	1@900	1@900
Tiger Clip	Not Applicable									
Duct segment max. length: 3930 mm										

1200	1300	1400	1500	1600	1700	1800	1900	2000
Reinforcement Specification								
1@600	1@600	2@600	2@600	2@600	2@600	2@600	2@600	2@600
1 Bars Centred	1 Bars Centred	2 Bars Centred	2 Bars Centred	2 Bars Centred	2 Bars Centred	2 Bars Centred	2@600	2@600
Not Applicable								
Duct segment max. length: 1200 mm								

Pressure Class: 1000 Pa (limited to 1000 Pa positive & 750 Pa negative)

Max. w or h (mm)	200	300	400	500	600	700	800	900	1000	1100
Joint Type	Reinforcement Specification									
Aluminium Grip & Bayonet	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@600	1@600	1@600	1@600
4-bolt	No Reinf.	No Reinf.	No Reinf.	No Reinf.	1@900	1@900	1@600	1@600	1@600	1@600
Tiger Clip	Not Applicable									
Duct segment max. length: 3930 mm										

1200	1300	1400	1500	1600	1700	1800	1900	2000
Reinforcement Specification								
2@600	2@600	2@600	2@600	2@600	2@600	2@600	3@600	3@600
2 Bars Centred	2@600	2@600	2@600	2@600	2@600	2@600	3@600	3@600
Not Applicable								
Duct segment max. length: 1200 mm								

Notes

1@Joint	Reinforcing Bars shall be placed at Joint only, at a maximum of 300mm from joint	● Tiger Clip: max 300mm from joint
1@900	Reinforcing Bars shall be placed at a maximum of 900mm centers, and	● Aluminium Grip & Invisible – the first and last bars should be placed at max. 450 mm from their respective ductwork section ends; ● 4-bolt – the first and last bars should be placed at max. 900 mm from their respective ductwork section ends; or ● Tiger Clip – the first and last bars should be placed at max. 300 mm from their respective ductwork section ends.
1@600	Reinforcing Bars shall be placed at a maximum of 600mm centers, and	● Aluminium Grip & Invisible – the first and last bars should be placed at max. 300 mm from their respective ductwork section ends; ● 4-bolt – the first and last bars should be placed at max. 300 mm from their respective ductwork section ends; or ● Tiger Clip – the first and last bars should be placed at max. 300 mm from their respective ductwork section ends.
2@600	Reinforcing Bars shall be placed as a pair at a maximum of 600mm centers, and	● All: FIRST and LAST pairs at max 300mm from joint
3@600	Reinforcing Bars shall be placed as a trio at a maximum of 600mm centers, and	● All: FIRST and LAST trio at max 300mm from joint

Notes

[illegible]

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