

Insulation



# Pal Duct™ System

Fabrication Guidelines



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# Kingspan PalDuct™ Fabrication Guidelines

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## Introduction

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.

Kingspan PalDuct™ Systems have been the pioneer in pre-insulated ducting. Pal was the first company in the world to introduce the innovative and revolutionary rigid pre-insulated ductwork as an alternative to sheet metal ductwork. It was invented by Claudio Ferraro of Bologna, Italy in 1965.

Kingspan Insulation has proven the value of its products and Kingspan PalDuct™ has been used in some of the most prestigious projects around the world, due to its known advantages over the traditional galvanised sheet metal ductwork.

Kingspan Insulation offers a complete product line, providing all materials, tools and accessories necessary for the effective fabrication of ductwork from Kingspan PalDuct™ Systems. Each component has been rigorously tested in the field, in a variety of ductwork applications, to the highest performance of standards.

In 2014 Kingspan Group acquired Pal International and assimilated it into its Insulation Division, which subsequently became responsible for the sales and marketing of Kingspan PalDuct™ products across the globe.



# Kingspan PalDuct™ Fabrication Guidelines

## Method Statement

### Fabrication of Ductwork

All personnel responsible for the fabrication of ductwork systems shall, prior to being engaged in the work, have successfully completed the specialised Pal Pre-insulated Ducting System training course and shall be familiar with all aspects of the fabrication techniques necessary for the fabrication of the complete system. All trainees who successfully complete the training course are awarded a Pal certificate of competency.

### Procedures

The fabrication of ductwork from Kingspan PalDuct™ Systems is accomplished by following a standardised procedure. The process is the same regardless of the shape of the duct element:

- tracing;
- cutting;
- gluing;
- folding;
- taping;
- sealing; and
- flanging and reinforcement.

Although each of the above operations is described in general below, this specification is by no means intended to serve as an instruction manual to replace the training course. Note that when fabricated correctly, finished duct sections will have no exposed insulation internally or externally.

### 1 Tracing

The tracing of the ductwork section's outline onto the panel is the first step of the process. This is accomplished by utilizing the teflon "pencils" supplied in each tool box which scribe a line as opposed to marking an ink line. Note that all measurements specified on drawings of duct systems refer to a duct's internal dimension. This corresponds to the cross-sectional area of the air passage necessary to satisfy design requirements. It is therefore recommended that the fabricator adopt the convention of internal measurements during plotting. Accordingly, all tracing and plotting will take place on the internal side of the duct.



### 2 Cutting

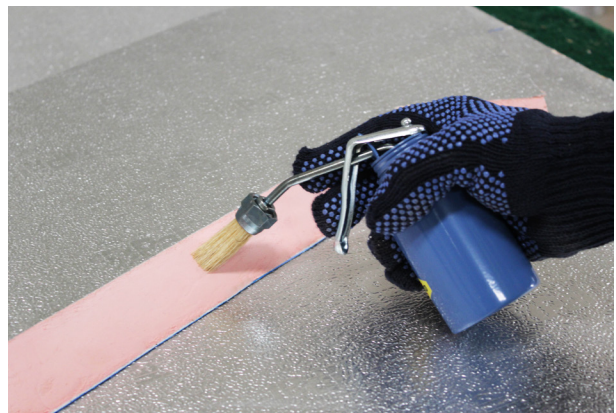
The operation involves cutting 45° miter cuts along each edge of the duct. The V-grooves made by the 45° Double Blade Jack Planes enable the panel to be folded into shape. The material that is discarded as a result of this operation must have been accounted for during the previous tracing. There are also several other special purpose Jack Planes available including the 22.5° and the Adjustable.



### 3 Gluing

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

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.

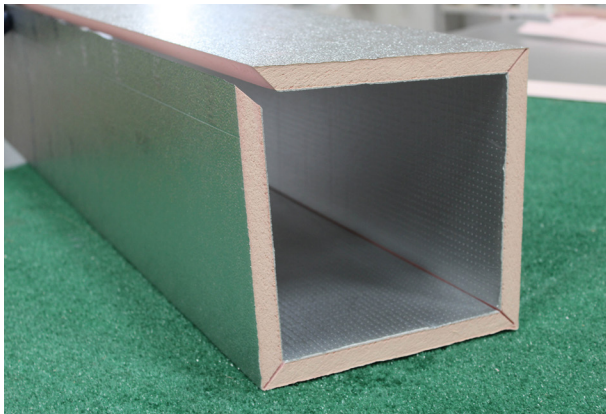


This operation should be performed in a well ventilated area and the precautions recommended on the COSH (Certificate of Safety and Handling) should be observed.

# Kingspan PalDuct™ Construction Guidelines

## 4 Folding

Following the curing phase, the sides are folded at right angles to each other (90°) and the duct shape is formed. Note that when two open sides of a duct are joined together, the aluminium foil edge of the mitre cut on the internal surface should be used for aligning purposes. When a duct is comprised of several individual pieces, the joining process should always be initiated from the same end so that the subsequent trimming operation of any excess length is only required at one end. The black hard spatulas should then be used to firmly crease along the edges of the duct to ensure maximum adhesion in the V-grooves.



## 5 Taping

Aluminium self adhesive tape is provided. The tape has been double cured for increased pliability, and contains two and one half times as much glue as standard tapes; also, it is a special glue with high technical characteristics to ensure maximum adhesion. The taping of the duct serves four purposes:

- it re-establishes the vapor barrier within the mitred cuts;
- external seams are taped to improve the duct's aesthetic appearance;
- tape is used to repair and cover any damage to the panel, both externally and internally; and
- it seals and isolates the insulating material from the surroundings.



Prior to applying the tape, ensure that all surfaces are dry and free of dirt, oil, silicon, and grease. If the surface cannot be thoroughly cleaned, then a simple solution is to apply a light coat of glue on the surface where the tape is to be placed (note that the glue must be allowed to cure first, as discussed within Section 3 above). The tape should ideally be applied in temperatures above 10°C (50°F) in order to assure a good bond. The tape should not be applied to the duct's surface when the temperature is below 0°C (32°F) due to the potential risk of ice getting into the joints.

Tape is only applied to seams where the external surface of the aluminium foil has been cut. On sides where the panel has been simply folded, as opposed to joined, no tape is required. The tape-marker is used to scribe a line on the panel which serves as reference during application of the tape. The soft spatula is brushed firmly along the surface of the tape during application to ensure maximum adhesion and to expel any air bubbles trapped underneath. When taping reducers or elbows, the tape must always be applied to the curved or creased side (not the straight side), and the supplemental directions within the respective sections should be observed.

## 6 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) 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.



# Kingspan PalDuct™ Construction Guidelines

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 surfaces to be sealed.

## 7 Aluminium / Polymer Profile and Reinforcement

There are a variety of profiles available to suit various installation requirements. Depending on both the system pressure and the duct's dimensions, the installation of a reinforcing bar may be necessary.



## Cutting Tools

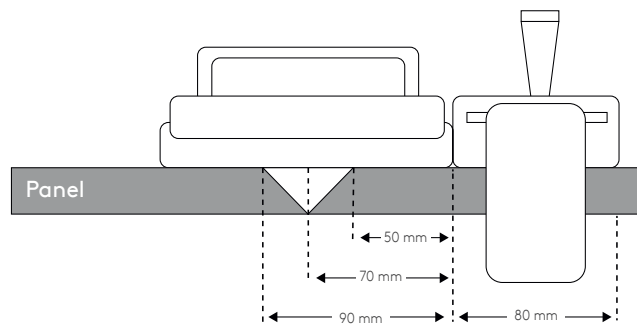


Figure 1a - Double Blade Cutter 45°

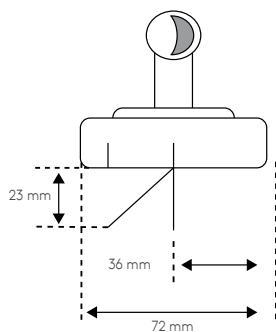


Figure 1b - Single Blade Cutter 45° Left

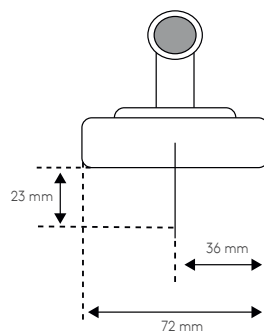


Figure 1c - Single Blade Cutter 90°

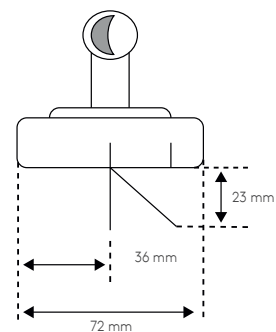


Figure 1d - Single Blade Cutter 45° Right

# Kingspan PalDuct™ Construction Guidelines

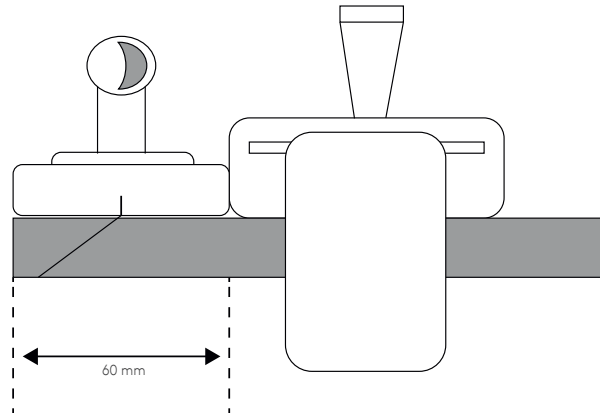


Figure 1e - Single Blade Cutter

## Straight Duct Method

### Method 1

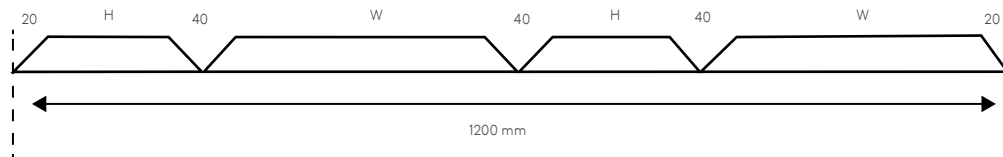


Figure 2a

- Cutting along the panel length
- The sum of 4 sides less than 1040mm ( $2H + 2W$ )

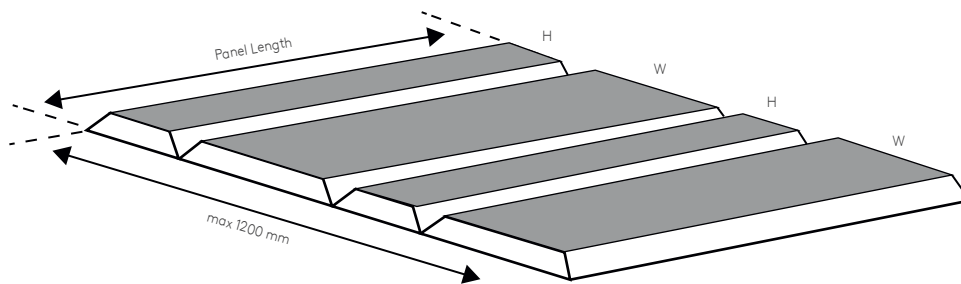


Figure 2b

### Sequence of Assembly

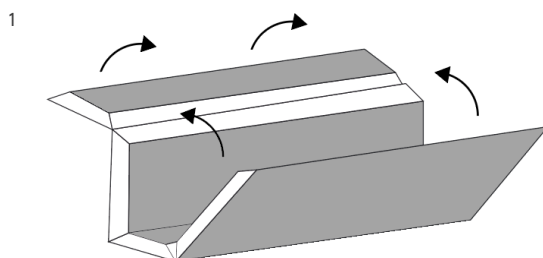


Figure 3b

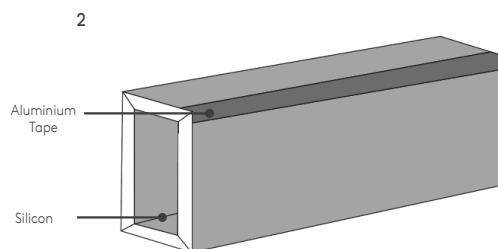


Figure 4b

# Kingspan PalDuct™ Construction Guidelines

## Method 2A

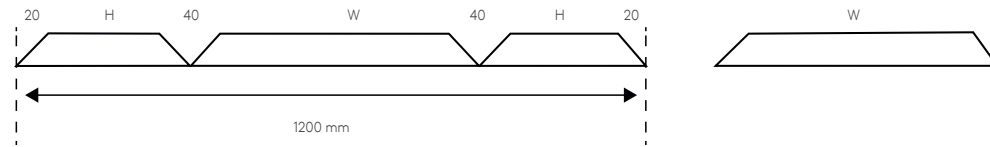


Figure 5a

- Cutting along the panel length
- The sum of 3 sides less than 1080mm ( $2H + W$  or  $2W + H$ )

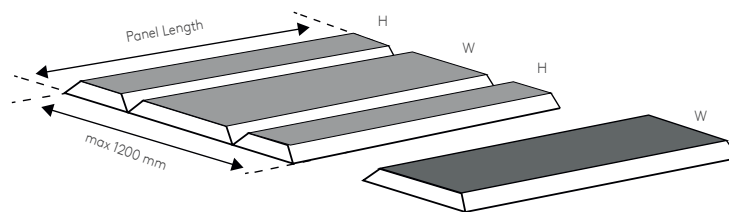


Figure 5b

## Sequence of Assembly

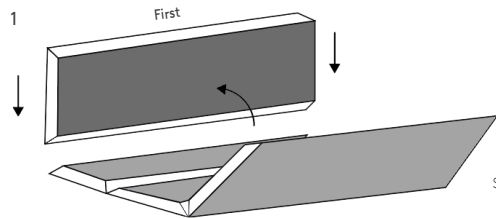


Figure 5c

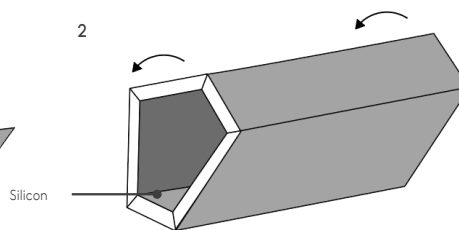


Figure 5d

## Method 2B

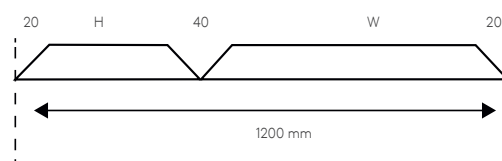
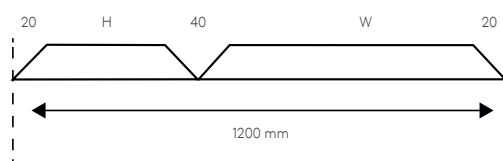


Figure 6a

- Cutting along the panel length
- The sum of 2 sides less than 1120mm ( $W + H$ )

## Sequence of Assembly

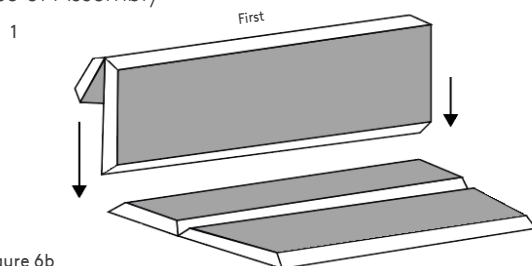
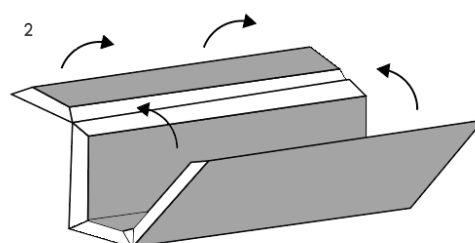


Figure 6b





# Kingspan PalDuct™ Construction Guidelines

## Method 2C

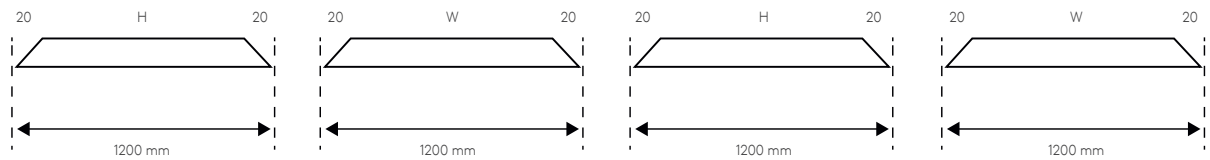


Figure 7a

- Cutting along the panel length
- Each side to be less than 1160mm

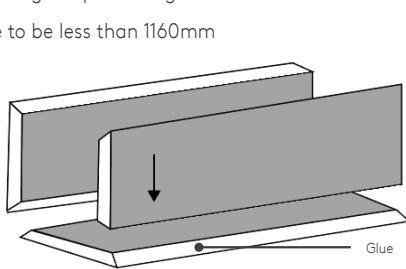


Figure 7b

Note: Extra Silicon (bigger tip cut)

When assembling the four sides, the sides should be checked (with T Square Ruler) and held in position

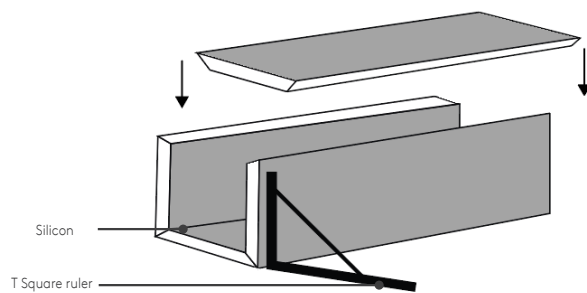


Figure 7c

## Method 3

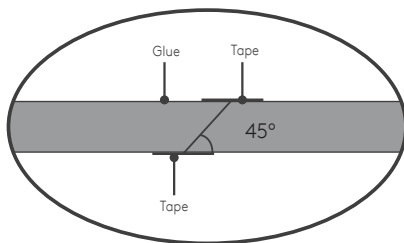


Figure 8a

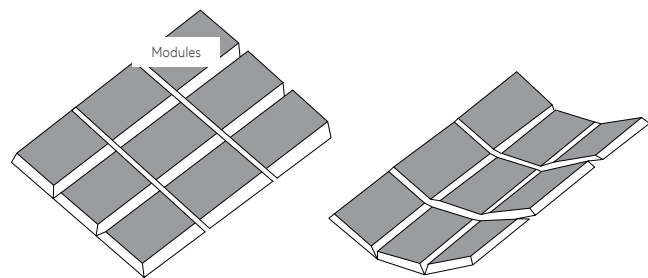


Figure 8b

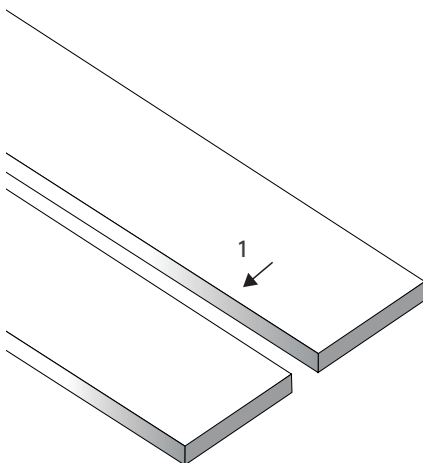


Figure 8c

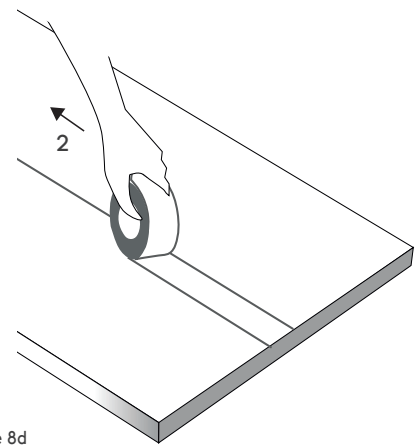


Figure 8d

# Kingspan PalDuct™ Construction Guidelines

## End Caps

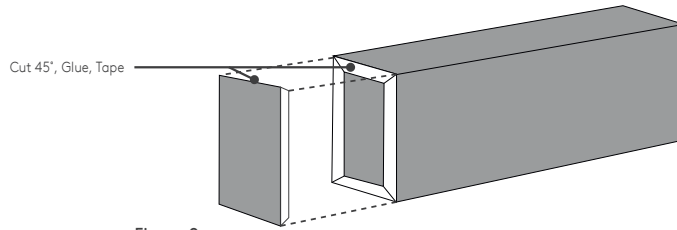


Figure 9

## Transitions

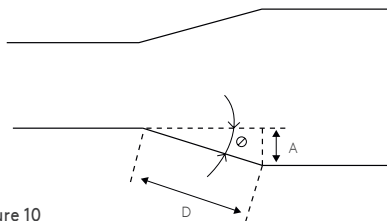


Figure 10

Concentric Transition

∅ max. 22.5° (D = 2.5 x A)

∅ suggested 15° (D = 4 x A)

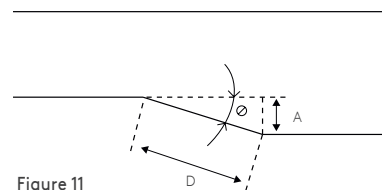


Figure 11

Eccentric Transition

∅ max. 22.5° (D = 2.5 x A)

∅ suggested 15° (D = 4 x A)

## Offsets

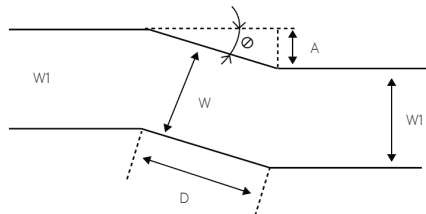


Figure 12

Offset - Angled

∅ max. 30° (D = 2 x A)

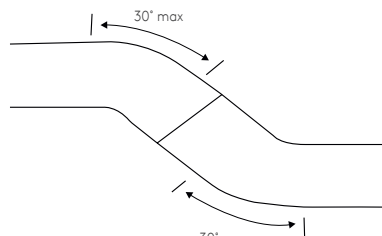


Figure 13

Offset - Radiused

## Elbow

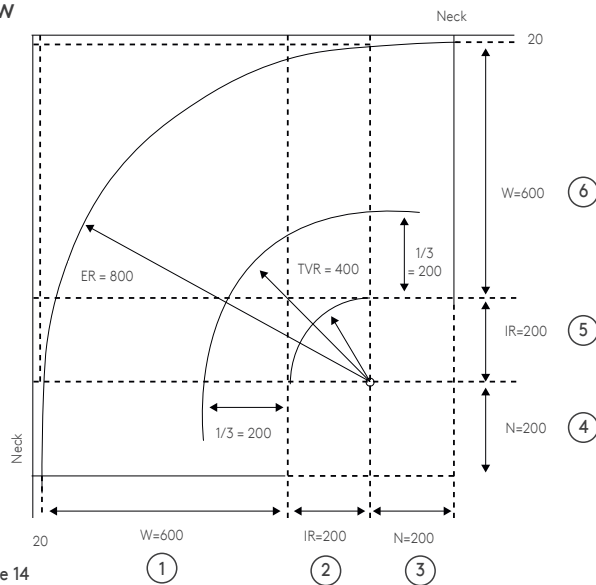


Figure 14

### LEGEND:

N = Neck

ER = External Radius

IR = Internal Radius

TVR = Turning Vane Radius

■ Dimension in "mm"

■ Numbers in the hoop show suggested tracing procedure

■ Splitter Vanes are not required in angles less than 45°

Turning Vane		
Elbow Side (mm)	Vane	Position
0-550	0	0
600-850	1	W/3
900-1200	2	W/4, W/2
Over 1200	3	W/8, W/3, W/2

# Kingspan PalDuct™ Construction Guidelines

## Concentric Reducer

- Dimension in "mm"
- D suggested =  $4 \times (450 - 300) = 600$
- D minimum =  $2.5 (450 - 300) = 375$

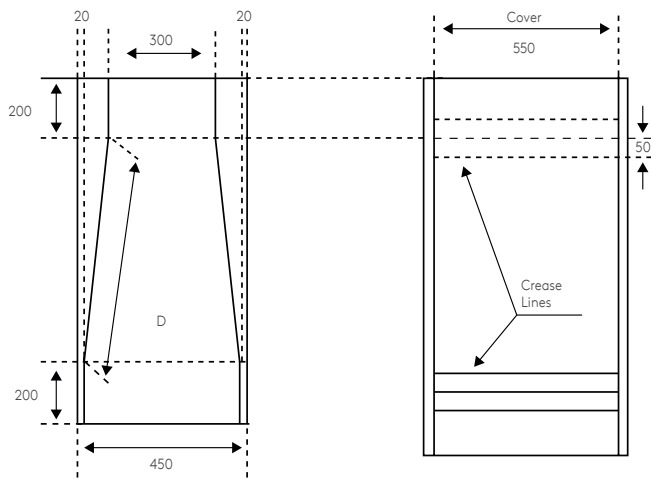


Figure 15a

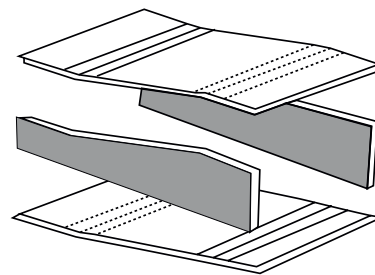


Figure 15b

## Eccentric Reducer

- Dimension in "mm"
- D suggested =  $4 \times (450 - 300) = 600$ :
- D minimum =  $2.5 (450 - 300) = 375$

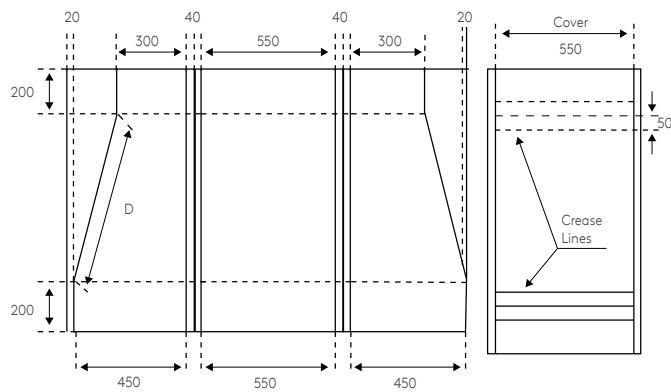


Figure 16a

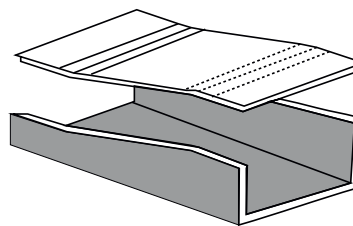


Figure 16b



# Kingspan PalDuct™ Construction Guidelines

## Tee Branch (External Side Flushed)

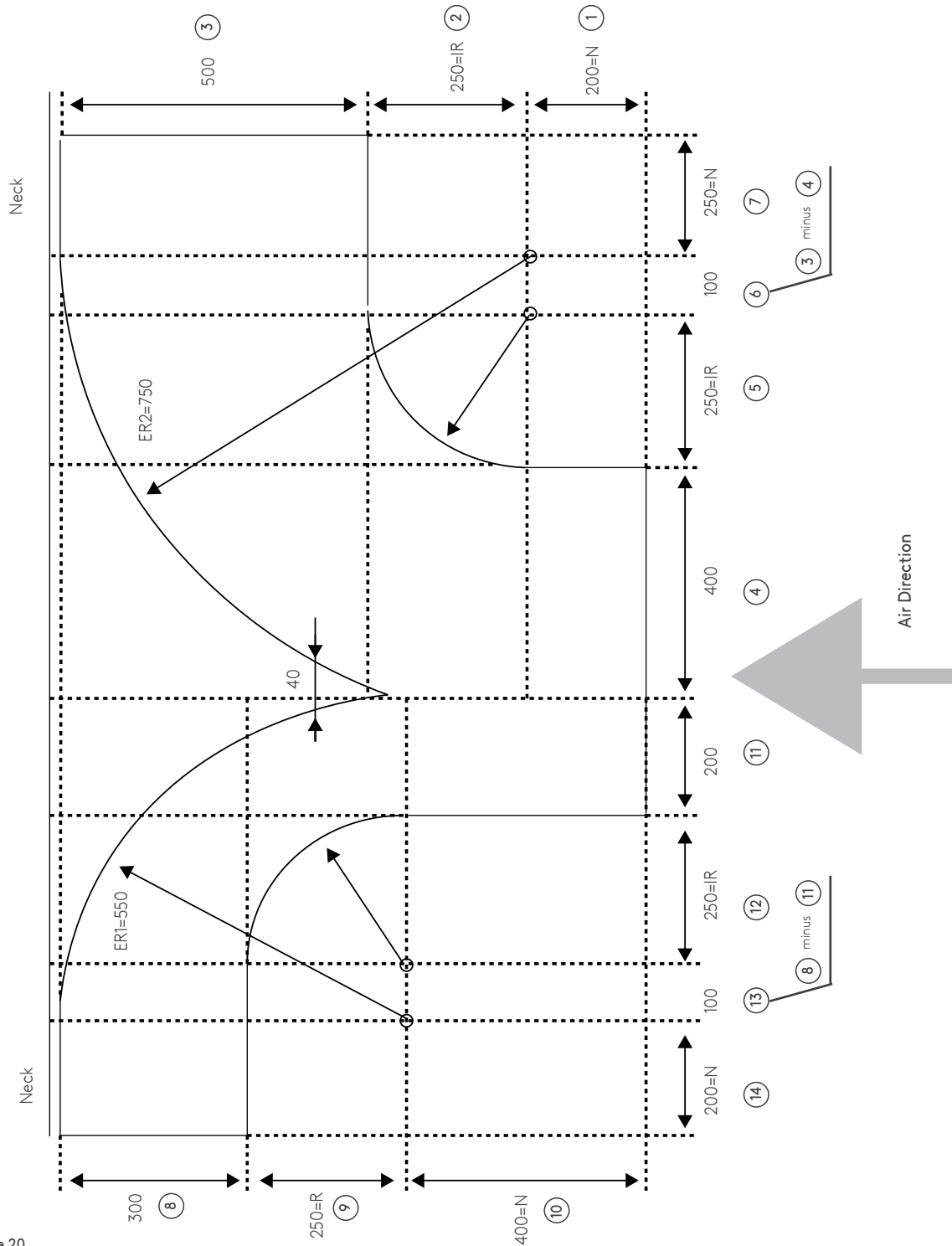


Figure 20

- Dimension in "mm"
- Numbers in the hoop show suggested tracing procedure

# Kingspan PalDuct™ Construction Guidelines

## Tee Branch (Internal Side Flushed)

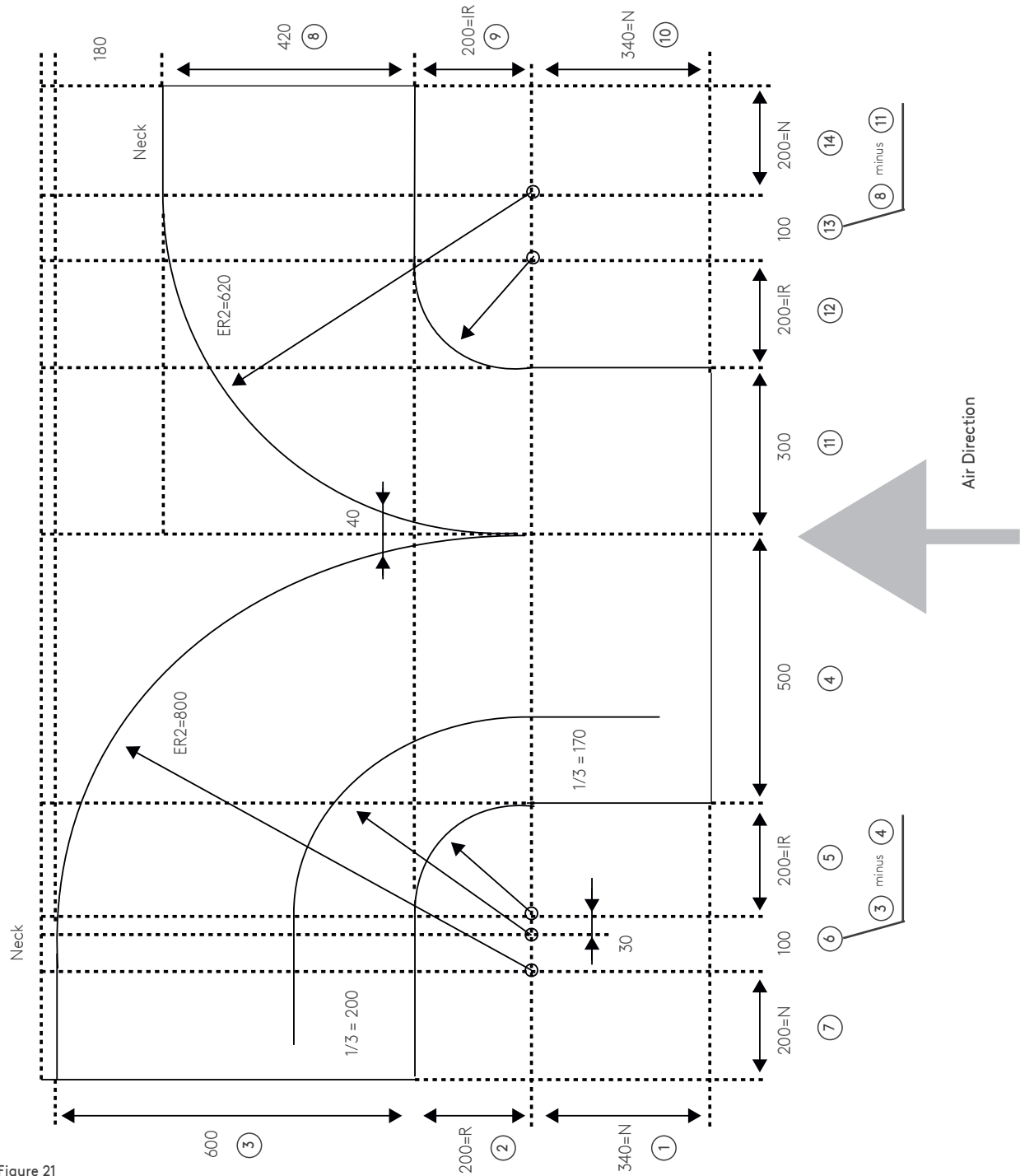


Figure 21

- Dimension in "mm"
- Numbers in the hoop show suggested tracing procedure

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# Kingspan PalDuct™ Construction Guidelines

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## Assembly Procedure

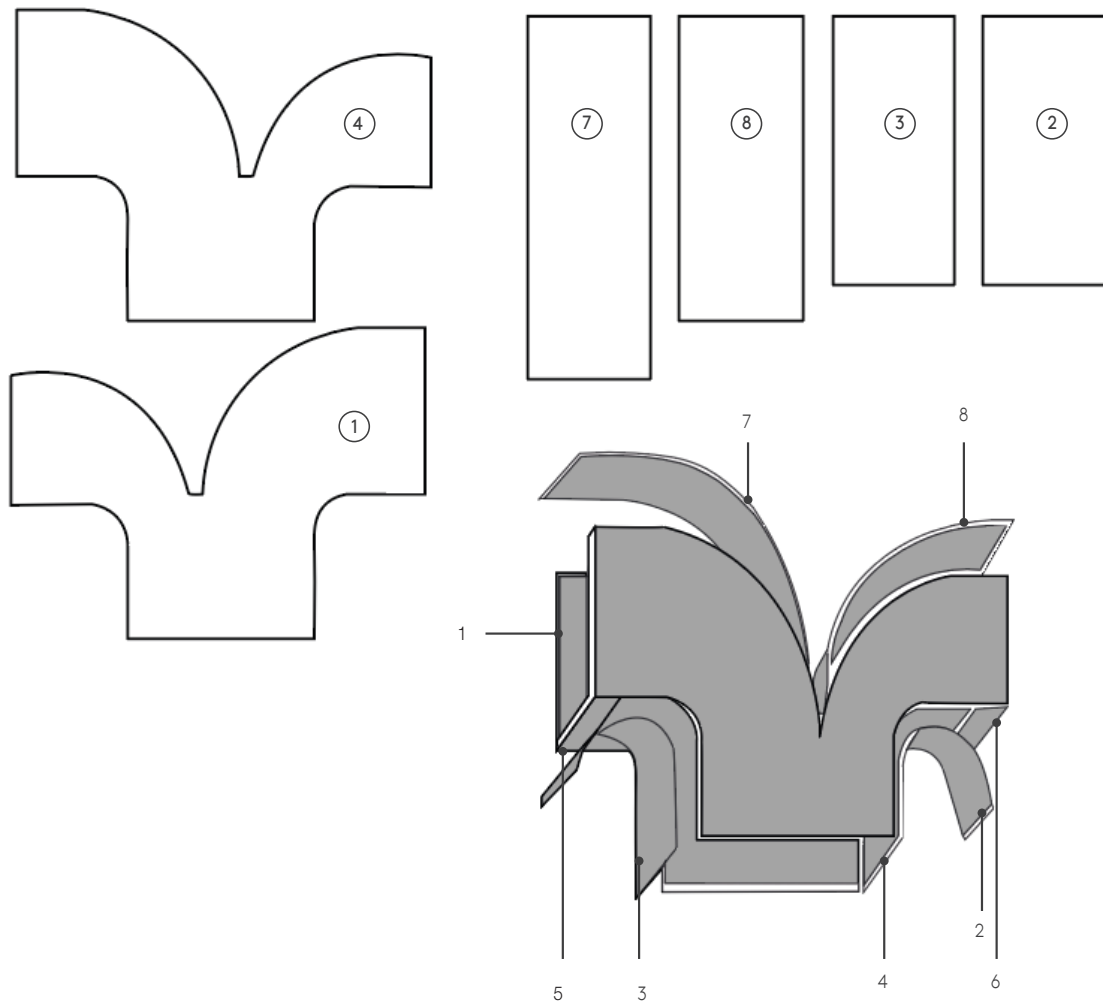


Figure 22

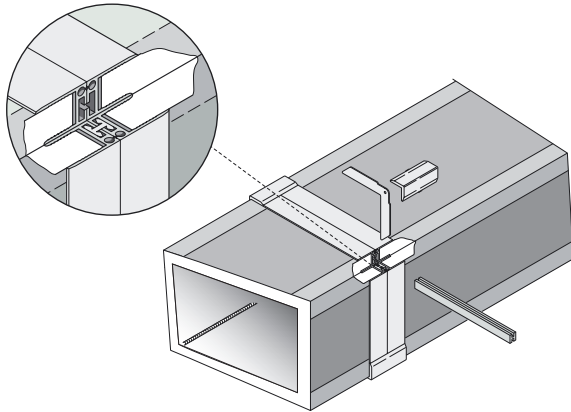
- Place 1 on the table.
- Join section 2 and 3 only the Neck Section.
- Add pieces (scraps) 5 and 6 with just Tape and on Glue.
- Install bigger Circumference Section with cover 7.
- Install Section 8.
- Remove section 5 and glue section 3.
- Remove section 6 and glue section 2.

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# Kingspan PalDuct™ Construction Guidelines

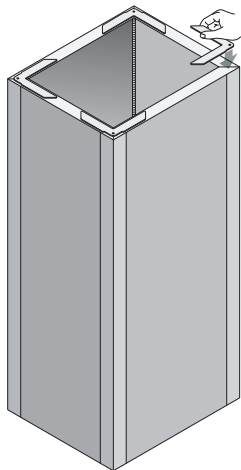
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## Flange Connection



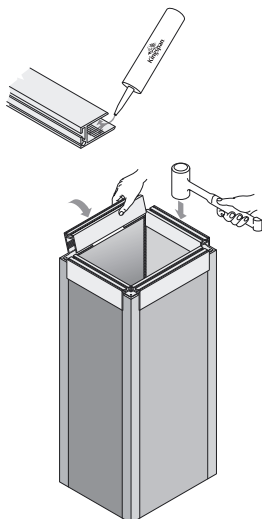
### Measuring

Four pieces of the invisible flange are necessary for each end of the ducts segment to be joined (each joint will require 8 pieces). The pieces must be cut in the same size as the inner measure of the duct reduced by 2/3 mm. Each joint also requires 4 pieces of PVC bayonet and these must be cut in a size that corresponds with the inner side of the duct.



### Application Of Reinforcements Corners

Before fitting the flange it is necessary to place the reinforcement corners in position. These must be fixed – sometimes glued or fitted in position by a self-threading screw – at the four angles of the duct before inserting the flange. This will ensure that the corner is fastened in position between the flange and the duct.



### Application Of The Invisible Flange On The Duct

After applying the glue, proceed to fit the flange. The segments of the invisible flange must be applied on all four sides of each of the sections of the duct to be joined. The flange should be inserted turning in the longest side towards the inner side of the duct. To make assembly easier, it is recommended to use the special rubber hammer.



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# Kingspan PalDuct™ Construction Guidelines

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## Duct Joining System

Option 1.A - Using Invisible Profile - H bayonet for 20mm & 30mm Panel

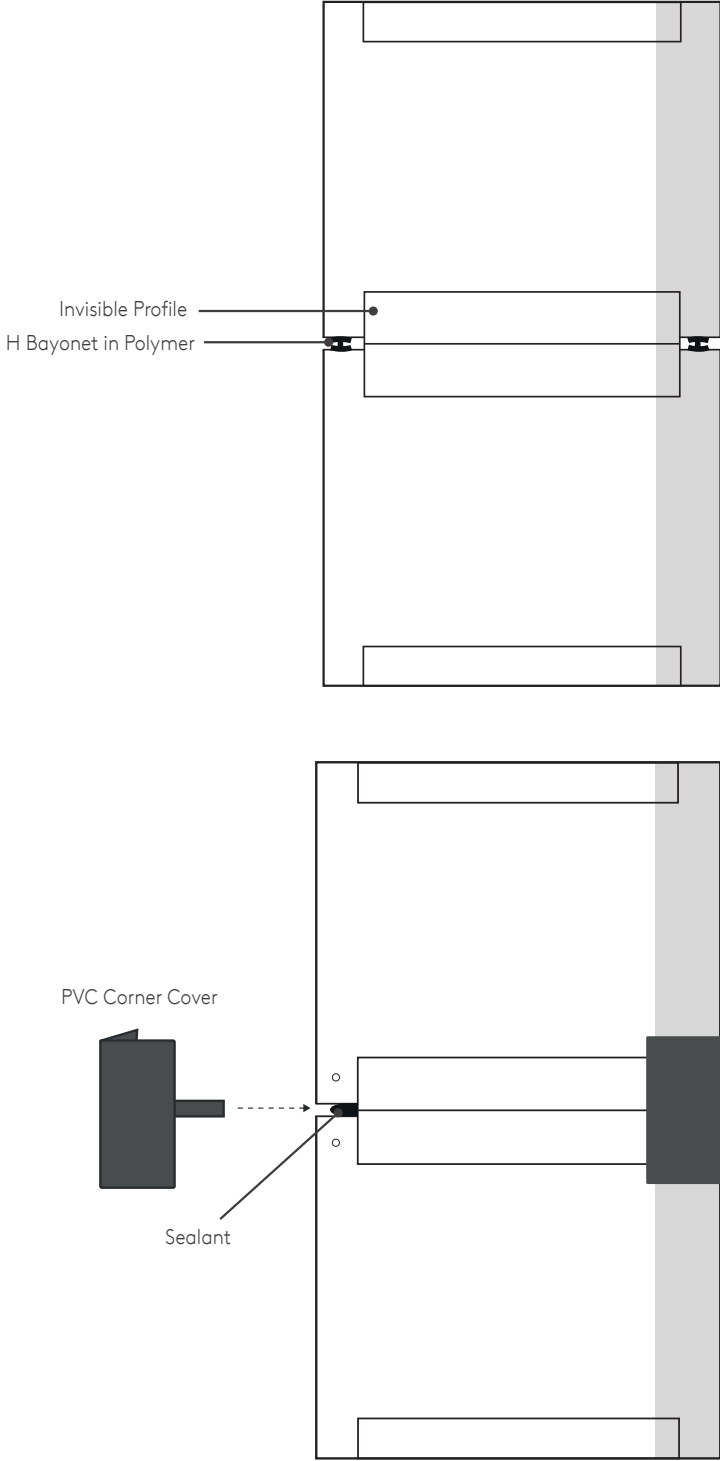
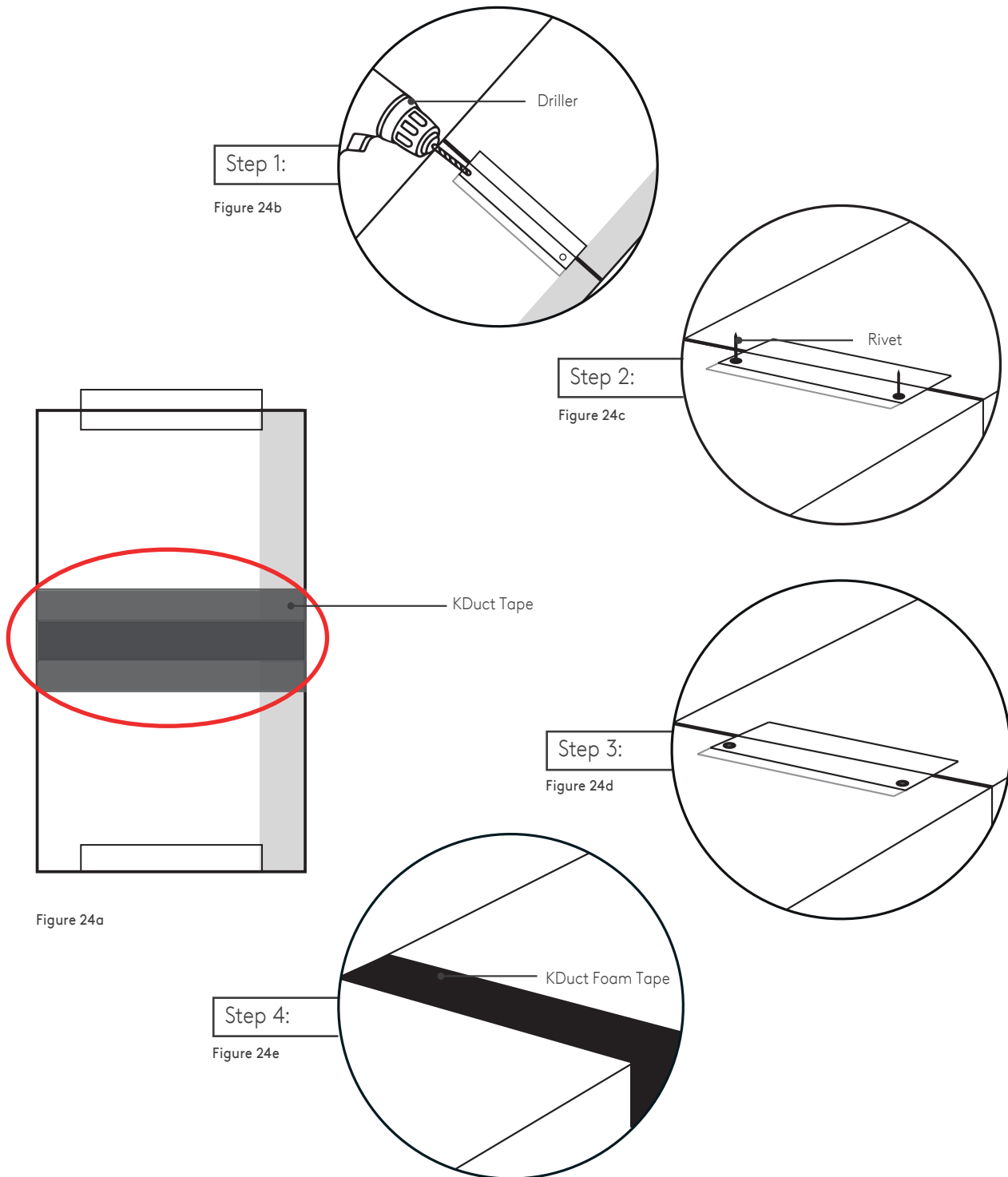


Figure 23  
Note: Sealant must be applied over the corners before inserting the PVC corner cover

# Kingspan PalDuct™ Construction Guidelines

## Option 1.B – Using U & Chair Profile for KDuct



Note: The maximum spacing between rivets is 200mm

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# Kingspan PalDuct™ Construction Guidelines

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## Option 2 – For Internal Duct (20 mm thick) Less than 500 x 500 mm Section Tiger Connection

### Step 1

Application of Aluminum Tape on both ends of the duct segments

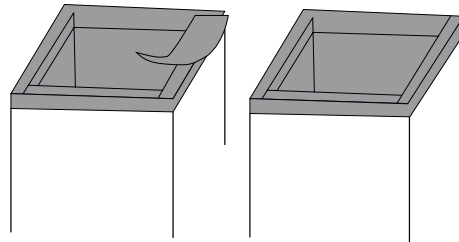


Figure 25a

### Step 2

Silicon is placed on one side of one duct, then the two duct segments are joined together

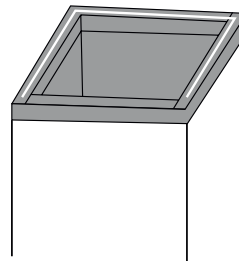


Figure 25b

### Step 3

Tiger Connectors are placed on all four sides of the duct. For small ducts up to 300 mm, use one Tiger Connector on each side of the duct.

For ducts with one side 350 to 500 mm, use two Tiger Connectors on each side.

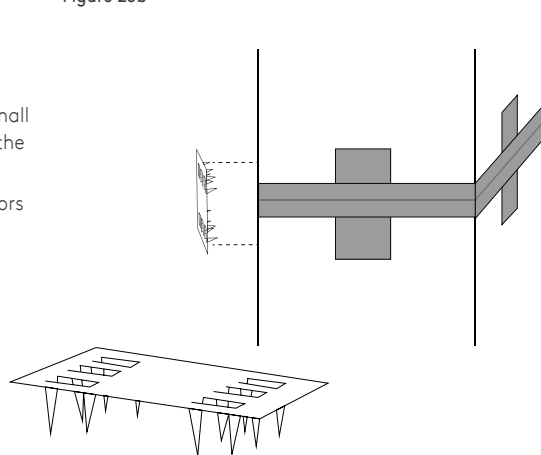


Figure 25c

### Step 4

Aluminum Tape then covers the connection of the two duct segments.

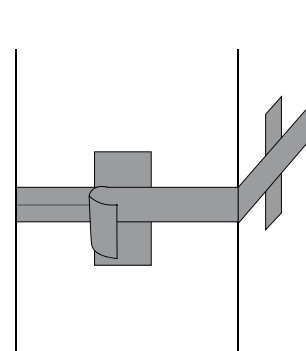


Figure 25d

# Kingspan PalDuct™ Construction Guidelines

Option 3 - For Internal Duct (20 mm thick)

Less than 500 x 500 mm Section

Male - Female Joining System

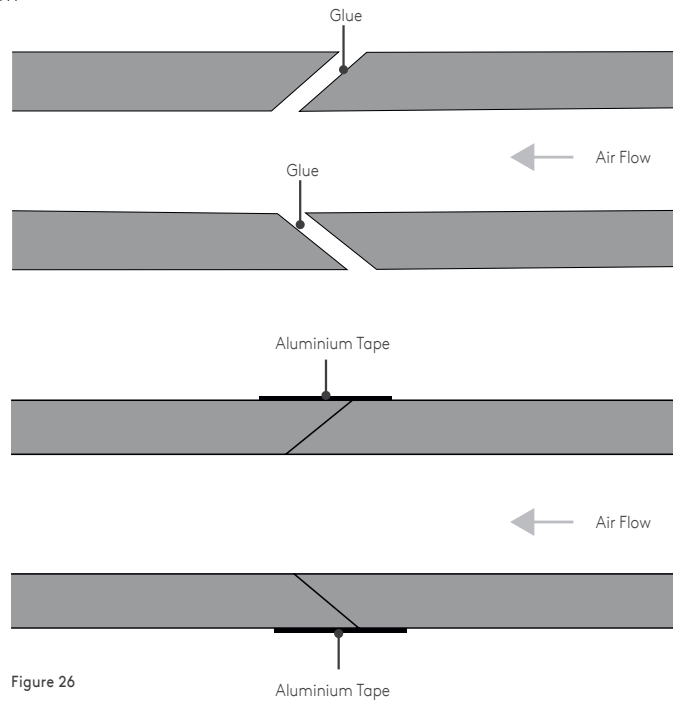


Figure 26

## GI Collar Installation for Round Diffusers & Flexible Ducts

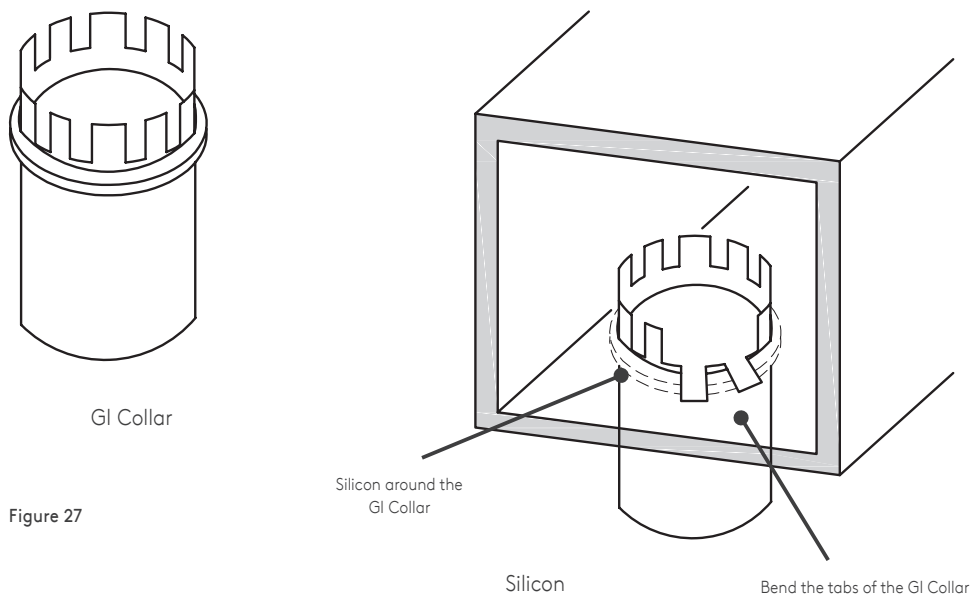


Figure 27

# Kingspan PalDuct™ Construction Guidelines

## GI Damper/Duct - PI Duct Connection

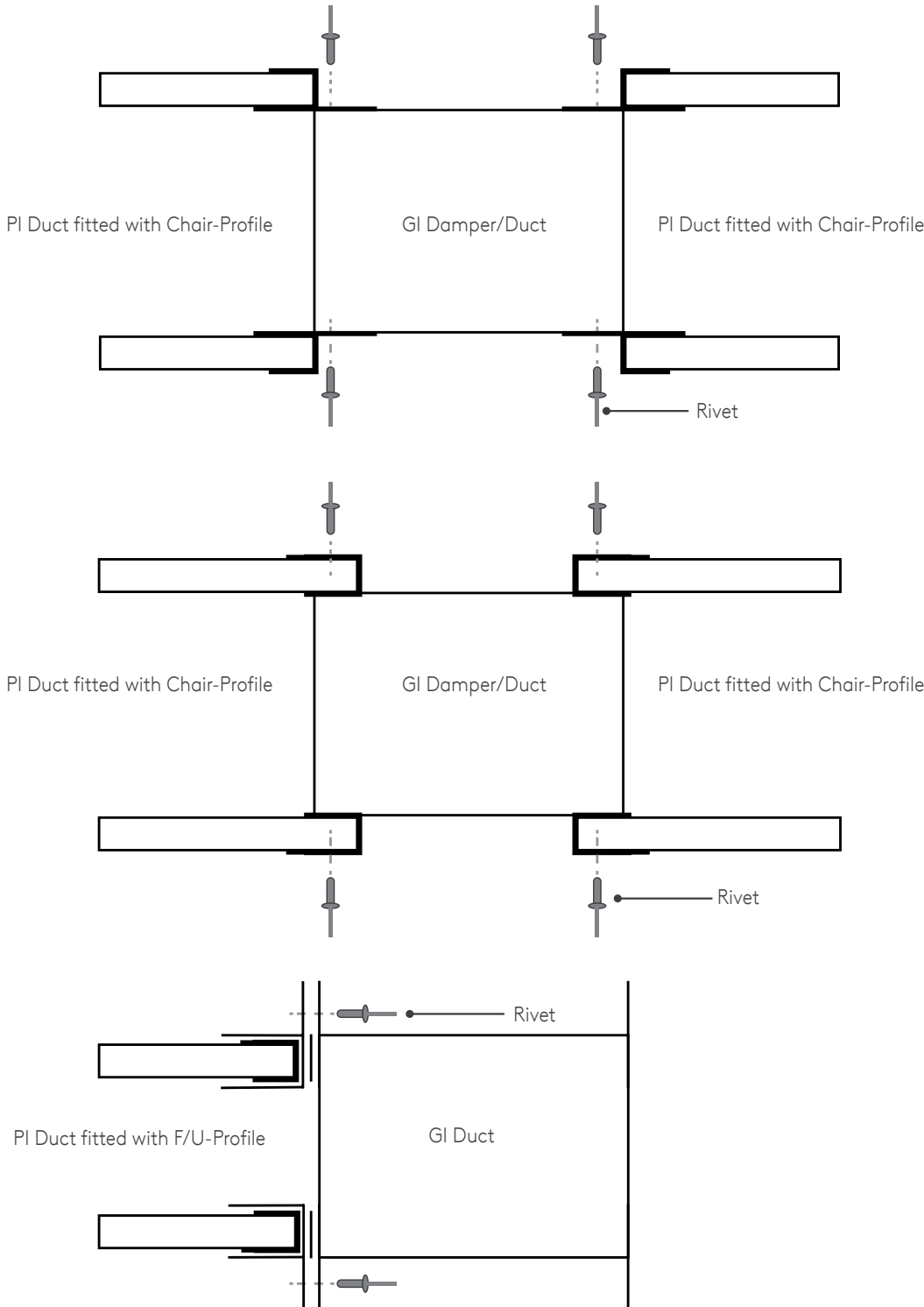


Figure 28

# Kingspan PalDuct™ Construction Guidelines

## GI VCD - Duct Connection

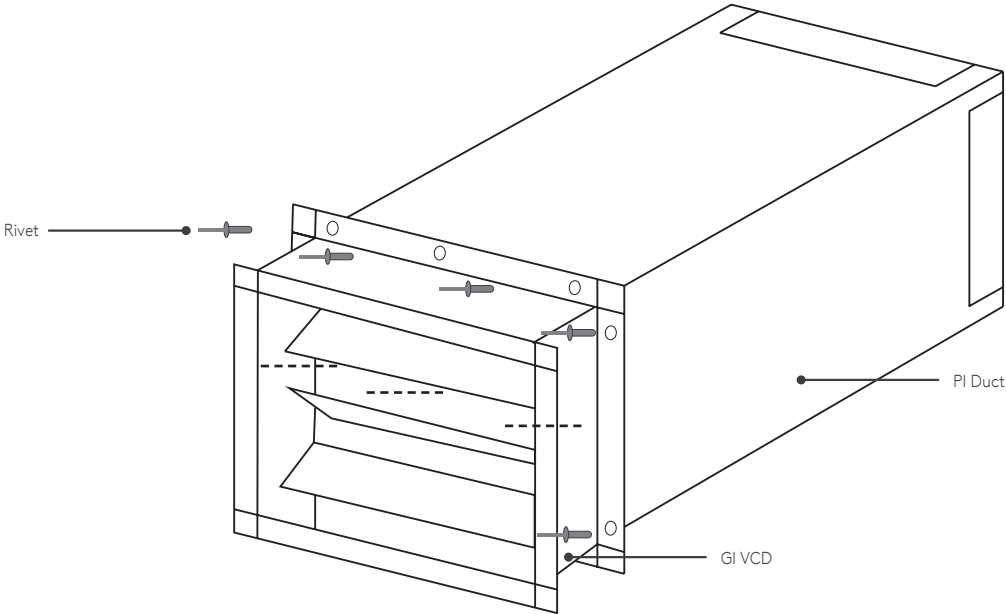
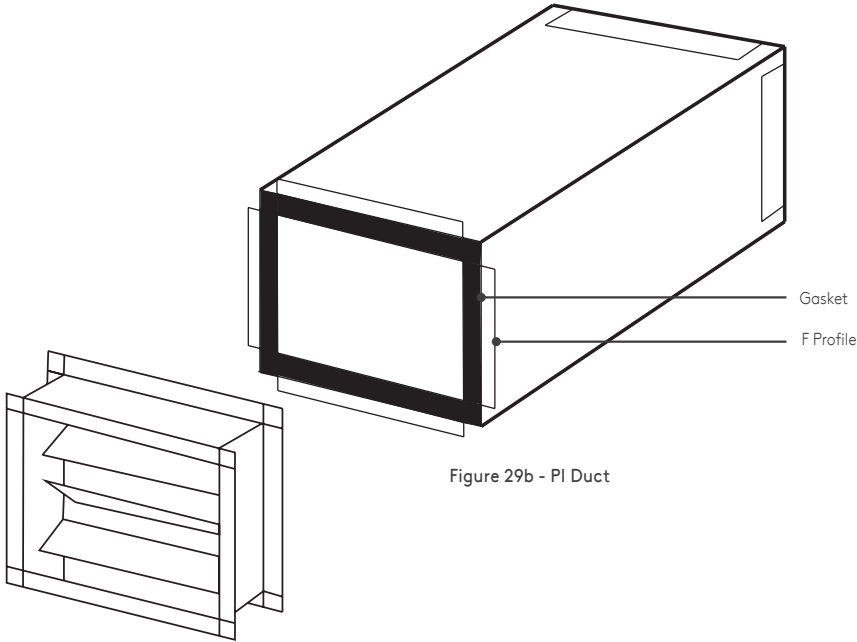


Figure 29c

Rivet/Screw Spacing: 4" (100mm)  
Maximum from Duct Corners: 2" (50mm)  
Maximum Spacing: 6" (150mm)

# Kingspan PalDuct™ Construction Guidelines

## Grill Installation with Aluminum / Polymer Profiles

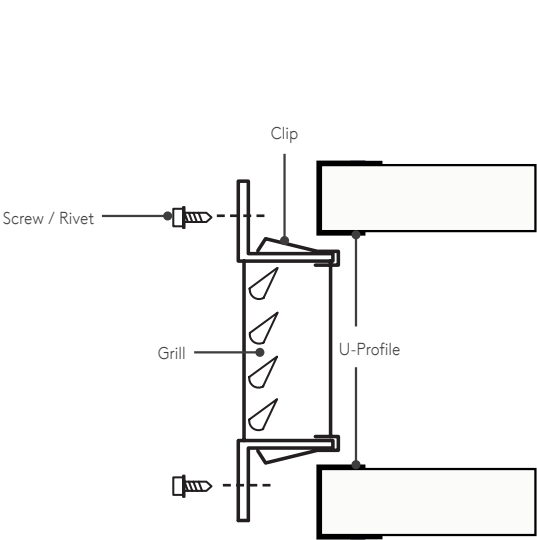


Figure 30a

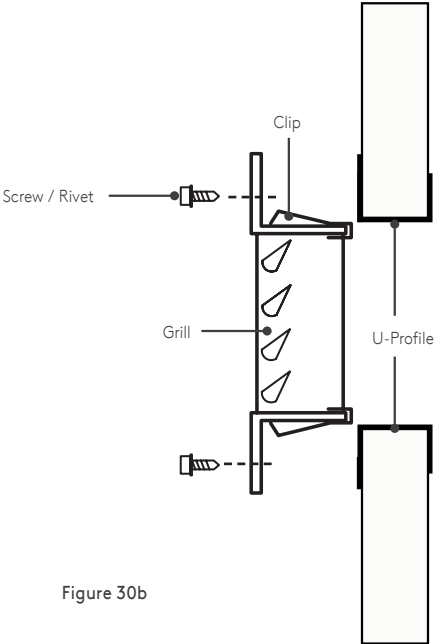


Figure 30b

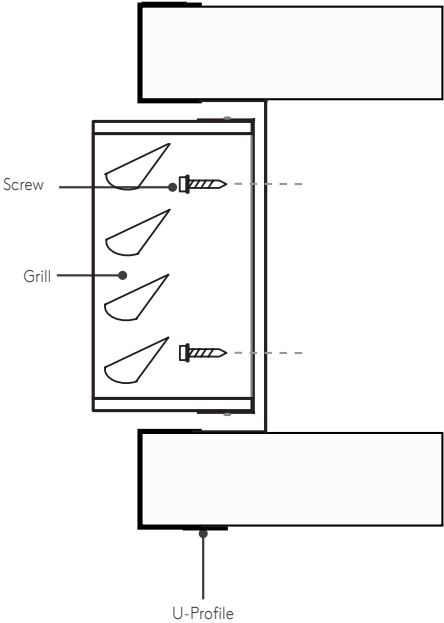


Figure 30c

# Kingspan PalDuct™ Construction Guidelines

## Take Off / Branch Connection

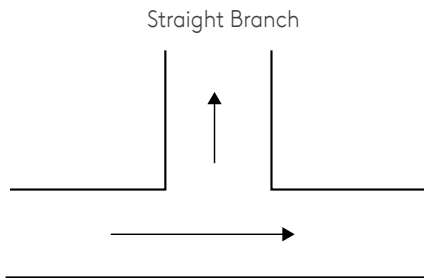


Figure 31a

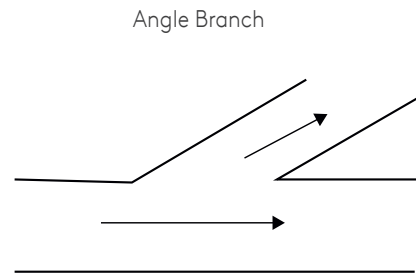


Figure 31b

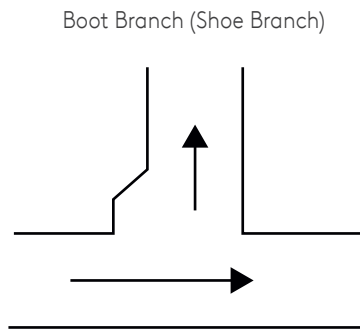


Figure 31c

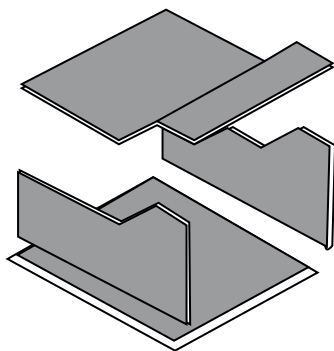


Figure 31d

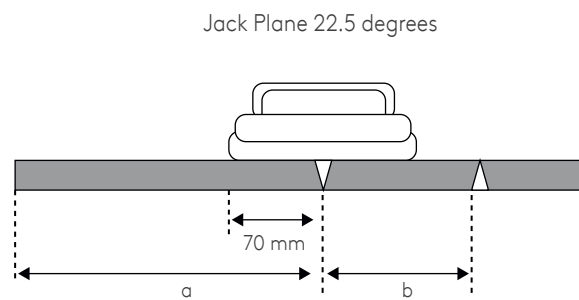


Figure 31e

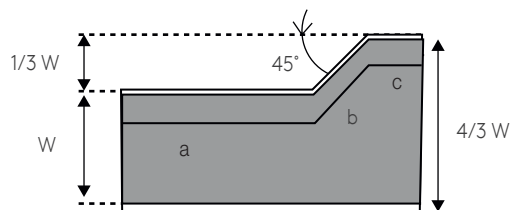


Figure 31f

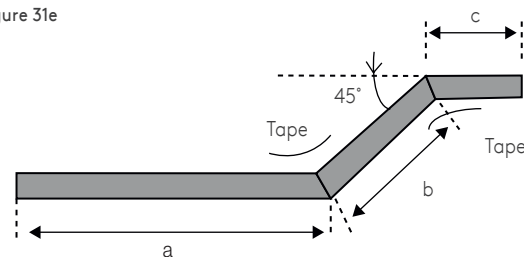


Figure 31g



# Kingspan PalDuct™ Construction Guidelines

## Take Off - Option 1

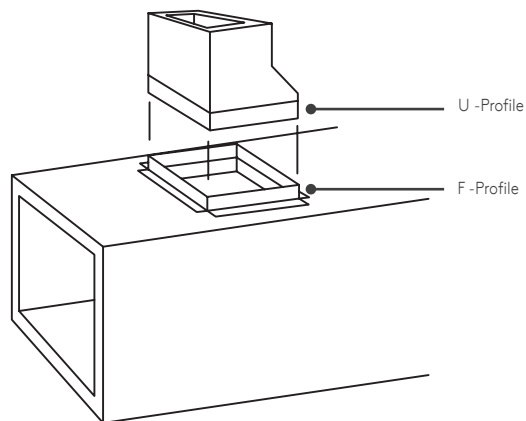


Figure 32a

Rivet/Screw Spacing: 4" (100mm)  
 Maximum from Duct Corners: 2" (50mm)  
 Maximum Spacing: 6" (150mm)

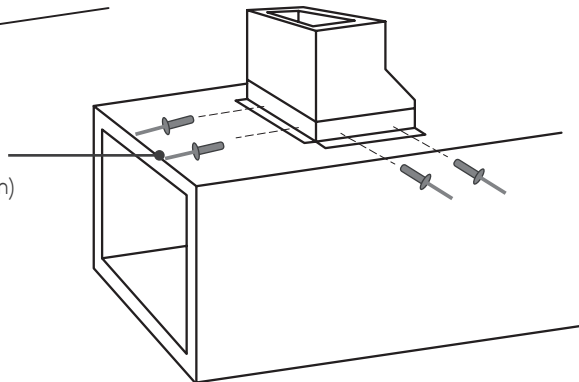


Figure 32b

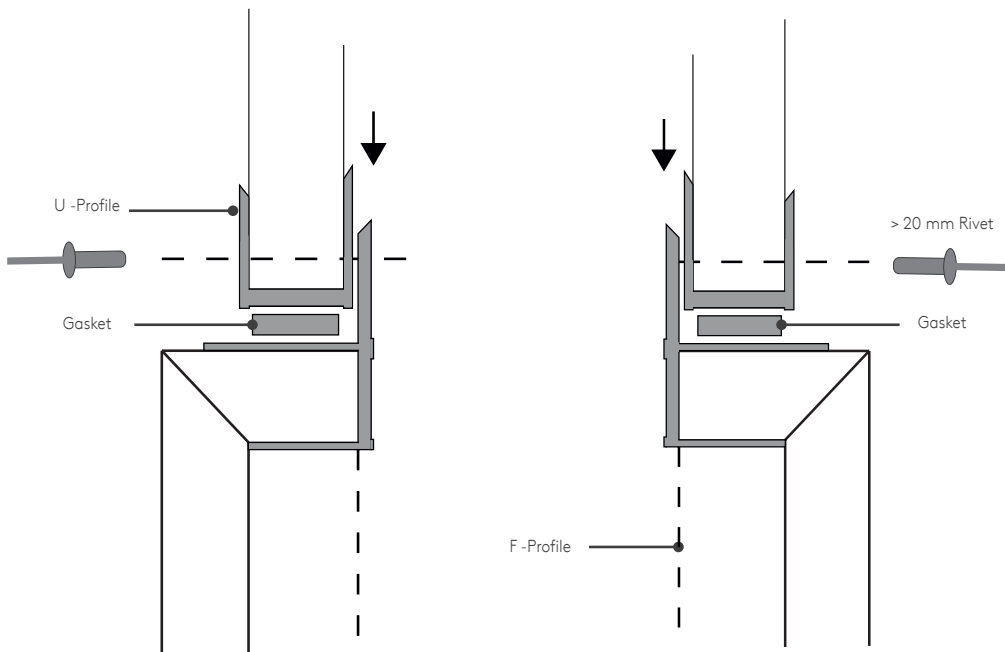


Figure 32c

Cut the opening 4mm shorter than take off inside dimensions

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# Kingspan PalDuct™ Construction Guidelines

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## Take Off - Option 2

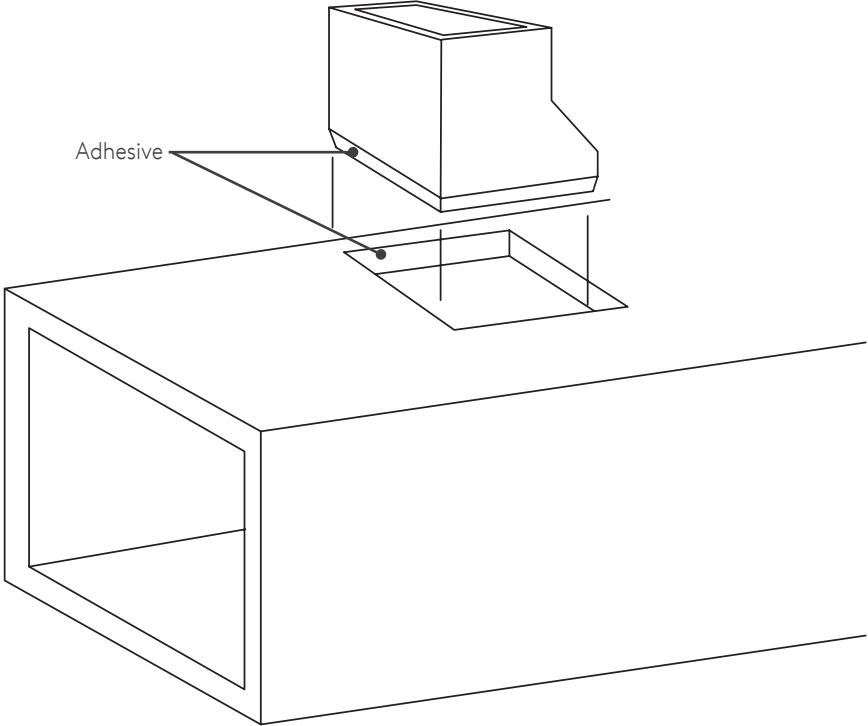


Figure 33a

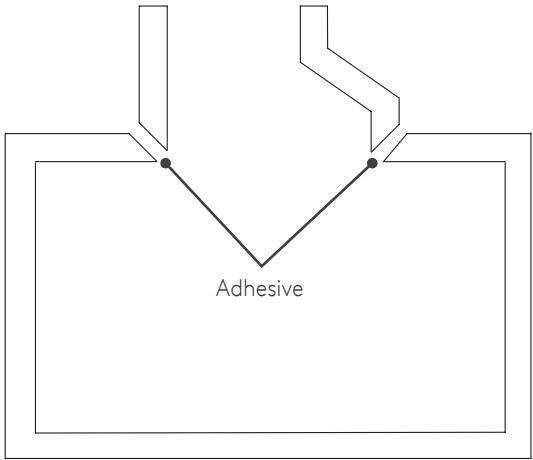


Figure 33b

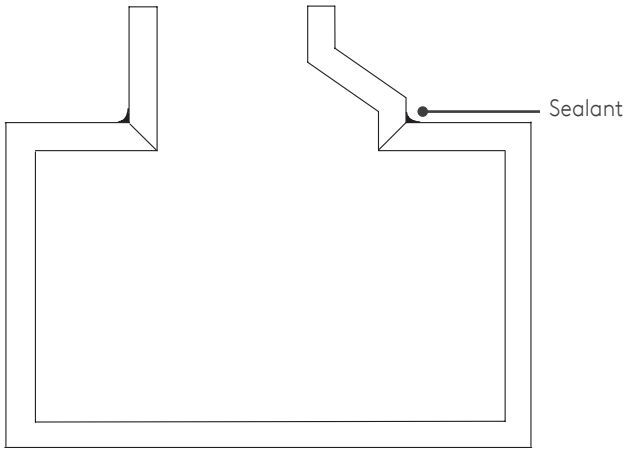
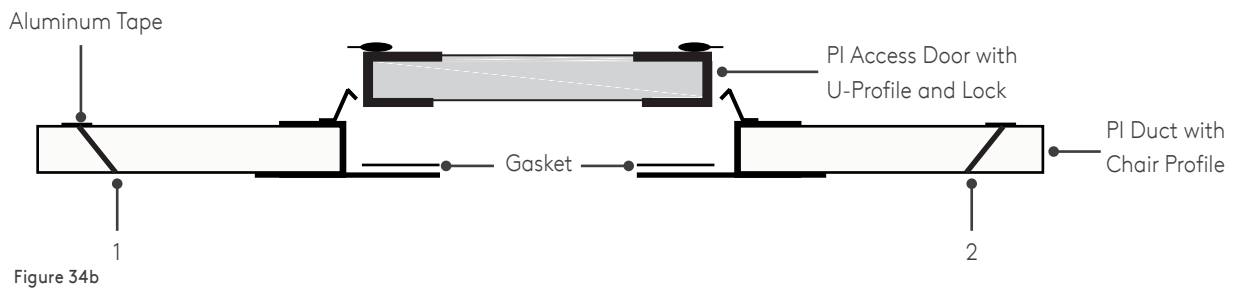
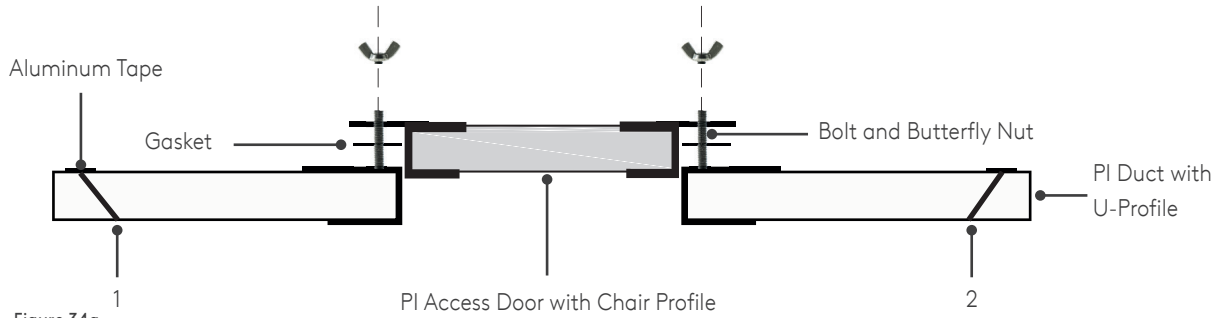


Figure 33c

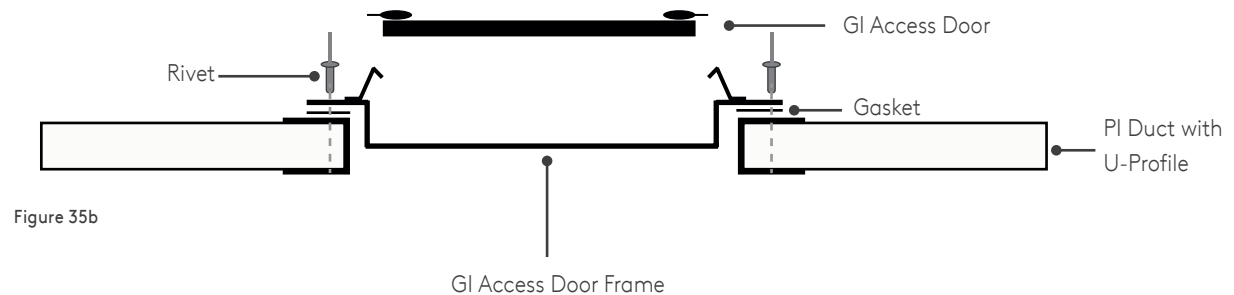
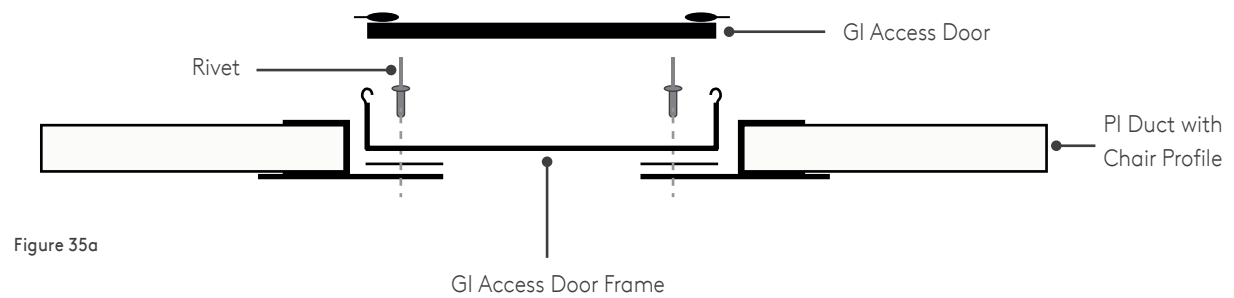
# Kingspan PalDuct™ Construction Guidelines

## PI Access Doors - PI Duct Connection



Note: Here 1 and 2 mentioned are 45° cut, where adhesive and tapes are applied to join the PI Access Door to PI Duct.

## GI Access Doors - PI Duct Connection



# Kingspan PalDuct™ Construction Guidelines

## Duct Reinforcement

Table for the Calculation of Stiffening

Duct Side (mm)	Pressure										
	PA 0-150	PA 160-300	PA 310-450	PA 460-600	PA 610-750	PA 760-950	PA 960-1000	PA 1010-1250	PA 1260-1500	PA 1510-1750	PA 1760-2000
510-600									1	1	2
610-700								1	1	1	2
710-800							1	1	2	2	2
810-900					1	1	1	2	2	2	2
910-1000	1	1	1	1	1	1	2	2	2	2	2
1010-1100	1	1	1	1	2	2	2	2	2	2	2
1110-1200	1	1	1	2	2	2	2	2	2	2	2
1210-1300	1	1	1	2	2	2	2	2	2	2	2
1310-1400	1	1	1	2	2	2	2	2	2	2	2
1410-1500	2	2	2	2	2	2	2	2	2	2	2
1510-1600	2	2	2	2	2	2	2	2	2	2	2
1610-1700	2	2	2	2	2	2	2	2	2	2	2
1710-1800	2	2	2	2	2	2	2	2	2	2	2
1810-1900	2	2	2	2	2	2	2	2	2	2	2
1910-2000	2	2	2	2	2	2	2	2	2	2	2

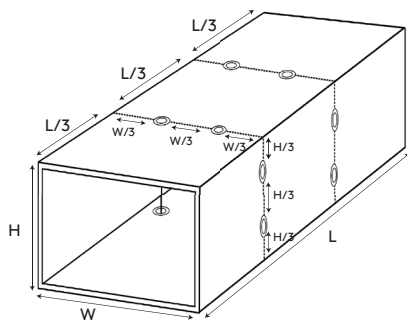


Figure 36a

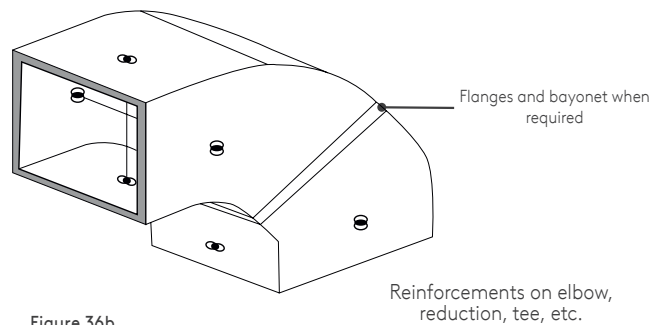


Figure 36b

L = Length of the Duct  
W = Width of the Duct  
H = Height of the Duct

# Kingspan PalDuct™ Construction Guidelines

## Hangers & Supports

### 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 PalDuct™ System, hangers and supports need not be as heavy, or as numerous, as those required for sheet metal ductwork.

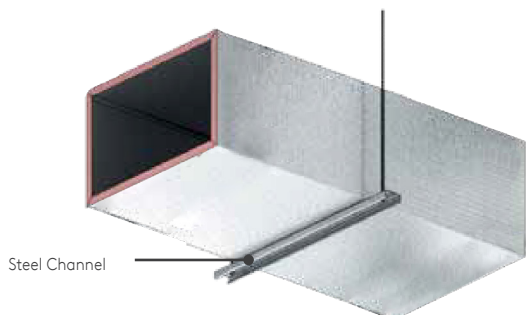
### Hanger & Support Design

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 PalDuct™ System in accordance with the project specification.

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



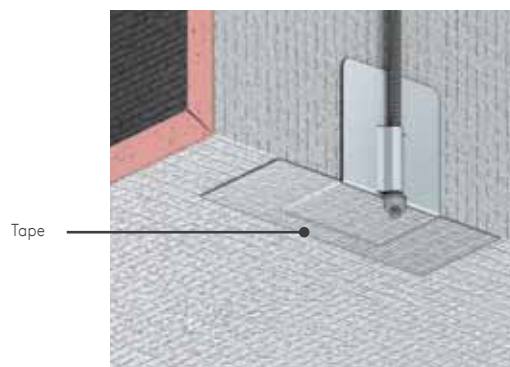
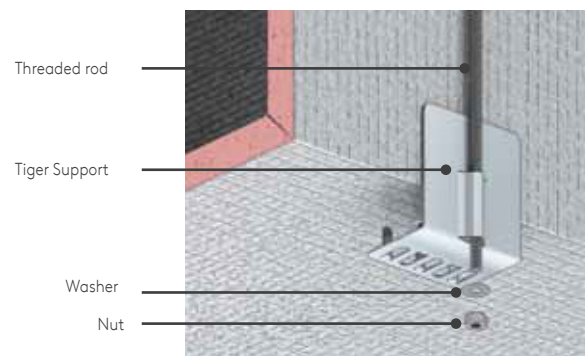
Conventional Hangers & Supports for Vertical Ductwork



Conventional Hangers & Supports for Horizontal Ductwork

## Vertically Orientated Ductwork

When used to support vertically orientated ductwork, Steel channels are used both sides in conjunction with 6–8 mm threaded steel rods.



Tiger Supports on Horizontally Orientated Plenum Box: Threaded Bar

# Kingspan PalDuct™ Construction Guidelines

## Components / HVAC Equipment

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

## Branch Connections

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

## 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.

## 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.

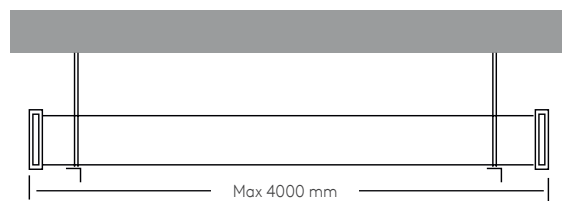


Figure 37

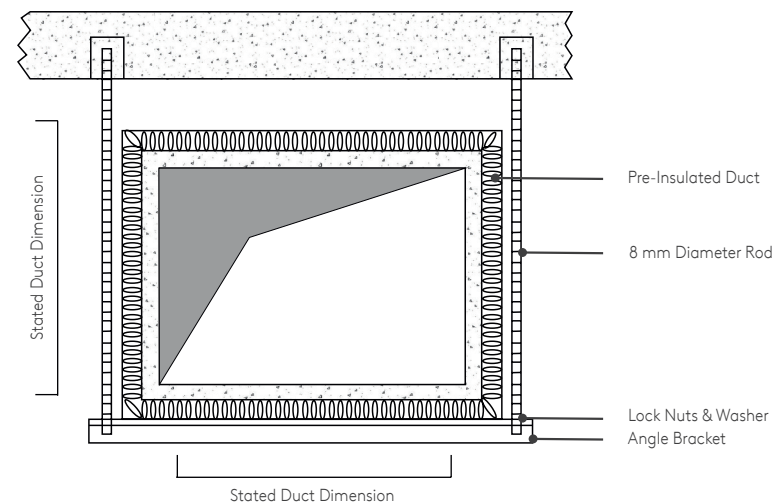


Figure 38

## Storage, Handling & Transportation

### General

To prevent physical damage, care should be exercised in the storage, handling and transportation, of both Kingspan PalDuct™ panels, and ductwork sections fabricated from the System.

### Storage Inside

Wherever possible, both Kingspan PalDuct™ panels, and ductwork sections fabricated from the System, should be stored inside, under cover, clear of the ground and away from direct heat sources

### Storage Outside

Where storage inside a building is not possible, Kingspan PalDuct™ 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.

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# Kingspan PalDuct™ Construction Guidelines

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## Damage Repair

### General

Localised damage to ductwork fabricated from The Kingspan PalDuct™ System can be repaired in-site in an efficient and economical manner, as opposed to replacing an entire ductwork section, which would be the case with some other ductwork systems.

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

### Repair Procedure

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

#### 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.

#### Substantial Damage

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

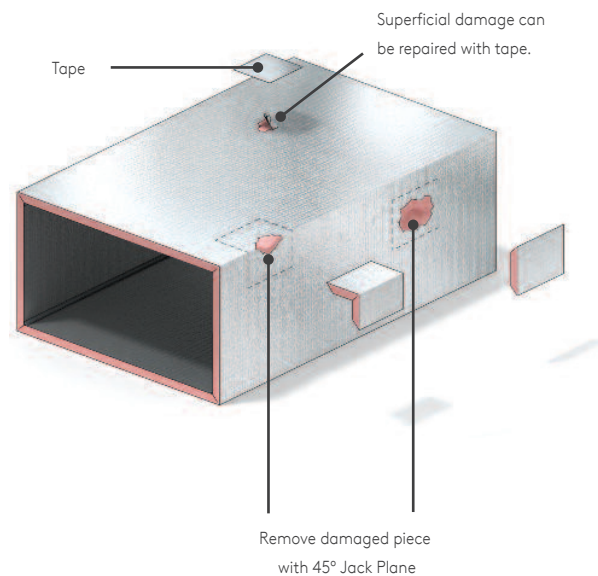
First, an outline, fully encompassing the damaged area, is marked on the ductwork section.

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.

Further apply glue on the exposed insulation on both pieces.

Once the replacement piece is fixed, a continuous bead of silicone sealant to be applied.

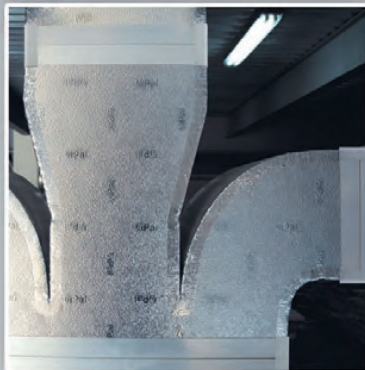
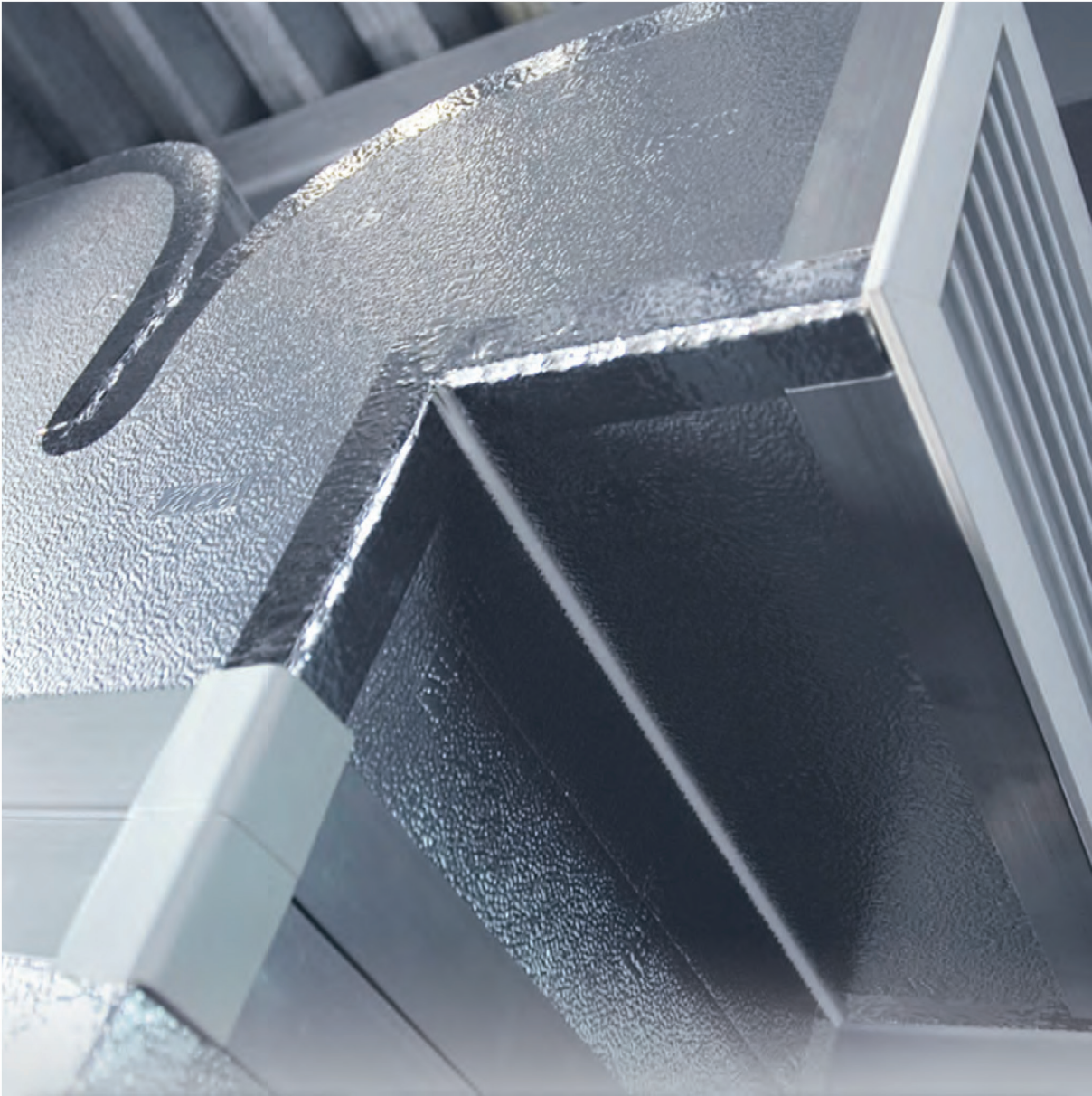
Finally, all exterior seams are fully covered with tape.



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# Kingspan PalDuct™ Construction Guidelines

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# Prestige Projects

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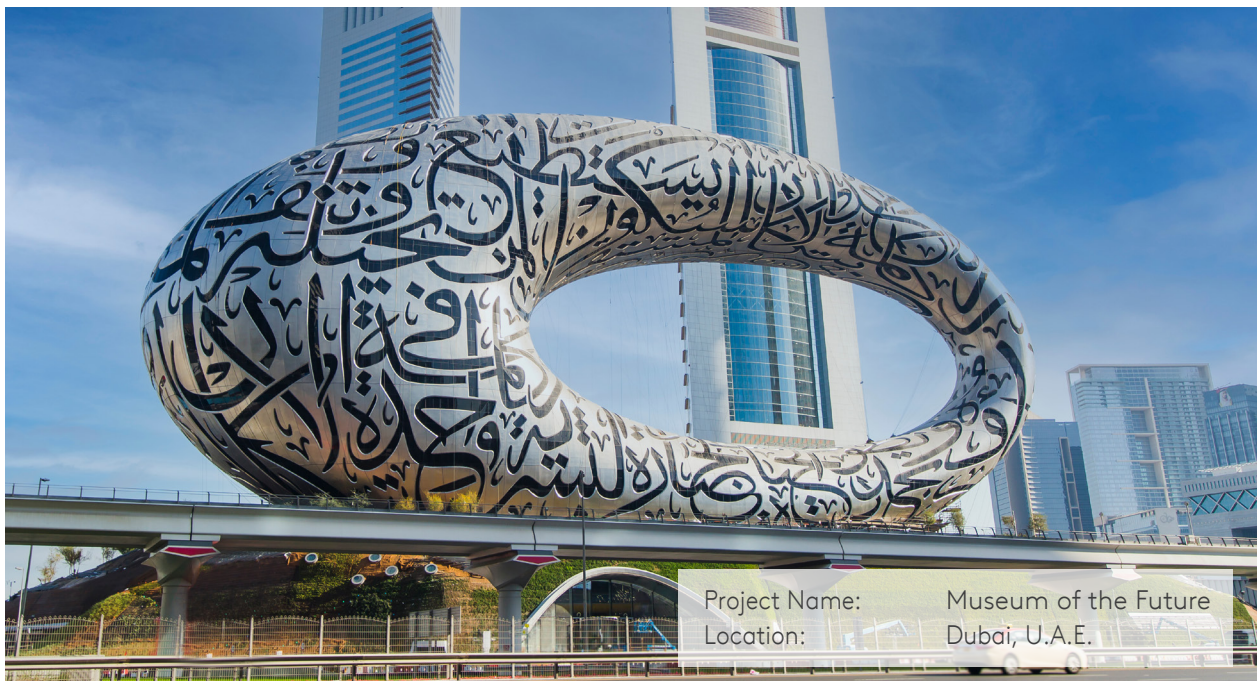
Project Name: Dubai Hills Estate  
Location: Dubai, UAE



Project Name: Opera Grand Tower  
Location: Dubai, UAE



Project Name: Dubai Creek Harbour  
Location: Dubai, UAE



Project Name: Museum of the Future  
Location: Dubai, U.A.E.

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# Contact Details

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## Kingspan Insulation LLC

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F: +971 (0) 4 883 8515

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[www.kingspaninsulation.com](http://www.kingspaninsulation.com)

## Technical Service

Kingspan Insulation has one of the most technically advanced support services in the industry offering a full spectrum of advice, free of charge for all types of design projects.

The Kingspan Insulation technical team are continually updating their knowledge on building regulations, best practise, construction methods and the development of building materials to ensure the advice and services provided are always one step ahead.

### Services available:

- U-value calculations;
- condensation/dew point risk calculations;
- advice on product selection and product data for the full range of Kingspan Insulation products;
- installation and fixing advice on all applications and products;
- specification and construction advice; and
- Tapered Roofing Design service.

Email: [technical@kingspaninsulation.ae](mailto:technical@kingspaninsulation.ae)

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