



Technical Guide

Foamalux



Products

Foamalux White	Foamalux Ultra
Foamalux Light	Foamalux Xtra
Foamalux Colour	Foamalux Eco

Description

Foam PVC
Flat Sheets

Products that work

Brett Martin is a privately owned world class industry leader and manufacturer of specialist plastic products for the construction, fabrication, print and display sectors. Our plastic sheet range encompasses multiwall sheets and systems, corrugated sheets, transparent flat sheets and opaque PVC flat sheets. This Technical Guide relates to the Foamalux foam PVC sheet range which includes Foamalux White, Foamalux Light, Foamalux Colour, Foamalux Ultra, Foamalux Xtra and Foamalux Eco. Please note that Foamalux Calibre is covered in a separate Technical Guide. Further details can be found at www.brettmartin.com.

Important note on semi-finished materials

Since the end uses of semi-finished materials are so diverse it is the responsibility of each user of Brett Martin's Foamalux Sheets to make their own tests to determine the material's suitability for the particular application.

All the information is given in good faith but without commitment and warranty given or implied. Brett Martin accepts no liability for defects, loss or damage resulting from misuse, improper installation, inappropriate specification or any other factor beyond its control. In accordance with our company's policy of continual product development, you are advised to check with your local Brett Martin representative to ensure that you have obtained the most up to date information.



Contents

04	PRODUCT RANGE	20	FINISHING/GRAPHICS APPLICATIONS
05	Product Options	20	Decorative Finishes
06	Standard Dimensions	20	Edge Finishing
06	Quality	20	Vinyl Graphics
		20	Mounting Photographs/Prints
		20	Adhesive Film/Vinyl
07	APPLICATION AREAS	20	Lamination
07	Design Versatility	21	Printing & Painting
07	Product Features	21	Surface Preparation
		21	Cleaning
		21	Static
08	STORAGE & DISPOSAL	22	Screen Printing
08	Surface Protection	22	Digital Printing
08	Storage	23	Painting/Varnishing
08	Handling		
09	Safety	24	DESIGN & INSTALLATION
09	Disposal/Recycling	24	Thermal Expansion
		25	Thermal Characteristics
10	FABRICATION	25	Low Temperatures
10	Cutting	25	Panel Orientation
10	Guillotining	26	UV Stability
10	Die Cutting	26	Wind Loading
10	Computer Controlled Cutting	26	Precipitation
10	Sawing	26	Sound Insulation
11	Drilling	27	Material Properties
11	Milling & Routing (CNC)	28	Food Contact
		28	Fire Rating
12	FORMING	28	Structures & Frames
12	Component Geometry	29	Fixings
12	Thermoforming		
14	Hot Bending	31	CLEANING & MAINTENANCE
15	Drape Forming	31	Cleaning
15	Cold Curving	31	Chemical Resistance
		31	Important Notes
16	BONDING & WELDING		
16	Bonding	32	APPENDICES
16	Tapes	32	Appendix 1. Thermal Expansion Calculation
16	Adhesive Bonding	33	Appendix 2. Chemical Resistance
16	Bonding Foamalux to Foamalux	37	Appendix 3. Adhesives Manufacturers
16	Bonding Foamalux to other materials		
18	Welding		
18	Hot Plate Welding		
18	Hot Air Welding		

Product Range

Brett Martin is a leading international manufacturer of a range of sign and display substrates. We work in partnership with a world-wide network of distributors to supply the versatile and durable Foamalux range.

Foamalux is one of the leading brands of rigid foam PVC sheet. Light in weight, versatile and durable, Foamalux has earned a reputation for quality performance and endless applications in sign, display and print due to its smooth finish, excellent fire performance and easy workability. It provides a flawless surface for different types of printing and mounting and combined with its wide range of colours, Foamalux is the ideal product to fabricate into an endless range of possibilities including displays, exhibitions, point of sale, signs and in-store fittings and graphics.

With bright white, matt and gloss colours and environmentally friendly options, the Foamalux range offers 6 different products: Foamalux White, Foamalux Light, Foamalux Colour, Foamalux Ultra, Foamalux Xtra and Foamalux Eco.



Product	Product Description
Foamalux White	An extruded closed cell, unplasticised PVC foam with a bright white surface ideal for printing.
Foamalux Light	An extruded closed cell, unplasticised PVC foam optimised for digital printing
Foamalux Colour	An extruded closed cell, unplasticised PVC Foam sheet in a vibrant palette of 6 colours
Foamalux Ultra	A co-extruded closed cell, unplasticised PVC foam with a high gloss solid PVC top surface providing an enhanced weatherable surface finish in white and 6 dynamic colours
Foamalux Xtra	A co-extruded closed cell, unplasticised PVC foam with a black core, made from up to 80% reclaimed foam PVC, thus utilising post production waste within a high quality sheet. Foamalux Xtra S2 consists of a black reclaimed core sandwiched between two smooth surfaces of virgin material. Foamalux Xtra S1 has one co-extruded white surface layer of Foamalux virgin material.
Foamalux Eco	An extruded closed cell, unplasticised PVC black foam made from up to 80% reclaimed Foam PVC.

Foamalux Foam PVC, as with all Brett Martin products, is manufactured to the highest standards of excellence which have earned Brett Martin BSI Registered status under BS EN ISO 9001. Production controls and specified tolerances ensure uniformity of surface finish, thickness, colour, cell structure and density across the Foamalux ranges and tight tolerances on all these parameters.

Foamalux products do not contain any of the six substances covered by RoSH (Restriction of Hazardous Substances in Electrical and Electronic Equipment: Directive 2011/65/EC) All rigid Foam PVC and associated packaging are compliant with REACH (Directive EC 1907/2006).

The products in the Foamalux range have very similar characteristics and are therefore dealt with together throughout this product guide, any differences being highlighted within the relevant section.

Foamalux White

Extensive research into colour pigmentation has led to the development of a bright white colour formulation throughout the Foamalux range which optimises graphical reproduction capabilities and UV stability to achieve outstanding print clarity and quality. The finely balanced blend of pigments in Foamalux White provides a perfectly clean, crisp printing surface resulting in a truer print finish, achieving optimum print clarity of the highest quality. Foamalux White also provides an ideal bright white surface for traditional sign and display applications.



Foamalux Light

Foamalux Light is specifically formulated for digital printing. Its bright white colour combined with a flat even surface optimises print quality and clarity.



Foamalux Colour

The depth and intensity of colour combines with the ultimate silky smooth matt surface finish to make Foamalux Colour the best coloured Foam PVC sheet on the market. Available in a choice of 6 colours as standard, Foamalux Colour provides the ultimate palette available for sign, print and display.



Foamalux Xtra

Make a greener choice with Foamalux Xtra, the environmental range of Foam PVC. Manufactured from reclaimed foam PVC recovered from post-production waste, Foamalux Xtra Foam PVC is the green alternative. Foamalux Xtra comprises of a reclaimed black core, co-extruded with one or two surfaces of premium quality virgin white PVC, providing the optimum surface for any sign and display applications. Containing up to 80% reclaimed content Foamalux Xtra reduces landfill and is the environmentally friendly sign and display solution.



Foamalux Eco

Foamalux Eco is a black PVC foam containing up to 80% reclaimed post production waste, thereby reducing landfill. Benefiting from the same printability and ease of processing as the rest of the Foamalux range, this is our greenest choice of product.












Foamalux Ultra

Foamalux Ultra is a strong and durable rigid foam PVC sheet with a high gloss finish. The co-extruded gloss surface gives improved UV protection and stability over standard foam PVC for external applications. Foamalux Ultra is available in white plus 6 deep intense colours.



Product Range

Standard Dimensions

Product	Sheet Size (mm)	Sheet Thickness (mm)	Colour
Foamlux White	1220 x 2440 1560 x 3050 2050 x 3050	1, 2, 3, 4, 5, 6, 8, 10, 13, 19, 24 2, 3, 5, 6, 8, 10, 15 & 19 1, 2, 3, 4, 5, 6, 8 & 10	 White
*Non Standard thicknesses available on request			
Foamlux Light	1220 x 2440 1560 x 3050 2050 x 3050	2, 3, 4, 5, 6, 8, 10 2, 3, 5, 10 2, 3, 4, 5, 6, 8 & 10	 White
*Non Standard thicknesses available on request			
Foamlux Colour	1220 x 2440 2050 x 3050	3 & 5 3 & 5	      Red Yellow Green Blue Grey Black
Foamlux Ultra	1220 x 2440	3 & 5	       Red Yellow Green Blue Grey Black White
Foamlux Xtra	1220 x 2440	3, 5 & 6	 Black/White
S1 – Single sided bright white surface with reclaimed black underside			
S2 – Double sided bright white surface with reclaimed black core	1220 x 2440 1560 x 3050 1560 x 4050	10 10 10	 White/Black/White
*Non Standard thicknesses available on request			
Foamlux Eco	1220 x 2440 2050 x 3050	3, 5 & 10 3, 5 & 10	 Black

Colour Chart				
Colour	Pantone*		RAL*	
	Lighter	Darker	Lighter	Darker
Red	1788C	1795C	3018	3020
Yellow	1215C	1235C	1018	1021
Green	355C	356C	6018	6024
Blue	299C	301C	5015	5010
Grey	7C	9C	7001	7000
Black	7546C	7547C	7021	9005
White			9003	

Pantone and RAL references are approximate colour matches for guidance purposes only

Quality

Manufactured under ISO 9001:2015. Please contact us for most up to date certification

Application Areas

Design Versatility

The Foamalux product range offers a choice of a vibrant colours plus white, in a satin or a high gloss, durable finish. The material can be exploited in many ways and used to produce stimulating signs, displays, in-store graphics, merchandising and endless fabrication possibilities. Foamalux is ideal for use in a wide variety of indoor and short term outdoor applications, such as:

Signage and Display		Wall Cladding	Partitioning	Fabrication	Furniture
Shop outfitting	Signs and Sign Lettering	Wall cladding	False ceilings	Models	Shelving
Portable display	Direct digital printing	Linings	Containers	Containers	Drawers
Exhibition stands and systems	Vinyl application and photographic mounting	Insulation sandwich panels	Temporary partitioning	Vacuum formed shapes	Furniture components
Custom Displays	Screen printing	Decorative panels		Fabrication into ducts	Chair Backs
Signage – temporary and permanent	Backing boards for samples			Equipment covers	Bird Houses
Point of purchase/sale				Enclosures	Lining pet enclosures
In-store graphics and merchandising					

Product Features

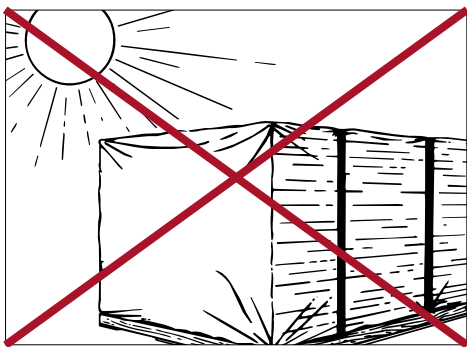
Characteristic	Foamalux White	Foamalux Light	Foamalux Colour	Foamalux Ultra	Foamalux Xtra	Foamalux Eco
Bright white surface	√	√			√	
Extensive range of colours			√	√		
Satin finish	√	√	√		√	√
Gloss finish				√		
Smooth even surface	√	√	√	√	√	√
Hard and resilient				√		
Density	Medium	Lower	Medium	Higher	Medium	Medium
Ideal for printing	√	√	√	√	√	√
Superb output quality	√	√	√	√	√	√
Excellent vinyl adhesion	√	√	√	√	√	√
Easily fabricated	√	√	√	√	√	√
Engraving opportunities					√	
Reclaimed content					√	√
Suitable for exterior applications				√		

Storage & Disposal

Surface Protection

All Foamalux sheets are covered by a protective polyethylene film. This surface protection is applied to one side of the sheet only and can be removed easily.

All Foamalux sheets are stacked on pallets at the end of the production line. The pallets are covered with stretch-wrap film and strapped to ensure they are received by the end user in pristine condition. The sheets should be similarly protected or packaged at all stages of process to ensure the quality of finished items.



Storage

Foamalux sheets are best stored indoors, away from direct sunlight, in a cool dry store under ambient conditions.

Foamalux sheets should be stacked horizontally, preferably on a continuous non-abrasive, flat, dry surface, for example, a solid topped pallet or wooden sheet raised from the floor or ground. Under the total weight of sheet loaded on to it, this support must not distort, or distortion of the sheet could occur during longer storage periods.

Stack heights should not exceed 1m. Sheets of differing length should not be placed on the same stack and standing sheets on ends or sides should be avoided.

Pallets should be stacked no more than three high. Always store indoors where possible, under ambient warehouse conditions, away from direct sunlight, in a cool dry store up to 20°C. Do not store close to heat sources, for example, radiant heaters or boilers.

If storage outdoors cannot be avoided then, particularly in the case of on-site storage while building construction progresses, a secure storage site should be provided, well away from foot traffic, vehicle traffic and ongoing construction work.

All sheets stored outdoors must be covered with a reflective, opaque, waterproof cover. Secure all covers to prevent the ingress of sunlight, wind and rain and the stack should be ventilated to avoid heat build-up.

Excessive temperatures during transport and storage can cause the protective film to become firmly adhered to the surface making it difficult to remove. It is recommended that the original packaging is kept in place during storage and after the pallet has been opened. The temperature of uncovered stacked sheets in direct sunlight can rise to levels which will be detrimental to the material: the presence of moisture between sheets can add to damage. Coloured sheets should be stored in their protective cardboard sleeves.

Surface Temperature in Direct Sunlight:

Surface Colour	Typical Temperature (°C)
Black	80
Blue	68
Grey	67
Red	68
Green	70
Yellow	57
White	40

Handling

Appropriate personal protective equipment should be worn when handling sheets as edges can be sharp and large/thick sheets are heavy. Foamalux is a relatively flexible material but, if lifted or carried incorrectly, sheets can be stressed beyond their flexible limits and cracked.

When carrying, sheets should be turned on edge and held top and bottom. It will require more than one person to carry a large sheet or panel. Particular care should be taken with panels which have been processed, for example, screen printed.

Use caution when handling large sheets in windy conditions. Sheets and cut panels should not be dragged off a stack but lifted up directly and set down directly. Surfaces on which sheets are set must be clean to avoid damage.

Safety

Foamalux is a rigid foam PVC sheet extruded from polyvinyl chloride. All products are compliant with both EU and UK REACH legislations in their current forms, and with the latest RoHS directive.

No special protective measures are needed when transporting or handling the material. When working with the material care must be taken to protect eyes and avoid inhalation of dust.

Foamalux sheets do not constitute fire, explosion or toxic hazard material. In case of a fire involving Foamalux or any other PVC material, water, foam and carbon dioxide extinguishers may be used.

Burning causes noxious fumes to be released e.g. hydrochloric acid, carbon monoxide. Do not breathe decomposition products. When decomposition products have been accidentally inhaled, medical assistance is required.

Please contact the Technical Department for full PSDS (Product Safety Datasheet). REACH (both EU and UK variants) define these products as “articles” and as such do not require formal Safety Data Sheets. This information is issued to support our customers and this product group in their particular markets.

Foamalux sheets do not contain hazardous substances such as:

- Lead
- Mercury
- Cadmium
- Hexavalent chromium
- Polybrominated biphenyls (PBB)
- Polybrominated diphenyl ethers (PBDE)
- Formaldehyde
- Any CFC's
- Asbestos
- Plasticisers
- Silicon

For most up to date information contact Technical Service Department.

Disposal/Recycling

Recycling

At the end of the product's life cycle, Foamalux is 100% recyclable and reusable if separated from other materials. Thermoplastics are an important and valuable material so it is advantageous both in material and contract cost to establish well-managed processing and finishing procedures that minimise waste and scrap, and maximise recovery of what is unavoidable. Foamalux Foam PVC according to industry standards falls within the remit of Category 3.



Off Cuts

Sheet off cuts produced by cutting and trimming to size as part of the installation process, or panels which have been mechanically damaged, but have been kept free of contamination by dust or dirt, may be recycled into lower grade products. The appropriate disposal route is through a specialist plastic recycling contractor.

Waste Material

Sheet off cuts that have been contaminated by dust, dirt or other materials which cannot be totally removed generally need to be granulated and compounded in order to remove contaminants and to restore the material to a usable form.

Energy Recovery

Energy recovery is a valuable alternative for plastics which cannot be sustainably recycled. Modern combined heat and power recovery plants (CHP Plants) can use waste plastics together with other high calorific input materials. This provides a valuable source of heat and power which can contribute to energy needs. Such energy recovery processes use only the best available technology to ensure they are safe, environmentally-responsible and efficient installations.

Landfill

As a last resort Foamalux can be safely disposed of in landfill alongside domestic waste if local regulations are observed. All Brett Martin products are lead-free and comply with current REACH legislation.

Combustion

Foamalux should not be incinerated unless done professionally. Smouldering and incomplete combustion may cause toxic fumes and soot particles.

Fabrication

Foamalux is an easy material to work with, using basic wood and metal working tools. When working with any power tool, the sheet temperatures must be kept below the material softening point of 70°C. PVC is a thermoplastic and excessive heat build-up can result in deformation, softening and surface deterioration or discolouration of the sheet substrate.

Compressed air is a suitable and easy to apply coolant. Efficient removal of dust and swarf from the cutting tool helps to lower temperatures.

These measures assist in obtaining a good quality cut finish. In general, machining operations require a combination of low feed speed and depth of cut together with a high cutting speed. Correct tool geometry is also important.

The recommendations given for tool geometries and speeds should be used as a guide: some experimenting may be required to obtain best results. It is necessary to have an effective means of removing dust produced by machining operations from the operator's environment.

Cutting

Different means of cutting are appropriate for various thicknesses, ranging from hand tools to power saws. Preheated sheets are easiest to cut; several light cuts give a better result than one single firm cut.

- Sheets 1- 2mm thick can be cut with shears;
- Sheets 1-3mm thick can be cut with a craft knife;
- Sheet exceeding 3mm in thickness should be sawn.

Guillotining

Guillotines can be used for rough cutting but are not usually employed to finish-cut as their action compresses the sheet and can give a poor edge finish e.g. permanent edge distortion. Cracks can also be initiated in cold sheets. Guillotines with blades heated to around 160°C give a good quality cut edge with less possibility of compressing or otherwise damaging the sheet edge.

Die Cutting

Flat shapes with complex outlines can be die cut from thinner sheets - up to 4mm thick – using sharp, accurately set, steel rule dies: best results are obtainable by preheating sheets to a maximum of 35°C to prevent fracturing the edges.

Cut shapes should be placed between flat metal plates to cool, avoiding distortion. When designing components to be die cut, narrow sections and radii less than 3mm should be avoided. Sheets thicker than 4mm can be die cut provided they are preheated and component radii are at least equal to sheet thickness. Edge finishing may be required.

Computer Controlled Cutting

Water-jet cutting is suitable for use in conjunction with Foamalux sheets. Laser cutting is not recommended for use in conjunction with Foamalux PVC sheets due to the excessive heat build-up.

Sawing

Foamalux is easy to saw and cut on standard workshop equipment. It can be machined on conventional milling machines with standard high speed tools.

Safety First

- Due to the high rotational speeds it is very important that:
- All protective devices are in good working order and that they are being used;
 - All prescribed personal safety equipment is being worn at all times.

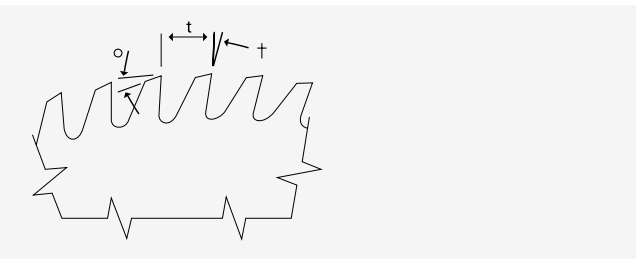
Blades designed for cutting plastics are ideal for cutting Foamalux, as are most types of wood saws – band, bench, circular, hand, jig and wall saws. Blades must be sharp, with a slight side set.

Hold and support sheets to avoid stress and vibration, particularly in cold conditions. Blunt blades and very fine tooth metal cutting blades, or incorrectly held material, produce an unsatisfactory finish.

Blades should always cut down into the gloss surface of Foamalux Ultra. When using power saws, clear swarf and avoid heat build-up at the cut to produce clean cuts.

A good quality cut can be obtained using both band and circular saws, see following table for guidelines of pitch, clearance angle and feed speed.

Angle (o)	10° - 15° circular saw
Rake Angle (†)	30° – 40° band saw
Tooth Pitch (t)	0°-8°
Circumference Speed	5-15mm circular saw
Feed Speed	2-8mm band saw
Circumference Speed	1000-3000m/min
Feed Speed	6-30m/min



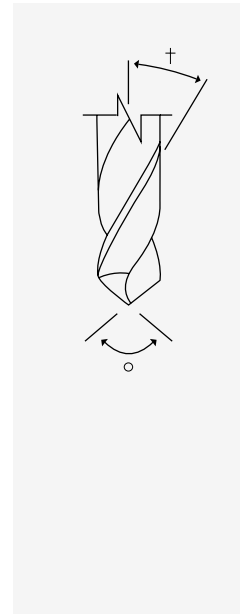
Drilling

The required sheet thickness and hole diameter determine the appropriate drill type. It is more difficult to drill large holes in thinner sheets than small holes in thicker sheets. Thin sheets require a high drill speed and low feed speed. Slower feed speeds are used in deeper holes to minimize heat build-up. Do not use liquid cooling to prevent overheating. When drilling deep holes it is recommended to regularly withdraw the drill bit.

Standard twist bits for metal are suitable for holes up to 12mm diameter in all thicknesses; good results can be obtained with a point of between 80-110° and helix angle of 10-30°. Holes over 12mm in diameter can be drilled with flat bits, normally used for drilling wood. Above 25mm diameter it is necessary to use hole saws or circular cutters.

Parameter	Value
Tip Angle (o)	100 – 110°
Helix angle (†)	30°
Drill speed	1000 - 3000 rpm
Feed speed	0.2 - 0.5mm/rev.

Hole Size	Recommended drill type
<12mm	Standard twist bits
12 – 25mm	Flat bits, used for drilling wood
>25mm	Hole saws or circular cutters

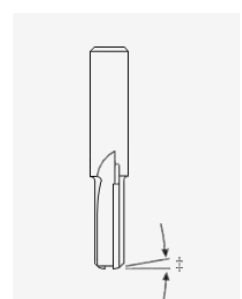


Milling & Routing (CNC)

All types of milling machines and routers can be used to machine Foamalux if suitable tool geometry and cutting conditions are used. Vacuum clamping machines are ideal as they are less likely to mark the surface than mechanical clamping. Where sheets are mechanically clamped, load spreading pads should be used to avoid surface marks. Depth milling will remove the smooth surface to reveal a matt closed cell structure.

Cutting tools must be capable of clearing large quantities of chips and cut depths and feed speeds must not be too high to avoid heat build-up and poor edge finish. Cutters with single or twin cutting edges are most suitable.

Parameter	Value
Relief Angle (‡)	0° - 15°
Cutting Speed	Up to 18000 rpm
Feed Speed	0.3 - 0.5mm/rev



Forming

Many processing operations involve heating. Foamalux is a thermoplastic material which attains an elastic state and is therefore formable at material temperatures in the range 115-135°C. The panel to be shaped or formed requires even heating throughout its area and thickness. The component formed in the elastic state, when cooled slowly to a rigid state in the forming device, retains the formed shape.

As Foamalux is a cellular material it is not suitable for forming operations which involve excessive stretching in the elastic state. When applying localised heating, care should be taken to avoid overheating that could cause permanent deformation or material degradation. Excessive temperatures and the application of pressure may result in the rupture of the cells and blemishing of the external surface.

Foamalux sheets are anisotropic which means the properties of the sheet vary depending on the manufacturing direction. Like wood, which is easier to split along its grain than across its grain, Foamalux sheets should always be bent across the manufacturing direction to reduce the risk of breakage.

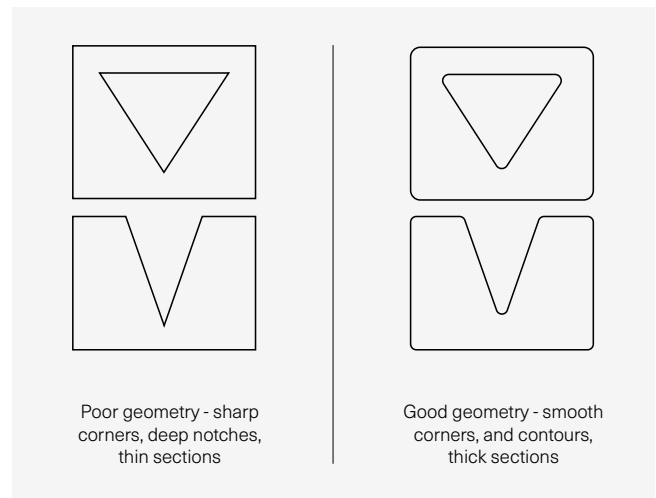
To identify machine direction, also known as direction of extrusion, see page 25.

It is essential to ensure that all panels are free from dust, oil and any other contaminants prior to any forming operation, as these will detract from the quality of the finished product.

Component Geometry

Sharp corners and notches in thermoplastic components assist in the initiation and propagation of cracks, particularly if a component is under stress. Creases, grooves and sharp bends also form potential weaknesses. Therefore component shapes should exclude such features and all internal and external corners or changes in direction should follow a smooth radius profile.

Where designs involve hot bending of sheets, radii should ideally be not less than two and half times the sheet thickness.



Thermoforming

Components which are relatively simple and shallow in form are thermoformable from Foamalux when it is heated to an elastic state. Air-pressure forming is possible in the thermo-elastic range at about 130°C and pressures of about 2 bars and vacuum forming at about 170°C.

Thermoforming Foamalux sheets at temperatures higher than 180°C will overheat and discolour and eventually degrade the sheet.

The temperature of the sheets is far more important than the temperature set on the machine.

Foamalux sheets do not need to be pre-dried prior to forming.

It is key to heat the sheets uniformly. Machines that have individual adjustable upper and lower heater banks or plug-assisted devices make it easier to control the temperature of the sheet. As Foamalux foam PVC has a relatively low density, heating and cooling cycles are faster than with solid thermoplastics due to the narrower processing window than solid sheets.

Higher temperatures enhance definition but at the expense of surface finish. Most industrial press and vacuum formers for thermoplastics are suitable. Temperature controlled moulds will result in significantly better, sharper shapes, with best outcome achievable from machines which controllably heat both sides of the sheet.

Large area panels and thick panels need some air pressure support during heating to avoid sag.

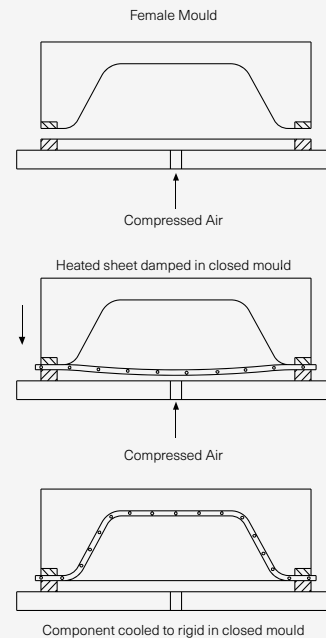
Prior conditioning, by suspending in an air circulating oven at about 130°C, removes inherent stresses. Local overstretching of the material (thin projections, narrow recesses, etc.) and premature mould contact should be avoided.

Male moulds are suitable for vacuum forming, female moulds for both vacuum and pressure forming. Secure clamping of the sheet during forming is essential to avoid shrinking; mould shrinkage (0.5 – 0.8%) and anisotropy of material should be taken into account during forming. Components must be completely rigid before removing from the mould. To minimize the risk of deformation always trim immediately after the formed part is removed from the mould and never place on a cold surface.

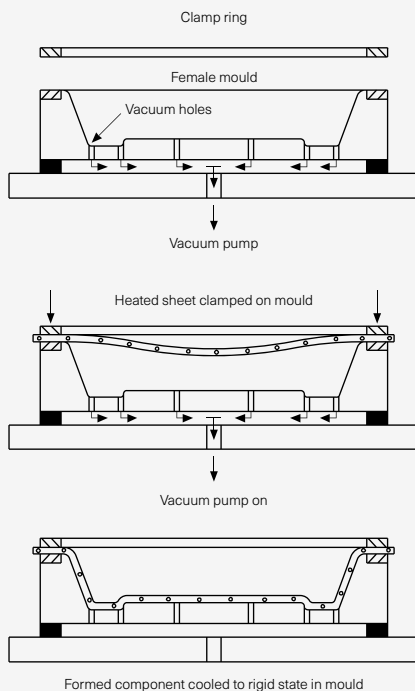
Realigning the sheet, adjustment in mould design and varying forming speeds can prevent wrinkling, webbing and bridging of the sheet.

When an item involves screen printing and thermoforming for its production, the thermoforming processes should always precede the printing unless using specialised thermoformable inks.

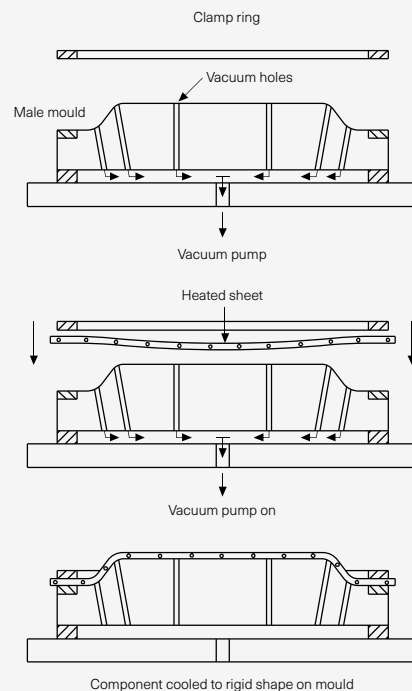
Pressure Forming in a Female Tool



Vacuum Forming in a Female Tool



Vacuum Forming in a Male Tool



Forming

Hot Bending

Care should be taken when hot bending/folding due to stressing and cracking of sheets. Prior to folding, localised strip heating to about 130°C is required. Heat the material for a distance equivalent to three times the sheet thickness on each side of the fold centre line.

Heat sources such as hot air blowers, hot gas welders, hot air circulating ovens and infra-red panel heaters can be used in conjunction with Foamalux products. All require controls which enable good regulation of their temperature and that of the Foamalux sheet.

When heating is complete and the required shape produced, it must be allowed to cool on the forming equipment before handling or further processing, to avoid warping. Foamalux can be folded on a simple jig, fitted with a forming tool having a radius of about two and a half times the sheet thickness.

For radiant heat applications, a heating time of 20 seconds for each 1mm of sheet thickness is a reasonable starting point. For oven heating applications, this increases to 40 seconds per 1mm of sheet.

Heating of one side will usually be enough for sheets up to 3mm thick. Above this thickness heat should be applied to both sides, reducing heating times and the possibility of surface damage.

Some experimentation will always be required to obtain optimum temperatures for forming, these being a function of sheet thickness and the specific forming operation.



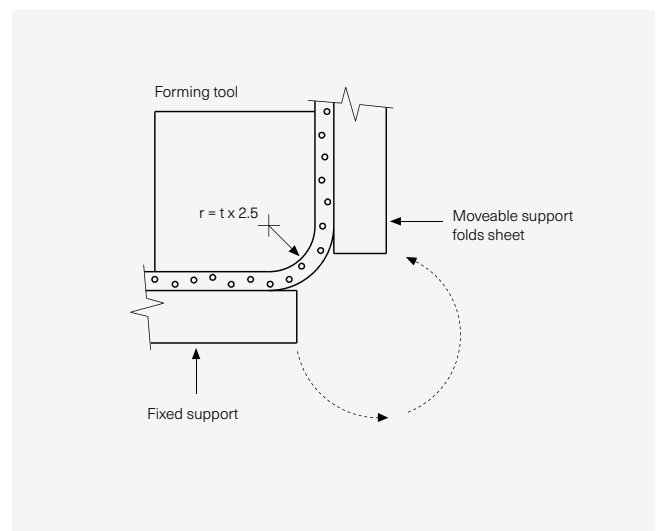
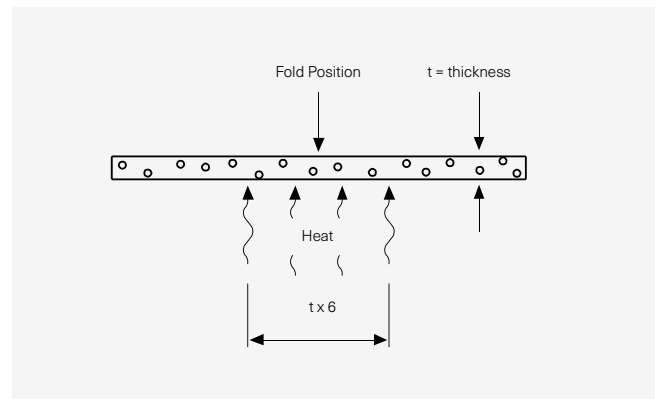
Sheet colour and atmospheric conditions also have some influence.

When using Electrical Heated Metal Tracks, the following guidelines should be adhered to:

- Maintain metal tracks at a temperature of 140- 160°C.
- Up to 4mm sheet can be heated on one side; 5mm or thicker sheet require heating on both sides.
- Keep heating time at approximately 50-60 seconds per mm of sheet thicknesses.

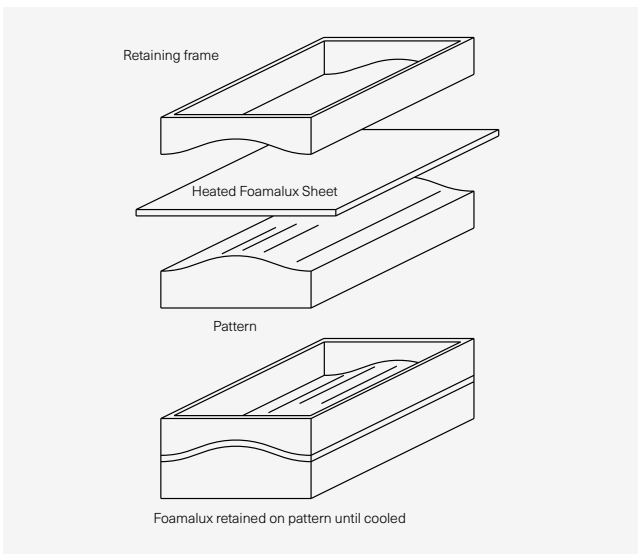
Hot Air Welding Guns can be used for small areas of sheet to be folded whilst Controlled Hot Air Blowers provide localised heating used for mobile assembly work.

Prior to bending thicker Foamalux sheets (8mm or above) it is important that any excess material at the inside of the bend is removed. This can be achieved by milling out a V groove. It is recommended to mill the V groove 1° wider than the desired bending angle for example 91° to obtain a 90° angle. The outside of the bending leg can then be carefully heated, one leg raised and the seam bonded together.



Drape Forming

Where a specific thickness of Foamalux is to be curved to a smaller diameter than is possible by cold bending, or it is required to form a simple curved skin, it is possible to do this by softening a panel to an elastic state, draping over an appropriately shaped pattern and retaining it until cooled and rigid.



Cold Curving

Sheets up to 6mm can be cold bent into basic shapes. The recommended temperature for cold bending is at least 20°C, preferably higher. The minimum bending radius is approximately 100 times the thickness of the sheet, for example 300mm for a 3mm sheet.

In order to cold bend sheets >6mm, parallel lines or grooves along length can be cut using a horizontal panel saw. It is best to use a pitch equal to the width of the saw blade in a sheet whilst leaving 1 to 2mm of the material.



Bonding & Welding

Bonding

Foamalux can be bonded to itself or to other materials using suitable commercially available tapes and adhesives. The following factors should be considered when selecting an adhesive for a particular application: heat resistance, elasticity, appearance (opaque/translucent), loading and ease of processing.

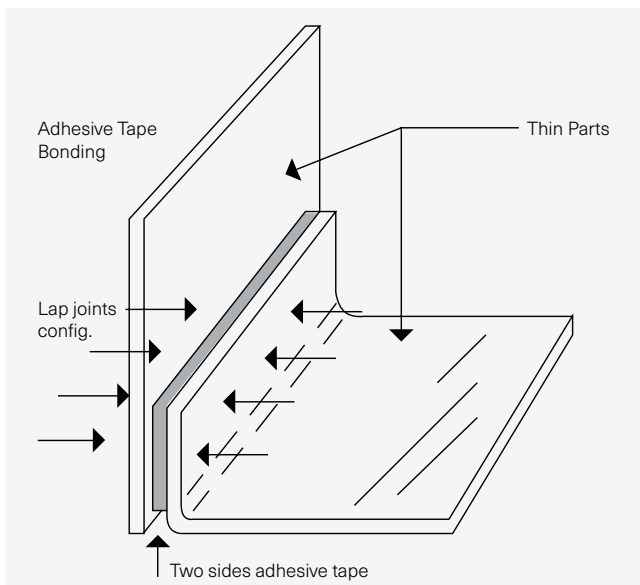
The joint faces must be cleaned prior to bonding (see page 31 for cleaning recommendations) and free from oil or grease.

The user should satisfy themselves by trial that any adhesive or bonding material will be suitable for the specific application and compatible with PVC. The user should at all times follow the adhesive manufacturer's recommendations as to suitability, surface preparation, use of primers, application methods, curing times and conditions to be satisfied for effective bonding. Manufacturers' health and safety precautions must also be observed.

Tapes

Acrylic based foam tapes can be used for rapid mounting or lap joints adequate for bonding small components. Use a roller and apply even pressure to remove any air bubbles and improve adhesion.

Double sided pressure sensitive adhesive tapes are a very efficient and effective means of attaching flat panels to each other and to support structures and of attaching other flat materials to Foamalux.



Adhesive Bonding

Foamalux can be bonded to itself and a variety of materials such as ABS, GRP, Polycarbonate, uPVC and various woods and metals. It is essential to use the appropriate adhesive. Never use standard PVC adhesives as they are not transparent or UV-stabilised, so joints will remain visible and may discolour when used in outdoor applications.

See appendix 3 for recommended adhesive suppliers.

Bonding Foamalux to Foamalux

Solvent adhesives based on methyl ethyl ketone (MEK), tetrahydrofuran (THF) and cyclohexanone are suitable. Adhesives set as solvents evaporate. Therefore successful bonding requires the application of pressure and components fitted together accurately as solvent based adhesives will not fill gaps.

Use extreme caution when working with solvents: They may be toxic or contain carcinogens. Adequate ventilation is essential. Obtain Safety Data Sheets from the solvent manufacturer.

Bonding Foamalux to Other Materials

- a) Reaction Adhesives - There are two basic types: 1-part adhesives set by reacting with moisture; 2-part adhesives set by the reaction between a chemical base and a catalyst.
- 1-part adhesives - polyurethane or cyanoacrylate based - set very quickly and are ideal for small components.
 - 2-part adhesives - polyester, polyurethane, polymethacrylate or epoxy based - are slower to cure, but ideal for bonding Foamalux to metals, wood and masonry.
- b) Contact Adhesives - These are used when bonding sheets of Foamalux to flat surfaces and are based on solvent solutions of synthetic rubbers - e.g. polychloroprene or nitrile rubber. Both surfaces to be joined should have adhesive applied: after solvent evaporation bring the two surfaces together under pressure.

Characteristic	Contact Adhesive	2-Part PU	Silicon Modifier Polymer	Elastic 2-part Acrylate	Adhesive Tape
Wood	√	√	√		
Chipboard	√	√	√		
Aluminium			√	√	
Galvanized Steel			√	√	
Brickwork		√	√		
Concrete		√	√		
Glass		√	√		
Thermoplastics		√			√
Expanded Polystyrene		√	√		
Rubber	√				
Elastomers	√				
PVC foam	√				
Paper	√				
Cardboard	√				
Textiles	√				
Leather	√				

Ensure adequate allowance for thermal expansion relative to ambient temperature are calculated prior to fixing. (See Appendix 1)



Bonding & Welding

Welding

When fabricating Foamalux sheets the same welding methods and PVC filler rods used for solid PVC welding can be used, achieving a bond strength ratio of 50-90%. As with all welding methods the sheet surface must be clean and the final bond strength depends on weld type, geometry, heating temperature and time, distribution of heat and skill level. Hot air welding and butt welding are most commonly used in fabrication.

Typical joints and the necessary panel preparations are illustrated in the diagrams.

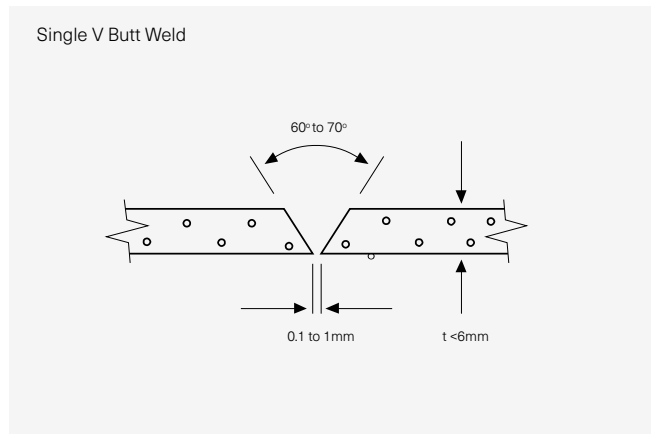
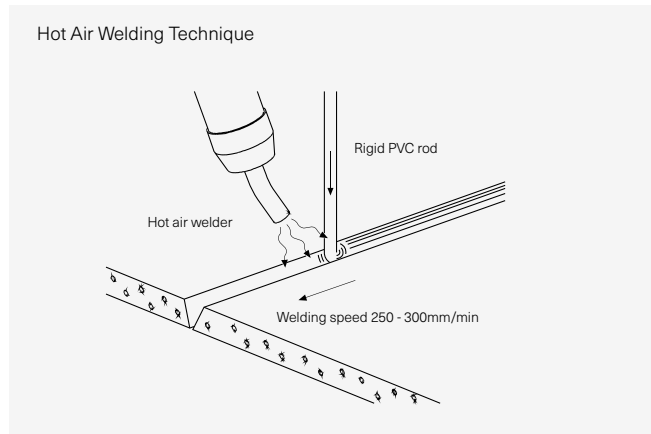
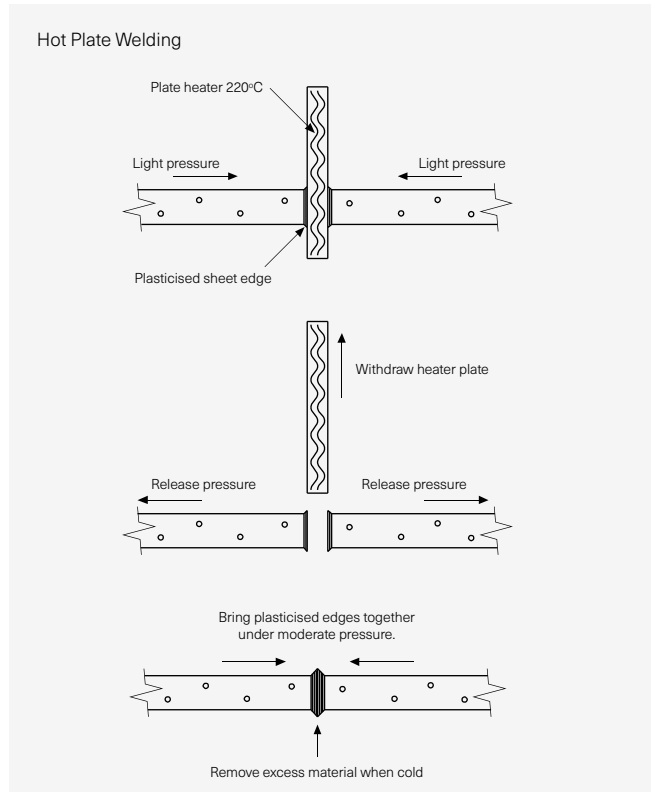
Hot Plate Welding

Butt welding of edges of sheets thicker than 3mm is possible using hot plate welding techniques. Sheet edges are plasticised through contact, under slight pressure, $0.05 - 0.07\text{N/mm}^2$, with a flat plate heater at a temperature of about 220°C . This is done to plasticise the sheet sufficiently for effective bonding and to induce material diffusion between the two substrates,

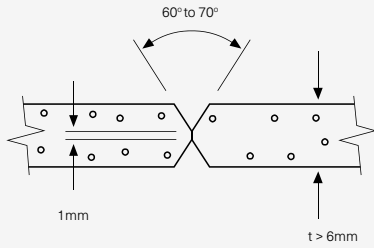
A welded joint is formed by withdrawing the tool, pressing the plasticised edges together under controlled pressure, $0.2 - 0.27\text{N/mm}^2$, and cooling.

Hot Air Welding

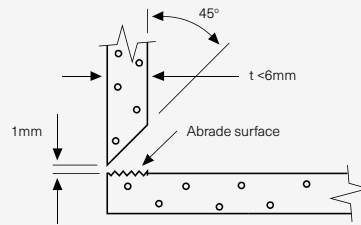
When welding using hot air, air temperatures should be about 250°C to plasticise the sheet and welding rod sufficiently for effective bonding. Speeds of $250 - 300\text{mm/minute}$ should avoid excessive heating which will damage the cell structure. Greater speed can be achieved with high speed welding nozzles. Where multiple welds of a joint are necessary, cooling between stages in fabrication is essential to avoid distortion when the component is moved.



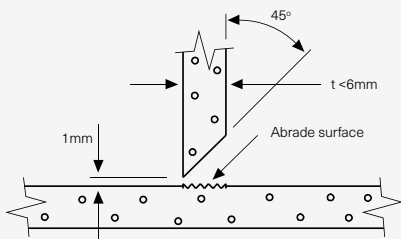
Double V Butt Weld



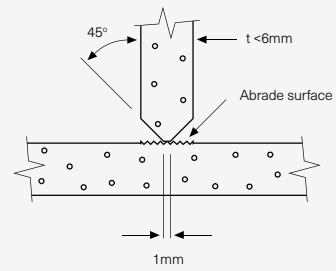
Single Bevel Corner Weld



Single Bevel Butt Weld



Double Bevel Butt Weld



Finishing/Graphics Applications

Foamalux is a suitable substrate for a range of graphic applications creating moisture resistant, lightweight Point of Sale (POS) displays, and interior and exterior signage.

Decorative Finishes

Foamalux is an excellent substrate, suitable for a varied range of decorative finishing techniques. Decorative composites suitable for furniture or interior works can be created by sanding the surface of Foamalux to create a roughened surface. Using a 2 part PU adhesive this can be bonded to sheet metal or synthetic resin similarly roughened.

Edge Finishing

Sheet edges can be finished by filing, sanding, grinding, planing or using a deburring tool, for example, a flat steel edge scraper. Such finishing operations on the sheet surfaces will expose the inner cell structure which might be undesirable in some applications. Glossy surface finishes can be obtained using soft buffing wheels and applying polishing compound, but avoid abrading the surface.

Creating a seamless edge which covers the visible cell structure on cut edges of Foamalux can be achieved via the following methods:

- 1 mm strips of Foamalux can be bonded to the edges with a Tetrahydrofuran (THF) based adhesive, excess material can be trimmed using a sharp cutting tool.
- Cells can be filled with putty suitable for use with PVC, once dry this can be sanded to give a smooth finish.
- Melamine heat activated edge banding can be applied along the edges with an industrial iron. However overheating $>60^{\circ}$ is to be avoided as this can lead to localized buckling of the sheet. Always follow the manufacturer's guidelines regarding application.



Vinyl Graphics

Decorative and lettering / script graphics can be applied to Foamalux as the material forms a very rigid and stable substrate. The surface quality ensures excellent results free from visual distortion.

All materials used in the application process must be dust and moisture free to avoid surface bumps and blisters. Application pressure must be even and strong enough to expel air from the vinyl but excessive pressure can lead to distortion of the graphic and may cause wrinkles.

Mounting Photographs/Prints

Photo mounting to Foamalux gives very high quality results due to the excellent surface finish and stability of the material.

Hand laminating is suitable only for small sizes and runs of panels. Laminating on a clear film protects the print or graphic surface while matt finishes can reduce glare.

Application of films which require high temperatures should be avoided as this could lead to buckling of the sheet. Once mounted leave photographs/ prints to rest on a flat, even surface for a minimum of 3hrs and avoid flexing for 24hrs.

Adhesive Film/Vinyl

The smooth, even surface of Foamalux foam PVC makes it the ideal substrate for lettering films and vinyl graphics. The following points need to be considered when determining film type;

- Location (indoor/outdoor)
- Durability (period of use)
- Type of bond (permanent/removable)
- Processability (printing/welding)

Lamination

All material used in the laminating process must be dust and moisture free while pressure must be even and strong enough to expel air across the sheet width. Roller laminating machines are essential for larger sizes and volumes of panels as ideal roll temperatures, pressures and laminating speed can be determined and accurately controlled to suit the sheet thickness and the material being applied. Wrinkles / Bubbles in the film are often caused by poorly aligned rollers or excessive roller pressure.

Printing & Painting

The surface of Foamalux is suitable for a variety of graphic design process including digital flatbed printing, screen printing, painting and varnishing. It is important to select the correct ink/paint with the end application in mind and always follow the manufacturer's instructions.

The flexibility of Foamalux should be taken into consideration. 1mm sheet is less stiff than thicker sheets and may cause certain inks to crack. The end-user should satisfy themselves that the product is suitable for the proposed application.

Surface Preparation

The sheet's protective film should remain on until just before printing/painting. Only a static brush or ionisation is therefore required to remove static build up and ensure a quality print. Always use lint free gloves when handling sheets and ensure that the surface to be printed is not touched by uncovered hands, as this can leave a greasy residue on the sheet.

Cleaning

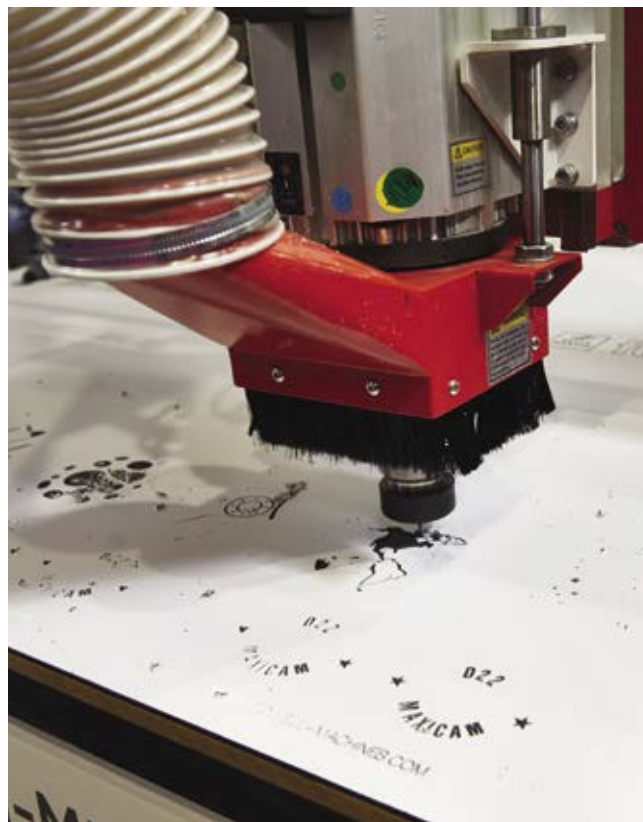
A perfectly clean surface is an essential prerequisite to any substrate use; it must be free of dust, grease and fingerprints.

Foamalux can be cleaned by wiping with a soapy water solution to remove any dust or dirt from prolonged storage. Residual soapy film may affect keying of inks and vinyl and should be removed using a lint free wipe moistened with aliphatic solvent – heptane or octane. These solvents will remove greasy deposits and dust or dirt adhering to the surface, as will methyl alcohol or methylated spirits. Always check the cleaner before use as they can dull the surface or make the material brittle. Cleaners must not contain silicone compounds, as residues of these prevent vinyl inks adhering.

Wipe in one direction only; wiping with a circular motion can create additional static charge.

To remove any paint or other substances, isopropyl alcohol can be used carefully, though the sheet will need to be cleaned, rinsed with water and dried with a soft cloth afterwards. Never use brushes, squeegees or other sharp materials as they will damage the sheet surface.

Please refer to the section on Cleaning and Maintenance for full recommendations.



Static

Static electricity is a natural environmental phenomenon common with all insulating materials that can produce unacceptable results in digital/screen printing applications.

In the case of PVC sheets, static can be generated from various sources for example, when the protective film is removed, friction from transport, dragging sheets across each other. The ultra-fine inkjet nozzles in modern printing equipment fire minuscule droplets of ink onto the surface of the print media and the presence of static electricity can cause these droplets to deflect from their intended path, resulting in variable ink coverage across the media causing overspray, shading and banding issues.

Static charge attracts dust prior to or during the printing process, causing poor quality prints and white-spotting. Ink can wick from the ink head onto the substrate if dust is transferred onto it.

Finishing/Graphics Applications

Listed below are a series of recommendations relating to the preparation of Foam PVC Sheets prior to processing through a digital print machine.

Prevention

Handling & Storage

- Avoid dragging sheets across each other, as this can impart additional and unwanted static into the material.
- Allow newly delivered material time to settle before printing, as movement during transportation can cause an increase in static.

Humidity & temperature can have a direct influence on the static levels within all materials:

- Try to maintain the relative humidity at 50% or more within the area of the printing machine. This can be controlled with the use of a Hygrometer, the higher the relative humidity, the lower the static charge.
- Avoid fluctuations in temperature around the machine by keeping doors and windows closed and minimising drafts and areas of rapidly moving air.

Discharging

- Rinse the surface with water or antistatic cleaning agent, or blow down the sheet with ionised air. The effect of this treatment is short term but usually sufficient for subsequent operations.

The use of professional ionising equipment is the most effective way of discharging static electricity and it is recommended that ionisation should take place immediately prior to printing.

- Anti-static bars are now standard on many machines and in most cases these can also be retro-fitted to printers that do not already have one installed.
- Ionising air pistols are also highly effective. They replace the need to wipe the sheet with an anti-static brush or cloth whilst also ionising the surface at the same time.
- Anti-static brushes are less effective than a bar or a pistol but can be used in the absence of the other two options.

It is advisable to always wear protective gloves and keep sheets covered when not in use. It is in the interest of the printer to ensure that all static is discharged from substrates prior to digitally printing them.

Screen Printing

UV curable, solvent based and vinyl inks formulated for rigid PVC adhere well to the surface of Foamalux Foam PVC. Use of unsuitable inks, i.e. with a high solvent content, is advised against as these may cause damage to the substrate and result in poor printing results. Tixotrope varieties are preferential over liquid based inks, whereas epoxy and enamel paints are unsuitable as they can cause substrate brittleness and even breakage on impact.

New or unfamiliar combinations of inks should be trialled prior to printing. The combination of ink and substrate should be matched with the envisaged printing process before launching a series production. Conditions of use (e.g. outdoor signage), high traffic areas or additional processing of the printed substrates should also be considered when choosing ink type. Care should be taken during the drying process as the intense UV & IR energy may cause warping or discolouration of the sheet if over-exposed. The temperature must not exceed 50°C. Good quality results have been achieved using a 150-31 mesh with dot size resolution of 23.



Digital Printing

Print on the filmed side of the sheet. Film should be removed slowly, in one direction to avoid additional static charge build up, for optimum print results follow the surface preparation detailed on page 21 Ionised air bar/gun, curtains or nozzles should be placed carefully at the sheet sides or above the surface of the sheet to maintain a constant stream of ionised air across the substrate.

It is recommended to use an Anti-Static Brush with a range of surface resistivity between 10¹² to 10¹⁶ Ohms for insulating materials such as Foam PVC. There are an array of environmental factors which are crucial for producing a quality print:

- UV Lamp & Bulb Settings - Too low UV setting can result in inadequate ink adhesion due to insufficient cross-linking between the ink and substrate. Too high a setting may cause the substrate to discolour. The IR energy discharged by the bulbs may lead to overheating and possibly cause warping of the substrate.
- Humidity - Excess ambient humidity increases static levels, which can lead to inadequate ink adhesion. Ink adhesion should be assessed 24 – 48 hours post print.
- Colour/Image - Bright and transparent shades adhere better to the substrate than dark and opaque shades. Large blocks of singular colours are more likely to show static related printing anomalies in comparison to other images.

To achieve the best print image, it is recommended to run a trial print to ensure the optimum print settings are obtained and consult the equipment manufacturer's settings.



Painting/Varnishing

Applications which require precisely matched colours can be achieved via film lamination or painting. For best results, surface preparations should again be followed. Painting the surface will enhance outdoor durability as the light stabilising effect of top coats will delay UV damage and discolouration.

All application techniques - brush, roller, and spray - can be used. Foamalux is most suited to paints known to have compatibility with rigid PVC. Polyurethane, acrylic, two part polyurethane, and vinyl based paints are generally recommended for use with Foamalux and suitable for outdoor applications. Always consult the paint manufacturer's guidelines to ensure suitability for use with Foam PVC. Water-based paints can be used but adhesion properties may not be adequate. Primers and lightly keying the surface before painting can assist with adhesion. Testing is recommended for the initial use of any coating as some paints have been known to cause embrittlement i.e. Epoxy.

When painting Foamalux for use in exterior applications note that darker colours are more heat absorbent and as a result may discolour or suffer localised buckling. A paint with a higher reflectance value will help reduce heat absorption.

Drying temperatures in excess of 60°C are not recommended.



Design & Installation

Thermal Expansion

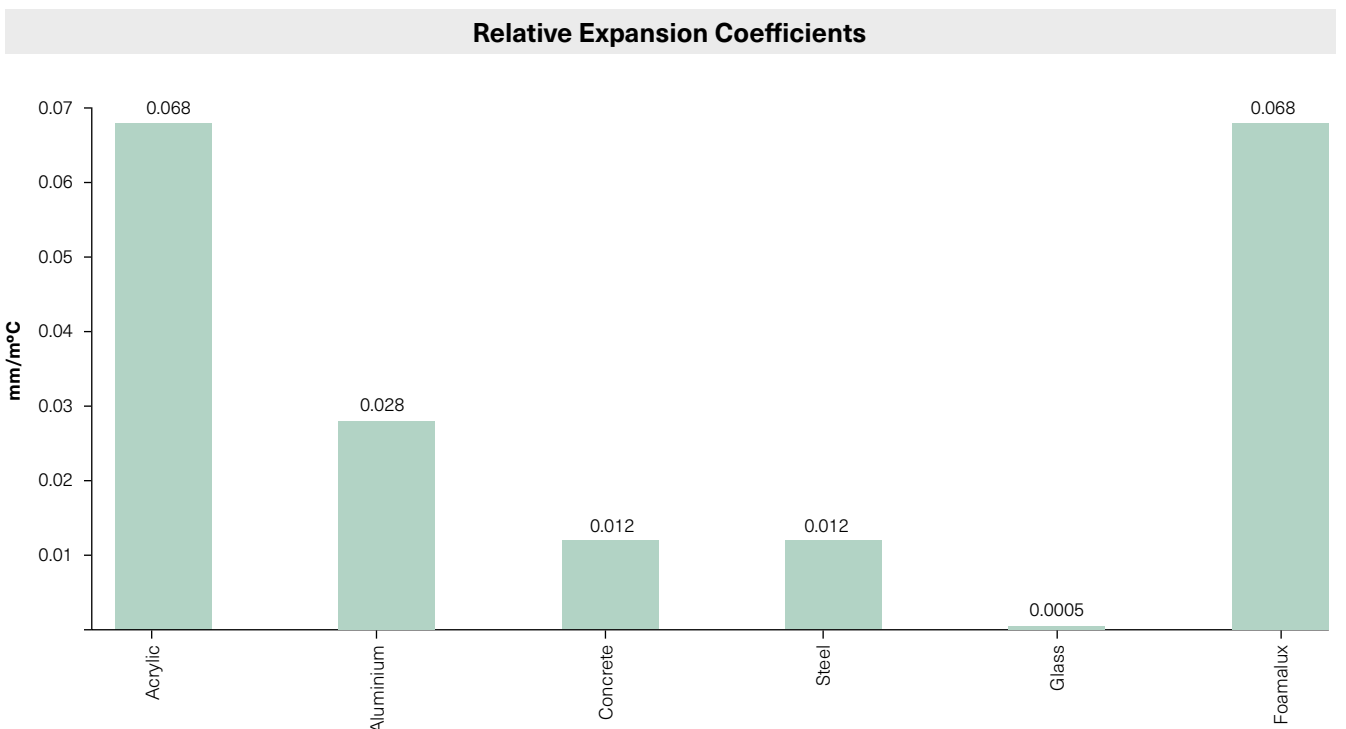
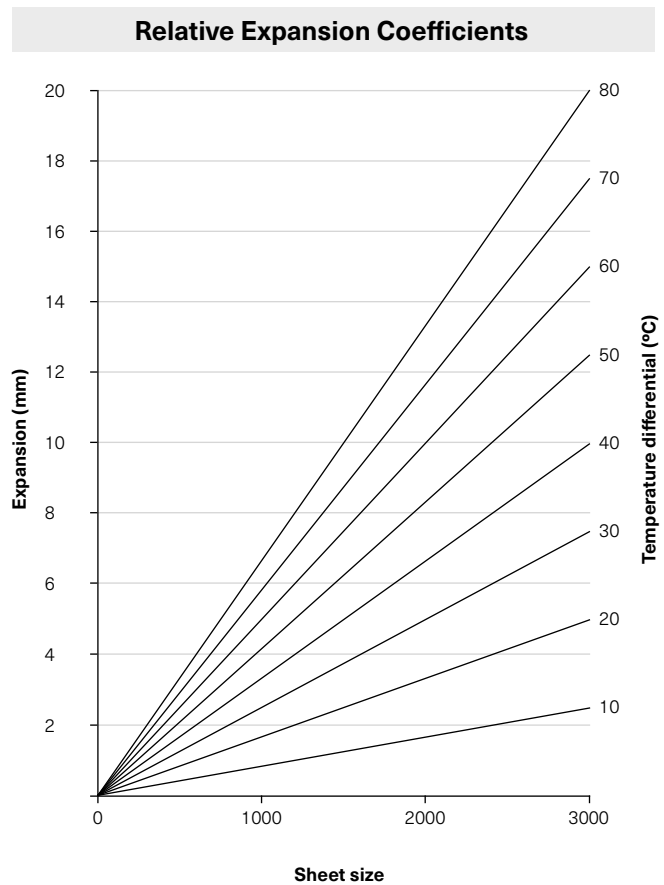
Dimensional change can occur both in sheet length and width due to changes in temperature; this is known as thermal expansion. The coefficient of linear expansion specifies by how much a sheet of 1 metre in length expands if the temperature increases by 1 degree Celsius. Foamalux sheets have a linear expansion coefficient of 0.068mm/m°C.

It is essential to consider the variations caused by Thermal Expansion when installing Foamalux sheets both in indoor and short term outdoor applications. This movement must not be inhibited otherwise distortion, warping or localized buckling will occur, bearing in mind that expansion affects both the length and width of the sheet.

The service temperature range limits of Foamalux are -20°C to +60°C, overall temperature differential range of 80 degrees.

Foamalux can be used in conjunction with many common building and accessory materials, the thermal expansion properties of which must also be taken into consideration. The graph below illustrates the relative coefficients for various materials. Foamalux clearly expands much more than timber, concrete, brickwork and metals when their temperature is changed by the same amount.

For examples of thermal expansion please see Appendix 1



Thermal Characteristics

Thermoplastic materials have a lower thermal conductivity (K) than that of typical construction materials, giving Foamalux products a higher insulation value. U-Value measures the amount of heat passing through the material for a unit area for every degree of temperature difference across the material. Therefore the lower the U value the better the material will retain the heat within the building.

Thickness (mm)	Thermal resistance, R (m ² K/W)	U - Value (W/m ² K)
1	0.18	5.5
2	0.19	5.2
3	0.20	4.8
4	0.22	4.6
5	0.23	4.4
6	0.24	4.2
8	0.26	3.8
10	0.29	3.5
13	0.31	3.1
19	0.38	2.5
24	0.45	2.2

Low Temperatures

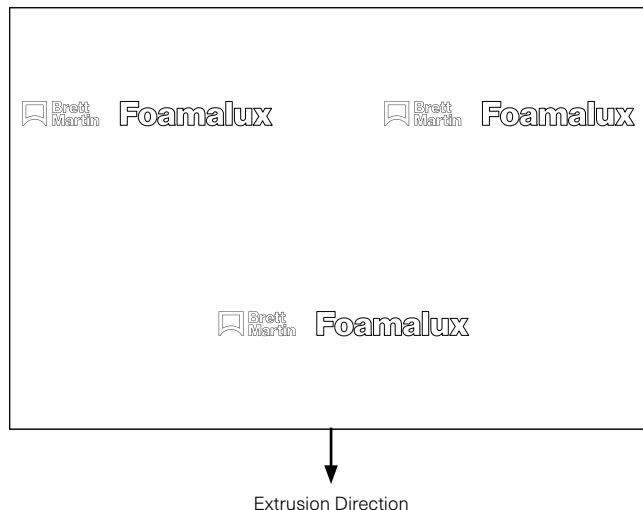
Foamalux should be handled with care in cold weather. All knocks and excessive twisting and bending should be avoided. When cutting, drilling or performing any other operations, care must be taken in colder conditions.

It should be noted that at lower temperatures, freezing point and below, all foam PVC sheet materials become less pliable and more brittle and therefore more susceptible to damages through rough handling and impact.

Panel Orientation

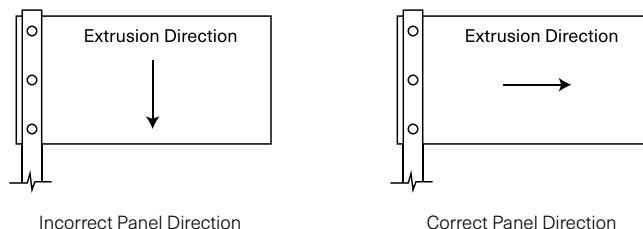
The protective film has the brand running across the direction of extrusion, providing ease of identification for correct cutting of panels for such applications.

Foamalux sheet with branded film



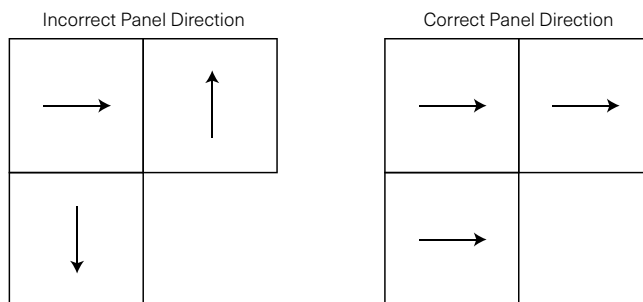
Flexibility

Panel orientation should be considered when mounting, for example, rectangular panels by only one short edge in external applications. Extruded materials generally have fractionally greater flexural strength, and therefore resistance to bending, in the direction of extrusion.



Colour

Due to the extrusion process, the refractive index of panel viewed in the line of extrusion can vary to that across the line of extrusion. This is more obvious in darker coloured sheets. When using multiple panels together, it is vital that they are assembled in the same orientation to avoid colour variations.



*Arrows denote extrusion direction

Design & Installation

UV Stability/Exterior Signage

Outdoor applications expose the sheets to sunlight. This influences the sheet in three ways; changing the temperature, creating thermal movement; degradation of the surface.

Surface degradation, indicated by colour change or “yellowing”, is slightly influenced by heat. However UV radiation from sunlight can have a much greater effect. It is not recommended to install PVC sheets in South-facing applications as this would be subject to maximum direct UV radiation and the exposed white or coloured sheet surface could discolour in a few weeks or months depending on the season. In North-facing, or permanently shaded situations where there is no exposure to direct sunshine, colour change could be gradual over a period of years.

Covering the surface with a UV opaque ink or laminate will reduce the effect of UV in relation to surface degradation. There is virtually no degradation in internal applications, except those close to heat source applications or applications fitted close behind glass subject to sunlight, where excessive temperatures can be reached.

The above apply to Foamalux White, Foamalux Light Foamalux Colour, Foamalux Ultra, Foamalux Eco and Foamalux Xtra as this family of products have several similar material and surface characteristics. In the case of Foamalux Xtra and Foamalux Eco, should the black reclaimed material core be exposed to UV radiation, the colour can fade to grey depending on exposure conditions.

Wind Loading

Any panel mounted outside a building will be subject to wind loading. Panels mounted on walls will not be critically affected by positive wind pressures which force the sheet against the wall. However, negative or suction pressures will tend to pull the sheet away from the wall.

In many external applications where panels are edge mounted in frames, they will be subject to wind pressures from both sides. When designing an external application, wind loads should be estimated and provision made from secure means of fixing, for example, the fixing spacing should be as recommended in the Fixings Section on page 29.

Wind loads can be calculated using EN 1991-1-4.

Precipitation

All panels in external situations will be subject to precipitation in the form of rain, sleet, snow and hail. Foamalux foam PVC does not absorb moisture from precipitation and therefore will not degrade or deteriorate in the presence of moisture.

Hail storms may cause damage through impact of large hail stones on cold panels.

Internal moisture such as condensation will also not degrade Foamalux.

Sound Insulation

Foamalux Foam PVC has good acoustic characteristics and provides sufficient sound insulation for a lightweight material, when used in the construction of exhibition stands, wall cladding and interior partitions. Airborne noise transmission reduction provided by a single leaf partition is dependent on the mass of the material it is the end users responsibility to ensure that material is appropriate for use.

Rated Sound Reduction Index RW:

Thickness	Airborne Sound Reduction Index (Rw)
10mm	28dB
19mm	32dB



Material Properties

The properties listed are typical values obtained by testing large numbers of specimens under specified conditions and procedures. As additional processing of the sheet can influence the material properties, the information given should be treated with caution when applied to finished products.

Physical Characteristics:

Properties	Foamalux	Units	Standard
Base polymer	Polyvinyl Chloride (PVC)		
Form	Unplasticised rigid foam PVC sheet		
Smell	Odourless		
Moisture absorption after 24hrs @ 23°C	<0.25	% by weight	ISO 62
Water solubility	Insoluble		
Oxygen index	49	%	
Thermal expansion Coefficient	0.068	mm/m°C	ISO 11359-2
Service Temperature	-20 to +60°C		
Vicat Softening Temperature	73-76	°C	
Thermal decomposition temperature	>200	°C	
Thermal conductivity K	0.085	W/m.K	ISO 22007

Properties	Foamalux White	Foamalux Light	Foamalux Colour	Foamalux Ultra	Foamalux Xtra	Foamalux Eco	Units	Standard
Shore Hardness	>30	>30	>30	>50	>35	>30		ISO 868
Tensile Strength	15	15	15	25	17	15	MPa	ISO 527
Flexural Modulus	1100-1300	900-1100	900-1100	1600-1800	1000-1200	900-1100	MPa	ISO 178
Impact Resistance - Charpy	11	10	12	14	12	12	kJ/m ²	ISO 179-1/1eU
Average Density	0.55-0.75	0.47-0.52	0.5	0.7-0.9	0.55-0.65	0.5-0.6	g/cm ³	ISO 1183

Design & Installation

Food Contact

Foamalux is rigid, closed cell foam, unplasticised PVC sheet.

The non-porous PVC finish on Foamalux does not absorb or harbour any microbial material and can be wiped completely clean. The closed cell structure means that the material will not absorb moisture and will not degrade or deteriorate in the presence of moisture.

Foamalux has resistance to dilute acids and alkalis, will not corrode or rot and is not prone to attack by pests. Non-abrasive domestic cleaning solutions are suitable for cleaning.

It can be used in a variety of applications in food preparation areas as wall cladding and signage for example.

Foamalux is not suitable for use in food container/packaging applications or other types of application where it is in continuous direct contact with food.

Fire Rating

Foamalux PVC is a self-extinguishing material and complies with the most demanding international fire test standards. Contact Brett Martin's Technical Department for the most up to date certification.

Structures & Frames

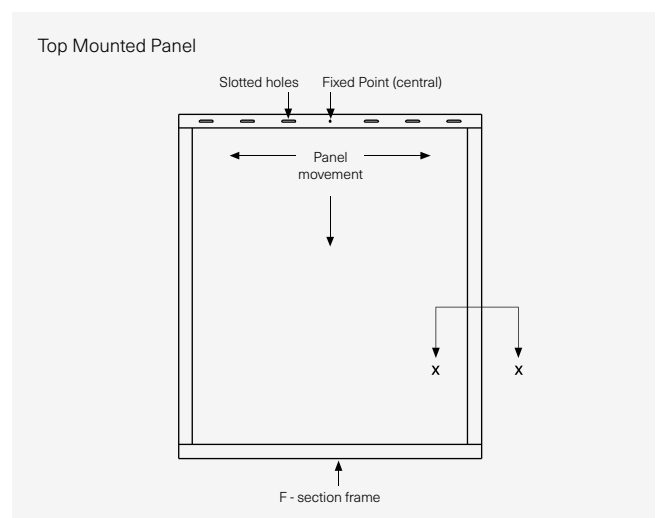
In practice Foamalux is fixed to structures and frames made from many materials, most commonly wood and metals. In the design of these, the differences in thermal expansions must be accommodated, for example, when calculating sizes for fixing holes adequate allowance for unrestricted movement is essential particularly when using Foamalux for cladding applications. Where possible Foamalux should be mounted in a frame where it can freely expand and contract with temperature change. In a relatively temperature stable environment Foamalux panels can be mounted using double sided tapes or adhesive (see adhesive section). Point fixing of Foamalux is possible but allowance must be made for thermal expansion (See page 24).

An illustration of a typical calculation is given in appendix I.

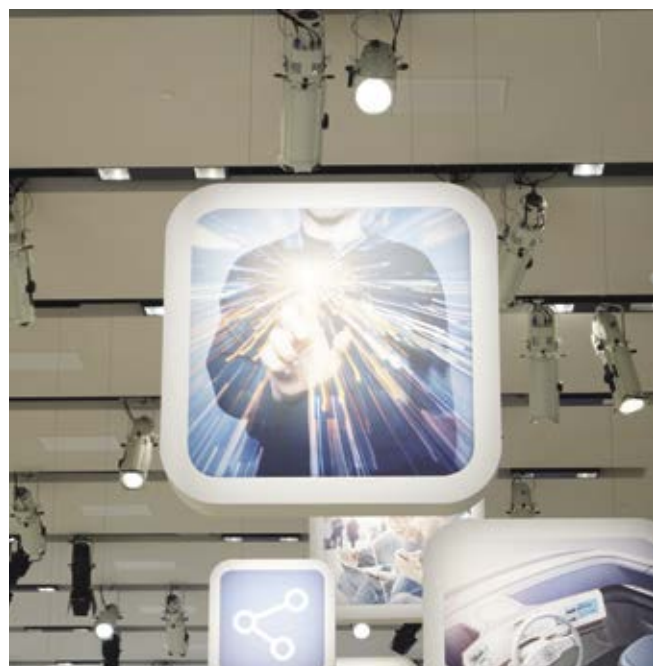
Fixings should be placed at centres not exceeding those recommended in Fixings section on page 29.

Fixings should be no closer than 25mm from the edge of the panel.

Where large and relatively heavy panels are being fixed, the panels should be suspended from a row of fixings located near the panel top, allowing it to expand down and to each side with temperature change. A large and relatively heavy panel mounted with most of its weight bearing on fixings near the bottom edge could distort at elevated temperatures.



Large panels mounted on external walls should be spaced from the wall surface using battens to maintain a ventilating air gap of about 20mm behind the panel. Direct mounting of the panels to the walls could result in distortion due to heat buildup.



Fixings

Panels can be point fixed to supporting structures. Screws are most suitable as they are most controllable: tightening a screw and then backing it off slightly allows the panel to move with temperature changes without deformation.

The table below gives an example of appropriate hole, or slot and washer size for given sheet dimensions and fixing shank diameters. For example a 1200mm panel should have a 6mm fixing shank diameter, minimum hole diameter of 12mm (Highlighted below) and a minimum washer size of 24mm.

V or H	d = 4		d = 5		d = 6		d = 8		d = 10	
	D	W	D	W	D	W	D	W	D	W
200	5	10	6	12	7	14	9	18	11	22
400	6	12	7	14	8	16	10	20	12	24
600	7	14	8	16	9	18	11	22	13	26
800	8	16	9	18	10	20	12	24	14	28
1000	9	18	10	20	11	22	13	26	15	30
1200	10	20	11	22	12	24	14	28	16	32
1400	11	22	12	24	13	26	15	30	17	34
1600	12	24	13	26	14	28	16	32	18	36
1800	12	24	13	26	14	28	16	32	18	36
2000	13	26	14	28	15	30	17	34	19	38
2200	14	28	15	30	16	32	18	36	20	40
2400	15	30	16	32	17	34	19	38	21	42
2600	16	32	17	34	18	36	20	40	22	44
2800	17	34	18	36	19	38	21	42	23	46
3000	18	36	19	38	20	40	22	44	24	48

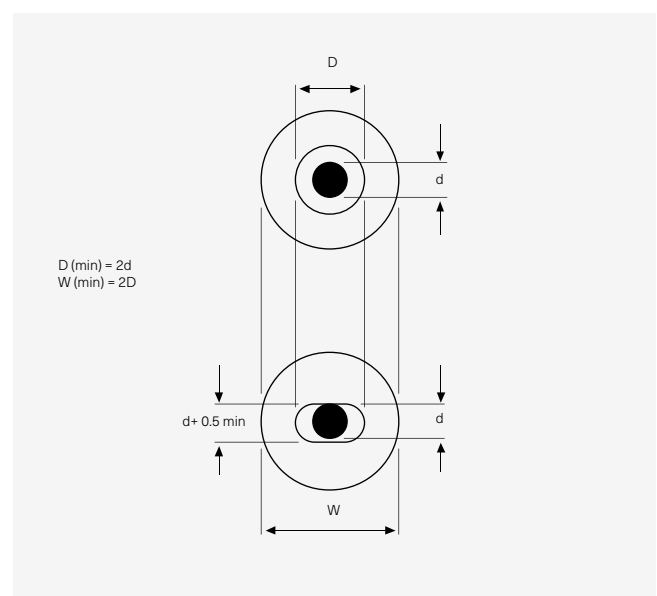
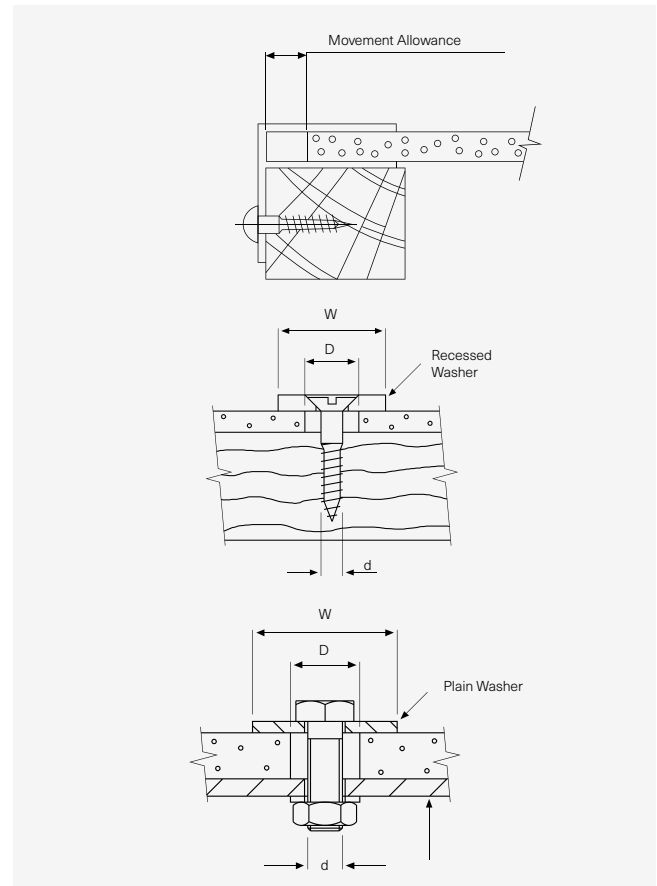
d = fixing shank diameter
D = minimum hole diameter or slot width

W = minimum washer diameter
V = vertical panel dimension
H = horizontal panel dimension

Fixings should be spaced at the separations given for each thickness of panel.

Thickness	Fixing Spacing (mm)
1mm	100 - 150
2mm	150 - 250
3mm	250 - 350
4mm	350 - 500
5-19mm	500

In all cases holes must be predrilled oversize through the panel to accommodate thermal movement. This in turn necessitates the use of an oversize washer on the fastener to provide adequate retention of the sheet and spread the load. Never use countersunk fixings.



Design & Installation

Screws

To fix external signage onto wooden or metal structures, it is recommended to use stainless steel façade screws with pre-fitted washers and rubber seals.

Always drill the hole approximately 5-6mm larger than the diameter of the screw shank. Avoid tightening the screws too much, but make sure the rubber washers seal the hole and fit smoothly onto the sheet, without applying too much pressure onto the sheet. Self-tapping screws can be used to mount lightweight items to Foamalux panels thicker than 6mm. Never use countersunk screws.

Nail/Rivet Joints

Nails and rivets can be used with small panels or in internal applications where there is little thermal movement since temperature differentials are small.

Aluminium blind or pop rivets that have a stainless steel mandrels are best suited. Make sure to always position the closing head on the support structure or metal side and make the clearance holes in the sheet at least 2mm larger than the shank diameter of the rivet.

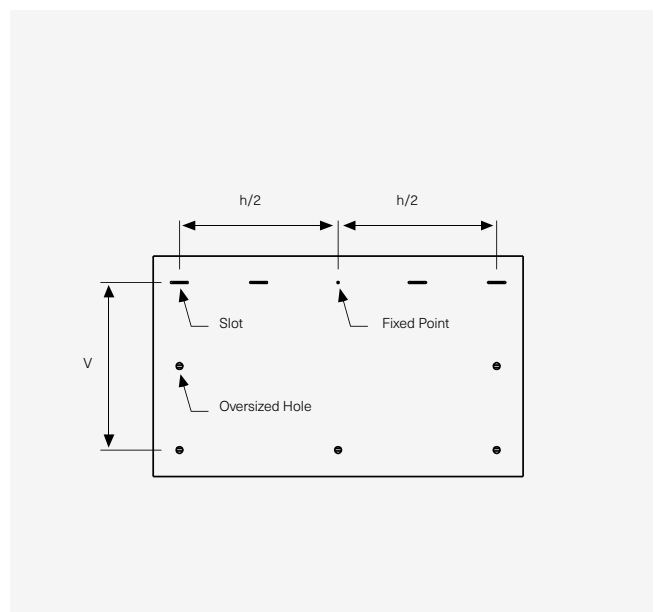
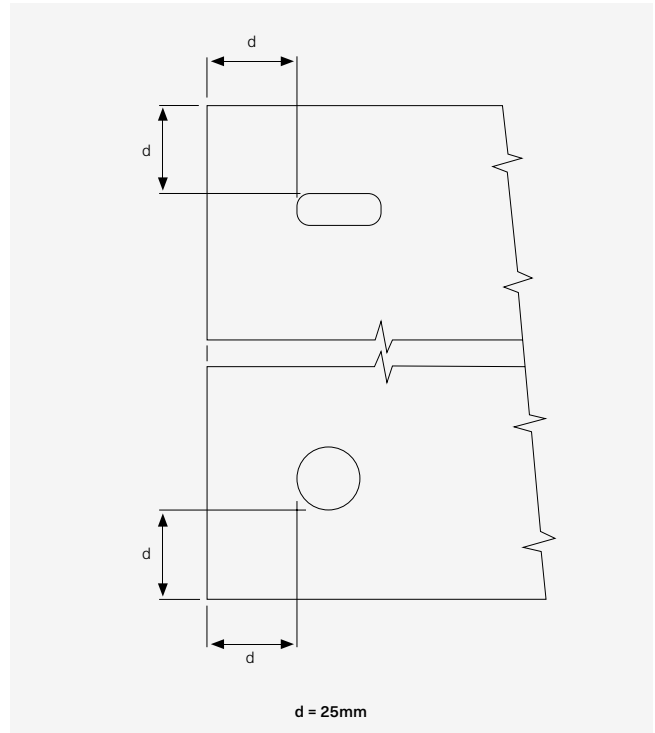
In order to avoid tension and material creeping use only pan head rivets with large heads or washers. Never use countersunk rivets.

Hole, Slot and Washer Sizes

As Foamalux sheet can be subject to thermal expansion and contraction in all directions, it is essential to drill circular locating holes in the centre of the edges and oblong holes to the left and right of the centre.

Always leave a space of 25mm between the holes and the edge of the sheet.

Appendix 1 gives an example of appropriate hole, or slot and washer size for given sheet dimensions and fixing shank diameters.



Cleaning & Maintenance

Cleaning

In principle, if stored correctly the surfaces of Foamalux sheets are ready for use. However, in order to ensure prime conditions for the adhesion of paints, bonding agents and adhesive films, the surfaces must be free of dust, grease, fingerprints and such before carrying out any decorative work, printing, lamination etc.

In order to preserve Foamalux in a good condition and ensure optimum performance when in use, it is recommended that the sheet is cleaned periodically using the following recommendations.

Dusty areas can be cleaned with water and a non-fluffy, lint free soft cloth or sponge but should never be rubbed when dry. Foamalux has good electrical insulation properties which may result in electrostatic charging and the attraction of dust particles.

Before any application of Foamalux we recommend removing any dust on the surface by blowing with ionised air. Normal compressed air will just spread the particles around the surface.

The recommended cleaning instructions are as follows:

- Use lukewarm water to rinse and soften dirt.
- Make up a solution of lukewarm water and ordinary household cleaner or mild soap and use this to wash the sheet.
- A sponge or soft cloth should then be used to gently remove dirt and grime.
- Stubborn marks can be removed with a fibrous cleaning pad, accepting a slight dulling of the surface.
- For large areas a pressure washer may be used with care.
- Ethyl alcohol or isopropyl alcohol used sparingly can be used to remove paint, grease or other such substances.
- Note: Allow adequate time for evaporation as streaks can form unless completely dry.
- The cleaning process should then be repeated and the sheet rinsed with clean water and dried with a soft cloth.

Warning

The following precautions should be observed:

- Do not scrub the sheet with brushes.
- Do not use razor blades or other sharp tools.
- Do not use squeegees.
- Avoid sanding or grinding as this causes irreversible changes to the surfaces.
- Avoid cleaners of a highly alkaline composition.
- Avoid cleaning in the hot sun or high temperatures.

- Liquid cleaners must be checked for suitability before use. They frequently leave residues, dull the surfaces (especially acetone) or make the material brittle, as many solvents contain a high level of aromatic components.
- Always follow manufacturer's instructions when using cleaning products.

Chemical Resistance

In general, the chemical resistance depends on reaction time, temperature of application, pressure, purity and concentration of the reagents as well as mechanical stress and other influences.

The base material for Foamalux foam PVC is highly resistant to attack from chemicals and from pollutants in the atmosphere. Contact with solvents and wet wood preservatives must be avoided.

In short Foamalux resists aqueous acids, alkalis and saline solutions as well as oils and aliphatic compounds. Sheets will swell or dissolve in aromatic compounds, chlorinated hydrocarbons, ether, esters and ketones.

Please see Appendix 2 for more detailed data.

Important Notes

Environmental Policy

Brett Martin Limited is committed to ensuring that high standards of environmental performance are maintained at all the Company's sites. The Company will continue to operate in such a way as to reduce any adverse effects on the environment arising from our activities, to a minimum and to consider the environment and the wellbeing of future generations in all Company policy decisions.

Responsibility of the End User

The information contained in this publication is based on current knowledge and is in our opinion reliable. However the accuracy of this information cannot be guaranteed for every application and for the results arising from their use.

The user/processor is always responsible for ensuring that the materials and processes are appropriate, cost effective and suitable for the intended purpose and location and they comply with laws and regulations. Technical knowledge and skills as customary in trade and industry, a normally developed capacity to make judgements as well as knowledge and observance of the applicable regulations appertaining to work, safety and hygiene are assumed.

Appendices Appendix 1. Thermal Expansion Calculation

Example 1

A Foamalux sheet is to be used to form a sign panel on the outside of a building. It is expected that the panel temperature will be as low as -12°C in winter and as high as 31°C in summer. The panel measures 1.2m wide and 1.5m high in a workshop at a temperature of 18°C. The panel is to be hung from its top edge with a fixed point at the centre, so that thermal movement takes place from the top down and from the centre horizontally to each side. Estimate the clearance required in retaining channels which will frame the bottom and sides of the sheet.

1. Width

Initial width = 1.2m
 Dimension change in cooling from 18°C to -12°C
 Temperature change = 30°C
 Expansion coefficient = 0.068mm/m°C
 Reduction in width = $1.2 \times 30 \times 0.068 = 2.45\text{mm}$
 Dimension change in heating from 18°C to 31°C
 Temperature change = 13°C
 Expansion coefficient = 0.068mm/m°C
 Increase in width = $1.2 \times 13 \times 0.068 = 1.06\text{mm}$
 Total width change = $w = 2.45 + 1.06 = 3.51\text{mm}$, 4mm when rounded up to the nearest mm.
 As the sheet is fixed at its centre it will move half of this distance each side of the fixed point, i.e. 2mm clearance is required in each side channel.

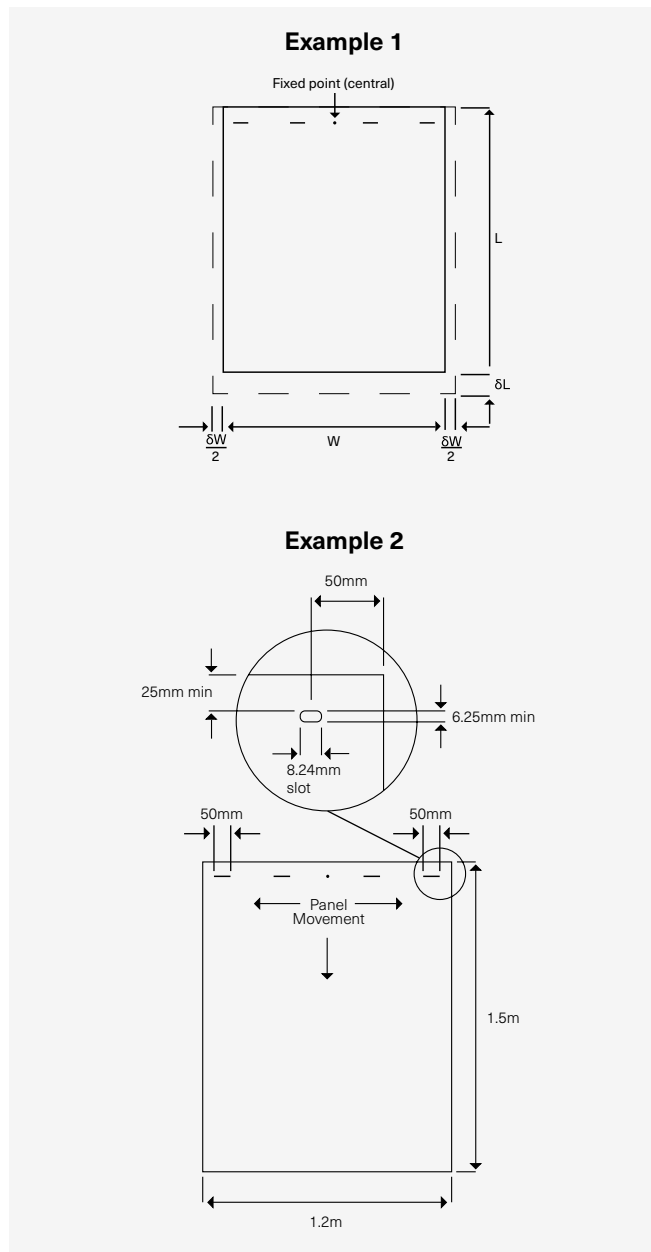
2. Length

Initial length = 1.5m
 Dimension change in cooling from 18°C to -12°C
 Temperature change = 30°C
 Expansion coefficient = 0.068mm/m°C
 Reduction in length = $1.5 \times 30 \times 0.068 = 3.06\text{mm}$
 Dimension change in heating from 18°C to 31°C
 Temperature change = 13°C
 Expansion coefficient = 0.068mm/m°C
 Increase in length = $1.5 \times 13 \times 0.068 = 1.33\text{mm}$
 Total length change = $L = 3.06 + 1.33 = 4.39\text{mm}$, 5mm when rounded up to the nearest mm.
 As the sheet is fixed at the top it will move vertically 5mm, i.e. 5mm clearance is required in bottom channel.

Example 2

The Foamalux sheet in the previous example is to be fixed with a row of screws along its top edge, with outer screws 50mm in from sheet sides. Estimate the size of slot required to accommodate thermal movement. Using screws that have a shank diameter of 6mm, the example below demonstrates how to calculate the required slot size to accommodate thermal movement.

Sheet width 1.2m
 Outer slot separation = $1.2 - (2 \times 0.05) = 1.1\text{m}$
 Distance from fixed point to slot centre = 0.55m
 This distance contracts as sheet cools from 18°C to -12°C by an amount $0.55 \times 30 \times 0.068 = 1.12\text{mm}$
 This distance expands as sheet heats up from 18°C to 31°C by an amount $0.55 \times 13 \times 0.068 = 0.49\text{mm}$
 The fixing must be centred in a slot with a length which can accommodate, at least, the greater amount of thermal movement. In this case, the greater movement is 1.12mm from cooling.
 Minimum slot length = fixing shank diameter + (2 x greater thermal movement)
 = $6 + (2 \times 1.12) = 8.24\text{mm}$



Appendix 2. Chemical Resistance

KEY:

- + Good resistance
- Poor resistance

Note: Values are only indications and should not be interpreted as absolute proof of resistance of any part against a certain substance. Testing under actual exposure conditions will provide a better indication of performance.

Chemical Name	Resistance at 23°C	Chemical Name	Resistance at 23°C
Acetaldehyde 40%	+	Amyl chloride	-
Acetaldehyde 100 %	-	Aniline	-
Acetic acid 10%	+	Aniline chlorohydrate	-
Acetic acid 20%	+	Aniline hydrochloride	-
Acetic acid 80%	+	Anthraquinone sulphonc acid	+
Acetic acid, glacial	+	Antimony trichloride	+
Acetic anhydride	-	Aqua regia	+
Acetone	-	Aromatic hydrocarbons	-
Adipic acid	+	Arsenic acid 80%	+
Allyl alcohol 96%	+	Arylsulphonic acid	+
Allyl chloride	-	Barium carbonate	+
Alum	+	Barium chloride	+
Aluminium alum	+	Barium hydroxide	+
Aluminium chloride	+	Barium sulphate	+
Aluminium fluoride	+	Barium sulphide	+
Aluminium hydroxide	+	Beer	+
Aluminium oxychloride	+	Beer sugar liquors	+
Aluminium nitrate	+	Benzaldehyde 10%	+
Aluminium sulphate	+	Benzaldehyde, above 10%	-
Ammonia gas (dry)	+	Benzene	-
Ammonia, liquid	-	Benzene	+
Ammonium acetate	+	Benzoic acid	+
Ammonium alum	+	Bismuth carbonate	+
Ammonium bifluoride	+	Bleach 12% Cl	+
Ammonium carbonate	+	Borax	+
Ammonium chloride	+	Boric acid	+
Ammonium fluoride 25%	+	Bromic acid	+
Ammonium hydroxide	+	Bromine liquid	-
Ammonium metaphosphate	+	Bromine water	+
Ammonium nitrate	+	Butadiene	+
Ammonium persulphate	+	Butane	+
Ammonium phosphate	+	Butanol normal	+
Ammonium sulphate	+	Butanol iso	+
Ammonium sulphide	+	Butyl acetate	-
Ammonium thiocyanate	+	Butyl phenol	+
Amyl acetate	-	Butyric acid	+
Amyl alcohol	+	Cadmium cyanide	+

Chemical Name	Resistance at 23°C	Chemical Name	Resistance at 23°C
Calcium bisulphite	+	Diazo salts	+
Calcium carbonate	+	Diglycolic acid	+
Calcium chlorate	+	Dimethylamine	+
Calcium chloride	+	Dioctyl phthalate	-
Calcium hydroxide	+	Disodium phosphate	+
Calcium hypochlorite	+	Distilled water	+
Calcium nitrate	+	Esters	-
Calcium oxide	+	Ethers	-
Calcium sulphate	+	Ethyl acetate	-
Carbon disulphide	-	Ethyl acrylate	-
Carbon dioxide	+	Ethyl alcohol	+
Carbon monoxide	+	Ethyl chloride	-
Carbon tetrachloride	+	Ethyl ether	-
Carbonic acid	+	Ethylene bromide	-
Castor oil	+	Ethylene chlorohydrin	-
Caustic potash	+	Ethylene dichloride	-
Caustic soda	+	Ethylene glycol	+
Chloroacetic acid	+	Ethylene oxide	-
Chloral hydrate	+	Fatty acids	+
Choric acid 20%	+	Ferric chloride	+
Chlorine (dry)	-	Ferric hydroxide	+
Chlorine (wet)	-	Ferric nitrate	+
Chlorine water	+	Ferric sulphate	+
Chlorobenzene	-	Ferrous chloride	+
Chloroform	-	Fluoboric acid	+
Chlorosulphonic acid	+	Fluorine gas (wet)	+
Chrome alum	+	Fluorine gas (dry)	+
Chromic acid 10%	+	Fluorosillicic acid 25%	+
Chromic acid 50%	-	Formaldehyde	+
Citric acid	+	Formic acid	+
Copper carbonate	+	Fructose	+
Copper chloride	+	Fruit juices and pulp	+
Copper cyanide	+	Furfural	-
Copper fluoride	+	Gallic acid	+
Copper nitrate	+	Glucose	+
Copper sulphate	+	Glycerine	+
Cottonseed oil	+	Glycol	+
Cresol	+	Glycolic acid	+
Cresylic acid	-	Heptane	+
Crotonaldehyde	-	Hexane	+
Crude oil	+	Hexanol, tertiary	+
Cupric fluoride	+	Hydrobromic acid 20%	+
Cupric sulphate	+	Hydrochloric acid 10%	+
Cuprous chloride	+	Hydrochloric acid 35%	+
Cyclohexanol	-	Hydrocyanide acid	+
Cyclohexanone	-	Hydrofluoric acid 50%	+
Detergents	+	Hydrogen	+
Dextrin	+	Hydrogen peroxide 30%	+
Dextrose	+	Hydrogen peroxide 90%	+

Chemical Name	Resistance at 23°C	Chemical Name	Resistance at 23°C
Hydrogen phosphide	+	Nickel chloride	+
Hydrogen sulphide	+	Nickel nitrate	+
Hydroquinone	+	Nickel sulphate	+
Hydroxylamine sulphate	+	Nicotine	+
Hypochlorous acid	+	Nicotine acid	+
Iodine	-	Nitric acid, anhydrous	-
Kerosene	+	Nitric acid 10%	+
Ketones	-	Nitric acid 60%	+
Lactic acid 25%	+	Nitric acid 68%	+
Lauric acid	+	Nitrobenzene	-
Lauryl chloride	+	Nitrous oxide	+
Lead acetate	+	Oils and fats, vegetable	+
Lead chloride	+	Oleic acid	+
Lead sulphate	+	Oleum	-
Lead tetraethyl	+	Oxalic acid	+
Linoleic acid	+	Oxygen	+
Linseed oil	+	Ozone	+
Lithium bromide	+	Palmitic acid	+
Lubricating oil	+	Paraffin	+
Machine oil	+	Perchloric acid 10%	+
Magnesium carbonate	+	Perchloric acid 15%	+
Magnesium chloride	+	Perchloric acid 70%	+
Magnesium citrate	+	Petrol	+
Magnesium hydroxide	+	Petrol high octane	+
Magnesium nitrate	+	Phenol	+
Magnesium sulphate	+	Phenylhydrazine	-
Maleic acid	+	Phenylhydrazine hydrochloride	+
Malic acid	+	Phosgene gas	+
Mercuric chloride	+	Phosgene liquid	-
Mercuric cyanide	+	Phosphoric acid 10%	+
Mercurous nitrate	+	Phosphoric acid 85%	+
Mercury	+	Phosphoric acid (yellow)	+
Methyl alcohol	+	Phosphorus pentachloride	+
Methyl bromide	-	Phosphorus trichloride	-
Methyl chloride	-	Photographic solutions	+
Methyl methacrylate	-	Pictic acid	-
Methylene chloride	-	Potassium alum	+
Methyl ethyl ketone	-	Potassium bicarbonate	+
Methyl iso butyl ketone	-	Potassium bichromate	+
Methyl sulphate	+	Potassium borate	+
Methyl sulphuric acid	+	Potassium bromate	+
Milk	+	Potassium bromide	+
Mineral oils	+	Potassium carbonate	+
Molasses	+	Potassium chromate	+
Monochloroacetic acid	+	Potassium chlorate	+
Muriatic acid	+	Potassium chloride	+
Naphtha	+	Potassium cyanide	+
Napthalene	-	Potassium dichromate	+
Natural gas	+	Potassium ferricyanide	+

Chemical Name	Resistance at 23°C	Chemical Name	Resistance at 23°C
Potassium ferrocyanide	+	Stannous chloride	+
Potassium fluoride	+	Starch	+
Potassium hydroxide	+	Stearic acid	+
Potassium nitrate	+	Sulphur	+
Potassium perborate	+	Sulphur dioxide (dry)	+
Potassium perchlorate	+	Sulphur dioxide (wet)	+
Potassium permanganate 10%	+	Sulphur trioxide	+
Potassium permanganate 25%	+	Sulphuric acid 3%	+
Potassium sulphate	+	Sulphuric acid 70%	+
Propane liquid	+	Sulphuric acid 80%	+
Propane gas	+	Sulphuric acid 85%	-
Propargyl alcohol	+	Sulphurous acid	+
Propyl alcohol	+	Tallow	+
Propylene dichloride	-	Tall oil	+
Plating solutions	+	Tannic acid	+
Rochelle salts	+	Tartaric acid	+
Sea water	+	Tetraethyl lead	+
Selenic acid	+	Tetrahydrofurane	-
Sewage	+	Thionyl chloride	-
Sillicic acid	+	Terpineol	+
Silver cyanide	+	Titanium tetrachloride	-
Silver nitrate	+	Tanning liquors	+
Silver plating solution	+	Toluene	-
Silver sulphate	+	Transformer oil	+
Soaps	+	Tributyl phosphate	-
Sodium acetate	+	Trichlorethylene	-
Sodium alum	+	Triethanolamine	+
Sodium benzoate	+	Trimethyl propane	+
Sodium bicarbonate	+	Trisodium phosphate	+
Sodium bisulphate	+	Turpentine	+
Sodium bisulphite	+	Urea	+
Sodium bromide	+	Urine	+
Sodium carbonate	+	Water - deionized	+
Sodium chlorate	+	Water - distilled	+
Sodium chloride	+	Water - demineralized	+
Sodium cyanide	+	Water - salt	+
Sodium dichromate	+	Whiskey	+
Sodium ferricyanide	+	Wines	+
Sodium ferrocyanide	+	Xylene	-
Sodium fluoride	+	Yeast	+
Sodium hydroxide 10%	+	Zinc chloride	+
Sodium hydroxide 50%	+	Zinc nitrate	+
Sodium hypochlorite	+	Zinc sulphate	+
Sodium nitrate	+		
Sodium peroxide	+		
Sodium sulphate	+		
Sodium sulphide	+		
Sodium sulphite	+		
Stannic chloride	+		

Appendix 3. Adhesives Manufactures

Ureka Global Ltd

(Formerly Alansons Industries Ltd)
7 Flowers Hill
Brislington
Bristol
BS4 5JJ
England
Tel: 0117 971 1364
Email: sales@thenamethatsticks.com
Web: alansonsuk.com

3M United Kingdom plc

3M Centre Cain Road
Bracknell
Berkshire
RG12 8HT
England
Tel: 01344 858000
Fax: 01344 858278
Email: innovation.uk@mmm.com
Web: 3M.co.uk

Stelmax Ltd

Unit 21-23 Gloster Road Martlesham Heath
Industrial Estate Ipswich
Suffolk
IP5 3RD
England
Tel: +44 (0) 1473 622265
Fax: +44 (0) 1473 610651
Email: sales@stelmax.co.uk
Web: stelmax.co.uk

Dunlop Adhesives Ltd

Building Adhesives Limited Longton Road
Trentham
Stoke-on-Trent
ST4 8JB
England
Tel: +44 (0) 1782 591100
Fax: +44 (0) 1782 591101
Email: info@building-adhesives.com
Web: dunlop-adhesives.com

Bostik Ltd

Ulverscroft Road Leicester
LE4 6BW
England
Tel: 01785 272727
Fax: 0116 268 9211
Email: technical.service@bostik.com
Web: bostik.co.uk

Dow Corning Europe SA

Parc Industriel –
Zone C Rue Jules Bordet
7180 Seneffe
Belgium
Tel: +32 64 888 000
Fax: +32 64 888 401
Web: dowcorning.com





PRINTED ON
Foamalux
Light

PRINTED ON
Foamalux
Light

PRINTED ON
Foamalux
Light

PRINTED ON
Foamalux
Light

PRINTED ON
Foamalux
Light

PRINTED ON
Foamalux
Light

PRINTED ON
Foamalux
Light

PRINTED ON
Foamalux
Light

PRINTED ON
Foamalux
Light

MAX. LOAD 150 LBS. 68 KG
MAX. WEIGHT PER SHEET 1.5 LBS. 0.7 KG

MODEL NUMBER 54011A
SERIAL NUMBER 123456

Head Office & Global Sales

Brett Martin Ltd
24 Roughfort Road
Newtownabbey, Co. Antrim
Northern Ireland, BT36 4RB

2296/0222

t: +44 (0) 28 9084 9999
f: +44 (0) 28 9083 6666
e: technical@brettmartin.com
commercial@brettmartin.com

For the latest information visit
brettmartin.com



Q09125

