



FOAMALITE



General Technical Information
PVC Foam Sheet Range

experts in plastics

www.foamalite.ie

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1 Characteristics

1.1 Characteristics

The general characteristics of Foamalite PVCUe sheet can be listed as follows:

- Good mechanical performance
- Excellent chemical resistance
- Lightweight (*foam grades*)
- Rustproof
- Durable
- Rigidity
- Good thermal insulation
- Machinable
- Hygienic
- Tough
- Non-flammable
- Printable
- Self extinguishing
- Easily fabricated by most techniques available
 - (*hot air welding, solvent bonding, vacuum forming etc.*)
- Rot proof
- Accommodates most fixing systems (*screwed, bolted etc.*)
- High quality smooth finish both sides
- Non toxic grades
- Wide range of colours available
- Low water absorption
- Specialist grades available
- Weatherable
- Paintable



NOTE: For specific detailed technical specifications for each product please refer to the specific product technical brochures.



2 Application Areas

2.1 Application Areas

The above inherent properties of Foamalite PVC product range provides many potential application areas as indicated in the following list:

- **Signage & Display Panels**
 - Internal wall hung displays
 - Exterior framed units
 - Screen printed panels
 - Digitally printed posters
 - Vinyl laminated pictures
- **Wall Cladding & Partitioning**
 - Hygienic cladding
 - Decorative cladding
 - Temporary partitioning
- **False Ceilings**
 - Moulded panels
 - Flat panels
 - Fabricated panels
- **Decorative Panels**
 - Exhibition shell stands
 - Custom displays
- **Instrument Covers & Cases**
 - Vacuum formed shapes
 - Fabricated units
- **Furniture Industry**
 - Shelving
 - Slat wall panels
 - Drawers
- **Clean Room Linings**
- **Fabrication in to Ducts**
 - Ventilation
 - Air conditioning
- **Corrosive Linings**
- **and many more**





3 Packaging & Storage

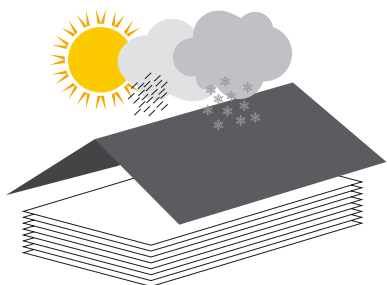
3.1 Packaging

Foamalite sheets are packed on purpose-made wooden pallets with the bottom of the stacked product protected by a “deck-sheet” and the top protected by a “cap-sheet”.

The stack is wrapped with stretch-wrap film that is anchored to the pallet and finally the complete pack is securely held using strapping. Each pallet is clearly marked with pallet details such as product type, size, colour and qty of sheets. Our Foamalite sales team can provide full details of our standard pallet sizes for each of the product types. It is advised that the cardboard “cap-sheet” is retained when in storage to further reduce the effects of dust and swarf collection on the surface of the top sheet.



3.2 Storage & Handling



Foamalite products should be stored in standard warehouse ambient conditions (15-25° C) and the product must be kept on a flat surface. Sheets must be stored flat on a pallet that the pallet supports ensure the sheets do not distort over a period of time.

Note: *Never stand sheets on ends or sides.*

Products should be stored under cover and not subjected to direct sunlight. The temperature of uncovered stacked sheets in direct sunlight can rise to temperature that can damage the material. The presence of moisture between sheets can add to this damage. Coloured sheets should be stored in protective cardboard sleeves.

Note: *Do not store close to heat sources such as radiant heaters or boilers.*

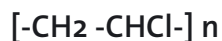
Foamalite products are relatively flexible but, if lifted or carried incorrectly, they can be stressed beyond their flexible limits and crack. Sheets should not be dragged off a stack but lifted directly up and set down directly. Surfaces on which sheets are placed must be clean to avoid damage. When carrying, sheets should be turned on edge and carried top to bottom. Particular care should be taken with panels which have been processed, for example, screen printing. It is advisable not to remove the protective PE film until absolutely necessary in order to avoid surface scratches or contamination. It is also recommended that the material be acclimatised at room temperature before use.



4 Production Process

4.1 What is PVC?

Polyvinyl Chloride or abbreviated to PVC is a high volume commodity thermoplastic material which has a very wide application base from medical pouches to window frames. The chemical structure can be represented as follows:



PVC is produced by the polymerisation of vinyl chloride monomer (VCM). VCM is obtained by the oxychlorination of ethane or the addition of hydrogen chloride to acetylene.

4.2 PVC Formulation

PVC in the form of a powder is the main raw material for the manufacturing process at Foamalite. PVC is generally not processed in its virgin form and requires compounding with a number of additives to enable easy processing on a wide range of plastics processing equipment. The control of the various properties (by compounding with additives) gives a unique versatile advantage for PVC as a material and allows an unlimited array of application uses. Typically PVC additives are used for enhancing properties such as flexibility, weatherability, cost reduction, surface hardness, colour, density, impact performance, service temperature, etc.

Foamalite has optimised their range of PVC formulations to obtain the best combination of physical properties and cost effectiveness. The foaming process preferred by Foamalite is a chemical blowing agent activated during heat processing.

PVC free foam sheet is produced by the hot melt extrusion of a flat profile that is subsequently cooled through a calendar roll stack, edge trimmed, cut to length and palletised. The controlled foaming reaction, if applicable, takes place within the twin-screw extruder.

Foamalite's extrusion facility, again, utilises the latest state of the art equipment with extensive process control and tight process parameters.

In line with '*best manufacturing practice*' the manufacturing process is controlled by stringent process cycles and the steady operation of the line is completely automatic. Finally the finished pallet of product is removed from the production line, packed and transferred to the storage area.



Mixing Plant



5 Quality Control

5.1 Quality Control

The quality procedural system introduced at Foamalite covers every step of the manufacturing process from receipt of the raw materials to the final packed product.



All raw materials are purchased from quality-approved suppliers and in many cases a certificate of analysis/ conformity is provided with each delivery. As described in the outline above, accurate control of the complete process cycle is maintained by modern, computer-controlled equipment.

A full range of quality control tests are conducted which are relevant to characteristics of the material using a tried and tested sampling plan.

These tests are documented and complete the history of raw material to final accepted product.

In addition, samples of finished product are routinely sent to an approved testing house for an independent assessment of the physical properties relevant to the application areas of PVC foam sheet.

Foamalite are committed to a proven quality management system and have gained ISO9002 registration.





6 Weathering

6.1 UV Rays



Sunlight affects all materials, to varying amounts, due to UV radiation and also the raising of surface temperatures. Free foam PVC, like all plastics, is affected by UV light. A colour will change according to its colourfastness and the quantity of radiation absorbed.

The rate and level of discolouration of white sheet is variable by the actual shade of white. The bluer/white the product the faster it will appear to discolour. The creamier whites tend to appear to discolour slower but in fact the initial shift is generally slower and then end result should be broadly the same regardless of shade.

The lighter the colour tone the slower it will discolour. For example a beige sheet should discolour slower than a blue sheet. A light blue sheet will appear to fade slower than a dark blue one. Red will fade the fastest with Black a very close second.

The intrinsic weathering properties of Foamalite PVC sheet are very good, however, by tailoring the formula to include strong light stabilisers; the weatherability of the product can be further enhanced. It is advisable to state whether the product is to be used for exterior applications since the factors that determine the performance of the materials are multi-fold and are often interdependent. Our technical staff can advise on the appropriate grade required. Specific care should be taken with coloured sheets for exterior applications with respect to light fastness. It should be noted that even in normal European climatic conditions, a wide variety of temperature and light radiation levels could be observed.

Summary:

The use of coloured PVC foam sheet in areas where exposure to UV light is expected should be avoided if possible. Short-term exposure should not cause noticeable changes to colour but consideration should be given to the choice of colour. Wherever possible do not use Dark colours.

6.2 Surface Temperature

Even at relative moderate air temperatures of between 25° C and 35° C, PVC material exposed to direct sunlight can, depending on the colour and duration, reach surface temperature that would adversely affect the Free Foam PVC sheet causing buckling. The maximum, in service, surface temperature for Foamalite products is 60° C. For exterior use, lighter colours, or darker sheets predominantly covered with light coloured laminates, paints or inks are best suited. Applications using extensive darker coloured panels, or panels with dark coloured laminates, paints or inks, when exposed to sunlight may achieve undesirably high temperature.

If used behind glass, ensure adequate spacing is left between the Free Foam PVC sheet and the glass, to enable ventilation between them. In internal applications, ensure Free Foam PVC sheets are not positioned close to heat sources.



6.3 Chemical Resistance

Foamalite sheets have excellent chemical resistance imparted by the inherent nature of the base PVC polymer. The general chemical resistance of PVC can be summarised as follows:

- Resistant to salt solutions
- Resistant to most alkali solutions
- Resistant to most acid solutions
- Resistant to most alcohols, petrol, oils, fats



PVC is not resistant, in varying degrees, to organic chemicals containing Nitro and Chlorine groups, aromatic hydrocarbons, ketones, some ethers and aromatic amino compounds.

6.4 Wind Loading

Most panels mounted outside a building will be subject to wind loading. If a panel is mounted flat on a wall, it will primarily experience positive wind loading forces, pushing it against the wall. However, if edge mounted in a frame, they will be subjected to wind pressure from both sides. When designing an external application, wind loads should be estimated and provision made for secure means of fixing.

6.5 Precipitation

All panels in external situations will be subject to precipitation in the form of rain, sleet, snow and hail. Foamalite Free Foam PVC panels do not absorb moisture from precipitation and will not degrade or deteriorate in the presence of moisture. Hail storms may cause damage through impact of large hail stones on cold panels.



7 Safety & Toxicity

7.1 Safety

PVC in the form of a sheet is physiologically and chemically inert. Foamalite PVC sheet requires no special safety handling precautions during subsequent machining/fabrication operations. However, normal safe working practices such as dust masks & fume extraction, machine guarding, solvent handling, lifting devices, etc. should be adhered to. PVC contains no products likely to give rise to health and safety concerns. In fabrication areas where the product is sawn or otherwise machined there is a possibility of dust generation. Such dust does not present a specific health hazard but good housekeeping with regard to dust collection and control should always be exercised.

7.2 Non-Toxicity

The Foamalite sheet range has been carefully formulated by selecting appropriate additives for non-toxic applications. Although PVC as a material requires no special precautions, the monomer (VCM) has a threshold limit value (TLV) of 3 parts per million (ppm).

All sources of PVC used by Foamalite are certified to be less than 1 ppm and thus well below the international agreed level. The heat stabiliser additive is based on tin, which is also recommended for non-toxic applications.

The chlorine content of Foamalite PVC means that it is difficult to ignite and will self-extinguish when the flame is removed. The material will conform to Class 1y of BS 476: Part 7: 1987 for surface spread of flame. PVC raw material is flame resistant. Rigid PVC is flammable with difficulty.

In the case of fire involving Free Foam PVC materials, water, foam and carbon dioxide extinguishers may be used.





8 Cleaning & Maintenance

8.1 Cleaning & Maintenance

It is essential that all panels are kept perfectly clean prior to use. Film protection is applied to most products to help maintain surface cleanliness and should be retained until the latest possible stage in processing. Prior to processing, eg. adhesive bonding and printing, the user must satisfy him/herself by trial that the qualities of the selected product is appropriate for the intended use and whether any additional surface cleaning or preparation is required prior to processing.

Foamalite sheets are durable, virtually maintenance-free and easily cleaned. Lightly soiled sheets can be cleaned with water and solvent-free, non scouring and non-abrasive liquids. If necessary, warm water, soapy solutions and dilute disinfectants may also be used, however hot water or steam cleaning techniques are not recommended as some distortion may occur.

Heavily soiled sheets can be carefully cleaned using methylated spirits, methyl alcohol and petroleum ether solvents. Normal precautions should be taken when handling solvents (flammability, ventilation etc.). For relatively large surfaces, soak a soft cloth with cleaner, wipe the soiled surface and allow to dry naturally-do not rub off.

Foamalite PVC sheet like most thermoplastic-based materials offers good electrical insulation properties and as a result a static charge could develop during handling and/or cleaning processes. The sheet can be treated with anti-static cleaners or ionisation equipment to minimise this effect. Foamalite do provide an anti-static product for specific applications such as screen printing, if required, however it should be noted that this type of treatment is generally not permanent.





9 Printing & Painting

9.1 Screen Printing



The Foamalite range is suitable for printing using vinyl compatible printing inks. Screen-printing provides excellent results and is widely used. The surface to be printed, as with any other material, must be clean and free of grease. It is generally advisable to use predominantly light coloured sheet outdoors. Dark colours should be avoided if possible as they, as with any dark coloured object, may absorb considerable solar radiation. As a result they may discolour and suffer degradation and/or distortion.

9.2 Painting

Foamalite sheets can be painted. This provides an easy means of colouring and the possibility of different surface finishes (such as matt, satin, stippled etc.). After preparation of the Foamalite surface, conventional paint systems (PVC, Acrylate, PU) can be applied using common applications techniques (brush, roller, spray gun etc.). Some solvent based paints should be approached with caution as they may not be compatible with the substrate and it is advisable to consult the paint supplier for advice prior to application.

Sheets used outdoors (e.g. signs) should have a light surface (white, light grey etc.). Large surface, dark coloured signs should not be used, as they, like any dark-coloured object, absorb considerable solar-radiation and as a result may be damaged.



9.3 Digital Printing

This new technology has brought specific demands in terms of product performance and quality, which have to be considered as demanding.

As standard Foamalite products are produced to the highest technical and aesthetic quality using state of the art equipment and processing techniques.

Whilst all Foamalite sheet products have as standard quality levels in all areas that will allow them to be printed we have available an enhanced range of super smooth products under the Foamalite range.



These materials are packaged specifically for use through the digital printing process and go through specific and regimented processing systems to ensure the highest overall product quality prior to use:

- No direct 'human' contact in factory so material is grease free.
- If requested, no protective film is applied to minimise static build up.
- Packaged direct from the extrusion line into protective packaging.
- Packaging sealed to minimise dust incursion.

For continued processing the following handling instructions may be helpful:

- Always wear protective gloves.
- Keep boxes sealed when material not in use.
- Remove each sheet immediately prior to printing.
- Wipe surface clean only if debris is considered as being present.



Foamalite is considered as being suitable for both UV and solvent based inks.

Every effort has been made by Foamalite Plastics to ensure the continued highest quality products are available to support this new and developing area of processing technology. It is then vital that when processing PVCUe sheet materials through this process that every effort is made to ensure the ongoing cleanliness and surface quality of the material at all times.

Foamalite will not accept any liability for materials not handling according with the above guidelines.



10 Fabrication Techniques

10.1 Fabrication

Foamalite sheets can be easily machined using traditional wood and metal working machines. However it should be noted that PVC being a thermoplastic is sensitive to heat build-up. If excessive it can result in deformation, softening and surface deterioration or discolouration of the sheet substrate. It should be noted that Foamalite products might vary in performance in certain applications so tests should be carried out prior to use to establish the most suitable product. In general, slow feed rates with highspeed cutters are preferred, combined with effective removal of the waste swarf.

10.2 Cutting

Thin Foamalite sheets (less than 3 mm) can be cut using a blade or Stanley knife. Thicker sheets can be cut using conventional techniques including hand, circular, band and jigsaws. A fine-toothed blade is recommended for best results and tipped blades may also be used.

10.3 Milling & Routing

Both techniques are suitable for PVC sheets using single or twin edged cutting tools. Depth milling of Free Foam sheets will remove the smooth surface finish to reveal a matt closed cell structure.

10.4 Drilling

Foamalite sheets may be drilled using standard twist drills for metal. A twist drill with 30° angle of rifling offers the best machining results. The point angle should be between 80° and 110° with a clearance angle of 10°. Cutting rates depend on the size and depth of hole to be drilled.

10.5 Grinding

Foamalite sheets can be machined with belt or disc grinding machines using 80-150 grit abrasives. The smooth skin layer formed during the extrusion process may be removed to reveal the foam structure (Foamalite F & C products).

10.6 Manual Cutting, Shearing and Stamping

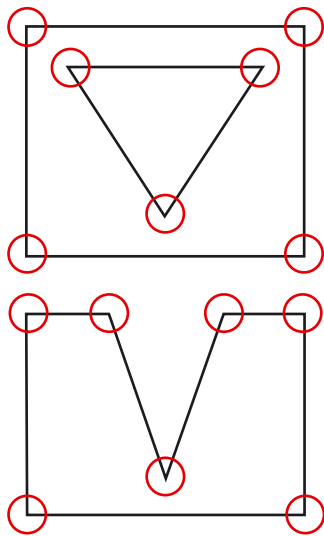
Foamalite sheet can be manipulated using these techniques, but are generally limited to thin board (up to 3 mm) and deformation of the cut edges may be observed. The material temperature should be approximately 20-30° C to obtain the best edge finish.



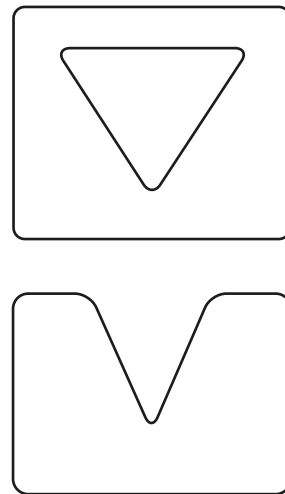
10.7 Component Geometry

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. Component shapes should exclude such features. 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 a half times the sheet thickness.



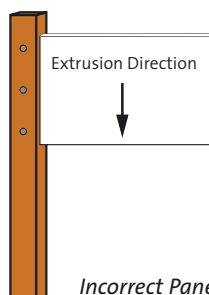
Poor geometry - sharp corners, deep notches, thin sections.



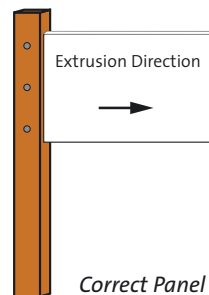
Good geometry - smooth corners and contours, thick sections.

10.8 Panel Orientation

Extruded materials generally have fractionally greater flexural strength, and therefore resistance to bending, in the direction of extrusion. The protective film has the brand running across the direction of extrusion, providing ease of identification for correct cutting of panel. This is important for applications where panels are only supported on one or two side and are exposed to stresses such as wind loading.



Incorrect Panel Orientation



Correct Panel Orientation

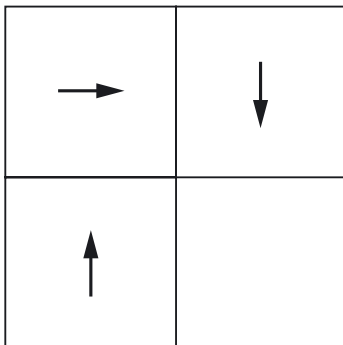


10.9 Colour Panel Orientation

Due to the extrusion process, the refractive index of panel viewed in the line of extrusion can vary to that viewed across the line of extrusion. This effects of this are most prevalent on darker colour panels.

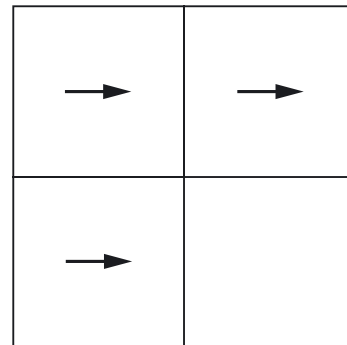
When using multiple panels together, it is vital that they are assembled in the same orientation to avoid colour variations.

Incorrect Panel Orientation



Arrows denotes extrusion direction

Correct Panel Orientation



Arrows denotes extrusion direction

10.10 Forming & Shaping

PVC is an amorphous thermoplastic that undergoes elastic and/or plastic deformations depending on the temperature the material is subjected to (The glass transition temperature (T_g) of PVC is approximately 80°C). In fact, PVC has a broad elastic processing window ($115\text{--}135^\circ\text{C}$) and a number of techniques are commonly used to shape PVC sheet in this softened elastic state. Care should be taken when applying localised heating to avoid overheating that could result in permanent deformation or material degradation. Excessive temperatures and the application of pressure may result in cell collapse for free foam structures.

10.11 Line Bending/Folding

Foamalite sheet can be folded to almost any angle by localised heating of the proposed fold, deformation either manually or automatically and cooling below the minimum softening temperature. Sharp fold angles can be obtained by machining a 'V' groove in the reverse side of the material at the fold position.



The following heating techniques are used in practice:

- Electrical Heaters (IR or ceramic, metal, quartz radiant type)
 - Up to 10 mm sheet by heating one side
 - Heating time approximately 1 minute per mm of sheet thickness
 - Heating time halved by double sided heating
 - This technique is known as a hot line bender
- Electrically Heated Metal Tracks
 - Metal tracks maintained at a temperature of 140-160° C
 - Up to 4 mm sheet by heating one side, > 5 mm is heated on both sides
 - Heating time approximately 50 to 60 seconds per mm of sheet thickness
- Controlled Hot Air Blower
 - Localised heating source used for mobile assembly work
- Hot Air Welding Guns
 - Used for small areas of sheet to be folded

10.12 Forming

Free Foam PVC is a thermoplastic material that has an elastic state and therefore formable at material temperatures in the range of 115-135° C. The panel to be shaped or formed requires even heat 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.

Typical heat sources can be hot air blowers, hot gas welders, hot air circulation ovens and infra-red panel heater. All heat sources must have controls which enable good regulation of their temperature and that of the Foamalite panel. Heating of one side will usually be enough for sheets up to 3mm thick, above this thickness heat should be applied to both side, reducing heating times and the possibility of surface damage. Using radiant heat, a heating time of 20 seconds for 1mm of sheet thickness and using a heating oven, a heating time of 40 seconds for each 1mm thickness of sheet are reasonable starting points from which to develop.

Some experimentation will always be required to obtain optimum temperature for forming, these being a function of sheet thickness and the specific forming operation, sheet colour and atmospheric conditions also have some influence. 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.

As Free Foam PVC are cellular materials they are not suitable for forming operations which involve excessive stretching in the elastic state. This will cause rupture of the cells and blemishing of the external surface.



10.13 Thermoforming

Air-pressure forming is possible at about 130° C and pressure of about 2 bar and vacuum forming at about 170° C. As the material has relatively low density, heating and cooling cycles are faster than with solid thermoplastics.

Best results are achievable from machines which control heat on both sides of the panel. Large area panels and thick panels need some air pressure support during heating to avoid sag. Prior conditioning, by suspending in an air circulated oven at about 130° C, removes inherent stresses.



Example of a thermoformed PVC foam

10.14 Welding

Foamalite sheets can be fabricated using conventional techniques applicable to solid PVC welding and using standard PVC filler rods. Typical bond strength ratios of 50-90% (cf mechanical properties of sheet) can be achieved.

As with all solid welding methods, the preparation of the surfaces is critical in terms of cleanliness and the final bond strength obtained is dependant upon various factors such as: weld type and geometry, heating temperature and time, homogeneous distribution of heat, operator skill level, etc.

10.14.1 Hot Gas Welding

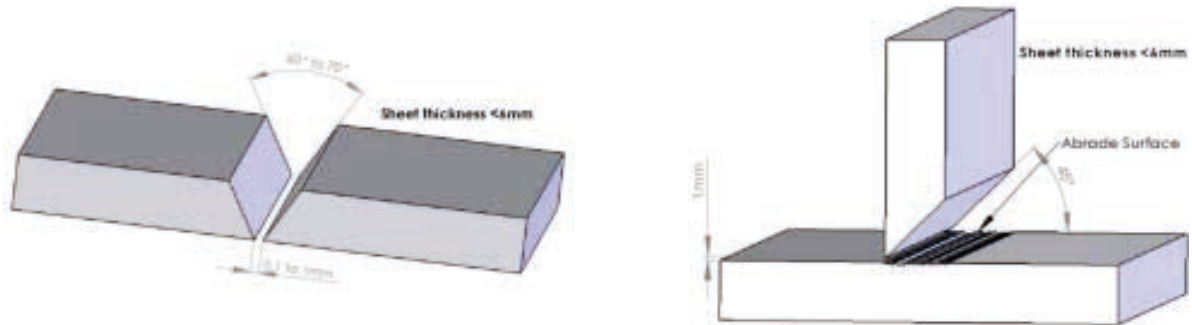
The prepared surfaces are heated using a hot air gun (270-300° C) with an appropriate nozzle. A filler rod is pressed with even constant pressure into the welding joint, material diffusion occurs between the two substrates and then the weld is allowed to cool until solidified. High speed welding guns that incorporate the automatic feeding of filler rod can also be used.

Below is typical welding joints and the panel preparation required:

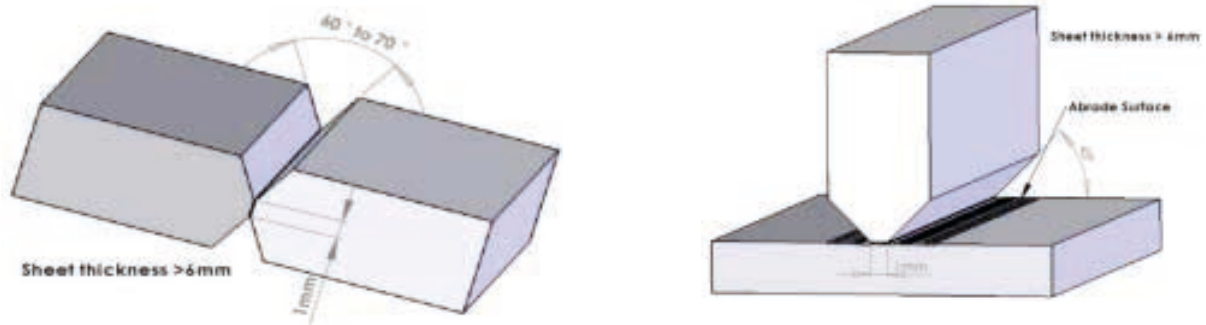




Welding for sheets less than 6mm



Welding for sheets greater than 6mm



10.14.2 Butt Welding: Hot Plate Method

Foamalite sheets over 3 mm can be welded using a hot plate. The two edges to be joined make contact with the heated tool until sufficiently softened. The tool then retracts and the butt edges joined under constant pressure until adequately cooled.

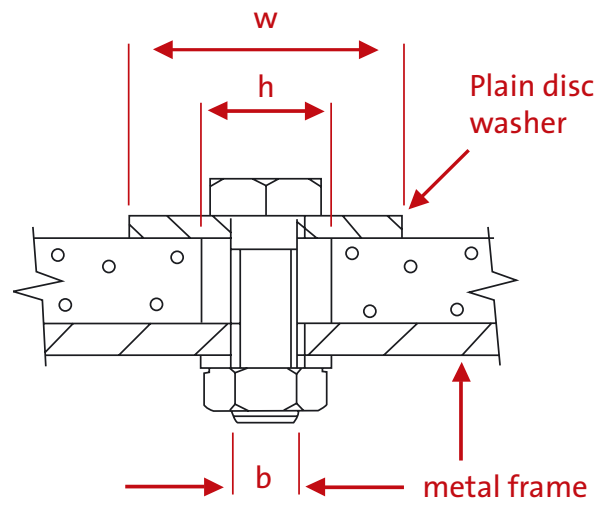
10.14.3 Mechanical Fastening

Panels can be fixed to supporting structures using screws or rivets. 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. Rivets can be used with small panels or in internal applications where there is little thermal movement since temperature differentials are small.

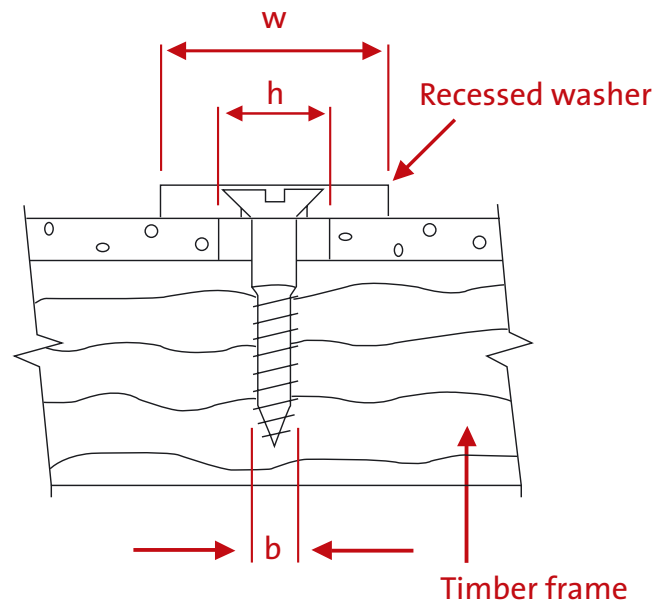
In all cases holes must be predrilled oversize through the panel to accommodate thermal movement. This in turn necessitates the use of an oversize washer on the fastener to provide adequate retention of the sheet and spread the load. Countersunk screws must never be used without a recessed washer (for details of hole, slot and washer size, see detail overleaf). Self tapping screws can be used to mount lightweight items to panels thicker than 6mm.



10.14.4 Bolt Fixing



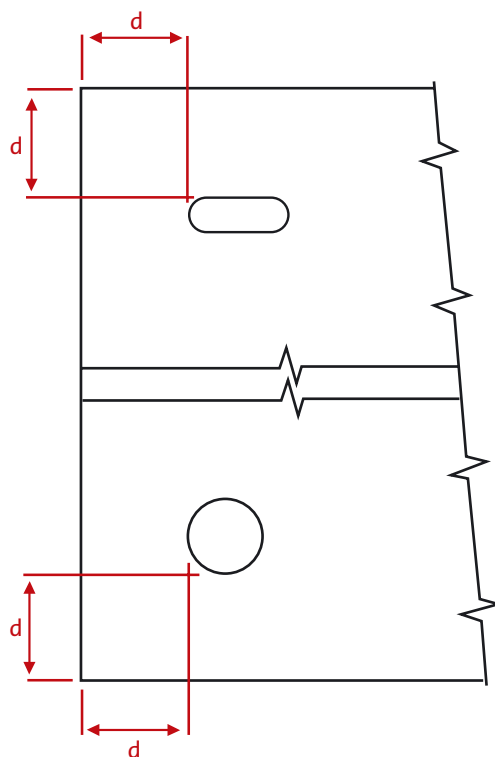
10.14.5 Wood Screw Fixing



w - washer diameter
 h - hole diameter
 b - fixing shank diameter



Holes or slots in a panel to accommodate fasteners should always be at least 25mm from the panel edge.



$d = 25\text{mm}$ minimum

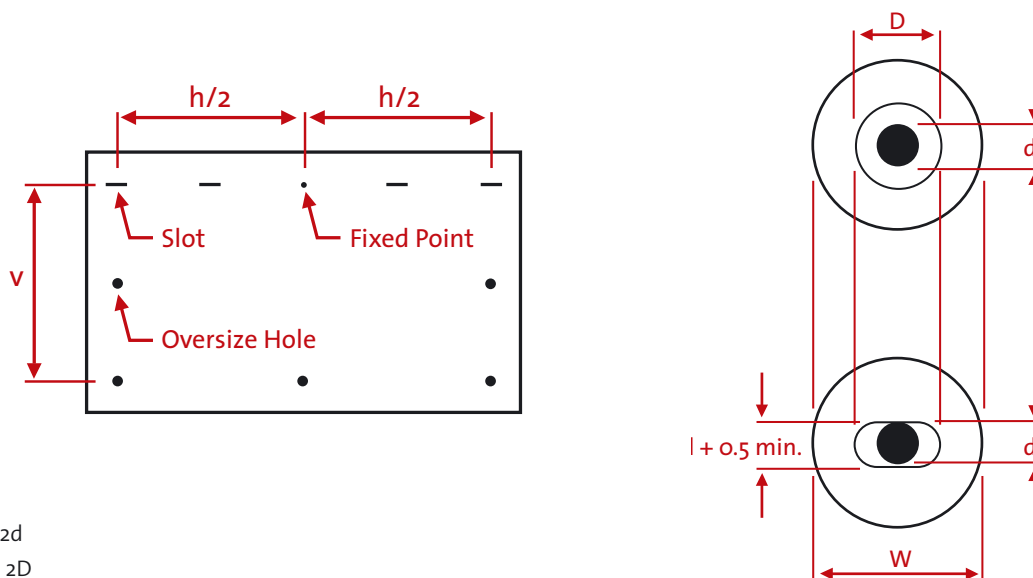
When fixing a PVC foam sheet the maximum spacing between screws that should be used as detailed in the table below.

Thickness	Fastener Spacing (mm)
1mm	100-150
2mm	150-250
3mm	250-300
4mm	350-500
5mm	500
6mm	500
8mm	500
10mm	500



10.14.6 Hole, Slot and Washer Sizes

The following table gives minimum hole diameter and slot lengths, 'D' and corresponding washer diameters, 'W', to be used for panel dimension 'v' or 'h', assuming screw diameter 'd' and using a maximum temperature differential of 60° C.



$$D \text{ (min.)} = 2d$$

$$W \text{ (min.)} = 2D$$

v,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

For more information on thermal expansion, please refer to section 11.



10.15 Bonding

Adhesives can be used to permanently or temporarily bond Foamalite sheet to like or dissimilar substrates. The surfaces to be bonded should be cleaned and if necessary degreased. Appropriate adhesives systems can be listed as follows:

- Solvent or Cement systems: Solutions of PVC in Tetrahydrofuran (THF), dimethyl formamide, methylene chloride etc. containing 10-25% solid content.
- Reaction adhesives: One and Two part systems (Polyurethane or Epoxy systems).
- Contact adhesives using synthetic rubbers (such as Neoprene based systems).
- Adhesives films.
- Pressure sensitive adhesive tape.

Foamalite sheets can be manipulated using any of the above fixing methods. Like most thermoplastic materials, the influence of thermal expansion must be taken into account. To ensure that dimensional changes relative to ambient temperature are calculated at the fixing stage. (*Refer to section 11.0 Coefficient of Thermal Expansion*).



11 Coefficient of Thermal Expansion

11.1 Coefficient of Thermal Expansion

Like all materials, Foamalite sheets are subject to a change in dimensions with changing ambient temperatures. This characteristic can be quantified by determining the linear coefficient of expansion (α), which considers the linear increase of a material per increase in temperature. The following table lists values for common materials used for the construction industry:

Linear Coefficient of Thermal Expansion Data

Material	α Value (m/mK)	α Value (mm/m/K)
Aluminium	23.8×10^{-6}	0.0238
Concrete	12.0×10^{-6}	0.011
Brass	18.5×10^{-6}	0.0185
Steel	12.0×10^{-6}	0.0115
Timber	40.0×10^{-6}	0.04
Quartz Glass	$.5 \times 10^{-6}$	0.0005
Polymeric Materials	$40-200 \times 10^{-6}$	0.040-0.200
Acrylic	75.0×10^{-6}	0.075
Foamlite F Sheet	50×10^{-6}	0.05
Foamlite C Sheet	52×10^{-6}	0.052
Foamlite S Sheet	52×10^{-6}	0.052

A change in linear length (ΔL) can be calculated using the following equation:

$$\Delta L = L \times \Delta t \times \alpha \quad \text{where} \quad \Delta t = t_{\max} - t_{\min}$$

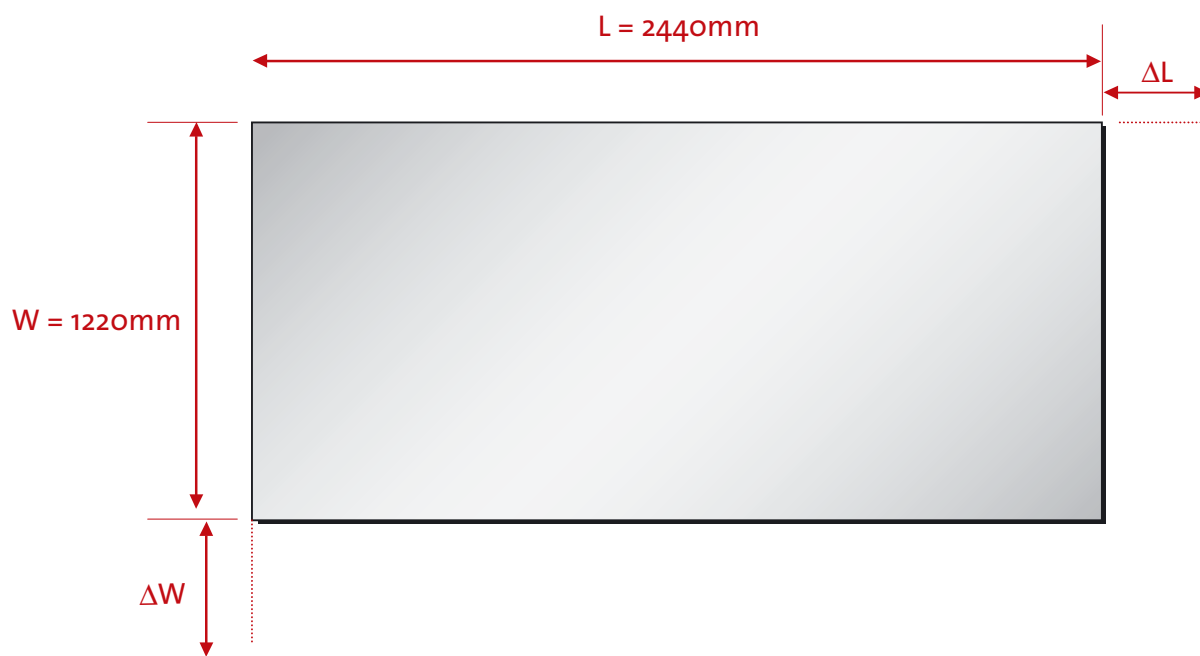
Symbols

ΔL	=	Linear change in length (m)
L	=	Original length (m)
Δt	=	Change in temperature (K)
α	=	Linear Coefficient of thermal expansion (m/m/K)
t_{\max}	=	Maximum temperature of sheet (K)
t_{\min}	=	Minimum temperature of sheet (K)

A possible linear change in length should be considered during installation to prevent the introduction of stresses in the mounted sheet. Excessive stresses can lead to deformation (warping) and even cracking. Even in a European climate, a considerable change in ambient temperatures can be observed (-20 to 50° C) and the maximum ambient temperature can be further increased if direct sunlight effects are relevant. The technical staff at Foamalite would be pleased to provide assistance on a case-to-case situation.



The practical implications of thermal expansion can be highlighted in the following example showing the increase in sheet length with increasing temperature:



Foamalite F Sheet @ 20° C

Sheet Temperature (°C)	Dimensional Change (mm)	
	ΔL	ΔW
0	-2.44	-1.22
10	-1.22	-0.61
20	0	0
30	+1.22	+0.61
40	+2.44	+1.22
50	+3.66	+1.83

The value taken for Δ is an approximate value and is not truly constant with temperature for thermoplastics. The fixing technique must allow for the effects of thermal expansion/constriction by estimating the change in dimensions over the anticipated service temperature. It should be noted that Foamalite products may vary in performance in certain applications so tests should be carried out prior to use to establish the most suitable product.



12 Environmental Policy



March 2007

Foamalite Ltd is committed to ensuring that high standards of environmental performance are maintained at all times by both the company and its employees. The company will endeavour to continue to operate in such a way as to reduce any adverse effects on the environment arising from its activities, to a minimum and to consider the environment and the well being of future generations in all company policy decisions.

The company have developed and continue to implement activities to increase efficiency of energy in the processing of raw materials and reduce emissions to earth air and water, wherever practicable.

The company have designed its products to meet society's standards for the protection of health and the natural environment and, to this end, it is the policy of the company to continually develop and refine systems of planning, organisation and control to strive for improvements in plant and technology.

The company promotes and encourages the correct use of its products to minimise pollution and increase recycling. Currently 80% of the processing waste is recycled and we are targeting a recycle rate of 95% by 2010.

Furthermore the company accepts that all employees have a responsibility for minimising harm to the environment and will continue a process of continuous education and development, allied to systematic training and information, to improve employee awareness of environmental principles.

J. Reilly
Director