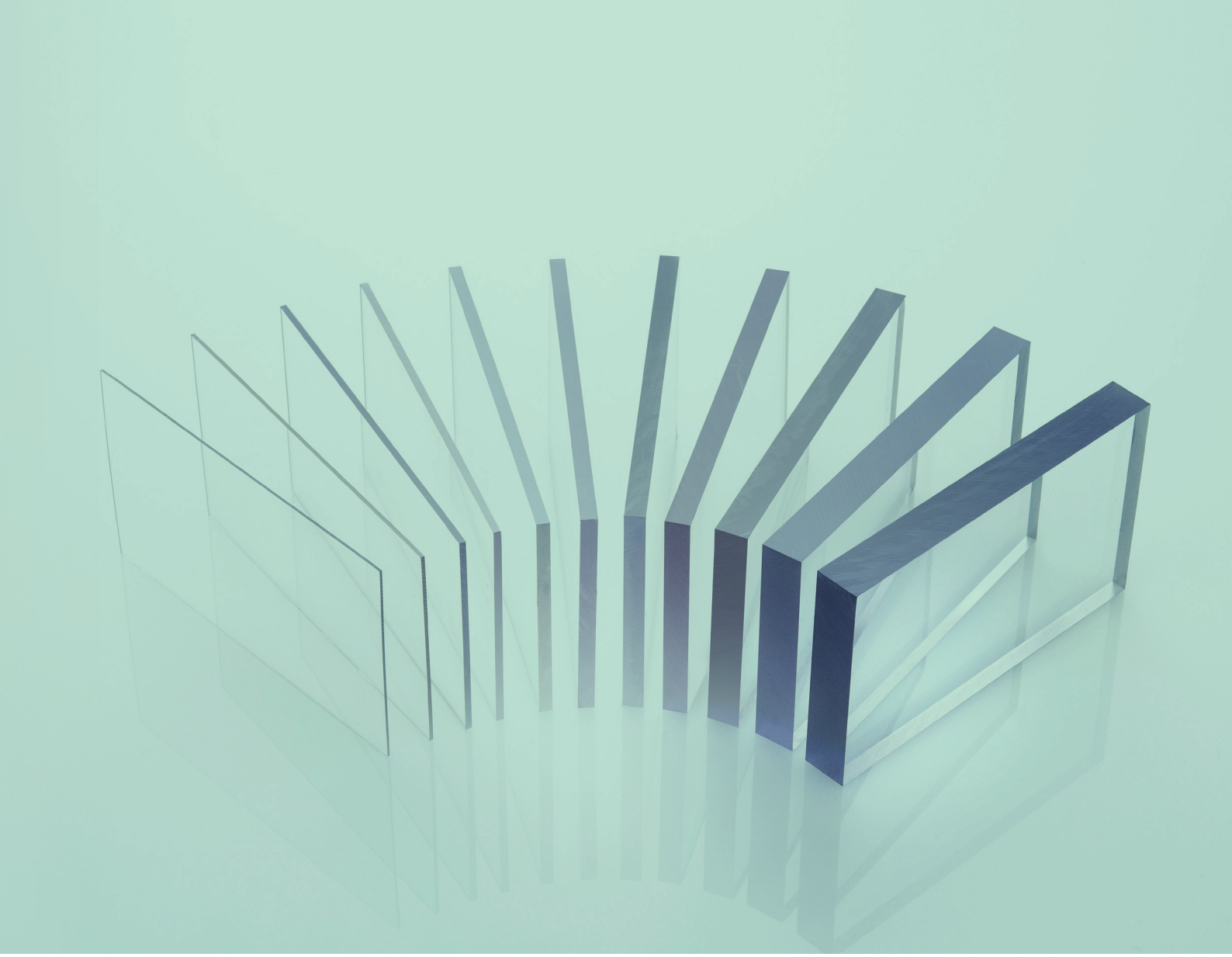


Technical Guide

Marpet

Brett Martin

Marpet-a FS | Marpet-g FS

Products that work

Brett Martin is a privately owned world class industry leader and manufacturer of specialist plastic products for the construction, fabrication, signage 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 Calibre calibrated foam PVC sheet range. 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 Marpet-a FS aPEt and Marpet-g FS PETg sheets to determine each material's suitability for their own particular use.

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.

Brett Martin

Contents

Marpet

Brett Martin's Marpet FS PET sheet range includes Marpet-a FS and Marpet-g FS, high-quality, extruded, solid polyester sheets. Each material option possesses individual properties and performance capabilities which determine its suitability for a variety of end use applications.

Marpet-a FS aPET

Marpet-a FS is high-quality, extruded, solid plastic sheet made of amorphous polyethylene terephthalate (aPET). No other plastic sheet offers its unique combination of mechanical, thermal and chemical properties. Combining exceptional quality, excellent transparency, impact strength, chemical resistance and fire performance, Marpet-a FS is ideal for applications which require its high performance characteristics and processability.

Its ability to cost effectively machine, cold bend and print lends Marpet-a FS particularly well to fabrication of items for the visual communications sector including point of purchase display stands, poster glazing and illuminated signage. Marpet-a FS may be thermoformed and hot line bent within a controlled temperature range to avoid crystallisation. Due to its superior strength and resistance to breakage Marpet-a FS is also equally suitable for safety equipment such as machine guards and visors. Its innovative combination of mechanical, thermal and chemical properties make Marpet-a FS a material that meets the highest demands in a wide range of flat and cold bent applications.

- Excellent optical clarity and light transmission
- Superior chemical resistance against cleaning agents, mineral oils and solvents
- High impact strength and resistance to breakage even at sub-zero temperatures
- Good scratch and scuff resistance
- Temperature range -20°C to + 60°C
- Suitable for cold bending
- Can be thermoformed and hot line bent within a controlled temperature range
- Excellent fire performance
- 100% recyclable
- Available with anti-reflective finish

Marpet-g FS PETg

Marpet-g FS is a clear transparent thermoplastic (polyethylene terephthalate glycol) polyester flat sheet that offers excellent strength to weight ratio, outstanding optical clarity, superior chemical resistance, durability, good fire performance and is 100% recyclable. A key benefit of this material is its processability for fabrication. It is easy to shape and form into complex designs. Marpet-g FS provides an exceptional surface for screen and digital printing, and, the adhesion of secondary graphics.

These properties make Marpet-g FS the ideal product for a wide range of sign & display applications including point of sale equipment, signage, illuminated advertising signs, displays and graphic arts and is suitable for protective glazing applications including vending machines, interior safety glazing and office partition screens.

- Optically clear sheet with excellent light transmission
- Good impact strength
- No pre-drying before thermoforming
- Excellent thermoforming properties
- Exceptionally printability
- Reduced process time
- Chemical resistance
- Easily machined and fabricated
- Temperature range -20°C to + 60°C
- Excellent fire performance
- 100% Recyclable
- Available in Eco option containing at least 50% reclaimed material

Standard sheet sizes

Sheet Sizes	Thickness	Colour
Marpet-a FS aPET		
1250 x 2050mm	0.5, 0.75, 1, 1.5 & 2mm	Clear
1250 x 2500mm	0.5, 0.75, 1, 1.5 & 2mm	Clear
Marpet-g FS PETg		
1250 x 2050mm	0.5, 0.75, 1, 1.5 & 1.8mm	Clear
1250 x 2500mm	0.5, 0.75, 1, 1.5 & 1.8mm	Clear
2500 x 1250mm	2, 3, 4, 5, 6, 8, 10, 12 & 15mm*	Clear
2050 x 3050mm	2, 3, 4, 5, 6, 8, 10, 12 & 15mm*	Clear
Marpet-g FS Eco**		
1250 x 2050mm	0.5, 0.75, 1, 1.5 & 2 mm	Clear
2050 x 3050mm	2 & 3 mm	Clear

* Minimum order quantities may apply.
** Limited availability only.
Special options are available, subject to request.

Application Areas

Design Versatility

The Marpet FS PET range offers a choice of Marpet-a aPET and Marpet-g FS PETg clear transparent flat sheets. Each material offers distinct and unique properties which increase its suitability for specific end use applications.

Product	Markets	Application	Key features
Marpet-a FS aPET	• Signage and display • Automotive • Transportation • Furniture • Industrial Manufacturing • Equipment, Sports, Leisure & Consumer Goods • Building & construction	• Document & poster holders, Display cabinets, Display shelving, Poster covers, Flat signs, Illuminated advertising, Price tags • Machinery guards and glazing, Industrial glazing, fume cupboards, Industrial trays • Advertising signs, Internal partitions and ceilings, DIY	• Cold-curving • Chemical resistance • High impact resistance
Marpet-g FS PETg	• Building & construction • Signage and display • Industrial • Furniture • Transportation • Manufacturing Equipment	• Interior design - partitions, furniture, lighting elements • Displays - hotels, stores, industry, offices, exhibition, 3D POS items, booths - walls, ceilings, floors, counters, pillars, • Store fixtures - modular concepts,individual solutions • Flat signs, formed signs, • Machine guards, safety glazing (interior), vending machines, indoor glazing, medical equipment, bicycle helmets, dispensers • Refrigerators and cold storeroom equipment	• Flat and arched applications • Freedom of design, vacuum forming, transparency & colour uniformity • Easy digital and screen print, print finish • No pre-drying for thermoforming

Specification & Performance

Material Properties

Property		Test Method	Marpet-a FS (aPET)	Marpet-g FS (PETg)
Physical	Density	ISO 1183-1	1.33g/cm3	1.27g/cm3
	Moisture absorption (24 hrs @ 23°C)	ISO 62-4	<0.2% by weight	<0.2% by weight
	Smell		Odourless	Odourless
	Water solubility	DIN 53122	Insoluble	Insoluble
Mechanical	Tensile Strength at Yield	ISO 527	≥50MPa	≥50MPa
	Flexural Strength	ISO 178	86MPa	80MPa
	Modulus of elasticity	ISO 527	2420MPa	2100MPa
	Elongation at break	ISO 527	No breakage	No breakage
	Rockwell Hardness (R-Scale)		111R	115R
	Impact resistance (Charpy test, un-notched)	ISO 179	No breakage	No breakage
	Ball pressure hardness		117MPa	
Optical	Refractive Index	ASTM D-542	1.578	1.570
	Light transmission	ISO 13468-1	89% at 1.5mm	88% at 3mm
Thermal	Vicat Softening Temperature	ISO 306 (B)	75°C	82°C
	Thermal conductivity, K	DIN 52612	0.25 W/m°C	0.2 W/m°C
	Heat deflection temperature (1.8MPa)	ISO 75-2		68°C
	Heat deflection temperature (0.45MPa)	ISO 75-2	≥60°C	72°C
	Thermal expansion coefficient	ISO 75-2	0.06mm/m°C	0.068mm/m°C
	Service Temperature Range		-20 to +60°C	-20 to +60°C
	Volume resistivity	IEC 60093	10^{15} Ωcm	10^{15} Ωcm
	Dielectric constant (1kHz)	IEC 60250	3.4	2.60
	Surface Resistivity	IEC 60093	10^{16} Ω	10^{16} Ω

Mechanical Properties

The mechanical behaviour of Marpet FS PET is characterised especially by its modulus of elasticity and impact resistance.

The modulus of elasticity is a measure of the rigidity or elasticity of a material. It denotes the relationship between the force exerted on the sheet in the tensile test and the resulting elasticity. The modulus of elasticity depends on the test conditions and temperature.

At room temperature elastic modulus is around 2400 MPa for Marpet-a FS and 2100MPa for Marpet-g FS.

Materials with a higher modulus of elasticity (> 2800 MPa) such as unmodified acrylic or quartz glass are more brittle – at higher stressing they break more easily. Those with a low modulus of elasticity (> 1800 MPa) become soft and easy to shape. Marpet-a FS and Marpet-g FS possess a modulus of elasticity that permits withstanding of sudden impacts.

Marpet-a FS and Marpet-g FS exhibit no fractures in the flexural impact test (Charpy) and are highly impact resistant.

Minimal bending radius = 150 x sheet thickness

Mechanical Properties

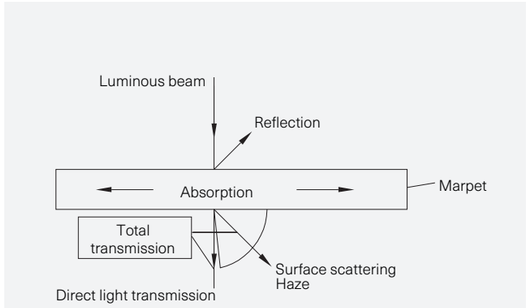


Fig. 1: Light diffusion

	Method	Marpet-a FS	Marpet-g FS	Unit
Reflective index nD at 589 mm (3mm sheet)	DIN 53491	1.578	1.570	-
Transmission (3mm sheet)	ISO 13468-1	86	88	%
Haze (3mm sheet)	ASTM 1003	<1	<1	%

Optical Characteristics

Transmission and haze to ASTM D 1003.

Light transmission, haze and clarity are interconnected terms. They can be classified under the collective term “transparency”.

Impinging rays of light are divided into reflected, absorbed, deflected (scattered) and penetrating rays. The light that penetrates the sheet is called total transmission. It is divided into direct light transmission and glaze.

The total transmission is the relationship of the total transmitted light to the incident light quality; it is reduced through absorption and reflection. The haze is the percentage part of the transmitted light that is scattered from the luminous beam on average by more than 2.5°.

Chemical resistance

Chemicals can affect the strength, flexibility, surface appearance, colour, dimensions or weight of plastics. The basic modes of interaction which cause these changes are:

- Chemical attack on the polymer chain, with resultant reduction in physical properties
- Physical change, including absorption of solvents, resulting in softening and swelling of the plastic;
- Stress cracking from the interaction of an incompatible chemical.

Other factors affecting chemical resistance include pressure and internal or external stresses, length of exposure, temperature and concentration of the chemical.

Marpet-a FS aPET
Marpet-a FS aPET sheet is characterised by its high stress cracking resistance. Because of its very good chemical resistance, Marpet-a FS can be installed with all standard sealing strips and materials, e.g. APTK (EPDM), TPE, silicone joint filler, butyl adhesive tapes and soft PVC tapes.

Marpet-a FS sheet is resistant to most acids, salts, alcohols, hydrocarbons and solvents, and is especially resistant to cleaning agents and glass cleaners containing alcohol. Environmental influences such as acid rain, soot and diesel fumes, salt-containing air and seawater do not affect Marpet-a FS.

Even graffiti can be removed from Marpet-a FS by using e.g. acetone-free and benzene-free solvent cleaners or diluting agents. Its optical and mechanical properties are not impaired.

Marpet-g FS PETg
Marpet-g FS PETg sheet has satisfactory resistance to mineral and vegetable oil, turpentine, detergents, alcohols: ethanol and methanol, petrol glycerine. Contact should be avoided with acetone, ammonia and toluene.

Mixing and/or dilution of certain chemicals may result in reactions that produce heat and can cause product failure. Pre-test your specific usage and always follow correct safety procedures. (See Appendix 1)

Fabrication

General guidance

Tools
Marpet-a FS and Marpet-g FS sheets may be machined using standard tools used for metal and woodworking. Carbide-tipped tools are recommended. It is important to use sharp cutting tools with the correct angles.

Cooling
Cooling is not necessary during the normal machining of Marpet-a FS and Marpet-g FS sheets. If overheating does occur during machining the area should be cooled with water or compressed air. The use of oil emulsions and cutting oils is not recommended as these may contain chemicals to which aPET and PETg are not resistant and could result in stress crack formation.

Dimensional accuracy
At 0.04 - 0.060 mm/mK Marpet-a FS and Marpet-g FS coefficient of linear expansion is significantly higher than for metal or glass. It is imperative that material dimensions are checked at room temperature. Shrinkage of around 3-6 % (dependant on thickness) will occur when the material is heated above the glass transition temperature (81°C) for the first time.

Protective film
Marpet FS PET sheets have a protective film on both sides to ensure that the smooth surfaces are not damaged during transport and machining. The surface of Marpet-a FS aPET sheet has a green film and a white film underside. The surface of Marpet-g FS PETg sheet has a blue film and a white film underside. The protective film should be left in place during machining.

Marking
Drill holes, cut edges and so on should be marked on the protective film using a soft pencil or felt-tip pen. Marking tools should not be used as the tracing mark has a notching effect, and a higher load at this point may cause the sheet to break.

Cutting and Punching

Marpet FS sheets up to 1.5 mm thick may be cut and punched. Generally the thicker the sheet, the poorer the quality of the cut and the greater the risk of cracking.

For best results use a sharp shearing tool with a wedge angle of max. 30°, with clearance between the tool and the cutting surface of 0.01 to 0.03 mm (see Figs. 2 & 3).

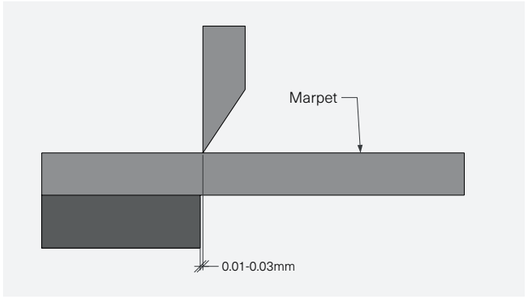


Fig. 2: Clean cut edges

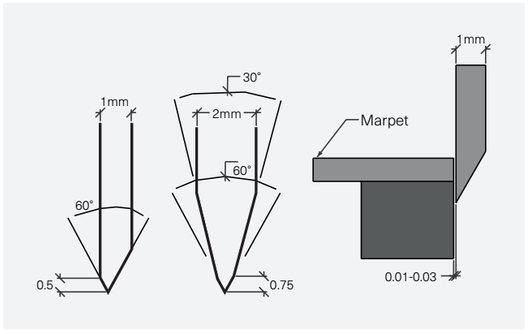


Fig. 3: Cutters for punching

For clean, smooth cut edges it is recommended to saw or mill Marpet-a FS and Marpet-g FS sheets >1.5mm in thickness. When punching close-tolerance holes make allowance for shrinkage if machining is to be followed by heat treatment of over 80 °C. The hole should be measured approx. 5 % larger than actually required. The bigger the hole and the thicker the sheet, the lower the tendency for the sheet to shrink. Good results are obtained using symmetrically bevelled shearing tools.

For punching/shearing Marpet-a FS and Marpet-g FS sheets that are more than 1.5 mm thick use an asymmetrically bevelled blade. To cut right angles, blades on one side bevelled with a wedge angle of 30° should be used. The back-up pad (polyamide or high density polyethylene) should be in place and centred with the punching tool to achieve clean cut edges.

Sawing

Hand saws
A standard hand saw with fine spacing between the teeth may be used to cut Marpet-a FS and Marpet-g FS sheets. When sawing by hand it is likewise better to use blades that are narrower and have more set.

Circular saws
A circular saw is the easiest way to cut Marpet-a FS and Marpet-g FS sheets. Carbide-tipped circular saw blades produce the cleanest cuts. The tooth pitch of the blade varies depending on sheet thickness (fine for thin sheets, too coarse for thicker materials). Remove swarf and shavings from the cutting surface to avoid potential damage to the protective film and sheets.

For sheets <1.5 mm use a thick underlay board or a pair of shears instead of a circular saw.

To cut curved or formed parts and irregular shapes use a band saw. Work on a solid cutting surface to achieve a clean cut edge. A blade with a wide tooth pitch is required when working with thicker sheets. For higher quality cut edges, circular saws or routers achieve a better result than band saws.

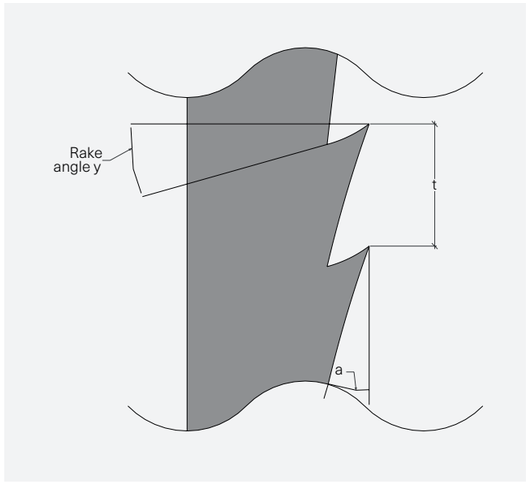


Fig. 4: Band Saw

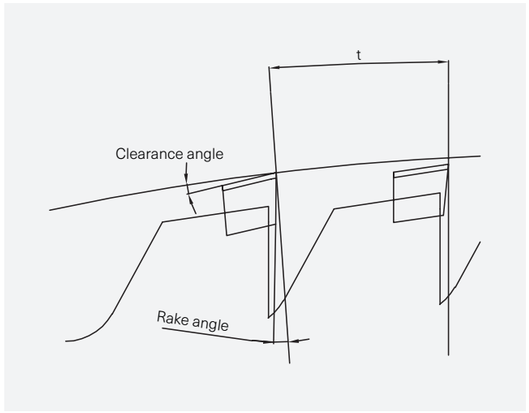


Fig. 5: Circular saw blade

Trouble-shooting

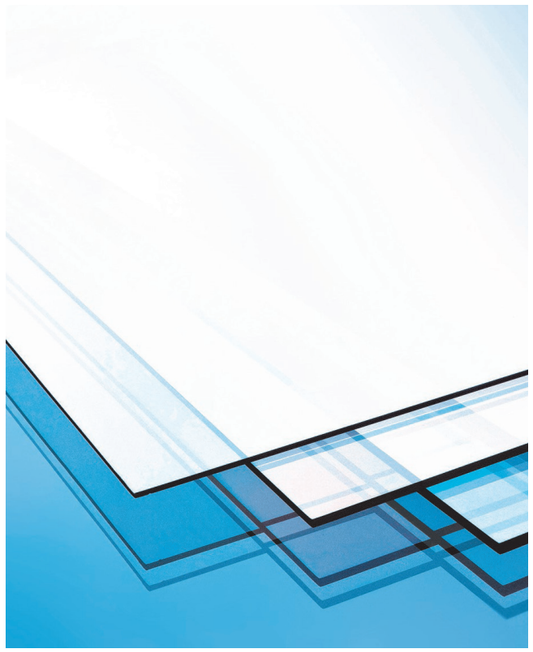
Fused cut edge:
- Check tool sharpness
- Check cutting speed and reduce if necessary
- Check rate of advance and reduce if necessary
- Cool if necessary

Notched cut edge:
- Check tool sharpness
- Check tool geometry
- Check cutting speed and increase if necessary
- Improve cutting surface (use an underlay if necessary)

Standard settings for sawing

	Band saw	Circular saw
Clearance Angle ‘a’	20 - 40°	0° - 15°
Rake angle ‘y’	0 - 5°	up to 31000rpm
Cutting speed (m/min)	600 - 1000	1000 - 3000
Tooth pitch ‘t’ (mm)	1.5 – 3.5	2 - 10

(see Figs. 4 & 5)



Fabrication

Drilling

Standard metal working drills are suitable for machining Marpet-a FS and Marpet-g FS. Ensure the drill bits are sharp. Cooling during drilling is generally not necessary. For large drilling depths use water or compressed air and/or regularly withdraw the drill from the hole to reduce heat and remove shavings.

Oil/water emulsions or cutting oils should not be used when drilling through Marpet-a FS and Marpet-g FS sheets. Standard circle-cutting equipment (e.g. circle cutters or compass saws) is suitable for large-scale drilling.

The drill holes should be smooth and as free as possible of notches or rough areas to ensure secure fastening.

Fig. 6: Drills for Marpet-a FS and Marpet-g FS sheets

Recommended angles for drilling (see Fig. 6):

Point angle	110° - 130°
Helix angle	19° - 40°
Cutting speed	30 - 60 m/min.
Feed	0.1 – 0.3 mm/Rev.

A distance of at least 2 times the diameter of the drill hole but minimum of 10mm should be allowed between the drill hole and the edge of the sheet.

Milling

Marpet-a FS and Marpet-g FS sheets are easy to process using milling machines. The choice of milling machine depends on the type of machining required. Ensure that your tool has good chip clearance and sharp cutters.

Hinge effect

Marpet-a FS has a very high level of fatigue resistance, creating scope for a diverse range of hinge effects. By pressing with a blunt blade, pre-punching or milling, it is possible to create the bent edges that may be required on the inside. Sheets of up to 1.5 mm in thickness can be crease line folded or pre-punched whilst V-shaped milling should be used for thicker sheets. These edges are permanently moveable, on a par with paper or cardboard flaps.

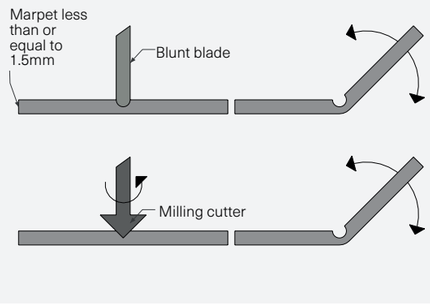


Fig. 7: Hinge effect

Laser cutting

When cutting intricate shapes and contours, lasers are more suitable. Marpet-a FS and Marpet-g FS sheets should be annealed following laser cutting. Thicknesses above 3mm can be laser cut although the finished edge will be slightly rough and discoloured. A glossy edge can be achieved from flame polishing depending on the sheet thickness.

Experimentation is needed to achieve the desired result. An effective extraction system is necessary to remove the smoke, vapours and other combustion gasses formed during cutting. Laser cutting aPET and PETg will produce noxious gases. It is strongly recommended that all combustion gases formed during cutting are eliminated before removing the part and that only thin sheets (less than 1mm) be laser cut.

Forming

Cold forming

Cold curving
Marpet-a FS and Marpet-g FS sheets may be cold curved with a minimum radius of 150 times sheet thickness. Thermoforming is recommended for smaller radii.

Minimum radius ≥ 150 x sheet Thickness

Cold bending – press break machine
Marpet-a FS and Marpet-g FS sheets can be cold formed. The best results are achieved with a rotating bending machine. Cavity folding is possible up to a thickness of 3 mm.

Bending Marpet-a FS and Marpet-g FS sheets up to 3mm thick may be performed without heating. For a sheet 3mm thick a 90° may be achieved using conventional metal folders.

The relaxation immediately following the cold folding process means that the sheet has to be overstretched by approximately 25°. The internal and external stress levels take a few days to become balanced with the parts, only then taking on their final shape.

The sheet should be folded parallel to the extrusion direction marked on the masking. Bear in mind that cold brake forming places high stresses on the edge areas of the material. Avoid the use of aggressive chemicals, particularly with cold brake formed and cold bent parts.

The use of cold folding should be restricted to Marpet FS sheets with low thicknesses.

Hot line bending

To hot line bend Marpet-a FS and Marpet-g FS sheet, locally heat the area to 100 °C using IR heaters or heating elements in a linear manner (see Fig. 8). When the optimum temperature is reached remove the sheet from the heating element, fold, place in the mould and clamp into position until the material cools and becomes rigid. This will achieve the required shape. The protective film does not need to be removed.

If using one-sided heating, the sheet must be turned over several times to guarantee even heating on both sides. With sheet thicknesses of 2 mm or more and when producing large numbers of units, it is best to heat both sides of the sheet simultaneously using a sandwich heating appliance. Various bending radii can be achieved by adjusting the heating width (see Fig.9). Do not exceed a minimum bend radius of 3 times the sheet thickness.

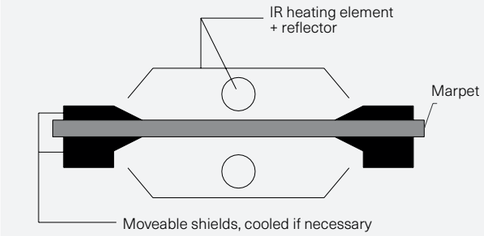


Fig. 8: Hot line bending

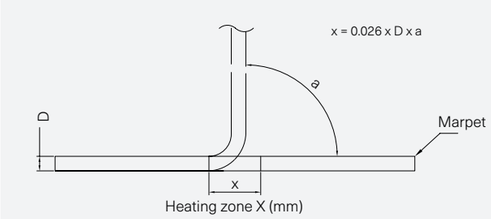


Fig. 9: Heating zone

Example:
For 3mm 45° angle
x = 0.026 x 3 x 45
= 3.51mm

IMPORTANT
Excessively high temperatures can lead to crystallisation and whitening in the heated area for Marpet-a FS aPET. Local heating may also create stresses in the finished part. Care should be taken when using chemicals with bent formed parts.

Forming

Thermoforming

Marpet-a FS and Marpet-g FS sheets may be thermoformed even at low temperatures (100 to 160°C). However, even at these temperatures Marpet-a FS sheets may crystallize resulting in whitening. To avoid crystallisation ensure short heating times and rapid cooling of the moulded part to preserve the material's transparency. Trials should be conducted in advance.

Pre-drying
It is not necessary to pre-dry Marpet-a FS and Marpet-g FS sheets prior to thermoforming.

Heating during thermoforming
Marpet-a FS and Marpet-g FS sheets should be heated evenly as part of a controlled process to a temperature of 100 to 160 °C. More precise results are achieved at the upper end of the forming temperature range. High temperatures can result in crystallisation of Marpet-a FS sheets.

As Marpet FS sheets cool quickly, heat sheets whilst on the forming machine and not in separate ovens.

For best results use two sided IR heating systems which provide a more even and faster heating of the material for shorter, more economical cycle times. This process also reduces the risk of crystallisation for Marpet-a FS sheets. It is important to cool Marpet-a FS quickly using compressed air until the parts are completely cooled.

Heating with IR or ceramic elements provide the best heating sources for Marpet-g FS sheets. One side heating is not recommended for sheets of 3mm or above.

Marpet-a FS and Marpet-g FS shrink by 0.4% during cooling.

IMPORTANT
Excessively high temperatures can lead to crystallisation and whitening in the heated area for Marpet-a FS aPET. Local heating may also create stresses in the finished part. Care should be taken when using chemicals with bent formed parts.

Thermoforming tools:
Depending on the size of the production series and desired surface quality, tools made from different materials can be used. Please note that the material selected will influence cooling time and surface properties. The mould should be sufficiently rounded. Marpet-a FS and Marpet-g FS sheets effectively reproduce detail. We recommend not polishing the surface of the mould but slightly matting it to avoid impressions on the formed part. When constructing forming moulds, allowance should be made for shrinkage of 0.4%. Special materials are available for producing porous forming tools without vents.

Male and female tools
The decision on whether to use a male or female tool depends on the application. To achieve a better surface quality on the outer side of the finished part, use of a female tool is recommended to attain greater detail.

Blow moulding

Blow moulding is used to form domes. This technique involves working with air pressure, whilst the thermoforming process is carried out in a vacuum. To produce the moulding, the sheets should be evenly heated. At a sheet temperature of approx. 80 °C, the part retains its desired shape and can be removed.

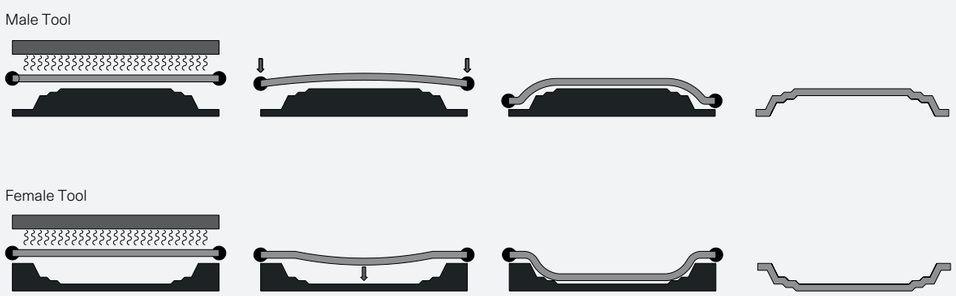


Fig. 10: Male and Female thermoforming tools

Thermoforming troubleshooting

Problems	Possible Causes	Solution	Hot Bending	Thermo-Forming	Blow Moulding
White coloration	Sheets too hot	Reduce heating	•	•	•
	Production cycle too long	Shorten cooling period		•	•
Badly formed parts	Sheets too hot	Reduce heating	•	•	•
	Production cycle too long	Shorten cooling period		•	
	Vacuum speed too fast	Limit vacuum		•	
	Sharp edges	Round off edges		•	
Thin edges	Sheets too small	Use larger sheets		•	
Wave formation	Uneven heating	Check heating surface		•	
	Too small distance between moulds	Increase min. distance between parts		•	•
	Vacuum too fast	Limit vacuum		•	•
	Sheet surface too large	Distance between clamp and tool <50mm		•	
Reduced details	Insufficient vacuum or compressed air	Increase vacuum or compressed air to check for lack of tightness		•	•
	Sheet temperature too low	Increase heating		•	
Moulding sticks to mould	Mould too hot	Reduce mould temperature		•	
	Release angle too small	Increase release angle		•	
Impressions	Mould surface too smooth	Slightly matt tool		•	
	Sheet temperature too high	Reduce heating/heating time		•	
Surface defects	Dust on sheet or mould	Clean with ionised/ compressed air		•	•
Uneven finished parts	Heating/cooling	Check for draughts; check heating		•	•
	Release too fast	Sufficient cooling of part		•	
Tears or cracks	Excessive stress	Slow heating, heat large surface area	•	•	•

Bonding & Fastening

General Guidance

Marpet-a FS is difficult to bond due to its high chemical resistance therefore bonding using adhesive tape, mechanical fastening and welding are recommended instead. Marpet-g FS can be bonded to itself or to other materials using commercially available adhesives suitable for polyester. It is recommended to check/test suitability of the adhesive with polyester prior to any application.

Bonding with Adhesive Tape

Double-sided adhesive tape (acrylic based) may be used for rapid bonding. These tapes are elastic and adhere well to Marpet FS PET sheets. They are particularly suitable for bonding thin Marpet FS sheets to other plastics, glass or metal.

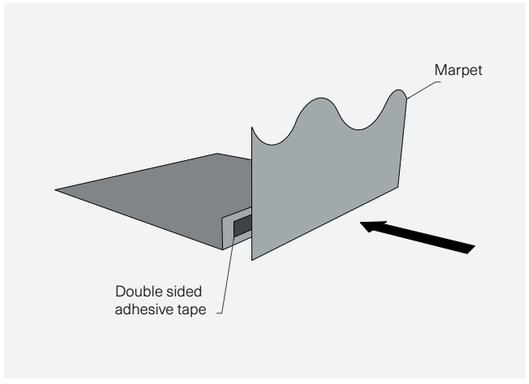


Fig. 11: Bonding using adhesive tape

Tips for good bonding:

- Clean the area with isopropyl alcohol.
- Carefully apply the adhesive tape.
- Use a roller to apply even pressure to remove any air bubbles and improve adhesion.
- Adhesives manufacturer's guidelines and safety advice must be observed.

Bonding with Adhesive Bonding Agents

Only a few industrial adhesives prove suitable for bonding Marpet-a FS e.g. instant products and/or cyanoacrylate, 2-component polyurethane products. Solvent adhesives could be used with Marpet-g FS for bonding small and plane surfaces. Stresses in the sheet or in the parts combined with the use of bonding agents may result in crack formation.

Welding

Ultrasonic and friction welding are possible options but mechanical fastening and bonding are preferable. Information is available from the equipment manufacturer.

Mechanical Fastening

Due to its good impact resistance, Marpet FS PET can be fastened mechanically using any method. Up to a thickness of 1.5 mm it can be nailed, tacked or riveted. When using screws, opt for screws with a cylindrical head to bond various parts further and avoid any with countersunk heads, as these can cause cracking (Fig.12). Drill holes should be measured to allow for expansion and shrinkage (Fig.13). All plastic screws are suitable. When using metal screws a suitable plastic washer is required. Avoid overtightening screws. Use a through bolt rather than cutting a thread in the sheet.

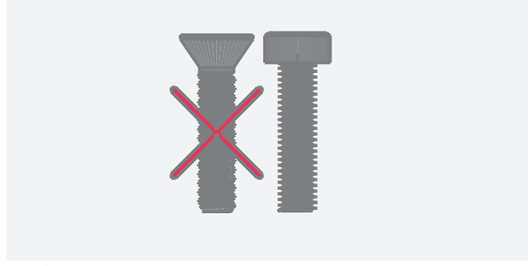


Fig. 12: Avoid screws with countersunk heads

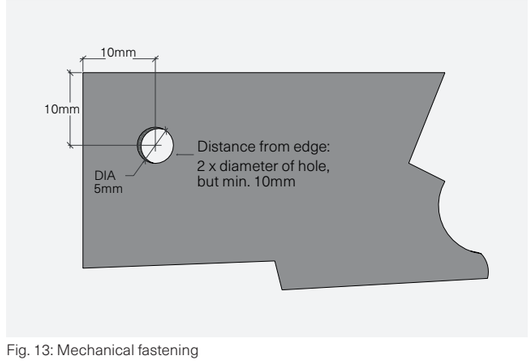


Fig. 13: Mechanical fastening

Finishing

Polishing

Flame Polishing
Taking care not to overheat and crystallise the material. An experienced flame polisher can achieve excellent results with propane, butane or other types of gas burner. Cracks may appear in the polished area in the long term.

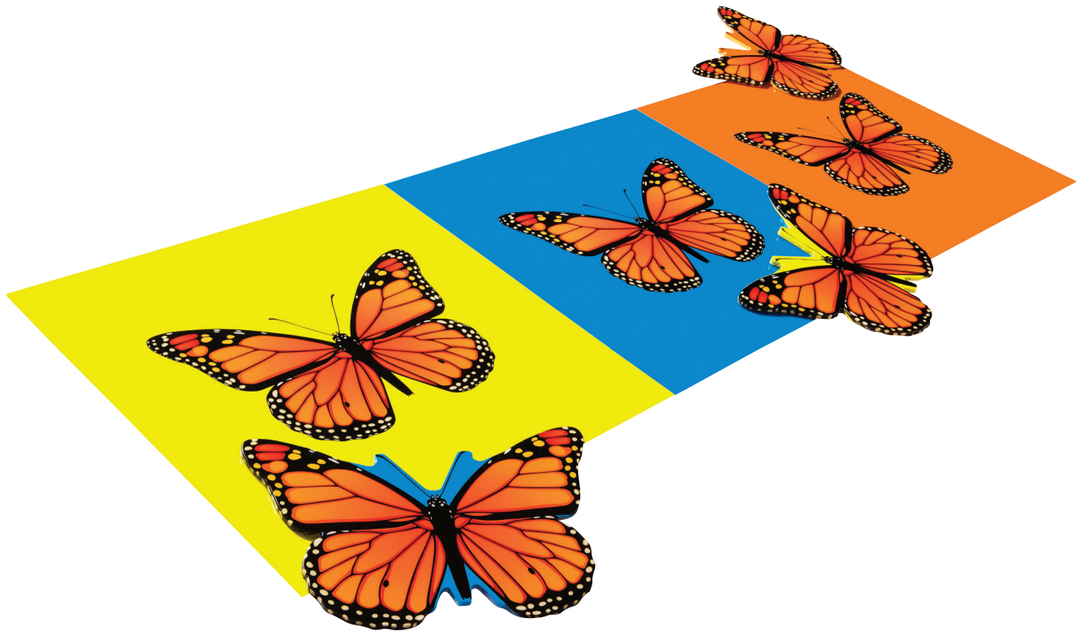
Buffing
Using alkali-free polishing pastes, medium-density polishing wheels with a peripheral velocity of 20 to 30m/s can be used to polish Marpet-a FS and Marpet-g FS sheets. A clean polishing wheel without polishing paste is then used to complete the polishing process. Large-surface polishing should be avoided.

Decorating

Marpet-a FS and Marpet-g FS sheets should be cleaned before secondary processing, such as coating, screen printing or thermoforming to remove any loose particles of dirt or dust from the surface. Use ionized air for best results. (See Section 8 on Cleaning).

Screen printing
Marpet-a FS and Marpet-g FS may be easily printed with standard screen printing equipment and inks suitable for thermoplastic polyesters (PET). The ink manufacturer's recommendations should be followed.

Digital printing
Marpet-a FS and Marpet-g FS sheets can be printed with UV cured inks. The short-term UV radiation has no impact on the physical properties. Due to the chemical and solvent resistance of Marpet-a FS some ink systems may have difficulty in obtaining a good bond to the sheet surface. In common with other plastic materials, special printing inks are usually required since the ink does not penetrate the plastic as it does paper and cloth. As the ink is not absorbed into the plastic, it may be subject to abrasion. However, this can be minimised by the application of a light coat of clear lacquer over the printing. It is recommended that a preliminary test with the inks should be performed to confirm quality of results. The maximum application temperature of 50°C should not be exceeded during the drying process. A primer is not required when digitally printing Marpet-g FS.



Cleaning

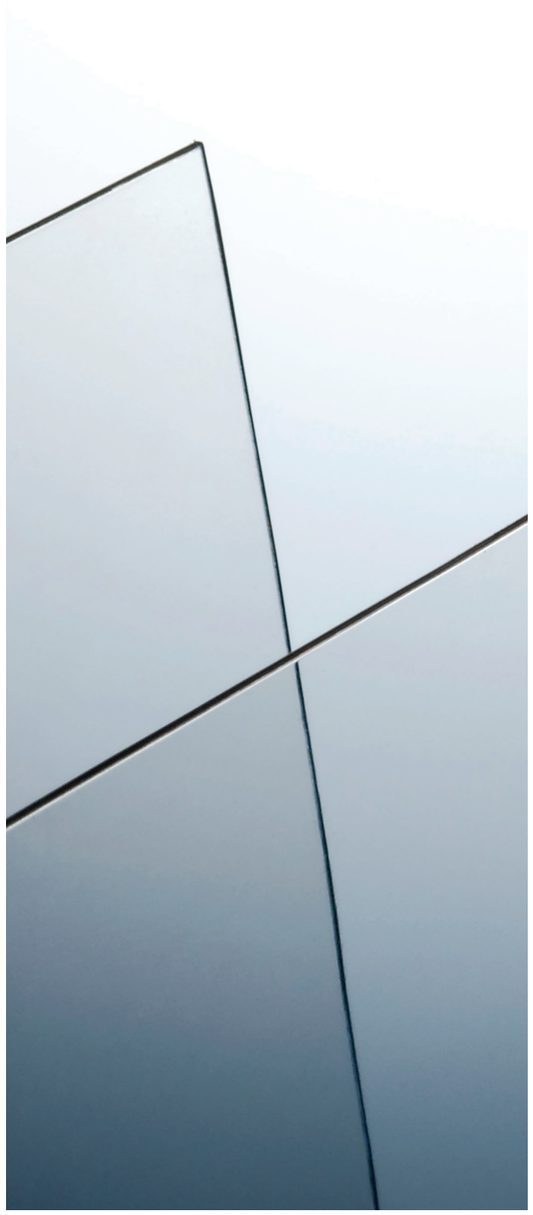
Dust can settle on the surface of the Marpet-a FS and Marpet-g FS sheets, particularly as a result of electrostatic charging. Dusty surfaces can be easily wiped clean with a damp, soft cloth or sponged with warm water containing some washing-up liquid. Before secondary processing of Marpet FS PET sheets, particularly when thermoforming or printing, remove any loose particles of dirt or dust on the surface by blowing with ionized air.

Grease and oil spots can be simply and quickly removed with ethanol or isopropanol because Marpet-a FS and Marpet-g FS are not attacked by these solvents.

For thorough cleaning, use a non-abrasive detergent such as washing up liquid. Razor blades or other sharp tools, abrasive or strongly alkaline detergents, solvents, leaded benzene and carbon tetrachloride should not be used.

The only way to achieve effective cleaning without streaks is to use a microfiber cloth that is simply dampened with water. In the case of a greater build-up of dirt or greasy stains in particular, use acetone – and benzene-free solvent cleaners or thinners. The optical and mechanical properties will remain unaffected by these cleaners. Some spray paint and graffiti can also be removed in this way.

Splashes of dye, grease etc. may be removed before curing using a soft cloth soaked in ethyl alcohol or isopropyl alcohol.



Packaging and Storage

Surface Protection

All Marpet-a FS and Marpet-g FS sheets are covered by a protective polyethylene film. This surface protection is applied to two sides of the sheet and can be removed easily.

All Marpet-a FS and Marpet-g FS 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 & Handling

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

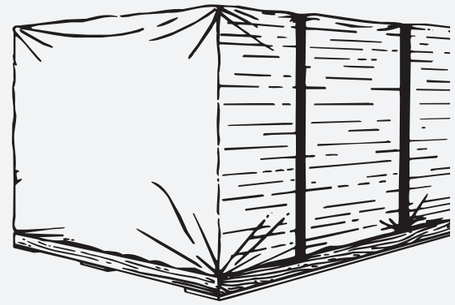
The temperature of uncovered stacked sheets in direct sunlight can rise to levels which will be detrimental to the material: the presence of moisture between sheets can add to damage. Do not store indoors close to heat sources, for example, radiant heaters or boilers.

Sheets, whether stored indoors or outdoors, should be laid horizontally on a flat clean 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. Standing sheets on ends or sides, even for short periods, should be avoided.

Where storage outdoors cannot be avoided, at all times the stack of sheets should be completely enclosed within a reflective waterproof cover, placed over wooden battens on top of the stack to avoid contact with the sheet surface. The cover should be secured to protect the stack against sun, wind and rain and the stack should be ventilated to avoid heat build-up.

Marpet FS PET is a relatively flexible material but, if lifted or carried incorrectly, sheets can be stressed beyond their flexible limits and cracked. 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.

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.



Safety

Marpet-a FS and Marpet-g FS are rigid polyester sheets. These materials are not subject to the laws governing the use of dangerous materials or chemicals and meets the requirements of the RoHS and WEEE directives of the European Union on the restriction of certain hazardous substances.

Installation

Expansion Behaviour

When measuring and installing Marpet-a FS and Marpet-g FS, the thermal expansion of the material should be taken into account, as with other plastic sheets.

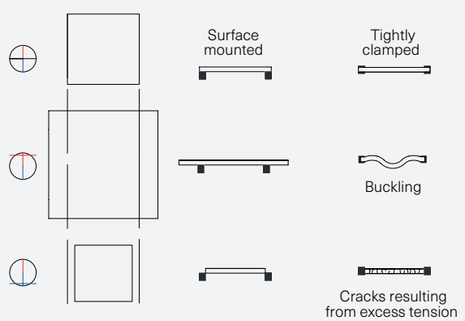
Ensure that the sheet can expand sufficiently in hot and moist conditions and can contract sufficiently in the cold and dry.

The following table provides a comparison of the coefficients of expansion of various materials.

Material	x10-6 K-1
Marpet-a FS (aPET)	approx. 68
Marpet-g FS (PETg)	approx. 60
Acrylic	approx. 70
Polycarbonate	approx. 65
Aluminium	approx. 22
Steel	approx. 13
Glass	approx. 0.8

The table shows that plastic sheet expands and contracts under the influence of temperature. These properties of the plastic must be taken into account when measuring and fitting the sheet.

Generally, 3.5mm/m expansion allowance will cover most applications.



The sheet must be secured so that effects shown here can be controlled

Fig. 14: Expansion behaviour

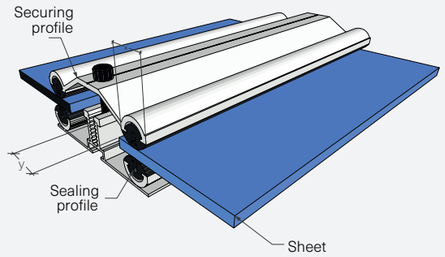
Installation

Linear securing
The preferred method of installing Marpet-a FS and Marpet-g FS either in large flat sheets or as cold curved sheets is to use a profile system.

Linear securing ensures a uniform spread of weight in the supporting construction. The contact pressure must not be so high that it prevents allowance for expansion or prevents the sealing profiles from working. Contact pressure that is too low would not ensure water-tightness and the sheet would not be properly secured.

The correct contact pressure can be produced, as shown here, with prefabricated spacer sleeves or with screws with limited thread length.

The allowance for expansion of the sheets is absorbed by the flexing of the sealing profiles because of its very good chemical resistance. Marpet-a FS and Marpet-g FS can be installed with all commercially available sealing profiles.



Clamping depth x: approx 20mm Tolerance y for thermal expansion and construction tolerance: Thermal length change of the sheet depends on the sheet format (3.5mm/m)

Fig. 15: Installation

Point Securing
Marpet FS sheets can be point secured for small areas, using machine screws. Self-tapping screws may only be used with washers and/tension rings or spring clips.

With screw connections the drill holes should be at least 50% larger than the diameter of the screws so that tension-free absorption of movement is possible.

For interior applications, the drill holes should be at least 1mm larger than the screw diameter. Slits and cut-outs may be advisable.

Distance from edge: 2x diameter of hole, but min. 10mm

Cold Curving

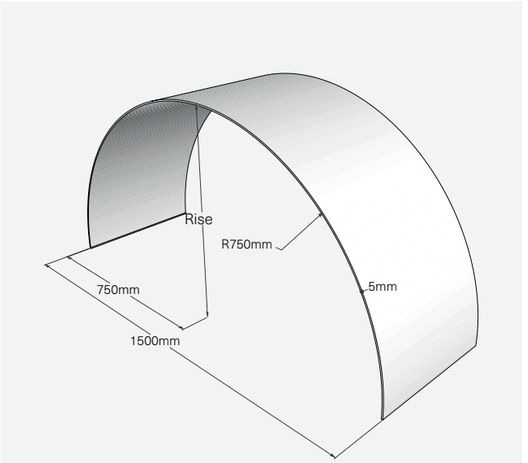
Because of its outstanding elasticity, Marpet-a FS and Marpet-g FS sheets are ideal for cold curving.

The performance of the sheet is fully retained provided the sheet remains above the minimum bending radius.

The minimum bending radius is calculated according to the following formula:

Minimum bending radius = 150 x sheet thickness

Sheet thickness (mm)	Min. Curving radius (mm)
1	150
1.5	225
2	300
2.5	375
3	450
4	600
5	750
6	900



Min. bending radius = 150 x sheet thickness
150 x 5mm = 750mm radius min.

Fig. 16: Minimum bending radius

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 well-being of future generations in all Company policy decisions.

Responsibility of End User

The information contained in this publication is based on current knowledge and is in our opinion reliable. However the correctness 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

Chemical Resistance

The data below concerning the chemical resistance of Marpet FS PET has been obtained from publically available data sources. The data should be treated with caution and should only be regarded as an indication of the chemical resistance since the resistance performance can be affected by many factors, such as temperature, concentration, and whether the samples are under stress. It is also difficult to predict the resistance against compounds containing several different chemicals.

Chemical Resistance Marpet-a FS aPET

Chemical Name	Concentration	aPET	Chemical Name	Resistance at 23°C	aPET
Acetic Acid	40% aq Glacial	Unaffected Some attack	Chloral Hydrate	Solid	Unsatisfactory
Acetic Anhydride	-	Unsatisfactory	Chlorobenzene	-	Unsatisfactory
Acetone	-	Unsatisfactory	Chloroform	-	Unsatisfactory
Aluminium Sulphate	Solid	Unaffected	Chromic Acid	Plating solution	Unsatisfactory
Ammonia	10% aq & 0.88 SG aq	Unsatisfactory	Citric Acid	-	Unaffected
Ammonium Chloride	Solid	Unaffected	Citronellol	-	Satisfactory
Ammonium Persulphate	Solid	Unaffected	Cupric Sulphate	Solid	Unaffected
Ammonium Sulphate	Solid	Unaffected	Cyclohexane	-	Unaffected
Amyl Acetate	-	Some attack	Cyclohexanone	-	Unsatisfactory
Amyl Alcohol	-	Satisfactory	Cyclohexanol	-	Unaffected
Amyl Methyl Ketone	-	Some attack	Diacetone Alcohol	-	Unaffected
Aniline	-	Unsatisfactory	Di-alkyl Phthalate	-	Unaffected
Anthraquinone	Solid	Unaffected	Di-butyl Phthalate	-	Unaffected
Barium chloride	Solid	Unaffected	Di-nonyl Phthalate	-	Satisfactory
Benzene	-	Unsatisfactory	Di-octyl Phthalate	-	Unaffected
Benzoic acid	Solid	Unaffected	Dimethyl Formamide	-	Unsatisfactory
Benzyl Acetate	-	Unsatisfactory	Dioxane	-	Unsatisfactory
Benzyl Alcohol	-	Unsatisfactory	Dipentene	-	Satisfactory
Benzyl Benzoate	-	Some attack	Di-1-phenyl Ethanol	-	Some attack
Butyl Acetate	-	Unsatisfactory	2-Ethoxy Ethanol	-	Satisfactory
Butyl Alcohol	-	Unaffected	Ethyl Acetate	-	Unsatisfactory
Butyl Lactate	-	Satisfactory	Ethyl Alcohol	-	Unaffected
Butyl Stearate	-	Unaffected	Ethyl Benzene	-	Some attack
Calcium hypochlorite	Solid	Satisfactory	Ethyl Digol	-	Unaffected
Camphor	Solid	Unaffected	Ethylene Chlorohydrin	-	Unsatisfactory
Camphorated Oil	-	Satisfactory	Ethylene Dibromate	-	Unsatisfactory
Carbon Tetrachloride	-	Satisfactory	Ethylene Dichlorate	-	Unsatisfactory
Castor Oil	-	Unaffected	Eugenol	-	Unsatisfactory
Cetyl Alcohol	Solid	Unaffected	Ferric Nitrate	Solid	Unaffected

Chemical Name	Concentration	aPET	Chemical Name	Resistance at 23°C	aPET
Formaldehyde	40% W/Waq	Unaffected	Pinene	-	Satisfactory
Formic Acid	3% aq & 30% aq	Satisfactory	Potassium Bromide	Solid	Unaffected
Furfuryl Alcohol	-	Unsatisfactory	Potassium Chromate	Solid	Unaffected
Geranoil	-	Satisfactory	Potassium Cyanide	Solid	Unaffected
Glycerine	-	Unaffected	Potassium Dichromate	Solid	Unaffected
Glycol	-	Unaffected	Potassium Hydroxide	Solid	Unaffected
Hydrobromic Acid	50% aq	Unaffected	Potassium Dichromate	Solid	Unaffected
Hydrochloric Acid	10% aq	Satisfactory	Potassium Hydroxide	1% aq & 10% aq	Unsatisfactory
Hydrofluoric Acid	60% aq Conc	Some attack Unsatisfactory	Potassium Permanganate	Solid	Some attack
Hydrogen Peroxide	-	Unaffected	Propionic Acid	-	Unsatisfactory
Hydroquinone Solid	-	Unaffected	Propyl Alcohol	-	Unaffected
Isopropyl Alcohol	-	Unaffected	Propylene Glycol	-	Unaffected
Lanoline	-	Unaffected	Salicylic Acid	Solid	Unaffected
Linalol	-	Satisfactory	Sodium Bicarbonate	Solid	Unaffected
Linseed Oil	-	Satisfactory	Sodium Borate	Solid	Unaffected
Lubricating Grease	-	Unaffected	Sodium Bromide	Solid	Unaffected
Oil	-	Unaffected	Sodium Carbonate	Anhydrous & 2.5% aq	Unaffected
Magnesium Chloride	Aq Solution	Satisfactory	Sodium Chloride	1% aq 10% aq	Unaffected Satisfactory
Maleic Acid	25% 50% aq	Some attack Unsatisfactory	Sodium Cyanide	Solid	Unaffected
Mercuric Chloride	Solid	Unaffected	Sodium Hydroxide	1% aq &10% aq	Unsatisfactory
Mercury	-	Unaffected	Sodium Nitrate	Solid	Satisfactory
2-Methoxy Ethanol	-	Some attack	Sodium Phosphate	Solid	Unaffected
Methyl Alcohol	-	Unaffected	Sodium Sulphite	Solid	Satisfactory
Methyl Cyclohexanol	-	Unaffected	Sodium Thiosulphate	Solid	Unaffected
Methyl Ethyl Ketone	-	Unsatisfactory	Stearic Acid	Solid	Satisfactory
Methyl Methacrylate	-	Some attack	Sulphur	Solid	Unaffected
Methyl Salicylate	-	Unsatisfactory	Sulphuric Acid	3% aq 30%aq	Some attack Satisfactory
Mathylene Chloride	-	Unsatisfactory	Tartaric Acid	Solid	Satisfactory
Mineral Oil	-	Unaffected	Tetrahydrofuran		Unsatisfactory
Naphtha	Crude Solvent	Unaffected Satisfactory	Tetralin		Unaffected
Nitric Acid	10% aq	Satisfactory	Toluene		Satisfactory
n- Octane	-	Unaffected	Transformer Oil		Satisfactory
Olive Oil	-	Satisfactory	Trichloroethyl Phosphate		Unaffected
Oxalic Acid	Solid Solution	Unaffected Satisfactory	Trichloroacetic Acid		Unsatisfactory
Paraffin	Medicinal	Unaffected	Trichloroethylene		Unsatisfactory
Paraffin Oil	-	Unaffected	Triethanolamine		Unsatisfactory
Petrol	-	Satisfactory	Vinegar		Satisfactory
Petroleum Ether	-	Unaffected	Xylene		Satisfactory
Phenol	-	Unsatisfactory	Zinc Chloride	Solid	Satisfactory

Chemical Resistance Marpet-g FS PETg

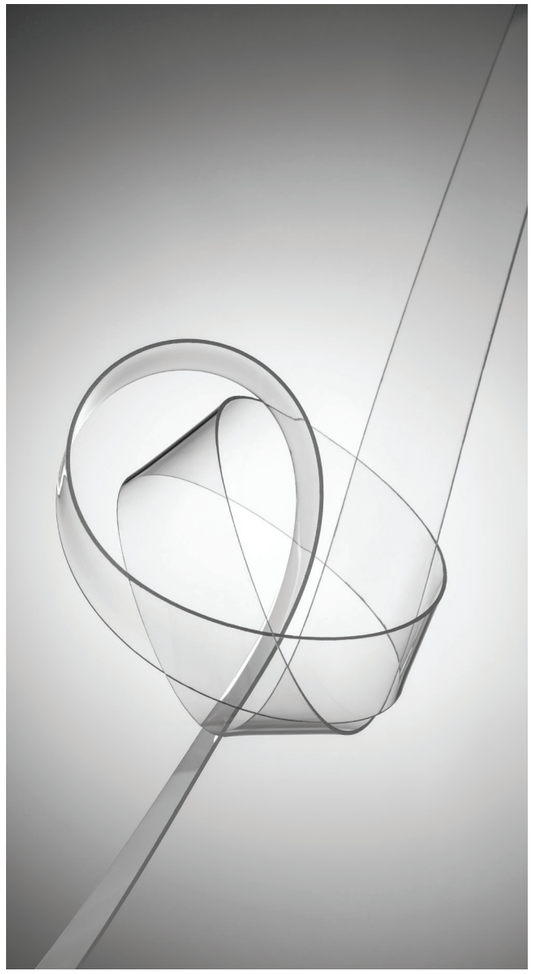
Resistance 1 = stable, 2 = conditionally stable, 3 = unstable

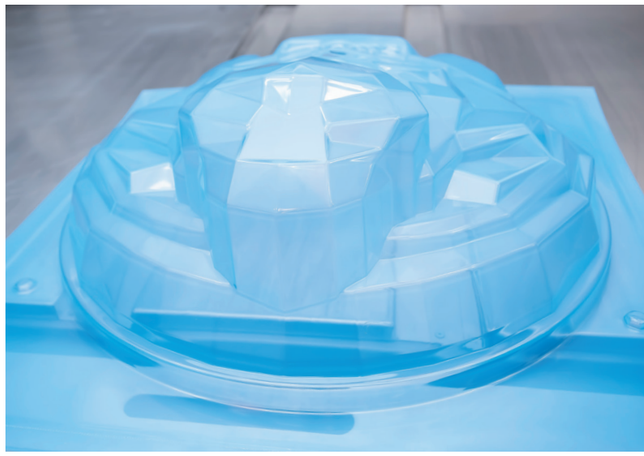
Contents	Concentration	PETg		Contents	Resistance at 23°C	PETg	
		@20°C	@50°C			@20°C	@50°C
Acetaldehyde	40%	3	3	Butanol	Techn. Pure	1	-
Acetic acid	10%	1	1	Butinediol	10%	1	-
Acetic acid	5%	1	1	Butyl acetate	Aqueous	2	-
Acetic acid (glacial acetic acid)	90%	3	3	Calcium chloride	Aqueous	1	-
Acetic acid ester	100%	3	3	Calcium hypochlorite	Aqueous	2	-
Acetone	-	3	3	Calcium hypochlorite	Saturated	2	-
Acetonenitrile	-	-	3	Calcium nitrate	50%	1	1
Acid, battery	38%	3	3	Calcium nitrate	Aqueous	1	1
Allyl alcohol	96%	1	-	Carbon dioxide, dry	Techn. Pure	1	1
Alum	-	1	1	Carbon dioxide, humid	Techn. Pure	1	1
Aluminium chloride	10%	1	1	Carbon tetrachloride	-	1	3
Aluminium chloride	Aqueous	1	1	Carbonic acid	Saturated	1	1
Aluminium nitrate	Aqueous	1	1	Caustic potash	30%	3	3
Aluminium sulfate	10%	1	1	Caustic potash	50%	3	3
Ammonia	25%	1	3	Caustic potash	Aqueous	3	3
Ammonia liquor	Any	1	3	Caustic potash	10%	3	3
Ammonium chloride	Aqueous	1	1	Caustic potash	50%	3	3
Ammonium fluoride	Saturated	1	1	Caustic soda	-	3	3
Ammonium fluoride	Aqueous	1	1	Chlorinated water	-	3	3
Ammonium nitrate	10%	1	1	Chlorine	10% wet	3	3
Ammonium nitrate	Saturated	1	1	Chlorine	97%	3	3
Ammonium nitrate	Aqueous	1	1	Chlorine gas	-	3	3
Ammonium sulfate	10%	1	1	Chloroacetic acid (mono)	-	3	3
Ammonium sulfate	Saturated	1	1	Chloroacetic acid (mono)	50%	3	3
Ammonium sulfate	Aqueous	1	1	Chloroacetic acid (mono)	Techn. Pure	3	3
Amyl acetate (Pentylacetate)	-	1	2	Chlorobenzene		1	3
Amyl alcohol	-	1	-	Chlorsulphonic acid	Techn. Pure	3	3
Antifreeze (Ethyleneglycol)	-	1	-	Chromic acid	10%	2	-
Aqua regia	-	3	3	Chromic acid	20%	3	3
Beer	-	1	-	Chromic acid	50%	3	3
Benzene	-	3	3	Chromic acid	Aqueous	3	3
Benzoic acid	Saturated	1	-	Chromic alum	Saturated	1	1
Benzoic acid	Aqueous	1	-	Chromic sulphuric acid	Pure	3	3
Borax	Any	1	1	Citric acid	10%	1	2
Boric acid	10%	1	-	Citric acid	10%	1	2
Boric acid	Aqueous	1	-	Common salt	-	1	1
Brake fluid DOT 3	-	1	1	Common salt	Aqueous	1	1
Brandy	-	1	-	Copper sulphate	Aqueous	1	1
Bromic vapours	-	3	3	Crude oil	100%	1	-
Bromine	-	3	3	Cyclanone	-	1	1
Butane	Techn. Pure	1	-	Cyclohexane	-	1	-

Contents	Concentration	PETg		Contents	Resistance at 23°C	PETg	
		@20°C	@50°C			@20°C	@50°C
Cyclohexanone	Techn. Pure	3	3	Hexane, -n	-	1	-
Dekalin (Decahydronaphtalin)	100%	2	-	Hydrobromic acid	-	1	-
Detergent solution	-	1	1	Hydrobromic acid	40%	3	3
Dextrine	-	1	1	Hydrobromic acid	50%	3	3
Dextrine	Aqueous	1	1	Hydrobromic acid	Diluted	2	-
Dibutyl phthalate (DBP)	-	1	-	Hydrochloric acid	1-5%	1	1
Dichloroethylene	Techn. Pure	3	3	Hydrochloric acid	20%	2	-
Diesel oil	100%	1	1	Hydrochloric acid	35%	3	3
Dimethyl formamide	-	1	-	Hydrochloric acid	Conc.	3	3
Dioxane	-	1	-	Hydrofluosilicic acid	32%	3	3
Emissions, carbon dioxide	Low	1	1	Hydrogen fluoride	Anhydrous	3	3
Engine oil	-	1	1	Hydrogene chloride gas	-	3	3
Ethanol	50%	1	1	Hydrosulphide	Saturated	1	-
Ethanol	96%	1	1	Isooctane	Techn. Pure	1	-
Ethyl acetate	-	2	3	Kerosene	-	1	-
Ethyl alcohol	40%	1	1	Kerosene	-	1	1
Ethyl alcohol	96%	1	1	Lactic acid	3%	1	-
Ethyl chloride	-	3	3	Lactic acid	Aqueous	1	-
Ethylene glycol	-	1	-	Lead acetate	Aqueous	1	1
Fat, vegetable	-	1	-	Lead-(II)-acetate	-	1	1
Fatty acid	Techn. Pure	1	-	Linseed oil	Techn. Pure	1	-
Fertilizer salts	Saturated	1	-	Liqueurs	-	1	-
Fluorhydric acid	100%	3	3	Lubricating oil	-	1	1
Fluorhydric acid	4%	3	3	Magnesium sulphate	Saturated	1	1
Fluorhydric acid	50%	3	3	Magnesium sulphate	Aqueous	1	-
Fluorine	-	3	3	Magnesium chloride	Aqueous	1	-
Fluorine	Dry	3	3	Mercury	Pure	1	1
Formaldehyde	10%	1	-	Mercury chloride	Aqueous	1	1
Formaldehyde	40%	1	-	Methanol	-	1	-
Formic acid	3%	1	-	Methyl acetate	Techn. Pure	2	-
Fruit juices	-	1	-	Methyl alcohol (methanole)			
Fruit wine	-	1	1	Methyl ethyl ketone	-	3	3
Gelatine	Any	1	1	Methylen chloride	-	3	3
Gelatine	Aqueous	1	1	Milk	-	1	1
Gelatine	-	3	3	Molasses	-	1	-
Glucose	Any	1	1	Molasses Wort	-	1	1
Glue (animal glue, gelatine)	Any	1	1	Mowilith D	-	1	1
Glycerin	Any	1	-	Nitric acid	100%	3	3
Glykol	-	1	-	Nitric acid	1-10%	1	1
Grape sugar	Any	1	1	Nitric acid	50%	1	1
Grape sugar	Aqueous	1	1	Nitric acid	66%	3	3
Hexane	-	1	-	Nitric acid	70%	3	3

Contents	Concentration	PETg		Contents	Resistance at 23°C	PETg	
		@20°C	@50°C			@20°C	@50°C
Oil (vegetable) and animal fats	-	1	-	Propane	Gaseous	1	-
Oleic acid	Techn. Pure	1	-	Propyl alcohol	-	1	-
Oleum	10% SO3	3	3	Propyl alcohol	100%	1	-
Olive oil	-	1	-	Sea water	-	1	1
Oxalic acid	Aqueous	1	1	Silicic acid	Any	1	1
Palm-oil	-	1	-	Silicone oil	-	1	-
Perchloric acid	-	3	3	Silver nitrate	-	1	1
Petrol	-	1	1	Silver nitrate	Aqueous	1	1
Petrol 10% ethyl alcohol	-	2	-	Silver salt	Saturated	1	1
Petrol 10% methanol	-	2	-	Soap solution	Any	1	1
Petrol normal	-	2	-	Sodium carbonate	Aqueous	1	-
Petrol normal unleaded	-	2	-	Sodium carbonate	Aqueous	1	-
Petrol Super unleaded	-	2	-	Sodium chloride	Any	1	1
Petroleum	-	1	1	Sodium chloride	Aqueous	1	1
Phenol	100%	1	1	Sodium fluoride	Saturated	1	1
Phenol	10%	3	3	Sodium hydroxide	1%	2	2
Phoshoric acid	1-5%	1	-	Sodium hydroxide	50%	3	3
Photographic developers	-	1	-	Sodium hydroxide	30%	3	3
Phthalilc acid	Saturated	1	-	Sodium hydroxide	45%	3	3
Plasticiser, DBS	-	1	1	Sodium hydroxide	60%	3	3
Plasticiser, DOP	-	1	1	Sodium hydroxide	Aqueous	3	3
Potash	Saturated	1	1	Sodium hypochlorite	-	2	2
Potash	Aqueous	1	1	Sodium hypochlorite	12% Cl	2	2
Potassium bichromate	Saturated	2	-	Sodium hypochlorite	15%	2	2
Potassium borate	10%	1	1	Sodium hypochlorite	50%	2	2
Potassium borate	Aqueous	1	1	Sodium hypochlorite	Saturated	2	2
Potassium bromide	Any	1	1	Sodium hypochlorite	Diluted	2	2
Potassium chloride	Aqueous	1	-	Sodium hypochlorite	Aqueous	2	2
Potassium hydroxide	50%	3	3	Sodium hypochlorite solution	20%	3	3
Potassium hydroxide	Conc.	3	3	Sodium hypochlorite solution	50%	3	3
Potassium hydroxide	Aqueous	3	3	Sodium hypochlorite solution	Diluted	2	-
Potassium hydroxide	10%	3	3	Sodium nitrate	Saturated	1	1
Potassium hydroxide	1%	3	3	Sodium nitrate	Aqueous	1	-
Potassium nitrate	50%	1	1	Sodium silicate	Aqueous	1	-
Potassium nitrate	Aqueous	1	1	Sodium silicate	Any	1	-
Potassium permanganate	-	1	1	Sodium sulfide	Aqueous	1	-
Potassium permanganate	Aqueous	1	1	Spindle oil	-	1	-
Propane	Liquid	1	-	Starch dilution	Any	1	1

Contents	Concentration	PETg	
		@20°C	@50°C
Starch sirup	-	1	1
Stearic acid	Crystals	1	-
Styrene	100%	1	1
Sugar sirup	-	1	1
Sulphur	Techn. Pure	1	1
Sulphur trioxid	-	3	3
Sulphuric acid	40%	3	3
Sulphuric acid	60%	3	3
Sulphuric acid	80%	3	3
Sulphuric acid	95%	3	3
Sulphuric acid	Smoking	3	3
Tallow	Techn. Pure	1	-
Terpentine	-	1	1
Terpentine oil	-	1	-
Tetralin	-	1	-
Toluene	-	1	-
Transformer oil	100%	1	1
Trichlorethylene	100%	3	3
Triethanol amine	Techn. Pure	1	-
Urea	Aqueous	1	-
Urea	(Carbamide)	1	-
Water	-	1	1
Water, distilled/ desalted		1	1
Wax alcohol	Techn. Pure	1	-
Wine vinegar		1	1
Wines		1	1
Yeast any		1	-
Zinc sulphate	10%	1	1





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