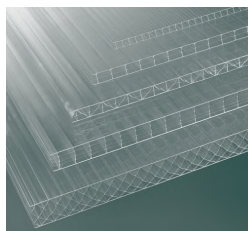


marlonst®

LONGLIFE

STRUCTURED POLYCARBONATE SHEET



This warranty applies only to
Brett Martin's Marlon ST
Longlife structured sheet

Brett Martin Ltd

24 Roughfort Road
Mallusk, Co. Antrim
Northern Ireland BT36 4RB
Tel: 028 9084 9999
Fax: 028 9083 6666
Email: mail@brettmartin.com



For the latest information
visit the company's website:
www.brettmartin.com





MARLON ST LONGLIFE WARRANTY

Brett Martin Limited issues the following warranty for Marlon ST Longlife structured polycarbonate sheets clear (ref. S) as outlined in paragraphs A and B, subject to the limitations and exclusions listed herein.

A Light Transmission

A 10 year warranty relating to the following properties:

For a period of 10 years, the yellowness index, measured in accordance with ASTM D 1925-77, shall change less than 10 delta in comparison with the original value.

For a period of 10 years, the light transmission, measured in accordance with ASTM D 1003-77, shall decrease by no more than 6% in comparison with the original value.

B Weather Breakage

A 10 year warranty relating to the following properties:

For a period of 10 years, no breakage will occur due to normal weathering of the UV protected surface of the sheet. Claims for hail damage will be evaluated using a hail simulation test. Any sheet tested and which remains unbroken by impact from artificial hail stones of 20mm diameter, with surface impact speeds of 21m/s, will not be the subject of any claim.

General Conditions

- 1 The commencement date of this warranty is the date of original purchase and remains valid to the original purchaser only. Claimants must provide a receipt indicating the proof of purchase date.
- 2 Any other claims for damage or loss, either direct or indirect, or consequential whatever the cause thereof, are expressly excluded from this warranty.
- 3 The warranty remains valid only if the sheet has been correctly stored, handled, installed and cleaned as recommended by Brett Martin Ltd.
- 4 Brett Martin Ltd, or its authorised agent, must be notified of any claim immediately and not later than 28 days after the alleged failure. The claimant must allow an inspection of the installation site prior to removal of the sheets from their original position. In addition, Brett Martin Ltd reserves the right to independently investigate the circumstances of failure, including checks with the local meteorological survey and others.

Samples of the sheet must be provided for testing when requested by Brett Martin Ltd.

Limitations and Exclusions

- 5 This warranty applies only to sheets which have been maintained in a scratch-free condition and have not been in contact with chemicals, paints, adhesives or other incompatible materials.
- 6 This warranty only applies to sheets which have been installed with their UV protected side facing outwards, therefore being the side exposed to solar radiation and normal weather conditions.
- 7 This warranty is not valid for sheets which have been thermoformed or altered from their original state.
- 8 For the warranty to remain valid, the sheets must be installed in accordance with the manufacturer's recommendations which include:
 - i. Maintaining support spacings at sizes appropriate for sheet thickness and structure and conditions of application.
 - ii. Full adherence to fixing recommendations with the avoidance of over tightening screws, glazing bars and any other fixings.
 - iii. Store sheets under an opaque cover at all times.
 - iv. Cutting, drilling and handling as advised by Brett Martin Ltd.
 - v. Specific details given for curved installations.
 - vi. All other information contained in labels and publications relating to Marlon ST Longlife structured sheet.
- 9 In the event of an agreed warranty claim, Brett Martin Ltd reserves the right to supply new sheets free of charge or issue a refund to the purchaser for the original purchase price of the affected sheets. Replacement or refund shall be in accordance with the table below. Installation costs are expressly excluded from this warranty. All further claims are excluded.

TIME FROM PURCHASE DATE	MATERIAL REPLACEMENT
Up to 5 years	100%
In 6th year	75%
In 7th year	60%
In 8th year	45%
In 9th year	30%
In 10th year	15%



Plastic Sheets

DECLARATION OF PERFORMANCE : (EU) No 305/2011
N° CE-PCFSX-000121-01-EN

1. **Marlon FSX** - unique identification code of the product type :
PCFSX-000121
2. **Intended use or uses of the construction product, in accordance with the relevant harmonised technical specification, as foreseen by the manufacturer :**
Light transmitting flat solid polycarbonate sheets for internal and external use in roofs, walls and ceilings of all building types.
3. **Name, registered trade name or registered trade mark and contact address of manufacturer as required pursuant to Article 11(5) : Regulation (EU) 305/2011**
Brett Martin Plastic Sheets., 24, Roughfort Road, Newtownabbey, Co. Antrim, BT36 4RB, United Kingdom.
4. **Where applicable, name and contact address of the authorised representative whose mandate covers the tasks specified in Article 12(2) ; Regulation (EU) 305/2011 :**
Not relevant.
5. **Number of the applicable system of assessment and verification of constancy of performance of the product as set out in Annexe V ; Regulation (EU) 305/2011 :**
System 3.
6. **In the case of a declaration of performance concerning a construction product covered by a harmonised standard:**
Number of harmonised standard :
EN16240 : 2017.
Name and identification number of the notified body :
Laboratoire National D'Essais – 0071.

Brett Martin Plastic Sheets
24 Roughfort Road,
Newtownabbey, Co. Antrim,
BT36 4RB
United Kingdom.

PCFSX ECD1-EN

Tel: +44 (0) 28 9084 9999
Fax: +44 (0) 28 9083 6666
Email: mail@brettmartin.com


www.brettmartin.com

www.doplookup.com



Plastic Sheets

7. Declared performance :

 0071
Brett Martin Plastic Sheets. 24, Roughfort Road, Newtownabbey, Co Antrim, BT36 4RB, United Kingdom. 17
EN16240:2017 Light transmitting flat solid polycarbonate (PC) sheets for external and internal use in roofs, walls and ceilings – requirements and test methods.

Intended use	[EN16240:2017 Table ZA1.1]	Roof coverings for buildings
---------------------	----------------------------	-------------------------------------

Essential characteristics	Performance	Harmonised technical specification
Mechanical resistance	NPD	EN16240:2017 - 4.7
Reaction to fire	National fire classifications apply	EN16240 – 4.13
External fire performance	E _{roof}	[EN13501-5:2005] EN16240 – 4.14
Resistance to fire	NPD	[EN13501-2:2007] EN16240
Water vapour permeability	3.6×10^{-4} mg/(m h Pa)	EN16240:2017 – 4.10
Water / air tightness	Comply	EN16240:2017 – 4.11
Release of dangerous substances	NPD	EN16240:2017 – 4.17
Dimensional tolerances	Comply	EN16240:2017 – 4.2
Small hard body impact resistance	Comply	EN16240:2017 – 4.5.1
Large soft body impact resistance (assembly)	NPD	EN16240:2017 – 4.5.2
Resistance to fixings	Principles of fixing are available on the Brett Martin website	EN16240:2017 – 4.1.8
Direct airborne sound insulation	NPD	EN16240:2017 – 4.8
Thermal properties, as:		
- thermal transmittance	4.76W/m²K	EN16240 :2017 – 4.9
Durability, as variation (after ageing)		
- variation of yellowness index	ΔA	EN16240:2017 – 4.6.1.3
- variation of light transmission	ΔA	
- variation of flexural modulus and tensile strength	Cu1 Ku1	EN16240:2017 – 4.6.1.4

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EN16240:2017 Light transmitting flat solid polycarbonate (PC) sheets for external and internal use in roofs, walls and ceilings – requirements and test methods.

Intended use	[EN16240:2017 Table ZA1.2]	External wall and ceiling finishes
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Essential characteristics	Performance	Harmonised technical specification
Reaction to fire	National fire classifications apply	EN16240 – 4.13
Water vapour permeability	$3.8 \times 10^{-5} \text{ mg/(m}^2 \text{ h Pa)}$	EN16240:2017 – 4.10
Water / air tightness	Comply	EN16240:2017 – 4.11
Release of dangerous substances	NRD	EN16240:2017 – 4.17
Shatter properties (safe breakability), as:		
Small hard body impact resistance	Comply	EN16240:2017 – 4.5.1
Flexural / tensile strength, as:		
-Flexural modulus	Mean value $\geq 2,200 \text{ MPA}$ Characteristic value $\geq 2,000 \text{ MPa}$	EN16240:2017 – 4.2
-Tensile strength at yield	Mean value $\geq 60 \text{ MPA}$ Characteristic value $\geq 55 \text{ MPa}$	
Resistance to fixings	Principles of fixing are available on the Brett Martin website	EN16240:2017 – 4.1.8
Durability, as variation (after ageing)		
- variation of yellowness index	ΔA	EN16240:2017 – 4.6.1.3
- variation of light transmission	ΔA	
- variation of flexural modulus and tensile strength	Cu1 Ku1	EN16240:2017 – 4.6.1.4

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EN16240:2017 Light transmitting flat solid polycarbonate (PC) sheets for external and internal use in roofs, walls and ceilings – requirements and test methods.

Intended use	[EN16240:2017 Table ZA1.3]	Internal wall and ceiling finishes
---------------------	----------------------------	---

Essential characteristics	Performance	Harmonised technical specification
Reaction to fire	National fire classifications apply	EN16240 – 4.13
Water vapour permeability	$3.8 \times 10^{-5} \text{ mg/(m}^2 \cdot \text{h} \cdot \text{Pa)}$	EN16240:2017 – 4.10
Water / air tightness	Comply	EN16240:2017 – 4.11
Release of dangerous substances	NPD	EN16240:2017 – 4.17
Shatter properties (safe breakability), as:		
Small hard body impact resistance	Comply	EN16240:2017 – 4.5.1
Resistance to fixings	Principles of fixing are available on the Brett Martin website	EN16240:2017 – 4.1.8
Durability, as variation (after ageing)		
-impact resistance	Comply	EN16240:2017 – 4.6.2

8. The performance of the products identified in points 1 and 2 is in conformity with the declared performance in point 7.

This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 3.

Signed for and on behalf of the manufacturer by :

Name : Ian McKane

Function : Technical Service.

Place of issue :

Brett Martin Plastic Sheets, 24, Roughfort Road, Newtownabbey, Co Antrim, BT36 4RB, United Kingdom.

Date of issue: February 2018

Signature : Ian W. McKane.

Brett Martin Plastic Sheets
24 Roughfort Road,
Newtownabbey, Co. Antrim,
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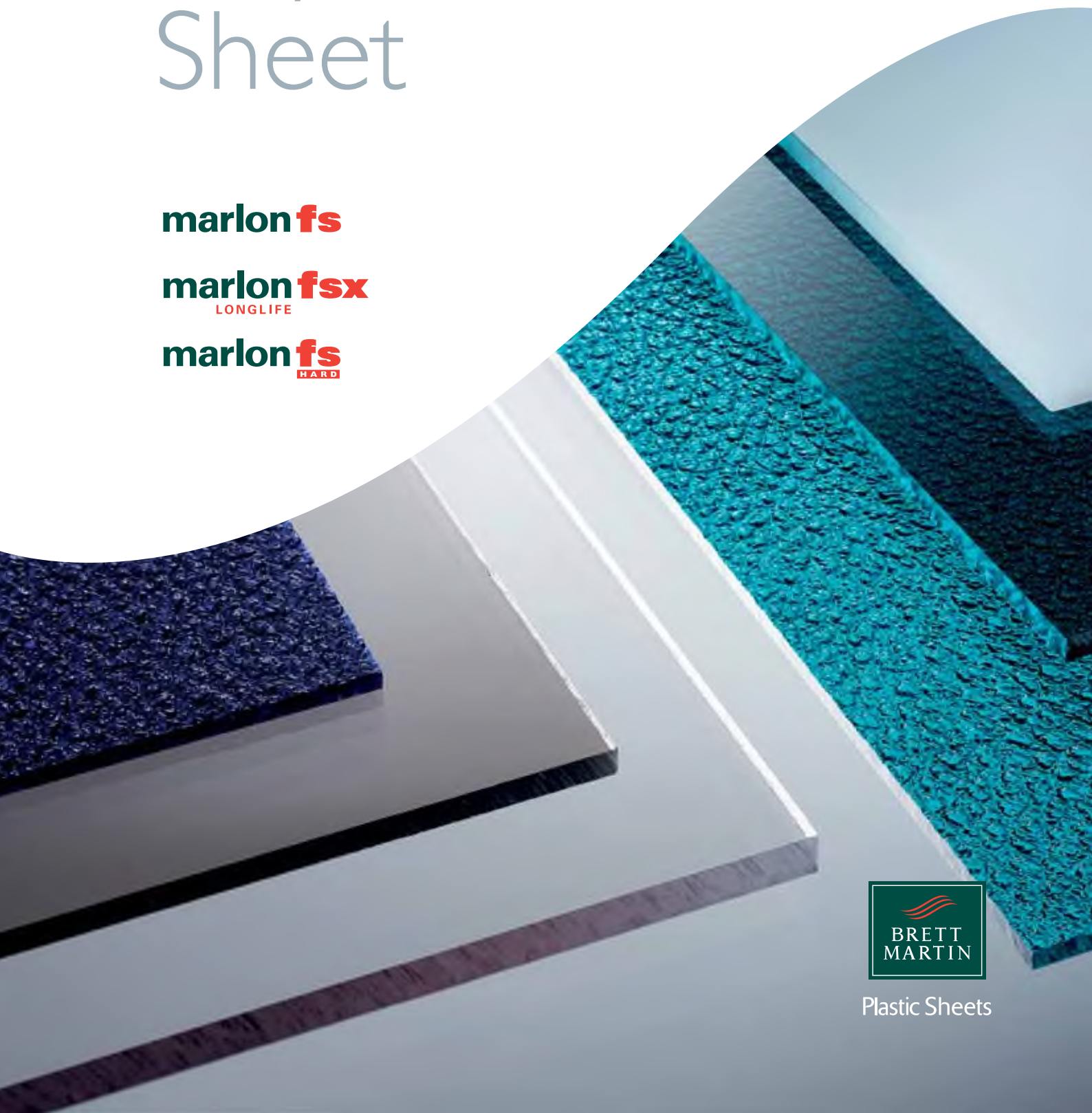
POLYCARBONATE
SHEET

Flat Polycarbonate Sheet

marlon**fs**

marlon**fsx**
LONGLIFE

marlon**fs**
HARD



Plastic Sheets

Marlon FS is a clear extruded flat polycarbonate glazing sheet that provides 200 times more impact resistance than glass, at only half the weight.

marlon fs



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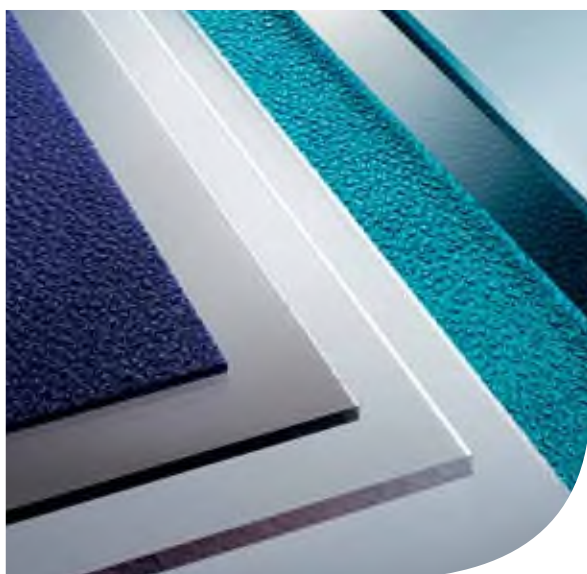
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marlon fs

Flat polycarbonate sheet

MARLON FS FLAT POLYCARBONATE SHEET OFFERS A UNIQUE COMBINATION OF MATERIAL PROPERTIES THAT MAKES IT SUPERIOR TO OTHER THERMOPLASTIC MATERIALS OR GLASS, MAKING IT THE IDEAL PRODUCT FOR ROOFING, GLAZING AND FABRICATION.

It provides unbeatable impact resistance, 200 times stronger than glass, providing protection against breakage and shattering. It easily withstands a blow of a hammer, hence it is extremely suitable for use in safety glazing applications, in vandal prone areas or in applications which require enhanced shatter resistance protective screening.



Marlon FS provides high impact resistance without compromising light transparency as this is the same as glass. Yet at only half the weight, it's easier to handle and install and remains flexible enough to be thermoformed, cold bent or fabricated offering brilliant design flexibility.

Marlon FS flat polycarbonate protects against damaging UV radiation as it offers a co-extruded UV protective layer on both sides of the sheet. As a result it can be used in the toughest climate conditions with enhanced protection against the effects of weathering and UV radiation, increasing sheet life expectancy and durability.

Marlon FS is available in a range of clear, translucent, opal, embossed and colour tinted options that offer different levels of light transmission and light diffusion. The embossed finish prevents glare due to the uniform dispersion of light over a large area, obscures views for added privacy and reduces visibility of scratches.



marlon fs

marlon fsx
LONGLIFE

marlon fs
HARD

TYPICAL PROPERTIES INCLUDE:

RESISTANT TO IMPACT
LONGLIFE UV PROTECTION
HIGH NATURAL LIGHT TRANSMISSION
LIGHTWEIGHT & EASY TO INSTALL

DESIGN FLEXIBILITY
ENERGY SAVING
EXCELLENT FIRE PERFORMANCE
10 YEAR WARRANTY



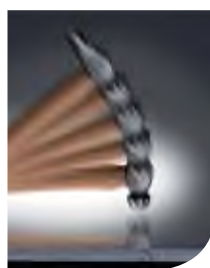
Material benefits



HIGH IMPACT RESISTANCE & SECURITY

Marlon FS flat polycarbonate sheet is a superior glazing solution particularly where safety and impact resistance is of importance. It is shatter resistant and is ideal for areas where high performance and reliability are essential.

In addition Marlon FS Hard contains an innovative protective coating that has been specially formulated to enhance abrasion and chemical resistance.



- Legendary strength 200 times greater than glass it is virtually unbreakable
- Superior toughness to protect those areas where high performance and reliability are essential
- High natural light transmission without compromising strength
- Hard coated options provide advanced abrasion resistance protecting against vandalism and graffiti
- Increased resistance to chemicals



UV PROTECTION & WEATHERABILITY

Marlon FS is available with a high performance longlife UV absorption layer co-extruded on both sides of the sheet. This layer prevents UV rays from penetrating the sheet, protecting people by cutting out 98% of the damaging UV radiation.

It also protects the sheet against the longterm effects of UV weathering making it the ideal material for external use, even in extreme weather conditions as the sheet retains its strength and clarity for longer.



- Protects people against harmful UV radiation
- Enhanced sheet life expectancy: prevents against yellowing, guards against loss of strength and light transmission
- Ideal product for external use in the toughest climate conditions

Material benefits

EXCELLENT LIGHT TRANSMISSION & SOLAR CONTROL

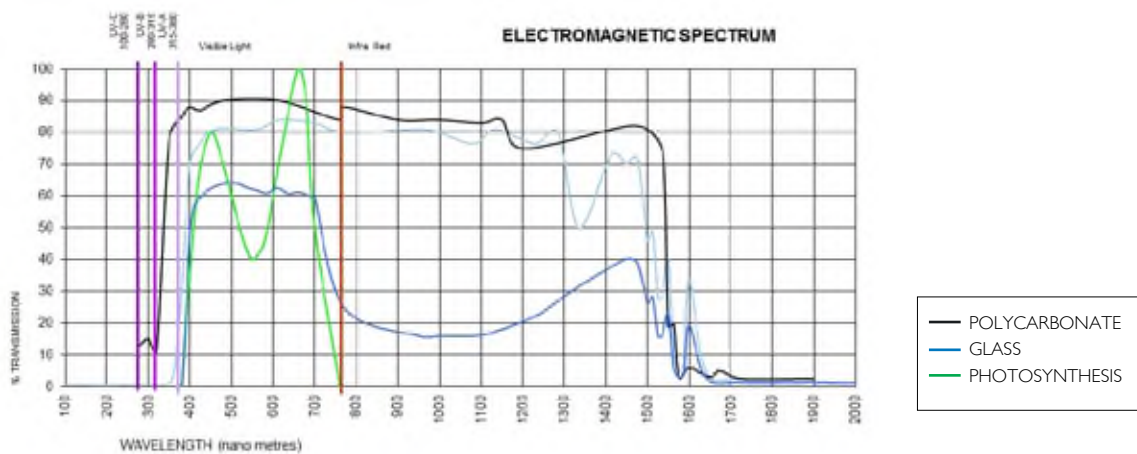
Marlon FS flat polycarbonate is available in a range of tints, colours and finishes that offer different levels of light transmission and light diffusion depending on the designer or specifier's requirements.

Clear sheet provides high optical clarity, making it the ideal glazing option for those applications that require high levels of light transmission. Depending on sheet thickness, clear Marlon FS offers exceptional light transmissions of between 80% and 92%.

Marlon FS is also available in tinted options including bronze, opal, green, blue and grey offering varying degrees of solar control, resulting in cooler internal environments. Whilst solar transmission is reduced, the sheet continues to transmit free natural light, reducing the need for artificial light, helping reduce energy cost and associated CO₂ emissions.



ELECTROMAGNETIC SPECTRUM



EXCELLENT FIRE PERFORMANCE

The fire performance of Marlon FS/FSX has been independently tested. For the most up to date certifications please contact the technical department.



Material benefits



LIGHTWEIGHT & EASY TO INSTALL

The weight of Marlon FS flat polycarbonate is only half that of plate glass, making handling and installation ultimately more convenient. The strength and rigidity of Marlon FS, FSX and FS Hard enhance the spanning capability, making the sheet self-supporting, resulting in reduced requirements for support structures and increased resource efficiency. The material is extremely practical and can be cut on site to the required shape or size, minimizing waste.

Marlon FSX features UV protection on both sides of the sheet which can help reduce both installation time and unnecessary losses due to incorrect installations.



DESIGN FLEXIBILITY

Marlon FS flat polycarbonate sheet provides excellent design flexibility. It can be cut, cold curved or thermoformed, without losing impact strength or durability, enabling the designer to create interesting glazing solutions for a bright naturally lit interior environment. It is the ideal glazing solution for covered walkways, canopies, skylights, domes, bus shelters and train windows.

In addition, Marlon FS flat polycarbonate can be screen printed directly and the smooth and even surface makes it ideal for vinyl adhesion. It has a great bonding compatibility and its resistance to knocks and scratches makes it perfect for use in high traffic areas and applications including signs, point of sale and store fixtures.



WARRANTY

Marlon FSX carries a limited 10 year warranty relating to breakage and light transmission. Marlon FS Hard carries a limited 10 year warranty relating to breakage and a limited 5 year warranty for light transmission and coating. For further information, contact the technical department.



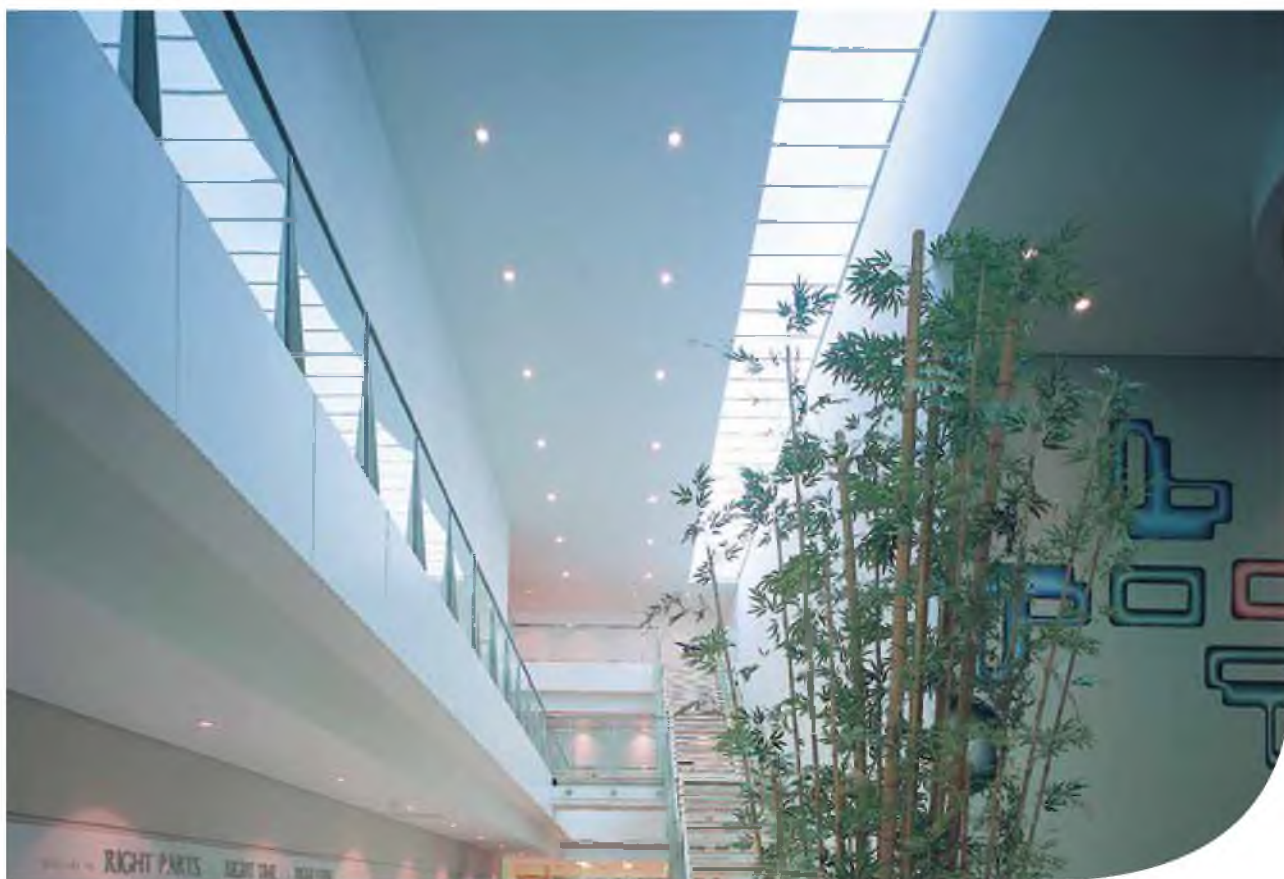
Product Range

The **Marlon FS** range contains 3 key products:
Marlon FS, a clear transparent flat polycarbonate, **Marlon FSX** with standard UV protection on both sides of the sheet and **Marlon FS Hard** that includes an abrasion resistant and chemical resistant coating.

marlon fs

marlon fsx
LONGLIFE

marlon fs
HARD

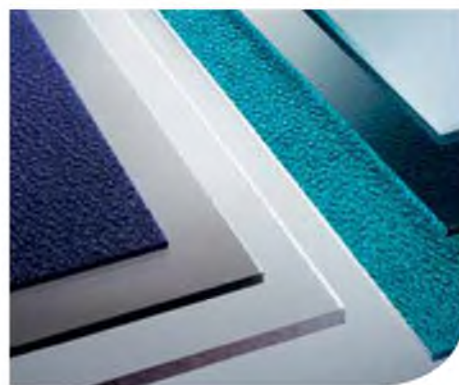


marlon fs

FLAT POLYCARBONATE SHEET

Marlon FS is a premium quality extruded flat polycarbonate sheet that is characterised by high impact resistance, excellent strength to weight ratio, optical clarity, light transmission, durability, design flexibility, thermal insulation and fire resistance.

Marlon flat polycarbonate sheet provides a superior glazing solution to that of other materials. It is available in clear for maximum light transmission, clear embossed and a range of tints including bronze, green, blue, opal and grey which offer additional solar control.



Colours and tints:	Clear, Opal, Bronze and specials* including Green, Blue & Grey
Widths:	Widths up to 2050mm
Thicknesses:	0.75, 1, 1.5, 2, 3, 4, 5, 6, 8, 10, 12 & 15*mm
Options*:	Embossed texture, single sided UV protection, Strong Adhesion Film
Specials*:	Special transparent, translucent & opaque options are available on request
Sheet weight:	3.6kg/m ² (3mm)
U-value:	5.41 W/m ² °K (3mm)

*Subject to request. Minimum order quantities may apply.
Please contact Brett Martin for further information.





marlon fsx
LONGLIFE



UV PROTECTED FLAT POLYCARBONATE SHEET

Marlon FSX Longlife features a co-extruded UV protection on both sides of the sheet cutting out 98% of the harmful UV radiation, making it the ideal product for use in some of the worlds' toughest climate conditions. The UV protective layer enables longer sheet life expectancy, prevents yellowing and guards against loss of strength. Combined with high impact and chemical resistance, light weight and high light transmission, Marlon FSX is the superior glazing material for architectural rooflights, vertical glazing and specialist glazing applications.

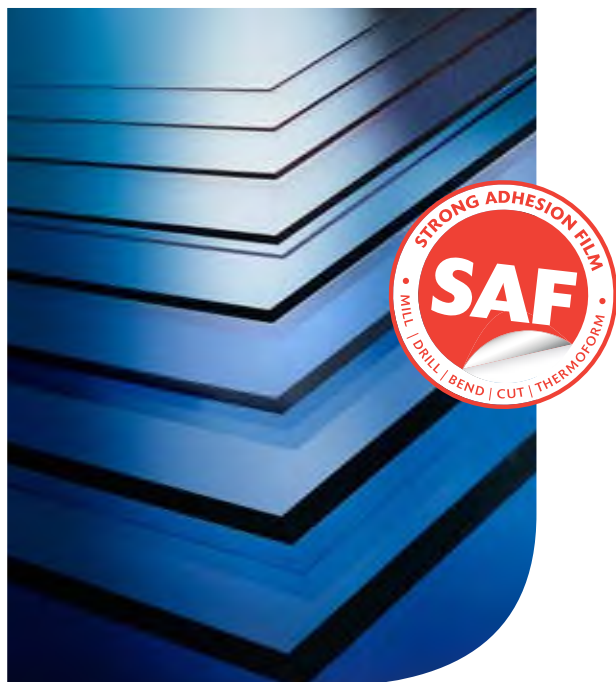


Colours and tints:	Clear, Opal, Bronze and specials* including Green, Blue & Grey
Widths:	Widths up to 2050mm
Thicknesses:	0.75, 1, 1.5, 2, 3, 4, 5, 6, 8, 10, 12 & 15*mm
Options*:	Embossed texture, Strong Adhesion Film
Specials*:	Special transparent, translucent & opaque options are available on request
Sheet weight:	3.6kg/m ² (3mm)
U-value:	5.41 W/m ² °K (3mm)

*Subject to request. Minimum order quantities may apply.
Please contact Brett Martin for further information.



Marlon polycarbonate flat sheet carries different limited warranties within the product range. Please contact the technical department for further information.



TYPICAL APPLICATIONS

- Machine protection
- Tanks
- High pressure applications around machine engineering
- Applications where high strength impact is required



STRONG ADHESIVE FILM (SAF)

Film Colour:	Transparent
Film Width:	2050mm
Thicknesses:	For use on 2, 3, 4, 5, 6, 8, 10, 12 & 15*mm
Sheet Range:	For use on Marlon FS & Marlon FSX Longlife

**Subject to request. Minimum order quantities may apply.
Please contact Brett Martin for further information.*

Strong Adhesion Film

A Strong Adhesion Film (SAF) is available for the Marlon FS and Marlon FSX polycarbonate product ranges, specifically aimed at high-end engineering and fabrication projects that require extra protection during repeated processing, including drilling, 3D milling, warm & cold bending, thermoforming and cutting.

The polycarbonate sheets that are used for these heavy fabrication projects, often go through different or aggressive mechanical processes before the end product is made. SAF ensures that our polycarbonate sheet withstands these rigorous fabrication processes and protects the surface from scratching and abrasion at all times.

ULTIMATE SHEET PROTECTION

SAF is a durable and much heavier film that provides outstanding surface protection particularly for the thicker range polycarbonate sheets (5-15mm) that can be more difficult to handle and that have more potential to score during handling, fabrication and storage. The film is applied to both sides of the sheets, ensuring maximum protection.

HIGH ADHESION LEVEL

Offering an adhesion level that is three times higher than standard film, SAF remains in place and intact during fabrication. It maintains its adhesion level and offers sufficient tack for reapplication in case the film needs to be peeled back. The film offers a good joggability and is easy to remove, even after thermoforming, without leaving residue.

SAF is glue-free, enabling the polycarbonate sheets to be used for warm bending and shallow thermoforming. In addition it is particularly suitable for cutting, cold bending and digital printing. It has a clear finish so the product remains visible.

Combined with the benefits of SAF, the Marlon FS and Marlon FSX Longlife polycarbonate ranges that provide high impact resistance at only half the weight of glass, high natural light transmission, optical clarity and abrasion resistance now offer the ideal choice for high end mechanical engineering projects.

BENEFITS

- High adhesion level, 3 times higher than standard range
- Stays on during fabrication
- Ultimate sheet protection
- Good joggability
- Increased protection during heavy fabrication
- Glue-free, for use in warm bending and thermoforming
- Double sided film protects both sides





marlon **fs** HARD

ABRASION RESISTANT FLAT POLYCARBONATE SHEET

Marlon FS Hard is an extruded polycarbonate flat sheet combined with an abrasion and chemical resistant coating. The highly resilient and abrasion resistant surface coating resists marks and scratches, vandalism, graffiti and physical attack and also withstands contact from a wide range of cleaning agents, organic solvents and corrosive elements.

Marlon FS Hard offers a superior toughness for those areas where high performance and reliability are essential whilst providing high natural light transmission. Combined with its shatter and splinter resistance it is much safer than glass, making it the ideal safety glazing solution for high traffic areas including bus stops, traffic signage, commercial glazing, schools and other public and commercial areas.



Marlon polycarbonate flat sheet carries different limited warranties within the product range. Please contact the technical department for further information.



IMPACT
RESISTANCE



CHEMICAL
RESISTANCE

ABRASION RESISTANCE (ASTM D 1003)

MATERIAL	CYCLES	HAZE CHANGE (%)
Uncoated	100	29.5
Hard coated	100	3 - 6
	500	<12
	1000	<20

Colours and tints:	Clear and specials* including Opal, Bronze, Green, Blue & Grey
Widths:	Widths up to 2050mm
Thicknesses:	3, 4, 5, 6, 8, 10, 12 & 15*mm
Options*:	Single or Double sided UV protection**
Specials*:	Special transparent, translucent & opaque options are available on request
Sheet weight:	3.6kg/m ² (3mm)
U-value:	5.41 W/m ² °K (3mm)





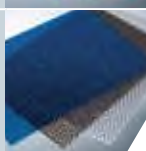
*Subject to request. Minimum order quantities may apply.

**Minimum order quantities apply to one side UV protection. Please contact Brett Martin for further information.

Product Options

Marlon flat polycarbonate is available in a range of clear, translucent, opal and colour tinted options that offer different levels of light transmission, light diffusion and solar radiation. It is also available in an embossed finish to prevent glare, obscure views for added privacy or to reduce the visibility of scratches.

COLOUR / TINT OPTIONS

COLOUR/ TINT	DESCRIPTION	LIGHT TRANSMISSION	PRODUCT
Clear	Similar light transmission to glass, between 90 - 92% natural daylight. Ideal for architectural and vertical glazing projects and safety and security applications that require high levels of transparency.	High	
Bronze	Transmits between 50% - 53% light. Ideal for those projects that don't need complete transparency but still require visible light.	Medium	
Opal	Transmits 35%. Ideal for those projects that don't need complete transparency but still require visible light.	Medium	
Embossed	Embossed finish prevents glare due to the uniform dispersion of light over a large area. It obscures the view for added privacy and reduces visibility of scratches. All colours can be provided with an embossed finish.	Varies by tint	
Diamond Embossed*	Offers a deeper, stronger and more uniform prismatic pattern than standard embossed finish, especially designed to provide excellent light diffusion without compromising impact strength. Available in Clear, Bronze and Blue it can also be used for added privacy.	Varies by tint	

*Subject to request. Minimum order quantities may apply. Please contact Brett Martin for further information.

PRODUCT RANGE

PRODUCT	PRODUCT DESCRIPTION
Marlon FS	Flat sheet polycarbonate
Marlon FSX Longlife	Flat sheet polycarbonate with UV Protective Coating on 2 sides
Marlon FS Hard	Flat sheet polycarbonate with Abrasion and Chemical Resistance Coating on 1 or 2 sides

STANDARD DIMENSIONS*

PRODUCT	SHEET SIZE (mm)	SHEET THICKNESS
Marlon FS	1220 x 2440 1250 x 2500 2050 x 3050	3, 4, 5, 6 0.75, 1, 1.5 2, 3, 4, 5, 6, 8, 10, 12
Marlon FSX Longlife	1220 x 2440 2050 x 3050 2050 x 6110	3, 4, 5, 6 2, 3, 4, 5, 6, 8, 10, 12, 15 2, 3, 4, 5, 6
Marlon FS Hard	2000 x 3000	3, 4, 5, 6, 8, 10, 12

Standard dimensions on offer. Other sheet size and thickness combinations are subject to request. Minimum order quantities may apply.



Applications

Marlon FS polycarbonate flat sheet offers solutions for a wide range of applications.

SAFETY & SECURITY



It can be used for:

- Protective Visors
- Security Glazing
- Prison Windows
- Machine Guards
- Vending Equipment
- Shields for Police & Security Forces
- Train Windows
- Guard Rails
- Bus Shelters
- Clean Rooms



CONSTRUCTION / GLAZING



It can be used for:

- Architectural Roofing
- Sunrooms
- Covered Walkways & Canopies
- Vertical Glazing
- Protective Screens
- Sound Barriers
- Interior Partitions
- Skylights
- Greenhouses
- Car Ports



Applications

Marlon FS polycarbonate flat sheet is an ideal substrate for display or fabrication.

PRINT & DISPLAY



It can be used for:

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Working with Marlon FS

Light in weight, **Marlon FS** is easy to handle and install across a wide array of applications. It's recommended to use the following fabrication and installation guidelines when working with **Marlon FS**.

WARNING

The following precautions should be observed: Always wear gloves when handling Marlon flat polycarbonate sheeting. Take great care when handling sheets in windy conditions.

SERVICE TEMPERATURE

Marlon FS, Marlon FSX Longlife and Marlon FS Hard can be installed in a diversity of applications, with varying temperatures. The materials mechanical performance is known to remain stable in prolonged service in temperatures ranging from -20°C to +100°C, short term unstressed from -40°C to +130°C.

STORAGE & HANDLING

Marlon FS, FSX and FS Hard sheets should be stacked horizontally, preferably on a continuous non-abrasive, flat, dry surface; on suitably constructed pallets or timber bearers at least 100mm wide spaced at intervals not exceeding 500mm. Stack heights should not exceed 1 metre. Sheets of differing length should not be placed on the same stack. Always store indoors where possible. If storage outdoors cannot be avoided then, particularly in the case of on-site storage while building construction progresses, a secure storage site should be provided, well away from foot and vehicle traffic and ongoing construction work. All sheets stored outdoors must be covered with a reflective, opaque, waterproof cover. Secure all covers to prevent the ingress of sunlight, wind and rain.

CUTTING / SAWING

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

Recommendations	Circular Saw	Band Saw	Milling Machine
Clearance Angle	20 - 30°	20 - 30°	20 - 25°
Rake Angle	15°	0 - 5°	0 - 5°
Cutting Speed	1800 - 2400m/min	600 - 1000m/min	100 - 500m/min
Feed Speed	19 - 25m/min	19 - 25m/min	0.1 - 0.5mm/rev
Tooth Spacing	2 - 5mm	1.5 - 2.5mm	—

**Notches adversely affect the mechanical properties of polycarbonate and should be avoided.*

DRILLING

When drilling Marlon FS flat polycarbonate sheets metal drills without a specially ground bit can be used, though a thermoplastic specific bit would be preferential. Do not use cutting oils.

Parameter	Values
Clearance Angle	5 - 8°
Tip Angle	90 - 130°
Helix Angle	Ca 30°
Rake Angle	3 - 5°
Cutting Speed	0.1 - 0.5mm/rpm
Drill Tip Speed	10 - 60m/min

Countersinking fixing is not recommended. Holes should be a minimum of 1.5 x hole diameter from the edge of the sheet. The hole diameter should be a minimum of 6mm larger than the fixing shank diameter for sheets up to 2m and an additional 3mm per meter length thereafter.

ROUTERING

It is easy to router either with hand held or CNC machines. Marlon FS can be machined on conventional milling machines with standard high speed tools. Notches adversely affect the mechanical properties of polycarbonate and should be avoided as these lead to cracking at a later stage. It is important that the part to be machined is securely held to prevent any vibration which would lead to a poor finish.

Cutters	Spindle Speed
6-12mm diameter or less	Ca 24000 rpm
> 12mm	Ca 18000 rpm

Light cuts are required to prevent the part from overheating. Overheating the polycarbonate can cause stress which may result in cracking the surface. Cooling the cutting tool and part with compressed air is typical as it also removes swarf. Do not use cutting fluids as this can chemical attack the polycarbonate.

Sharpened tools provide the best finish; HSS double-edged cutters are preferred, ground and honed with a back clearance angle of 12° or greater, although standard bits can also be used successfully. For thinner materials fluted cutters are preferred.

Avoid countersinking fixings and always use fixing threads if there is no alternative. Holes should be at least 1.5 x hole diameter from the edge of the sheet.

COLD CURVING

Marlon FS flat sheets can easily be cold curved. The minimum allowable radius for cold curved applications is the thickness of the sheet x 150. At low radii high stresses are built up in the material which will lower chemical resistance. For good design practice it is advisable to limit the minimum radius to 175x the sheet thickness. This incorporates a factor of safety to cope with the stress effects produced by curving and environmental stress factors. The table below shows the recommended minimum radii for various thicknesses.

Thickness (mm)	Min Radius (mm)
2	300
3	450
4	600
5	750
6	900
8	1200
10	1500
12	1800
15	2250

Marlon FS Hard should not be cold curved below 1500mm radius for all thicknesses up to and including 10mm.



HOT LINE BENDING

Pre-drying is not normally required. The recommended temperature is between 155°C and 165°C. The area of material to be heated must be approximately five times as wide as the sheet thickness. Up to and including 4mm thick can be bent when heated from one side only. Over 4mm it is necessary to heat from both sides. Bending sharp internal corners should be avoided. Always use a former radius at least equal to the **sheet thickness**.

THERMOFORMING

Before thermoforming, remove masking films and pre-dry at 120°C to remove absorbed moisture. Air circulation ovens with accurate temperature control are most efficient; air must circulate between sheets. Sheet age and storage conditions determine drying time. Dry storage can reduce pre-drying time in oven by up to one third; some experimentation is usually necessary. As moisture re-absorption starts when the dried sheet temperature falls below 100°C, thermoforming should be performed immediately after drying.

NB. Marlon FS Hard is NOT recommended for thermoforming

Sheet Thickness (mm)	Drying Time * at 120° (hr)
0.75	1
1	1
1.5	2
2	4
3	8
4	13
5	18
6	24
8	28
10	30
12	33
15	37

*Approximate: drying time may vary depending on storage equipment.

Marlon FS flat sheets can be moulded on any standard vacuum or pressure forming equipment. Forming can be made at temperatures between 175°C and 200°C. When the mould temperature falls below 125°C formed parts can be removed. Mould shrinkage will be between 0.5% and 1.0%.

VACUUM FORMING

Components that are relatively simple and shallow in form are thermoformable from sheet heated to an elastic state. Most industrial press and vacuum formers for thermoplastics are suitable. Best results are achievable from machines that controllably heat both sides of the sheet. Large area panels and thick panels need some air pressure support during heating to avoid sag. Male moulds are suitable for vacuum forming, female moulds for both vacuum and pressure forming. The following points should be taken into account when vacuum forming:

- Pre-drying is essential, remove film prior to drying.
- Sheets should be mounted vertically and air allowed to circulate.

- Pre-drying should be at about 120°C and the sheet thermoformed soon after, as moisture will gradually be re-absorbed when cooled below 100°C.
- If material has been correctly stored in a dry place, drying time can be reduced by one third.
- Pre-drying may be dispensed with if fast and effective heating is used e.g. infra-red heaters.
- Secure clamping of material during forming is essential to avoid shrinking.
- Heating to thermoforming temperatures of 175-200°C should be evenly applied to both sides of the sheet.
- Parts should be allowed to cool in the mould to below 125°C and components must be completely rigid before removal from the mould.

BONDING

The material can be bonded using one of the following adhesives: Epoxy, Polyurethane, Hot Melt or Silicone. Ask your adhesive supplier for the most appropriate type of adhesive for your particular application. Solvents such as Methylene Chloride give a good bond but can lead to stress cracking and are therefore not recommended.

PRINTING

Printing directly onto Marlon FS only is a regular process. Experimentation will usually be necessary in order to achieve the best results from a particular printing setup. Reverse printing is normally used to maintain the gloss surface on the exterior. This will also allow the use of non-UV stable inks.

Thorough cleaning of the sheet should be carried out prior to printing and an anti-static regime may be required for some printing methods. Most ink and paint manufacturers have a range of inks specifically for plastic substrates. Chemical compatibility of paint/ink systems with polycarbonate is paramount.

Recommendations:

- Clean the polycarbonate thoroughly before printing
- Use only recommended paints, inks and thinners
- Do not mix different paints and inks
- Do not substitute toluene, xylene, cellulose acetate, methylethylketones or other solvents for the recommended thinners
- Provide good ventilation during drying periods
- Follow the paint/ink manufacturers recommendations at all times especially items relating to health and safety

Printing cannot be carried out on Marlon FS Hard as the abrasion resistant coating will prevent permanent paint/ink adhesion.

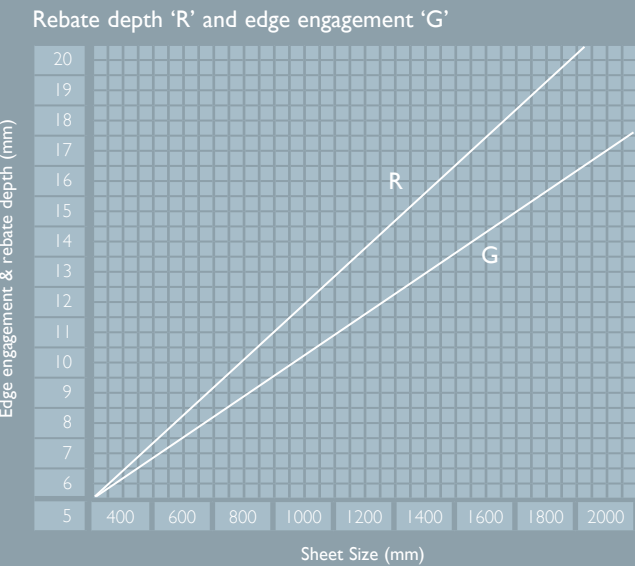
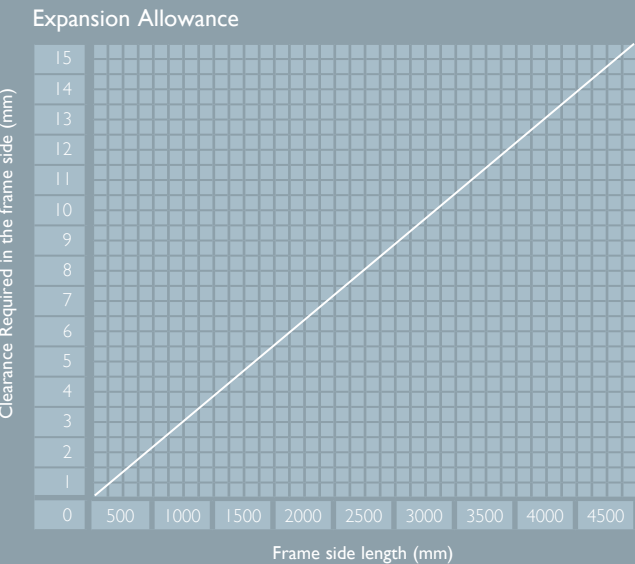
CLEANING

A mild detergent with lukewarm water and a soft cloth or sponge should be used to clean Marlon flat sheet. Always rise thoroughly with clean water. Ethyl Alcohol can be used to remove paint and other such substances. This should always be washed and rinsed thoroughly afterwards.

Installation

MARLON FS FLAT SHEETS CAN BE INSTALLED IN MOST TYPES OF FRAMES INCLUDING PVC, WOOD, STEEL AND ALUMINIUM. THE FRAMING SYSTEM MUST RETAIN THE SHEET BUT ALLOW THERMAL MOVEMENT.

Only compatible sealants must be used, including silicone, EPDM, neoprene or 'plasticiser free' chloroprene materials of proven performance. Please note that PVC gaskets are not compatible with polycarbonate.



EXPANSION ALLOWANCE

Care must be taken when cutting sheets to allow space for thermal expansion to avoid stress or bowing with temperature change (see table next page).

Allowance must be made in both length and width. In vertical installations the expansion allowance must be left at the top of the frame and at both sides.

EDGE ENGAGEMENT

Each rebate details must allow enough depth to include the expansion allowance plus a sufficient sheet edge engagement to prevent sheet 'pop-out' from the frame.

SHEET SIZING

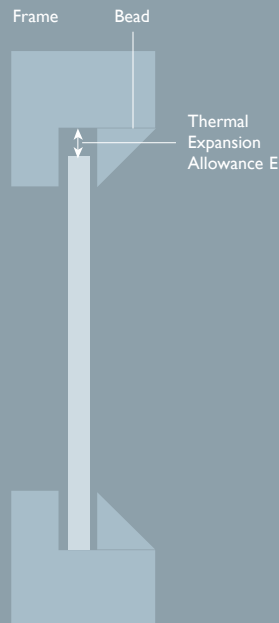
Use the table below to calculate the required trimming of Marlon FS flat sheets to allow for expansion dependent on the sash dimensions.

Sash Dimensions (mm)	Trim Marlon FS by 'E' (mm)
300-1000	3
1000-1300	4
1300-1700	5
1700-2000	6
2000-2300	7
2300-2700	8
2700-3000	9

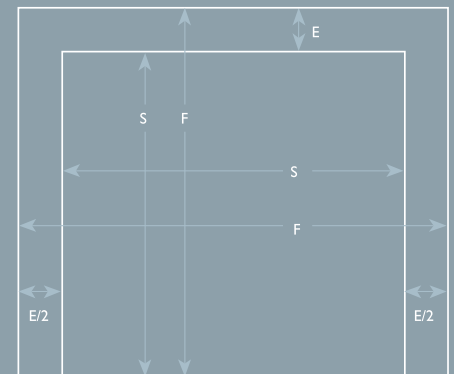
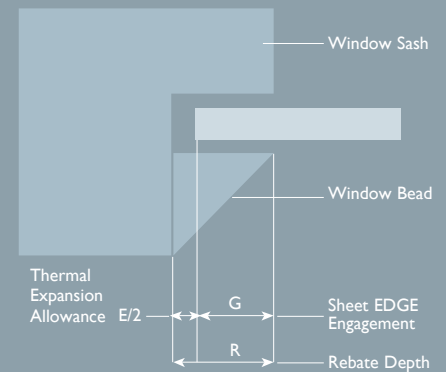
SHEET THICKNESS

The following charts indicate the required sheet thickness to maintain sheet deflection to a maximum of 50mm and assumes four side edge engagement. Having first calculated the effective area of the sheet, the required thickness for a given wind load can be selected. Guidance is also available from BS5516.

WINDOW SECTION



FRAME SECTION



Calculation of the effective sheet area

	SHEET LENGTH (m)																			
SHEET WIDTH (m)	0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5	2.75	3.0	3.25	3.5	3.75	4.0	4.25	4.5	4.75	5.0
0.25	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1
0.5	A1	A2	A3	A4	A4	A4	A4	A4	A4	A4	A4	A4	A4	A4	A4	A4	A4	A4	A4	A4
0.75	A1	A3	A5	A6	A7	A7	A7	A7	A7	A7	A7	A7	A7	A7	A7	A7	A7	A7	A7	A7
1.0	A1	A4	A6	A8	A9	A9	A10	A10	A10	A11	A11	A11	A11	A11	A11	A11	A11	A11	A11	A11
1.25	A1	A4	A7	A9	A10	A11	A12	A13	A13	A14	A14	A14	A14	A14	A14	A14	A14	A14	A14	A14
1.5	A1	A4	A7	A9	A11	A13	A14	A15	A16	A16	A16	A17	A17	A17	A17	A17	A17	A17	A17	A17
1.75	A1	A4	A7	A10	A12	A14	A16	A17	A18	A19	A19	A19	—	—	—	—	—	—	—	—
2.0	A1	A4	A7	A10	A13	A15	A17	A18	A19	—	—	—	—	—	—	—	—	—	—	—

Selection of sheet thickness in mm

Load kN/m ²	EFFECTIVE AREA																		
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19
0.6	3	3	4	4	5	5	6	6	8	8	10	10	10	10	10	10	12	12	12
0.8	3	3	4	4	5	6	6	6	8	8	10	10	10	12	12	12	12	12	-
1.0	3	4	4	5	5	6	8	8	8	10	10	10	10	12	12	12	-	-	-
1.2	3	4	4	5	5	6	8	8	8	10	10	12	12	-	-	-	-	-	-
1.4	3	4	5	6	6	8	8	8	10	10	12	12	-	-	-	-	-	-	-

Curved Installation

MARLON FS FLAT SHEETS CAN BE INSTALLED IN A CURVED GLAZING SYSTEM ON SITE, WITHOUT PRIOR FORMING. THE THICKNESS OF SHEET THAT MUST BE USED WILL DEPEND UPON THE CURVATURE AND THE SPAN, THE DISTANCE BETWEEN GLAZING BARS AND THE MAXIMUM LOAD THAT WILL BE APPLIED TO THE SHEETS.

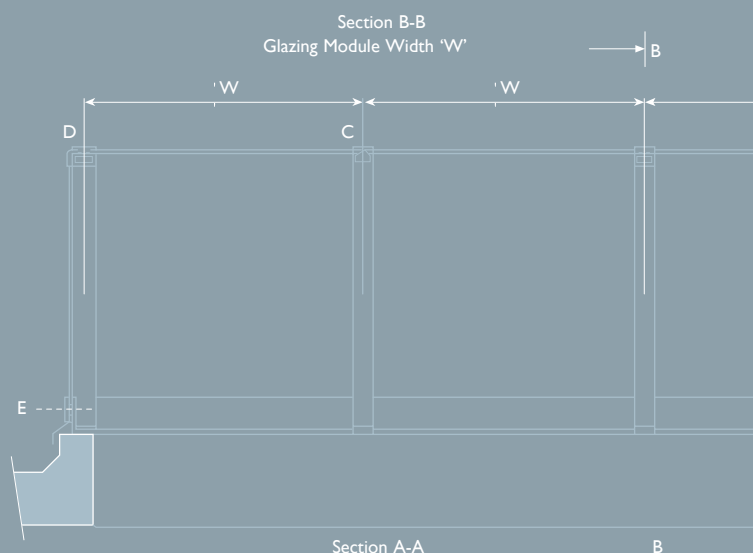
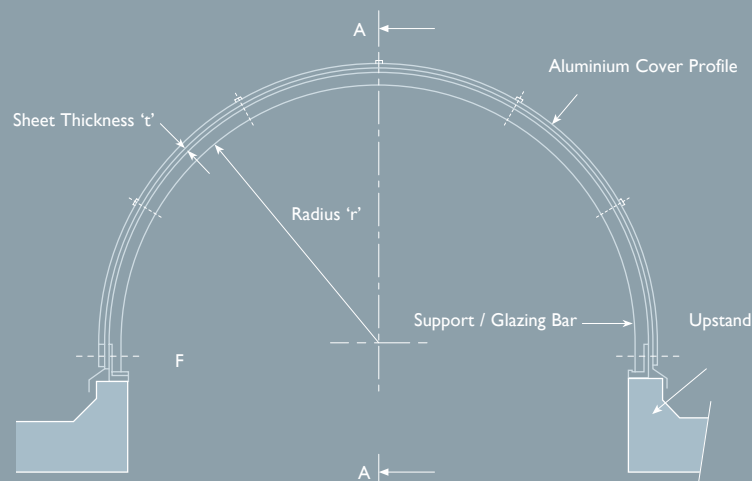
Each thickness has a minimum allowable radius.

Thickness (mm)	Min Radius (mm)
2	300
3	450
4	600
5	750
6	900
8	1200
10	1500
12	1800
15	2250

Marlon FS Hard minimum radius for all thicknesses = 1500mm

The critical load at which buckling will occur is a function of the geometry of the structure and the intrinsic properties of Marlon flat sheet.

A safety factor of 1.5 is applied in all cases.

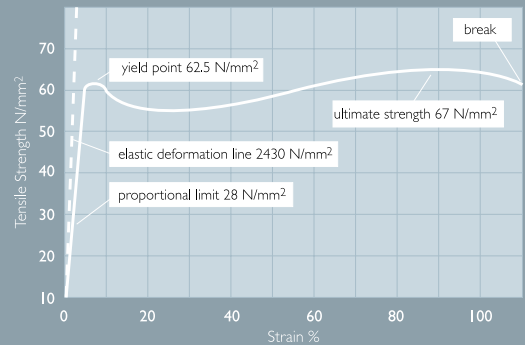


Properties of Marlon FS Polycarbonate

PROPERTIES		TEST METHOD	VALUE	UNITS
Mechanical	Tensile strength at yield	DIN 53455	>60	N/mm ²
	Tensile strength at break	DIN 53455	>70	N/mm ²
	Modulus of elasticity	DIN 53457	2300	N/mm ²
	Charpy notched impact strength	DIN 53453	>30	kJ/m ²
Physical	Density	DIN 53479	1.20	g/cm ³
	Refractive index	DIN 53491	1.586	
	Light transmission (3mm thick, clear)	DIN 5036	92	%
Thermal	Linear expansion coefficient	—	68x10 ⁻⁶	m/K
	Deflection temperature (load 1.81MPa)	DIN53461	135	°C
	Thermal conductivity	DIN52612	0.21	W/m.K
	Maximum service temperature	Permanent	100	°C
	Short term unstressed	Short term	130	°C

Tensile Strength

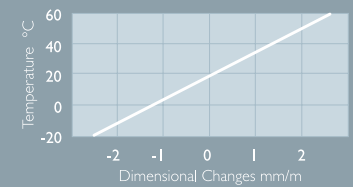
Measured on injection moulded test specimens



Light Transmission Marlon FS DIN5036

COLOUR CODE	0.75mm	1mm	1.5mm	2mm	3mm	4mm	5mm	6mm	8mm	10mm	12mm	15mm
Clear (S)	92%	92%	92%	92%	92%	92%	92%	90%	88%	80%	80%	80%
Clear (S embossed)	—	—	—	88%	—	—	—	82%	—	—	—	—
Bronze (CE)	—	—	—	—	50-53%	50-53%	47%	40%	—	—	—	—
Opal (FH)	—	—	—	—	35%	35%	—	—	—	—	—	—

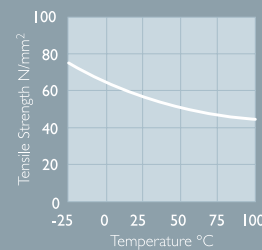
Thermal Expansion



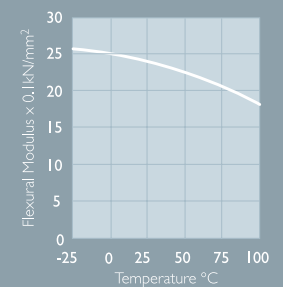
Thermal Transmittance - U value

Sheet Thickness (mm)	Marlon FSX (W/m ² K)	Glass (W/m ² K)
0.75	5.76	—
1	5.72	—
1.5	5.64	—
2	5.56	—
3	5.41	5.87
4	5.27	5.82
5	5.13	5.80
6	5.00	5.77
8	4.76	5.71
10	4.55	—
12	4.35	—
15	4.08	—

Tensile Strength v Temperature



Flexural Modulus v Temperature



Weight

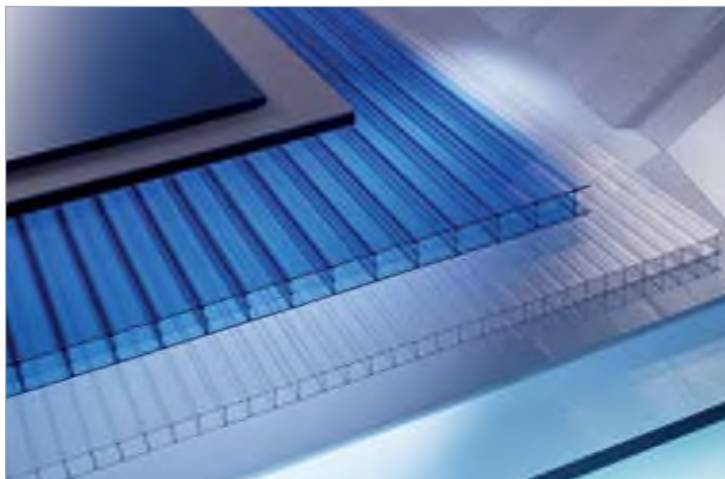
Sheet Thickness (mm)	Marlon FSX (kg/m ²)	Glass (kg/m ²)
0.75	0.9	1.80
1	1.2	2.50
1.5	1.8	3.75
2	2.4	5.00
3	3.6	7.50
4	4.8	10.00
5	6.0	12.50
6	7.2	15.00
8	9.6	20.00
10	12.0	25.00
12	14.4	30.00
15	18.0	37.50

At just about half the weight of glass, Marlon flat sheet offers savings in handling, transportation and installation.

Chemical Resistance Marlon FS Hard

CHEMICAL RESISTANCE SOLVENT	MARLON FS HARD
Ethanol (90%)	Long
Propanol	Long
Acetone	Short
MEK	Long
Petrol	Long
Dilute Ammonia	Medium
Dilute Caustic Soda	Short
Concentrated Caustic Soda	Short
Dilute Organic Acid	Long
Dilute Inorganic Acid	Long

Short Term Resistance Drop/spills, significant changes in physical properties.	Medium Term Resistance Some reduction in physical properties occurs.	Long Term Resistance No attack, little or no reduction in physical properties.
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Email: mail@brettmartin.com

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