Technical Manual

makrolon®
multi UV

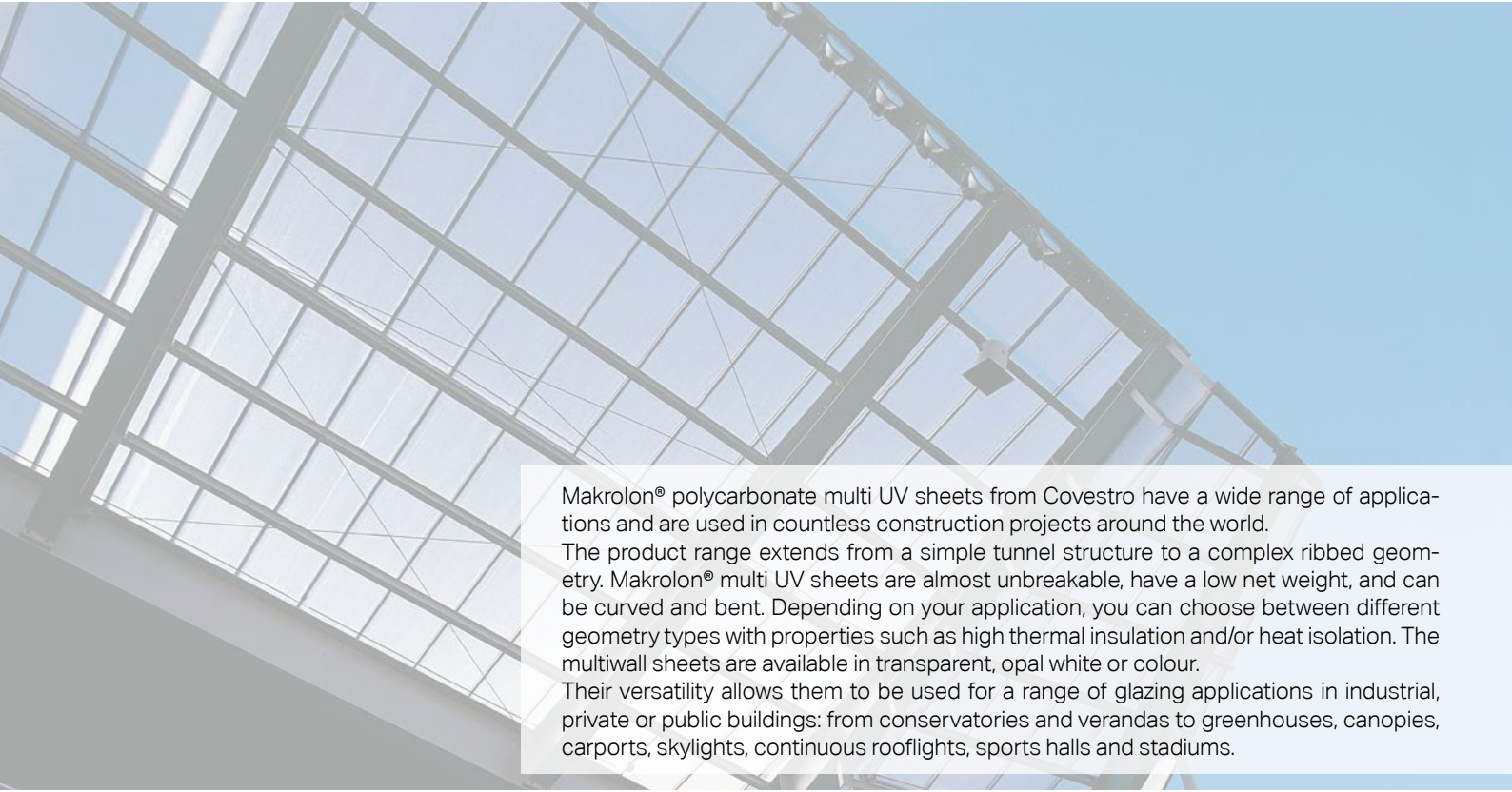
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makrolon®
multi UV

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Makrolon® polycarbonate multi UV sheets from Covestro have a wide range of applications and are used in countless construction projects around the world.
The product range extends from a simple tunnel structure to a complex ribbed geometry. Makrolon® multi UV sheets are almost unbreakable, have a low net weight, and can be curved and bent. Depending on your application, you can choose between different geometry types with properties such as high thermal insulation and/or heat isolation. The multiwall sheets are available in transparent, opal white or colour.
Their versatility allows them to be used for a range of glazing applications in industrial, private or public buildings: from conservatories and verandas to greenhouses, canopies, carports, skylights, continuous rooflights, sports halls and stadiums.

CONTENTS

1. THE POLYCARBONATE MULTIWALL SHEET 6

1.1 At a glance technical specification 6
1.2 Characteristics 8
1.3 Warranty 14
1.4 CE marking 15

2. STANDARD PRODUCT RANGE 18

3. MATERIAL PROPERTIES 21

4. CHARACTERISTICS 25

4.1 Impact strength 25
4.2 Light weight 27
4.3 Weathering resistance 27
4.4 Thermal insulation 28
4.5 Light transmission 28
4.6 Solar transmission 30
4.7 Fire behaviour 34
4.8 Smoke behaviour 35
4.9 Temperature resistance 37
4.10 Noise insulation 37
4.11 Chemical resistance 38

5. TRANSPORT AND STORAGE 41

5.1 Transport and handling 41
5.2 Storage 42

6. INSTALLATION 45

6.1 Installation considerations 45
6.2 Construction details 51
6.3 Preparations for installation 56
6.4 Important remarks 61

7. STATICS 67

7.1 Flat applications 69



1. THE POLYCARBONATE MULTIWALL SHEET

1.1 At a glance technical specification

Each grade designation shows the profile, colour, light transmission and additional properties of Makrolon® multi UV sheeting.

Additional properties (optional)	
IQ-Relax	energy selective
CC clear	ClimateControl, energy selective
no drop	no drop coating on 1 side
ES	extra strong
BF	Butterfly

Example:

Makrolon® multi UV	5X/16-25	white	1146

Brandname	Geometry	Colour	Definition (4 digits)
Makrolon® multi UV	**1st digit: layers** 2: twinwall 3: triplewall 4: 4-wall 5: 5-wall 7: 7-wall **Optional: structure** X: X-structure M: M-structure	clear white bronze green blue	**1st digit: properties** 1: 1 side UV-protected 2: 2 sides UV-protected 4: 1 side UV, 1 side no drop
	2nd digit: thickness e.g. 16: 16 mm thick 3rd digit: rib distance e. g. 25: 25 mm		**2nd digit: colour** 0 clear 1 white 2 orange 3 red 4 violet 5 blue 6 green 7 grey 8 brown/bronze 9 black
			3rd & 4th digit: approximate light transmission example: 1146 1 side UV-protected, white LT ~ 45 %

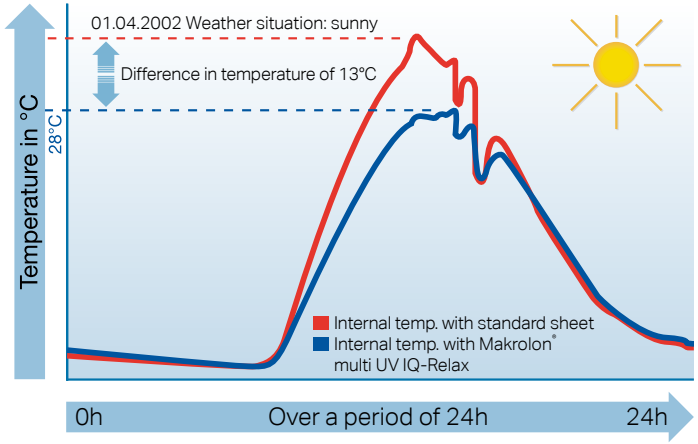


1.2 Characteristics

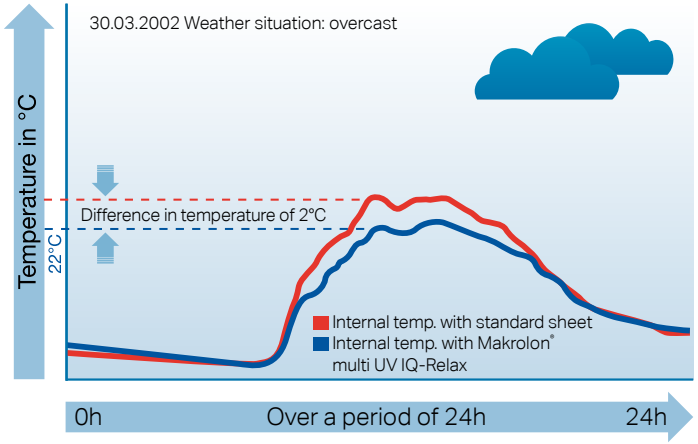
IQ-Relax – Energy selective
Makrolon® multi IQ-Relax comprises opal white sheets ideal for glazing applications in the roofs of closed buildings such as conservatories, winter gardens, pergolas or industrial buildings. They have a built-in 'intelligence' system that automatically adjusts to ambient conditions.
Compared with standard opal white sheets, Makrolon® multi IQ-Relax sheets have higher selectivity as they allow more light into a building, but less heat - giving you the best of both worlds!
However their reflective properties deflect the sun's rays, giving you the best of both worlds!

Tests in unventilated conservatories have shown remarkable heat reduction of up to 13°C compared with standard sheets. This guarantees pleasant room temperatures regardless of the weather. The extraordinary homogeneous gain in light results in a comfortable 'light ambience'. This will enable you to enjoy your conservatory or pergola for extended periods throughout the day and in every season.

In industrial buildings, energy management can be optimised, because less ventilation or air conditioning is required.



Evolution of inside temperature in an unventilated/unheated conservatory on a sunny day. The sheet reflects the sun's radiation and reduces heat build-up inside the room by more than 46%.



The sheet adapts to the climatic conditions and the heat insulating properties come into their own, while keeping the loss of light transmission to a minimum.



No drop
Some sheet types are available with a 'no drop'-coating. These sheets must be installed with this coating facing inwards.

The 'no drop'-coating of Makrolon® multi UV prevents damp air from forming droplets due to condensation. It disperses the condensation to a continuous film, which has minimal effect on the ability of the sheet to transmit light. Condensation flows off in a controlled manner, preventing random dripping and avoiding subsequent damage - for instance - to plants in greenhouses. The sheet dries quickly and without marks.

The 'no drop' functional layer is covered with a protective layer. This layer can be removed by washing with clear water or it will come off automatically after a while due to condensation on the sheet. The 'no drop layer' is only fully activated once the protective layer has been completely washed off.

This type of sheet is ideal for greenhouses and swimming pools.

ES – Extra strong
This type of sheet has increased layer thicknesses, which improve load-bearing characteristics and offer greater stability. They are available on request and can be adapted to special requirements in large-scale projects, such as football stadiums.


Makrolon® multi UV clear 4099 no drop.





ClimateControl clear

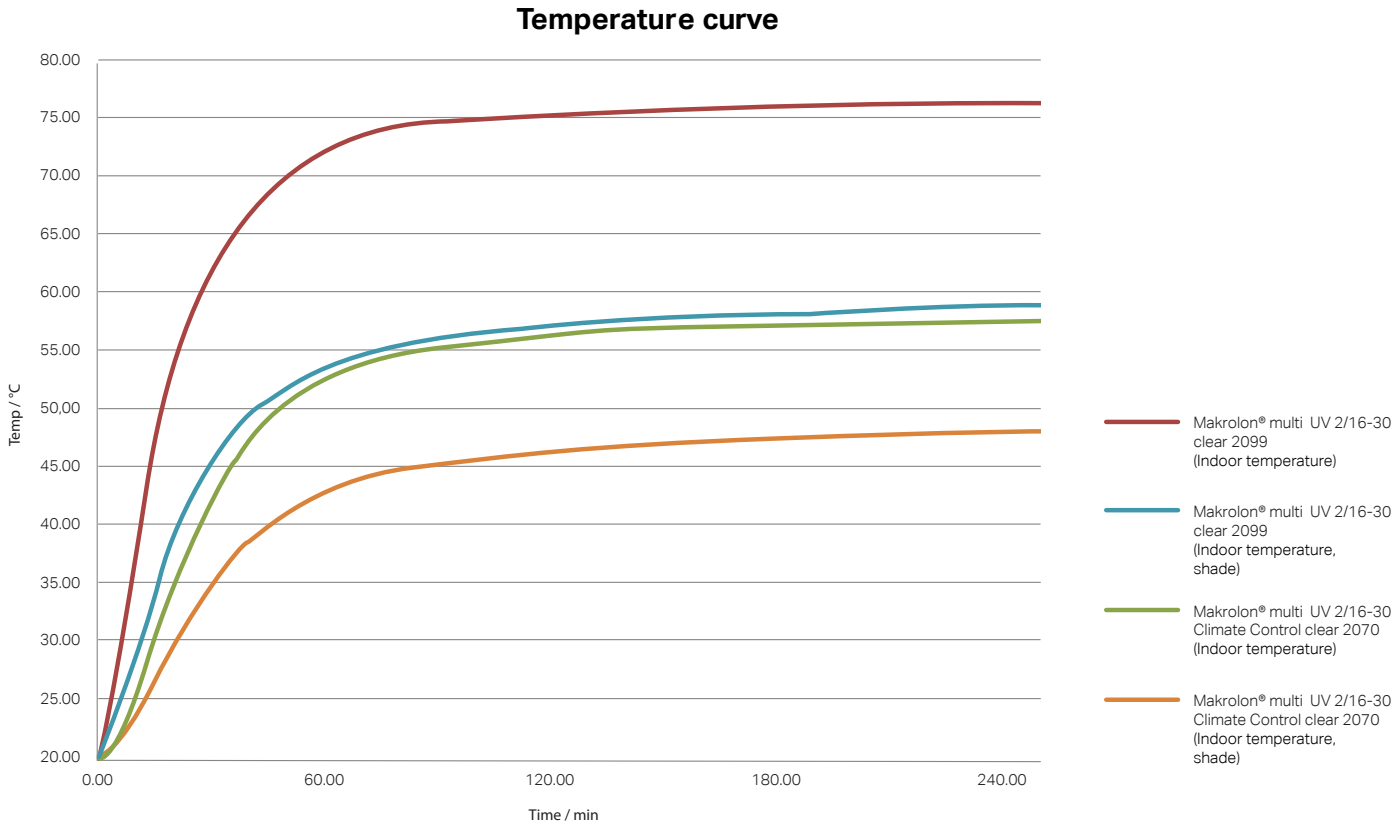
ClimateControl clear polycarbonate sheets absorb a large proportion of infrared light on both sides. They substantially reduce heat input while retaining a high level of light transmission.

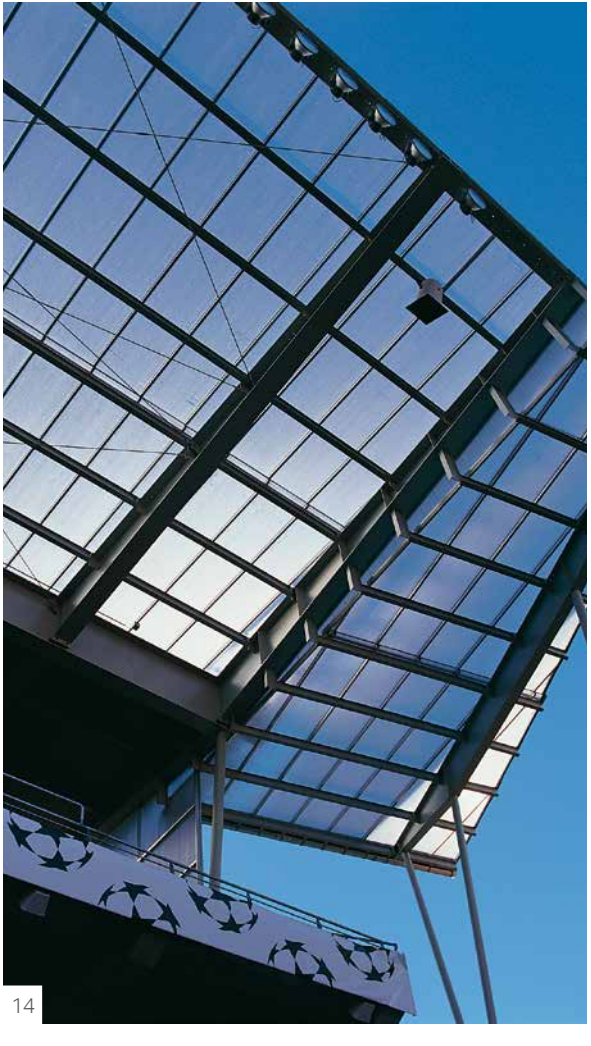
The sheets are suitable for any application where a comfortable room temperature needs to be matched with cool transparency and brightness.

The diagram across the page shows how the temperature curve develops with constant thermal radiation over a period 240 minutes (4 hours). Changes to both the general indoor temperature and the indoor temperature in the shade were measured.

The results speak for themselves: in a closed room fitted with standard Makrolon® multi UV 2/16-30 clear 2099 sheets, the indoor temperature under direct sunlight increases by 33% more than if Makrolon® multi UV ClimateControl clear 2070 is used. This corresponds to a temperature reduction of approx. 20°C.

Multiwall sheet





1.3 Warranty

Makrolon® multi UV comes with a up to twenty years warranty against weathering and hail. Its longevity is down to its protective coextruded layer, our stringent quality control on the raw materials used, and the quality of the production process. Artificial and natural weathering tests have shown that the sheets still have an excellent performance after twenty years, even under extreme climatic conditions.

A detailed warranty statement is available from your distributor or on our website www.sheets.covestro.com.

1.4 CE marking

The CE marking is a conformity marking applied to certain products. It indicates that a product corresponds to a European standard or technical specification. Many glazing system manufacturers mark their products in accordance with at least one of the following standards:

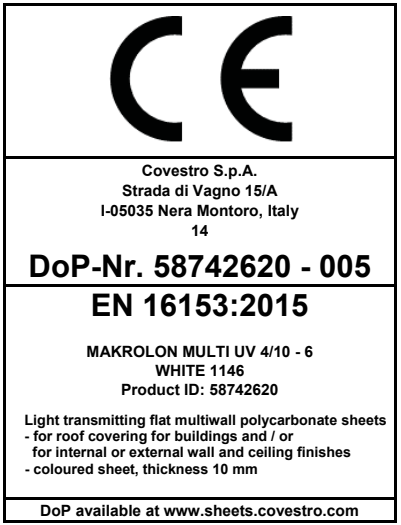
EN 1873 Prefabricated accessories for roofing. Individual rooflights of plastics. Product specification and test methods;
EN 14963 Roof coverings. Continuous rooflights of plastics with or without upstands. Classification, requirements and test methods
EN 12101 Smoke and heat control systems.

The manufacturer must ensure that all the components of their glazing systems meet the requirements of the relevant European standards, even if those components are obtained from other manufacturers.

As such, we mark our multiwall sheets in accordance with one of the following standards:

EN 16153 Light transmitting flat multiwall polycarbonate (PC) sheets for internal and external use in roofs, walls and ceilings. Requirements and test methods.

You can identify CE-marked sheets from the pallet marking. The relevant standard can be found on the sticker (in this case: EN16153:2015), as well as the so-called DoP number (in this case: 58742620 - 005).

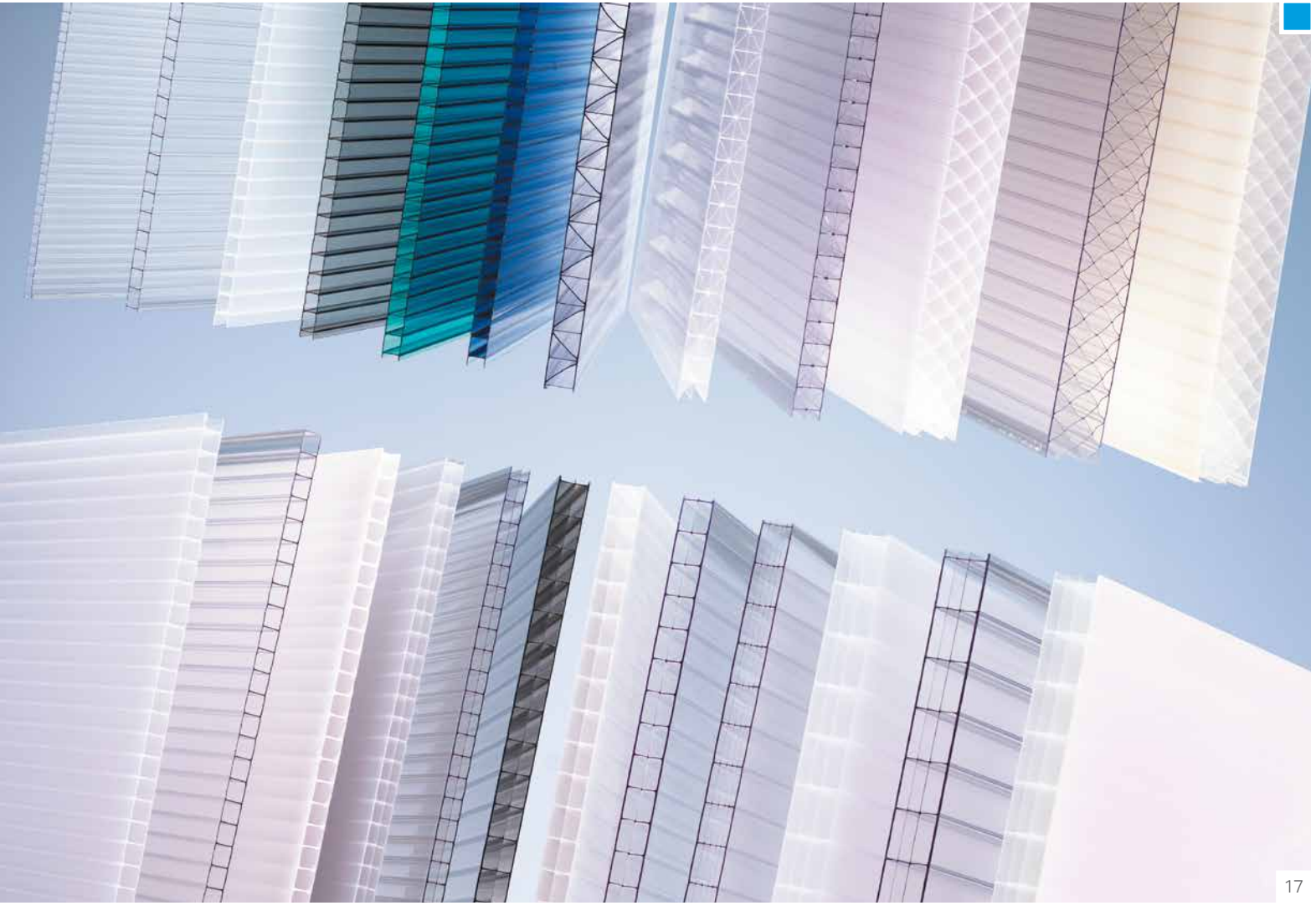


Example

DoP Number
DoP is short for Declaration of Performance. It contains a summary of the properties of a specific sheet (type, colour, thickness, weight) in accordance with EN 16153.
If you find the note "See inkjet on sheet" instead of the DoP number, you can find the DoP number with the information inkjet-printed directly onto the sheets. If no DoP number is available, it will be marked NPD (No Performance Determined) instead.

Sheets with no CE marking
There are two cases where pallets might not have any CE marking.
When customers supply special specifications or requirements that are not in accordance with the prescribed requirements of EN 16153 (e.g. certain special tolerances relating to the width or the length of the sheet), a CE marking is not permitted. As of 2015, multiwall sheets without a CE marking may no longer be delivered.
Customer-specific individual sheets made in our Cutting Centre cannot be be labelled by inkjet. This also applies to the corresponding CE label on the pallet marking.

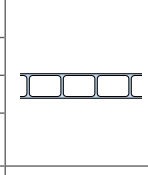
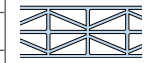
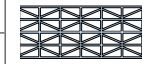
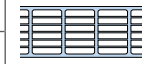
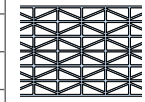
Accessing DoP documents
- Visit the homepage http://www.sheets.covestro.com/Products/Europe/DOP
- Enter the DOP number in the input field of the website in order to obtain the document in PDF format.



2. STANDARD PRODUCT RANGE

Our commitment to continuous product development means there are always new and improved products in the pipeline.
Multiwall sheets with a greater load bearing capacity or enhanced weather resistance for specific applications are available on request as well as sheets with different colours and different transmission values.

The diagrams in the chapter statics (see page 67) can help you determine which sheet type is best suited for your application.

Description	Profile	Thick-ness in mm	Weight in kg/m²	Width in mm	Colours	U_g-value in W/m²K EN-ISO-10077-2		Available Types
						vertical	horizontal	
Makrolon® multi UV 2/4-8		4	0.80	2100	clear, white	4.0	4.3	
Makrolon® multi UV 2/6-8		6	1.30	2100	clear, white, bronze, blue, green	3.5	3.8	2UV
Makrolon® multi UV 2/8-10,5		8	1.50	2100	clear, white, bronze, blue, green	3.3	3.6	no drop, 2UV
Makrolon® multi UV 2/10-10,5		10	1.70	2100	clear, white, bronze, blue, green	3.0	3.3	IQ Relax, no drop, 2UV, ES
Makrolon® multi UV 2/16-30		16	3.60	980, 1200	clear, white, bronze	2.8	3.0	no drop, 2UV, CC clear
Makrolon® multi UV 3/16-20		16	2.60	980, 1200, 2100	clear, white, bronze	2.2	2.4	no drop, 2UV, CC clear
Makrolon® multi UV 4/10-6		10	1.75	1200, 2100	clear, white	2.5	2.9	IQ Relax
Makrolon® multi UV 5X/16-25 BF		16	2.25	980, 1200, 2100	clear, white, bronze	2.0	2.1	IQ Relax, 2UV
Makrolon® multi UV 5X/16-25		16	2.40	980, 1200, 2100	clear, white, bronze	2.0	2.1	IQ Relax, 2UV
Makrolon® multi UV 5X/16-25 ES		16	2.70	980, 1200, 2100	clear, white, bronze	2.0	2.1	IQ Relax, 2UV
Makrolon® multi UV 5M/25-20		25	3.40	980, 1200, 1230	clear, white	1.4	1.4	IQ Relax, 2UV
Makrolon® multi UV 5M/32-20		32	3.70	980, 1200, 1230	clear, white	1.2	1.3	IQ Relax
Makrolon® multi UV 7/16-14		16	2.6	980, 1200, 2100	clear, white	1.8	1.9	IQ Relax
Makrolon® multi UV 7/20-14		20	2.85	980, 1200, 2100	clear, white	1.5	1.6	IQ Relax
Makrolon® multi UV 7M/16-28		16	2.6	980, 1200	white	1.72	1.81	IQ Relax
Makrolon® multi UV 7M/20-28		20	2.9	980, 1200	white	1.55	1.49	IQ Relax
Makrolon® multi UV 7M/25-28		25	3.3	980, 1200	white	1.28	1.33	IQ Relax
Makrolon® multi UV 7M/32-28		32	3.6	980, 1200	clear, white	1.09	1.13	IQ Relax
Makrolon® multi UV 7M/40-28		40	4.1	980, 1200	clear, white	0.95	0.98	IQ Relax
Makrolon® multi UV 7M/50-28		50	4.5	980, 1200	clear, white	0.84	0.86	IQ Relax



3. MATERIAL PROPERTIES

Makrolon® is synonymous with first-class sheets. They are made from polycarbonate and available in solid (GP) and multiwall (multi) format. Their versatility is such that they can be used in many applications and can withstand a large temperature range.

Makrolon® sheets are renowned for good transparency, extremely high break resistance and impact strength, high dimensional behaviour stability and good electric insulation. They also obtain excellent fire ratings (see the specific datasheets for more detailed information).

Thanks to the excellent extrusion expertise of Covestro, our comprehensive quality management system and our advanced production processes, the consistency of our sheets is certified in accordance with DIN ISO 9001/2.

	Test Conditions	Typ. Values	Unit	Test Method
Physical				
Density		1.2	g/cm³	ISO 1183-1
Moisture absorption	after storage in standard climate 24h/23°C/50% RH	0.15	%	ISO 62-4
Moisture absorption	after storage in water at 23°C until saturation	0.35	%	ISO 62-1
Refractive index	20°C	1.586	-	ISO 489
Mechanical				
Tensile stress at yield		> 60	MPa	ISO 527-2/1B/50
Elongation at yield		6	%	ISO 527-2/1B/50
Tensile strength		> 60	MPa	ISO 527-2/1B/50
Elongation at break		> 70	%	ISO 527-2/1B/50
Elastic modulus		2400	MPa	ISO 527-2/1B/1
Limiting flexural stress		ca. 90	MPa	ISO 178
Impact strength	Charpy, unnotched	no break	kJ/m²	ISO 179/1fU
	Charpy, notched	ca. 11	kJ/m²	ISO 179/1eA
	Izod, notched	ca. 10	kJ/m²	ISO 180/1A
	Izod, notched*	ca. 70	kJ/m²	ISO 180/4A
Thermal				
Vicat softening temperature	Method B50	148	° C	ISO 306
Thermal conductivity		0.2	W/mK	DIN 52612
Coeff. of linear thermal expansion		0.065	mm/mK	DIN 53752-A
Heat deflaction temperature under load	Method A: 1.80 MPa	127	° C	ISO 75-2
	Method B: 0.45 MPa	139	° C	ISO 75-2

* The mechanical properties were measured on solid sheets of 4 mm or 3 mm thickness.





4. CHARACTERISTICS

4.1 Impact strength

Hail impact
Makrolon® outperforms most other transparent materials on impact strength. Makrolon® multi UV sheets provide guaranteed protection against hailstones, due to the material's high impact resistance. This is why, all Makrolon® multi UV sheets have a 10-year warranty on weathering and hail resistance.
These outstanding properties have been proven in repeated hail simulation tests. In tests, pellets of 6.6 polyamide with a diameter of 20 mm (weight approx. 4.5 g) are shot at room temperature against the weathered surface of a sheet at a speed of 21 m/s, equivalent to a kinetic energy of 1 joule.
According to expertise, a natural hailstone of 23 mm in diameter has an average impact velocity of 17 m/s and a kinetic energy of 1 joule. However a hailstone study has concluded that the chances of experiencing hailstones of more than 10 mm in diameter in, for example, the Stuttgart area (Germany), are only around 2.9%. Hailstones of a greater diameter are even less frequent.

For detailed information on our warranty, please check our warranty statement, available at our distributors and on our website www.sheets.covestro.com.





4.2 Light weight

With area weights of 0.8 to 4.5 kg/m² Makrolon® multi UV sheets are notably light weight. They have been designed to offer optimal load-bearing characteristics at minimal weight. In roof glazing, for example, no massive supporting construction is necessary, which enables light and open constructions.
For special applications, such as stadiums, sheets with higher load bearing characteristics and higher weight per m² are available on request.



4.3 Weathering resistance

Makrolon® multi UV sheets are extremely weather-resistant because the sheets are produced with a coextruded UV-protective layer. This layer comprises the same basic material as the sheet material and is homogeneously fused with it. No delamination of the layer is possible, even after years of exposure to the elements or if the sheets are cold bended. The UV-protected side must be installed facing upwards/outwards.
This system has been extensively tested both in artificial weathering tests as well as in natural weathering under extreme climatic conditions. It provides Makrolon® multi UV with a highly effective protection against weathering, guaranteed up to 20 years.
For detailed information on our warranty, please check our warranty statement. This document is available at our distributors and on our website:
www.sheets.covestro.com



4.4 Thermal insulation

Makrolon® multi UV sheets offer much better heat insulation than single glazing, because of their special multiwall structure and low heat conductivity. This is measured as the U-value and depends on the number of chambers and the thickness of the air cushion: the more chambers and the thicker the air cushion, the lower the U-value.
In recent years, Covestro has continued to develop sheets with improved thermal insulation. This helps reduce the CO_2 outputs associated with global warming. This has resulted in several new types, such as 4-wall, 6-wall and 5M-wall sheets, which have lower Ug values than other sheets of the same thickness.

See the individual data sheets for more details or the table in chapter 2 (see page 18).

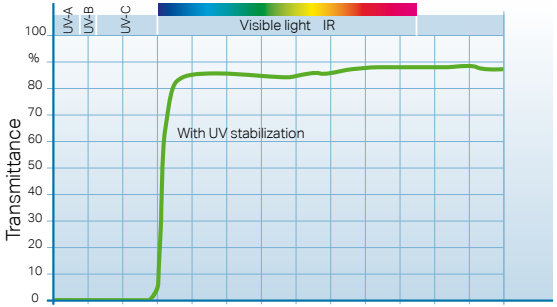
4.5 Light transmission

Makrolon® multi UV sheets have a light transmission value of up to 81%, depending on the structure, colour and thickness of the sheet (check the individual data sheets for more details). Makrolon® multi sheets are structured such that the transmitted light is dispersed homogeneously, preventing unpleasant light spots and hot spots.
Coloured and/or translucent sheets reduce light intensity and heat, which results in pleasant room climate and ambience.
Our newly developed opal white sheets (type 1146) offer improved light transmission, resulting in a more diffuse but brighter light, ideal for working environments.

Makrolon® multi IQ-Relax are opal white sheets, which dramatically reduce heat from sunlight, whilst allowing visible light to pass through. Real-life tests in unventilated conservatories have shown remarkable heat reduction of up to 13°C compared with standard sheets. This guarantees comfortable room temperatures regardless of the weather. More light, less heat!

Makrolon® multi UV ClimateControl clear sheets significantly reduce solar heat input, yet are fully transparent. Tests have shown a temperature reduction of approx. 20 °C compared to Standard Makrolon® multi UV sheets.

Makrolon® multi UV sheets absorb dangerous UV radiation (under 400 nm). These sheets are therefore ideal as continuous roof lights or in situations where protective glazing is needed to shelter materials sensitive to UV-light in factory units, museums or shopping centres.
However, plant growth is not negatively influenced by Makrolon® multi UV sheets, as they transmit the relevant light spectrum (PAR = photo active radiation). This important property means the sheets are well suited for applications such as greenhouses or football stadiums.



Solid sheet - Transmittance as a function of wavelength - Makrolon® clear transparent





4.6 Solar transmission

Sunlight is made up of visible light, UV-light and infra-red light. The infra-red light, which is invisible, is responsible for transferring heat from sunlight. The solar transmission shows the amount of heat transmitted by the sheet. This is expressed by the total energy transmission g; the lower the g-value, the less heat transmitted by the sheet, and the lower the heat build-up in the building.
Coloured sheets have a lower g-value, usually in line with their light transmission. Makrolon® multi UV IQ-Relax sheets have energy selective properties: they allow as much visible light as possible, while simultaneously reducing the g-value, resulting in more light and less heat (see also page 12).

Typical values of light transmission and solar heat transmission are shown below:

	light transmission tauD65	total energy transmission g	Shading Coefficient*
Makrolon® multi UV 2/4-8			
clear 1099	ca. 82 %	—	—
white 1146	ca. 80 %	—	—
Makrolon® multi UV 2/6-8			
clear 1099	ca. 82 %	—	—
white 1146	ca. 80 %	—	—
bronze 1845	ca. 51 %	—	—
Makrolon® multi UV 2/8-10,5			
clear 1099	ca. 81 %	—	—
white 1146	ca. 78 %	—	—
bronze 1850	ca. 48 %	ca. 62 %	ca. 71.3 %

(*) Shading coefficient = Total energy transmission/0.87

	light transmission tauD65	total energy transmission g	Shading Coefficient*
Makrolon® multi UV 2/10-10,5			
clear 1099	ca. 80 %	ca. 75 %	ca. 86.2 %
white 1146	ca. 70 %	ca. 69 %	ca. 79.3 %
IQ-Relax 1140	ca. 70 %	ca. 60 %	ca. 69 %
bronze 1850	ca. 41 %	ca. 58 %	ca. 66.7 %
Makrolon® multi UV 2/16-30			
clear 1099	ca. 77 %	ca. 74 %	ca. 85.1
white 1146	ca. 57 %	ca. 60 %	ca. 69 %
bronze 1850	ca. 70 %	ca. 54 %	ca. 52.9 %
CC clear	ca. 70 %	ca. 54 %	ca. 62 %
Makrolon® multi UV 3/16-20			
clear 1099	ca. 74 %	ca. 70 %	ca. 80.5 %
white 1146	ca. 62 %	ca. 62 %	ca. 71.3 %
IQ-Relax 1140	ca. 47 %	ca. 44 %	ca. 50.6 %
bronze 1850	ca. 30 %	ca. 49 %	ca. 56.3 %
Makrolon® multi UV 4/10-6			
clear 1099	ca. 68 %	ca. 65 %	ca. 74.7 %
white 1146	ca. 61 %	ca. 61 %	ca. 70.1 %
IQ-Relax 1140	ca. 52 %	ca. 49 %	ca. 56.3 %
bronze 1850	ca. 33 %	ca. 48 %	ca. 55.2 %
Makrolon® multi UV 5X/16-25			
clear 1099	ca. 64 %	ca. 61 %	ca. 70.1 %
white 1146	ca. 55 %	ca. 54 %	ca. 62.1 %
IQ-Relax 1140	ca. 47 %	ca. 45%	ca. 51.7 %
bronze 1850	ca. 27 %	ca. 45 %	ca. 51.7 %





	light transmission tauD65	total energy transmission g	Shading Coefficient*
Makrolon® multi UV 5M/25-20			
clear 1099	ca. 49 %	ca. 48 %	ca. 55.2 %
white 1146	ca. 40 %	ca. 42 %	ca. 48.3 %
IQ-Relax 1140	ca. 32 %	ca. 34 %	ca. 39.1 %
bronze 1850	ca. 13 %	ca. 32 %	ca. 36.8 %
Makrolon® multi UV 5M/32-20			
clear 1099	ca. 48 %	ca. 47 %	ca. 54.0 %
white 1146	ca. 38 %	ca. 41 %	ca. 47.1 %
IQ-Relax 1140	ca. 30 %	ca. 32 %	ca. 36.8 %
bronze 1850	ca. 12 %	ca. 31 %	ca. 35.6 %
Makrolon® multi UV 7/16-14			
clear 1099	ca. 55 %	ca. 53 %	ca. 61 %
white 1146	ca. 45 %	ca. 46 %	ca. 53 %
IQ-Relax 1140	ca. 38 %	ca. 38 %	ca. 44 %
Makrolon® multi UV 7/20-14			
clear 1099	ca. 55 %	ca. 52 %	ca. 60 %
white 1146	ca. 44 %	ca. 45 %	ca. 52 %
IQ-Relax 1140	ca. 38 %	ca. 38 %	ca. 44 %

(*) Shading coefficient = Total energy transmission / 0.87

	light transmission tauD65	total energy transmission g	Shading Coefficient*
Makrolon® multi UV 7M/16-28			
white 1146	ca. 34 %	ca. 35 %	ca. 40 %
IQ-Relax 1151	ca. 32 %	ca. 31 %	ca. 36 %
Makrolon® multi UV 7M/20-28			
white 1146	ca. 32 %	ca. 34 %	ca. 39 %
IQ-Relax 1151	ca. 30 %	ca. 29 %	ca. 33 %
Makrolon® multi UV 7M/25-28			
white 1146	ca. 31 %	ca. 33 %	ca. 37 %
IQ-Relax 1151	ca. 27 %	ca. 27 %	ca. 31 %
Makrolon® multi UV 7M/32-28			
clear 1099	ca. 39 %	ca. 41 %	ca. 47 %
white 1146	ca. 30 %	ca. 33 %	ca. 37 %
IQ-Relax 1151	ca. 26 %	ca. 28 %	ca. 32 %
Makrolon® multi UV 7M/40-28			
clear 1099	ca. 38 %	ca. 41 %	ca. 47 %
white 1146	ca. 28 %	ca. 33 %	ca. 37 %
IQ-Relax 1151	ca. 22 %	ca. 25 %	ca. 29 %
Makrolon® multi UV 7M/50-28			
clear 1099	ca. 38 %	ca. 39 %	ca. 47 %
white 1146	ca. 28 %	ca. 33 %	ca. 37 %
IQ-Relax 1151	ca. 23 %	ca. 27 %	ca. 31 %





4.7 Fire behaviour

Makrolon® multi UV sheets meet the stringent quality standards set by many different countries in the area of fire safety. In realistic large-scale fire tests, Makrolon® multi UV sheets have been rated as a flame-retarded construction material. This means that the material does not cause flame propagation, but it cannot be considered as a fireproof material.

Its self-extinguishing properties, low area weight and structure allow the sheet to soften in the event of fire. It then tears open and shrinks back from the fire source without spreading the fire itself. Smoke and heat dissipate through the opening which is formed, thus leading to a drastic temperature reduction in the room and, more critically, reduced load on the supporting structure. In effect, the sheet is acting as a heat extractor. Heat extractors relieve the thermal load on a building in temperatures of 300 °C or more in a fully developed and growing fire. The benefit is prolonged fire resistance.

In DIN 18230-1, Part 1 'Fire safety in industrial building constructions', roof and wall elements made of Makrolon® are included in the calculations as suitable heat extractors. The use of Makrolon® reduces the thermal load on the building and the fire resistance required of building components. This needs to be evaluated with fire safety engineering methods as part of an overall fire safety concept for a specific building. Remember also to check local regulations to see such a construction is allowed.

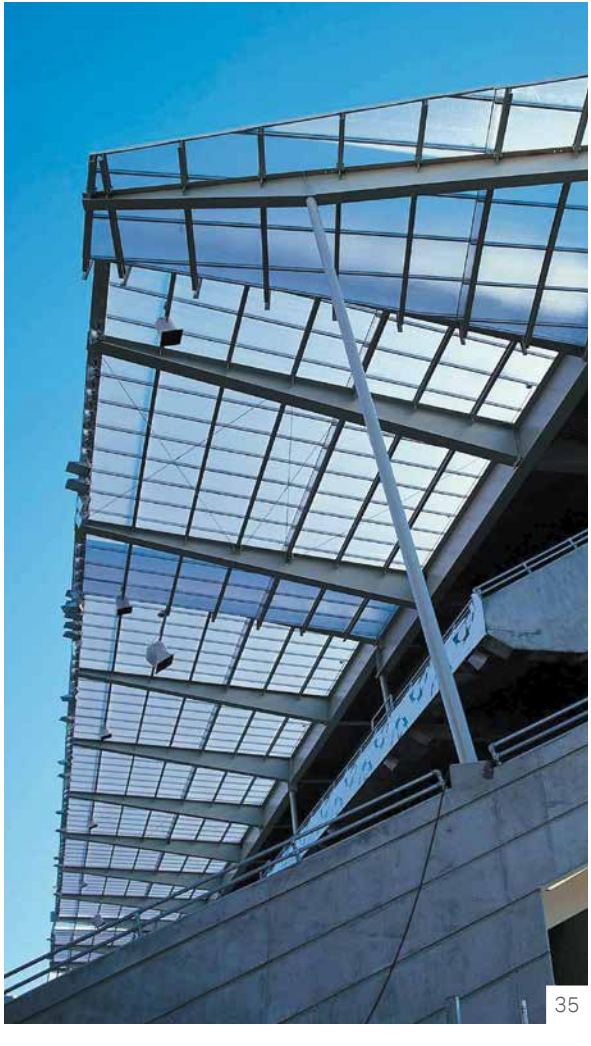
Typical classifications* of Makrolon® multi UV sheets:

Country	Standard	Typical classification
Europe	EN13501-1	B-s1 d0 or C-s2 d0
Germany	DIN 4102	B1-B2
France	NF 92 501/505	M1-M2
UK	BS 476, part 7	class 1Y
Italy	CSE RF 2/75/A & 3/77	classe 1

(*) Depending on their thickness, colour and application, Makrolon® sheets meet the requirements of many national fire protection standards. The fire behaviour of polycarbonate sheets can be influenced by their age and level of weathering. For more information please contact our Technical Service.

4.8 Smoke behaviour

The tests for classifying building products mainly determine the primary burning characteristics - ignitability and spread of flame. However, smoke evolution and its effects are also important for risk assessment.
The most crucial aspect in assessing smoke gas evolution is the phase of the fire and the risk situation in which the smoke development is detected. Conditions change markedly as a fire develops. If people are present in the burning room, smoke gas toxicity is likely to be significant only in the development phase of the fire. It is no longer decisive in a room that is already in a full-scale blaze with temperatures above 500 °C.





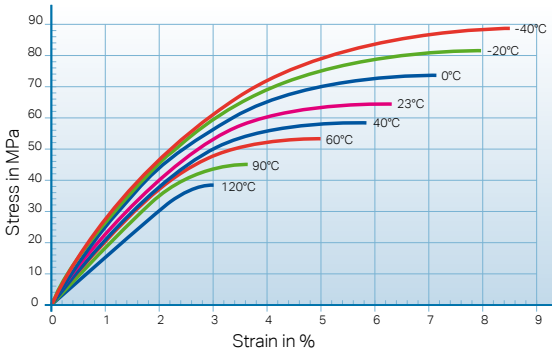
Systematic tests with the decomposition apparatus to DIN 53436, showed that Covestro products do not pose any more toxicity risk than natural products. The products of decomposition in Makrolon® are no more toxic than those resulting from burning wood or paper. In case of fire, the sheet will soften, tear open and shrink back from the fire, creating an opening that allows smoke to dissipate.
It is always difficult to give a statement on single substances which may be released in the event of fire. Every fire is unique and the development of combustion gases depends largely on particular circumstances.

In fires the combustion gases of Makrolon® comprise mainly carbon dioxide, carbon monoxide and water. In some cases, minor quantities of subsidiary constituents may be released: aliphatic and aromatic hydrocarbons, aldehydes, acids and phenol derivates. During combustion Makrolon® does NOT produce hydrogen cyanide, phosgene, acrolein, hydrogen chloride or sulphur dioxide. Combustion products are essentially non-corrosive.

On the whole it may be stated that the toxicity of these combustion gases is determined largely by the toxic effect of carbon monoxide, and that the contribution of other constituents is much less important.

4.9 Temperature resistance

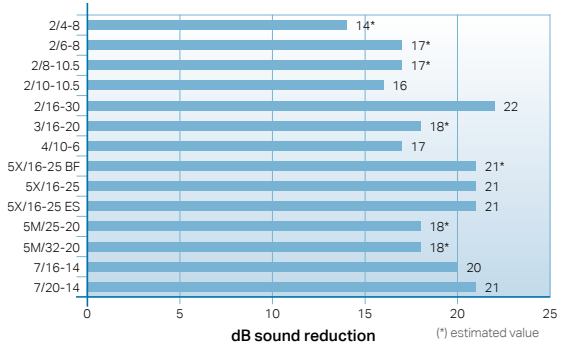
Makrolon® multi UV sheets can be used at temperatures between -100 °C up to +120°C. The stability of the sheets remains at a high level within this temperature range. Due to this, the sheets can be used where other plastics will fail. In normal circumstances, the temperatures to which the sheets are exposed will be in the range of -15 °C up to +60 °C, which is well within the material's tolerances.

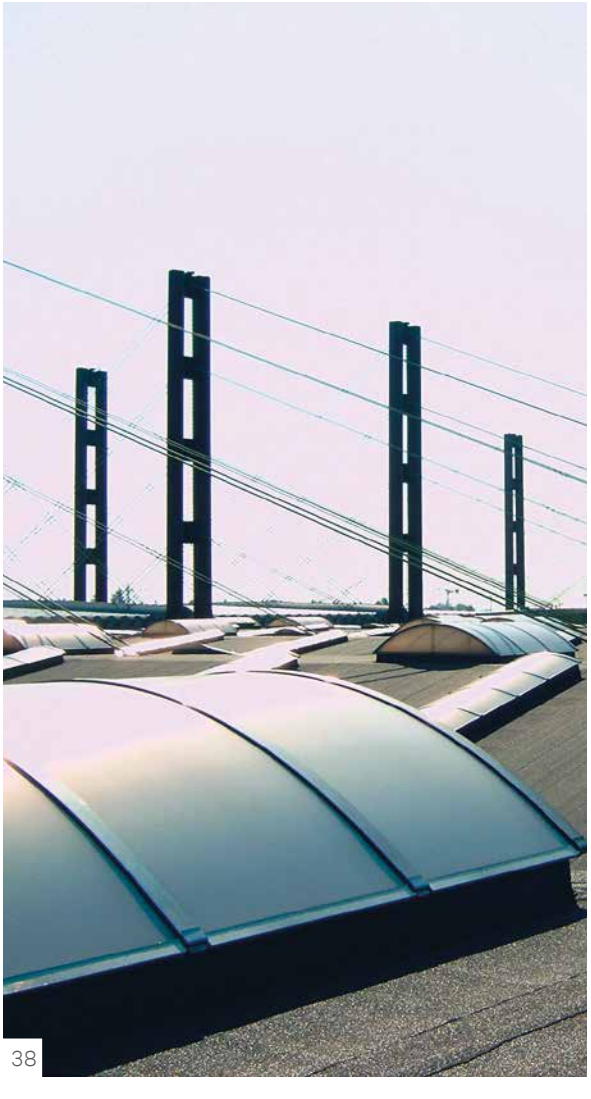


Tensile stress of Makrolon® in relation to the temperature.

4.10 Noise insulation

Makrolon® multi sheets have useful noise insulation benefits. They have to be regarded as single-shell elements, because of the rigidity of their layers. All Makrolon® multi products are tested to ISO 140/3 and ISO 717/1. Depending on the sheet type, typical sound reduction values in the range of 10 to 21 dB can be reached. The weighted sound reduction index is stated in the individual product data sheets.





4.11 Chemical resistance

Makrolon® multi UV sheets can, like other plastics, be affected by certain substances. In order to avoid hairline cracks, only compatible clamping bars, seals and cleaning agents may be used. Contact with plasticised PVC, cement, thinners, insecticide sprays, impregnating agents, strong industrial cleaning agents and other corrosive solvents must be avoided at all times. Also avoid alkaline, ammonia-based or acetic-based sealing materials and use neutral systems instead. Suitable sealant systems are available - please ask your sheet supplier.
Due to the risk of stress cracking, no vapours must be allowed to filter into the sheet cavities.
Follow this advice very closely, since most problems arise from using unsuitable and non-recommended auxiliary products.

It's important to remember that contact with non-compatible products can happen not just with the installation equipment or during the construction of the building. It can also happen afterwards, as a result of emissions emanating from the installation production processes or nearby. If in doubt, please contact our technical service.

As a general guideline on the chemical resistance of Makrolon®, we can state as follows:

Polycarbonate
resists:

- mineral acids up to higher concentrations
- neutral and acidic salt solutions
- oxidising and reducing agents
- saturated, aliphatic hydrocarbons and alcohol, with the exception of methanol (methyl alcohol)
- many oils, fats, waxes

is damaged by:

- alkali
- ammonia and amines, as well as their solutions
- aromatic or halogenated solvents
- aldehydes, ketones and esters
- methyl alcohol





5. TRANSPORT AND STORAGE

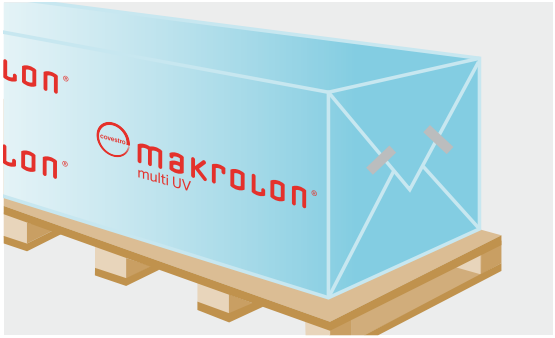
5.1 Transport and handling

Makrolon® multi UV multiwall polycarbonate sheets are light weight and as a result easy and safe to handle in warehouses and on building yards. However, some details must be taken into account in order to avoid damage to the sheets and help towards a successful installation.

For the handling of standard size pallets, lift trucks which accommodate the pallet width (2100 mm max.) and length (6 to 7 m) are recommended. In some projects, sheets of at least 12 m are used – often longer than the pallet supporting them.

We recommend taking the following precautions:

- Prevent the pallet from flexing when lifting it with a crane. Use adequate lifting methods to prevent the pallet breaking and to avoid any protruding pallet nails.
- The cables must be tightened in such a way that they don't harm the sheet packaging. A suitable upper rocker arm, on which the lifting hook is to be linked, must be prearranged.
- When the package is laid on the ground, the sheet ends will hang down. They must be adequately supported to avoid contact with the ground.



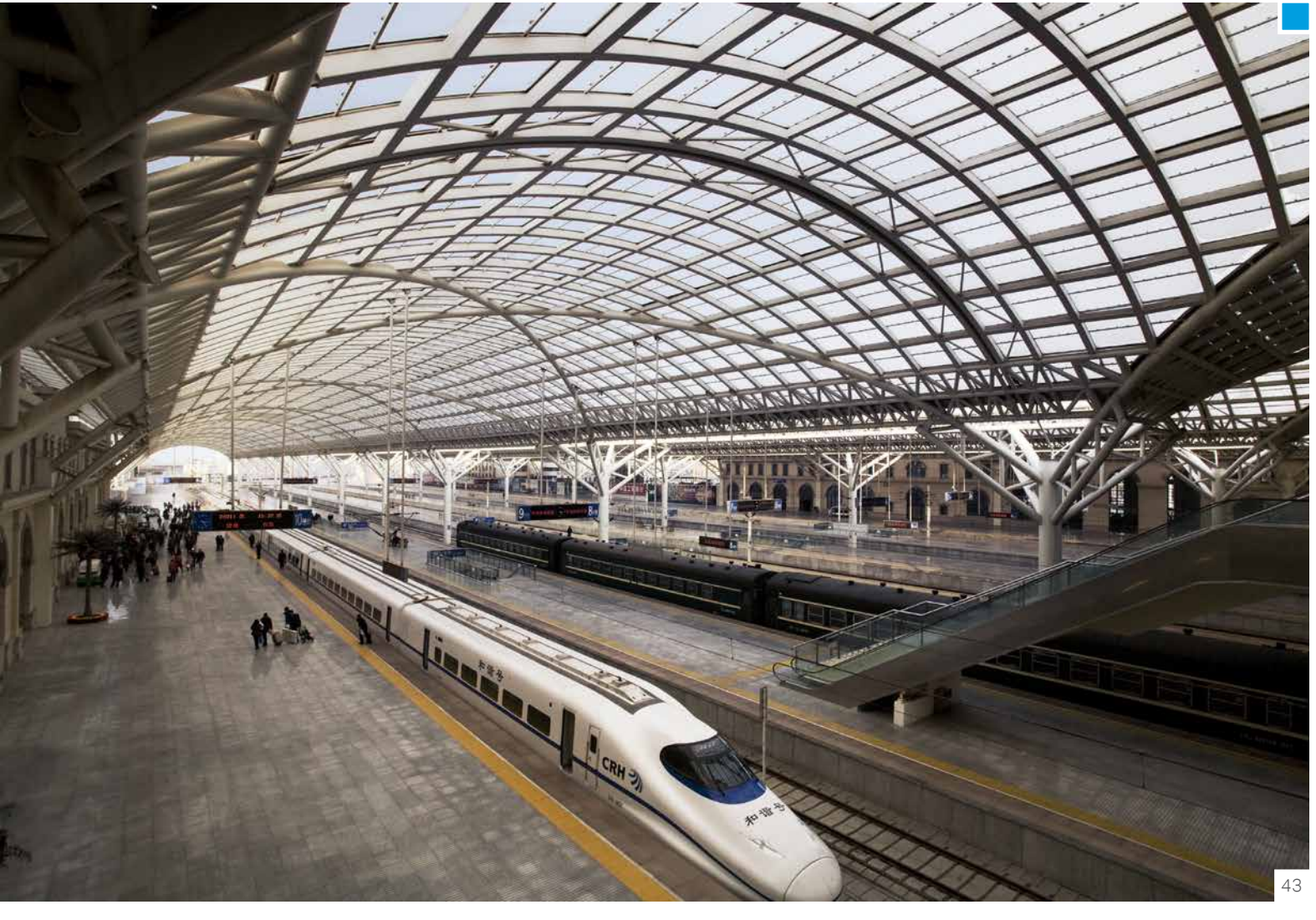
Typical packaging of Makrolon® multi UV sheets with polyethylene wrapping.

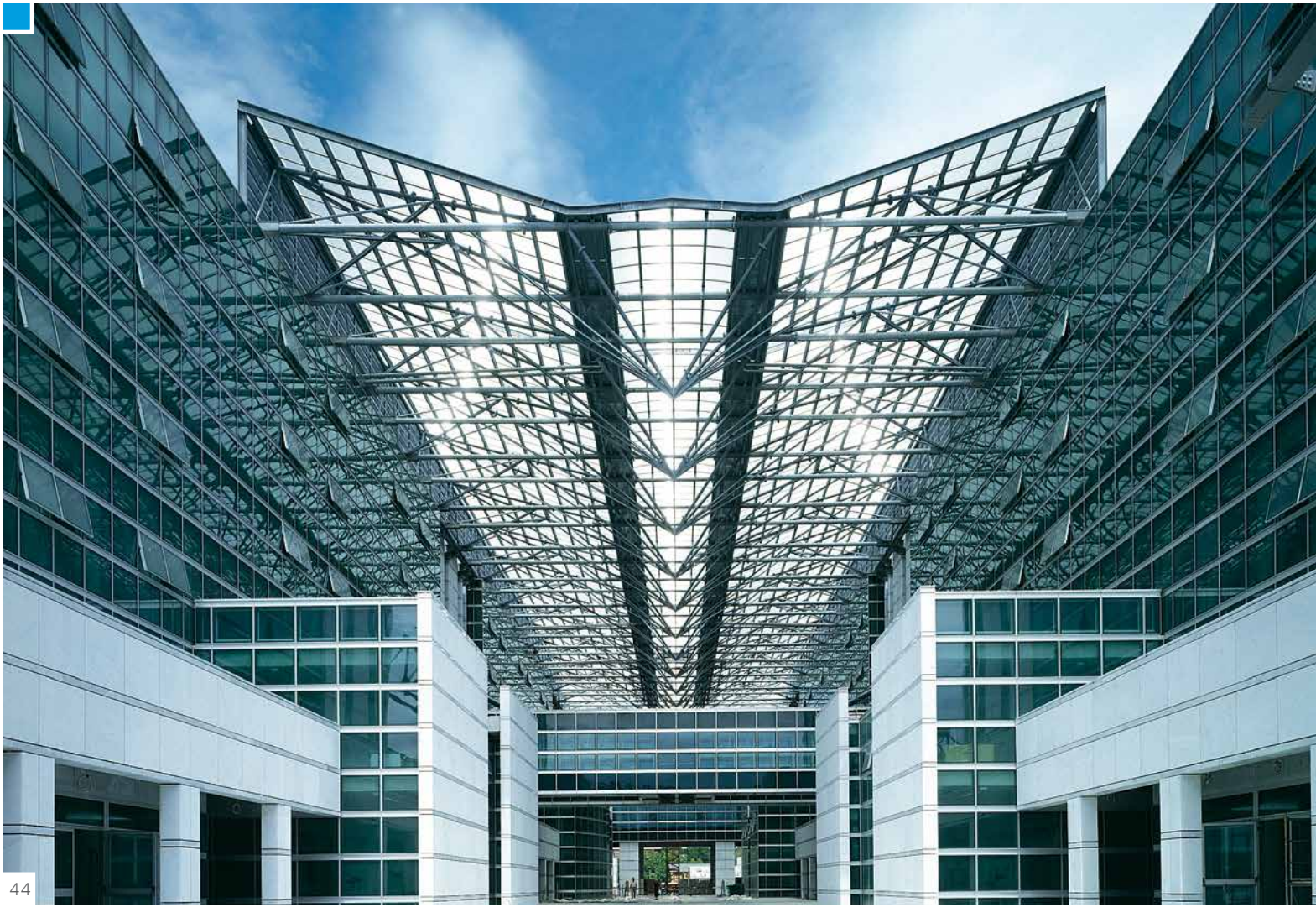


5.2 Storage

The best way of storing the sheets is to keep them indoors in a horizontal position. During production, protective tape is applied to the edges of the sheets to protect the cavities. It prevents dust - attracted by electrostatic charges on the sheet - from settling. The tape must stay on the sheet during transport and storage, but must be removed before installation and be replaced by a suitable sealing system.

Makrolon® multi UV sheets can be stored outside if necessary. Make sure the sheets are still protected by the polyethylene wrapping as with the delivery. The wrapping must be intact and well fixed, even if some of the contents have already been used.
However, it is better to limit outdoor storage: whilst the wrapping protects the sheets from rain, it is not completely vapour-proof. This may, under certain conditions (for example a sudden cooling after a long period of wet heat), lead to the formation of condensation inside the cavities.
All sheets are covered with protective masking prior to delivery. Long outdoor storage under high temperature, or direct sunlight, can make the masking too sticky, and removal after installation can then be very difficult or even impossible.


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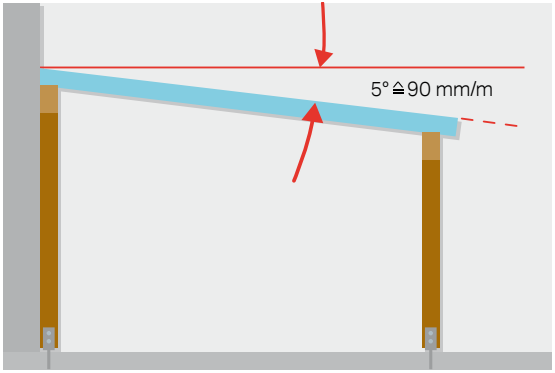
6. INSTALLATION

6.1 Installation considerations

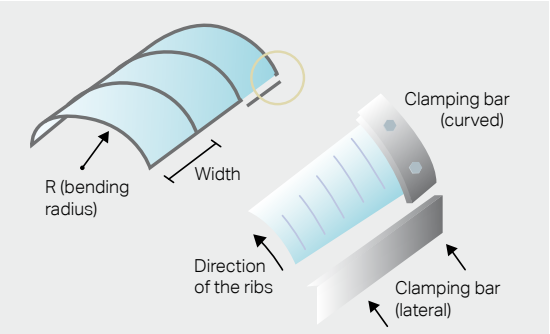
Flat glazing
If Makrolon® multisheets are employed as roof or wall elements, we advise installing them in such a way that the ribs are parallel to the direction of the water flow.

The large sheet lengths means installation is almost always possible without butt joints. For roofing up to a length of 6m, the pitch should be at least 5°. In practice, that means a pitch of approx. 90mm per meter of sheet length. This ensures that rainwater flows off readily and that a good self-cleaning effect is achieved due to the smooth surface of Makrolon® sheet. Larger roofs should be built with a higher angle (>90mm/m).

The potential sheet length (unsupported span) depends on several parameters, such as: the load bearing characteristics of the sheet, spacing of the purlins and expected wind or snow loads.
The tables as of page 71 take all these parameters into consideration and can be used as a guideline to determine the construction design.



Recommended angle of inclination for sheets lengths up to 6 m.



Makrolon® multi UV	thick-ness	Min. cold bending radius* in mm
2/4-8	4	600
2/6-8	6	900
2/8-10.5	8	1200
2/10-10.5	10	1500
2/16-30	16	2400
3/16-20	16	2400
4/10-6	10	1500
5X/16-25 BF	16	2400**
5X/16-25	16	2400**
5X/16-25 ES	16	2400**
5M/25-20	25	not recommended
5M/32-20	32	not recommended
7/16-14	16	2400
7/20-14	20	3000
7M	all types	not recommended

Curved glazing

Makrolon® multisheets are ideal for arched structures such as barrel vaults and tunnel greenhouses. The sheets have to be bent in the direction of the ribs, never the other way. There is no need to heat them (cold curving). Curving the sheets increases the rigidity of the sheet.
We recommend clamping the sheets on all four sides to achieve maximum load bearing capacity.

The spacing of the hoops depends on the load bearing characteristics of the sheets, the maximum assumed load and the chosen bending radius. For load bearing calculation of curved glazing applications, please contact our Technical Department.

The following table lists the minimum curving radii. Please bear in mind that the smallest permissible radius is stated for each sheet type. In order to avoid excessive sheet stress, lower values must be avoided.

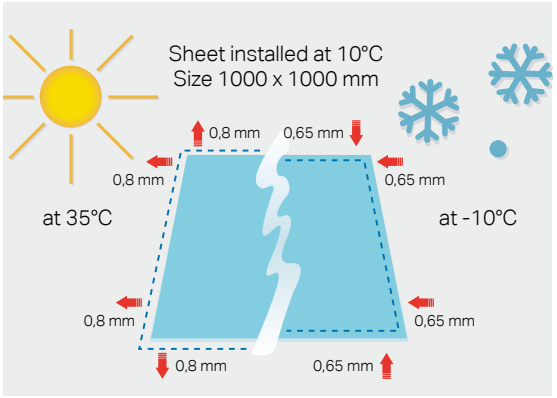
(*) Bending radius = thickness × 150 [mm]
(**) This may result in an optical distortion of the interior ribs. However, this has no negative impact on the mechanical properties of the product provided that our installation tips are correctly followed.

Thermal expansion
Makrolon® multi UV sheets expand when heated and contract when cooling. The linear thermal expansion coefficient of polycarbonate is:

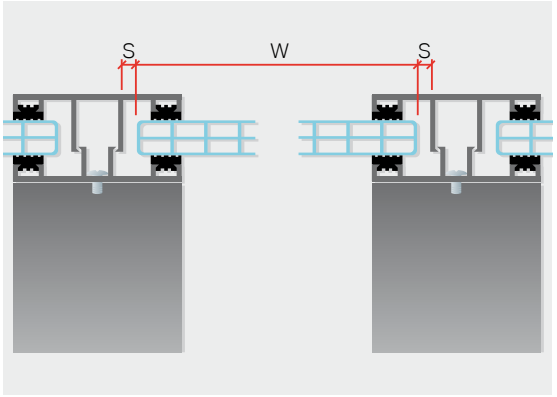
$$\alpha = 0{,}065 \text{ mm/mK} = 6{,}5 \bullet 10\text{-}2 \text{ mm/mK}$$

As with most polymers, this thermal expansion coefficient is much higher than other materials (about 8 times higher than glass, 6 times higher than steel and 4 times higher than aluminium). This movement can sometimes cause a creaking noise, but it does not compromise the functional effectiveness of the sheet. For this reason, all fastening and clamping devices must be fashioned to allow sufficient room for expansion and shrinkage.

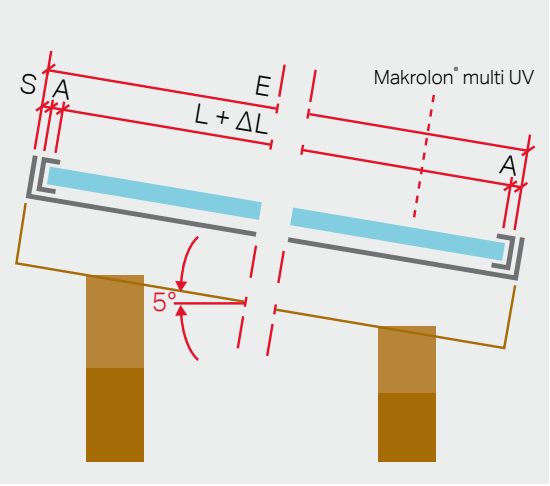
- If the sheet edge touches the inner part of the profile and the temperature increases, the sheet will not be able to expand. The sheet will distort or, in extreme cases, get damaged.
- If the sheet is installed with the edge too close to the outer extremity of the profile, the sheet could slip out of the support frame when it shrinks during cold winter weather. This effect can be reinforced by other factors such as snow load.
- The design of rubber joints must allow for significant expansion and shrinkage to prevent the joints coming out of the profiles or damaging the sheet.



Thermal expansion.



Allowance for expansion in width.



Allowance for expansion in length.

Calculation example:
Sheet size: 1000 x 3000 mm (1 x 3 m)
Expected highest temperature: 35° C
Expected lowest temperature: -10° C
Temperature difference ΔT: 45° C
Expansion in width: α . ΔT . W = 0.065 mm/mK . 45° C . 1 m = 2.92 mm
Expansion in length: α . ΔT . L = 0.065 mm/mK . 45° C . 3 m = 8.77 mm

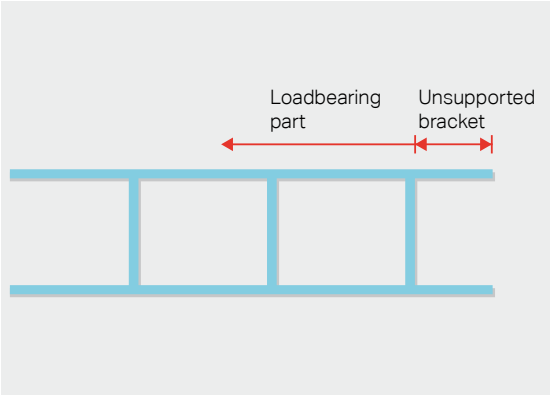
We recommend allowing for expansion of 3 mm/m.

E = maximum clearance in mm between the lower stop and the upper limit.
A = length in mm added by the lower edge closure section
(if also used at the upper end, add to A)
ΔL = longitudinal tolerance according to sales range
S = allowance for expansion (3 mm/m for Makrolon® multi UV).

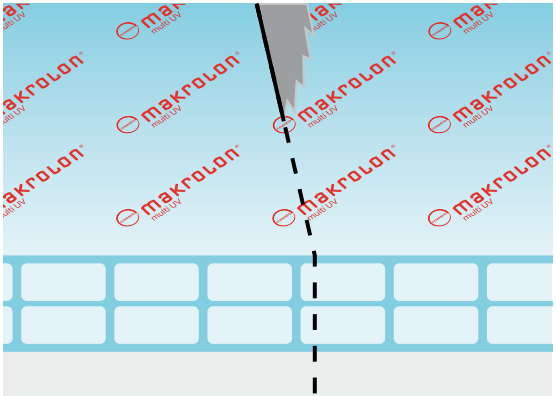
Rabbet depth design

For a proper installation of Makrolon® multi UV sheets the clamping profiles must have a correct rabbet depth design. There are various aspects to be considered:

- The difference in thermal expansion between the sheets and the profiles must be taken into account (see previous chapter).
- As Makrolon® is a plastic material, it will flex slightly when subjected to pressure from external loads. Even though the sheets are very rigid, this causes a virtual shortening of the dimensions of the sheet. All Makrolon® multi UV sheets have been tested for load bearing capability in real life tests (see chapter 7). When the rabbet depth on both sides of the sheets is calculated according to the expected temperature variations (with a minimum of 20 mm) and the tables in chapter 7 are used to determine the sheet dimensions, you do not need to make any further calculations to account for the virtual shortening as we have already allowed for this.
- When Makrolon® multi UV sheets are cut longitudinally (i.e. the cut is made parallel to the direction of the ribs), there may be some unsupported brackets. These use up some mm of rabbet depth, but do not contribute to the load bearing capacity of the sheet. For safety reasons calculate the rabbet depth starting at the first closed rib.



Unsupported bracket.



Try to cut close to the ribs.



The ink-jet marks the UV-protected side of the sheet.



Surface direction
One side of the Makrolon® multi UV sheets has a UV-protective layer which is applied by coextrusion and is homogeneously fused with the sheet.

Important: Always install the sheet with the UV side facing upwards/outwards, i.e. turned towards the sun! This UV side is masked with a clear, printed protective film as a standard feature. The UV side can also be identified by the imprint applied by ink-jet along the edge of the sheet. Multiwall sheets with a UV protection on both sides can be installed regardless the side orientation.

Our warranty statements only apply if the sheets have been installed correctly.

Some sheet types are available with a 'no drop' coating on the other side of the UV-protected surface. These sheets must be installed with this coating facing inwards/inside.
The 'no drop' functional layer is covered with a protective film. This film can be removed by washing with clear water or it will come off automatically after a while due to condensation on the sheet. The 'no drop layer' is only fully activated once the protective layer has been completely washed off.

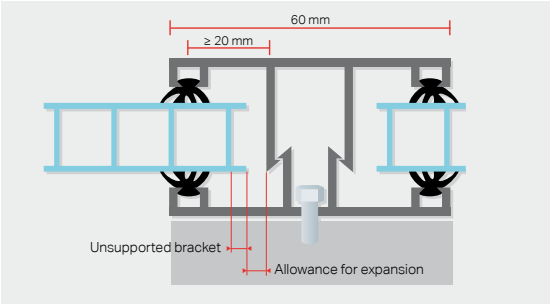
6.2 Construction details

Profiles

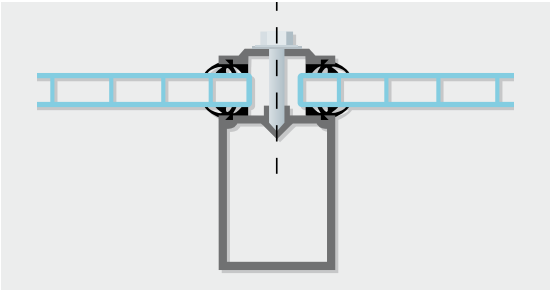
Many different profiles are available, from single profiles to fully modular mounting systems. Aluminium profiles with EPDM rubbers are most commonly used with multiwall sheets. In practice every classical construction is possible as long as the specific characteristics of polycarbonate are respected.
To fulfil the requirements for optimum load characteristics it is important that all the edges are properly clamped with a rabbet depth of at least 20 mm, with at least one rib of the sheet located in the clamping area.

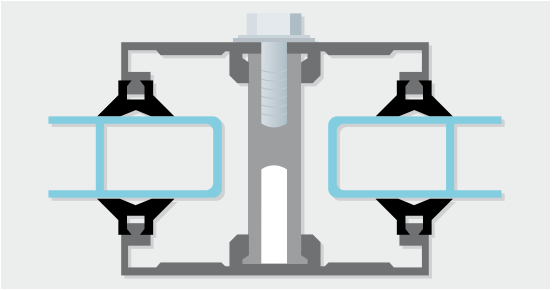
Any gaskets used must be chemically compatible with polycarbonate (see also page 38) and care must be taken not to stress the sheets during the construction. In all glazing systems with Makrolon® multi UV, the contact pressure exerted on the sheet by the glazing bead or clamping plate is important. This pressure is transmitted to the sheet via the glazing gasket or seal. The pressure must be regulated and uniform to ensure an adequate weather seal. Excessive contact pressure will adversely affect the glazing gasket or seal. Since the glazing gasket is the softest part in the glazing system, excessive contact pressure will cause it to bulge, or even be displaced from the glazing system which will then no longer be watertight.

We recommend using a distance ring or a profile system in which the clamping pressure is preset by the design.



Rabbet depth design.


Profile system with preset clamping pressure.


Distance ring.



Gasket and seals
For Makrolon® multi UV to remain waterproof, the gasket used in the glazing system must be resilient yet still allow for the predicted expansion and contraction of the sheet. To achieve weathertightness the gasket must be the right shape and be made of the right material.

The material from which the gasket is manufactured must be compatible with Makrolon®. The following materials are likely to be compatible:

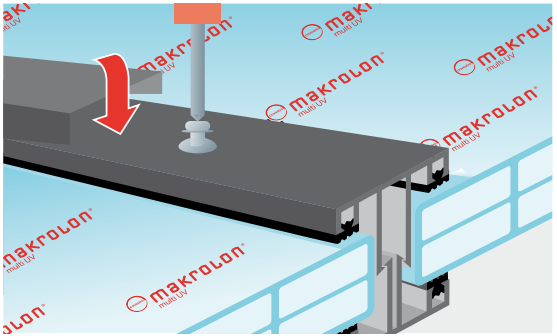
- EPDM
- Polychloroprene
- Polyethylene (PE)
- PTFE
- Neoprene
- Silicone
- EPT

The following materials are usually not compatible:

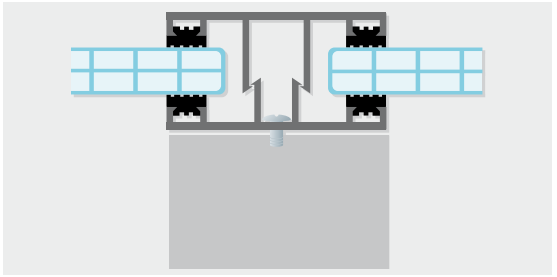
- PVC
- PVC/Nitrile
- Polyurethane (PU)

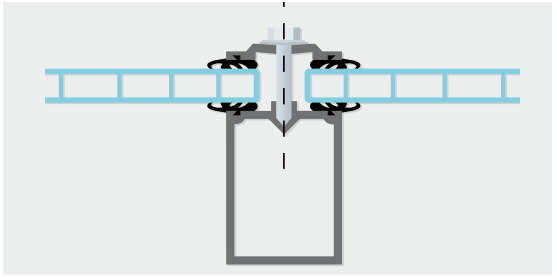
In general, gaskets must be tested for compatibility before being incorporated into glazing systems for use with Makrolon®.
Because of sheet movement caused by expansion and contraction, gaskets must be mechanically secured to the glazing system or they will become dislodged. Securing by adhesion is not adequate.

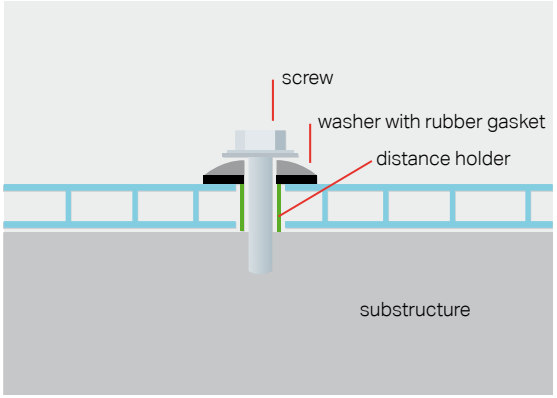
In all Makrolon® glazing systems, the contact pressure exerted on the sheet by the glazing bead or clamping plate is important. This pressure is transmitted to the sheet via the glazing gasket or seal. The pressure must be regulated to be sufficient to ensure an adequate weather seal. However too much pressure can also shorten the life of the seal. We recommend using a distance ring or profile systems in which the clamping pressure is preset by the design.



Adjusting the contact pressure on the sheet.


Typical profile systems and gaskets.


Too much pressure must be avoided.



Fixing buttons.

Additional support systems

In some constructions the sheets will not only be clamped at the edges, but they will have an additional support. For instance, if a 6 m roof is required and the calculations advise a maximum unsupported span of 3 m it is possible to either install 2 sheets of 3 m or 1 sheet of 6 m with an additional support structure in the middle.
Be aware that loads on the sheet can act in both directions: a snowload typically exerts a downward pressure. Wind can create downward or upward pressure or depression. Additional support structures must be effective for any eventuality: just placing an additional purlin under the sheet will not be sufficient.

There are two possible solutions:

1. Perforating the sheet and using special 'buttons' to fix the sheet to the purlin underneath. These buttons must have a gasket that makes an effective seal and a form that prevents over-tightening, which would cause the sheet to deform.

Please take into account:

- Fixing buttons can only be used for flat glazing applications, otherwise a good seal won't be possible.
- The hole in the sheet must be oversized to allow for thermal expansion of the sheet (3 mm/m sheet length).
- The hole must be at least 50 mm from the edges of the sheet.
- Perforation of the support underneath will produce shavings which could remain inside the sheet. If made from conventional steel (not stainless steel) be aware that these shavings could oxidize and create rusty stains in the sheet.

In general, fixing buttons are only advisable if you don't require a perfect visual appearance.

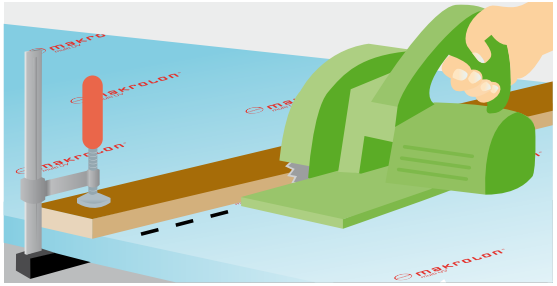
2. Structures required to push the sheet against the support underneath as part of the load bearing framework will have to be designed by a suitably qualified structural designer.

Also in this case, some considerations could be useful for the designer:

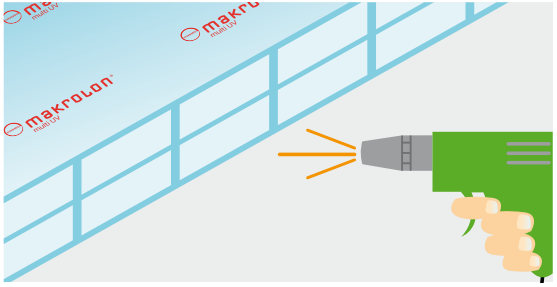
- It is important to consider placing suitable plastic materials between the sheet and the sheet-pusher in order to avoid direct contact between the polycarbonate and the steel.
- The form and the dimension of these accessories will have to be such that they don't hinder the flow of rainwater.

As this second solution is more difficult to accomplish, it is usually only applied in special projects.

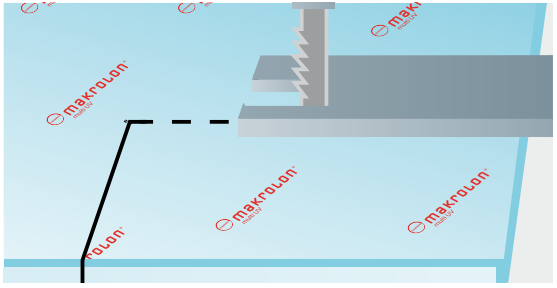




Always use guidance when cutting.



Remove swarfs after cutting.



Use a jigsaw without stroke action for curved cuts or recesses.

6.3 Preparations for installation

Cutting

Makrolon® multi UV sheets are most easily cut with a sharp knife.
Sheets with a compact structure or with thick outer skins can be cut with fine-toothed handsaws, circular saws, band saws or other types of saws. Make sure the saw is new and the blade very sharp.

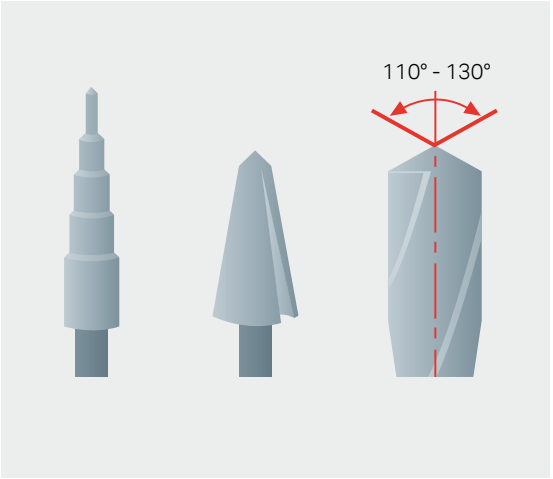
In particular, our advice is to:

- leave the protective masking on the sheet whenever possible during sawing;
- mark the desired cut with a soft pencil only;
- work with a stop or a guide;
- make sure the sheet is placed on a firm support;
- work at a cutting speed of approx. 50 m/sec with continuous feed;
- use jigsaws without stroke action for curved cuts and recesses;
- remove swarf by vacuum or blowing down with oil-free compressed air;
- follow the relevant safety regulations;
- when cutting with a knife, use blades that are short and rigid.

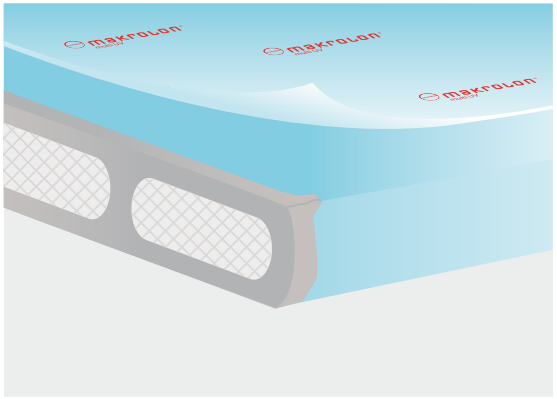
Drilling
If you need to drill holes in Makrolon® multi UV, you may use drills suitable for metal-working.

For best results, we advise you to:

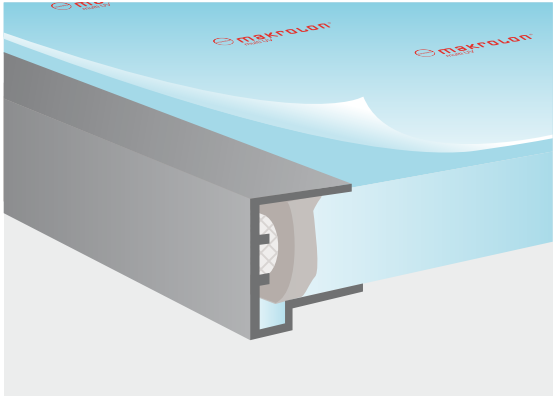
- use tube and sheet drills normally used for working sheet metal;
- make sure the sheet is placed on a firm support;
- try to drill holes with clean edges;
- work at moderate pressure to prevent splitting when perforating the sheet;
- always work with sharp drills!



Typical drills.



Seal with ventilating tape at the bottom.



Aluminium end closing section.

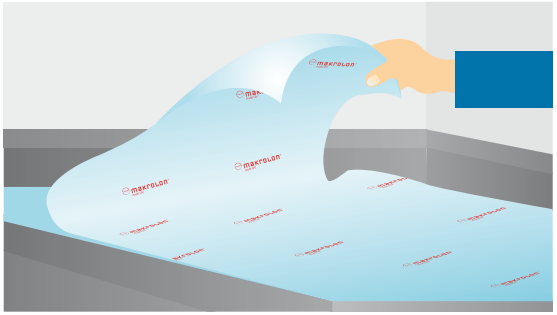
Sealing the open ends of the sheets

The open ends of Makrolon® multi UV multiwall sheets are sealed at our factory with protective tape for transportation and storage purposes. For durable installation, it is advisable to remove this transport tape and to seal the sheets with weather-resistant adhesive tape, e.g. aluminum tape. Use only suitable products. There is a simple but very important rule for closing the open ends of the sheets: as tight as possible at the top and as tight as necessary at the bottom.

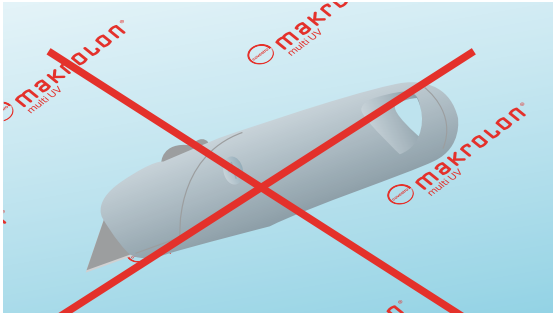
To allow the chambers to ventilate and keep spores out we recommend using ventilating tape with about 50µ pores at the bottom and an impermeable (aluminium) sealing tape on the top. After taping, push on an aluminium end closing section at both ends. This largely prevents the infiltration of dirt, insects and water, while allowing air to circulate inside the sheet and condensation to evaporate or drain off.

The tape itself should have a good weathering and tearing resistance and no loss of long term adhesion or mechanical strength. Be sure that all sheet edges are smooth and rounded before applying the tape, so the tape will not be punctured. Sealing tapes for Makrolon® multi UV sheets are available at most distributors and specialised installers.
Since plastics are permeable to water vapour, condensation may occur even in multiwall glazing elements such as Makrolon® multiwall sheets. It is therefore important that Makrolon® multi UV sheets are always mounted with the ribs running downwards to assist the drainage of condensation water.
When mounting the sheets into the glazing profiles it is important to make sure that the tape is not damaged and that the profiles cover the tape completely. Replace damaged tape if necessary.

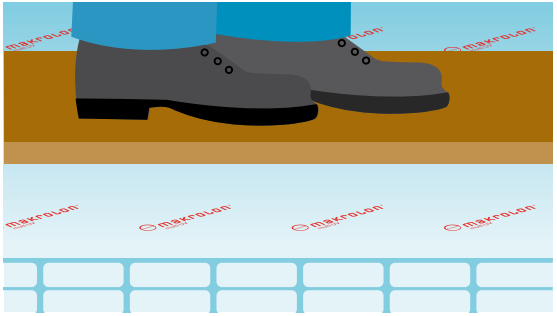




Remove the masking immediately after installation.



Never cut the masking on the sheet with sharp tools.



Never walk directly on the sheets.

Removing the masking

The surfaces of Makrolon® multi UV sheets are protected during transportation, storage and installation by self-adhesive PE masking film. This masking does not cover the edges of the sheets. This is to enable installation while the protective masking is still on the sheet and to enable removal of the masking after installation.

In general all films should be removed straight after installation especially if the sheets are exposed to weathering, otherwise the films risk becoming brittle or more adhesive. If this happens the film cannot be removed correctly and damage to the sheets can no longer be ruled out.

Safety

Roofs covered with Makrolon® multi UV cannot be walked on.
Always use supports to walk on the roof. Never walk on structures which incorporate Makrolon® multi UV sheets without such supports!

Tip: For your own safety use planks, rigid board or similar items, when installing and cleaning the roof and abide by the appropriate safety regulations. Be careful not to damage the sheets and the sheet surface during the process.

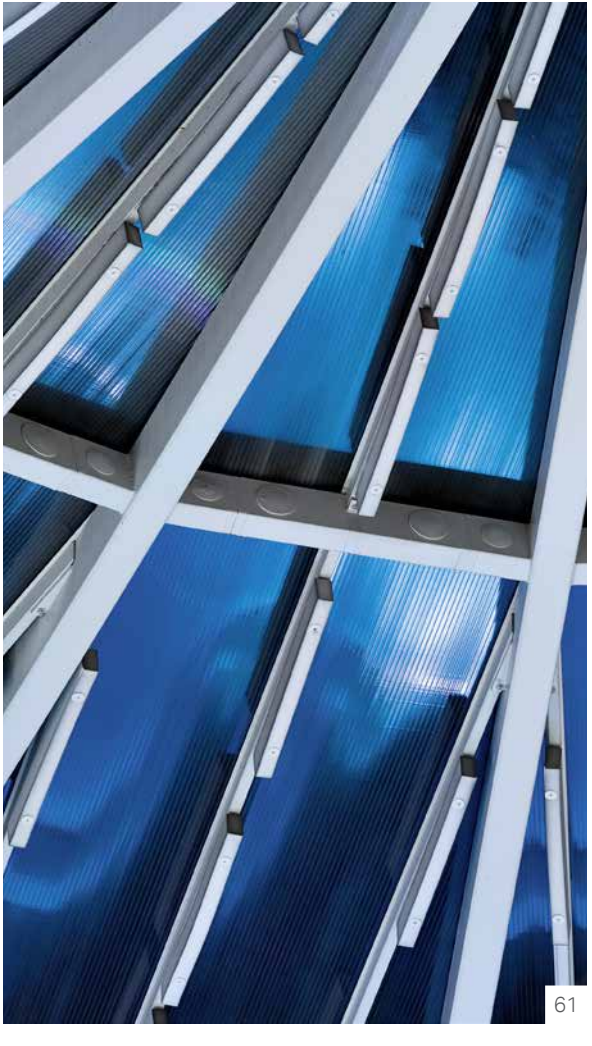
6.4 Important remarks

The effect of condensation
In the atmosphere around us there is always some natural humidity - known as relative humidity (R.H.). This is the ratio, in percentage terms, between the quantity of water present in a certain volume of air and the maximum quantity that the same volume can contain as vapour without condensation.
When the temperature decreases, the air reduces its capacity to contain water vapour, so the value of the relative humidity depends not only on the quantity of water present but also on its temperature.

If the capacity of the air to contain water vapour is exceeded (also called the dew point), this vapour will condense into liquid drops. A typical example is the dew which occurs in meadows and gardens in some periods of the year, during the night, when the temperature drops.

Condensation can affect the Makrolon® multi UV sheets in two different ways:

1. Inside the hollow chambers
Polycarbonate has a certain permeability to water vapour and inside the hollow chamber there will always be humid air with variable percentages of relative humidity (R.H.). Whenever the temperature inside the hollows decreases under the dew point, the humid air will condense into water drops.
This effect must be taken into consideration when choosing the right direction of the ribs and the right method of sealing the sheet edges.





Excessive condensation is in many cases due to the infiltration of rainwater or to clogging of the condensation drains in the end closure section. To prevent this, installation should be performed correctly according to our guidelines and attention must be paid to careful mounting of the end-closure sections.

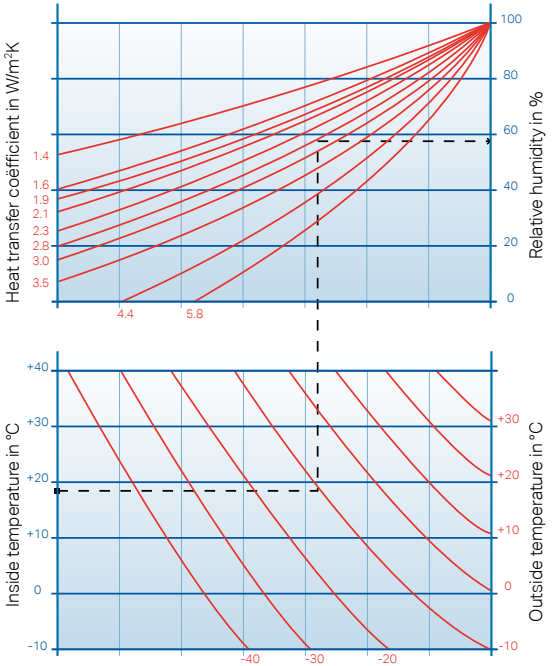
2. On the inner surface of the sheet
Whenever the microclimatic conditions (local temperature of the sheet and relative humidity of the air around it) on the inner surface of the sheet reaches the dew point there will be condensation on the sheet surface.

The water drops on the inner surface can have several consequences: diminution of the light transmission, damage to cultivated plants below if the drops fall, formation of water pools on the floor, etc.
This will typically occur in greenhouses or on swimming pool covers. It can be considered and calculated in advance and avoided by choosing a sheet with 'no drop' coating.

With the diagram on the next page, one can find out what temperatures (inside and outside the building) and humidity (inside the building) will cause condensation to form, depending on the Ug value of the sheet. Sheets with a high insulation (low Ug-value) will have a higher temperature on the inner surface and can tolerate more relative humidity without the effect of condensation. However, the effect of condensation can't always be avoided especially in the coldest countries.

How to use the diagram:

1. Determine in the lower diagram where the curve representing the outside temperature crosses the horizontal line representing the inside temperature (in this example: an inside temperature of 18 °C and an outside temperature of -10 °C).
2. From this point, draw a vertical line to the diagram above.
3. Determine the Ug value of the glazing in the diagram above (example: 2.8 W/m²K for Makrolon® multi UV 2/16-30).
4. Where the vertical line you have just drawn crosses the line representing the Ug value, you will find on the right hand side the dew point (in the example: with a relative humidity of 55%, condensation will occur on the glazing).



Determining the dew point of an installation.



Rib direction

Makrolon® is permeable to water vapour, which means that a tiny quantity of water can permeate through the sheet surface into the hollow chambers. This in turn may lead to condensation inside the sheet (see previous chapter).

We would therefore make the following recommendations:

- Never install Makrolon® multi UV sheets with the hollows in a flat position. The sheets must have a slope in the direction of the ribs to allow drainage of any condensation.
  A minimum slope of 5° (= 90 mm/m) is recommended.
- For the same reason, in case of a vertical installation, the sheets must be installed with the ribs in vertical position.

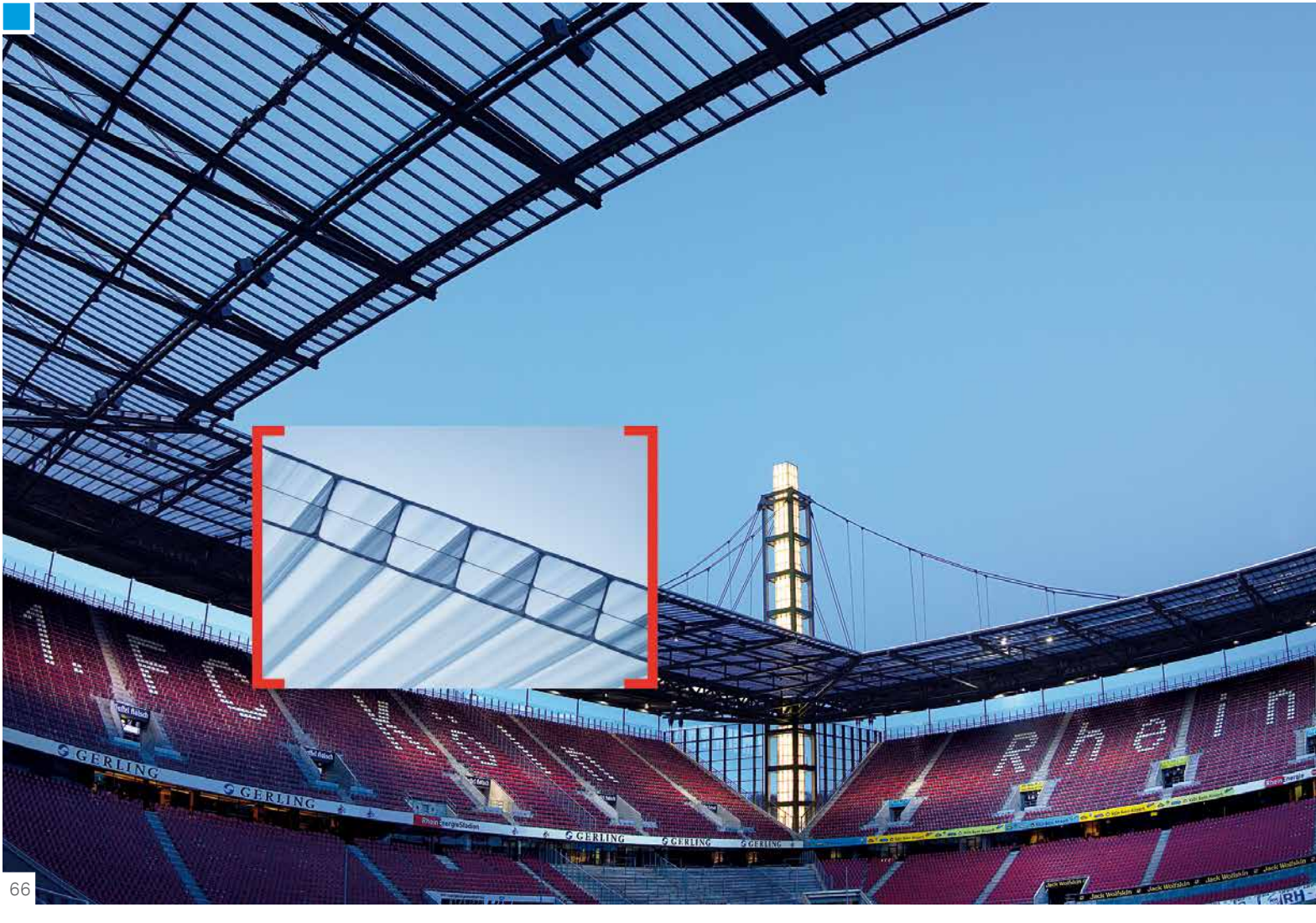
Not following these suggestions may cause the accumulation of condensation inside the sheet, leading to the growth of moss or moulds.

Of course this effect doesn't occur with installations in inner spaces where there are no temperature differences. In such cases Makrolon® multi UV sheets can be installed with the ribs in a horizontal position.

Cleaning
Makrolon® sheets can be cleaned using a soft clean sponge by washing with lukewarm water containing a mild soap or a slightly acidic or neutral detergent. Rinse well afterwards with clean water and dry with a chamois or a moist cellulose sponge.
Fresh paint splashes, grease, smeared glazing compounds, etc. can be removed before drying by rubbing lightly with ethyl alcohol or petroleum ether on a soft cloth followed by a thorough wash and rinse as described above.
Larger areas can also be cleaned with high pressure water and/or steam cleaner (max. 80° C). Move the water jet continuously to minimise prolonged contact on the same part of the surface.

Remark: Cleaners and solvents generally recommended for use on PC are not always compatible with the UV protected surface of Makrolon® sheets.




GERLING
GERLING
GERLING
GERLING
GERLING
Rhein

7. STATICS

If Makrolon® multi UV is used in roofing or walls, the forces from wind and snow must be absorbed by a suitable sub-structure. We recommend taking the support distance for each load from the diagrams in annex.

For flat and barrel vault applications the system resistance (bounding state of load bearing capacity) of our Makrolon® multi UV sheets has been determined in accordance with European guideline ETAG 10 (European Technical Approval on "self-supporting light-transmitting roofing systems", which came into force in September 2002) in real tests.



All calculations are based on extensive tests on real systems.



The loads are applied as uniformly distributed linear loads; i.e. load components acting vertically on the sheet, both load and suction.

These values are guide values, which were determined in extensive tests on real systems carried out by a testing, monitoring and certification centre recognised by the building inspectorate. Adequate safety values, which should be assessed on a case-by-case basis, are to be observed with regard to these values.
The values published are calculated with an adequate safety factor. However, this does not replace the country-specific certifications prescribed by the building inspectorate.
Each sheet type has been submitted to extensive and realistic tests to determine the load bearing capabilities. Our published values are calculated based on these tests – not on a purely mathematical calculation model as is often the case with other producers.

7.1 Flat applications

Load-bearing characteristics
The characteristic values of the system resistance have been determined in an unfavourable situation, i.e. the sheets were not fixed, but laid loosely (free rotation) in real test. The curves show the load bearing capacity for Makrolon® multi UV sheets (supported on all sides with a rabbet depth of 20 mm) as a function of load via unsupported span with sheet width as the parameter.

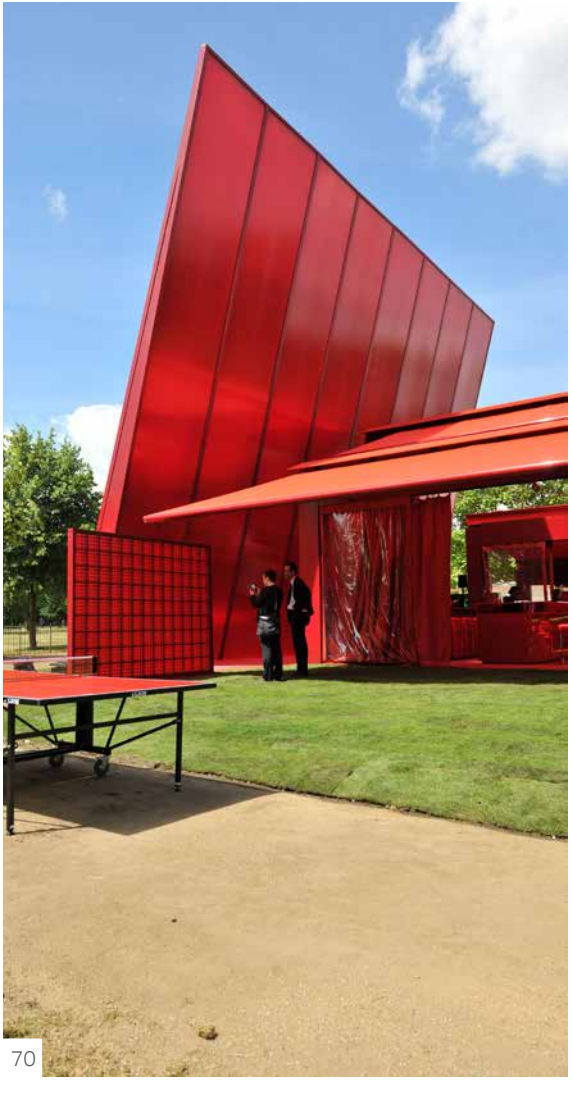
In general, experience has shown that a safety factor of 1.3 is adequate with regard to the measured resistance values. This safety factor is included in the diagrams.

If the rabbet depth is smaller, the support distances should be reduced suitably for the given load.

If sufficiently stable profiles are used, the allowable load increases by a factor of 1.2. For pure wind loads (short time load) the allowable load increases again by a factor of 1.1.







How to use the diagrams:

1. Select your sheet type.
2. At a given load you will find the unsupported span, depending on the sheet width, on the abscissa.
3. If unsupported span is too low, switch over to sheets with higher load-bearing capacities or use reduced sheet width.

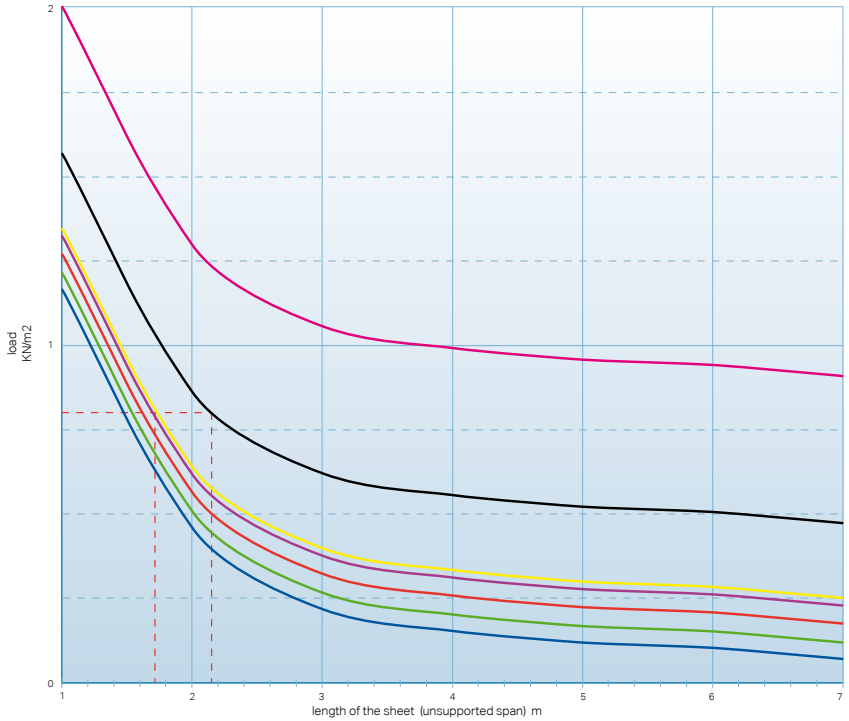
Example: (see diagram on next page)
Type of sheet: Makrolon® multi UV 2/6-6 (twinwall 6 mm)
Expected windload: 800 N/m² (= 0,8 kN/m²)

If the sheet is installed with 700 mm width, it can have an unsupported span (length) of 2150 mm.

If the sheet is installed with 1050 mm width, it can have an unsupported span (length) of 1650 mm.

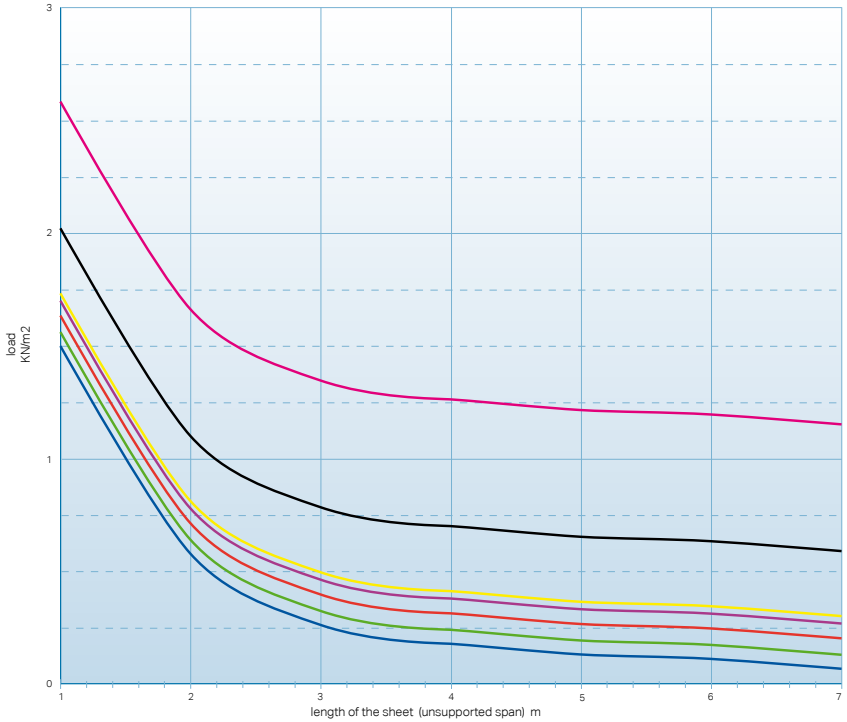
For load bearing calculation of curved glazing applications,
please contact our Technical Service.

load bearing characteristics of Makrolon multi UV 2/6-8 flat glazed



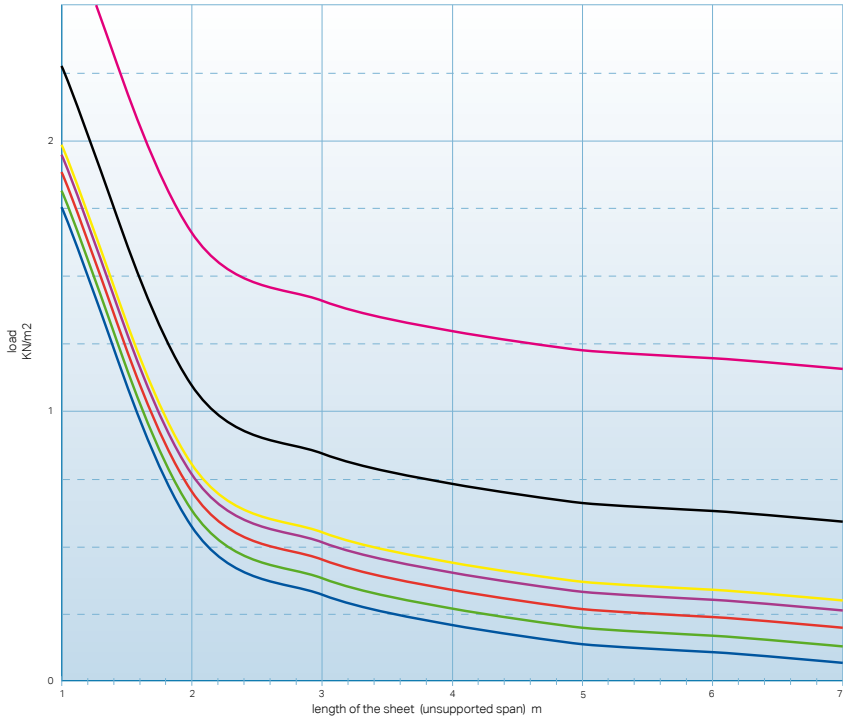
- width = 500 mm
- width = 700 mm
- width = 980 mm
- width = 1050 mm
- width = 1200 mm
- width = 1500 mm
- width = 2100 mm

load bearing characteristics of Makrolon multi UV 2/8 -10.5 flat glazed



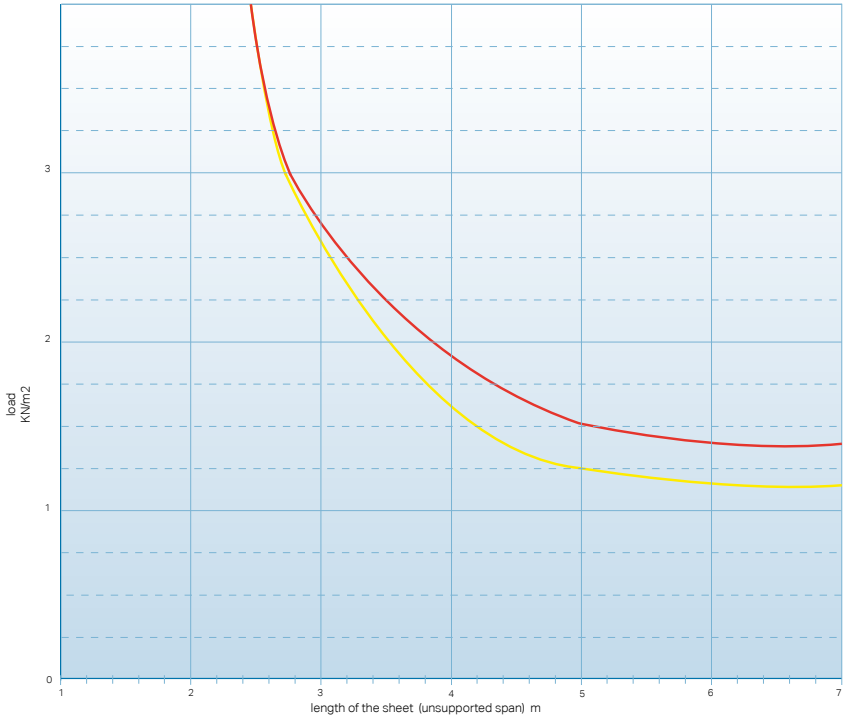
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- width = 1500 mm
- width = 2100 mm

load bearing characteristics of Makrolon multi UV 2/10-10.5 flat glazed



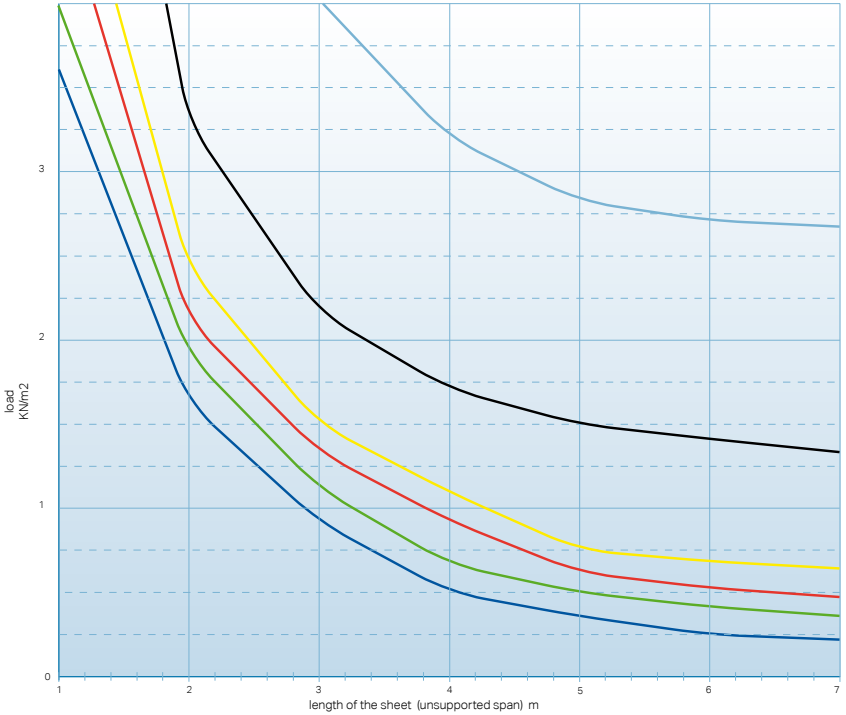
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- width = 2100 mm

load bearing characteristics of Makrolon multi UV 2/16-30 flat glazed



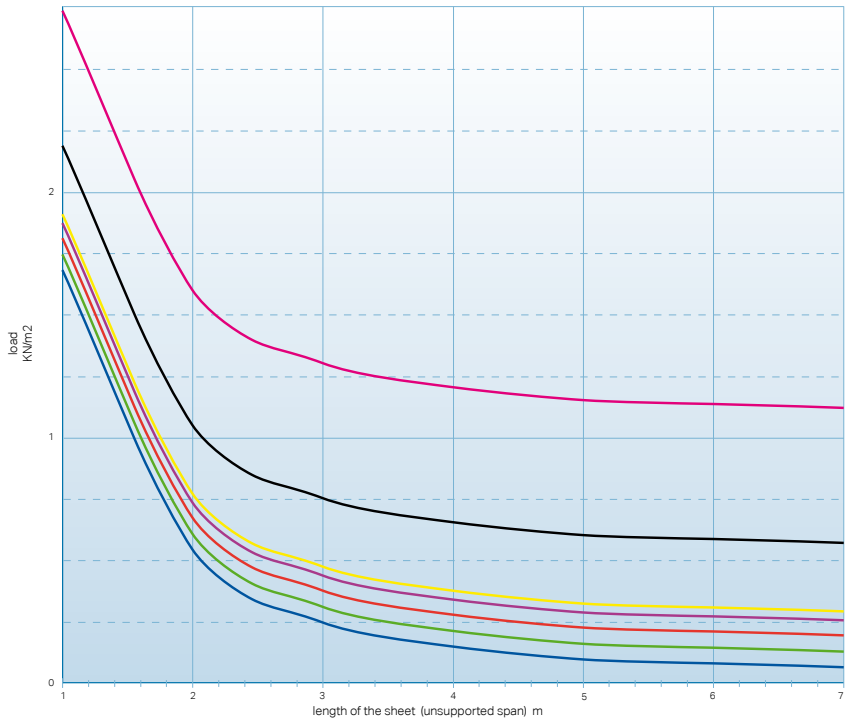
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load bearing characteristics of Makrolon multi UV 3/16-20 flat glazed



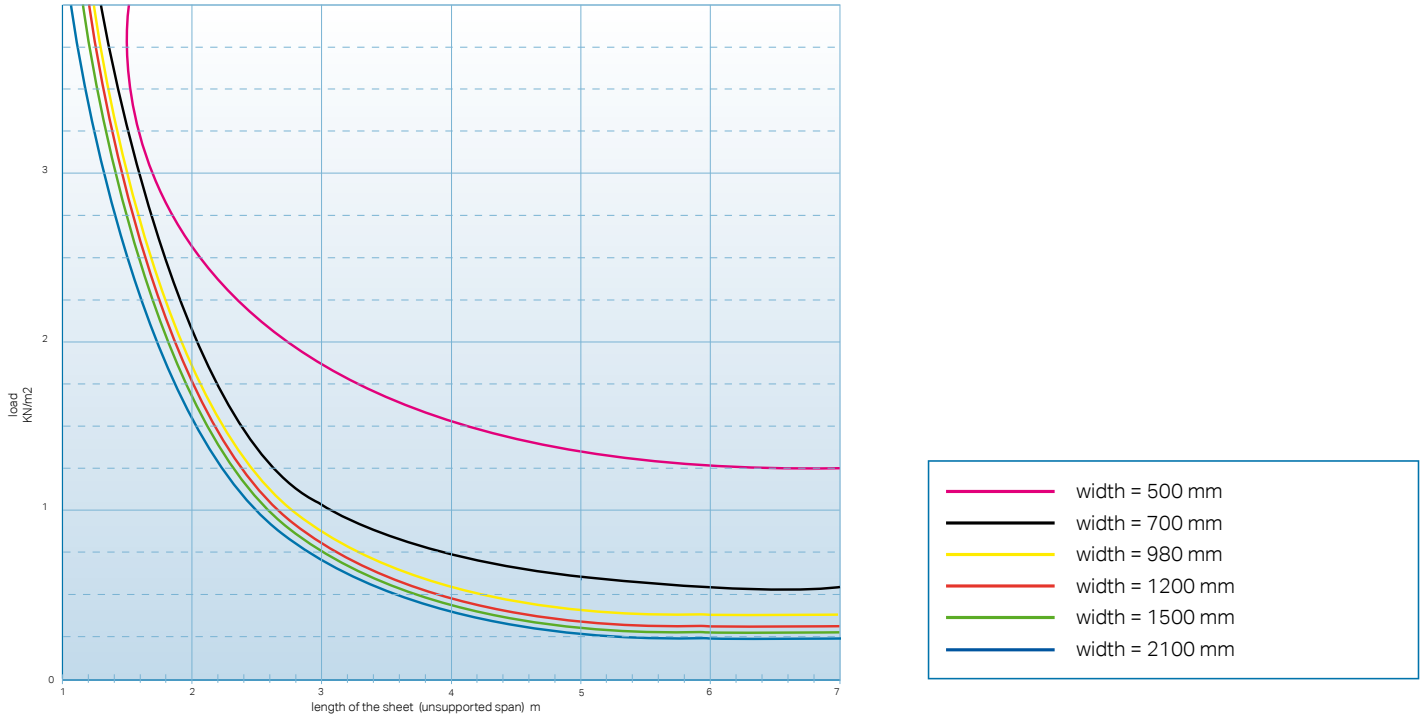
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width = 1500 mm
width = 2100 mm

load bearing characteristics of Makrolon multi UV 4/10-6 flat glazed

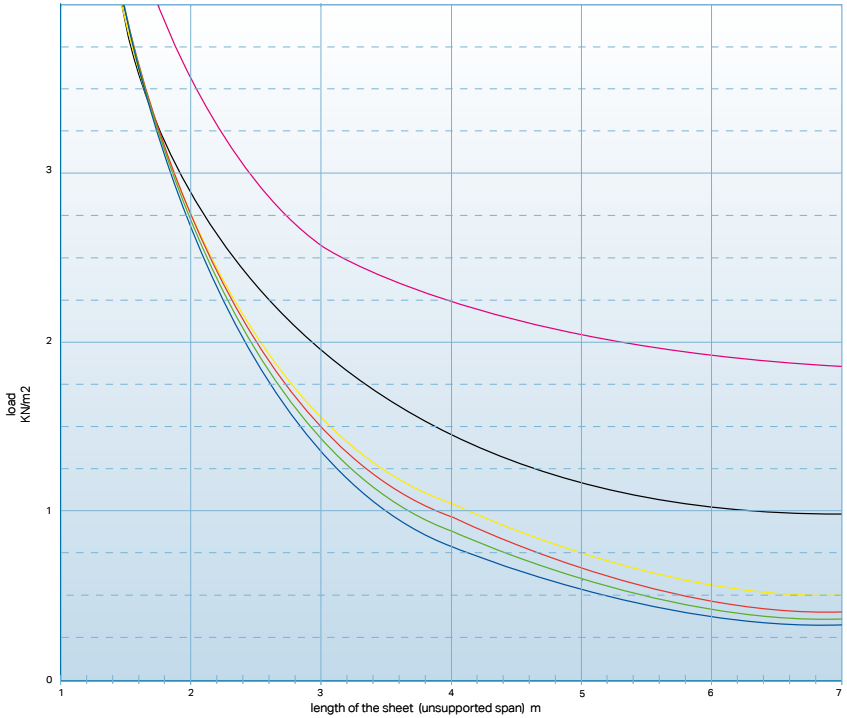


- width = 500 mm
- width = 700 mm
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- width = 2100 mm

load bearing characteristics of Makrolon multi UV 5X/16-25 BF flat glazed

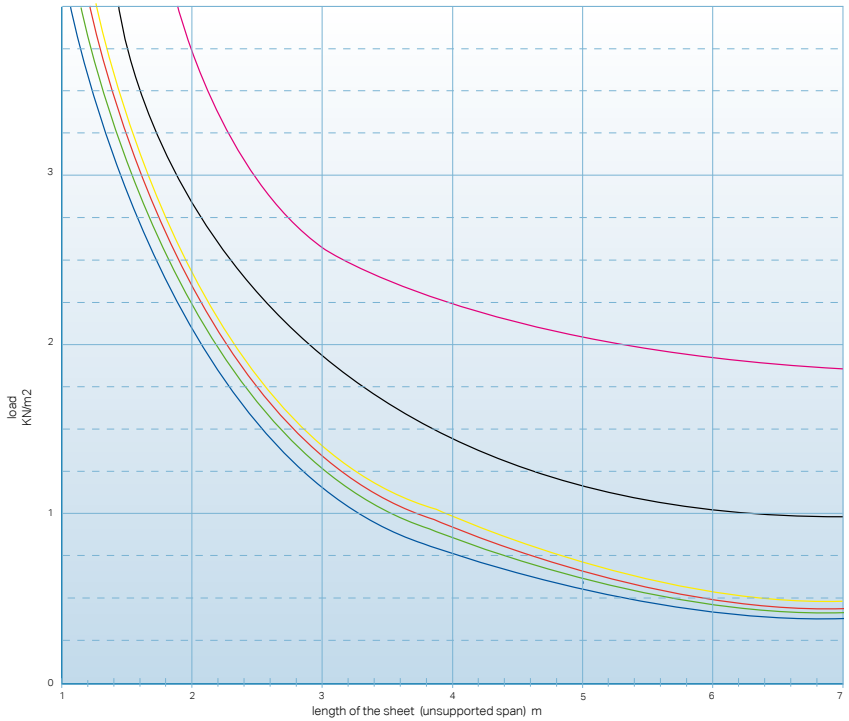


load bearing characteristics of Makrolon multi UV 5X/16-25 flat glazed



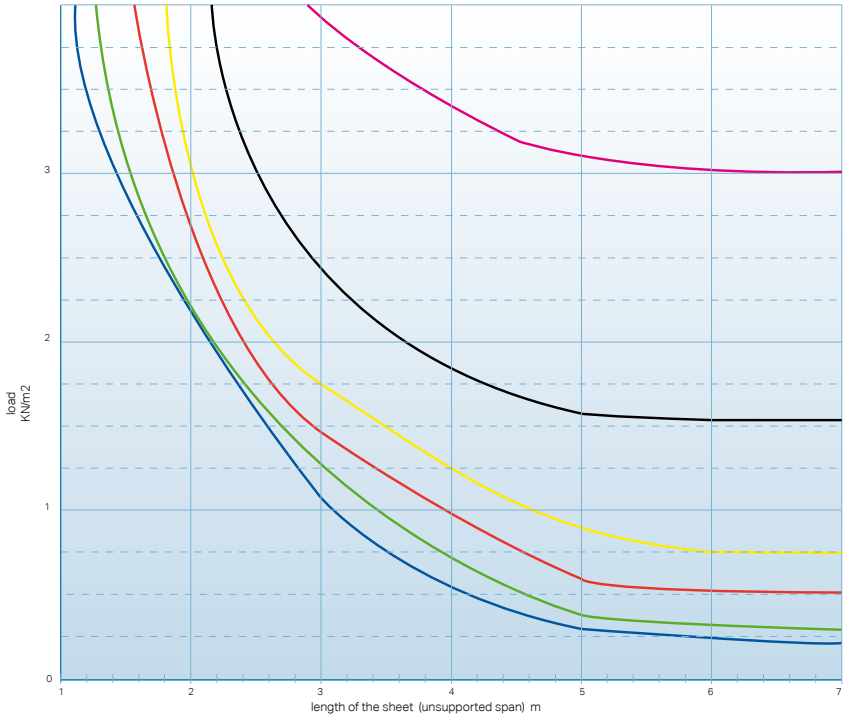
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- width = 2100 mm

load bearing characteristics of Makrolon multi UV 5X/16-25 ES flat glazed



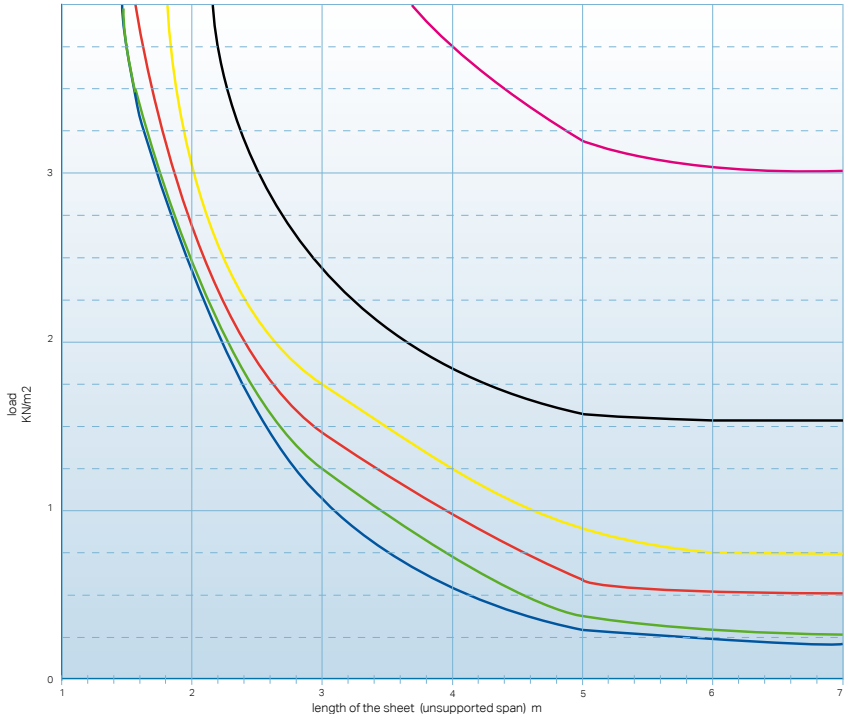
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width = 2100 mm

load bearing characteristics of Makrolon multi UV 5M/25-20 flat glazed

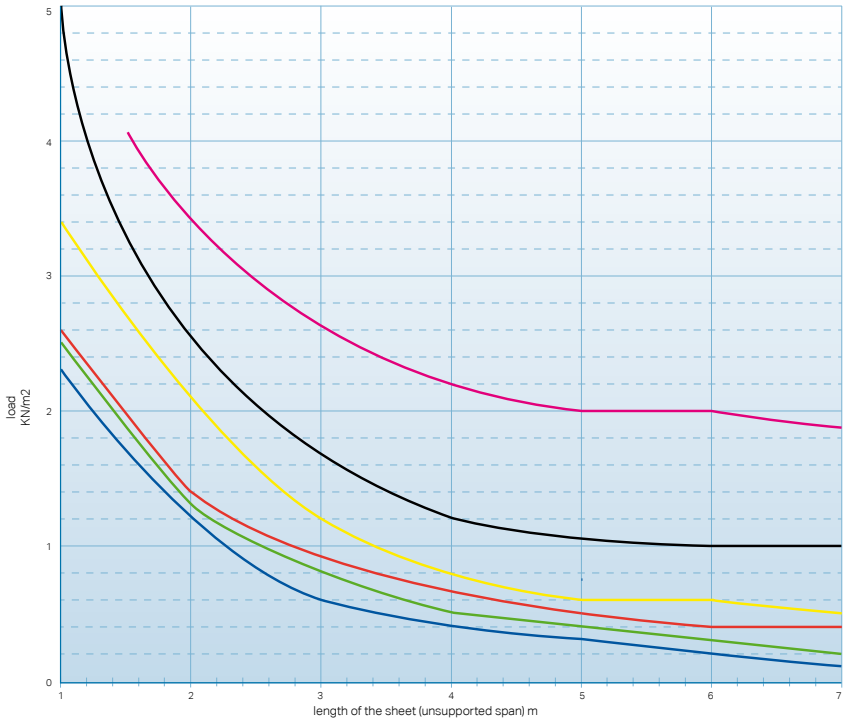


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- width = 2100 mm

load bearing characteristics of Makrolon multi UV 5M/32-20 flat glazed

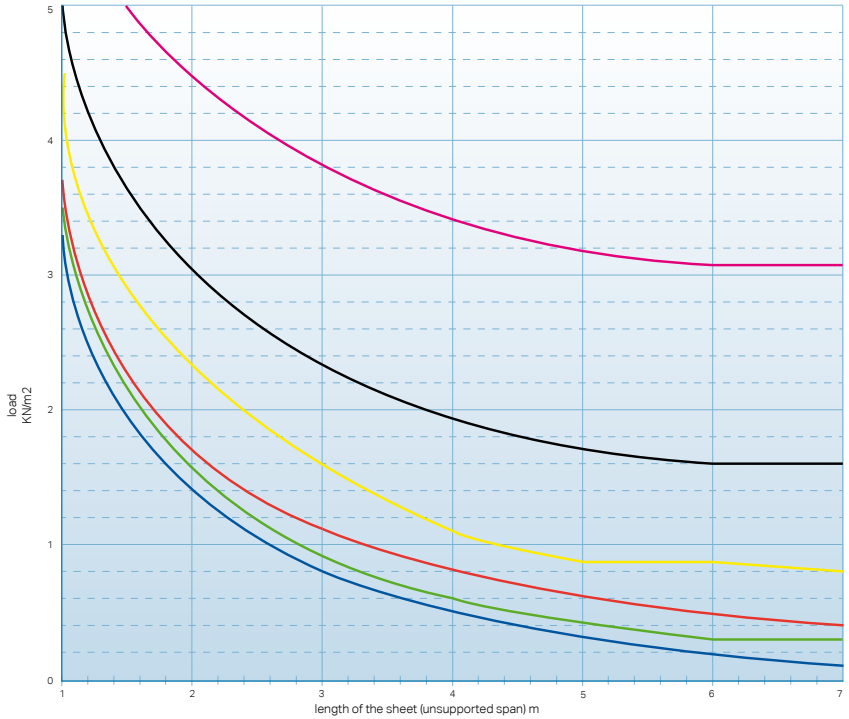


load bearing characteristics of Makrolon multi UV 7/16-14 flat glazed



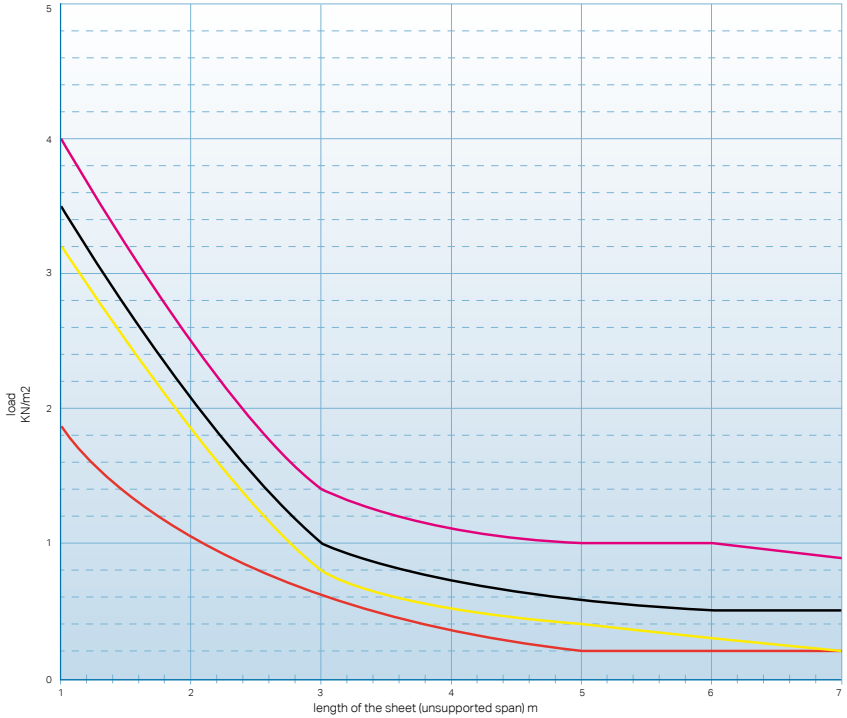
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- width = 2100 mm

load bearing characteristics of Makrolon multi UV 7/20-14 flat glazed



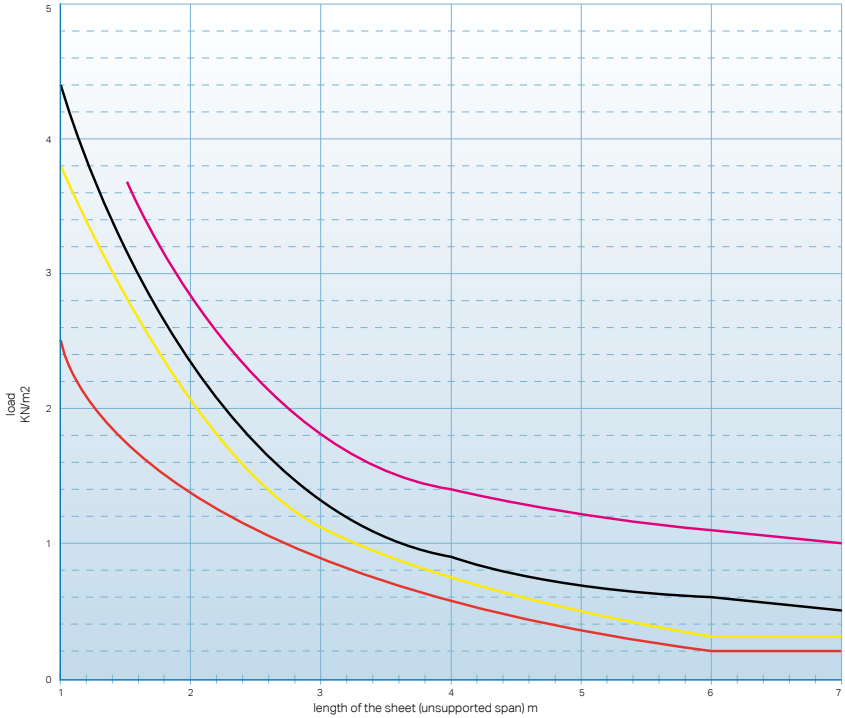
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load bearing characteristics of Makrolon multi UV 7M/16-28 flat glazed

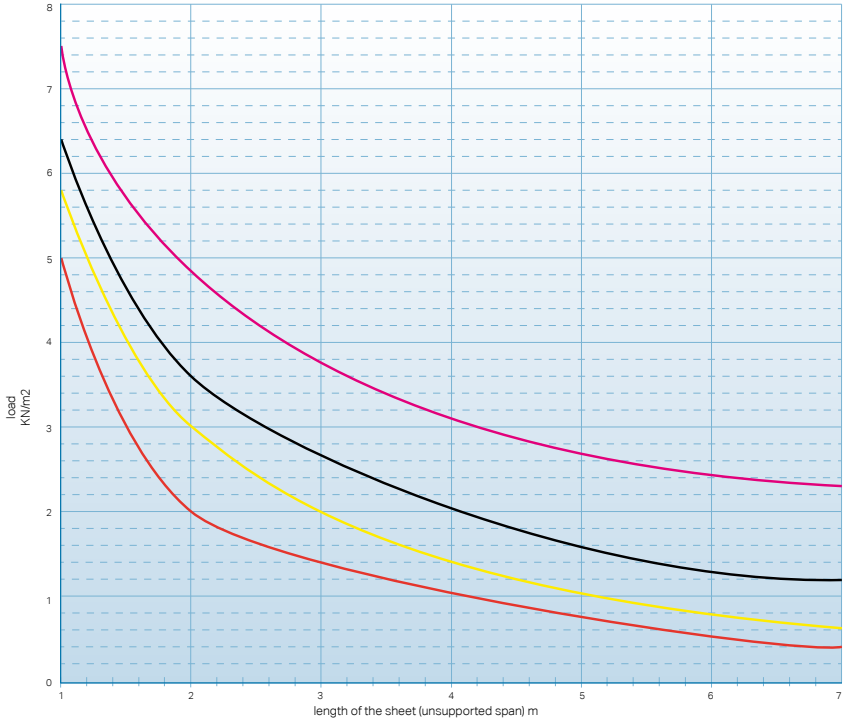


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width = 1200 mm

load bearing characteristics of Makrolon multi UV 7M/20-28 flat glazed

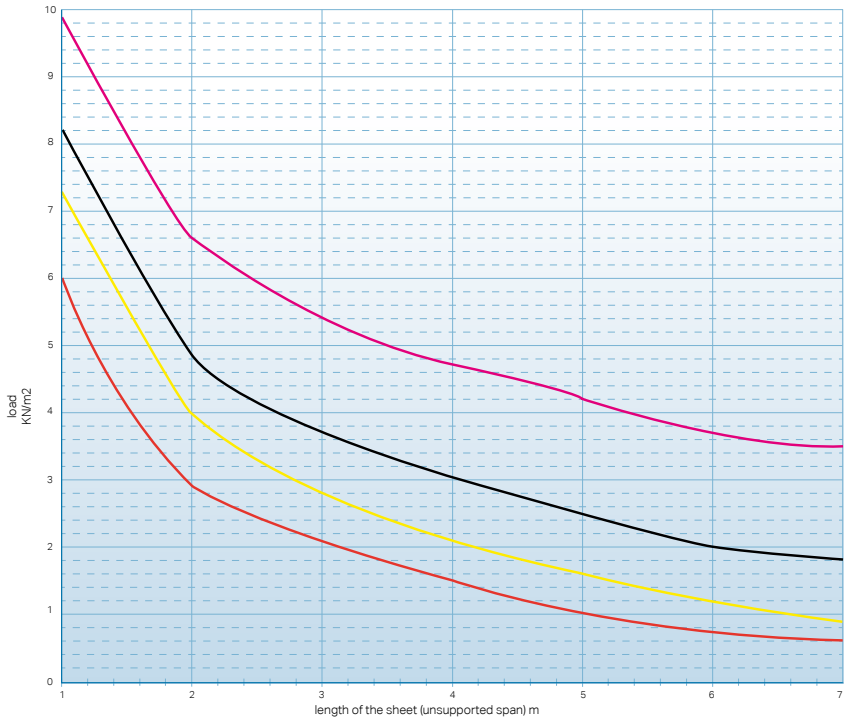


load bearing characteristics of Makrolon multi UV 7M/25-28 flat glazed



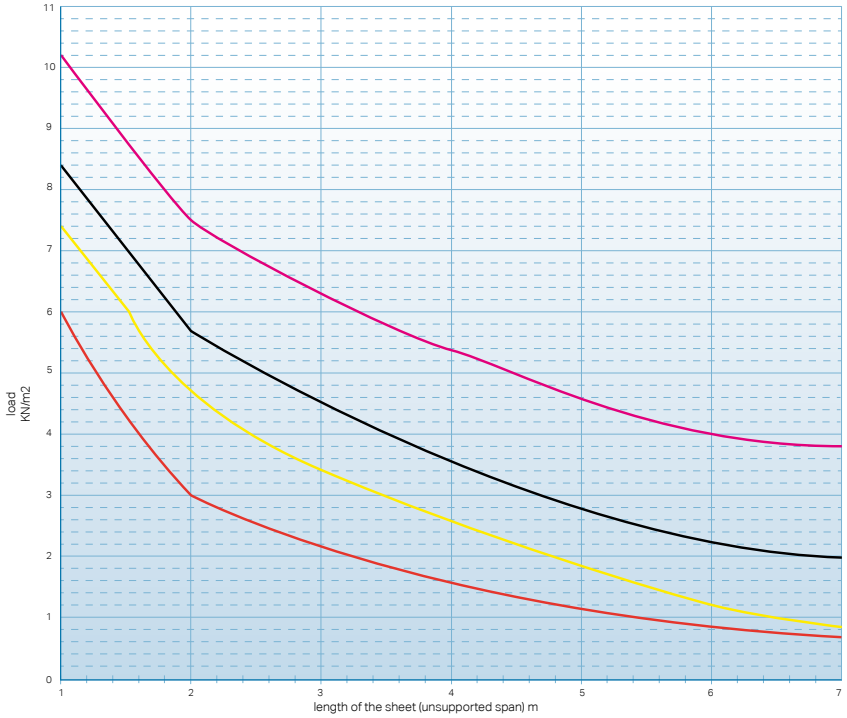
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load bearing characteristics of Makrolon multi UV 7M/32-28 flat glazed



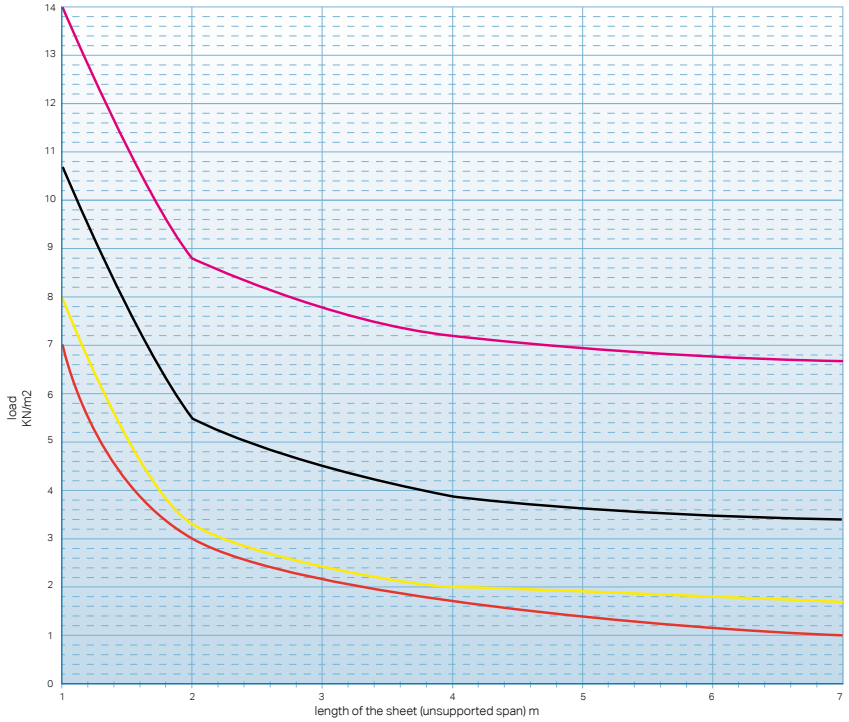
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load bearing characteristics of Makrolon multi UV 7M/40-28 flat glazed



width = 500 mm
width = 700 mm
width = 980 mm
width = 1200 mm

load bearing characteristics of Makrolon multi UV 7M/50-28 flat glazed



- width = 500 mm
- width = 700 mm
- width = 980 mm
- width = 1200 mm

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