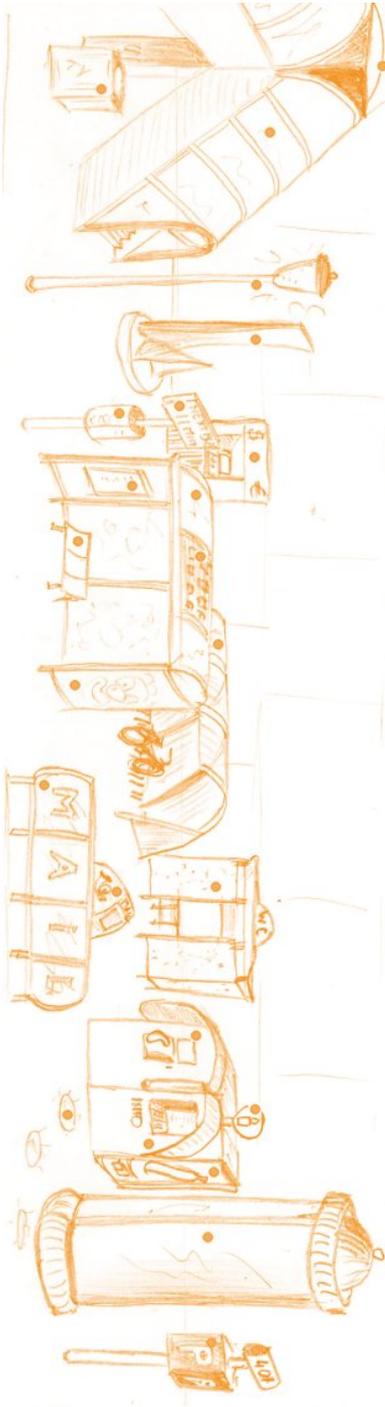




Application booklet
Street furniture





Street furniture is a collective term for objects and pieces of equipment installed on streets for various purposes, including benches, post boxes, phone boxes, streetlamps, street lighting, traffic signs, bus stops, tram stops, public lavatories, fountains and art, walkways, kiosks, balustrades, shelters, footlights, sound walls and waste receptacles. But also all types and objects for advertisement. An important consideration in the design of street furniture is how it affects road safety.

Both our solid (MAKROLIFE®, COLORADO™UV, GRIPHEN™ UV, SAPHIR™ and SAPHIR™ SPD, but also MAKROTECH™UV) and MULTICLEAR™ multiwall sheet can be suitable products for the majority of these applications. Where solar heat reduction is an issue, our solar green sheet can be an effective alternative. In order to determine the right product for the right application, it is important to understand the technical requirements and limitations.

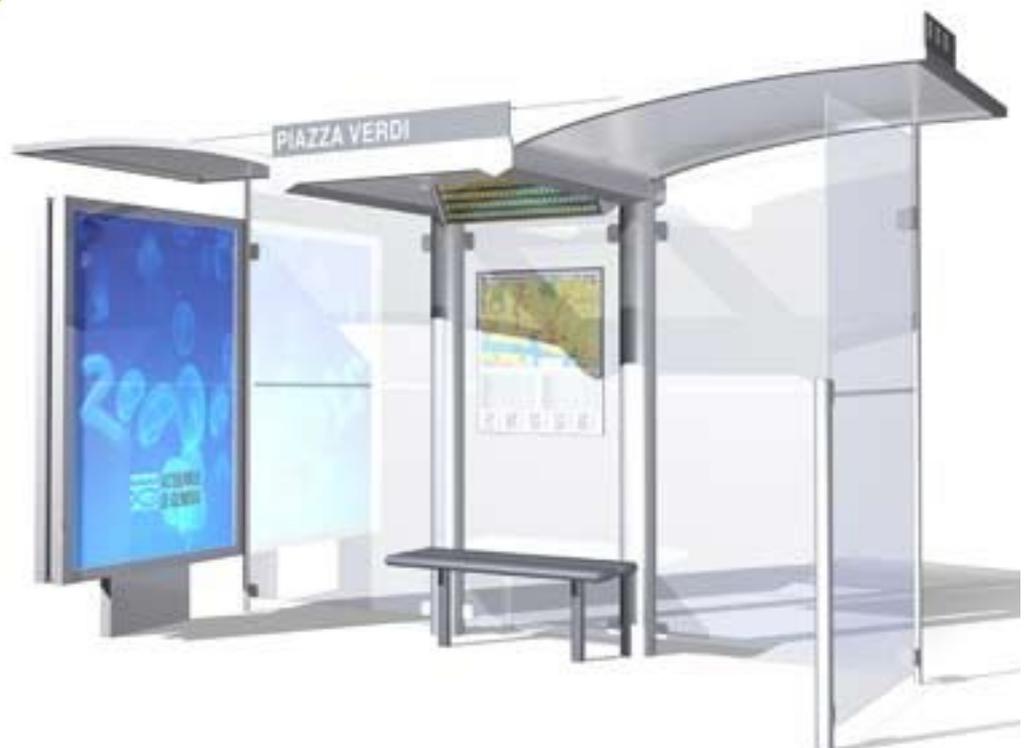
In today's street furniture applications, advertisement space plays an important role. The presentation of this advertising has to fit in the overall public planning rules of cities and their architecture. These requirements lead to interesting design approaches for advertisement presentation in different formats. Street furniture families were designed to fit these needs. Over the years they were completed with additional components like restrooms, automatic toilet facilities and kiosks to name a few. But also litter bins today has advertising space.

To finance this infrastructure long term contracts (10 to 15 years) are signed between cities and outdoor advertising companies.

But apart from advertisement –related street furniture, there remains a large number of applications which do not pass through advertisement companies' hands: for instance street lighting, signs, walkways, pedestrian bridges, cycle shelters.

All our thermoplastic sheets are suited for flat applications, but they give more design freedom when curved or even thermoformed into complex shapes.

For more information contact your local agent or contact Arla Plast directly



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1 SHEET PROPERTIES

1.1 Impact resistance

Impact resistance can be measured using various tests, but for all tests our polycarbonate sheet show the highest impact resistance of all transparent materials.

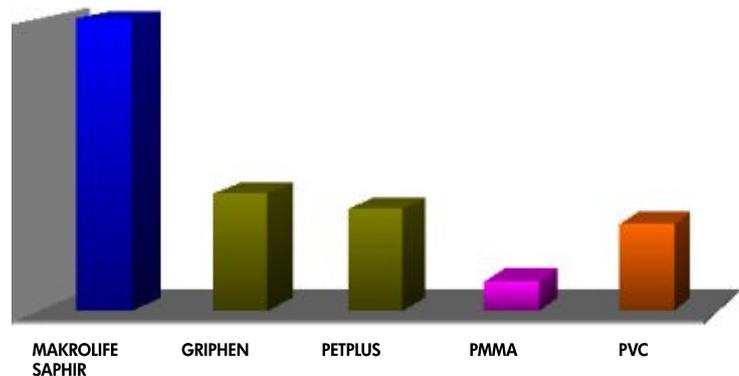
Impact resistance decrease at lower temperature, but our materials are suitable between -40°C and plus 65°C for GRIPHEN™ and $+100^{\circ}\text{C}$ for our solid and multiwall polycarbonate range.

Impact resistance decreases when parts are influenced by chemicals, tensions, sharp edges, ...

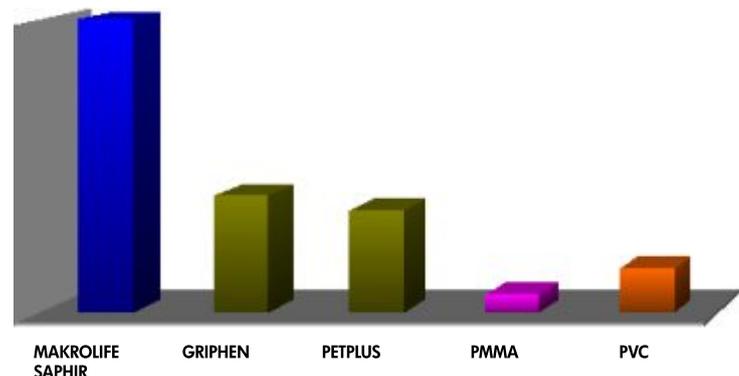
Impact resistance of polycarbonate extruded sheet is higher than the impact of injection moulded ... polycarbonate.

In fact, even GRIPHEN™ can have a higher impact resistance, depending on the test method!
But whatever test method is taken, polycarbonate sheet are the most impact resistant of all clear sheet.

Falling dart impact at 23°C



Falling dart impact at 0°C



Arla Sheet materials have similar impact resistance down to -20°C

1.2 Shatter proof

Polycarbonate and GRIPHEN™ sheet have a very high impact resistance, but in case the part breaks, it will not break into sharp fragments like for glass or PMMA.

1.3 Scratch resistance

Scratch/mar resistance and impact resistance mostly do not comply with each other.

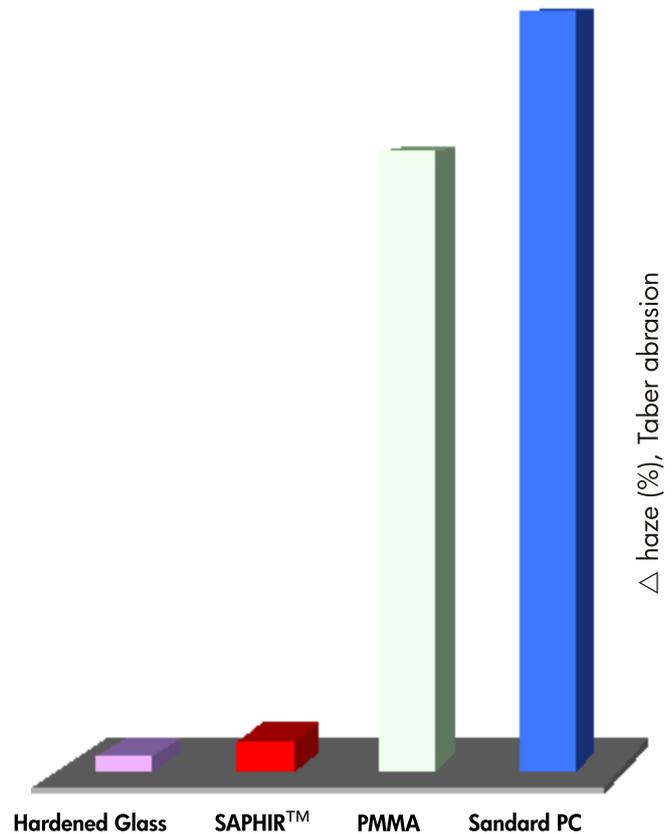
Polycarbonate and GRIPHEN™ sheet are equally resistant to scratches, and like glass, these can not easily be repaired.

Resistance to industrial brush cleaning systems.
When screens are regularly cleaned with industrial brush cleaning systems, it is recommended to use scratch resistant hard coated SAPHIR™ sheet (for flat glazing only).

In areas exposed to vandalism, SAPHIR hard coated sheet offers the best protection. Even graffiti and paints are easily removed, due to its extremely smooth and chemically inert surface.

When bird repellent stripes are needed, SAPHIR™SPD is recommended, as it combines a screen printed design with the abrasion resistant surface of the SAPHIR™ sheet.

For mass transport areas and any other zone more prone to scratching or marring, SAPHIR™ or SAPHIR™ SPD sheet are a way to overcome this. Alternatives are scratch-hiding surfaces such as our textured sheet TEXT™UV and ICE™UV. A combination of texture and SAPHIR™ is also possible.



1.4 Graffiti

For our entire thermoplastic sheet range it is difficult to fully remove graffiti: most cleaners will leave marks on the sheet. In areas where graffiti is a problem, SAPHIR™ sheet offer an ideal surface to remove graffiti easily: either by means of an adhesive film or by application of cleaners. Care has to be taken to avoid that the cleaning agent contacts the sheet edges.

A graffiti removal operation should be completed with a normal cleaning step.

Certain surfaces are less popular for permanent marker graffiti: ICE™UV, TEXT™UV and their SAPHIR™ version are examples.



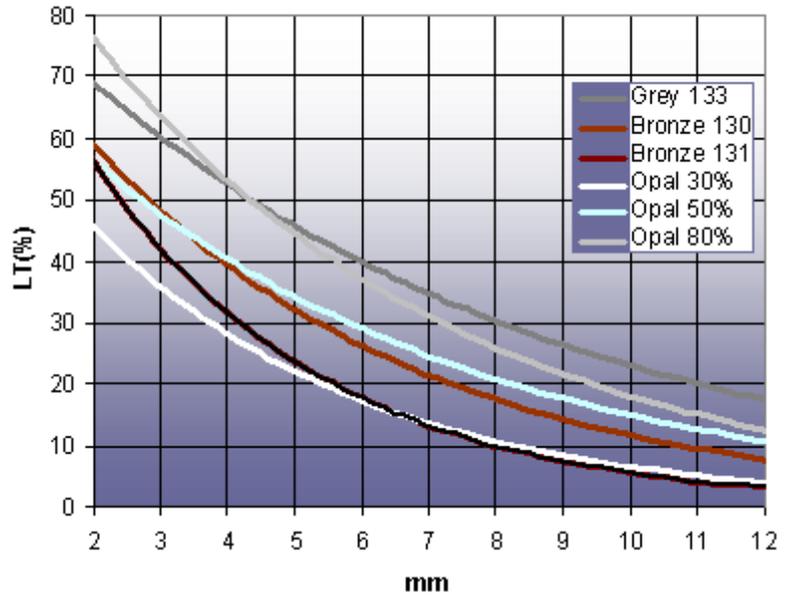
1.5 Light transmission

A light transmission tolerance of +/-5% applies.

Light transmission is less important when it comes to light diffusing panels such as back-lit advertisement panels or signs. Then the light diffusivity is more important. Our opal white sheet products all have a certain diffusivity, but also surface textures cause diffusion of the light.

Light transmission (average in the visible range) decreases with increasing material thickness. Transparent colours, opaque colours, light diffusing colours, metallic effect colours: most colours can be matched. For a colour match a sample is needed. For opaque colours, a RAL code or NCS colour code is preferred. Surface textures and coextrusion layers can alter the colour appearance.

Light transmission



Light transmission on multiwall products is difficult to measure, due to the many internal reflections. Indicated values therefore are typical values.

Special types will have different light transmissions.

In southern areas it is recommended to use solar reflecting or solar absorbing grades, such as solar green and solar grey.

Type	Thickness	Clear	Opal	Bronze
MULTICLEART™				
	4	84	70	60
BOX 2Wall	6	82	60	50
	8	80	60	50
	10	80	58	49
BOX 3Wall	16	70	30	25
STRONG	10	64	44	35
	16	60	30	25
	20	56	25	23
	25	45	22	20
LIGHT	32	43	15	20



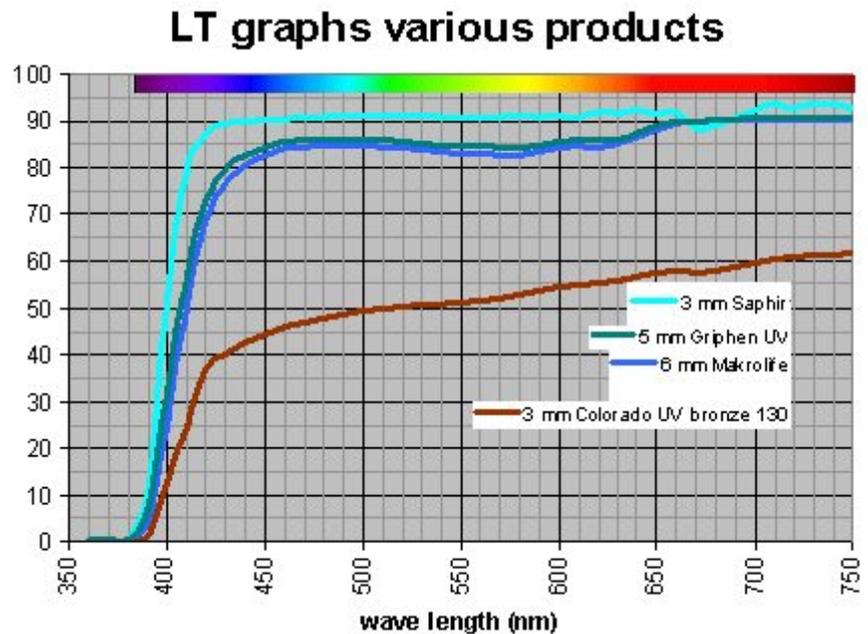
1.6 Colours

Arla Plast offers a comprehensive range of transparent colours, opal white diffusive tints and opaque colours. Most colours can also be colour-matched.

All polycarbonate sheet with UV-protection have a UV-cut-off at 380 nm. Below that wavelength all radiation is absorbed.

It therefore is the ideal protection for the materials behind the plastic part, such as advertisement posters, bus stop schemes, brochure holders, ...

There also is hardly a difference in the light transmission graphs of GRIPHEN™UV and MAKROLIFE® and SAPHIR™.



Note that optical measurements on textured sheet or multiwall sheet are not so simple.

Please contact our agent to make sure you have the latest information on product range and availability.

1.7 Weathering resistance

All outdoor applications are exposed in some way to weather influences, therefore we offer UV-resistant products in order to limit loss of light transmission and discoloration. All UV –protected products are backed by a Warranty up to 10 years.

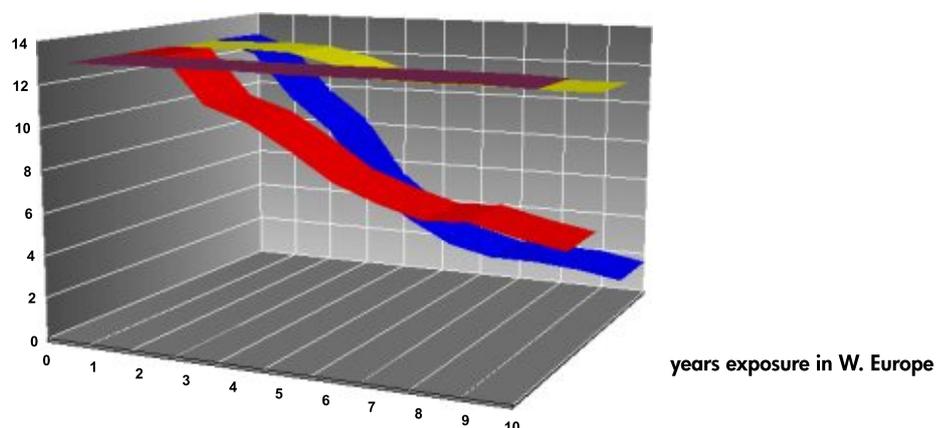
In some outdoor applications, where there is no UV radiation (opal diffusers in back-lit advertisement panel on a vending machine), or where life time is limited (e.g. brochure holders in a bus stop), products without UV protection can be used.

Impact resistance decreases quickly for non-UV protected products, when exposed in outdoor applications.
(tested on solid sheet)

When these sheet are not protected by a UV-absorbing layer, they are prone to visible yellowing within 1 to 3 years. Yellowing will be more visible when new material is installed nearby. Therefore, refurbishment should always take place for the street furniture in the whole area .

INSTRUMENTED IMPACT (2-6 mm)

■ Makrolife min, up ■ Makroclear min, up ■ Makrolife min,down ■ Makroclear min, down



1.8 Fire safety

As fire safety for street furniture might not be important as they are outside, it is an issue for certain applications, such as walkways, litter bins, pedestrian bridges.

All mentioned products are self-extinguishable, due to their high oxygen index of 25-26%.

Products are tested to EN 13501 Euroclasses for building products.

Best protection against vandalism is when all sheet edges are protected by a metal profile or covered otherwise.

Glow wire test is a test for luminaries and other lighting applications.

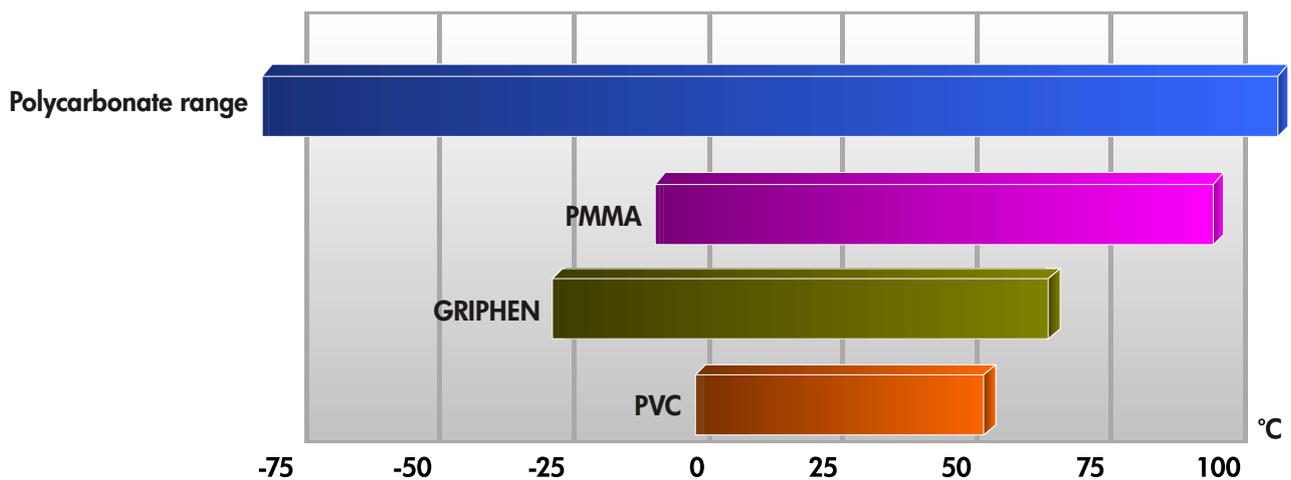
Our sheets are tested to this requirement at 750 and 850°C.

UL94 is an Underwriters Laboratories test for electrical appliances.

Polycarbonate typically is HB, where GRIPHEN™ resins can get V2. For better ratings Flame retardants are needed.

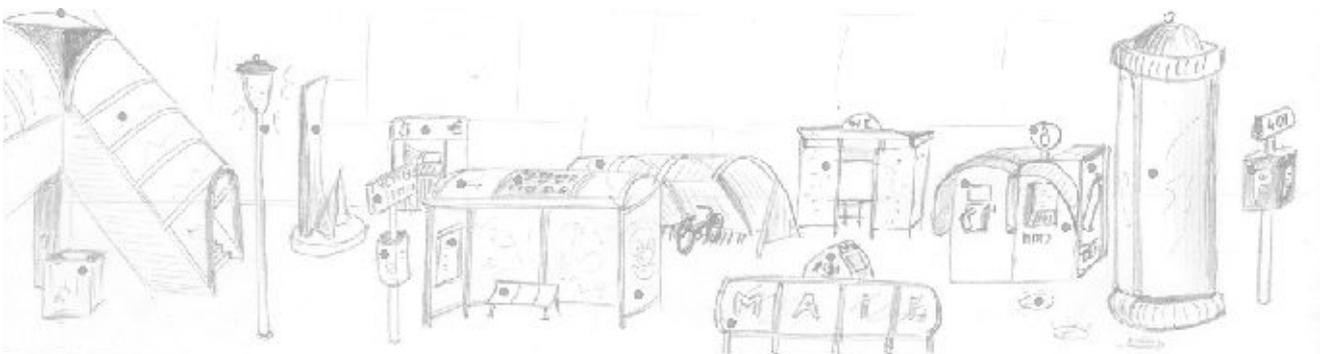
1.9 Textures

We have a comprehensive range of standard textures such as TEX™, ICE™ and ANTI-REFLEX™, but also other textures are possible.



There are no bad products, there are no bad applications. But it is important to choose the right product for the right application.

Although that air temperatures seldom get over 40°C, sheet temperatures can go much higher, depending on colour. A clear sheet in the sun in southern Europe can reach 55°C, where a very dark sheet might reach up to 70°C and more.



2 APPLICATION AND INSTALLATION

2.1 Sheet thickness

Sheet thickness depends on the design, stiffness requirements and loading requirements: A two mm solid MAKROLIFE® sheet might serve as a glazing, but might not be aesthetically pleasing due to the large deflection under load.

For our MULTICLEAR™ multiwall range, please check our technical manual for loading tables and graphs. For our solid polycarbonate range and GRIPHEN™ range simple calculations can be performed rapidly.

For any complex application, finite element analysis can be performed to search for an answer on your questions.

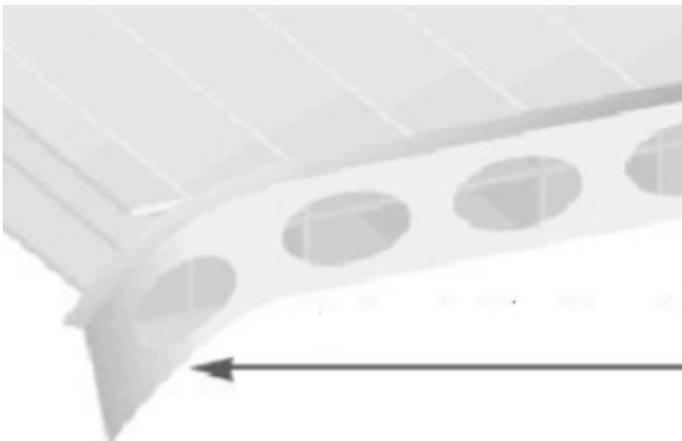
Due to the higher thermal expansion than for metals, the fixing/clamping method should be as such as to allow for thermal movement where applicable.

In order to smoothen expansion and contraction and to limit internal tensions it is recommended to avoid direct metal contact with profiles. Intermediate materials should be compatible to polycarbonate, like EPDM and neoprene.

Wherever possible, materials should not be drilled, as this might weaken the construction and hinder thermal expansion and contraction. In cases where drilling or routing is essential, care should be taken to avoid rough edges, sharp cuts and notches. In this relation, care has to be taken when using countersunk bolts, when no tension-reducing measures have been taken.

Parts also can be glued to other substrates using the correct glue for that application.

In any application with MULTICLEAR™ multiwall sheet, channels should be installed pointing upwards in vertical direction, and should have the right edge sealing: closed on top and open tape on lower edge.



2.2 Decoration

When applicable, decoration techniques such as screen printing, hot stamping or sign film can be applied.

Only use products which are compatible with polycarbonate.

In SAPHIR™ SPD, polycarbonate sheet are printed and hard coated.

Applications can be Telephone boot wings, Bus shelter panels, ... and can be either functional or aesthetical.

2.3 Flat application

When applicable, decoration techniques such as screen printing, hot stamping or sign film can be applied.

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In SAPHIR™ SPD, polycarbonate sheet are printed and hard coated.

Applications can be Telephone boot wings, Bus shelter panels, ... and can be either functional or aesthetical.

2.4 Curved application

Minimum radius of 150 times the sheet thickness applies.

With a radius, higher loads are possible.

SAPHIR™ sheet are only suitable for flat applications. Contact Arla Plast for formed applications.

Preferably, sheets are placed in a frame on 4 sides.

For thicker sheet with shallow radii, also point fixing or combinations are possible.

In those cases it is recommended to check loading capabilities with FEM or other analysis method.

2.5 Formed application

For radii smaller than the allowed cold curving radius, sheet should be thermoformed.

It is possible to obtain SAPHIR™ surface properties on formed parts.

3 CLEANING

The surface may be cleaned using a clean soft sponge and washing with lukewarm water containing a mild soap or a slightly acidic, neutral or slightly alkaline detergent. Then rinse thoroughly with clean water and dry with chamois leather or a moist sponge.

Fresh paint splashes, grease, smeared glazing compounds, etc. can be removed before drying by rubbing lightly with isopropyl alcohol on a soft cloth followed by a thorough wash & rinse as described above. Rust stains can be removed with a 10% oxalic acid solution.

Do not use abrasive or highly alkaline cleaners, acetone, benzene, leaded gasoline or carbon tetrachloride on the plastic surfaces. Never scrape with razor-blades or other sharp instruments.

Suitable cleaning solvents at room temperature are water, white spirit, hexane, heptane, Ethyl alcohol, Butyl alcohol, isopropyl alcohol (also known as IPA or Isopropanol).

For internal surfaces (lighting applications a.o.) there are some commercially available products which act simultaneously as cleaning agent and anti-static agent.

The protective coating of the SAPHIR™ sheet makes it more tolerant towards chemical attacks. Stains from ink, paint and marks from graffiti can be removed with products designed for this purpose (ask the supplier for the right graffiti remover). Always be careful not to scratch the surface of the sheet, and – in case it is not compatible with polycarbonate – to avoid contact with non-coated areas (edges, holes,...).

4 OTHER

Our management system is ISO 9002 and ISO 14000 certified.

For any questions or information please contact Arla Plast or our Agents.

