



Den Braven



Compatibility of sealants with PMMA and PC

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General information

Polymethyl methacrylate (PMMA) and polycarbonate (PC) are plastics that are frequently used in construction and industry. Both products are supplied in (glass) clear and colored versions. There are also glass fiber reinforced versions. The materials are hard, rigid, and have high impact and scratch resistance. The materials are used in: bulletproof glass, safety glass, pool covers, bathroom furniture, light domes, aquariums, terrariums, etc. With respect to PC, PMMA has the advantage that the product is clearer in the transparent version, less yellowish and more scratch-proof. PC is more resistant to mechanical impact and has many uses. It is widely used in anti-burglary products and bulletproof glazing systems. Well-known brand names of PC are Lexan® from GE Plastics and Makrolon® from Bayer. PMMA is known as Plexiglas®, which is a trademark of Rohm and Haas.

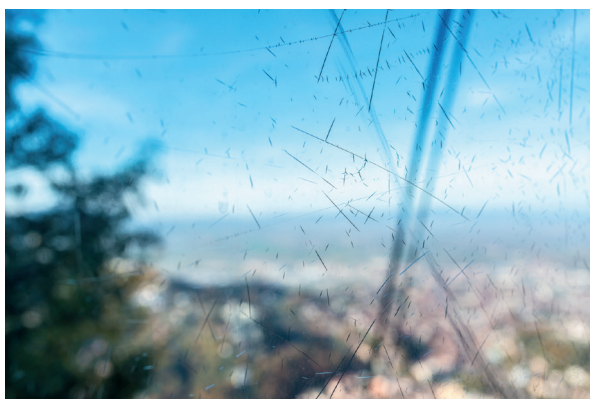
Processing of PMMA and PC

The processing and sealing of PMMA and PC should be considered with a number of things;

Coefficient of expansion

At high temperatures each material will exhibit expansion and shrinkage. Plastics show greater movement in temperature differences than, for example, metals, glass or stone-like materials. At a 100°C temperature difference PMMA and PC will expand or shrink 8 mm per meter. In outdoor applications where temperature differences are significantly higher than in interior applications, this should be taken into account in the measurements. For example, if you choose to apply PMMA or PC instead of glass, PMMA and PC will expand and shrink 10x more compared to glass (coefficient of expansion of glass 0,8 mm per meter At 100°C temperature difference). In practice, the maximum temperatures will fluctuate about 80°C (ΔT). For example, if we place a 3 meter length of plate PC in an outdoor application, this plate will move 19.2mm while fluctuating between the extreme temperatures. Therefore it is possible to calculate what the foreseeable movement will be if, for example, this plate is placed at 25°C. Because of the high expansion coefficient, it is also important to ensure that the anticipated movement through the fixing material, adhesives and sealants can be absorbed when attaching, gluing or sealing PMMA or PC.

PMMA and PC have a high surface tension and should therefore be stress-free as much as possible to prevent tension in the material, resulting in damage or breakage.





Risk of stress cracking

PMMA and PC have a relatively high surface tension and are therefore highly sensitive to chemicals, paints, adhesives, sealants, solvents, detergents etc. Manufacturers and suppliers of PMMA and PC will often provide instructions on cleaning the material. In some cases, advice is also given for correct placement with fasteners, rubbers, sealants and adhesives. It is essential to follow these instructions to prevent irreversible damage.

When PMMA or PC come into contact with substances that can affect surface tension, the risk of stress cracking is very high. Stress cracking reveals itself as cracks in the surface of the material. Fiber-enhanced PMMA and PC are much less sensitive to stress cracking than pure, transparent or crystal clear PMMA and PC.

Choice of adhesives and sealants

It is very important to be careful when selecting sealants and adhesives. Many sealants contain substances that can damage the surface tension of the PMMA or PC with stress cracking. Pure PH-neutral silicone sealants without mineral plasticizers are the only products that are compatible with these sensitive plastics. However, when choosing a sealant or adhesive, it is important to check the compatibility beforehand.

It is very difficult to test compatibility without the appropriate means and knowledge, so it's findings should be based on the information provided by the manufacturer of the products. We strongly advise against applying any sealant or adhesive before testing, as irreversible damage might occur. Due to the high surface tension, adhesion of sealants and adhesives is more difficult than to most common building materials. Adhesion can be tested by manufacturers of sealants and adhesives, however, differences between substrates of different brands may occur. In addition to compatibility with the plate material, it is also important to choose sealants with an as low as possible E-modules (force needed to stretch the sealant). High modules sealants and adhesives may impede the movement of the sheet material, causing tension in the sheet material which might cause damage.

Den Braven has two sealants available that are compatible with PMMA and PC. Zwaluw Silicone-N is a slow skin forming, slow curing matt finish universal silicone sealant. Zwaluw Silicone-COLOURS is a glossy neutral silicone sealant with fast skin formation, available in colours and in transparent. This product contains fungicide that makes it suitable for sanitary applications.

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Joint dimensions

Sealants and elastic adhesives are able to absorb a certain movement. If you choose to seal PMMA or PC sheet material, maximum motion recording is limited to 25%.

The expansion coefficient of PMMA and PC is significantly higher than most other building materials. We calculate an 80°C temperature difference when determining the joint dimensions. In order to correctly determine the movement of the sheet material we assume the longest size of the sheet material used. If we take 2 meters as the longest length with a temperature delta.

of 80°C, theoretically the movement of the sheet will be $6.4\text{mm} \times 2 = 12.8\text{mm}$.

This movement will be half of the total at both ends, which amounts to 6.4mm.

However, this is the maximum expansion (and shrinkage) from the lowest (or highest) temperature. It is therefore realistic to assume a temperature somewhere between the maximum and minimum temperature. This means that the actual expected movement of the sheet material will be 50% of the extremes. For the 2 meter plate material, the expected movement on the ends will be a ratio of $6.4 : 2 = 3.2\text{ mm}$. Using a sealant with a durable maximum movement capability of 25%, the joint width around this plate must be $3.2 \times 4 = 12.8\text{ mm}$.

In order to prevent the sheet material from obstructing its movement, it is advisable to select a sealant with a soft character (E-modules). For further information regarding joint dimensions, please refer to our Technical Bulletin Joint Dimensions.

Application of PMMA and PC laminated glass and bulletproof glass

Some types of laminated and bulletproof glass are manufactured from multiple glass sheets combined with a PMMA or PC interlayer or outside, joined together by a foil.

If a sealant is used to seal this type of glass and the sealant will be in direct contact PMMA or PC, the sealant should always be compatible.

Application of PMMA and PC in sanitary areas

Where in the past baths, shower basins and sinks were made of enameled steel and ceramics, modern bathroom furniture, baths and shower bins are often made from PMMA.

Because this is almost always fiber-reinforced material, the risk of stress cracking is almost nil. It is important to do an adhesion test beforehand as the classical acetoxy sanitary silicones have a limited adhesion spectrum. With neutral silicone sealants, if degreased, better bonding is obtained. The joint size in sanitary areas is also important. Unlike classic sanitary materials, bathtubs and shower cabins made of plastic expand and shrink more under the influence of temperature and pressure. In order to adequately absorb this movement, the joint size must be calculated correctly. If the joints are too narrow, there is a chance that the joint will break through. For this reason low modules neutral sanitary silicones are recommended.

Warranty and liability

The above information is based on years of practical experience and tests and is of a general nature. Via this bulletin Den Braven aims to provide information and suggest possible solutions, without any guarantee being given, nor acceptance of any liability whatsoever.

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