

Fabricating Tips for PLEXIGLAS® Solid Sheets

Guidelines for Workshop Practice



General Information

PLEXIGLAS® is our registered trademark for the world's first acrylic, a polymethyl methacrylate (PMMA), invented by Dr. Otto Röhm and manufactured for the first time in 1933. Since then, this high-quality plastic has been used not just for industrial applications (glazing in buildings, signage, countertop displays, sanitary ware, aircraft canopies, furniture etc.) but also in particular by craftsmen and do-it-yourselfers for innumerable applications.

Ranging from handicraft pieces through picture glazing to art objects. From balcony parapet through carport to patio roofing. The grades, colors, thicknesses, sizes and cut-to-size sheets of the many PLEXIGLAS® product families available from your local authorized distributor of PLEXIGLAS® are the source of unlimited inspiration for creative users and a guarantee of individual and successful design.

PLEXIGLAS® GS (cast sheet production) is available as solid/flat sheets and blocks ranging in thickness from 2 to 80 mm, as tubes up to 650 mm and rods up to a diameter of 100 mm.

PLEXIGLAS® XT (extrusion) is available as flat/solid sheets (up to a thickness of 25 mm), textured sheets, mirror sheets, tubes, rods as well as corrugated and multi-skin sheets.

The sheets have high-gloss, matte or textured surfaces, are crystal-clear or diversely colored.

At our PLEXIGLAS® Shop you will find the largest range of sheets, tubes, rods and accessories straight from the manufacturer:
www.plexiglas-shop.com

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- Waterproof marker
- Medium to fine machine file
- Scraper
- Spray bottle
- Compass saw max Ø 60 mm (for machining plastics and acrylic)
- Step drill
- Conical drill
- Countersink
- Metal drill with correct grinding for acrylic (point angle 60° to 90°)
- Flush cutter with stop ring
- Contour cutter with stop ring
- Jigsaw blade with straight teeth and tooth pitch of 2.5 mm
- Circular saw blade with straight teeth (ideally trapezoidal flat teeth) and tooth pitch of approx. 13 mm

Using the Right Tools for Success



Ideally, tools should only be used for machining PLEXIGLAS®

Dirt finds it hard to adhere to the perfectly smooth surface of PLEXIGLAS®. Dusty surfaces can be cleaned with water to which some washing-up liquid has been added, using a soft, non-linting cloth or sponge. Do not rub dry.

Vileda® Microclean cloths dampened with water have a good and practically smear-free cleaning effect.

In the event of heavier soiling, particularly with grease, benzene-free petroleum ether or isopropyl alcohol can be used to clean PLEXIGLAS®.

Suitable cleaning agents are:

- lukewarm water with a little washing-up liquid
- isopropyl alcohol (2-propanol)
- pure petroleum ether
- soft, damp viscose sponge
- soft, damp non-linting cloth
- sponge cloth
- chamois leather
- glove-lining fabric
- cotton tea-towel
- shower squeegee with soft rubber lip
- damp microfiber cloth for the final touch (e.g., Vileda® Microclean)

Cleaning and care of PLEXIGLAS®

Tip

Abrasive cleaning agents should never be used for cleaning acrylic.



Always predrill recesses and apertures in the corners of cut edges and cut them out with a jigsaw or overhead template router.

Machining PLEXIGLAS®

Drilling

Commercially available twist drills (for metal) always have to be ground correctly before using them on acrylic. DIY enthusiasts can order them preground from: www.plexiglas-shop.com

Please bear in mind the following when drilling:

- Position the drill slowly and carefully when you start drilling.
- Slow the feed just before the bit exits the bottom surface. The aim is to ease the drill through gently (possibly place a sheet of wood underneath).
- Use tap water for cooling. Commercially available step drills and conical drills have proved especially suitable when working on site with a manual drill.

Step drill

This one-edged drill does not leave any chatter marks and guarantees clean cylindrical bores. With each subsequent drilling step, the hole is simultaneously chamfered.

Conical drill

The drill holes are slightly conical, but there is no chipping on the exit side of the hole. Pay attention to a triple-edge design.

Routing

The drill holes are slightly conical, but there is no chipping on the exit side of the hole. Pay attention to a triple-edge design.

- Only use immaculate, sharp cutters.
- The cutter shaft must be inserted in the collet chuck deep enough to fill this completely.
- The workpieces must always be firmly clamped. If possible, start by cutting a larger workpiece and then sawing it into smaller sections.
- Always guide the workpiece against the cutting direction (opposed routing).
- Perform a trial cut on a piece of PLEXIGLAS® and check the setting of the overhead template router.
- Always work with a stop and/or a template.

Tip

The PLEXIGLAS® sheets are protected by polyethylene films. The masking film must be left on the clear-transparent side of the sheet until it is put to its final use, and should normally be left on the sheet underside until machining is completed. If the masking film is no longer in place, the area to be machined should be covered with parcel tape.

A guide rail or parallel stop is used to safely guide the circular handsaw.



Sawing

The standard machines used for wood and metalworking are suitable for machining PLEXIGLAS®. Non-vibrating high-speed machines provide clean cut edges.

Circular handsaws and circular table saws

When cutting PLEXIGLAS® to size, the blades of circular handsaws or of circular table saws should protrude only slightly beyond the sheet.

- Always use carbide-tipped saw blades.
- Teeth: trapezoidal flat tooth or alternate teeth
- Tooth pitch: ~ 13 mm
- Always work with a stop.
- Carefully saw into the sheet with the saw running.
- Make sure that cutting is exact.
- Do not tilt the material.
- Fix the sheets to avoid flutter.
- Saw at an average feed rate.

Jigsaws

- Only use saw blades with straight teeth and a tooth pitch of 2.5 mm.
- Only tackle the workpiece with the saw running.
- Place the shoe firmly on the masking film of the sheet.
- Set an average cutting speed and adjust stroke action to zero.
- Select average feed rate.
- Cool with tap water.
- Prevent water from splashing the machine.

PLEXIGLAS® GS und XT

Clearance angle	3° to 8°
Rake angle	0° to 4°
Point angle	60° to 90°
Angle of twist	12° to 16°, usually 30°
Cutting speed	10 to 60 m/min
Feed	0.1 to 0.3 mm/U

Scribing and Breaking:

- Possible with PLEXIGLAS® sheets (except for impact-modified PLEXIGLAS RESIST®) up to a thickness of 3 mm and a length of approx. 500 mm.
- Scribe workpiece several times (thickness in mm = number of scribes).
- Use a knife with a hook-shaped edge.
- Break workpiece along the scribed line over the edge of a table (protect hands with gloves or soft material) or press your thumb against the end of the sheet overhanging the edge.
- Broken edges which then need to be bonded have to be wet sanded at a right angle on a flat support.

Tip

Cool thoroughly with water, especially when working with spiral drills, conical drills, compass saws and jigsaws.



Routers with ball bearing bits require no other guides and can be used both for straight and curved edges.

Edge Treatment

By sanding and polishing, parts of PLEXIGLAS® whose cut edges have become rough and dull during machining can be restored to their original high gloss and transparency.

- Always perform wet sanding (prevents thermal stress in acrylic and clogging of the abrasive surfaces).
- Sanding is performed in three steps:
 - coarse, 80–240 grit
 - medium, 400 grit
 - fine, 600–1000 grit
- For polishing, use waxes, pastes or commercially available car polish.
- Use very soft materials for polishing, such as glove-lining fabric or a buffing wheel.
- Remove traces of polish after treatment and clean the edges with water or petroleum ether.

Deburring the edges

- Sawed or routed edges can be smoothed and deburred using a scraper or machine file.

Profiling the outer edges

- The edges can be given the desired form using a profile router with ball bearing bit.

Tip

It is quite sufficient to smooth or deburr the edges with a scraper if they are concealed once they are installed (e.g., by a light switch).

Always mark recesses and apertures on the masking film and predrill holes in the corners of cut edges.



PLEXIGLAS® Sheet

The ideal sheet size

When installing the sheets, allowance must be made for expansion of the sheets on all sides due to heat and moisture. For use indoors, at least 3 mm must be allowed per meter of length and width. This should be considered when ordering the sheets.

Marking out

Please bear in mind the following when marking out:

- Leave the masking film on the PLEXIGLAS® sheet during machining.
- Only mark drill holes, cut edges and contours on the masking film.
- Do not use scribes or prick punches.

Drill holes and recesses

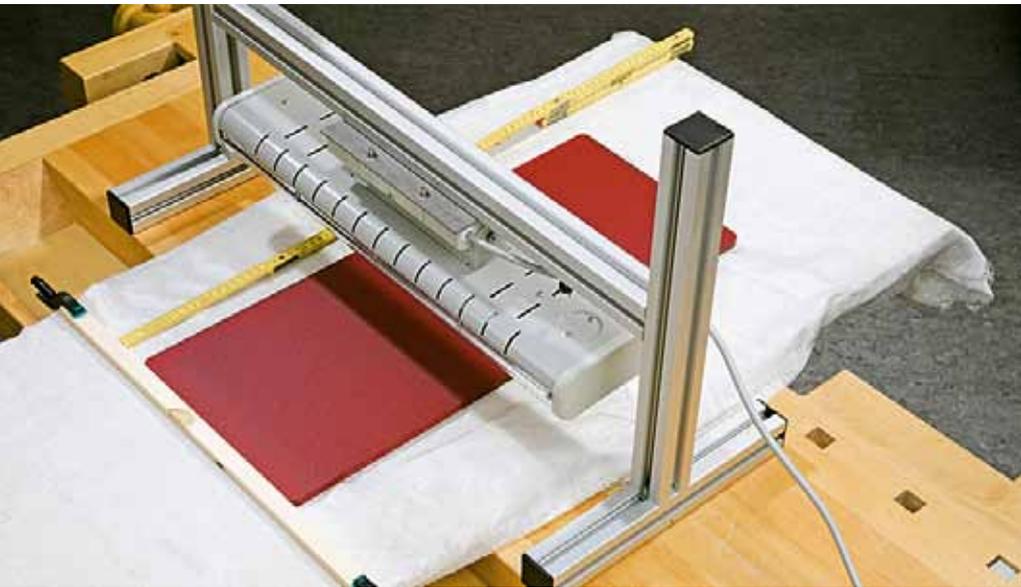
Please bear in mind the following when drilling and cutting recesses:

- Place the PLEXIGLAS® sheet on a flat and stable surface.
- Turn the 'useful' side upwards.
- Transfer the dimensions of any recesses to be made (e.g., for switches) to the masking film.
- Drill holes in the corners of the recesses.
- Debur drill hole edges.
- Cut recesses or apertures using a jigsaw or overhead template router.

Preparing the Sheet for Installation

Tip

Always predrill holes in the corners of edges to be cut when routing or sawing recesses or apertures. This prevents notch effects and possible sheet breakage. The holes should have a diameter of at least 10 mm. All machined edges should be deburred.



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The cut-to-size PLEXIGLAS® sheet is placed under the bath radiator for heating.

Forming

Heating up to forming temperature:

All solid PLEXIGLAS® sheets are suitable for forming. The protective masking on the PLEXIGLAS® sheet is removed before forming for practical reasons.

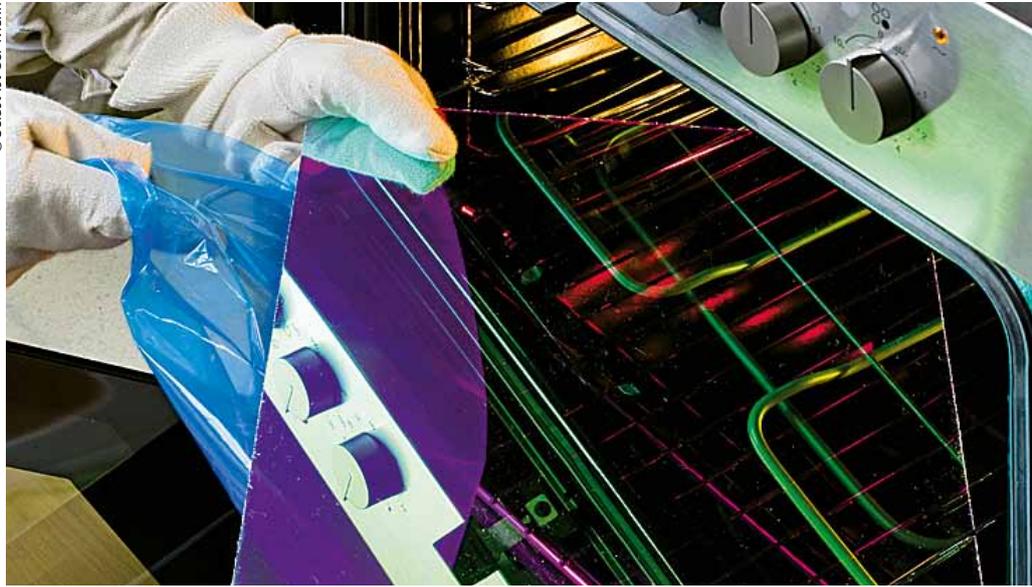
The forming temperature for PLEXIGLAS® XT is approx. 150 °C, for PLEXIGLAS® GS approx. 160 °C. The following serve as heat sources for partial heating – e. g. for line bending – :

- heating rod (perhaps also hot plate, covered with glass fabric except for an open central strip),
- IR radiator (strong infrared lamp).

The following serve as sources of heat when heating the entire cut-to-size sheet:

- airflow oven,
- oven,
- hot plate covered by an aluminum plate.

Place the PLEXIGLAS® sheet to be heated on a level, non-glossy support and avoid direct contact of the sheet with the heating element by allowing an air gap of at least 1 cm or use an aluminum plate. Heating time depends on the thickness of the material. From a thickness of 4 mm onwards, the material should be heated on both sides or turned several times. Watch the material during heating to avoid overheating.



The PLEXIGLAS® sheet is placed in the airflow oven without its protective masking. Wear gloves to remove the sheet from the oven!

Preparations

Edges should be polished – if required – before they are formed.

Thermoforming:

The workpiece is formed immediately after heating and held in the formed position by hand or by means of an appropriate jig until it has cooled down (below approx. 60 °C). No special force is required for forming (otherwise the material has not yet reached the optimum temperature!).

When line bending, we recommend bending the sheet sides slightly more than required as they may spring back slightly when cold. Where the side length is shorter, the entire sheet should be heated, otherwise there is a risk of warpage.

Tools for drape forming should be covered with glove material (to avoid mark-off on the molding) and should have holddown strips for the heated sheet.

For complex moldings, a forming station is required with a male and female mold between which the sheet is clamped.

Other forming methods are thermoforming or blow molding but require greater technical expertise.

You should engage professional PLEXIGLAS® fabricators to do this.

After forming, the PLEXIGLAS® workpiece can be further processed as usual.



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Bond PLEXIGLAS® sheets in a vertical position using gap-filling ACRIFIX® 1R 0192

Bonding

Bonding of PLEXIGLAS® with PLEXIGLAS®

PLEXIGLAS® – particularly colored material – is bonded generally and most simply with ACRIFIX® 1S 0116 (ACRIFIX® 116) similar to general-purpose adhesive. Finely sanded edges are needed for precise bonding of accurately fitting adherends. The joint areas are cleaned with lighter gas before the adhesive is applied. Ventilate the room well, do not smoke and avoid skin contact!

- Apply ACRIFIX® 1S 0116 (ACRIFIX® 116) thinly from a tube (or PE bottle) onto one PLEXIGLAS® part, join parts together immediately and fix, e. g. with adhesive tape.
 - You can handle the parts after about 1 to 2 hours even if they finally harden only after several days.
 - Crystal-clear cut-to-size sheets of PLEXIGLAS® are most securely bonded with ACRIFIX® 1R 0192 (ACRIFIX® 192)
 - It is applied directly from the tube, is gap-filling and hardens when exposed to daylight or fluorescent lamps.
- Where fit has to be most precise, superglues based on cyanoacrylates are also suitable.
 - The PLEXIGLAS® parts to be bonded should be stress-free. Adhesive and adhesive fumes must be prevented from entering the cavities, since this may lead to stress cracking.
 - To obtain perfect bonds, it is advisable to anneal the parts before and after bonding at approx. 70°C.



ACRIFIX® 1R 0192 seeps into the joint area on its own.

Bonding PLEXIGLAS® with other materials

PLEXIGLAS® is preferably bonded with other materials such as metal, glass and stone using elastic adhesives on a silicone basis.

Neutrally crosslinking grades such as ACRYLGLAS SILICON 400 or Otto Seal S 72 are recommended.

Always bear in mind the manufacturer's statements when processing silicone rubber, and use corresponding adhesion promoters if required. Silicone rubber and its fumes should be prevented from entering the cavities. Silicone rubber should not be applied to cold-curved or stressed PLEXIGLAS® in order to avoid stress cracking.

Method:

- Clean the surfaces to be bonded
- Surfaces should be dry and free from dust
- Mark out the bonding area, e.g. with Scotch™ tape
- Treat the surface or edge with adhesion promoter (bearing in mind manufacturer's instructions)
- Fix the parts into position
- Apply silicone rubber using pressure
- Smooth the adherend surface with a dampened tool
- Remove the marking tape before a skin forms
- Select a glueline with a large surface area
- Bear in mind the manufacturer's instructions also during curing.

Types of adhesive which can be used for bonding PLEXIGLAS® and other materials are:

	PLEXIGLAS®	Metal	Stone	Ceramics	Hard plastics (PS, ABS, Hard-PVC)	Rubber
PLEXIGLAS®	A, S, (C)	S, (C)	S, (C)	S, (C)	A, S, (C)	C

A = ACRIFIX®
1S 0116 or
1R 0192
(ACRIFIX®
116 or 192)

S = silicone rubber

() = for small adherends and where
fluctuations in application temperature
are low

C = cyanoacrylate
(superglue)

® = registered trademark

PLEXIGLAS is a registered trademark of Evonik Röhm GmbH, Darmstadt, Germany.

Certified to DIN EN ISO 9001 (Quality) and DIN EN ISO 14001 (Environment).

The Performance Polymers Business Unit of Evonik Industries is a worldwide manufacturer of PMMA products sold under the PLEXIGLAS® trademark on the European, Asian, African and Australian continents and under the trademark ACRYLITE® in the Americas.

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