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Processing of SIMOPOR

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1 Introduction

SIMONA is acknowledged as one of the leading producers and development partners in the field of thermoplastic products. Across several production sites, we manufacture sheets, finished parts, profiles, welding rods, rods, pipes, fittings and valves to meet the most demanding customer requirements. PVC foam sheets have been part of the company's product portfolio for decades, and SIMONA has established itself within this segment as a high-quality manufacturer offering a comprehensive range of products and services as well as a high level of expertise in the field of formulas.

Within the SIMONA Group, the Turkish subsidiary SIMONA PLASTECH is the centre of excellence for the production of high-quality PVC foam sheets, boasting innovative products, a state-of-the-art manufacturing technology and many years of expertise in the European market.

SIMONA's SIMOPOR product family unlocks new possibilities for creative designs in the field of visual communication and construction. From pure white to vibrant colours, from low flammability to light as a feather – our extended product range includes solutions tailored precisely to your projects.

Products within the SIMOPOR range can be easily processed using standard tools and their dimensional stability is excellent. With this work.info we would like to give you important advice for an easy workability.

Thermoplastics can be machined with the help of equipment used in wood and metal processing. High-speed machine tools with strong bearings are preferable; adequate precautions must be taken to extract/vacuum swarf and dust. Machining should always be performed at room temperature.

Always bear in mind that plastics are relatively poor heat conductors. Rises in temperature can be reduced by ensuring that cutting edges of tools are sharp and chips are removed efficiently or prevented by cooling with compressed air or water (including cooling lubricants). Standard grades of tool steel are sufficient for machining. Using carbide-tipped cutting tools can prolong tool life and improve the neatness of cutting.

As regards SIMOPOR E, we can only issue a limited processing recommendation. This applies to all classic processing techniques such as cutting, milling or printing.

Standard health and safety measures for working with machines must be observed (protective goggles, hearing protection, ...).

2 Drilling

Thermoplastic semi-finished products can be drilled with standard HSS twist drills. Generally speaking, no specific grinding is required, but we recommend the use of relief-ground cutting edges and the helix angle should be small. In the case of large drilling depths, it is advisable to withdraw the bit from the hole a number of times in order to extract the shavings effectively. At relatively large drill hole diameters a rise in material temperature can cause the cutting tool to jam. This effect can be counteracted by making a pilot hole in advance. Drill holes with a diameter above 20 mm should be made using a double-edged bit with a pilot. In the case of drill holes with a diameter above 40 mm, it is advisable to use circle cutters.

Cutting speed and forward feed depend on the depth of the drill hole. Smearing of the thermoplastic material is to be avoided. As regards thin-walled workpieces, it is advisable to use a high cutting speed.

Reference data for drilling SIMOPOR

α	Clearance angle	°	6 - 10
β	Helix angle	°	12 - 16
ψ	Rake angle	°	3 - 6
φ	Point angle	°	80 - 120
v	Cutting speed	m/min	30 - 100
f	Forward feed	mm/U	0.1 - 0.5

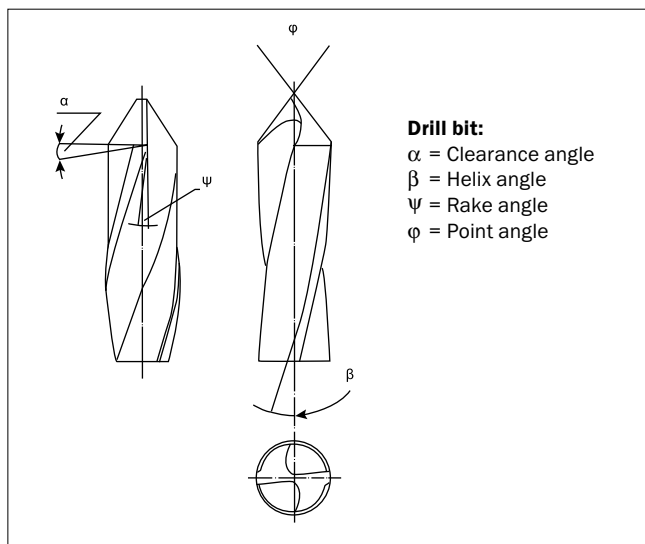


Figure 1: Cutting edge geometry of a drill bit

3 Threading

Screw threads are easy to tap with conventional thread tap sets. A rake angle of 0° should not be exceeded.

However, due to the foam structure of the product, we recommend the use of appropriate threaded bushings in such cases. Essentially, the use of self-tapping screws is also possible. For this purpose, for example, "high-low", "Spax" or window screws can be used. The use of sheet metal screws is not recommended.

Please note that due to the foam structure, the pull-out forces are lower compared to a solid sheet.

4 Milling

As regards the milling of SIMONA® plastics, all standard milling machines that are used in metal machining and are designed for high speeds are suitable. Working at a high cutting speed and a small depth of cut is considered advantageous.

The milling cutter should have adequate space for swarf to ensure uniform chip removal and efficient dissipation of heat. Good results can usually be achieved if attention is paid to ensure a polished cutting edge and high positive cutting geometry during tool selection. In practice, milling cutters for machining aluminium have proved to be suitable tools. However, there are also product lines on the market that have been specially adapted to the properties of various plastics.

A pointed cutting tool is crucial to the quality of milling. The milling cutter intended for plastics processing should therefore not be used for cutting other materials.

Reference data for milling SIMOPOR

α	Clearance angle	°	5 - 10
ψ	Rake angle	°	0 - 15
v	Cutting speed	m/min	up to 1,000
f	Forward feed	mm/tooth	up to 0.5

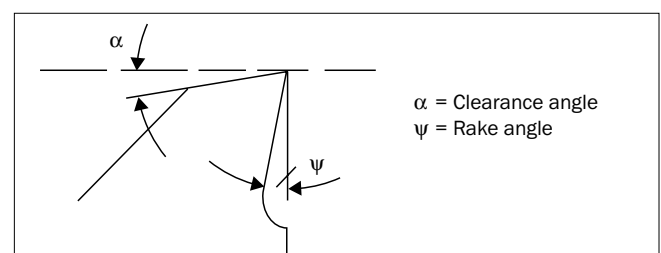


Figure 2: Cutting edge geometry

5 Sawing

5.1 Circular sawing

Neat-cut surfaces are produced when the saw blade protrudes only slightly beyond the plastic sheet to be cut.

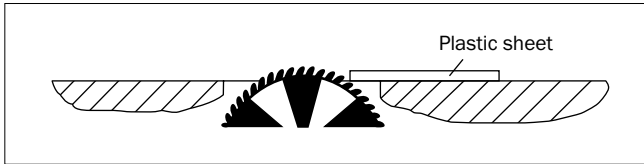


Figure 3: Schematic representation of circular sawing

Sheets up to a thickness of 5 mm can be cut with unset saw blades. Above that, however, it is advisable to use relief-ground saw blades. The use of carbide-tipped saw blades increases the tool life of the saw blade considerably; this also helps to improve cutting performance and the quality of cut neatness. The latter is also largely dependent on the sharpness of the saw blade. Therefore, a saw blade intended for sawing plastic should not be used for cutting other materials.

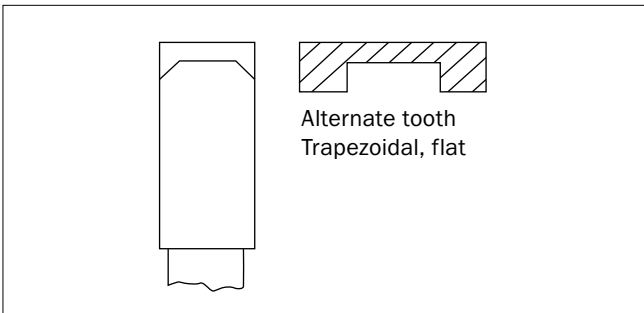


Figure 4: Tooth profiles for circular saws (carbide-tipped)

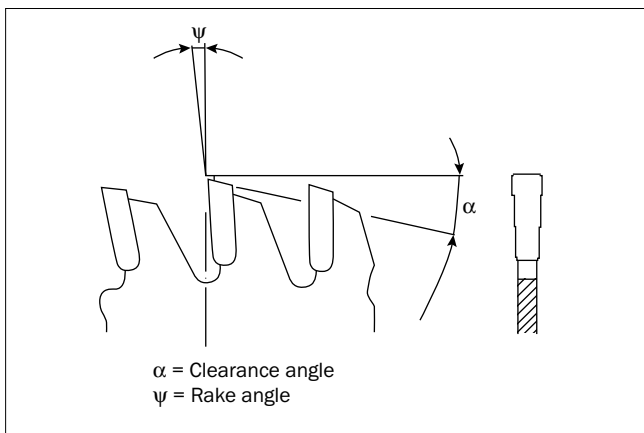


Figure 5: Cutting edge geometry of a saw tooth

Parameters for circular sawing of plastics

			PVC
Circular saws			
α	Clearance angle	°	5 - 10
ψ	Rake angle	°	0 - 5
t	Tooth pitch*	mm	3 - 5
v	Cutting speed	m/min	2,500 - 4,000

* For brittle materials, select a small tooth pitch

5.2 Band sawing

In band sawing, heat dissipation is more efficient owing to the rotating saw band. Band saws are suitable for cutting pipes, blocks, thick sheets and curves. Please note that on account of free-cutting the saw bands have to be set properly (± 2 mm) and they must be sharp.

Parameters for band sawing of plastics

			PVC
Band sawing (HSS)			
α	Clearance angle	°	30 - 40
ψ	Rake angle	°	0 - 5
t	Tooth pitch*	mm	2 - 5
v	Cutting speed	m/min	up to 2,000

* For brittle materials, select a small tooth pitch

5.3 Jigsawing

SIMOPOR can be cut using a jigsaw and an appropriate saw blade for plastics.

6 Die-cutting and cutting

6.1 Die-cutting

Die-cutting can be performed effectively on conventional presses, especially if wall thicknesses are thin. The quality of the cut edge is dependent both on the sharpening of the cutter dies and on sheet thickness. In the case of thin sheets, cutting is generally neater than in the case of thick sheets. To avoid stresses and splintering in the sheet to be machined, the cutting angle should be less than 70°.

SIMOPOR should not be die-cut at temperatures below 20 °C, as chipping may occur at the cut edge. The quality of the cut edge can be improved somewhat if the sheets are warmed up slightly (if possible).

6.2 Water-jet cutting

SIMOPOR can be processed by means of water-jet cutting. The quality of the cut edge depends on the operating parameters.

6.3 Laser cutting

Cutting by means of a laser beam is not recommended. The vapours produced by the high temperature may lead to corrosion of the system.

6.4 Guillotine shears

SIMOPOR can be cut to a thickness of approx. 3 mm using guillotine shears. Well-sharpened, undamaged blades and a maximum play of ± 0.1 mm between the moving blade and the stationary blade are crucial to the quality of cutting.

However, when using guillotine shears, compressed and rounded cutting edges on one side are unavoidable.

7 Bending and forming

Due to the manufacturing process involved, SIMOPOR sheets are anisotropic. This means that they behave differently longitudinally and transversely to the direction of manufacture and also exhibit slightly different properties. It is advisable for bending edges to run at right angles to the direction of production, as the risk of breakage is lowest here.

7.1 Cold bending

Whether a sheet can be cold-formed or has to be hot-formed depends on the desired bending radius. The minimum bending radius for cold bending is 500 times the sheet thickness. For a sheet with 5 mm thickness, this means a 2.500 mm radius.

7.2 Hot bending

In those cases in which the radius is small, the sheet will have to be processed by means of hot bending in order to avoid breakage.

When hot bending, we recommend the use of a bending bench with upper and lower heating units to achieve an even build-up of heat within the bending zone. To avoid compression, a minimum bending radius of twice the sheet thickness should be maintained. The forming temperature is approx. 120 °C.

7.3 Vacuum forming

SIMOPOR can be formed to a limited extent by means of vacuum forming as well as pressure forming. Due to the foam structure, however, there are limits in respect of the draw ratio and edge sharpness of the components.

In this case, the forming temperature is also in the range of 120 °C. Temperatures that are too low will damage the foam structure.

At temperatures above 170 °C, the material turns brown and thermal destruction of the sheet may occur.

8 Gluing

A suitable adhesive should be selected with the help of the adhesive manufacturer's advice, as various adhesives can be used depending on the application, the desired appearance of the glued seam and the desired properties. A clean joining surface is important for good bonding. It must be dry and free of dust and grease. 2c PUR adhesives have proved to be suitable for bonding SIMOPOR to other substrates (wood, metal, ...). Please follow the relevant safety precautions as specified by the adhesive manufacturer.

9 Edge banding

In this case, similar to furniture manufacture, so-called edge banding made of melamine (coated with hot glue) can be ironed onto the edges using an iron. Likewise, the pores of the cut edge can be sealed with a suitable filler.

10 Surface finishing

10.1 Foils

The surfaces of SIMOPOR are also ideal for applying decorative and lettering foil. When it comes to the choice of a suitable foil, the location of use (indoor or outdoor application), duration of application (durability), type of adhesion (permanent or removable) and the processability of the foil (printing, weeding) are some of the key factors to be considered.

The sheet surface should be cleaned accordingly before applying the foil. Adhesion may be adversely affected by static charges. Soiling by fingers or handprints can be reduced with the appropriate use of cotton gloves.

If possible, the images and prints should only be affixed to the sheet by means of cold foil application. It is also advisable to use quality foils with a permanent adhesive layer suitable for the substrate. Images and inkjet prints should always be reconditioned or pre-dried prior to affixing.

The settings of the laminator (pressure, parallelism of the rollers) must be checked regularly in order to avoid faulty laminations.

Possible causes of error:

Bubbles under the foil, as well as poor adhesion, can usually be eliminated by improved processing conditions (for example, increasing the flash-off time of the cleaning agent, higher roller pressure). Deformation (cupping) can be caused when the printed material is too moist or the adhesive foil is exposed to excessive tension. Wrinkles are often caused by warped adhesive foil, poorly aligned rollers or excessive roller pressure.

11 Printing

11.1 Screen printing

The majority of printing inks developed for PVC-U adhere very well to the surfaces of SIMOPOR. UV inks and solvent-based inks have been proved to be the most suitable solutions. Epoxy and enamel inks, on the other hand, are not suitable.

However, it is always advisable to carry out a test print beforehand with an ink that has not yet been used. Please note that the surfaces must be free of dust and grease.

IMPORTANT:

Too intense IR and UV radiation applied during the drying process can lead to a yellow discolouration of the substrate. Furthermore, excessively long dwell times may result in deformation of the sheets. Unsuitable screen printing inks (e.g. very hard or those with a high solvent content) can also lead to substrate brittleness when subjected to impact.

11.2 Digital printing

SIMOPOR can also be printed using digital direct printing. As regards this printing technology, please note that there are a number of factors other than the sheets that influence the printing result. These factors include protective film, printing machine, ink, image composition and machine operation as well as various environmental influences.

Other influencing factors:

UV lamps (age, number and setting):

Excessively low UV intensity causes insufficient cross-linking, resulting in insufficient adhesion of the ink. Excessive UV intensity can lead to yellowing of the sheet. Overheating as a result of IR radiation (which is also emitted as part of the process) can lead to deformation of the sheet.

Image and colour shading:

Due to differences in cross-linking, light and translucent shades adhere better than dark and opaque shades. Insufficient ink adhesion can also be attributable to excessive humidity. An ink adhesion test should be carried out after 48 hours.

Protective films:

A protective film prevents soiling, but increases the static charge of the sheets when removed. These static charges can lead to an uneven print image ("cloudiness").

12 Hazardous solvents

Solvents can partially dissolve, swell or even completely destroy PVC. For this reason, the following solvents should not be used – even for cleaning:

- Acetone
- White/mineral spirit
- Methyl ethyl ketone (MEK)
- Tetrahydrofuran (THF)
- Toluene

13 Special processing instructions

Despite the protective film, scratches may be pressed into the surface if handled improperly.

In the case of backlighting and printing on both sides of the sheets, printed items on the reverse side may show through very slightly in the case of thin sheets.

14 Storage

SIMOPOR must be stored flat and in a dry place at temperatures of around 20 °C.

Packed pallets must not be stored outdoors (risk of deformation due to heating up in sunlight).

Please follow our general instructions for the storage of SIMONA® PVC Foam Sheets. These can be found at www.simona.de/storage or using the following QR code:



15 Sustainability

PVC sheets are very durable products. They do not release any toxic hazardous substances and therefore do not need to be labelled. PVC sheets do not contain plasticisers.

15.1 Sustainability in the production process

During the production / extrusion of PVC sheets, PVC sheet material that is not yet production-ready accumulates when the extruder is started up. The material is separated, collected by type and fed into the production process in doses as a recycled material after preparation. The edge offcuts that occur during production are processed and usually fed directly back into the production process as recycled material. Manufactured panel material that does not meet the product specification is separated, collected by type and fed into the production process in doses as recycled material after preparation. This sustainable process achieves an extremely high material efficiency and ensures an almost perfect material cycle with virtually no residual materials.

15.2 Sustainability in processing

During the processing of PVC sheets, offcuts are produced by the customer despite the greatest optimisation and care. These offcuts must be collected by type. It is important to ensure that the material is free of any impurities and correctly labelled. These offcuts can be processed by specialised companies and passed on for recycling. Waste cuttings that are not sorted according to type or contaminated are currently still sent for thermal recycling.

15.3 Sustainability after the use phase

PVC sheets are mostly used for long-lasting quality products. After their use phase, which can last several decades, the sorted sheets can be returned to the material cycle after processing.

Further information on the disposal of the respective SIMOPOR product can be found on the "Safety Data Sheet according to 1907/2006/EC Article 31", which is available in the [download centre](#) on our website.

Our integrated [quality, environmental and energy management system](#) forms the basis for continuous improvement in the quality of our products and processes, the sustainability of our environmental protection measures and our efforts to reduce our energy consumption and carbon footprint. Detailed information on this can be found on our website www.simona.de.

16 User's responsibilities

The information in this document is state of the art. However, we do not provide a guarantee of accuracy. In all cases, the user or processor shall be responsible for ensuring that the materials and processes are appropriate for the intended use and location, while also being financially viable and compatible with local laws and regulations.

We assume that users/processors possess the technical knowledge and skills customary in industry and trade, a normal sense of judgement as well as knowledge of and the ability to comply with the applicable regulations regarding occupational safety and hygiene.

17 Legal notice and advice

17.1 Legal notice

Upon publication of a new edition all previous editions shall become void. The authoritative version of this publication can be found on our website at www.simona.de.

All information furnished in this publication reflects our current scope of knowledge on the date of publication and is designed to provide details of our products and potential fields of application (errors and omissions excepted, including typographical mistakes). This shall not be deemed as constituting the provision of legally binding guarantees or warranties as to specific properties of the products or their suitability for specific areas of application.

We guarantee the perfect quality of our products exclusively within the scope of our Terms and Conditions and to the extent stated therein.

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Any reproduction of this publication or any unconnected use of specific content taken from this publication are strictly prohibited; legal action will be taken in any case of infringement. Exceptions hereto will require our prior approval in writing.

17.2 Advice

Our application-specific advice is given to the best of our knowledge and is based on the information you have provided and the state of the art known to us at the time such advice is furnished. The advice shall not constitute a guarantee or warranty of specific characteristics or qualities and shall not establish an independent contractual legal relationship.

We shall only be liable for cases of intent or gross negligence. Under no circumstances shall we be held liable for the correctness or completeness of information you have provided or the advisory/consulting services rendered by us on the basis of such information. Any information provided by us shall not release you from your obligation to conduct your own assessments and evaluations.

We reserve the right to make changes based on new findings and evaluations.

Our Technical Service Centre and Customer Service staff will be happy to advise you on the processing and use of semi-finished thermoplastic products and the availability of our products.

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