

# SEMI-FINISHED PRODUCTS

FOR EXTREME APPLICATIONS  
MADE FROM PE, PP, PVDF,  
ECTFE, FEP, PFA





## The Plastics Experts.

The AGRU success story already spans seven decades. Founded in 1948 by Alois Gruber sen., the company is now counted among the most important comprehensive suppliers for piping systems, semi-finished products, protective liners for concrete and geomembranes made of engineering plastics. The fact that we provide everything as a single source supplier distinguishes us from many competitors. We process exclusively high-quality thermoplastic materials. And when it comes to problem-solving expertise for material selection and installation, we are your best partner.

### Universal scope of applications

AGRU semi-finished products made of thermoplastics are an excellent and durable solution for modern, premium apparatus and tank construction, and for manufacturing wear-resistant products. In the chemical and heavy industries, and in plant construction, a variety of requirements exist for semi-finished products in terms of acid and alkali resistance, application temperature and low static charge in areas with a risk of explosion.

Users can work with various processing methods, including diverse proven joining technologies such as extrusion welding, hot gas welding, and butt welding. Customer satisfaction is the first priority for AGRU. Technical consultation, seminars, welding training and expert on-site instruction form the foundation for achieving this.



### Quality

AGRU maintains a quality management system according to the ISO 9001:2015 standard, as well as an environmental management system according to the ISO 14001:2015 standard. Thus the products comply with international standards and are monitored and evaluated by independent testing agencies on a regular basis.

The start-to-finish attention to quality ensures that the products meet the strictest technical specifications and ensure the safe operation of equipment and tanks.

# SEMI-FINISHED PRODUCTS

## Chemical-resistant sheets, pipes, bars, and welding rods

The semi-finished products made of thermoplastic materials from AGRU are distinguished by their high acid and alkali resistance, resulting in lower life cycle costs due to extended maintenance intervals and the long service life of the products. Our comprehensive programme of semi-finished products provides solutions for a temperature range from -190 °C to +260 °C. Consistent high quality ensures the reliability and long service life of all our components.

### Highest media resistance

#### **A stable polymer is available for each chemical application**

Optimised price-performance ratio for each application

- thanks to consultation and material recommendations by plastics experts
- due to the operational reliability provided by AGRU solutions
- resulting from longer-than-average service lifetime

### One stop shopping

#### **Comprehensive semi-finished product portfolio and extensive stock-keeping**

Since all semi-finished products are manufactured in-house, we can

- deliver a broad range of products for diverse applications
- fabricate custom parts for specific customer needs
- process special materials (flame retardant, electrically conductive, foamed)

### Consistently high quality

#### **Raw material specifications, cutting-edge production, and quality assurance**

Reliable products with consistent properties

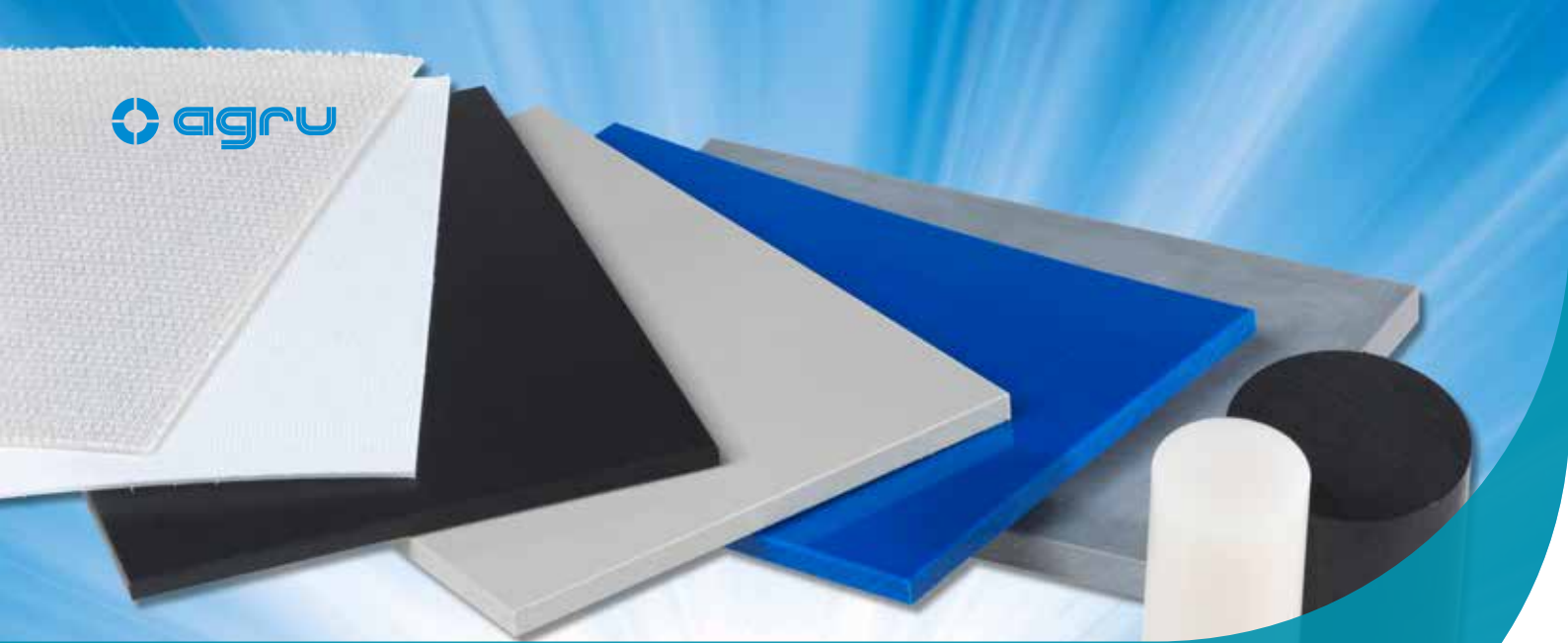
- monitored by ISO-certified quality and environmental management systems
- due to conformity to national and international standards
- ensured by regular audits and external monitoring

### Different fabric backings available

#### **Chemically resistant fabrics made of various materials (Polyester-, Synthetic- and Glass fabric)**

We provide the optimal long-lasting solution for each application

- through our production including PE, PP, PVDF, ECTFE, FEP, and PFA-fabric backed sheets
- thanks to the high acid and high hydrolysis resistance of the the synthetic fabric
- due to easy handling provided by thermoformability
- because AGRU utilises a proven method for adhering the fabrics in the plastic material



## SEMI-FINISHED PRODUCTS

### Sheets, round bars, and welding rods

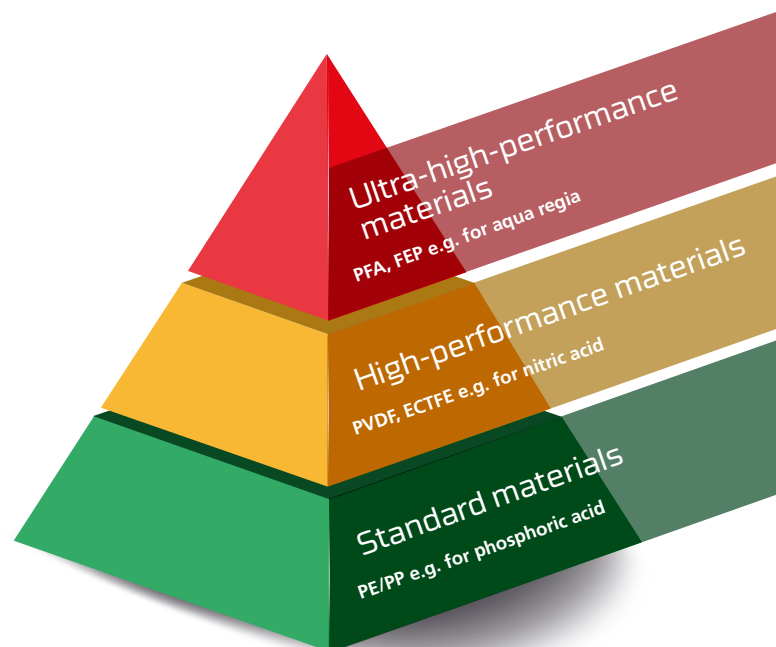
Semi-finished products made of thermoplastics are an excellent and durable solution for modern, high-quality apparatus and tank construction, and also for manufacturing wear-resistant products. In the chemical and heavy industries, and in plant construction, a variety of material requirements exist. These include resistance to acids and lyes, resistance in a wide temperature range, low static charging in potentially explosive atmospheres (ATEX) and many other things.

The AGRU product range is distinguished by a unique variety of products and materials. All our sheets, round bars, welding rods, and liner pipes are available in everything from standard up to high-performance plastics. Solutions and finished parts for any application can be realised with our pressed and extruded sheets, round bars and hollow bars, laminated pipes, and welding rods made of PE, PP, PVDF, ECTFE, FEP and PFA. In addition to our standard portfolio, many specialised products are also available upon request.

Users can choose from various proven processing methods, such as extrusion welding, hot-gas welding and butt welding.

#### AGRU material pyramid

The respective industrial application determines which material provides the optimal cost-effectiveness and operational reliability. AGRU experts will help you select the best plastics for your application. AGRU semi-finished products made of PFA and FEP are resistant to even the most aggressive media, meaning that almost every corrosion problem can be solved.



# Polyethylene

Semi-finished products made of polyethylene (PE 100 and PE 100-RC) are characterized by high toughness and very good chemical resistance, and can be used from -40 °C to +60 °C. Other characteristics of semi-finished products made of PE 100 or PE 100-RC include the following:

- good resistance to wear
- very good electrical insulation
- high vibration damping

For decades now, semi-finished products made of PE 100 and PE 100-RC black have proven to be reliable when used outdoors. The addition of special carbon black types (approx. 2%) ensures light and weather resistance. Semi-finished products made of PE 100 and PE 100-RC black are unaffected by natural UV radiation.

The development of polyethylene materials and their use as material for semi-finished products has reached its current peak with a design stress (minimum strength) of 10 N/mm<sup>2</sup> in terms of mechanical stress tolerance. In recent years, further development has focused on „resistance to stress cracking“. These raw materials are referred to as „PE 100-RC“. Now the development of the PE 100 type into an „RC“ material is not only being used in and benefiting the pressure pipe sector, but also tank cons-

truction. The main technical advantage of PE 100-RC is that it is significantly more resistant to crack growth. This is reflected by the minimum service life produced by the FNCT („full notch creep test“), which is > 8760 hours compared to 300 hours for PE 100 materials. Semi-finished products made of PE 100-RC materials therefore exhibit significant advantages for applications with media that cause stress cracks. As a result, it is possible to develop new applications involving PE 100-RC and to increase the service life considerably.

**Electrically conductive** polyethylene (HDPE el) is a material that conducts electrical charges, because conductive particles (carbon black) have been added to it. Semi-finished products made of this special material have integrated stabilisers that counteract the effects of natural UV light and are therefore also suitable for outdoor applications. Due to their special electrical properties, these semi-finished products are particularly well suited to transporting highly flammable media or dusts. HDPE el can also be used in areas where sparking from electrostatic charging needs to be prevented due to explosion protection requirements.

To comply with purity requirements, AGRU offers sheets made of **natural** HDPE as well.

	PE 100 black [mm]	PE 100-RC black [mm]	HDPE natural [mm]	HDPE el black [mm]
<b>Extruded sheets</b>				
2000 x 1000	2-30	35-40	3-10	4-20
3000 x 1500	3-30	3-50	3-25	5-15
4000 x 2000	3-30	12-40		
<b>Pressed sheets</b>				
2000 x 1000	10-120	10-120	10-80	25-60
4000 x 2000	15-60		15-60	
<b>Laminated / polyester-backed sheets</b>				
3000 x 1500	4-5			
<b>Round bar</b>				
		15-640		50-160
<b>Welding rod round, 3kg roll</b>				
	3-5	3-5	3-4	3-4
<b>Welding rod round, 10kg roll</b>				
	3-5			
<b>Welding rod triangular rounded, 3kg roll</b>				
	5x3			

Other dimensions and colours available on request



# Polypropylene

Polypropylene (PP) is a partly crystalline thermoplastic similar to HDPE, but with higher stiffness, strength, and hardness levels. It is also characterised by very good chemical resistance. Polypropylene can be used in temperatures of up to 95 °C. However, below freezing point PP is very sensitive to impact (use at temperatures below -10 °C should be avoided). Semi-finished products made of PP are also characterized by the following:

- a low density of 0.91 g/cm<sup>3</sup>
- relatively high surface hardness
- electrical insulation properties
- high creep strength



PP is the ideal material for use in pickling plants, the chemical industry, and also for extremely aggressive waste water, as chemicals are used at high temperatures in these areas. The AGRU product range includes various PP polymer types:

- PP homopolymer (PPH), which is made up exclusively of propylene molecules,
- PP random copolymers (PPR), a polypropylene in which statistically distributed ethylene monomers are integrated into the molecular chain.
- PP copolymer (PPC), a polypropylene block copolymer in which ethylene monomers in block form are integrated into the molecular chain.

All three propylene types are very thermally stable, perfectly compatible, and can be easily integrated into all standard welding procedures as per DVS 2207. Semi-finished products made of grey polypropylene are not UV-stabilised and therefore need to be protected accordingly.

**Low-flammability** polypropylene (PPs) is a PP homopolymer, which is equipped with a flame retardant. Consequently, PPs can be classified as a material with higher flame resistance according to DIN 4102 and UL94. **Low-flammability and electrically conductive** (PPs-el ESD) polypropylene is made of PP copolymer and is equipped with both flame-resistant and electrically conductive / anti-static properties. The surface resistance is <math><10^6</math> Ohm, which means that electrostatic charging is prevented. Semi-finished products made of polypropylene **natural** and **white** (made of PPH) complete our extensive range of PP semi-finished products.

	PPH grey RAL 7032 [mm]	PPR grey RAL 7032 [mm]	PPC (B) grey RAL 7032 [mm]	PP natural [mm]	PP white [mm]	PPs grey RAL 7037 [mm]	PPs el black [mm]
<b>Extruded sheets</b>							
2000 x 1000	1-40			2-6		3-10	3-20
3000 x 1500	3-50		3-20	3-25	6-20	3-20	4-15
4000 x 2000	3-40	40-50					
<b>Pressed sheets</b>							
2000 x 1000	10-60	70-120		10-60		25-40	
4000 x 2000	15-60			15-60			
<b>Laminated / polyester-backed sheets</b>							
2000 x 1000	3-6						
3000 x 1500	3-6						
25000 x 1000	3-4						
25000 x 1500	3-4						
<b>Laminated / glass-backed sheets</b>							
3000x1500		5					
<b>Polypropylene-backed sheets</b>							
25000 x 1500	3-4						
<b>Round bar</b>		15-640			70-150		20-100
<b>Welding rod round, 3 kg roll</b>	3-5	3-5	3-4	3-4	3-4	3-4	3-4
<b>Welding rod round, 10 kg roll</b>	3-4						
<b>Welding rod round, 1m bar</b>	3-4						
<b>Welding rod triangular rounded, 3kg roll</b>	5x3 / 6x4					5x3	
<b>Welding rod oval, 3kg roll</b>	5x3 / 6x4						

Other dimensions and colours available on request

# Fluoroplastics (PVDF, ECTFE, FEP, PFA)

## Highest corrosion resistance in the plastics sector

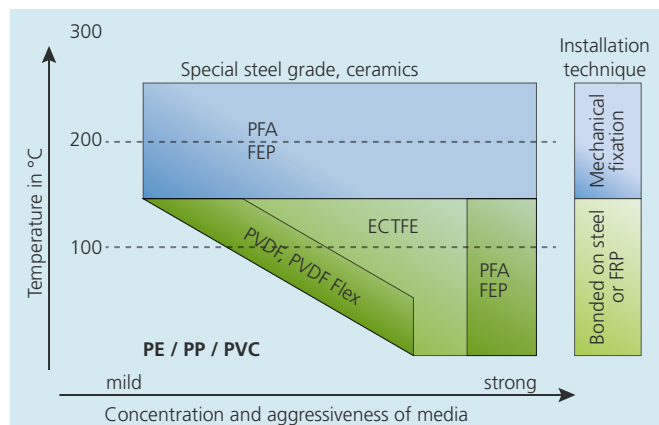
Depending on the application temperature, media and concentration, a number of fluoroplastics are available for use. These can be used as structural materials or as corrosion protection cladding. In addition to the polymer, the type of lining plays a role in determining the maximum operating pressure.

## Almost unlimited chemical resistance

- thanks to partially and fully fluorinated materials
- fluorination provides extremely high corrosion resistance
- for each kind of chemical strain, we have the ideal material

## Developed for extreme temperatures

- outstanding temperature stability between -190 °C and +260 °C
- excellent low-temperature flexibility
- exceptional weathering and UV-resistance



## Ideal for high-purity applications

The minimal leaching behaviour of PVDF and PFA is achieved by using carefully selected raw material and optimised production processes. Semi-finished products from AGRU are therefore ideal for applications with ultrapure water and highly purified chemicals, and for cleanroom use. From the raw materials all the way to the end product, the production process at AGRU also takes place under ISO class 05 cleanroom conditions. The production process has been optimized to guarantee excellent purity as well.



## Self-cleaning surfaces

Fluoroplastics are distinguished by their extremely low surface tension and thus their antiadhesive qualities. This makes it possible to empty tanks and pipework virtually residue-free, and cleaning is very easy. As a result of their surface tension, fluids have the tendency to minimise their surface area and try to revert to a spherical shape. They therefore pearl off of the hydrophobic surface of fluoroplastics, taking dirt particles with them.





# High-end materials Product range

## PVDF

AGRU PVDF is a highly crystalline non-reinforced plastic that combines good mechanical, thermal, and electrical properties with excellent chemical resistance. In addition, it possesses good radiation resistance, which makes it ideal for high-end applications in the semiconductor, pharmaceutical, life science, and photovoltaic industries.

PVDF can be processed without additives, which gives it excellent leaching behaviour. HP PVDF is manufactured under strictly controlled purity conditions using carefully selected raw materials. Areas of application for these products include pipeline systems, storage and transport tanks, and apparatuses requiring high media purity and leaching behaviour standards.

PVDF can be equipped with electrically conductive particles especially for the electrical industry and explosion-proof areas. The conductive PVDF el ESD (electrostatic discharge or electrically conductive) can be manufactured in sheets, rods, pipes, and welding rods and has a lower surface resistance, which in turn prevents electrostatic charging.

PVDF Flex is an excellent alternative to well-known, conventional fluoropolymers. When it comes to processing, important rationalisation effects can be achieved using the glass-fibre-reinforced plastic through increased flexibility, especially in the case of systems bonded to steel, but also in the case of confined spaces or small radii.

	PVDF [mm]	PVDF - Flex [mm]	PVDF el ESD [mm]
<b>Extruded sheets</b>			
1000 x 610	50 - 100		
2000 x 1000	2 - 20		
2440 x 1220	3,18 - 25,4		
3000 x 1500	3 - 10	2,3	3 - 8
<b>Pressed sheets</b>			
2000 x 1000	10 - 40		10 - 40
<b>Laminated / polyester-backed sheets</b>			
2000 x 1000	2 - 5		
3000 x 1500	3 - 4		
25000 x 1000	2 - 3		
25000 x 1500	3 - 4		
<b>Backed sheets SK+</b>			
3000 x 1500	3 - 4	2,3 - 3	3 - 4
10000 x 1500	3 - 4	2,3 - 3	
Round bar	10 - 325		20 - 200
<b>Hollow rod</b>	25 - 45		
<b>Welding rod round</b>	3 - 4	3 - 4	3 - 4
<b>Welding rod triangular</b>	5 x 3		
<b>Pipe</b>			32 - 250
<b>HV-Liner</b>	20 - 355		32 - 250

Other dimensions and colours available on request



## ECTFE

ECTFE possesses a unique combination of properties that are the result of its chemical structure, which consists of a copolymer with ethylene and chlorotrifluoroethylene arranged alternately. ECTFE demonstrates excellent resistance to the corrosive influence of heat, strong radiation, and weathering. The material has high impact resistance and shows almost no property changes in a wide temperature range, making it particularly well-suited for demanding industrial applications. Its excellent welding properties and thermoplastic formability also make simple and cost-saving processing possible, both in the workshop and on-site. Compared to PVDF, ECTFE has a better chemical resistance, especially when exposed to lyes.

## FEP

FEP, which is a fully fluorinated plastic, offers outstanding corrosion resistance. It performs reliably over the enormous range of temperatures between -190 °C and +205 °C, and can therefore be used in numerous industrial applications. Flexibility, thermoplasticity and optimum welding properties mean AGRU FEP products can be manufactured reliably at low costs.

## PFA

PFA is the highest grade plastic in the AGRU portfolio. It is suitable for an extremely broad spectrum of applications thanks to its resistance to almost any medium and its temperature range of -190 °C to +260 °C, meaning it can be offered as a solution even for extreme chemicals at high temperatures. The products made of PFA are also available in HP quality and are manufactured, packaged, and stored under strictly controlled purity conditions. The HP quality means it can be used for applications in the semiconductor, pharmaceutical, and food industries that require high purity levels.

ECTFE [mm]	
<b>Extruded sheets</b>	
2000 x 1250	4 - 20
2440 x 1220	3,18 - 25,4
3000 x 1500	2,3 - 3
<b>Pressed sheets</b>	
2000 x 1000	10 - 30
<b>Laminated / SK+ sheets</b>	
3000 x 1500	2,3 - 3
15000 x 1500	2,3 - 3
<b>Laminated / GGS sheets</b>	
3000 x 1500	2,3 - 3
15000 x 1500	2,3 - 3
<b>Round bars</b>	20 - 100
<b>Welding rod round</b>	3 - 4
<b>Pipes SK+ (1 m / 5 m)</b>	20 - 160

Other dimensions and colours available on request

FEP [mm]	
<b>Laminated / GGS sheets</b>	
2000 x 1250	0,8 - 2,3
10000 x 1250	2,3
15000 x 1250	1,5
<b>Welding rod round</b>	3,5 - 4
<b>Pipes</b>	32 - 160
<b>Pipes GGS (1 m / 5 m)</b>	32 - 160

Other dimensions and colours available on request

	PFA [mm]	PFA HP [mm]
<b>Extruded sheets</b>		
2000 x 900	15 - 20	15 - 20
2000 x 920	10 - 12	10 - 12
2000 x 1250	2,3 - 6	4 - 6
10000 x 1250	2,3	
20000 x 1250	1,5	
<b>Laminated / GGS sheets</b>		
2000 x 1250	0,8 - 2,3	
10000 x 1250	2,3	2,3
<b>Round bars</b>	20 - 100	20 - 100
<b>Welding rod round</b>		3,5 - 4
<b>Pipes</b>	32 - 110	
<b>Pipes GGS (1 m / 5 m)</b>	32 - 110	

Other dimensions and colours available on request



# Applications

## Plant construction

AGRU semi-finished products are ideal construction materials for custom-built equipment. Because they are low in weight and process, it is possible to realise very complex geometrical forms with them.



## Tank construction

Tanks for diverse chemicals can be made quickly and reliably using AGRU semi-finished products. The comprehensive product range offered by AGRU provides significant advantages, because in addition to semi-finished products, pipes and diverse fittings are also used to construct a complete overall system. The operating conditions, such as the chemicals and temperatures involved, also play a significant role in the process.

The advantages of an AGRU solution are obvious:

- low tank weight in comparison to steel
- high chemical resistance
- easy processing of the semi-finished products
- variety of materials



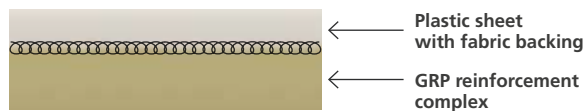
## Finished parts

As a leading company in the plastics industry, AGRU manufactures semi-finished products and also processes these further as needed to create a final product. Much expertise has been gathered, in particular in the area of special parts. Thus AGRU fabricates fittings up to an outer diameter of 2500 mm in its own CNC machining department.

# Lining material

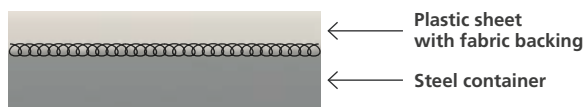
## GRP dual laminate

Tanks made of glass-fibre-reinforced plastic (GRP) are lined with laminated plastic film to maintain chemical resistance and leak-tightness. Such tanks, boilers, reactors, and scrubbers are then suitable for operation under vacuum and pressure at up to 180 °C.



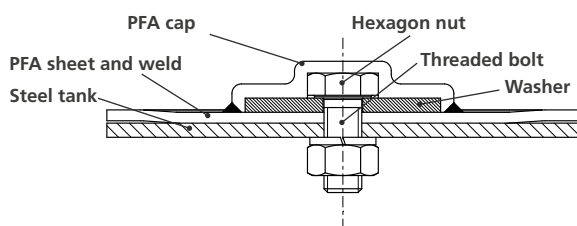
## Fully bonded lining

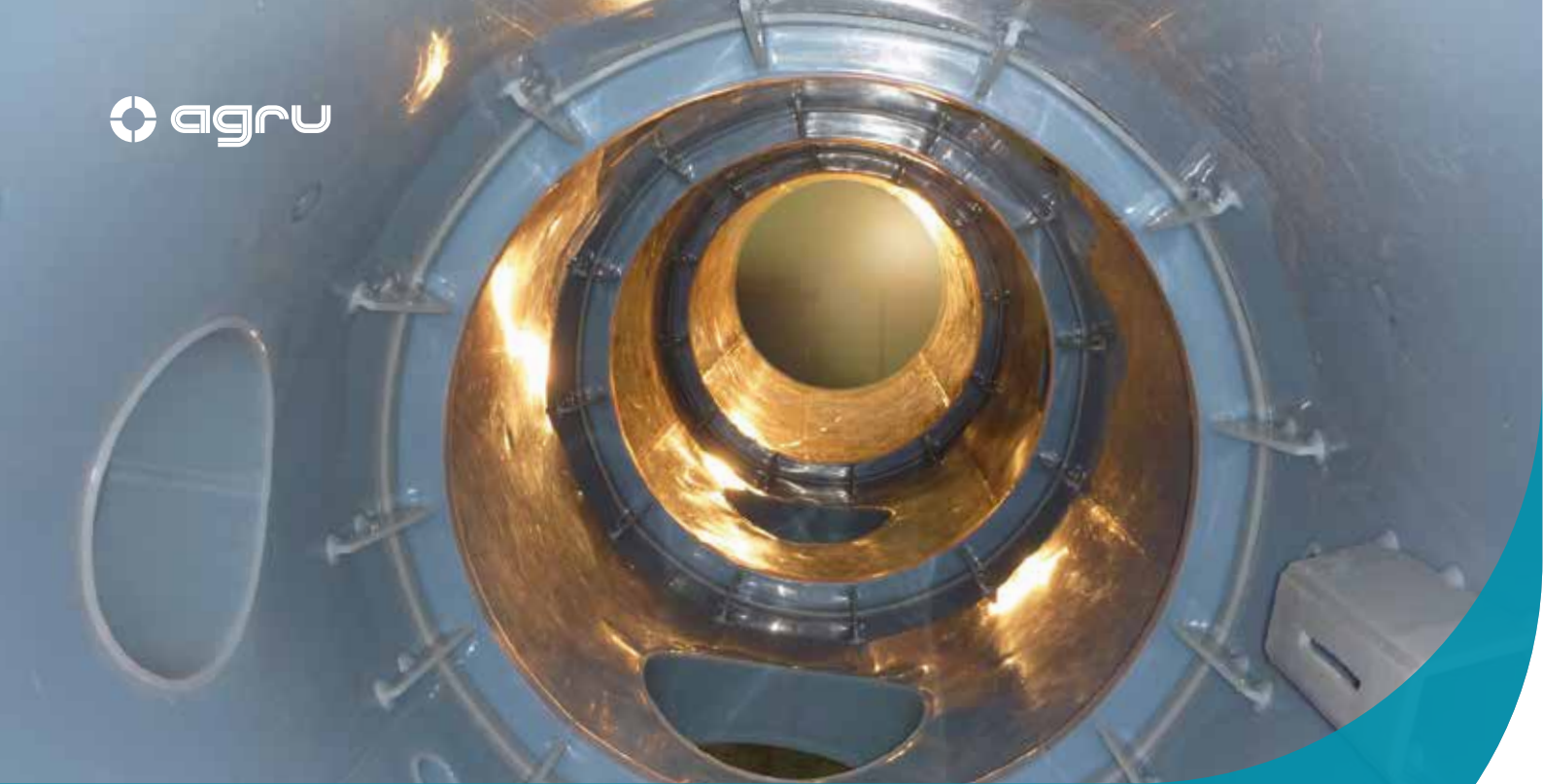
A fully bonded lining made of fabric backed sheet material applied to steel provides long-term chemical resistance at temperatures up to 120 °C for storage and shipping containers, reactors, centrifuges and related equipment. Suitable for operation with vacuum and pressure is available.



## Fixpoint lining

AGRU semi-finished sheets can also be fastened to steel substrate by mechanical means such as clamps, bolts, or screws. This system is mainly used with PFA for flue gas applications and desulphurization systems at temperatures up to 260 °C.








# Fabric backing systems

## Excellent bonding with steel tanks and glass-fibre-reinforced plastics

The great variety of materials (PE, PP, PVDF, ECTFE, FEP and PFA) as well as different backing systems (polyester, glass, synthetics) make it possible to realise solutions for temperatures from -190 °C to +260 °C. We always have the best material for the respective task, whether for lining steel tanks, for dual-laminate containers, or for fix point linings. The decisive factors for linings is the choice of fabric and the bond achieved between it and the plastic as well as the bond with the GRP and surface of the steel substrate.

- optimised price-performance ratio for each application and long-lasting solutions thanks to acid-resistant fabrics made of different materials
- easy handling due to the thermoformability of the fabrics
- consistent fabric backing quality and optimal bonding between fabric and plastic thanks to proven fabrication processes

SHEET MATERIAL	PROPERTIES
<b>Polyester fabric</b> 	<ul style="list-style-type: none"> <li>• most economical and proven solution</li> <li>• available for PE, PP and PVDF</li> </ul>
<b>GGS Glass fabric</b> 	<ul style="list-style-type: none"> <li>• available for all materials</li> <li>• extreme temperature stability</li> <li>• good thermoformability</li> <li>• good bonding strength</li> </ul>
<b>SK+ Optimised synthetic fabric</b> 	<ul style="list-style-type: none"> <li>• very high hydrolysis resistance</li> <li>• top resistance against acids</li> <li>• high bond strength at high operating temperatures</li> <li>• available for PVDF and ECTFE</li> </ul>

# HV-Liners and fabric backed pipes

## Custom-tailored piping systems for any application

AGRU offers special liner pipes for GRP applications. Whilst the GRP pipe provides the necessary stiffness, the inliner provides chemical resistance for the application. That way, custom-tailored pipes can be produced for any application:

- high bonding strength between the laminate and the GRP-resin system (DIN 16964) > 5 N/mm<sup>2</sup>
- flangeless GRP pipe connections minimise maintenance costs
- low weight of the entire piping system
- saves material costs compared to solid-wall piping

### HV-Liner



The PVDF HV-Liner from AGRU is an economical alternative to traditional fabric backed pipe. The surface-treated PVDF pipe has a three-dimensional surface structure that provides for optimal bonding with the GRP pipe. The piping systems are available in PVDF, PVDF-FLEX, and PVDF-el. The pipes can be produced in diameters from 20 – 355 mm.

### SK+ and GGS laminated pipes



The laminated piping systems are available in ECTFE, FEP, and PFA. AGRU GGS glass fabrics are the standard for typical industrial applications. The GGS fabric backing is the standard for materials with a high melting point (PFA and FEP).

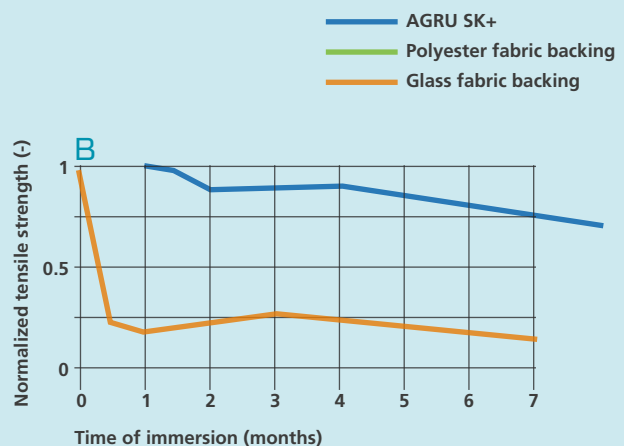
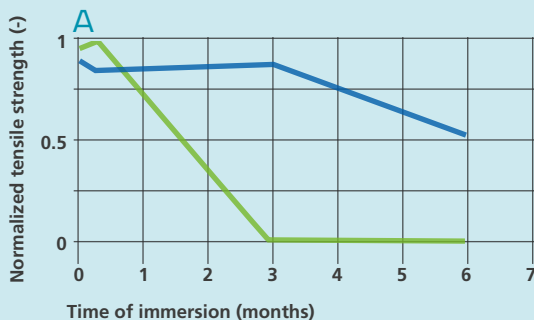
The SK+ laminated ECTFE pipe from AGRU is characterised by outstanding resistance to chemicals and hydrolysis, even at high temperatures. Due to the high resistance of the SK+ laminate, it is the preferred system for applications with hydrochloric acid (HCl) or hydrofluoric acid (HF).

## Immersion test AGRU SK+

Fabrics were immersed directly (no polymer layer)

**A:** Boiling water (100 °C)

**B:** 20 % HCl at 40 °C





## Custom tailored solutions

In direct collaboration with our customers, we create state-of-the-art plastic solutions that reflect the latest technological developments in design, functionality and economic efficiency.



### Technical application consultation

Often it's nothing more than an idea on a piece of paper brought to us by a customer that AGRU's expertise in plastics technology turns into reality. AGRU design teams are constantly working on the realisation of tangible customer wishes. Ultimately, the economic efficiency and technical feasibility is determined by the choice of material, because it must fully meet all the requirements in the areas of chemical resistance and temperature stability, as well as physical durability. That's why the selection of the optimal material for the specific requirements of an application is one of AGRU's core competencies. Thanks to the extensive experience of our application engineers at AGRU, we create custom-tailored solutions that are perfectly adapted to the operating conditions.



### Manufacturing expertise

Whether in the construction business or for semiconductor production: Intelligently designed plastic parts from AGRU are used everywhere. A key factor for success is certainly the seamless process chain, consisting of our own fabrication with numerous technologies found in-house and our worldwide logistics capabilities. With a combination of expertise, automated technology, and careful manual craftsmanship, we engineer products that are among the best in the industry. The necessary drilling, turning, milling, and welding operations are done on state-of-the-art machining centres.

# Foamed sheets

## Developed for lightweight construction

Foamed sheets made of polypropylene are perfect for lightweight construction. The most common applications are in the areas of insulating linings for boat and shipbuilding, tanks and apparatus construction, inner linings in the automotive, aircraft, and model building industries. AGRU's range of products includes coextruded sheet material with a foamed core between compact, structured outer layers on both sides. Compared to a solid plastic plate, this results in a weight reduction of approx. 30 percent!

Foamed semi-finished sheets from AGRU are resistant against numerous chemicals and can be brought into the right form using common tools for working with plastics. Because they can easily be welded using extrusion or hot-gas welding methods and because of their good stability, they are the best choice for all structures where weight reduction and chemical resistance are particularly important.

### Product benefits in detail:

- extremely low density and weight (0.65 g/cm<sup>3</sup>)
- excellent insulating characteristics due to low thermal conductivity (0.10–0.15 W/mK)
- outstanding sound attenuation
- minimal water absorption

### PRODUCT RANGE

#### Foamed PP sheets in grey (similar to RAL 7040)

Thickness	Length x Width
8 mm	3000 x 1500 mm
10 mm	3000 x 1500 mm
12 mm	3000 x 1500 mm

Appropriate welding rod with diameters of 3 mm and 4 mm round out the product range.

Foamed sheets from AGRU have an extremely lightcore. That makes them the ideal lightweight construction material that also provides high chemical resistance.





The Plastics Experts.

Your distributor

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