

DESIGNING WITH ENGINEERING

# PLASTICS

with survey tables





**LICHARZ**  
**STANDARD PLASTICS**

*The competitive edge through engineered components made of plastic*

# Polyethylene (PE)

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Polyethylene is a semi-crystalline thermoplastic with high toughness and chemical resistance, but rather low mechanical strength in comparison to other plastics and cannot be used at high temperatures. The different polyethylenes differ in regard to their molar mass (molecular weight), which is important for the respective physical properties. This means that in addition to the common properties that all types have, certain ones have type-specific properties.

The polyethylene finished products that we offer consist of high density polyethylene types produced by extrusion or moulding processes.

## Main properties

- Low density compared to other materials (0.94 g/cm<sup>3</sup>)
- High impact resistance, also at low temperatures
- Minimum water absorption (< 0.01%)
- Excellent chemical resistance
- High corrosion resistance
- Anti-adhesive
- Very good electrical insulator
- High vibration absorption
- Physiologically safe (does not apply to regenerate semi-finished products)

## Colours

PE-HD: natural, black

PE-HMW: natural, green

PE-UHMW: natural, green, black.

Other colours on request.

## Sliding properties

PE-HD (PE 300; molar mass approx. 200,000 g/mol) is very suitable for welding due to its relatively low molar mass; however, it is not abrasion resistant and has low strength values. This leads to a high level of sliding abrasion, which excludes its use in sliding applications.

PE-HMW (PE 500; molar mass approx. 500,000 g/mol) has better sliding properties because of its higher molar mass and is also more abrasion resistant than PE-HD. In combination with its good level of toughness, it is suitable for use in low load components that are not subject to any high degree of sliding abrasion.

PE-UHMW (PE 1,000; molar mass approx. 4,500,000 g/mol). Because of its high molar mass it has very good wear resistance, bending strength and impact resistance and good noise absorption. Due to its excellent sliding properties and low sliding abrasion, it is the ideal material for lightly loaded components.

Both PE-HMW and PE-UHMW are also available as regenerated material, although it must be noted that the respective physical properties are slightly reduced.

## Chemical resistance

All PE types are resistant to acids, alkaline solutions, salts and salt solutions, alcohols, oils, fats, waxes and many solvents. Aromatics and halogenated hydrocarbons cause swelling. All PE types are not resistant to strong oxidising materials (e.g. nitric acid, chromic acid or halogens), and there is a danger of stress corrosion cracking.

## Weathering effects

As a general rule, no PE types are resistant to UV rays. This does not apply to the black coloured types, which are resistant to UV rays also in combination with atmospheric oxygen.

## Behaviour in fire

All PE types are rated as normal flammable. When the source of ignition is removed they continue to burn and form droplets. However, apart from carbon dioxide, carbon monoxide and water, only small quantities of carbon black and molecular constituents of the plastic develop as conflagration gases. The oxygen index (the oxygen concentration required for combustion) at 18% is low compared to other plastics.

## Areas of use

### PE-HD

- Electroplating industry
- Chemical industry
- Chemical apparatus construction

### PE-HMW

- Food industry
- Meat processing industry
- Sporting venue construction

### PE-UHMW

- Electroplating industry
- General machine engineering
- Coal processing
- Packaging industry
- Conveying technology
- Paper industry
- Electrical industry

## Applications

### PE-HD

- Component parts in chemical equipment design
- Fittings
- Inserts
- Stacking boxes

### PE-HMW

- Cutting table surfaces
- Agitator blades
- Wall linings in refrigeration rooms
- Impact bands
- Knife blocks

### PE-UHMW

- Sheaves, guide rollers
- Sprocket wheels and pinions
- Gears
- Chain guides
- Slides
- Suction plates
- Roller knife and scrapers
- Chute linings for silos
- Conveyor trough linings
- Abrasion protection strips



## Machining

In addition to the good welding properties of PE-HD and PE-HMW, all PE types can also be machined on machine tools. The semi-finished products can be drilled, milled, sawed, planed and turned on a lathe. It is also possible to cut a thread into the material or insert a threaded element. As a rule, no cooling or lubricating emulsion is necessary.

# Polypropylene (PP)

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Polypropylene is a semi-crystalline thermoplastic with high rigidity and very good chemical resistance. Characteristic for polypropylene is a CH<sub>3</sub> side-group in the monomer structural unit, which can be aligned in various spatial positions during polymerisation. The various spatial alignments are significant for the physical properties and differ according to the following:

- Isotactic (regular, one-sided alignment in the macromolecule),
- Syndiotactic (regular, double-sided alignment in the macromolecule),
- Atactic (irregular, random alignment in the macromolecule).

## Alignment

A distinction is also made between homopolymers and copolymers; copolymers are tougher but have less mechanical and chemical stability.

As the physical properties improve considerably with the increase in the isotactic concentration in the polymer, isotactic polypropylene homopolymers should be the first choice for use in the technical area. The polypropylene finished products that we offer consist of high density polypropylene types produced by extrusion or moulding processes.

## Main properties

- Low density compared to other materials (0.91 g/cm<sup>3</sup>)
- Minimum water absorption (< 0.01%)
- Excellent chemical resistance, also to solvents
- High corrosion resistance
- Relatively high surface hardness
- Very good electrical insulator
- Physiologically safe

## Colours

Natural (white), grey (≈ RAL 7032)

Other colours available on request.

## Sliding properties

PP-H is subject to strong sliding abrasion and is thus not suitable for use in sliding applications.

## Chemical resistance

PP-H is resistant to acids, alkaline solutions, salts and salt solutions, alcohols, oils, fats, waxes and many solvents. Aromatics and halogenated hydrocarbons cause swelling. PP-H is not resistant to strong oxidising materials (e.g. nitric acid, chromic acid or halogens) and there is a danger of stress corrosion cracking.

## Behaviour in fire

PP-H is rated as normal flammable. When the source of ignition is removed PP-H continues to burn, forming droplets. However, apart from carbon dioxide, carbon monoxide and water, only small quantities of carbon black and molecular constituents of the plastic develop as conflagration gases. The oxygen index (the oxygen concentration required for combustion) at 18% is low compared to other plastics.

## Weathering effects

PP-H is not resistant to UV rays. UV rays, in combination with atmospheric oxygen, oxidise the surface and discolouration occurs. If the material is exposed to the effects of UV rays for a longer period, this will cause irreparable damage and decomposition of the surface.

## Areas of use

- Electroplating industry
- Chemical industry
- Machine engineering
- Stamping/punching plants

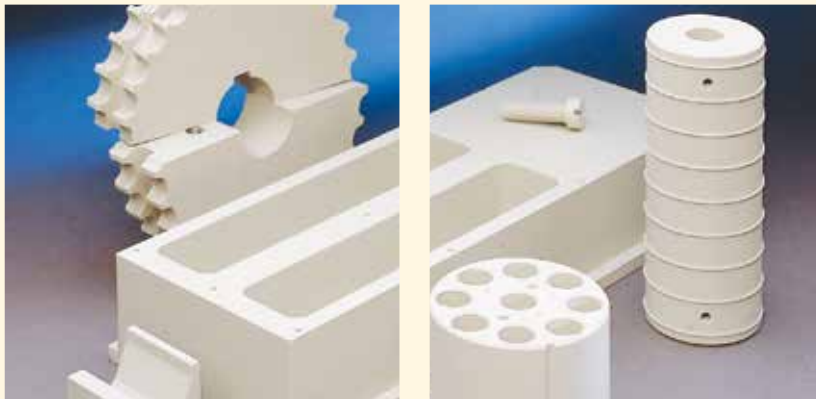
## Applications

- Pump parts
- Component parts in chemical apparatus construction
- Fittings
- Valve bodies
- Product holders for electroplating processes
- Punching plates

## Machining

In addition to its good welding properties, PP-H can also be machined on machine tools. The semi-finished products can be drilled, milled, sawed, planed and turned on a lathe. It is also possible to cut a thread into the material or insert a threaded element. Generally no cooling or lubricating emulsion is necessary.

During cutting, it is very important to ensure that the tools that are used are always adequately sharp. Blunt tools cause the surface to heat, which can cause "smearing" and consequently unacceptable surface finishes.



# Polyvinylchloride (PVC)

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Polyvinylchloride-hard (PVC-U) is an amorphous thermoplastic with no added plasticiser. It has a high hardness and rigidity. According to DIN 16 927 the material is classified as normal shock resistant, however its toughness values border on being rated as highly shock resistant, which gives it a high degree of safety in regard to the design of components. The polyvinylchloride finished products that we offer consist of high density polyvinylchloride types produced by extrusion or moulding processes.

## Main properties

- Hard surface
- High rigidity
- Low water absorption
- Excellent chemical resistance
- Fire resistant (UL 94 V 0)
- Easily thermoformed
- Can be bonded
- Good cutting properties

## Colours

grey (≈ RAL 7011), black, red, transparent  
Other colours available on request.

## Sliding properties

PVC-U is not subject to any major sliding abrasion and is thus suitable for use in sliding applications.

## Weathering effects

PVC-U is not resistant to the effects of UV rays. In combination with atmospheric oxygen, the surface oxidises and discolouration occurs. If the material is exposed to UV rays and atmospheric oxygen for longer periods, irreparable damage and decomposition of the surface will occur.

## Food law suitability

PVC-U does not comply with the requirements of the European Union regulation 10/2011 or the FDA and may not be used for manufacturing consumer goods that come into direct contact with food.

## Chemical resistance

PVC-U is resistant to acids, alkaline solutions, alcohols, oils, fats, aliphatic hydrocarbons and petrol. PVC-U is not resistant to benzene, chlorinated hydrocarbons, ketones or esters. In combination with strong oxidising materials (e.g. nitric acid or chromic acid), there is a danger of stress corrosion cracking.

## Behaviour in fire

PVC is rated as fire resistant in the highest category, even without additives. When the source of ignition is removed, PVC is self-extinguishing. The oxygen index (the oxygen concentration required for combustion) at 40% is very high compared with other plastics.

## Areas of use

- Electroplating industry
- Machine engineering
- Filling plants
- Photo industry

## Applications

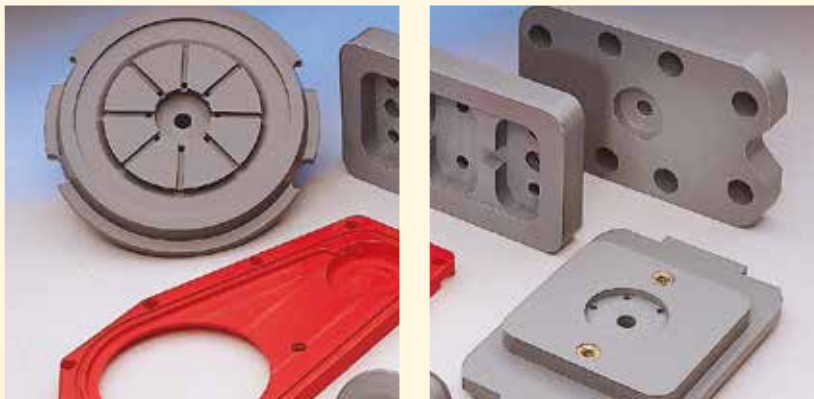
- Pump parts
- Fittings
- Valve bodies
- Component parts in chemical equipment design
- Feed tables
- Machine and equipment covering

## Machining

In addition to its good welding properties and the possibility for glueing, PVC-U can also be machined on machine tools. The semi-finished products can be drilled, milled, sawed, planed and turned on a lathe. It is also possible to cut a thread into the material or insert a threaded element. Generally no cooling or lubricating emulsion is necessary.

During machining it is very important to ensure that the tools that are used are always adequately sharp. If this is not the case, the high temperatures caused by the blunt cutting edge can cause the material to degrade and, in combination with atmospheric moisture, can cause small quantities of hydrochloric acid to form as aerosols.

In addition, because of its hard-brittle properties, we recommend that elastomer or thermoplastic washers are used for PVC-U component parts that are to be fastened by screwing. The use of washers such as this reduces the danger of transmitting high stresses by tightening the screws and the stress cracking around the edge of the drilled hole that this causes.





# Polycarbonate (PC)

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Polycarbonate is an amorphous thermoplastic with high mechanical strength and rigidity as well as good creep qualities. The material is, by virtue of its amorphous molecular structure, translucent and transparent. Particular features are the excellent impact resistance over a large range of temperatures which remain constant even at low temperatures. The combination of impact resistance and transparency make polycarbonate the ideal material for armoured windows, outer casings and safety glass for machines and the building trade. Special types are available for glazing where impact resistance remains almost unchanged for years despite weather conditions. These modified types are considered practically indestructible. The polycarbonate finished products that we offer consist of high density polycarbonate types produced by extrusion or moulding processes.

## **Main properties**

- excellent transparency
- high level of toughness even at low temperatures
- high dimensional stability
- good electrical insulator
- high rigidity
- high creep resistance over a wide range of temperatures
- large temperature range (-100 °C to +120 °C)
- physiologically harmless
- good welding and bonding properties

## **Colours**

natural (clear, transparent)

Colours available on request.

## **Sliding properties**

PC is subject to strong sliding abrasion and is therefore not suitable for sliding applications.

## **Weathering effects**

The PC-standard type is equipped with UV stabilisers and is generally considered UV resistant. However, a product made from this type can only be used indoors. Under constant exposure to direct, strong UV rays and other atmospheric influences there is a risk that the material will become brittle. This may result in stress cracking and breakage. Therefore, we recommend using a type with a special UV protection coating for products intended for outside use. This has been proven in long-term trials and is generally considered as UV-stable and weather resistant.

## **Chemical resistance**

PC is resistant to mineral oils, weak and dilute acids and aliphatic carbohydrates. It is unstable towards strong acids and alkalis, chlorinated and aromatic carbohydrates as well as solvents. It is also not resistant to hydrolysis.

## Behaviour in fire

PC is rated as normal flammable without additional fire retardant additives. But there are also modified types available with fire retardant additives, which are classified according to UL-94 test criteria as a flame retardant. After removal of ignition source both the modified and the unmodified types are self-extinguishing. The oxygen index (the oxygen concentration required for combustion) is 26%.

## Areas of use

- Optics
- Electrical/Electronics
- Medical
- Vehicle
- Mechanical engineering
- Data Technology
- Construction

## Applications

- Machine covers
- Glazing
- Light domes
- Equipment housing
- Sight glasses
- Precision mechanical parts
- Insulators
- Parts for medical technology



## Machining

In addition to its good welding properties and bonding ability, PC can be machined without problem. The semi-finished products can be drilled, milled, sawed, planed and turned on a lathe. It can also be tapped or receive threaded inserts. Use of cooling-lubricating emulsions and cutting oils are not recommended as the additives here can cause tension cracks to form. Cooling, is however, generally not necessary. If cooling is required, use of water or oil-free compressed air is recommended.

Semi-finished products of PC can be reshaped by various means. For example machine covers can be given the required form by bending or bevelling (either cold or warm). Light domes, bowl shapes or similar components can be manufactured by vacuum forming, positive forming or pressure forming.

In comparison to other thermoplastics PC is classified as sensitive to stress cracking. For structural parts made of PC, which will be secured by screws, we recommend using elastomeric or thermoplastic washers. These discs reduce the risk of transmission of excessive pressure stresses that can be caused by tightening the screws. Thus, avoiding stress cracks occurring around the edge of the drilled hole.

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## LICHARZ

### EXACTLY YOUR SOLUTION:

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- we check your design drawing
- we recommend the material and the process
- we manufacture a prototype for you if required

You will receive your product quickly and economically, exactly as you need it!



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