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XANTAR[®], a Brand of Mitsubishi Engineering Plastics

XANTAR, a brand of Mitsubishi Engineering Plastics, is a family of high-end engineering plastics. XANTAR was established over two decades ago – and has been successful since then in a significant number of high-end market segments. This brochure provides an overview of the XANTAR product range, and demonstrates how we are your global partner for innovative added value in the next decades.

Global supply

As brand of Mitsubishi Engineering Plastics, XANTAR has a well-established, fully backward integrated supply chain with strong global support at each stage. Thanks to these strong supply chains, outstanding customer service levels, and world-class technology program, all on a global scale with full and agile local coverage at the highest standard, we are a reliable long-term partner to create innovative added value for all demanding applications.

Innovations

Facing the challenges of high-end markets and getting the most out of a polycarbonate resin requires materials knowledge and experience that goes beyond the key engineering skills of most customers. With XANTAR, we are able to offer continued support and the expertise required to simplify and shorten your development times, to reduce system costs, and to make your products successful. In addition, we continue to invest in the development of new innovative materials that address the high market standards and needs. Our impressive customer portfolio is clear proof of our ability to deliver both innovative concepts and solutions to help meet the challenges our customers face.

Partnership

The successful translation of your vision into viable products and solutions starts with in-depth understanding of your needs and the application itself. Partnership and discretion are key, and here we have a track record of materials knowledge and experience built over two decades.

In-depth understanding of the applications and partnership are key

Quality & consistency

In engineering plastics, product consistency is of the utmost importance. A high product consistency of the feedstock contributes to higher productivity and lower processing scrap rates. During the production of XANTAR Polycarbonate & Blends we enhance both the in-lot and lot-to-lot consistency by continuously monitoring, post-blending and implementing all necessary improvements. From design to final production, our working procedures are fully compliant with ISO 9001 and ISO/TS 16949 Quality Standards, which also help to deliver constant quality whilst minimizing any fluctuations or changes.

Sustainability

Concern for the environment is fully integrated in our innovation and production processes. All our products comply with Europe's RoHS and WEEE directives and similar standards that are currently in development around the world.

Production processes and material formulations are optimised for responsible use of natural resources and minimize the impact on the environment. XANTAR Polycarbonate & Blends offer halogen free solutions for the vast majority of products and applications and we are continuously expanding our portfolio of green products.

Product range

The comprehensive XANTAR portfolio comprises all common types of polycarbonate, specialized in their diversity and customization to specific market requirements. XANTAR C blends of PC/ABS and XANTAR E (PC/Polyester) extend the scope while maintaining the same high quality standards of XANTAR products (Table 1). Mitsubishi Engineering Plastics has the capability to develop grades to meet new requirements, either in terms of performance, improved productivity and/or reduction of system costs. The superior properties and processability of XANTAR C grades, and new material innovations such as XANTAR LDS, XANTAR AM and XANTAR XRM demonstrate that Mitsubishi Engineering Plastics has the ability and resources to deliver results and be your global partner for innovative added value.

Table 1. XANTAR, XANTAR C and XANTAR E commercial grades coding.

XANTAR	
XXX NN YY ZZ	Special additive package (no indication: general purpose grade)
	F = FR (flame retardant): UL 94, V-0, 3.0 mm, Transparent
	FC = FR; V-0, 1.5 mm
	G2F = 10% GF, FR (V-0, 1.5 mm)
	G4F = 20% GF, FR (V-0, 1.2 mm)
	G6F = 30% GF, FR (V-0, 1.5 mm)
	G8F = 40% GF, FR (V-0, 1.5 mm)
XXX NN YY ZZ	Indication of melt viscosity
	18 = extremely low viscosity 23 MFR
	19 = very low viscosity 16 MFR
	22 = low viscosity 10 MFR
	24 = medium viscosity 7 MFR
	25 = high viscosity 5 MFR
	27 = very high viscosity 3 MFR
XXX NN YY ZZ	General purpose additive package
	R = mould release
	U = UV stabilized
	UR = U + R
	SR = Steam resistant + mould release
XXX NN YY ZZ	Additional material characteristic
	FD = Food and drug approved

XANTAR C and XANTAR E	
CM 206 U	Which blend
	Cx xxx x = PC/ABS
	Ex xxx x = PC/Polyester
CM 206 U	Major characteristics
	xM xxx x = injection moulding
	xF xxx x = flame retardant
	xE xxx x = extrusion
CM 206 U	Temperature resistance
	xx 1 xx x = vicat < 110 °C
	xx 2 xx x = vicat ≥ 110 °C
	xx 4 xx x = vicat ≥ 120 °C
	xx 5 xx x = vicat ≥ 130 °C
	xx 6 xx x = vicat > 135 °C
CM 206 U	Reinforcement
	xx x0 x x = unreinforced
	xx x2 x x = 10% GF reinforced
	xx x4 x x = 20% GF reinforced
CM 206 U	Further classification
	xx xx 5 x = low temperature, high impact
	xx xx 6 x = standard
	xx xx 7 x = flame retardant
CM 206 U	Additional information
	xx xxx U = UV stabilized

Facing the challenges of high-end markets and getting the most out of a polycarbonate resin requires materials knowledge and experience that goes beyond the key engineering skills of most customers. With XANTAR, we continue to invest in the development of new innovative materials that address the high market standards and needs. In-depth understanding of the applications and partnership are key, and our portfolio of innovative materials is proof of our capabilities and commitment to deliver the right results.

XANTAR® Laser Direct Structuring (LDS)

The XANTAR LDS portfolio is ideally suited for integrated mobile phone antennas from antenna carriers (Figure 1) to fully integrated antennas in the housing or frame. The application area has now been extended to antennas in laptops and notebooks.

Full Colour custom-made PC- and PC/ABS-based grades are available that enable selective electroless plating by means of laser direct structuring (LDS) to integrate electric circuits into moulded parts.

Benefits of XANTAR LDS for laser direct structuring technology (based on joint development with LPKF):

Optimized for LDS technology:

- Highest-impact material available for laser direct structuring
- Halogen free flame retardant
- Resolution (line/space) down to 100 microns
- Extremely well suited for antennas in mobile phones and notebooks
- Full colour availability for PC- and PC/ABS-based LDS grades

High-performance/robustness:

- Dielectric constant of PC/ABS helps to assure high antenna performance (see Table 2)
- Outstanding impact strength outperforms competitive PC-blends

Table 2. High antenna performance thanks to excellent combination of dielectric constants and loss tangents for various XANTAR LDS grades.

	1 GHz		3 GHz	
	Dielectric Constant (ϵ')	Loss Tangent ($\tan\delta$)	Dielectric Constant (ϵ')	Loss Tangent ($\tan\delta$)
XANTAR LDS 3710	2,8 ±0,05	0,0088	2,8 ±0,05	0,0078
XANTAR LDS 3720	2,8 ±0,05	<0,009	2,8 ±0,05	0,0049
XANTAR LDS 3730	3,0 ±0,05	<0,009	3,0 ±0,05	0,0053

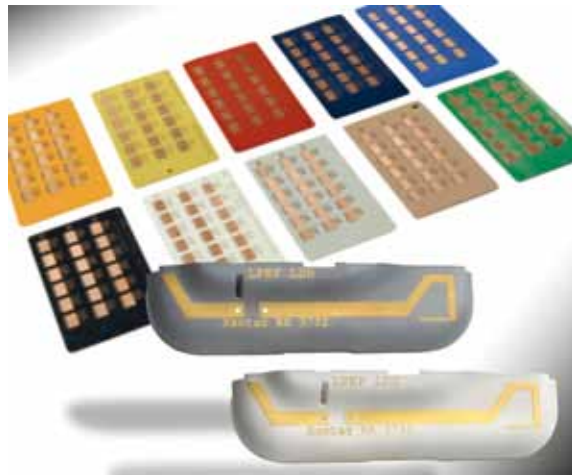


Figure 1. The full colour capability and excellent surface quality of XANTAR PC and XANTAR PC/ABS LDS grades opens up endless aesthetic design possibilities.

Advantages of innovative LDS technology:

- Higher flexibility compared to other moulded interconnect device (MID) technologies, providing faster time-to-market
- Enables 3D shapes and electrical connections simultaneously
- Suitable for relatively small surface areas
- Only three process steps: moulding, laser processing, metallization

XANTAR LDS is the highest-impact material available for laser direct structuring

XANTAR® Xtra Robust Modified (XRM)

For those demanding applications, where conventional grades may not meet all requirements (Figure 2), we have developed a new family of impact modified flame retardant PC, which is completely based on an innovative additive technology: XANTAR XRM.

This naturally bright white grade can be colored easily and exhibits a unique combination of properties, exceeding those of conventional PC and PC/ABS grades:

- No plasticizing effect, high ultimate temperature use, equal to PC
- Excellent low temperature impact, down to e.g. -40°C
- Outstanding dimensional stability, excellent creep behavior
- UL94 V-1, V-0 and 5V flammability ratings, offering security to applications
- Excellent electrical performance
- Excellent environmental stress cracking resistance, outperforming even the most robust PC/ABS grades
- Offering long term reliability, with second to none UV-, weatherability, hydrolytically and thermo-oxidative stability, outperforming even the most robust PC/ABS
- Easy processing, no juicing or outgassing



Figure 2. XANTAR XRM (glass reinforced XANTAR RX 5010) meets the stringent requirements for MCCB's.

XANTAR XRM is completely free of chlorine, bromine, phosphorous and antimony, enhancing the green image of its applications, and is available in both reinforced and non-reinforced grades.

XANTAR XRM is the only choice if you require high impact, secured low and high temperature performance, chemical resistance, stability and reliability.

XANTAR® Anti Microbial (AM): inhibits bacterial growth

Increasingly, today there is a substantial risk of bacterial infections in public buildings and transport and any other places where large numbers of people gather in a confined space. Hospitals and nursing homes need to exercise particular caution to protect against nosocomial infections.

Notorious 'superbugs' such as MRSA but also ESBL bacteria are known for their strong resistance against certain antibiotics and therefore pose a real threat for originating Hospital Acquired Infections.

XANTAR AM is a unique new product that offers a high level of microbial resistance through prevention of cross-contamination by effectively reducing bacteria populations and inhibiting the growth of pathogenic bacteria on plastic surfaces.

XANTAR AM is formulated with a silver-based inorganic antimicrobial compound that controls the growth of gram-negative and gram-positive bacteria on the surface of the product. Typical applications are found in consumer durables, sanitary products and medical devices.

XANTAR AM offers a high level of microbial resistance

XANTAR AM has been tested and evaluated according to the widely accepted standards ISO 22196 / JIS Z 2801 and ASTM E2149.

The grades XANTAR C RC 3800 (PC/ABS) and XANTAR RX 3812 (PC), provide protection greater than log 3 (i.e. = bacteria kill exceeding 99.9%), according to ISO 22196 / JIS Z 2801, see for instance Figure 3.

XANTAR AM is delivered as ready-to-use compounds in all standard available colours.

The introduction and use of antimicrobial products may be subjected to (inter)national legislation for registration of biocides. For further information, please contact our Technical Center in Geleen, The Netherlands.

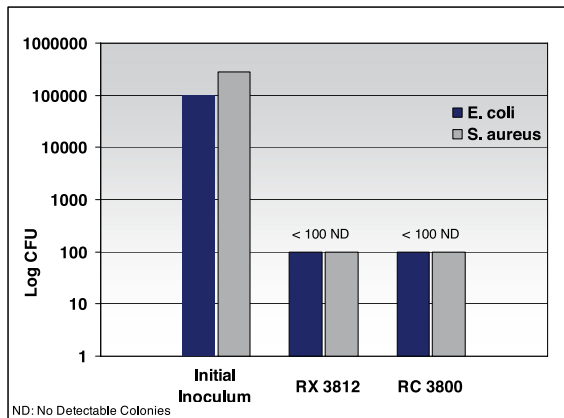


Figure 3. XANTAR AM grades inhibit bacterial growth (ISO 22196 / JIS Z 2801).

XANTAR® C for train interior cladding

Safety is the operative word for public transportation. The demands are not limited to aviation but are also applicable to train, metro, tram and bus transport. Flame retardant XANTAR C now has a number of grades to match the broad scope of Europe's legislation in the public transport sector. XANTAR C is flame retardant and it also matches demands for smoke toxicity and smoke density. This ensures that in the event of a fire, people will not die because of insufficient evacuation time so they are unable to find a safe exit or suffer from sudden asphyxiation.

Benefits of XANTAR C extrusion grades for public transport (Figure 4):

Design and Assembly

- Low-weight solution for interior cladding
- Design freedom: double curved surfaces possible
- Modular assembly for quick installation and turnaround times
- Recyclable, environmentally progressive solution
- Excellent sound damping properties

Safety

- Flame retardant (according to UL94 V-0 and 5VB)
- Compliant with railway specifications for fire and toxicity (according to DIN 5510 / NF-F 16-101, etc.)
- Bromine-free and chlorine-free (according to VDE 0472 part 815)
- High-impact sheet, facilitating vandal-proof solutions

Maintenance

- With optional PTFE top layer for anti-graffiti and easy cleaning



Figure 4. Innovative train cladding with XANTAR C CE 407.

XANTAR® C for cable trunking

Fire safety and environmental issues with current cable management systems have paved the way for alternative construction materials. Today, one of the most widely used chlorine-free and bromine-free flame retardant alternatives is extrudable PC/ABS Blends and PC. Benefits are:

- Self-extinguishing according to UL94 V-0 and 5VB
- Halogen-free according to VDE 0472 part 815
- Low smoke density and toxicity NF F 16-101/102 (F2)
- Compliant with EN 50085 and NF P 92-507 (M1)
- A “green” alternative for PVC
- Recyclable, eco-progressive solution
- Light weight solution vs. aluminium or steel trunking
- Processing with high output and high quality performance
- Low outgassing, low deposit tendency

XANTAR C is recommended for installation trunking and slotted trunking, desk cable management, and cable conduit and channel (Figure 5).

Versatile, easy to process extrudable FR PC/ABS grades are:

- XANTAR C CE 407
- XANTAR C MC 3435

Both grades come with a full Yellow Card and have been rated with various certificates regarding flame retardancy and toxicity.



Figure 5. XANTAR C CE 407 and XANTAR C MC 3435 have a successful track record in halogen-free installation trunking.

XANTAR and XANTAR C have a number of grades to match the broad scope of Europe's legislation in the public transport sector

XANTAR® Applications

Thanks to their excellent mechanical, thermal and electrical properties, XANTAR, XANTAR C and XANTAR E grades are very widely and successfully used in industry segments such as Electrical & Electronics (E&E), Information & Communication Technology (ICT), Automotive, and General Industries.

E&E applications

Cash dispensers (ATM)

Demanding applications such as ATMs require a combination of mechanical, flame retardant and electrical properties along with easy processing. XANTAR and XANTAR C grades have proven to be the prime choice of materials for these applications (Figure 6). Thanks to their excellent impact resistance, colourability and paintability, UL94 V-0 and 5V ratings, as well as electrical properties, they not only meet the stringent requirements, but also help to further reduce system costs, for instance by reducing the number of parts.

Other special innovative XANTAR grades, such as semi-conductive and low friction grades, are ideally suited for interior high end technical components.



Figure 6. Cash dispenser (ATM), made possible by various XANTAR and XANTAR C grades.

Mobile phones and accessories

Housings for mobile phones must have high impact strength to avoid breakage of the housing and to protect the enclosed electronics in the event of an accidental drop. At the same time, visual appearance is an important selling tool for a mobile phone.



Figure 7. XANTAR MX 1004 is specifically designed to meet the demanding requirements for mobile phone charger housings.

Mitsubishi Engineering Plastics offers XANTAR and XANTAR C grades which have been developed specifically to meet the high technical demands of thin walled mouldings. XANTAR and XANTAR C provide good flow properties, impact resistance, surface quality and (for sliding parts) excellent tribological properties.

Material requirements for chargers are prescribed by industry standards which demand V-1 flammability according to UL94 and passing ball pressure test at 125°C. Furthermore, chemical resistance and processing performance are important. Mitsubishi Engineering Plastics has developed specific modified XANTAR grades that fulfil all these requirements (Figure 7).

Smart metering

With the international deregulation of the energy markets and the increasing drive for energy efficiency, there is a vast demand for smart and intelligent meters for electricity, gas and water that can be accessed remotely.

In-depth application knowledge, proven track records in for instance e-meters and enclosures (Figure 9, bottom), and interactive partnership along the entire value chain have resulted in XANTAR and XANTAR C grades being fully approved in major smart meter replacement projects, for instance in several important European venues (Figure 8). The focus to proactively create additional value for our customers is underpinned by the Frost & Sullivan Customer Value Enhancement Award presented to Mitsubishi Engineering-Plastics.

Both existing grades as well as newly developed stabilized grades meeting enhanced requirements have been introduced, ranging from transparent FR XANTAR grades (UL94 V-0 @ 2mm), high flow XANTAR C grades combining mechanical integrity and excellent surface appearance to high HDT (145°C) glass reinforced grades. In line with our sustainability focus, all materials use eco-friendly flame retardant technologies.



Figure 8. Smart e-meters, replacing conventional e-meters across European venues, enabled by XANTAR C MC 3433, high HDT XANTAR G2F 23 R and specially developed transparent XANTAR RX 2124.



Xantar is fully compliant with ISO 9001 and ISO/TS 16949 Quality Standards

Power distribution; wiring accessories, installation & industrial control

We have been supplying all major producers both in and outside Europe for many years. Our PC and PC/ABS Blends meet the specific needs of local industries:

- halogen free flame retardant systems for 960°C GWFI, 775°C GWIT and V0 requirements
- thermal properties and flammability requirements meeting standards for wiring accessories
- excellent aesthetics providing high class surface quality
- optimal UV resistance in different light colour shades (Figure 9, top)
- electrical properties adequate for specific low voltage switch gear applications like auxiliary switches (Figure 9, middle) and MCCB's (Figure 2)

Relevant grades are certified according to the standards for transportation and building industry. A full range of products is available for enclosure and cabinet applications, ranging from low viscous crystal clear towards flame retardant and glass reinforced coloured types (Figure 9, bottom).

The Power Distribution segment is ruled by regional and local standards and norms.

Because we understand and respond to the needs of the industry, our XANTAR and XANTAR C product portfolio contains innovative materials and specialties that excel in distinguishing features such as:

- improved stress cracking resistance
- high LT impact strength in combination with UL94 V-0 (Figure 2)
- high productivity and consistency
- antibacterial properties

In today's competitive markets, optimized production processes are essential.

We offer a combination of global reach, extensive application knowledge and a complete range of engineering materials for installation components that helps you to achieve logistics and production rationalisation so you can provide your customers in turn with a competitive edge.



Figure 9. Top: switches made from XANTAR C MC 3700.
Middle: auxiliary switch, XANTAR MX 1094.
Bottom: enclosures composed of non-reinforced, XANTAR 22 UR and XANTAR FC 22 UR, and reinforced grades, XANTAR G2F 23 R

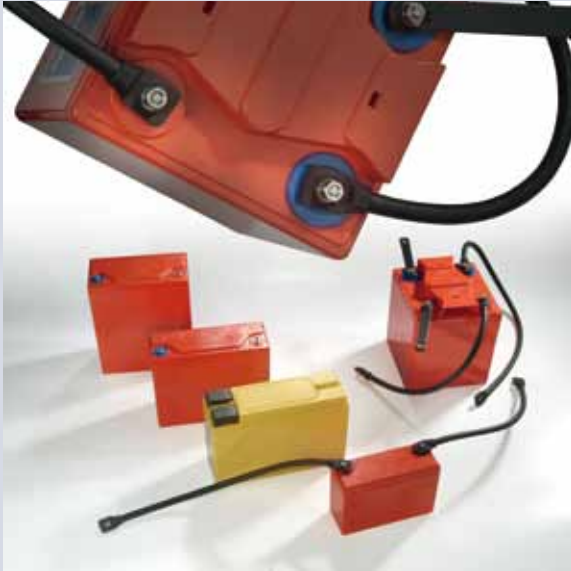


Figure 10. High reliability battery cases, XANTAR C MC 3433.

Battery cases

Battery cases are usually made of plastics. In contrast to car batteries, high-end battery boxes are produced in PC/ABS (Figure 10). Their essential function is to be emergency power supply units for hospitals, trains or in military aircraft, high reliability is required in most demanding circumstances. Important reasons for choosing FR XANTAR C are high temperature resistance, good processing characteristics and a combination of excellent flame retardant performance with 'WEEE' compliance.

Lighting

Luminaries (Figure 11) in industrial environments are required to be water proof (IP66/IP67) and have a high impact resistance, in addition to the standard criteria of high transparency, good UV performance and flammability properties according to IEC/EN 60598.

For fluorescent tube covers (Figure 11), XANTAR fulfils these requirements. To optimize the cost of the cover, manufacturers try to design for the thinnest possible wall sections. In going beyond the conventional limits in flow whilst still meeting the impact standards, XANTAR offers optimal part performance.

Front running LED-technology is made possible using generic and specialised XANTAR lighting grades (Figure 11, left).



Figure 11. Top, right: Outdoor luminaries made from XANTAR G2F 23 R and XANTAR 19 UR. Bottom, right: Fluorescent tube transparent cover, XANTAR MX 2034. Left: Front-running LED-technology is made possible using generic and specialised XANTAR lighting grades.

Automotive applications

XANTAR Polycarbonate & Blends automotive applications are predominantly found in car interiors. Specially developed grades offer solutions for demanding applications such as for instance air conditioning and venting nozzles (Figure 12, top), steering column claddings (Figure 12, bottom), dashboard components and interior lighting.

XANTAR based materials pass today's very stringent environmental requirements with respect to absence of heavy metals and undesired volatile components. They therefore match demands for fogging, emission of volatiles and odour in the car interior.

With XANTAR E, a blend of Polycarbonate and Polyester, the severest impact requirements can be met. XANTAR C, a blend of PC and ABS, is available in several compositions to match the applications demands for heat resistance and impact.

XANTAR materials offer excellent surface finish – but they can be painted if desired.

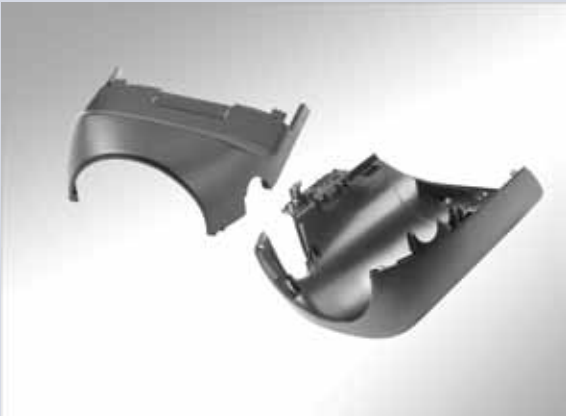


Figure 12. Top: air ducts, XANTAR C CM 406.

Bottom: steering column cladding, XANTAR E EM 605.

General Industry applications

Thanks to its versatility, XANTAR Polycarbonate is able to offer unique solutions in the general industries market. Examples can be found in the building industry, with applications such as window spacer profiles (figure 13, top), cable ducting systems or (twin wall) sheet for construction panels. XANTAR Polycarbonate's easy processing in combination with transparency, purity and intrinsic flame retardancy as well as UV stability makes it the material of choice.

XANTAR Polycarbonate is also a good choice for applications in the food (packaging) and toy industries. Grades that meet both FDA- and EC-legislation are available in a multitude of viscosities and can be custom coloured (Figure 13, bottom). Where design of the part is delicate or complex, the excellent demoulding properties of XANTAR polycarbonate facilitate secure and uninterrupted production processes.



Figure 13. Top: window spacer profiles, XANTAR 27 UR.
Bottom: food approved closures, XANTAR RX 2050 FD.

Extruded applications

The extrusion shaping process imposes rigorous demands on processing performance. Without the right performance, a faultless production process cannot be achieved. The compounding process of XANTAR Polycarbonate is tuned to meet all the relevant demands. Apart from the use of high purity resin to start with, XANTAR production is characterised by spiking to ensure mid specification production runs and a batch homogenization treatment. The combination of these two processes ensures batch-to-batch consistency every time.

Colour and impurities are controlled both visually and digitally to ensure our customers' flawless production of optical quality large panel sheets. XANTAR extrusion grades are available in transparent, translucent and opaque colours (Figure 13, top). On request, UV-resistant grades can be produced. Alternatively, a specially tailored material is available for the production of high UV-resistant cap layers, which can be used in combination with a co-extrusion line to further reduce system costs.

Typical properties of XANTAR®

XANTAR® Polycarbonate

Mitsubishi Engineering Plastics' XANTAR Polycarbonate is a versatile thermoplastic resin that is suitable for a wide range of applications and can be converted using all common melt-processing techniques. The XANTAR product line consists of general purpose and special grades.

General purpose grades

These XANTAR grades are available in a range of melt viscosities, from extremely low to very high, and with several additive packages (basic stabilized, steam resistant, mould release, UV stabilized). A general rule for polycarbonate is that the higher the melt viscosity of a grade, the better its (long-term) performance. When selecting the best suitable XANTAR grade, it is important to find the optimum balance between processing characteristics (ease of processing, melt flowability) and performance (mechanical integrity and long term stability).

General purpose XANTAR grades are self-extinguishing and are rated UL94 V-2 down to 0.75mm; for some special cases even down to 0.4mm.

XANTAR grades are also available in versions approved for food contact.

XANTAR general purpose grades are characterised by:

- Crystal clear transparency
- High impact strength
- Excellent temperature resistance
- Good dimensional stability
- Biological inertness

Flame retardant (FR) grades

The self-extinguishing characteristics of XANTAR can be further enhanced through the use of various flame retardant (FR) additive packages, none of which contain chlorine or bromine. There are two main XANTAR FR grade ranges:

- Transparent or opaque grades with a UL94 V-0 at 3mm rating (F series e.g. XANTAR F 23 R)
- Opaque grades having a UL94 V-0 at 1.5mm rating (FC series e.g. XANTAR FC 23 R)

In addition, a number of special grades are available, for instance:

- Special grades meeting more demanding glow wire ignition (GWI) requirements, for instance according to EDF specifications.
- Special grades with low smoke density and low smoke toxicity, for instance according to NF F16-101/102, DIN 5510-2 and EN 45545-2.

Glass fibre reinforced grades

The addition of glass fibres leads to increased stiffness and improved dimensional stability, while normally ductility is decreased. Glass fibre reinforcement is often combined with extra flame-retardancy.

Reinforcement levels of between 10% and 40% glass fibres are offered, whereas grades with 20% reinforcement are available in various melt viscosities.

XANTAR G2F 23 R (with 10% glass fibres) exhibits an exceptional ductility (elongation at break > 15%) even though it is reinforced.

Engineering structural foam grades

The XANTAR SF 22 series is optimized for structural foam applications. Together with a blowing agent masterbatch, it offers superior impact resistance combined with a UL94 V-0/5VA rating at 4.8mm. Structural foam grades are available with 5, 20 and 30% glass fibre reinforcement. For convenient and reliable processing, it is highly recommended to use XANTAR MX 1051, blowing agent masterbatch (exothermic chemical blowing agent with polycarbonate carrier).

Stress crack resistance modified grade

In certain circumstances, brittle failure can occur in articles made from unmodified polycarbonate. Examples are: failure due to the presence of notches and/or the combination of chemicals (e.g. gasoline) with stresses. Modified XANTAR grades are available with improved stress crack behaviour for those 'impact danger zone' situations.

High-flow flame retardant grades

The XANTAR MX 1000 series is tailored for the requirements of office equipment (e.g. computer and monitor housings) and other electric and electronics applications (chargers, junction boxes, cartridges, etc). Besides high flow, good impact, UL94 V-0 at 1.5mm flammability, and excellent colour stability, these grades also meet requirements such as the glow-wire test at 960°C at 1.5mm and the ball pressure test at 125°C.

Tailor-made grades

Although the XANTAR portfolio covers a very wide range of applications, specific requirements (e.g. special flame retardancy regulations, extreme temperatures) or processing techniques (e.g. blow moulding, extrusion or rotational moulding) can require fine-tuning or adaptation of a grade. This has resulted in a series of special tailor-made XANTAR grades. For example, for extrusion applications, optimised grades are available for solid sheet, twin wall sheet and UV cap layer co-extrusion. Other special extrusion grades are suitable for applications where severe flame retardancy requirements have to be met.

Besides high flow, good impact, UL94 V-0 at 1.5mm flammability, and excellent colour stability, these grades also meet requirements such as the glow-wire test at 960°C at 1.5mm and the ball pressure test at 125°C.

XANTAR® C, Blend of PC and ABS

Blending of XANTAR polycarbonate with ABS has a variety of effects on the properties of the blend, resulting in a new class of materials. For some properties, such as temperature resistance, the blend performance is in between those of the two parent materials. Specific advantages of these materials are due to synergetic effects, such as lower melt viscosity and higher impact resistance under unfavourable conditions (low temperatures, sharp notches, exposure to chemicals or applied stresses).

XANTAR C incorporates specially developed high purity ABS and offers an improved property profile compared to other PC/ABS blends.

Key XANTAR C properties are:

- highest flow in combination with excellent toughness
- high level of purity
- high stability
- bright natural colour

The benefits are: easier filling of complex parts, lower mould deposit during injection moulding, low volatiles level and reduced fogging tendency, better long-term property retention and improved colour consistency and appearance.

XANTAR C delivers value through broadening the design and application scope.

The XANTAR C product line consists of standard, flame retardant and special grades.

Standard grades

XANTAR C grades are based on the excellent resin qualities of XANTAR polycarbonate and optimised ABS grades and are produced by state-of-the-art compounding technology.

XANTAR C shows an excellent property balance where extremely high flow is combined with very high impact, heat resistance and long term performance; all features which aid in the manufacturing of thin walled parts (e.g. mobile phone housings). In comparison with other PC/ABS blends, XANTAR C excels in processability with significantly reduced mould deposit during injection moulding, enabling longer uninterrupted processing, consistent quality and an improved, smoother part surface. Compared to the yellowish natural tint of conventional PC/ABS blends, XANTAR C provides an intrinsically bright white natural colour (Figure 14).

Moreover, part appearance (gloss and surface quality) is less sensitive to process conditions and more stable during long term ageing.



Figure 14. In contrast to standard PC/ABS (left), XANTAR C shows a bright white natural colour (right).

Flame retardant (FR) grades

XANTAR C flame retardant (FR) grades are based on a low volatile flame retardant, that is 100% chlorine free and bromine free. Due to the low plasticizing effect of the flame retardant the Vicat softening temperatures of FR XANTAR C grades are 10-15°C higher compared to conventional FR PC/ABS grades. The strongly reduced volatility of the flame retardant minimises juicing, outgassing and pollution of processing equipment. All grades pass UL94 V-0 rating at 1.5mm, and in addition exhibit 5V-ratings. Like all XANTAR C grades, the FR XANTAR C grades show very high flow, are clean and brightly coloured and have improved stability.

For applications requiring high flow, XANTAR C CF 107 is recommended. If there is a need for increased heat distortion temperatures or more robust mechanical performance, XANTAR C CF 407 can be used. Both XANTAR C CF 107 and CF 407 comply with 'Blue Angel' and 'WEEE' directives.

Tailor-made grades

To meet specific requirements or processing techniques a series of special tailor-made XANTAR C grades is offered. These include: FR grades, glass fibre reinforced grades (also in combination with flame retardant), extrusion grades, and others.

Some examples are:

- *XANTAR C CE 407 / MC 3435/ MC 3437 for extrusion (PVC replacement)*
These XANTAR C grades are flame retardant PC/ABS with optimised melt viscosity for extrusion, rated UL94 V-0 at 1.5mm, and for instance complying with 'Blue Angel' and DIN VDE 472, part 815.
- *XANTAR C MC 3433 for high-end enclosures, such as battery boxes and advanced metering equipment*
XANTAR C MC 3433 is a (chlorine- and bromine free) flame retardant PC/ABS meeting UL94 V-0 at 1.5mm with optimized environmental stress crack resistance, mechanical performance and good flowability.
- *XANTAR C CF 447 for structural parts*
XANTAR C CF 447 is a 20% glass fibre reinforced and (chlorine-free and bromine free) flame retardant PC/ABS grade, ideally suited to structural parts for office equipment such as printer guiding systems. It offers high dimensional stability, stiffness and flame retardancy.
- *XANTAR C MC 3700 for high aesthetics*
XANTAR C MC 3700 is a PC/ABS grade with the highest quality surface appearance and low weld-line visibility, offering clear benefits in 'eye-catching' applications.

XANTAR® E, Blend of PC and Polyester

XANTAR E is a blend of XANTAR polycarbonate (PC) and polyethylene terephthalate (PET) or polybutylene terephthalate (PBT). These products are mainly developed for the automotive industry, both interior and exterior applications and consist of standard and special grades.

Special additive and compounding technology results in a property profile for XANTAR E, which is unique compared to other blends of polycarbonate and polyester.

It exhibits high ageing resistance and has benefits in demanding impact situations e.g. the combination of low temperature performance and weld lines. It also displays low volatility during processing (low odour) and end-use (reduced windshield fogging). Due to its excellent compatibility with other polyester components it can easily be recycled with optimal retention of properties (e.g. recycling in combination with polyester textile claddings).

Guaranteed highly accurate colour matching to specification as well as batch-to-batch consistency

XANTAR®, XANTAR® C and XANTAR® E

Colours

A dedicated approach to colour development, including sophisticated compounding, has resulted in a family of carefully selected and tested additives, which give enhanced colour consistency during processing and during application life-time. No cadmium-containing pigments are used.

Transparent, translucent (only XANTAR!) and opaque colours can be made according to customer specification. This specification can be visual, instrumental or both, depending on customer requirements. State-of-the-art colour lab facilities and expertise guarantee both highly accurate absolute colour matching to specification as well as batch-to-batch consistency.

XANTAR grades show excellent transmission over a very wide wavelength range, which for instance also enables IR applications. 'Fantasy colours' is a feature offered with XANTAR and XANTAR C in which metallic flakes are incorporated into the material, giving the plastic part a 'metallic painted' appearance. Fantasy colours reduce painting costs in applications such as cellular phones, housings and desk lamps.

Electrical properties

XANTAR, XANTAR C and XANTAR E grades have intrinsic good and constant electrical properties thanks to low water absorption and the use of high purity raw materials.

Electrical properties for XANTAR and XANTAR C grades are provided in the UL yellow card file. These properties include hot wire ignition (HWI), high current arc ignition (HAI), high voltage arc tracking rate (HVTR), high voltage arc resistance (D495) and comparative tracking index (CTI).

Typical ratings are:

- HWI Class 2 (special flame retardant grades class 0)
- HAI Class 0 to 1, depending on grade
- HVTR Class 2 to 3 for unreinforced grades, Class 0 to 1 for glass filled grades
- D495 Class 5 to 6
- CTI Class 2 to 3.

More detailed information on electrical properties can be found in Table 3.

Chemical resistance

XANTAR, XANTAR C and XANTAR E grades are resistant against many substances, although some chemical agents may attack under certain circumstances. The chemical resistance of XANTAR, XANTAR C and XANTAR E grades not only depends on the nature of the substance or chemical it is exposed to, but also on the concentration, the temperature, the exposure time, the molecular weight and the stress (which can be a result of moulding and/or external loading). In general, modified XANTAR grades and XANTAR blends will be less sensitive to environmental stress cracking compared to standard XANTAR grades. For most demanding applications, where environmental stress cracking should be as low as possible at both high

and sub-zero temperatures, XANTAR XRM grades are developed.

Table 4 gives a general overview of the chemical resistance of XANTAR. This overview merely gives indicative information. In order to determine the actual chemical resistance under practical circumstances, a basic and fast test procedure is available at our Technical Center in Geleen, The Netherlands. The test allows us to easily establish the effect of a chemical agent on a selected grade under certain combinations of time, temperature and stress. For highest accuracy it is recommended to determine the performance under 'real life' conditions.

Table 3. Underwriters Laboratories yellow card file for XANTAR, XANTAR C, XANTAR XRM and XANTAR LDS

XANTAR grades

Description	Grade designation	Col	Min thickness mm	UL94	RTI °C ¹⁾			H W I ¹⁾	H A I ¹⁾	H V T R ¹⁾	D 4 9 5 ¹⁾	C T I ¹⁾
					EI	WI	WOI					
Non-reinforced	19 R (f2) - 22 R (f2)	All	0.4	V-2	130	130	130	2	0	2	5	2
	18 XX(f1) - 24 XX(f1)	All	0.75	V-2	130	130	130	2	0	2	5	2
	25 XX(f1) - 27 XX(f1)	All	1.5	V-2	130	130	130	2	0	2	5	2
	F 22 YY(f1)- F 25 YY(f1)	All	3.0	V-0	130	125	130	3	1	2	6	2
	FC 19 YY(f1) - FC 22 YY(f1)	All	1.5	V-0	130	125	130	2	0	3	6	2
	FC 23 YY(f1) - FC 25 YY(f1)	All	1.5	V-0, 5VA (3 mm)	130	125	130	2	0	3	6	2
Glass reinforced	G2F 23 YY(f1) - G2F 25 YY(f1)	All	1.5	V-0, 5VA (3 mm)	130	130	130	2	1	1	6	3
	G4F 22 YY(f1) - G4F 25 YY(f1)	All	1.2	V-0	130	130	130	2	1	1	6	3
	G6F 23 YY(f1)	All	1.5	V-0	130	130	130	2	1	0	5	3
	G8F 23 YY(f1)	All	1.5	V-0	130	130	130	2	0	1	5	3
Specialties	MX 1000	All	1.5	V-0, 5VB (2 mm)	110	105	110	0	1	2	5	2
	MX 1001	All	0.75	V-0	80	80	80	2	0	0	6	2
	MX 1002	All	1.5	V-0, 5VB (2 mm)	110	105	110	0	1	2	5	2
	MX 1004	GY/BK	1.5	V-0	80	80	80	1	0	2	7	0
	RX 2121	WT	2.0	V-0	80	80	80					
	RX 2124	NC	2.0	V-0	80	80	80	2	2	2	7	3
Structural foam	SF 22	All	4.8	V-0, 5VA	80	80	80	2	4	1	6	4
	SF 2220 - SF 2230	All	4.8	V-0, 5VA	80	80	80					

XANTAR XRM grades

Description	Grade designation	Col	Min thickness mm	UL94	RTI °C ¹⁾			H W I ¹⁾	H A I ¹⁾	H V T R ¹⁾	D 4 9 5 ¹⁾	C T I ¹⁾
					EI	WI	WOI					
Glass Reinforced	RX 5010	All	3.0	V-0, V-1 (1.5 mm)	80	80	80	1	0	0	6	3

XANTAR C grades

Description	Grade designation	Col	Min thickness mm	UL94	RTI °C ¹⁾			H W I ¹⁾	H A I ¹⁾	H V T R ¹⁾	D 4 9 5 ¹⁾	C T I ¹⁾
					EI	WI	WOI					
General purpose	CM 206, CM 206 U	All	1.5	HB	60	60	60	3	0	0	6	0
	CM 406, CM 406 U	All	1.5	HB	60	60	60	3	0	0	7	2
	CM 506, CM 506 U	All	1.5	HB	60	60	60	3	0	0	7	2
Flame retardant	CF 107	All	1.5	V-0, 5VB (2 mm), 5VA (3 mm)	95	80	80	1	0	4	6	1
	CF 407	All	1.5	V-0, 5VB (3 mm)	95	95	95	2	0	0	7	0
	CE 407	All	1.5	V-0, 5VB (3 mm)	95	95	95	1	0	0	6	0
	MC 3433	All	1.5	V-0	95	80	80	2	0	2	6	2
	MC 3435	All	1.5	V-0, 5VB (3 mm)	95	95	95	3	2	2	7	0

XANTAR LDS grades

Description	Grade designation	Col	Min thickness mm	UL94	RTI °C			H W I	H A I	H V T R	D 4 9 5	C T I
					EI	WI	WOI					
General Purpose	LDS 3710	BK	1.6	HB	60	60	60					
Improved ductility	LDS 3720	BK	0.7	HB	60	60	60					
	LDS 3722	GY	1.0	HB	60	60	60					
Flame retardant	LDS 3730	BK	1.0	HB	60	60	60					

1) These data are for 3 mm thickness

Detailed and up-to-date UL-data can be found on the internet website of Underwriters Laboratories Inc. <http://data.ul.com>.

Table 4. Indicative chemical resistance of XANTAR polycarbonate.

Chemical	Rating
Alcohols:	
monohydric	Good
polyhydric	Good
Bases:	
concentrated	Poor
diluted (1:1)	Poor
Esters	Poor
Fats, oils, and greases	Fair
Hydrocarbons:	
aliphatic	Poor-Fair
aromatic	Poor
fully halogenated	Fair-Good
partially halogenated	Poor
Inorganic acids:	
concentrated	Fair
diluted (1:1)	Good
Ketones	Poor
Organic acids:	
concentrated	Fair
diluted (1:1)	Good
Phenols	Poor
Salt solutions:	
acid	Good
basic	Fair
neutral	Excellent

Excellent - Recommended; no adverse effects after extended exposure.

Good - Acceptable; minimal loss of mechanical properties after long periods of exposure.

Fair - Marginal acceptability; loss of mechanical properties with intermittent exposure.

Poor - Not recommended for use with polycarbonate resins.

Designing with XANTAR®

One of the most critical steps in the design of a plastic product is the selection of the material. The combination of transparency, high impact resistance, intrinsic flame retardancy, high temperature resistance and excellent electrical properties are united in XANTAR Polycarbonate.

Where transparency is not required and a lower temperature resistance is acceptable, polycarbonate blends are a good choice.

XANTAR C (PC/ABS blends) offers improved flow and ESCR (Environmental Stress Crack Resistance). Combined with the ductility of XANTAR C, this makes it an excellent material for Information & Communication Technology (ICT) and automotive interior parts.

XANTAR E (PC/Polyester blends) combines outstanding ductility at very low temperatures and very low emission of volatiles. For this reason it has been successfully used in very critical automotive interior applications.

Making the right choice requires knowledge beyond comparing data sheets.

Choosing the right XANTAR® grade

XANTAR polycarbonate is available in grades ranging from an average molecular weight between 18000 and 27000.

Many of the properties that are commonly used to describe a plastic do not vary with molecular weight in polycarbonate. This applies to tensile modulus, light transmittance, HDT or Vicat etc. In fact, most of the properties quoted in brochures do not change with variations in molecular weight. However, some important properties are largely influenced by molecular weight. Viscosity is a good example: the higher the molecular weight, the higher the viscosity (less flow). Also the engineering or long-term performance of polycarbonate improves with increased molecular weight. A grade with a higher molecular weight has a higher critical strain and is less notch sensitive.

In other words: a high-molecular weight polycarbonate has more 'body' than a low-molecular weight grade.

Selecting the right product depends on the environment as well as the long-term performance requirements of the application (see Table 5).

A low molecular weight product will process more easily than a high molecular weight polycarbonate. However, for injection moulding applications, select the grade with the highest molecular weight that can be processed in the specific mould and moulding equipment. This will provide the best long term performance although this strategy may appear to run contrary to the philosophy of selecting the material that is easiest to process.

Extrusion applications follow the same rule, although in extrusion processes the melt strength determines the material's processibility. In general, the material with the highest viscosity is the optimal grade.

Table 5. Selecting the right XANTAR grade type.

Requirement	Recommendation
Long term properties	Higher viscosity
Complex/long flow parts	Lower viscosity
Cold temperature impact	Higher viscosity
Higher critical strain	Higher viscosity
Long term water/steam	"SR" grades
UV exposure	"UR" grades
Flame retardancy	"F" or "FC" grades
Higher modulus	Glass fibres

Product design

Dimensions

Dimensional tolerances play a major role in determining the cost and difficulty in making a part. The design engineer should determine whether or not tight tolerances are in fact necessary and can be justified. Optimally, tolerances should be tight enough to ensure satisfactory part performance and large enough to avoid unnecessary tooling and manufacturing costs. At the same time, the environment in which the part must operate will often preclude the acceptance of close tolerances. E.g. if a part must operate through a wide range of temperatures, the dimensional change resulting from this temperature variation may be greater than that allowed by these tolerances.

Parts moulded from unreinforced XANTAR, XANTAR C and XANTAR E shrink between 0.005mm and 0.007mm per linear mm. Because of the isotropic nature of XANTAR, XANTAR C and XANTAR E, it is possible to hold very tight tolerances depending on the part, tool design and processing conditions. It is always best to have as much tolerance as possible while still maintaining part functionality.

Surface appearance

XANTAR, XANTAR C and XANTAR E offer excellent reproduction of the mould surface. Everything between high gloss and heavily textured surfaces can be created. Glass reinforced materials tend to be abrasive and care should be taken to maintain the mould surface so that part appearance does not vary from the original intent. Ejector pins and second-surface ribs and bosses can detract from the aesthetics of the part so it is important to avoid placing these in critical appearance areas.

While XANTAR, XANTAR C and XANTAR E are capable of good mould surface reproduction, they are highly reliant on proper moulding. Therefore, it is critical to follow the recommendations for processing polycarbonate and polycarbonate blends to obtain the best surface appearance.

Wall thickness

Wall thickness should be equal to or greater than the minimum allowed by the functional requirements of the part and the processing capabilities of the material. Walls that are thicker than necessary add

cost by increased material usage and longer cycle times. Additionally, thicker walls may cause problems such as sink marks, internal voids, and poor surface appearance. In order to achieve greater strength and stiffness in the part, ribs and gussets can be used. The use of ribs and gussets, generally, provides optimal cost performance.

For solid injection moulding, parts made out of XANTAR, XANTAR C and XANTAR E should not exceed 3mm to 4mm nominal wall thickness. Walls thicker than 3mm to 4mm result in increased cycle times (due to longer periods required for cooling), raise the likelihood of voids, and significantly decrease the physical properties of the part. Where wall thickness exceeds 4mm, foam injection moulding (XANTAR SF 22-series) is preferred. The optimal thickness for foam applications is around 6mm.

Care should be taken for those applications that require UL94 listings that the thinnest section of the design still corresponds with the listed flammability on the UL 94 Yellow Card.

Ribbing

The addition of ribs to the part allows for a thinner overall wall thickness. By allowing thinner walls, ribbing also reduces cycle time and cross sectional area versus thick walled parts. This allows material usage and part weight reduction without sacrificing physical properties.

Typically ribs should be no more than 60% of the adjacent wall thickness in order to prevent sinks on the opposite side. Radii should be incorporated to prevent stress concentration at the juncture of ribs and adjacent walls.

Corners & radii

Sharp corners act as stress risers and are among the major causes of part failure. Most thermoplastics are particularly sensitive to this phenomenon. A good rule to follow is to employ inside radii equal to a minimum of 60% of the adjacent wall thickness. Additionally, external corners should maintain a constant wall thickness around the radius of the internal corner. This reduces variations in wall thickness and helps prevent warpage and sinks.

Tool design

XANTAR, XANTAR C and XANTAR E have been successfully moulded in a wide variety of tools using conventional two-plate, three-plate, and hot runner systems. It is essential that good design practices are followed in order to produce high quality product. The following are recommendations for tool design details.

Gates & runners

Most of the familiar gating systems such as conventional, sub-surface, and fan work well with XANTAR, XANTAR C and XANTAR E. Gate location and size should be selected with care to minimize shear (especially important for the blends), surface imperfections, and part distortion. Gates should be located so that material flows from thicker to thinner wall sections and are balanced in all directions, as much as possible. Runners should be sized large enough to allow free flow of the material required to fill the cavities without producing unnecessary rework. Radii should be used at all corners, including gates. The use of cold slug wells will assist in removing cold material from the melt front and allow the delivery of hot material to the cavities.

Hot runner systems can be of great benefit. They reduce runner scrap and produce lower moulded-in stresses in parts by delivering uniformly hot material to the cavity. Most of the hot runner system manufacturers make products which can be used with XANTAR, XANTAR C and XANTAR E.

The key characteristics to remember when selecting a system include:

- Runner system should be well balanced
- Material channels should be open, free flowing, and devoid of areas where material can hang up and degrade
- The heaters should be sized to allow sufficient heat to be delivered anywhere in the system
- All areas should be uniformly and accurately heated
- Each branch runner and drop should have its own individual control.

Venting

Medium to high injection speeds are recommended for XANTAR, XANTAR C and XANTAR E, therefore venting is particularly important. Vents should be located at the end of fill and any other location where melt front knitting and resultant gas entrapment can occur. Dimensions of venting can be read from Figure 15.

The dimensions are chosen in such a way that air can escape without flash. When vents cannot be placed on the parting line, they should be located on ejector pins. Vents located on static pins, such as core pins, should not be used as they will become clogged very quickly unless they are connected to a vacuum system to keep them clean and open.

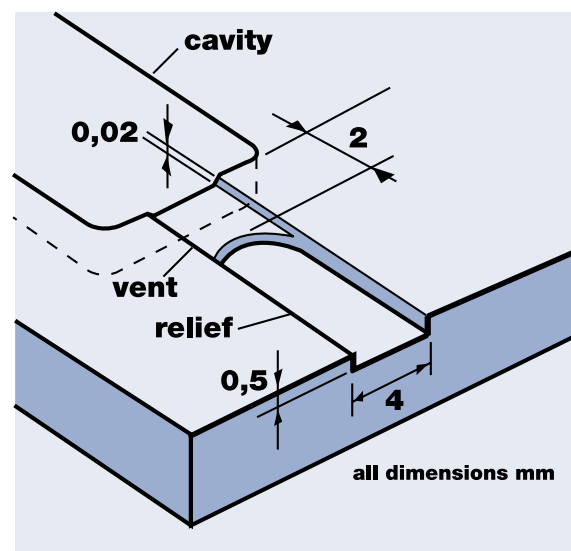


Figure 15. Construction of a venting channel for XANTAR Polycarbonate & Blends.

Secondary operations

Machining

Standard machining tools work well for cutting XANTAR, XANTAR C and XANTAR E and generally provide a long service life. Either high-speed steel or carbide tooling can be used. If extensive machining is necessary, you are advised to use tools that have optimum geometry as defined by The Society of the Plastics Industry to ensure maximum productivity and best surface finish.

Welding

Welding of XANTAR, XANTAR C and XANTAR E is based on the interdiffusion of molecule chains, which needs elevated temperature and time. Pressure is required for good mechanical contact; in addition it helps to clean weld surfaces by outflow of impurities. A variety of welding techniques does exist of which vibration/spin, ultrasonic and hot plate welding are the most popular. Nowadays, laser welding is becoming increasingly popular. XANTAR Polycarbonate is excellent for laser welding thanks to its high transparency at visible to near infrared wavelengths. Using for instance conventional Nd:YAG lasers, it is possible to successfully weld XANTAR on polyesters and copolyesters.

Adhesive bonding

Adhesive bonding allows great freedom in design because it can be used effectively to bond XANTAR and XANTAR C to a variety of material including to itself, other plastics, metals, wood, glass and ceramics. Adhesive bonding, however, is not without draw-backs. The primary concerns are slow processing rates, limited use in certain environments and difficulties in applying the adhesive during the assembly operation.

Adhesive bonding with XANTAR, XANTAR C and XANTAR E can be satisfactory if:

- The proper adhesive (an epoxy, polyurethane or silicone) is selected for the application and environment
- The joint design is adequate for the size and shape of the product
- The joint surface is not smooth. The surface can have moulded-in texture or matte finish, or it can be treated in a secondary roughing operation
- The joint surface is clean and free of foreign materials, such as dirt, mould release spray, water, oil, etc.
- The adhesive is properly applied and cured

Adhesives that utilize components incompatible with XANTAR Polycarbonate should be avoided.

Solvent bonding

XANTAR, XANTAR C and XANTAR E are well suited to solvent bonding because of their amorphous nature. The most common solvent is methylene chloride or a 5% solution of polycarbonate in methylene chloride where surfaces do not mate perfectly.

When solvent bonding, methylene chloride is applied to the joint area of one or both components and the two components are then held together in a fixture under a pressure of 1.5-4 MPa. The bond is then cured to form a joint in one to five minutes, depending on the size and shape of the joint area.

Environmental conditions, such as elevated temperatures, can cause stress crazing. Therefore, the bond should be dried for 24 to 48 hours at a temperature just below the maximum anticipated operating temperature. This often eliminates crazing, which can be caused by entrapped solvent.

Printing

XANTAR, XANTAR C and XANTAR E can be printed using various processes including hot stamping, pad printing, and silk screening. XANTAR, XANTAR C and XANTAR E may be hot stamped using standard equipment and foils. Hot stamp foils come in a wide variety of grades offering different textures, colours, and mechanical and adhesive properties. For the best grades to be used in combination with XANTAR, XANTAR C or XANTAR E, consult the supplier of the hot stamping foil.

Laser marking

Laser printing offers specific advantages, impossible to meet with conventional printing systems (environmentally friendly and very flexible). Several single-colour, high contrast, laser printable XANTAR, XANTAR C and XANTAR E grades have been developed by the laser experts at the Technical Center in Geleen, The Netherlands (Figure 16).

Painting/coating

Due to the polarity of XANTAR, XANTAR C and XANTAR E, painting and coating can take place without any problems. However, since both materials are sensitive to stress cracking in contact with certain solvents, it is strongly advised to use paints or coatings which are suitable for polycarbonate.

Metalising

XANTAR, XANTAR C and XANTAR E can be readily metalised by most common techniques, e.g. vacuum metalising, cathode sputtering, flame spray, arc spray and electroless plating. Metalising can be applied for various reasons such as EMI shielding, (light) reflection and aesthetics. High reflective metal layers can be obtained with uniform thickness which show, in general, very good adhesive bonding to XANTAR, XANTAR C and XANTAR E. For (mechanical) protection, the metal layer can be coated additionally. Also, other methods for metalising are possible, e.g. application of a conductive coating or very selectively by employing the innovative XANTAR LDS technology.



Figure 16. XANTAR, XANTAR C and XANTAR E grades can readily be laser marked. Using special laser marking grades, design freedom can be further enhanced.