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## 1. Product identification

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BARLO XT is the brand name for extruded Polymethyl methacrylate (PMMA) sheets manufactured by Quinn Plastics.

The BARLO XT programme offers solutions to both indoor and outdoor applications. BARLO XT is available in clear and opal white standard products, and a wide range of colours and designs.

BARLO XT sheets are produced and tested according to DIN EN ISO 7823-2.

## 2. Characteristics

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BARLO XT sheets have good optical properties and a brilliant surface.

BARLO XT sheets offer excellent transparency, good mechanical properties, are UV resistant, have very good weathering and ageing resistance and remain colour constant for years.

High impact grades, BARLO XT610, XT620, XT630, have outstanding mechanical properties and excellent impact strength.

Both BARLO XT sheets and all high impact grades can be used in contact with foodstuffs, as they meet all current European food control legislation.

BARLO XT sheets and the high impact grades do not contain any toxic materials or heavy metals, which may cause environmental damage or health risks. It is insoluble in water, and not subject to hazardous materials identification.

BARLO XT sheets and the high impact grades are easy to recycle.

## 3. Applications

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- Construction components
  - Light domes
  - Partition walls
  - Door glazing
  - Roofing
  - Skylights for caravans
- Advertising and signage
  - Moulded letters
  - Store Displays
  - Shop fittings
  - Illuminated graphics panels
- Lighting
  - Lighting control lenses
  - Domestic light fittings
- Other applications
  - Containers
  - Lettering templates
  - Solariums (special grade, UV-transmitting)
  - Sound barrier walls
- Engineering components
  - Machine housings
  - Machine safety covers

## 4. Fabrication and finishing techniques

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BARLO XT sheets are easy to handle.

They can be machined using all the usual methods, such as sawing, drilling, polishing etc., and are easy to thermoform.

More detailed information on these items can be found in our 'USER GUIDE', further in this brochure.

## **5. Statements and certificates**

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### **5.1. Food approval statement**

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BARLO XT and BARLO XT High Impact sheets can be used in contact with food.

BARLO XT and BARLO XT High Impact clear sheets are extruded from a high quality raw material Polymethyl methacrylate which meets the compositional requirements of EU directive 2002/72/EC (August 6, 2002) relating to plastic materials and articles which come into contact with foodstuffs.

A detailed certificate of conformance are available from our customer service department.

### **5.2. Fire classification according to European and national standards**

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■ Europe EN 13501-1 (formerly DIN 4102-1)	Euroclass E (formerly B2)
■ France NF P 92 501 + NF P 92 505	Class M4
■ Netherlands NEN 6065 + NEN 6066	Class 4

### **5.3. Noise protection**

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BARLO XT sound barrier walls have been tested and approved according to the German regulatory ZTV-Lsw88 and the European standards EN 1793 and EN 1794.

They comply with the requirements: noise insulation, fire performance, stability under wind load and stone cast resistance.

Certificates are available from our customer service department.

### **5.4. Quality management**

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BARLO XT and BARLO XT High Impact sheets are manufactured and audited for quality in compliance with the certified and regularly audited production and quality management system according to EN ISO 9001:2000.

### 5.5. Warranty

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BARLO XT and BARLO XT High Impact sheets are suitable for outdoor use.

Quinn Plastics provides a 10-year warranty for flat transparent sheets for minimum light transmission and mechanical properties.

The warranty shall come into force the day the BARLO XT and BARLO XT high impact sheets are delivered to the customer.

The warranty applies exclusively to standard BARLO XT and BARLO XT high impact sheets used correctly as flat sheets which are installed, handled, machined, fabricated and maintained according to Quinn Plastics' recommendations and instructions.

No warranty will be available for sheets that have been exposed to corrosive materials and environments.

Detailed warranty terms and conditions in accordance to CISG (United Nations Convention on Contracts for the International sale of Goods) are available from our customer service department.

### 5.6. Safety data statement

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Safety data sheets for BARLO XT and BARLO XT high impact products in accordance to 2001/58/EG are available upon request.

## 6. Technical information

### 6.1. Technical data sheet BARLO XT - BARLO XT 610 - XT 620 - XT 630

<b>■ GENERAL</b>						
Property	Method	Units	BARLO XT	BARLO XT 630	BARLO XT 620	BARLO XT 610
Density	ISO 1183	g/cm <sup>3</sup>	1.19	1.17	1.16	1.15
Water absorption 24h/23°C – 50x50x4mm <sup>3</sup>	DIN 53495 Method 1	%	0.2	0.25	0.3	0.3
Ball indentation hardness	ISO 2039-1	MPa	235	155	135	100
Forming temperature air pressure		°C	140-160	130-150	130-150	130-150
Forming temperature vacuum		°C	160-190	140-170	140-170	140-170
Moulding shrinkage		%	0.5-0.8	0.6-0.9	0.6-0.9	0.6-0.9
<b>■ MECHANICAL</b>						
Property	Method	Units	BARLO XT	BARLO XT 630	BARLO XT 620	BARLO XT 610
Tensile strength	ISO 527-2	MPa	70	55	50	40
Elongation at break	ISO 527-2	%	4	15	25	35
Tensile modulus	ISO 527-2	MPa	3200	2400	2100	1800
Flexural strength	ISO 178	MPa	115	90	85	65
Flexural modulus	ISO 178	MPa	3300	2400	2100	1800
Impact strength Charpy unnotched	ISO 179-1	kJ/m <sup>2</sup>	17	25	35	60
Impact strength Charpy notched	ISO 179-1	kJ/m <sup>2</sup>	2	3	4	5
<b>■ THERMAL</b>						
Property	Method	Units	BARLO XT	BARLO XT 630	BARLO XT 620	BARLO XT 610
Vicat temperature (B 50)*	ISO 306	°C	105	104	102	98
Specific heat capacity	IEC 1006	J/gK	1.47	1.5	1.5	1.5
Linear thermal expansion	DIN 53752	K <sup>-1</sup> *x10 <sup>-5</sup>	7	9	10	11
Thermal conductivity	DIN 52612	W/mK	0.18	0.18	0.18	0.18
Service temperature continuous use		°C	70	65	65	65
Max. temperature short term use		°C	90	85	80	75
Degradation temperature		°C	>280	>280	>280	>280
<b>■ OPTICAL</b>						
Property	Method	Units	BARLO XT	BARLO XT 630	BARLO XT 620	BARLO XT 610
Light transmission (3mm)	DIN 5036-3	%	92	91	91	90
Refractive index	ISO 489	n <sub>D20</sub>	1.492	1.492	1.492	1.492
<b>■ ELECTRICAL</b>						
Property	Method	Units	BARLO XT	BARLO XT 630	BARLO XT 620	BARLO XT 610
Surface resistivity	IEC 60093	Ω	3x10 <sup>15</sup> - 3x10 <sup>16</sup>	-	-	-
Volume resistivity	IEC 60093	Ω x m	1x10 <sup>13</sup> - 5x10 <sup>13</sup>	-	-	-
Electrical strength	IEC 60243-1	kV/mm	10	-	-	-
Dielectric strength	DIN 53481	kV/mm	30	30	30	30
Dielectrical dissipation factor 50 Hz	DIN 53483-2		0.06	-	-	-
Dielectrical dissipation factor 1 KHz	DIN 53483-2		0.04	-	-	-
Dielectrical dissipation factor 1 MHz	DIN 53483-2		0.02	0.03	0.03	0.03
Relative permittivity 50 Hz	DIN 53483-2		2.7	-	-	-
Relative permittivity 1 KHz	DIN 53483-2		3.1	-	-	-
Relative permittivity 1MHz	DIN 53483-2		2.7	2.9	2.9	2.9

\*pre-treatment 16h at 80°C

## 6.2. Chemical resistance

At room temperature BARLO XT and BARLO XT high impact sheets are resistant to saturated hydrocarbons, aromatic free carburettor fuel and mineral oils, vegetable and animal fats and oils, water, aqueous salt solutions, diluted acids and alkalis.

Aromatic hydrocarbons and hydrogen chlorides, ester, ether and ketones attack BARLO XT and high impact BARLO XT.

### ■ Chemical resistance at 20°C

Acetone	-	Ethyl acetate	-	Acidity of wine	+
Ammonia	+	Glycerine	+	Xylene	-
Amyl alcohol	-	Fuel oil	o	Paraffin	+
Benzene, free from aromatics	+	Hexane	+	Petroleum ether	+
Benzole	-	Isopropanol	o	Phosphoric acid 10%	+
Boric acid	+	Coffee	+	Sulphuric acid 10%	+
Butanol	-	Caustic potash solution	+	Nitric acid 10%	+
Chlorinated hydro-carbon	-	Ketone	-	Hydrochloric acid 10%	+
Chloroform	-	Methylene chloride	-	Hydrochloric acid conc. 35%	+
Chlorinated water/air	o	Lactic acid 10%	+	Sodium carbonate	+
Dibutyl phthalate	-	Mineral oil	+	Salad vinegar	+
Diocetyl phthalate	-	Caustic soda	+	Stearic acid	+
Glacial acetic acid	-	Nitrocellulose lacquer	-	Tea	+
Acetic essence	-	Oxalic acid	+	Turpentine	+
Aqueous acetic acid	+	Wax	+	Toluene	-
Ethanol	o	Hydrogen peroxide	o	Diluting agent	-

- + resistant
- o limited resistance
- not resistant

## 6.3. Product range BARLO XT

BARLO XT sheets are protected on both sides by laminated PE-film, except BARLO XT patterned sheets, which are only laminated on the smooth side.

### ■ BARLO XT thickness range

From 1.5 mm up to 25 mm

Standard thicknesses of flat, clear sheets: 1.5 - 2 - 3 - 4 - 5 - 6 - 8 - 10 - 12 - 15 - 20 - 25 mm

### ■ BARLO XT widths cut-on-line

Max. 2000 mm

for 1.5 mm

Max. 2050 mm

from 2.0 mm up to 25 mm

### ■ BARLO XT length cut-on-line

Minimum length

1000/1250 mm (depending on the extrusion line)

Standard length

3050 mm

Over-lengths available upon request

### ■ BARLO XT thickness tolerances

1.5 mm up to 3mm ± 10%

3 mm up to 25 mm ± 5%

### ■ BARLO XT cut-on-line tolerances

More than 1000 mm - 0 / + 0.3% (3 mm per 1000 mm)

## ■ BARLO XT cut-to-size tolerances

-0 / + 1.0 mm

## ■ BARLO XT minimum production order for

Special thickness	3.000 kg/5.000 kg/12.000 kg (depending on the extrusion line)
Special pattern	5.000 kg
Custom made colour	10.000 kg

Other thicknesses, sizes and tolerances are available upon request.  
For a detailed overview of our product range ask for our Product selector brochure.

## 6.4. Special products

### ■ BARLO XT Sound Wall Barrier (SWB) 15 mm – 20 mm

BARLO XT SWB is a sound absorbing material used in noise protection equipment on roads. It is transparent and allows an unhindered view of the surroundings.

BARLO XT sound wall barriers surpass the required minimum sound insulation factor (according to ZTV-Lsw88 and EN 1793).

Further characteristics of BARLO XT SWB are mechanical stability, weathering resistance and fire stability.

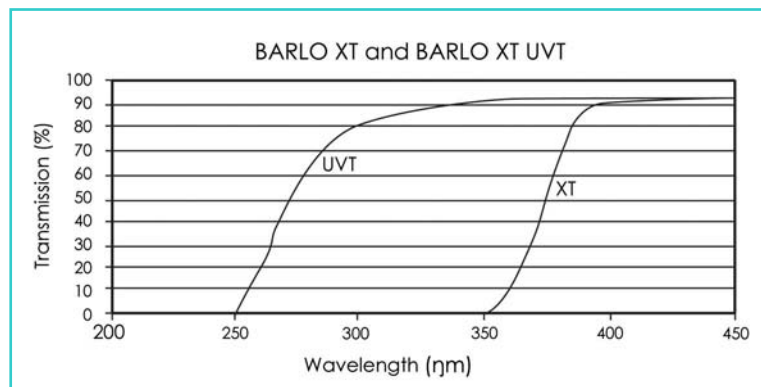
The relevant test certificates according to Lsw88 and EN 1793/EN 1794 can be obtained from our customer service upon request.

### ■ BARLO XT UVT

BARLO XT UVT is perfectly suitable for solariums and sun beds.

BARLO XT UVT has high transmittance in the UVA/UVB spectral range and very good resistance to degradation following exposure to these rays.

Further technical information and relevant warranties can be obtained from the technical service department upon request.



### ■ BARLO XT soft tone

BARLO XT soft tone combines the same mechanical properties of class leading BARLO XT clear sheet, but with the additional benefits of a double sided matt finish, providing a stylish, trendy look without distracting reflections and an easy to maintain surface.

Technical data sheet are available from the customer service department.



## **7. User guide**

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### **7.1. Introduction**

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The manufacture of plastic articles from BARLO XT sheet normally involves secondary fabrication operations, including sawing, drilling, bending, decorating, and assembling. This guide covers the properties and characteristics of BARLO XT that need to be taken into account if secondary operations are to be performed successfully.

### **7.2. Storing and handling**

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The originally packed plastic sheets should neither be stored outside nor be exposed to great variations of weather and/or temperature. When storing under conditions with substantial variation of temperature and humidity, flat shape distortion (corrugation) of the sheet can happen, even when stored flat and stacked.

Polyethylene film protects sheets against dirt, mechanical load and scratches. It is recommended to leave the protective PE film in place until final processing.

PE protective film is not designed for long-term open-air exposure/protection - it has only moderate UV- and heat-resistance.

If sheet is stored outside, without protection, the protective foil should be removed after four weeks time, as there is a risk of brittleness and difficult removal of the degraded PE film. This could lead to the damage of the sheet surface.

Depending on storage and climatic conditions, plastic sheets absorb moisture. Although humidity absorption has no practical influence on the physical properties, it may interfere during further processing of the sheets at higher temperatures e.g. during bending, or heating before thermoforming. Therefore, according to the intended use, the sheets may have to be pre-dried (see 7.3.2. Drying).

### **7.3. Material preparation**

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#### **7.3.1. Cleaning**

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Protection film removal will induce a build-up of the electrostatic charge on the sheet surface. This electrostatic charge attracts airborne dust, and other fine particles. Therefore, prior to further processing, it is recommended to clean the sheet by antistatic treatment (e.g. blowing by ionised compressed air or cleaning by hand with a cloth wetted with suitable antistatic agents).

This is particularly important prior to thermoforming process, as dust or dirt particles will cause imprints on the moulded surface.

Plain water will suffice for both cleaning and care of the sheets.

In case of excessive dirt, clean with warm water and a weakly alkaline, non-abrasive cleaning agent.

The sheets should be dried with a soft cloth or with chamois leather.

Dry scrubbing of the surface will cause scratches and possible damage.

Very greasy and oily surfaces should be cleansed with aromatic -free benzine or petroleum ether.

Other chemicals suitable for cleaning BARLO XT sheets:

- Diluted acids such as citric acid, hydrochloric acid, sulphuric acid
- Diluted caustic soda or caustic potash solution
- Common vinegar
- White spirit, neutral soap and household detergents.

### 7.3.2. Drying

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As with most plastics, BARLO XT sheets absorb moisture during storage.

Whilst processing at higher temperatures, this can produce bubbles; therefore, pre-drying below softening point temperature is advisable. Normally pre-drying of BARLO XT sheets with high moisture contents in an oven with air circulation, for 24 hours, will suffice.

To achieve good drying results, air circulation between the sheets must be ensured; the protection foil must be removed before drying

In general, BARLO XT sheets need not be pre-dried prior to thermoforming, provided that the material has been adequately stored and the foil is undamaged.

To minimise costs, the drying heat should be exploited by immediate follow-on forming after the drying process.

### 7.3.3. Dimensional change

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There are substantial orientation forces involved in the extrusion process to form the sheet from the molten polymer. A part of these forces remains "frozen" in the sheet.

When the sheet is to be heated e.g. before thermoforming, this stress became apparent in shrinkage of the sheet. The shrinkage is always higher in parallel to the extrusion direction. Longitudinal shrinkage is always higher in thin sheets and lower in thick sheets.

Such dimensional change has to be taken into consideration when cutting sheets to be thermoformed.

When the material is heated and fixed in a clamping frame, no material shrinkage will arise.

As the shrinkage value depends on both heating temperature and heating time, preliminary tests are advisable.

Maximum longitudinal shrinkage values of BARLO XT safely comply with ISO 7823-2, annex B:

<b>Sheet Thickness</b>	<b>Amount of shrinkage</b>
1.50 mm up to <2 mm	≤15%
2.00 mm up to <3 mm	≤12%
3.00 mm up to 25 mm	≤7%

### 7.3.4. Thermal linear change

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Like all materials, BARLO XT is subject to linear change at variable temperatures. Plastics show higher linear change than metals, and this must be taken into account when mounting BARLO XT sheets into frames.

**BARLO XT shows a coefficient of linear thermal expansion of 0.07 mm/m °C.**

When mounting BARLO XT sheets, attention must be paid to the elongation clearance in order to avoid damage during material usage.

For more technical data - see chapter „7.8 Glazing“.

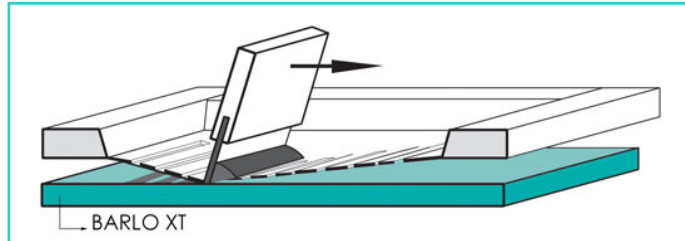
## 7.4. Surface treatment

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### 7.4.1. Printing

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Silk-screen printing is the most commonly used method for printing BARLO XT and allows the creation of a wide range of graphics.



Distortion screen printing allows the flat sheet to be formed after printing into a three dimensional article with correct print register. Allowance must be made for "stretching" of the image when designing the graphics.

Halogen spotlight systems should not be used when thermoforming printed sheets.

During the silk-screen print process, the high-viscous ink is pushed through a photochemically pre-treated screen print fabric (polyamide or polyester) by mechanical action or by means of a hand-operated scraper. The ink is transferred to the sheet beneath the screen fabric.

In order to avoid stress cracking of BARLO XT, only acrylic compatible inks must be used. The lacquer systems must be suitable for the intended application.

Addresses of appropriate ink suppliers can be obtained from the Technical Service Department upon request.

Spray painting is another popular method for decorating sheet after moulding. Only ink or paints suitable for use with acrylic sheets should be used.

### 7.4.2. Laminating

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The application of decorating foils or self-adhesive lettering or transfers is only suitable for flat or slightly curved sheets. Care should be taken that adhesive foils are used which do not produce stress cracking of BARLO XT sheets.

Evaporation may cause partial separation of the self-adhesive film; therefore BARLO XT sheets should be pre-dried overnight at a temperature of 70 - 80°C. Impurities such as dust particles can also lead to partial foil removal, which will impair the appearance of the lamination.

Addresses of appropriate adhesive foil suppliers can be obtained from the Technical Service Department upon request.

## 7.5. Machining

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### 7.5.1. General recommendations

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BARLO XT sheets can be worked with most tools used for metals. Both cutting speed and forward feed should be such that the material doesn't melt.

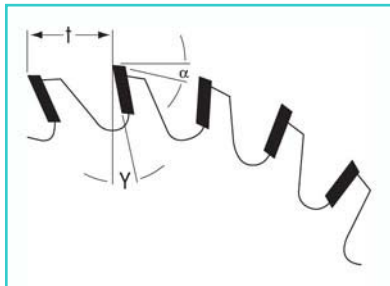
The lowest possible heat development during cutting operations will avoid the need for material lubrication.

Sharp cutting tooling with cutting clearances suitable for BARLO XT are prerequisite.

Moreover, tool cooling, which should exclusively be done by water or acrylic compatible cooling emulsions, may eliminate heat. Cooling reduces local heating of the surface in process and the resultant post-processing strains and stresses.

7.5.2. Sawing

Circular saws, band saws and jig saws can easily be used to work BARLO XT. The use of new and well sharpened tools is recommended. When using circular saws, blades with tungsten carbide-tipped cutting edges have proven effective. At very high cutting speeds and cut-off frequency



respectively, the saw blade should be cooled by compressed air, water spray or using an adequate cooling emulsion. It is very important to employ an efficient saw dust extraction system to remove saw dust and chips generated by the saw blade.

Band saws are frequently used to trim the mouldings. The cut edge remains quite "rough" due to the slightly "crossed" saw teeth.

Jigsaws can cut out recess clearances. The cut edge often turns out to be rough.

Only saw blades should be used which are suitable for acrylic treatment. When working with jigsaws, the shoe of the jigsaw must be tightly pressed to the surface of the sheet and a high cutting speed should be selected. The rotary stroke should be switched off, especially when using thin sheets. The sheets must be adequately fixed to avoid saw chattering or vibrating.

**Table 1**  
Sawing recommendations

Band saw/circular saw machining	Band saw	Circular saw	Jigsaw
Clearance angle $\alpha$	30-40°	15-20°	Commercially available saw blades suitable for acrylic
Rake angle $\gamma$	0-8°	0-5°	
Cutting speed	1000-3000 m/min.	3000 m/min.	
Circular pitch $t$	3-8 mm	10-20 mm	

7.5.3. Drilling

Commercial quality twist drills for metal can be used. The point angle should be adapted to about 60°-90°. Best drilling capacity is achieved with a cutting speed of 25-80 m/min and a feed rate of 0.1-0.2 mm p.r.

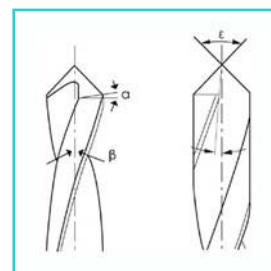
Excessive feed rate will cause brittle fracture of material; low feed rate at high cutting speed will lead to material overheating.

Material thickness beyond 5 mm will require cooling and lubrication with acrylic compatible drilling emulsion or bore oil.

Deep-hole boring requires frequent airing of the drill in order to prevent local overheating.

When drilling thin sheets, it is advisable to fix them on a solid, flat support to avoid brittle breaks of the lower edge of the drilled hole.

Drilling of BARLO XT	
Clearance angle $\alpha$	3 – 8°
Twist angle $\beta$	12 – 16°
Point angle $\epsilon$	60-90°
Rake angle $\gamma$	0 – 4°
Cutting speed (m/min)	25 - 80



#### 7.5.4. Thread cutting

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Internal thread cutting in BARLO XT sheets is feasible with commercially available taps. Tools producing threads with slightly rounded core diameters are particularly suitable. Compared to steel, the core drilling clearance should be about 0.1 mm larger. Thread cutting requires frequent chip discharge with compressed air. Only cooling lubricants compatible with acrylic should be used.

Follow-on screw fitting implies that the metal screws employed are oil film-free or protected against corrosion by means of an oil compatible with acrylic. Compared to cast acrylic' extruded acrylic shows an increased breakage risk by notch effect. Fixings which are frequently removed should be provided with threaded inserts.

#### 7.5.5. Milling

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Universal, profile, spindle moulding and hand milling cutters at cutting speeds up to 4500 m/min can be used for milling BARLO XT sheets.

Small tool diameters require the application of one or two-edged milling cutters. They offer perfect removal of chips, high cutting speed and an excellent milling pattern.

When using one-edged milling cutters, the clamping chuck must be carefully tightened to avoid component marks on the sheet.

Cooling is not always required when milling BARLO XT sheets with one or two-edged end mills, as they produce less heat than multi-edged end mills.

#### 7.5.6. Laser cutting

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BARLO XT sheets are easy to cut with a CO<sub>2</sub>- laser. Brilliant edges of cut can be achieved but this can vary depending on type, thickness and surface treatment. The laser operating efficiency should amount to 300 – 1000W. Inert gas rinsing and extraction of monomer vapours must be ensured.

Preliminary tests are essential in order to determine exact positioning in each case.

Inclined edges of cut, not being square to the sheet surface, will result from increasing material thicknesses. Neodym-YAG lasers permit excellent engraving of coloured BARLO XT sheets.

High thermal load in the cut edge zone generates stresses liable to produce stress cracking when being in contact with corrosive substances (during bonding process for example).

Tempering of components will prevent cracking by stress relief at a temperature of 80°C (see chapter 7.7.3 „Tempering“).

During laser cutting, the cut edges of BARLO XT high-impact grades do not show the same brilliancy as BARLO XT grades; the edges of cut can be somewhat “tacky”.

#### 7.5.7. Water jet cutting

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Similarly to laser cutting, the possible cutting speed depends on both thicknesses of the material to be cut and desired cutting quality.

Unlike laser cutting, the cut edges look “sand-blasted” as a result of water jet cutting. No thermal stresses occur in the material when using water jet cutting technique.

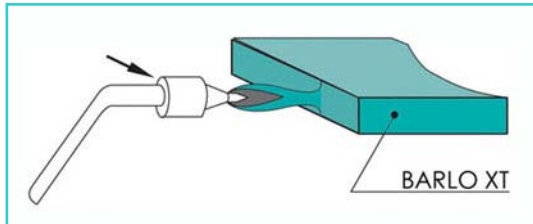
The water used for cutting BARLO XT sheets contains abrasive additives.

Good results are achieved with a cutting speed of 1500 - 2000 mm/min and a material thickness of 4 mm.

A feed rate of 400 - 800 mm/min and a material thickness of 10 mm will produce good results.

## 7.5.8. Polishing

Prior to hand-operated polishing, the sheet must be ground. Hand-operated grinding requires the use of 80-600-grit abrasive paper as well as several grinding work cycles from rough-grind up to finish-grind. Mechanical grinding should be done with belt grinders and a belt speed of 5 - 10 m/s. High surface temperatures can be avoided by lightly pressing on the work piece. Polishing is made with buffing or fleece polishing wheels, polishing felts and adequate polishing wax.



Polish-milling with diamond-tipped tools is another process option. The surface quality is such that no further treatment is required. Polish-milling - in one single work cycle without rough-grinding - will produce excellent finish. No internal stress occurrence; tempering which is essential to other procedures, becomes redundant.

Flame-polishing of BARLO XT does not require additional grinding work cycles. The edges to be polished must be sawdust free and oil free.

Sawing and milling lines may still be visible - even after polishing. Improved surface finish is achieved by treating the sawn edge with an iron scraper prior to flame polishing.

Due to pigments, coloured material often shows matt edges.

Flame polishing is not recommended for sheets with a thickness of more than 10 mm because of local overheating and resultant stresses.

If followed by contact with corrosive substances such as solvents, glues or inappropriate cleaning agents, tempering will be essential.

## 7.6. Jointing

### 7.6.1. Bonding

The joint faces must be cleaned prior to bonding. Use warm water containing some washing-up liquid, if necessary; dry with an absorbent, lint free fabric (e.g. glove material). Highly greasy or oily surfaces can be washed with cleansing petrol.

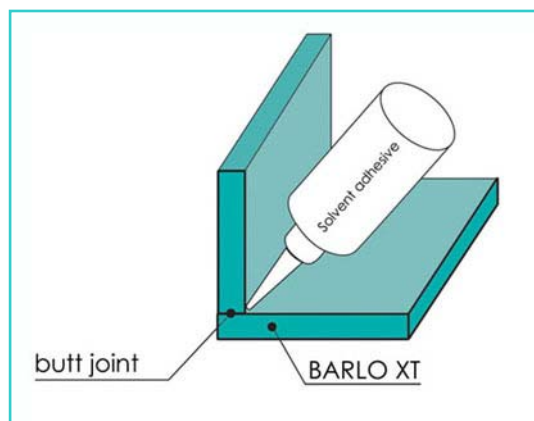
The components to be bonded should be tempered to release stresses prior to bonding in order to avoid potential stress cracking (crazing) due to the reaction with the solvent glue; this applies especially to components having been machined by metal-cutting tools or cut by laser.

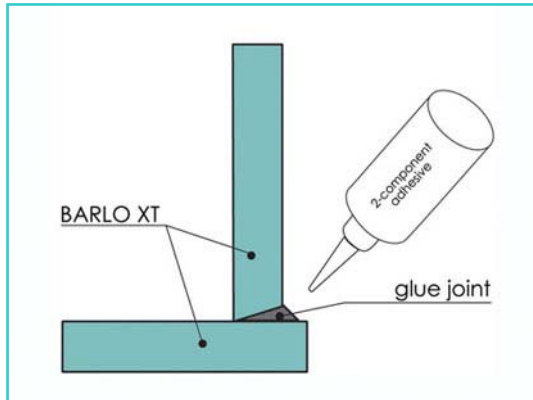
Solvent adhesives are particularly suitable for small and plane bonding surfaces.

As the solid content of such glues is low, they have no joint filling capability. When bonding the sawn edge, smoothing the surface to be bonded using sharp edge scraper can reduce possible bubble formation.

Immersion technique implies that the edge to be glued is dipped into solvent or solvent adhesive, which is poured approx. 1 mm high onto a glass or PE sheet; the parts are afterwards firmly jointed.

Capillary method offers a simple technique for jointing and fixing of the parts. Solvent adhesive/solvent, is applied onto the bonding surface by means of a PE-vial and is soaked into the glued seam due to the capillary effect; a few seconds later, the joint should be firmly pressed together to set the joint.





Polymerisation adhesives are also suitable for large and uneven bonding surfaces. Planar bonding is possible.

The pasted seam must be prepared by chamfering; this does not apply to butt joint bonding. The adjacent sheet area must be masked with an adhesive compatible tape. The adhesive must be mixed as prescribed by the adhesive supplier. Removal of bubbles in vacuum is possible.

The adhesive must be applied bubble-free by means of a PE-vial or a disposable syringe. Excess adhesive must be provided, as the polymerisation adhesive exhibits volume shrinkage during curing.

Silicones are often used to seal glazing. For this purpose, only silicones compatible with acrylic must be employed.

Silicone sealants as found in DIY centres, give off substances during curing which will result in stress cracks of the glued components.

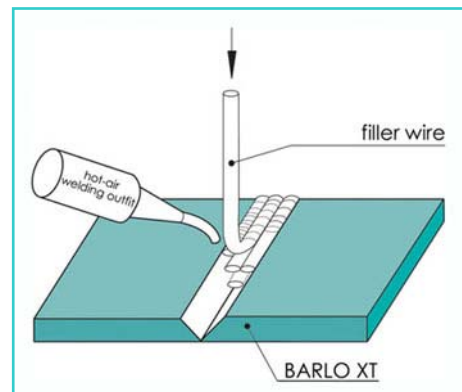
Our technical service department will provide you with information on appropriate products.

### 7.6.2. Welding

Hot-gas welding is the most frequent welding technique used for BARLO XT sheets.

The strong heating of the weld zone and the cooling effect from the adjacent sheet surface areas result in tensile stress formation after cooling which must be relieved by tempering, as they will lead to stress cracking when in contact with solvent and adhesives. Quadratic sheet strips of BARLO XT, round rods or sheet strips of PVC rigid will serve as filler material.

Gas-welding temperature should amount to 280 - 350°C.



**More technical data:**

Welding pressure/3 mm rod:	20 Newton
Welding speed:	150 to 250 mm/min
Distance from nozzle to	
Welded joint:	10 to 20 mm
Air mass:	about 25 l/min

The die diameter should be more or less the same as the filler rod diameter.

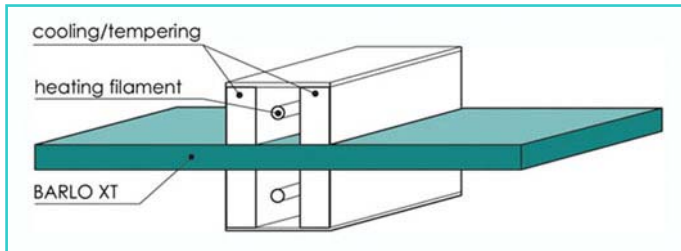
### 7.7. Forming

**NOTE:**

Prior to thermoforming and hot bending of BARLO XT, it is recommended to remove the protective foil. As the foil behaviour depends on material processing conditions such as draw ratio and required temperatures, simple mouldings can be formed without removing the foil. Preliminary tests are essential to determine the foil behaviour in each individual case.

**7.7.1. Hot bending**

Hot bending technique means extended heating of the sheets followed by bending and fixing until the sheets have cooled down.  
Extended heating is carried out by filaments or heating rods.



The heating time depends on the equipment employed and will rise considerably according to increased material thickness.

The bend radius must be twice as big as the material thickness in order to prevent wrinkles and high stresses.

Visual appearance of the inner bend

can be improved by using the biggest possible bend radii and thin sheets.

The heating width should be at least 3 to 5 times larger than the sheet thickness. A heating width of 3 times the sheet thickness is adequate for small bend radii.

Too small heating zones will lead to excessive elongation and straining in the bend area and - as a result - to optical impairment.

Large heating widths will enable production of big bend radii.

Due to the memory effect, the exact angle specifications must be determined by preliminary tests.

**7.7.2. Thermoforming**

Thermoforming technique means that, at increased temperatures, thermoplastic semi-finished products are shaped into three-dimensional plastics mouldings. The sheet material is heated up to the thermo-elastic temperature range and shaped by suitable moulds

Vacuum forming requires a forming temperature of 160 - 190°C. Good results are realized with a mould temperature of 85°C. Venting bores in vacuum moulds should have a diameter of Ø 0.8 mm; too large diameters will cause marks.

Processing shrinkage of BARLO XT will amount to 0.5 - 0.8% depending on the procedures employed.

Lower forming temperatures will suffice to form high-impact BARLO XT grades.

A forming temperature of 140 - 170°C is sufficient when forming BARLO XT 610. The forming temperatures necessary to form high-impact grades XT620 and XT630 are between those required for BARLO XT610 and BARLO XT.

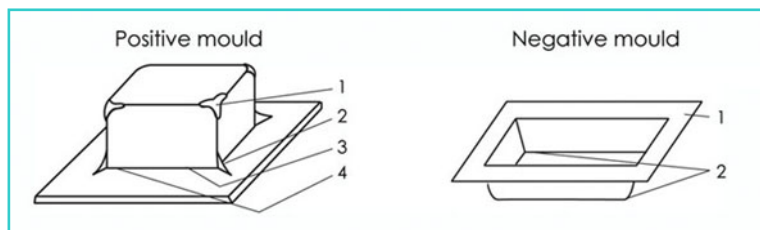
At a temperature beyond 80°C, BARLO XT610/620/630 grades will show a distinct turbidity that will recede during cooling process.

Should bubbles appear when heating BARLO XT, this is due to moisture absorption during storage; in that case, the sheets must be pre-dried before forming.

In general, overnight pre-drying at 80°C will suffice (see chapter 7.3.2. "Drying").

**■ Positive and negative forming**

Dependent on whether the inside or the exterior of the mouldings contact the tool, the techniques are called "positive" or "negative" forming.



Positive forming means that the heated semi-finished product is pulled over the mould. This is also known as "male" forming

In doing so, some surface areas of the heated semi-finished products may excessively cool down, so that complete drawing is not feasible and "thick spots"



will occur.

Some typical problems during positive forming, such as wrinkle or web formation (2) and shock marks, can be solved by adequate pneumatic stretching prior to final "pull down".

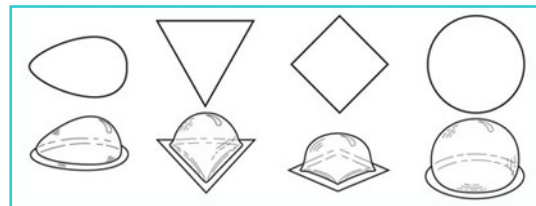
High tool temperatures and high tool speed can also cause shock marks.

Negative forming means that the semi-finished sheet is drawn into the mould cavity. This is sometimes called "female" forming

Thin corner areas (2), which may appear during negative forming of sharp-edged components, can be reduced by mechanical top die stretching.

**■ Procedure variant**

Dome-shaped mouldings can be thermoformed without a mould. This method produces mouldings of good surface quality showing no optical defects. The dome form is determined by the clamping frame's shape and the dome height by the blown air pressure.



**7.7.3. Tempering**

BARLO XT is able to take up rather high tensile stresses, but only if corrosive substances do not simultaneously act upon the materials.

Tensile stresses are induced by machining, laser-cutting, thermoforming, varying heating and external stresses, for instance.

Tensile stresses expand the material structure thus reducing the resistance to environmental conditions. The effect of printing ink solvents, monomer vapours, sealing and foil plasticizers as well as inappropriate cleaning agents may result in crack formation.

Crack formation will be excluded by stress free components. Therefore, generation of tensile stresses and contact with corrosive substances must be avoided.

As accidental contact with corrosives cannot be ruled out, tensile stresses must be avoided. Stress relief tempering of the parts can achieve reduction of internal stresses. External stresses must be excluded by using adequate fastening systems.

Tempering of BARLO XT should take place in heating cabinets with air circulation, at a temperature of 70 - 80°C.

It is recommended to temper without protection film.

<b>Material thickness (mm)</b>	1,5	2	3	4	5	6	8	10	12	15	18	20	25
<b>Tempering duration (h)</b>	2	2	2	2	2	3	3	4	4	5	6	7	8

BARLO XT sheets must be cooled down slowly to avoid repeated induction of the internal stress due to cooling down too fast after annealing. The maximum cooling speed after annealing has to be less than 45 °C per hour.

The maximum oven temperature from which the material may be removed is 60°C.

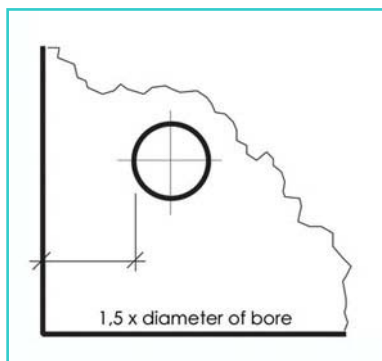
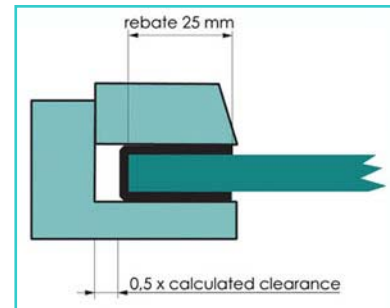
**7.8. Glazing**

BARLO XT expands under heat and moisture absorption and contracts in cold and dry weather. The linear change solely due to the change in temperature can be determined by calculating the coefficient of thermal expansion.

BARLO XT shows a coefficient of thermal expansion of 0.07 mm/m\*°C.

The linear change must be allowed during the sheet's storage time. The maximum expected value of linear deformation depends on the temperature used when mounting the sheets.

An adequate free space of 5 mm/m should be kept with BARLO XT. The rebate should be approx. 20 – 25 mm deep.



To achieve glazing impermeability to rain water, only sealing agents shall be used which are compatible with extruded acrylic sheet. Construction and sealing material must allow the movement of sheet inside the profiles due to dimensional changes of sheet.

Profiled EPDM joints, preferably in white, have proven to be successful in heat loss avoidance. In most cases, profiled joints of non-rigid PVC and PUR foam are incompatible, due to the migration of plasticizers.

The drilled holes must be adequately dimensioned when fixing to specific points, in order to also allow for a sheet length clearance of 5 mm/m.

In that case, sheet length is deemed to be the greatest existing distance between two holes. To avoid material breaking at the sheet edge, a distance of 1.5 times the hole diameter must be left.

**7.8.1. Vertical and horizontal glazing**

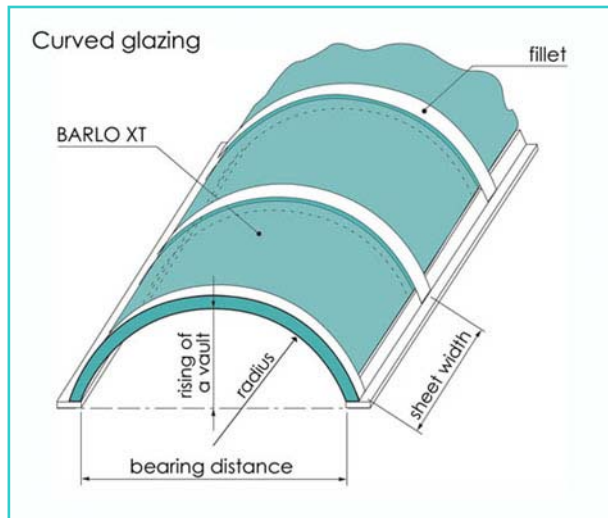
The required material thickness for glazing can be specified according to the following table. Material thicknesses needed for glazing primarily depend on the sheet size.

A surface load of 750 N/m<sup>2</sup> is taken as basis for the recommended material thickness in mm.

		BARLO XT (material thickness)										
		Length (m)										
Width (m)		0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
	0.5	3	4	4	4	4	4	4	4	4	4	4
	1.0	4	6	8	8	8	8	8	8	8	8	8
	1.5	4	8	10	10	12	12	12	12	12	12	12
	2.0	4	8	10	12	15	15	-	-	-	-	-

Information on deviating surface loads or sizes is available from our application technology department upon request

7.8.2. Barrel vaults



BARLO XT is suitable for cold bending technique. This method facilitates the application of thinner material gauges compared to plane roofing, as an increased self-rigidity of the sheet is achieved due to the change in geometry.

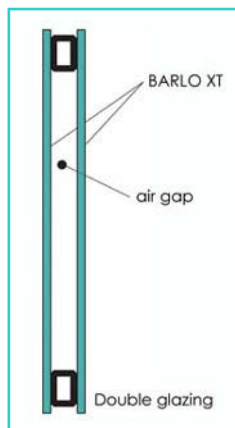
In order to exclude material damage caused by tension stress and environmental influences, the min. bending radius must not be less than 330 x the sheet thickness. As far as fixing and sealing are concerned, only materials not having corrosive (crazing) effect on BARLO XT should be used.

Recommended material thicknesses in mm at a given surface load of 750 N/m<sup>2</sup> can be obtained from the following table.

Information on recommended material thicknesses in case of various surface loads is available from our Technical Service Department upon request.

BARLO XT					
Radius r (mm)	Fixing span (mm)				
	500	750	1000	1250	1500
1000	3	3	3	3	
1500	3	3	4	4	4
2000	3	4	4	5	5
2500	4	4	5	5	6
3000	4	5	5	6	6
3500	4	5	6	6	8
4000	5	5	6	8	8
4500	5	6	8	8	8
5000	5	6	8	8	8

7.8.3. Thermal insulation



BARLO XT sheets when used for glazing represent considerable energy cost savings as they prevent excessive heat loss in winter and heat intrusion in summer. The heat loss factor of BARLO XT normally referred to as K-value is significantly lower than for glass of the same thickness. The K-value is the parameter which identifies the heat loss of a building with glazed walls.

**Definition:** The K-value (U-value) identifies the heat loss in watt per m<sup>2</sup> wall surface and per °C difference in ambient temperature of premises separated by the sheet.

The K-value depends on the glazing assembly. Examples of the thermal insulation power of BARLO XT in single, double and triple glazing systems are indicated below. Compared to glass, they show significant advantages as to insulating effect and weight reduction.

Installation		BARLO XT			Window glass	
Sheet thickness (mm)	Air gap (mm)	Composite strength (mm)	K-value (W/m <sup>2</sup> *K)	Weight (kg/m <sup>2</sup> )	K-value (W/m <sup>2</sup> *K)	Weight (kg/m <sup>2</sup> )
<b>Single glazing</b>						
2	-	2	5,54	2,38	5,83	4,96
3	-	3	5,39	3,57	5,80	7,44
4	-	4	5,24	4,76	5,77	9,92
5	-	5	5,10	5,95	5,74	12,40
6	-	6	4,96	7,14	5,71	14,88
8	-	8	4,72	9,52	5,66	19,84
10	-	10	4,49	11,90	5,60	24,80
<b>Double glazing</b>						
2	5	9	3,34		3,55	
2	10	14	2,94	4,76	3,10	9,92
2	15	19	2,77		2,91	
3	5	11	3,23		3,53	
3	10	16	2,85	7,14	3,09	14,88
3	15	21	2,69		2,90	
4	5	13	3,12		3,50	
4	10	18	2,77	9,52	3,07	19,84
4	15	23	2,62		2,88	
5	5	15	3,02		3,48	
5	10	20	2,69	11,90	3,05	24,80
5	15	25	2,55		2,87	
<b>Triple glazing</b>						
2	2 x 5	16	2,39		2,55	
2	2 x 10	26	2,00	7,14	2,11	14,88
2	2 x 15	36	1,84		1,94	
3	2 x 5	19	2,30		2,53	
3	2 x 10	29	1,94	10,71	2,10	22,32
3	2 x 15	39	1,79		1,93	
4	2 x 5	22	2,22		2,52	
4	2 x 10	32	1,88	14,28	2,09	29,76
4	2 x 15	42	1,74		1,92	
5	2 x 5	25	2,15		2,50	
5	2 x 10	35	1,83	17,85	2,08	37,20
5	2 x 15	45	1,70		1,91	

Information on further specific glazing systems can be obtained from our Technical Service Department upon request.

### 7.9. Concluding remarks

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For more details on further processing methods, please contact our technical customer service.

**NOTE:**

Our technical recommendations are without legal obligation.

The information given in this brochure is based on our knowledge and experience to date. It does not release the user from the obligation of carrying out their own tests and trials, in view of the many factors that may affect processing and application; neither do they imply any legally binding assurance of certain properties or of suitability for a specific purpose.

It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislation are observed.

Technical data of our products are typical ones; the actually measured values are subject to production variations.

## **8. BARLO XT soft tone datasheet**

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### **8.1. Product identification**

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BARLO XT is the brand name for extruded Polymethyl methacrylate sheets from Quinn Plastics. BARLO XT soft tone is a standard BARLO XT grade with double-sided mat finish the finish glazing being achieved by a special type of co-extruded lamination applied on both sides of the sheets. Owing to its outstanding properties, BARLO XT soft tone offers a wide range of creative possibilities for both building and industrial glazing, decoration, lighting and advertising...

### **8.2. Characteristics**

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Compared to BARLO XT, BARLO XT soft tone is perfectly appropriate for display applications, its mat finish characteristics being particularly suitable to increase the light scatter. As reflective effects must be avoided with display and advertising sign applications, both covered or glass printed pictures consequently show to their best advantage. The mechanical properties still cope with the well-known quality of BARLO XT grades.

### **8.3. Applications**

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- Decorative housing equipment
- Interior decoration
- Information signs
- Displays
- Showcases
- Shop fittings
- Advertising signs
- Company-applicable advertising materials

### **8.4. Fabrication and finishing techniques**

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BARLO XT soft tone sheets are easy to handle and can be machined by sawing, drilling, milling, mechanical polishing, thermoforming, hot bending and bonding process. More detailed information on these items can be found in the "USER GUIDE", available on request.

#### **Some recommendations:**

##### **■ Bonding:**

Bonding techniques to be applied to BARLO XT soft tone sheets are the same as used for BARLO XT standard grades. That implies the application of bonding agents of the same kind. Compared to BARLO XT, care must be taken that the partial dissolving time of solvents and solvent adhesives should be slightly longer. The bonding agent shall not contact the mat finish; the mat glazing will disappear / decrease otherwise.

##### **■ Polishing:**

Edge polishing of BARLO XT soft tone can be done by mechanical polishing and polish-milling procedures, these methods will produce excellent results. Flame polishing is not recommended, because the high temperature of the flame may decrease the soft tone effect in the area close to the polished edge of the sheet.

##### **■ Printing:**

BARLO XT soft tone is as easy to print as BARLO XT standard grades; no special pre-treatment is required to achieve outstanding print results.

**Thermoforming:**

BARLO XT soft tone can be thermoformed in the same way as standard products without adverse effect on the mat finish. Recommended forming temperatures shall be 160-180°C depending on the moulded part and procedures applied.

The mat glazing is preserved after thermoforming; only extreme drawing conditions are susceptible to slightly affect the mat finish.

**8.5. Technical information**

BARLO XT soft tone shows the same mechanical properties as BARLO XT standard grades. Varying optical properties, however, are due to its mat finish and are shown in the table below.

<b>GENERAL</b>			
<b>Property</b>	<b>Method</b>	<b>Unit</b>	<b>BARLO XT soft tone</b>
Density	ISO 1183	g/cm <sup>3</sup>	1,19
Forming temperature – air pressure	-	°C	140-160
Forming temperature – vacuum	160-190		
Moulding shrinkage	-	%	0.5-0.8
<b>MECHANICAL</b>			
<b>Property</b>	<b>Method</b>	<b>Unit</b>	<b>BARLO XT soft tone</b>
Tensile strength	ISO 527	MPa	70
Elongation	ISO 527	%	4
Modulus of elasticity in extension	ISO 527	MPa	3200
Flexural strength	ISO 178	MPa	115
Impact strength Charpy unnotched	ISO 179	KJ/m <sup>2</sup>	17
Impact strength Charpy notched	ISO 179	KJ/m <sup>2</sup>	2
<b>THERMAL</b>			
<b>Property</b>	<b>Method</b>	<b>Unit</b>	<b>BARLO XT soft tone</b>
Vicat temperature (B 50)	ISO 306	°C	104
Specific heat capacity	IEC 1006	J/gK	1.47
Linear thermal expansion	DIN 53752	K <sup>-1</sup> x10 <sup>-5</sup>	7
Thermal conductivity	DIN 52612	W/mK	0.19
Service temperature- continuous use	-	°C	70
Max. temperature short term use	-	°C	90
<b>OPTICAL</b>			
<b>Property</b>	<b>Method</b>	<b>Unit</b>	<b>BARLO XT soft tone</b>
Light transmission	DIN 5036-3	%	88
Gloss value	DIN 67530	-	< 35

The gloss value of BARLO XT standard grades is >100.

The higher the determined non-dimensional value, the stronger the surface brilliance of the examined work piece.

## 9. BARLO XT & High Impact datasheet

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### 9.1. Product identification

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BARLO XT is the brand name for extruded Polymethyl methacrylate sheets from Quinn Plastics, standard or high impact.

The BARLO XT and High Impact programme offers solutions to both indoor and outdoor applications. As a result of the extrusion process, Quinn Plastics can offer a variety of colours and designs.

### 9.2. Characteristics

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- Good optical properties
- Brilliant surface
- Easy to fabricate, to vacuum form
- Show an exceptional high light transmission
- Good scratch resistance for the standard grade
- High surface hardness for the standard grade
- Good recyclability
- XT and XT High Impact meet all current European food contact legislation and can be used in contact with foodstuffs
- Excellent transparency

### 9.3. Applications

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#### ■ Constructional components

- Light domes
- Partition walls
- Door glazing
- Roofing
- Roof hoods for caravans

#### ■ Advertising and decoration materials

- Letters
- Decorations
- Displays
- Advertising fittings
- Advertising panels

#### ■ Lighting

- Covers for lighting
- Coffered lighting
- Kitchen lighting
- Illuminated plates

#### ■ Other applications

- Containers
- Lettering templates
- Sign equipment etc.
- Solariums UVT (UV-translucent grade)

#### ■ Engineering components

- Housing
- Machine covers

### 9.4. Fabrication and finishing techniques

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BARLO XT and BARLO XT High Impact sheets are easy to handle.

They can be machined using all the usual methods, such as sawing, milling, drilling, turning, grinding and polishing, and are most suitable for thermoforming.

More detailed information on these items can be found in the "USER GUIDE", available on request.



9.5. Technical information

<b>■ GENERAL</b>						
Property	Method	Units	BARLO XT	BARLO XT 630	BARLO XT 620	BARLO XT 610
Density	ISO 1183	g/cm <sup>3</sup>	1.19	1.17	1.16	1.15
Water absorption 24h/23°C – 50x50x4mm <sup>3</sup>	DIN 53495 Method 1	%	0.2	0.25	0.3	0.3
Ball indentation hardness	ISO 2039-1	MPa	235	155	135	100
Forming temperature air pressure		°C	140-160	130-150	130-150	130-150
Forming temperature vacuum		°C	160-190	140-170	140-170	140-170
Moulding shrinkage		%	0.5-0.8	0.6-0.9	0.6-0.9	0.6-0.9
<b>■ MECHANICAL</b>						
Property	Method	Units	BARLO XT	BARLO XT 630	BARLO XT 620	BARLO XT 610
Tensile strength	ISO 527-2	MPa	70	55	50	40
Elongation at break	ISO 527-2	%	4	15	25	35
Tensile modulus	ISO 527-2	MPa	3200	2400	2100	1800
Flexural strength	ISO 178	MPa	115	90	85	65
Flexural modulus	ISO 178	MPa	3300	2400	2100	1800
Impact strength Charpy unnotched	ISO 179-1	kJ/m <sup>2</sup>	17	25	35	60
Impact strength Charpy notched	ISO 179-1	kJ/m <sup>2</sup>	2	3	4	5
<b>■ THERMAL</b>						
Property	Method	Units	BARLO XT	BARLO XT 630	BARLO XT 620	BARLO XT 610
Vicat temperature (B 50)*	ISO 306	°C	105	104	102	98
Specific heat capacity	IEC 1006	J/gK	1.47	1.5	1.5	1.5
Linear thermal expansion	DIN 53752	K <sup>-1</sup> *x10 <sup>-5</sup>	7	9	10	11
Thermal conductivity	DIN 52612	W/mK	0.18	0.18	0.18	0.18
Service temperature continuous use		°C	70	65	65	65
Max. temperature short term use		°C	90	85	80	75
Degradation temperature		°C	>280	>280	>280	>280
<b>■ OPTICAL</b>						
Property	Method	Units	BARLO XT	BARLO XT 630	BARLO XT 620	BARLO XT 610
Light transmission (3 mm)	DIN 5036-3	%	92	91	91	90
Refractive index	ISO 489	n <sub>D20</sub>	1.492	1.492	1.492	1.492
<b>■ ELECTRICAL</b>						
Property	Method	Units	BARLO XT	BARLO XT 630	BARLO XT 620	BARLO XT 610
Surface resistivity	IEC 60093	Ω	3x10 <sup>15</sup> - 3x10 <sup>16</sup>	-	-	-
Volume resistivity	IEC 60093	Ω x m	1x10 <sup>13</sup> - 5x10 <sup>13</sup>	-	-	-
Electrical strength	IEC 60243-1	kV/mm	10	-	-	-
Dielectrical dissipation factor 50 Hz	DIN 53483-2		0.06	-	-	-
Dielectrical dissipation factor 1 KHz	DIN 53483-2		0.04	-	-	-
Dielectrical dissipation factor 1 MHz	DIN 53483-2		0.02	0.03	0.03	0.03
Relative permittivity 50 Hz	DIN 53483-2		2.7	-	-	-
Relative permittivity 1 KHz	DIN 53483-2		3.1	-	-	-
Relative permittivity 1MHz	DIN 53483-2		2.7	2.9	2.9	2.9

\* pre-treatment 16 h at 80 °C

**■ Resistance to chemicals**

BARLO XT and High Impact sheets are – at room temperature – resistant to saturated hydrocarbons, aromatic free carburettor fuel and mineral oils, vegetable and animal fats and oils, water, aqueous salt solutions as well as diluted acids and alkalis. Aromatic hydrocarbons and hydrogen chlorides, ester, ether and ketones attack BARLO XT and XT High Impact.