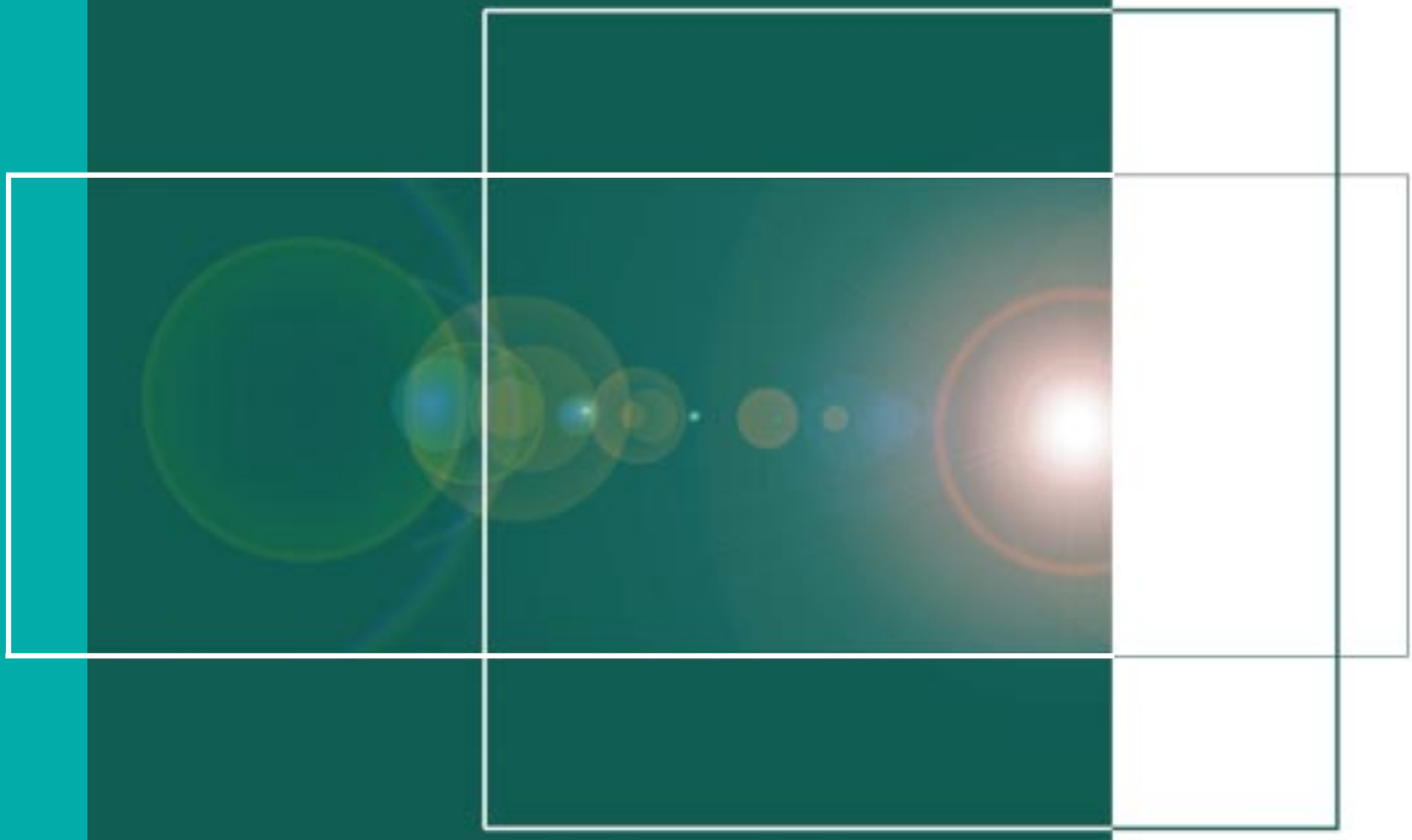
BARLO® XT

Technical Product Information



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1. PRODUCT IDENTIFICATION

BARLO XT is the brand name for extruded Polymethyl methacrylate sheets from Barlo Plastics. The BARLO XT programme offers solutions to both indoor and outdoor applications.

As a result of the extrusion process, Barlo Plastics can offer, apart from the clear and 5 standard opal white versions, a variety of colours and designs.

2. CHARACTERISTICS

BARLO XT sheets have good optical properties and a brilliant surface.
The BARLO XT range contains sheets that are easy to fabricate, to vacuum form, and show an exceptional high light transmission (92 % wavelengths: 380-780 nm, thickness 3mm).

Good scratch resistance and excellent colour stability.

Important benefits of BARLO XT sheets are good scratch resistant and have excellent colour stability. BARLO XT sheets are UV-stabilised and remain colour constant for years.

BARLO XT sheets meet all current European food contact legislation and can be used in contact with foodstuffs. Our high impact grade BARLO XT610 is not intended for food contact and is therefore not covered by this warranty.

BARLO XT sheets also combine the following excellent properties:
- Excellent transparency
- Very good weathering and ageing resistance
- High surface hardness
- Scratch resistance
- Good recyclability

3. APPLICATIONS

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

Lighting
- Covers for lighting
- Coffered lighting
- Kitchen lighting
- Illumited plates

Engineering components
- Housing
- Machine covers

Advertising and decoration materials
- Letters
- Decorations
- Displays
- Advertising fittings
- Advertising panels

Other applications
- Containers
- Lettering templates
- Sign equipment etc.
- Solariums UVT (UV-transmitted grade)

4. FABRICATION AND FINISHING TECHNIQUES

BARLO XT 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", further in this brochure.

5. STATEMENTS

5.1. FOOD APPROVAL STATEMENT

BARLO XT sheets can be used in contact with foodstuffs.
Therefore, in applications where covers for foodstuffs or fittings for shops etc. are needed, BARLO XT sheets can offer a perfect solution.

BARLO XT clear sheets are extruded Polymethyl methacrylate sheets, which are produced from raw materials which meet the compositional requirements of the EEC directives 89/109/EEC and 90/128/EEC.

89/109/EEC lays down requirements for all materials intended for food contact applications, not only plastics. 90/128/EEC relates to plastic materials and articles intended to come into contact with foodstuffs. There is currently no EEC legislation for additives and aids to polymerisation and hence the national standards are still applicable. As a result of this, the raw materials used to produce BARLO XT clear sheets are not compliant with the national regulations in Germany and the Netherlands, but meet the requirements in all other main West European countries.

The "monomers and other Source Materials" used for the manufacture of BARLO XT, are specified without particular limitations in the German Official Regulation on Commodity Objects, dated 10th April 1992 (Bundesgesetzblatt 1992, part 1, page 866, supplement 3,sub-sections A+B).
As to the substances used furthermore for the manufacture of BARLO XT, they are specified (in the order of quantities employed by us), in the recommendation XXII, entitled "Polyacrylates and Polymethacrylates, their copolymers and mixtures of these polymers", issued by the German Government Health Department, dated 15th April 1991, (Bundesgesundheitsblatt 34/1991, page 296, notice no. 187).

These statements do not apply to BARLO XT610 and BARLO XT UVP.

The above information does not relate to finished articles made from BARLO XT clear sheets.
It is the responsibility of the manufacturer of the final article to ensure that the required migrational requirements are met.

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5.2. STATEMENT ON 10-YEAR GUARANTEE

As stated before, all BARLO XT sheets and grades are suitable for outdoor use.

1. BARLO XT sheets are made of a high quality raw material, Polymethyl methacrylate (PMMA).
   Barlo Plastics provides a 10 year warranty for flat transparent BARLO XT sheets for minimum light transmission and mechanical properties as described below. The warranty shall come into force the day the BARLO XT sheets are delivered to the customer.

2. This warranty applies exclusively to standard BARLO XT sheets used correctly as flat sheets which are installed, handled, machined, fabricated and maintained according to Barlo Plastics' recommendations and instructions. The purchaser is presumed to be informed of said recommendations and instructions. If this is not the case he can obtain said documents through the sales representative or authorised distributor.

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

4. In the event of a claim against this warranty, the sheet and the original sales receipt must be returned to Barlo Plastics via the sales representative or original authorised distributor.

5. The extent of change in light transmission will be measured according to test method DIN 5036. Multiple samples will be taken from the sheet and cut into sizes suitable for testing, the samples will be cleaned prior to testing and, if necessary, polished. BARLO XT sheets showing a change in light transmission which is less than 4 % of the original value, as defined by Barlo Plastics on the date of manufacturing, will not be subject to any claim. This part of the warranty applies to flat sheets, not to patterned and coloured sheets.

6. The mechanical properties are defined by the flexural modulus (DIN 53452) and the tensile strength (DIN 53455). Multiple samples will be taken and a sheet showing a change of less than 10 % in the flexural modulus and the tensile strength compared to its original value, as defined by Barlo Plastics on the date of manufacturing, will not be subject to any claim.

7. In the event of a claim against this warranty proving justified, Barlo Plastics will provide a replacement for the material at issue without any other liability for any other additional indemnification whatsoever.

   Up to 5 years time from the purchase date, Barlo Plastics will replace 100 % material.
   Between 5-7 years time from the purchase date, Barlo Plastics will replace 60 % material.
   Between 8-10 years time from the purchase date, Barlo Plastics will replace 30 %material.

   If replacement material cannot be provided within a reasonable period of time, Barlo Plastics may choose to refund the original cost of the material without any other liability for any additional indemnification whatsoever. This warranty does for instance, not cover (re)installation expenses or any other incidental costs which may result from a breakage.

8. There are no express or implied, written or oral warranties and or representations by Barlo Plastics including warranties and representations of merchantability or fitness of purpose, except as set forth herein.

5.3. SAFETY DATA STATEMENT

This statement indicates all safety rules, to be taken into account when applying BARLO XT sheets.

A safety data sheet is available on request.

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5.4. STATEMENT ON THERMAL INSULATION

BARLO XT sheets used in glazing applications result in considerable energy cost savings by preventing excessive heat loss in winter and blocking heat entry in the summer. The heat loss factor, normally referred to as the K-value, of BARLO XT is significantly lower than for glass at the same thickness. Some examples of the heat insulation performance of BARLO XT in single and double glazing systems are given below and compared with glass.

Advantages of BARLO XT to glass

1. At the same thickness: *** Improvement of the K-value**
*** Weight saving**

Single glazing:

* Improvement K-value:

glass 5 mm:	K-value = 5.74 W/m²°C
BARLO XT 5 mm:	K-value = 5.06 W/m²°C
Δ = 0.68 W/m²°C = 11.8%	

* Weight saving:

glass 5 mm:	12.5 kg/m²
BARLO XT 5 mm:	5.95 kg/m²
Δ = 6.55 kg = 52.4%	

Double glazing:

* Improvement K-value:

2 x glass 4 mm with airgap 5 mm:	K-value = 3.57 W/m²°C
2 x BARLO XT 4 mm with airgap 5 mm:	K-value = 3.18 W/m²°C
Δ = 0.39 W/m²°C = 10.9%	

* Weight saving:

2 x glass 4 mm:	20 kg/m²
2 x BARLO XT 4 mm:	9.52 kg/m²
Δ = 10.48 kg/m² = 52.4%	

2. At the same K-value: *** Weight saving**
*** Volume saving**

Single glazing:

glass 10 mm:	K-value = 5.60 W/m²°C
BARLO XT 2 mm:	K-value = 5.52 W/m²°C

* Weight saving:

glass 10 mm:	25.0 kg/m²
BARLO XT 2 mm:	2.38 kg/m²
Δ = 22.62 kg/m² = 90.5%	

* Volume saving:

Δ = 8 mm

Double glazing:

2 x glass 5 mm with 15 mm air:	K-value = 3.05 W/m²°C
2 x BARLO XT 3 mm with 10 mm air:	K-value = 3.01 W/m²°C

* Weight saving:

glass 2 x 5 mm:	25.0 kg/m²
BARLO XT 2 x 3 mm:	7.14 kg/m²
Δ = 17.86 kg/m² = 71.4%	

* Volume saving:

glass 2 x 5 + 15:	25 mm
BARLO XT 2 x 3 + 10:	16 mm
Δ = 9 mm	

K-values for customer specific glazing systems can be provided upon request.
For more information contact one of the sales offices of Barlo Plastics.

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6. TECHNICAL INFORMATION

6.1. TECHNICAL DATA SHEET

BARLO XT AND BARLO XT610

Property	Method	Units	BARLO XT	BARLO XT610
GENERAL				
Density	ISO 1183	g/cm^3	1,19	1,15
Rockwell Hardness	D-785	M - scale	-	-
OPTICAL				
Light Transmission	DIN 5036 T3	%	92	90
Refractive Index	ISO 489	n_D^{20}	1.492	1.492
MECHANICAL				
Flexural Modulus		MPa	-	1700
Flexural Strength	ISO 178	MPa	120	65
Tensile Modulus	ISO 527	MPa	3200	1850
Tensile Strength	ISO 527	MPa	70	40
Elongation	ISO 527	%	4	35
THERMAL				
Vicat Temp. (VST/B 50)	ISO 306	°C	>100	98
Heat Deflection Temp. (A)	ISO R 75	°C	97/101	90
Specific Heat Capacity	-	J/gK	1.47	1.5
Coefficient of linear thermal expansion	DIN 53328	$K^{-1}x10^{-5}$	7	12
Thermal conductivity	DIN 52612	W/mK	0,19	0.18
Degradation temperature		°C	>280	>280
Max. service temperature continuous use		°C	70	65
Max service temperature short term use		°C	85	90
Sheet forming temp. range		°C	130-170	140-160
IMPACT STRENGTHS				
Izod (notched)	ISO 180	kJ/m^2	-	55
Charpy (notched)	ISO 179	kJ/m^2	2	5.2
Charpy (unnotched)	ISO 179	kJ/m^2	11	70
ELECTRICAL				
Dielectric constant 50 HZ	DIN 53483		3.7	-
Volume Resistivity	DIN 53482	Ω.cm	10^{15}	10^{14}
Surface Resistivity	DIN 53482	Ω	10^{14}	10^{14}
Dielectric strength	DIN 53481	kV/mm	30	15
Dissipation Factor (50 HZ)	DIN 53483		0,06	-

RESISTENCE TO CHEMICALS

BARLO XT 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.

BARLO XT AND BARLO XT610

CHEMICAL RESISTANCE AT 20°C	
Acetone	-
Acids (weak soln)	+
Alcohols	
Ethyl	+
Isopropyl	+
Methyl	+
Ammonia (weak soln)	+
Benzene	-
Carbon tetrachloride	-
Chloroform	-
Ethyl Acetate	-
Glycols	+
Glycerine	+
Hexane	+
Methylenechloride	-
Methylethylketone	-
Mineral Oil	+
Paraffin	+
Toluene	-
Sodium Chloride (aq)	+
Sodium Hydroxide (aq)	+

- = Attacked

+ = Not attacked

6.2. PRODUCT RANGE BARLO XT

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

A. Thickness Range
From 1.5 mm up to 20 mm
Standard thicknesses for clear sheets are: 1.5-2-3-4-5-6-7-8-9-10-12-15-18-20 mm

B. Widths cut-on-line

Max 2000 mm	for 1.5 mm
Max 2020 mm	for 2.0 mm
Max 2050 mm	from 2.5 mm up to 20 mm

C. Length cut-on-line

Min	1000 mm
Standard length	3050 mm Over-lengths on request

D. Thickness tolerances

1.5 mm	- 0.1 / + 0.2 mm
2.0 mm and 2.5 mm	± 10 %
3.0 up to 20 mm	± 5 %

E. Cut-on-line tolerances

More than 1000 mm	- 0 + 3‰ (3 mm per 1000 mm)
Less than 1000 mm	± 1.5 mm

F. Cut-to-size tolerances
± 1.00 mm

G. Minimum production runs for

Special thickness	5.000 kg
Special pattern	5.000 kg
Special colour	10.000 kg

Other thicknesses, sizes and tolerances on request.
For the standard stock programme see our product overview brochure.
NEW in our standard program: silicat green (glass look).

6.3. USER GUIDE

BARLO XT

6.3.1. INTRODUCTION

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.

6.3.2. FABRICATING

6.3.2.1. MACHINING GUIDELINES

BARLO XT sheet can be worked with most tools used for machining wood or metal. Tool speed should be such that the sheet does not melt from frictional heat. In general, the highest speed at which overheating of the tool or plastic does not occur will give the best results.
It is important to keep cutting tools sharp at all times. Hard, wear-resistant tools with greater cutting clearances than those used for cutting metal are suggested. High-speed or carbon-tipped tools are efficient for long runs and provide accuracy and uniformity of finish.
Since plastics are poor heat conductors, the heat generated by machining operations must be absorbed by the tool or carried away by coolant. A jet of air directed on the cutting edge aids in cooling the tool and in removing chips.
Plain water or soapy water is sometimes used for cooling unless the trim scrap is to be reused.

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6.3.2.2. MILLING

Sheet manufactured from BARLO XT can be machined with standard high-speed milling cutters for metal, provided they have sharp edges and adequate clearance at the heel.

6.3.2.3. DRILLING

Drills designed especially for plastics are available, and their use is suggested. Standard twist drills for wood or metal can be used; however they require slower speeds and feed rates to produce a clean hole. Twist drills for plastics should have 2 flutes, a point with an included angle of 60° to 90°, and a lip clearance of 12° to 18°, as shown in figure 1.
Wide, highly polished flutes are desirable since they expel the chips with low friction and thus tend to avoid overheating and consequent gumming. Drills should be backed out often to free chips, especially when drilling deep holes. Peripheral speeds of twist drills for plastics ordinarily range from 30 to 61 m per minute. The rate of drill feed into the plastic sheet generally varies from 0.25 to 0.63 mm per revolution.

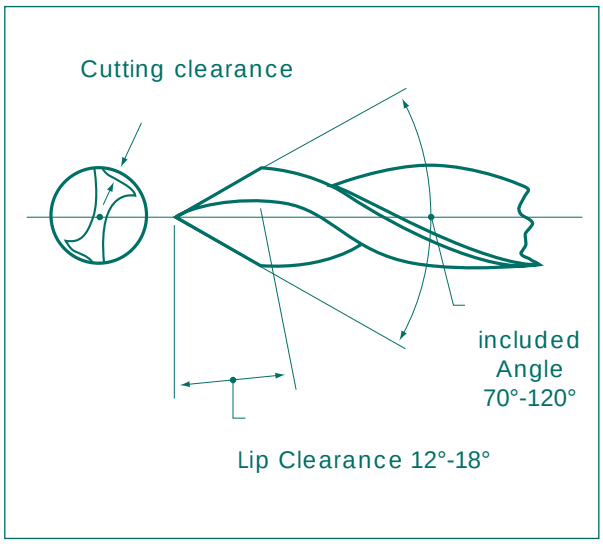


Figure 1
Suggested Drill-point Design for Drilling Plastic sheet

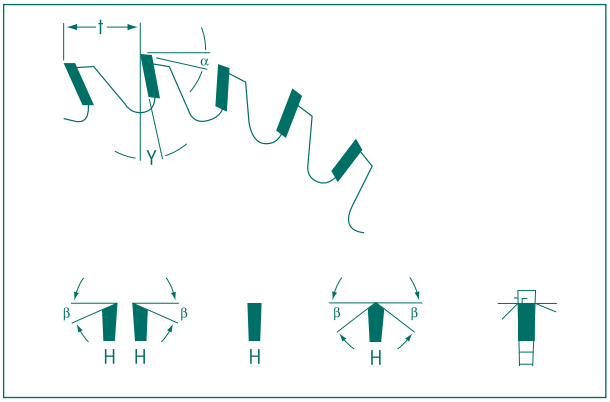
NOTE:
When drilling, be sure to hold or clamp the part securely to prevent it from cracking or slipping and presenting a safety hazard to the operator.

6.3.2.4. TAPPING

Conventional 4-flute taps can be used for cutting internal threads in plastic sheet when a close fit is required. Such taps, however, have a tendency to generate considerable heat during the tapping operation. A high-speed, 2-flute tap should offer longer life and greater tapping speed than a conventional tap, as well as provide clearance for chip discharge. Flutes should be ground so that both edges cut simultaneously; otherwise the thread will not be uniform. Cutting edges should be 85° from the centreline, giving a negative rake of 5° on the front face of the lands so that the tap will not bind in the hole when it is backed out. It is desirable to have some relief on the sides of threads.

6.3.2.5. SAWING

Figure 2 Example of Sawblades



Alternate tooth | Flat tooth | Broaching tooth | Laterally chamfered alternate tooth

Following types of sawing operations can be used to saw thermoplastic materials: band saw, circular saw and jig saw as well as hand operated saws.
It is recommended that new or well sharpened tools are used. At very high cutting speeds the saw blade should be cooled a jet of air, water or an alternative appropriate cooling emulsion.

Table 1 Sawing Recommendations

Type of sawing	Band saw	Circular saw
Clearance angle α	30 to 40°	15°-20°
Rake angle Y	0°-8°	0°-5°
Cutting speed	1000-3000 m/min	2500 - 4000 m/min
Circular pitch t	3-8 mm	10-20 mm

6.3.2.6. LASER CUTTING

BARLO XT sheet can be cut by laser beam. A laser may be used to make intricate holes and complex patterns, or it can be controlled to merely etch the plastic. Holes and cuts produced by a laser have a slight taper, the cuts are clean and precise, with finished appearance. Tolerances can be controlled more closely with a laser than with conventional machining operations. Laser power and travel speed must be optimised to minimise 'whitening' of the BARLO XT sheet while cutting.

6.3.2.7. ROUTING

Routers with sharp two-flute straight cutters produce very smooth edges. They are useful for trimming the edges of flat or formed parts, particularly when the part is too large or irregular in shape for a band saw. Portable, overarm, and under-the-table routers work equally well. The plastic sheet should be fed to the router slowly to avoid excessive frictional heating and shattering. The router or plastic sheet, whichever is moving, must be guided with a suitable jig. Compressed air can be used during the routing operation to cool the bit and aid in chip removal.

6.3.3. FORMING

6.3.3.1. HOT BENDING

BARLO XT sheet can be bent on a small radius by preheating an area on both sides with an electric strip heater and then quickly bending the sheet along the heated line. Thicker gauges [above 3mm] may need to be turned periodically during the heating cycle. The side of the sheet that is to form the inside angle should be heated first and the outer side last. When the optimum sheet temperature is reached [slightly over 105°C] and a slight resistance to bending is noticeable, the part can be readily formed. If bending is performed too cold, stresses will be created that will result in a brittle part; however, overheating can cause bubbles in the bend area. Before heating, the protection film must be removed from at least the two sides of the zone to be heated. The smallest radius should be twice the sheet thickness. Strip heaters are available from C P Clarke, Ammanford, South Wales and from Shannon B.V., Voorschoten (The Netherlands).

6.3.3.2. THERMOFORMING

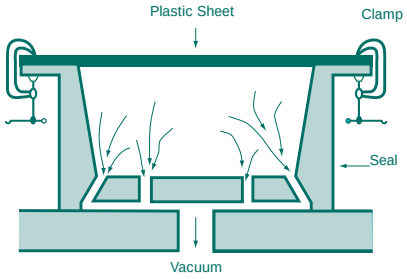
There are a number of different thermoforming techniques that can be used to form BARLO XT sheet, once heated, into the shape of a mould by mechanical, air pressure, or vacuum forces. Both male (plug) and female (cavity) moulds are used. Tooling can range from low cost plaster moulds to expensive water cooled steel moulds, but cast aluminium is more commonly used. Other materials including wood, gypsum, and epoxy can also be used. Forming processes to be discussed include straight vacuum, drape, matched mould, pressure-bubble plug-assist, plug-assist pressure, vacuum snap-back, pressure-bubble vacuum snap-back, trapped-sheet contact-pressure, free, and mechanical. In the event that during the heating up of BARLO XT small bubbles appear, this is due to the fact that the sheets have absorbed moisture during storage. In this case, the sheets must be predried before they are worked on. In general, this is achievable if the sheets are dried overnight at 70° - 80°C. The average forming temperature varies (according to the heating equipment, the type of material, the degree of forming and the material thickness) between 140° and 190°C, the mean value of the forming temperature is about 160°C. The mould temperature should be 60° - 70°C. After thermoforming, the cooling procedure must be slow and uniform. Generally, the protection film is removed prior to heating. Items produced by thermoforming include light fixtures, instrument panel components, tote trays, housewares, toys, and a variety of different transparent enclosures.

6.3.3.3. STRAIGHT VACUUM FORMING

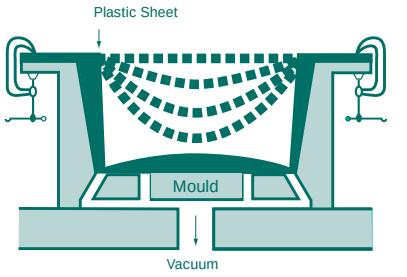
Vacuum forming is the most versatile and widely used forming process. The equipment costs less and is simpler to operate than most pressure or mechanical techniques. In straight vacuum forming, BARLO XT is clamped in a frame and heated. When the hot sheet is in an elastic state, it is placed over the female mould cavity. The air is then removed from the cavity by vacuum, and atmospheric pressure then forces the hot sheet against the contours of the mould. When the BARLO XT sheet has cooled sufficiently, the formed part can be removed. Thinning at the upper edges of the part usually occurs with relatively deep moulds. Thinning is caused by the hot sheet being drawn to the centre of the mould first. Sheeting at the edges of the mould must stretch the most and thus becomes the thinnest portion of the formed item. Straight vacuum forming is normally limited to simple, shallow designs.
See figure 3

6.3.3.4. DRAPE FORMING

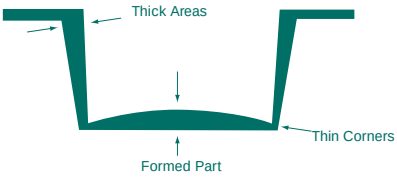
Drape forming is similar to straight vacuum forming except that after the BARLO XT sheet is framed and heated, it is mechanically stretched, and a pressure differential is then applied to form the sheet over a male mould. In this case, however, the sheet touching the mould is close to its original thickness. It is possible to drape-form items with a depth-to-diameter ratio of approx. 4 to 1; however, the technique is more complex than straight vacuum forming. Male moulds are easier to build and generally cost less than female moulds; however, male moulds are more easily damaged. Drape forming can also be used with gravitational force alone. For multi-cavity forming, female moulds are preferred because they do not require as much spacing as male moulds.
See figure 4



(A) A clamped, heated sheet is forced down into the mould by air pressure after a vacuum is drawn in the mould.

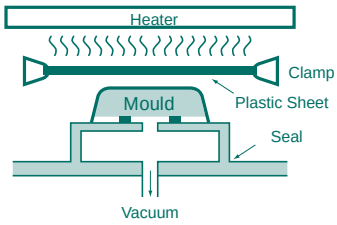


(B) Plastic sheet cools as it contacts the mould.

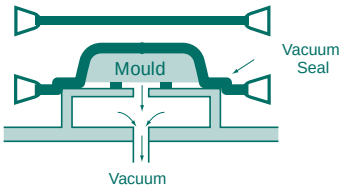


(C) Areas of the sheet that touch the mould last are the thinnest.

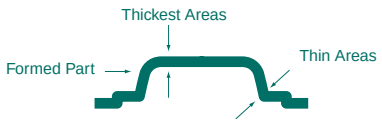
Figure 3
Straight Vacuum Forming



(A) Clamped, heated plastic can be pulled over the mould, or the mould can be forced into the sheet.



(B) Once the sheet has formed a seal around the mould, a vacuum is drawn to pull the tightly against the mould surface.



(C) Final wall thickness distribution in the moulded part.

Figure 4
Drape Forming

6.3.3.5. MATCHED-MOULD FORMING

Matched-mould forming is similar to compression moulding in that heated BARLO XT sheet is trapped between male and female dies made of wood, plaster, epoxy or some other material.
Although they cost more, water-cooled matched moulds produce more accurate parts with close tolerances.

6.3.3.6. PRESSURE-BUBBLE PLUG-ASSIST VACUUM FORMING

The pressure-bubble plug-assist vacuum forming technique can be used when BARLO XT sheet is to be formed into deep articles that must have good thickness uniformity. The sheet is placed in a frame and heated, and controlled air pressure is used to create a bubble. When the bubble has been stretched to a predetermined height, the male plug-assist (normally heated) is lowered to force the stretched sheet into the cavity. Plug speed and shape can be varied for improved material distribution; however, the plug is made as large as possible so that the plastic material is stretched close to the shape of the finished product. The plug should penetrate 75 to 85 % of the mould cavity depth. Air pressure is then applied from the plug side while a vacuum assist is being drawn on the cavity. The female mould must be vented to allow the escape of trapped air.

6.3.3.7. PLUG-ASSIST PRESSURE FORMING

Plug-assist pressure forming is similar to plug-assist vacuum forming in that a plug forces the hot BARLO XT sheet into a female cavity. Air pressure applied from the plug then forces the plastic sheet against the walls of the mould. Plug design and plug speed can be varied to optimise material distribution.

6.3.3.8. PLUG-ASSIST VACUUM FORMING

Corner or periphery thinning of cup- or box-shaped articles can be prevented by use of a plug-assist to mechanically stretch and pull additional plastic material into the female cavity. The plug should be 10 to 20 % smaller than the mould and should be heated to just under the forming temperature of the sheet. Once the plug has forced the hot sheet into the mould cavity, air is drawn from the mould to form the part.
Plug-assist vacuum forming and plug-assist pressure forming (see previous section) allow deep drawing and permit shorter cooling cycles and good wall thickness control. Both processes require close temperature control and are more complex than straight vacuum forming.

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6.3.3.9. FREE FORMING

In free forming, air pressures of about 2.76 MPa can be used to blow a hot BARLO XT sheet through the silhouette of a female mould. Air pressure causes the sheet to form a smooth bubble-shaped article such as used in skylight panels or window well covers. Since only air touches each side of the pad, there will be no mark-off unless a stop is used to form a special contour in the bubble.
See figure 5

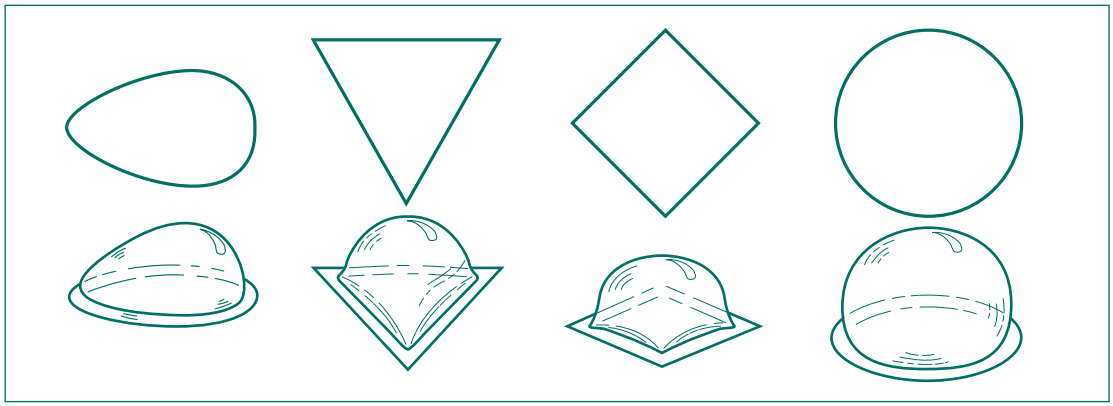


Figure 5
Examples of free-form shapes that can be obtained with openings

6.3.4. ASSEMBLY

BARLO XT sheet can be fabricated into a variety of shapes and articles with solvent, cement (a polymer dissolved in a solvent), or adhesive bonds. In general, when the surfaces to be joined are irregular, a cement is preferred over a solvent.
Solvents and cements are not the best choice when bonding BARLO XT sheet to other thermoplastics. Adhesives, including cyanoacrylates, two-part acrylics and hot melts, are more effective when bonding BARLO XT to dissimilar plastics and can be used to bond BARLO XT to itself.

6.3.4.1. ASSEMBLY GUIDELINES

The following guidelines should be observed when bonding BARLO XT sheeting:

1. The sheet edges must be clean and free from contamination.
2. The surfaces must be smooth and accurately aligned.
3. A solvent or cement must be sufficiently active to soften the mating surfaces for some flow to occur when pressure is applied.
4. When using solvents in BARLO XT sheet assembly, it is advisable that the work area be climate controlled with low humidity to minimise joint 'whitening'. If this is not possible, the addition of 10 % glacial acetic acid to the solvent or use of a slower curing cement-type bond is suggested.
5. Fixture pressure must be maintained to prevent movement of the joint until it is solid.
6. Good ventilation is required when working with solvents. Exposure levels must be controlled according to OSHA guidelines.

6.3.4.2. BONDING TECHNIQUES: SOLVENTS, CEMENTS AND ADHESIVES

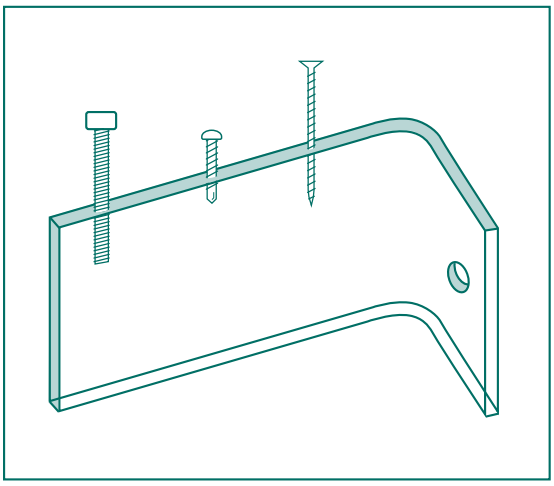
Small articles with flat surfaces can be joined by placing the pieces together and applying the appropriate bonding agent (solvent, cement, or adhesive). Care should be taken to ensure that the joints are uniformly coated; a solvent can be effectively applied with a needle applicator. The assembly should be clamped into position until the bond is set. When larger articles are to be solvent bonded, it is best to immerse the joining surfaces in a solvent bath until the material is softened and then clamp them into position until the bond has set. A constant level of solvent immersion should be maintained in a shallow pan with a support pad, screens, and other means to ensure part-to-part uniformity.

List of several solvents, cements, and adhesives that provide strong bonds with good clarity when used in BARLO XT sheeting fabrication operations.

Barlo Plastics can provide the following:

Glue	Base	Description
Colacril 20	Solvent	Does not fill in joints
Colacril 30	Solvent/polymer	Fills in joints
Colacril 75	2 component	Strong bonding Fills in joints

6.3.4.3. MECHANICAL FASTENING



BARLO XT sheet can be fabricated with mechanical fasteners into attractive joints. Self-threading screws are used if the fastener is not to be removed very often: when frequent disassembly is required, threaded metal inserts are preferred. Screws and rivets provide permanent assembly. Standard nuts, bolts, and machine screws are used in many instances. In addition, special screws and rivets specifically designed for use with plastics are available. Springs, clips, and nuts are low cost, rapid, mechanical fasteners. Hinges, knobs, catches, and dowels are some other devices used in mechanical assemblies. BARLO XT sheets have a linear expansion of 0.07 mm/m.°C. The bolts should not be tightened too much so as to still allow a "working" of the material. A bolt pressure distribution by means of washers is recommended.

6.3.5. FINISHING

6.3.5.1. SANDING

BARLO XT sheet is best sanded wet to avoid the frictional heat build-up that is characteristic of dry sanding techniques. If water coolants are used, the abrasive lasts longer and the cutting action increased. Progressively finer abrasives are used: for example, rough sanding with 80-grit silicon-carbide would be followed by finer sanding with 280-grit silicon-carbide, wet or dry. The final sanding may be with 400 or 600-grit sandpaper. After the sanding is finished and the abrasives removed, additional finishing operations may be required.

6.3.5.2. JOINING

A standard woodworking jointer-planer will produce an accurately aligned and good quality finished edge on BARLO XT sheeting. Carbide or high speed blades, which have a longer life, will provide a uniform finish as well.

6.3.5.3. FILING

When many thermoplastics, including BARLO XT, are filed, a light powder that tends to clog some files is produced. Therefore, aluminium Type A, shear-tooth, or other files that have coarse, single-cut teeth with an angle of 45° are preferred.

6.3.5.4. FLAME POLISHING

BARLO XT sheet can be flame-polished using a standard propane torch or a Hot Nitrogen Welder. Both techniques require accurate control of the distance between the sheet and the heat source; otherwise surface whitening or excessive material flow will occur. A heat gun can be used to remove scratches from BARLO XT sheet. A gun with a temperature range of about 400° to 540°C, should be held about 100 mm from the scratch for approx. 5 seconds. The time may vary according to the severity of the scratch. It is important to keep the flame moving and not to dwell on one spot.

6.3.5.5. PRINTING

BARLO XT sheeting can be printed with conventional equipment; however, the ink does not penetrate a plastic as it does with paper and cloth and is therefore subject to damage by abrasion. This can be minimised by applying a light coat of clear lacquer over the printing. There are a number of different methods used when printing on plastics including letterpress, letterflex, dry offset, offset lithography, rotogravure, stencilling, and a commonly used silk screen process. In silk screening, the ink is forced through a fine metallic or fabric screen onto the product, and a squeegee is used to force the ink through the screen that is blocked off in areas that are not to be printed.
Since each application may require a different type of ink, it is suggested that an ink manufacturer be consulted for recommendations. Care is to be taken that only printing inks and varnish paints for acrylic are used.

6.3.6. VERTICAL GLAZING

In order to determine the required dimensions for BARLO XT sheets, fixed on all sides, the following factors are to be taken into consideration:

- Coefficient of thermal expansion
  70×10^{-6} corresponding to 0.07 mm per m length and a 1°C change of temperature.
- Inside width of the frame
  The frames can be made of plastic, wood or metal. It is highly recommended that the frame rebate consists of relatively dense material. For a defined edge length, the frame must be larger- and this according to the amounts indicated below:

Edge lenght	Addition
500 mm	3.0 mm
1000 mm	5.0 mm
1500 mm	7.0 mm
2000 mm	10.0 mm
3000 mm	15.0 mm

- Depth of rebate
  The rebate should be approx. 25 mm deep.

- Wind loading
  The wind loading is to be taken into account. It has been assumed as hurricane force (1000 N / m^2).
  The permissible deflection of the sheet is around 20 mm per edge length.
  For a sheet with a determined dimension, the short side of the sheet is used for the definition of the material thickness.

Edge length	Thickness
Up to 400 mm	3.0 mm
Up to 1000 mm	4.0 mm
Up to 1400 mm	5.0 mm
Up to 1600 mm	6.0 mm
Up to 1750 mm	8.0 mm
Up to 2000 mm	10.0 mm

For internal glazing, not subject to loading, the following dimensions apply:

Edge length	Thickness
Up to 1000 mm	3.0 mm
Up to 1250 mm	4.0 mm
Up to 1500 mm	5.0 mm
Up to 1750 mm	6.0 mm
Up to 2000 mm	8.0 mm
Up to 2250 mm	10.0 mm
Up to 2500 mm	12.0 mm

- Length /width ratio
  The figures take a length/width ratio of 1:1.5 up to 1 : 3 into account.

Important when glazing with BARLO XT sheets:

- Care is to be taken - when installing - for adequate free space (thermal expansion).
- The edging tape must not stick to the BARLO XT sheets.
- Unplasticised rubber and plastic profiles can be used for the edging tape.
- The sealing medium must have permanent elasticity, suitable materials being poly sulfides and silicon rubbers in a neutral position.
- Other criteria apply to BARLO XT sheets when used for safety glazing purposes.