



## **TECHNICAL REPORT**

# **HOLLOW POLYCARBONATE**

## **A Brief Introduction**

Polycarbonate is a very well-known engineering thermoplastic, as clear as glass and as resistant as steel, it is a carbon derivative that gathers a high level of mechanical resistance quality, as well as optical, thermal and electric. It useful in many different engineering applications, because of its high versatility, either on flat or curved situations.

It was discovered in Europe in the early 50's and its commercial production started in the late 50's.

## CHEMICAL COMPABILITY

Alkalis	Normally do not cause problems at low concentrations and room temperature. High temperatures and/or higher concentration will harm the material.
Acids	Do not attack the material at normal temperatures and concentrations.
Alcohols	Normally do not cause problems at low concentrations and room temperature. High temperatures and/or higher concentration will harm the material.
Amines	Chemical attack will occur. Avoid this material.
Ketones	They are solvents. Avoid solvents.
Detergents and Cleaning materials	Neutral solutions of soap and detergents are applicable. Avoid too high pH material.
Esthers	Avoid. Partially solvents to Polycarbonate. Can cause blisters to the
Hydrocarbons	Can be partially solvent to the material causing stress cracking. Avoid.
Aliphatic Hydrocarbons	Usually compatible with the product.
Halogenated Hydrocarbons	They are solvents. Avoid.
Silicon oil and grease	Normally compatible up to 85 °C. Some may contain aromatic hydrocarbons and therefore one should avoid them.
Oil and greases	Oil and greases coming from petroleum are generally compatible. Some additives they contain are not compatible.

## Hollow Polycarbonate

It is a flat sheet with an internal hollow cavity, between two external walls, that restrains the heat exchange from one side to the other, preserving the temperature of the internal area.

The impact resistance is far better than glass, about 30 times bigger, and the sheet can be bent without heating being able to stand a bending radio of minimum 175 times its thickness.

Hollow Polycarbonate sheets have good performance in temperatures ranging from minus 40°C up to 120°C. In one of its side, a treatment prevents the damage to the material by the ultra-violet rays, especially from the sun.

The material is self-extinguishing and do not propagate fire.

By selecting the correct thickness, one can regulate the structure to be used. By using colored sheets, one can regulate the quantity of light and heat coming into the ambient. Special length dimension makes it easier to use less emendation, what avoids easier points for infiltration.

Hollow Polycarbonate is used in general coverage, side closing and sheds, fair booths, winter gardens, metro stations, sports stadiums, industrial covering, domes, footbridge, etc. enhancing the natural lightning of the ambient.

Comparison of weight of Polycarbonate with other material		
Material	Thickness (mm)	Weight (kgf/m <sup>2</sup> )
Solid Acrylic Sheet	6	7,2
GRP sheet (Polyester)	1,5	2,3
Solid PVC Sheet	6	8
Hollow Polycarbonate	6	1,3
Wired Glass	6	16

## Hollow Polycarbonate

Thickness	Weight
4 mm	0,8 kg/m <sup>2</sup>
6 mm	1,3 kg/m <sup>2</sup>
8 mm	1,5 kg/m <sup>2</sup>
10 mm	1,7 kg/m <sup>2</sup>
16 mm	2,7 kg/m <sup>2</sup>

## OPTICAL AND THERMAL CHARACTERISTICS

Color	Thick (mm)	Light Trans TL (%)	Trans. Solar TST (%)	Direct Solar Transm. DST (%)	Total Solar Reflect. RST (%)	Solar Reflect. RS (%)	Solar Adsorpt. AS (%)	Shadow Coef. SC
Blue	6	27	55	40	45	30	30	0,63
	8							
	10	27	55	40	45	20	30	0,63
	16	27	55					
Bronze	6	35	55	40	45	30	30	0,63
	8	35	55	40	45	30	30	0,63
	10	35	55	40	45	20	30	0,63
	16	35	55					
Gray	6	20	50	33	50	4	63	0,58
	8							
	10	20	50	33	50	4	63	0,58
	16	20	50					
Clear	6	82	86	79	14	7	14	0,98
	8	82	86	79	14	7	14	0,96
	10	81	85	79	15	9	12	0,89
	16	79	82					
Smoky	6	40	76	65	24	13	22	0,66
	8	40	75	65	25	15	0	0,66
	10	40	71	65	29	23	12	0,66
	16	40	71					
Green	6	62	60	40	40	30	30	0,69
	8	65	60	40	40	30	30	0,69
	10	68	60	40	40	20	30	0,69
	16	68	60					

<b>TRANSMISSION OF LIGHT AND ENERGY</b>		
<b>Thicknesses</b>	<b>Transmission values %</b>	
	<b>Visible light</b>	<b>Solar energy</b>
6 mm	83	88
8 mm	82	86
10 mm	80	85
<b>CHARACTERISTICS</b>	74	82

## GENERAL CHARACTERISTICS

Thermal		6 mm	8 mm	10 mm	16 mm
K Factor (w/m <sup>2</sup> .°k)		3,5	3,3	3	2,4
Heat gain in summer (BTU/H-m <sup>2</sup> .°C)		0,62	0,59	0,57	0,52
Heat loss in winter (BTU/H-m <sup>2</sup> .°C)		0,65	0,62	0,6	0,55
Temperature of application (°C)		De -40°C a 100°C			
Deformation temperature (°C)		140°C			
Tensile strength as a function of temperature		80 Mpa = -2,5°C 70 Mpa = 0°C 65 Mpa = 25°C 59 Mpa = 50°C			
Flexural modulus as a function of temperature		26 Mpa = -2,5°C 25,5 Mpa = 0°C 25 Mpa = 25°C 23 Mpa = 50°C			
Breaking Temperature		-110°			
Thermal conductivity		0,21 W/m.°C			
Thermal expansion coef-ficient		7 x 10 <sup>-5</sup> m/m. °C			
Oxygen Index		25%			
FLAMABILITY		6 mm	8 mm	10 mm	16 mm
Horizontal burn (flame propagation speed) AEB (mm)	ASTM D 635	CC-2			
Ignition Temperature - spark	ASTM D-1929B	471°C			
Self-Ignition Temperature	ASTM D1929B	-	-	585°C	582°C



## Direct Resistance to Chemicals

CHEMICAL RESISTANCE				
<b>Good Resistance</b>	Acetylene	Butane	Hexane	
	Chromic Acid	Potassium carbonate	Calcium Hypochlorite	
	Acetic Acid	Sodium Carbonate	Sodium Hypochlorite	
	Arsenic Acid	Aluminum Chloride	Mercurium	
	Citric Acid	Ammonium Chloride	Methane	
	Hydrochloric Acid , 20%	Antimony Chloride	Carbon Monoxide	
	Hydrochloric Acid, 5%	Calcium Chloride	Ammonium Nitrate	
	Sulfuric Acid, 50%	Calcium Chloride	Calcium Nitrate	
	Lactic Acid	Cupric Chloride	Aluminum Oxalate	
	Nitric Acid, 10%	Cuprous Chloride	Phosphorous Oxide	
	Oleic Acid	Ferric Chloride	Oxygen	
	Oxalic Acid	Magnesium Chloride	Ozone	
	Per chloric Acid	Mercurium Chloride	Pentane	
	Per chloric Acid, 20%	Potassium Chloride	Calcium soap	
	Tartaric Acid, 20%	Sodium Chlorate	Sodium Hydroxide	
	Water	Sodium Chloride	Resorcinol, 1%	
	Butyl Alcohol	Zinc Chloride	Calcium Chloride sol.	
	Ethanol 96%	Hydrogen Peroxide	Sulfates	
	Propyl Alcohol	Sulfur	Aluminum Sulfate	
	Chrome Alum	Ethanol	Ammonium Sulfate	
	Alum	Dinonyl Phthalate	Copper Sulfate	
	Sodium Bicarbonate	Formaldehyde, 10%	Magnesium Sulfate	
	Potassium dichromate	Coal Gas	Manganese Sulfate	
	Carbon Dioxide	Propane	Potassium Sulfate	
	Sodium bisulfate	Glycol	Sodium Sulfate	
	Sodium Bisulfite	Butylene Glycol	Ferrous Sulfate	
	Borax	Ethylene Glycol	Hydrogen Sulfite	
	Boric Acid	Diethylene Glycol	Potassium Bromide	
	Heptane	Urea	Allylic Acid	
		Dinonyl Phthalate		

<b>Limited Resistance</b>	Isoamyl Alcohol	Trichloric Acid	Dry Chlorine
	Isopropyl Alcohol	Sulfuric Acid, 70%	Glycerin
	Nitric Acid, 10 - 20%	Cyclo hexyl alcohol	Calcium Hydroxide 30%
	Perchloric Acid	Tetraethyl lead	Kerosene
	Formic Acid	Petroleum Ether	
<b>Not Resistant</b>	Acetone	Potassium Cyanide	Iodine
	Amyl Acetate	Cyclohexanone	Methanol
	Butyl Acetate	Benzyl Chloride	Methylamine
	Nitric Acid,20%	Chloroform	Methyl Methacrylate

## Chemical Resistance

Resistência Química			
<b>Not Resistant</b>	Butyric Acid	Ethyl Chloride	Nitrobenzene
	Hydrochloric Acid, conc.	Ethylene Chlorohydrin	Perchlorethylene
	Phenilc Acid	Methylene Chloride	Pyridine
	Phenyl Ethyl Alcohol	Cresol	Sodium Hydrox. sol.
	Propionic Acid	Carbon Disulfide	Potassium solution
	Sulfuric Acid concent.	Dimethyl naphthenic	Caustic Soda
	Sulfurous Acid, 10%	Dibutyl phthalate	Ammonium Sulfate
	Benzilic Acid	Dioxane	Phenyl ethyl alcohol
	Diethyl ether	Ethane Tetrachloride	Ammonium
	Ether	Tetrahydrofuran	Aniline
	Ethyl amide	Tetrahydronaftalen	Benzaldehyde
	Styren	Thiofuran	Benzene
	Dimethyl formamide	Toluene	Benzoic Acid
	Tricresyl phosphate	Trichlorethylene	Ethyl Bromide
	Ammonium Fluoride	Phosphor Trichloride	Brome
	Brome	Chlorine gas umid	Nitrous vapor
	Brome Benzene	Ammonium Hydroxide	Xylene
	Cyano Ethylene	Potassium Hydroxide	

Cleaning Agents			
<b>Good Resistance</b>	Ethanol Pure	Lysoform, 2 %	Resorcinol solution
	Baktol, 5%	Maktol	Sublimed
	Chloramine	Mefen, 2%	Trosilin G extra, 1,5%
	Delegol, 5%	Oktozon, 1%	Hydrogen Peroxide
<b>Limited Resistance</b>	Dimamin T, 5%	Iodine Tincture	Zephirol
	Sagrotan, 5%		
<b>Not Resistant</b>	Carbolic Acid	DDT	TB-Lysorform

Pharmaceutical/ Cosmetics			
<b>Good Resistance</b>	Delial Sun Milk	Periston blood substit.	Vaseline
	Lanoline	Blood Plasma	Vick's vapor rub
	Odol mouthwash		
<b>Limited Resistant</b>	Tincture of Iodine		
	Menthol, 90% in alcohol		

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Big care was taken in the compilation of the information herein contained. The recommendations about the use of the products are made without guarantee as the using conditions are not controlled by Bérkel. It is responsibility of the customer provide assurance that the product will be appropriate for each situation and that the conditions of its application be adequate.

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**Every information of this publication are reliable and issued on good faith. They were though not intended to be a guarantee and therefore we take no legal responsibilities. The users of polycarbonate sheets should run enough experiments as to establish that the material is appropriate of their real particular cases.**