



**GEVACRIL** THE ACRYLIC SPECIALIST

○ ● ■ Cast and Extruded Acrylic Tubes, Rods, Bars, Balls ■ ● ○

All extruded acrylic products in PMMA – technical properties

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## Preface

Extruded acrylic tubes, bars and rods in PMMA are polymerized plastic semi-finished products. They are manufactured through extrusion. After the production process they are clear and bright on both the internal and external wall. They have the same thermo-plastic features of extruded acrylic sheets<sup>1</sup>. That is to say:

- clearness: a transparency of 98%;
- brightness of the walls: very good transmittance of the light (92,0%);
- good resistance to weather conditions and corrosion;
- good chemical resistance<sup>2</sup>;
- good break resistance.

Extruded acrylic products in PMMA have to be distinguished from cast acrylic products as they have different physical and chemical properties. We suggest you to use extruded acrylic products in all applications of the visual communication.

## 1 Technical properties

The most important technical characteristics which are analytical described in the following chapters are to find also in the table 2 of § 1.4.

### 1.1 Mechanical properties

The extruded acrylic glass is a light stuff: its specific weight is 1,19 g/cm<sup>3</sup>. Thanks to its molecular structure it is a hard but elastic material, it has a high tensile resistance to the traction and to break and at the same time is easy to be manufactured on mechanical tools. Extruded acrylic glass is according to the Rockwell's scale is one of the hardest within the thermo-plastic materials.

<sup>1</sup> Extruded acrylic glass is normally called PLEXIGLAS ® as a trademark of Röhm GmbH, the German firm that invented it

<sup>2</sup> As indicated in the table 1



## 1.2 Thermic and electric properties

The service temperature of all extruded acrylic products is max. 70° C. As the transformation from solid into liquid takes easily place as for the other thermo-plastic materials, mould and form them does not require a lot of energy. The acrylic glass remains in the solid state until 102° C. The forming temperature is between 150 and 160° C.<sup>3</sup>

Extruded acrylic glass is besides a more isolating stuff as glass or rubber; it does not conduct energy. Like all kind of plastics it is an electrostatic material.

## 1.3 Chemical properties

Extruded acrylic glass resists to the most common chemical products. It does not resist to alcohol and spirits with more than 30° vol., some solvents and some acids. The table 1 shows the chemical resistance of extruded acrylic tubes, rods and bars in PMMA.

**TABLE 1: Chemical resistance of extruded acrylic tubes, rods and bars in PMMA**  
R= resistant; N= non resistant; M= medium resistance

INORGANIC ACIDS							
boric acid	R	chlorine-sulphuric acid	R	nitric acid <20%	M	sulphuric acid > 30%	R
hydrochloric acid 40%	R	hydrofluoric acid <20%	R	concentrated nitric acid	N	sulphurous acid 1%	N
chromic acid 40%	N	phosphoric acid <10%	R	citric acid <20%	R	battery acid	M
ORGANIC ACIDS							
concentr. acetic acid	N	formic acid	N	oxalic acid	R	tartaric acid <50%	R
acetic acid <25%	M	formic acid 2%	R	picric acid 1%	R	thioglycolic acid 10%	M
butyric acid 5%	R	lactic acid <80%	M	stearic acid	R	trichloroacetic acid	N
ALKALI							
ammonia	R	saturated potassium carbon.	N	concentr. caustic potash	M	lime	R
saturated barium hydrate	N	saturated sodium carbon.	M	concentr. caustic soda	R	soap solution	R
INORGANIC SUBSTANCES							
chlorine water	R	barium sulphide	R	bichromic potassium	R	sodium chlorate	R
hydrogen peroxide 40V	R	calcium chloride	R	potassium carbonate	R	sodium chloride	R
hydrogen peroxide 120V	N	calcium hypochlorite	R	potassium cyanide	R	sodium fluoride	R
aluminium chloride	R	liquid chlorine	N	potassium chloride	R	sodium phosphate	M
aluminium fluoride	M	sulphuryl chloride	N	potas. ferricyanide	R	sodium ipochloride	R
aluminium oxalate	R	chloride iron	R	potas. ferrocyanide	R	sodium nitrate	R
aluminium sulphate	R	chlorinated iron	R	potassium nitrate	R	sodium sulphate	R
rock alum	R	sulphated iron	R	potassium permanganate	R	sodium sulphur	R
ammonium carbonate	R	magnesium chloride	R	potassium sulphide	R	chloride tin	R

<sup>3</sup> See § 2.5



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Ammonium chloride	R	magnesium sulphate	R	potassium sulphate	R	chlorated tin	R
Ammonium phosphat	R	manganese sulphate	R	copper chloride	R	sulphate tin	R
Ammonium nitrate	R	mercury	R	copper sulphate	R	sulphate zinc	R
Ammonium sulphate	R	sulphate nickel	R	silicon tetrachloride	N	chloride zinc	R
Silver nitrate	R	chloride nickel	R	sodium bisulphite	R	sulphur	R
Barium chloride	R	potassium bicarbon.	R	sodium cyanide	R		
<b>SOLVENTS AND ORGANIC SUBSTANCES</b>							
Banana oil	N	aniline	N	diethyl phtalate	M	monobromic naphthalate	R
Ethyl acetate	R	petrol	M	heptane	N	naphthalate	R
Acetone	N	benzol	N	esalin	R	pyridine	N
Allylic alcohol	N	ethyl bromide	N	hexan	R	propylene	R
Amylic alcohol	N	ethyl butyrate	N	ethylchloroether	N	carbonate sulphur	N
Butyl alcohol	N	Chlorophenol	N	oil ether	R	tetrachloroethan	N
Ethyl alcohol 30%	M	Chloroform	N	ethyl ether	N	tetrachlorethylene	N
Ethyl alcohol anhydr.	N	amyl chloride	N	phenol	N	tetrachlor.carbonat e	N
Isopropylic alcohol	M	ethyl chloride	N	phtalate diamilic	M	tetrahydrofuran	N
Methylic alcohol	N	aircraft fuel	M	phtalate dibuthylic	N	tetrahydroptalene	N
Propylic alcohol	N	cresol	N	glycerine	N	toluolo	N
Acetic aldehede	N	decaline	R	glycol diethylene	R	turpentine	R
Benzoic aldehede	N	diacetonalcohol	N	glycol ethylene	R	trichlorethyl.	N
Formic aldehede	R	dioxan	R	buthyle lactate	N	trietilammin	R
Acetic anhydride	N	ethylene bromide	N	methylethylketone	N	xylol	N
<b>FOOD-STUFFS</b>							
Vinegar	R	coffee	R	bay leaf	R	pepper	R
Water	R	cinnamon	R	cloves	N	fruit juices	R
Mineral water	R	chocolate	R	milk	R	wine	R
Anise	R	onion	R	liqueurs	R	ice cream	R
Beer	R	camomile	R	nutmeg	R	salt	R
<b>OILS;WAXES</b>							
Refining acid	R	diesel oil	M	oils silicon fats	M	oils, minerals fats	R
Polishing wax	M	oils, vegetable oils	M	oils adipose	R	transformer oils	R
<b>DETERGENTS</b>							
Alcohol 30%	R	pure petrol	R	dry cleaner	N	spot remover	R
Alcohol anhydrous	N	bleach	R	tincture of iodine 5%	N	ammonia water solution	R
<b>DISINFECTANTS</b>							
Hydrog. peroxide < 40%	R	formalin	R	chloride paste/lime	R	sodium carbonate	R
Phenic acid	N	petrol	N	denatured alcohol	N	corrosive sublim.	R
<b>GASES</b>							
Ammonia	R	sulphide anhydride	R	sulph. hydrogen	R	oxygen	R
Carbon dioxide	R	nitrogen dioxide	R	methane	R	ozone	R
Sulphuric anhydride	R	illuminating gas	R	carbonate oxid	R	chloride vapour	M



## 1.4 Optical qualities

All extruded acrylic products are characterised by a very good purity and brightness. Acrylic tubes, rods and bars are the plastic materials with the highest light transmittance: 92,0%. This property remains unalterable over years. Light is reflected without any absorption or dispersion: a ray of light that strikes the surface of a tube is completely reflected over the whole surface; for this reason extruded PMMA is also very good as light conductor. The tubes transmit ultra-violet rays.<sup>4</sup>

## 1.5 Technical properties: synthetic table

TABLE 2: Technical properties

PROPERTY	NORM <sup>5</sup>	UNIT	VALUES
<b>MECHANICAL PROPERTIES</b>			
specific weight	DIN 53479	gr/cm <sup>3</sup>	1,19
water absorption	ISO 62	mg	38
flexural strength	ISO 178	MPa	105
tensile strength at break	D638	MPa	100
modulus of elasticity	D790	Kg/cm <sup>2</sup>	3300
elongation at break	DIN 53455	%	4,5
notch impact strength	DIN 53453	kJ/m <sup>2</sup>	1.6
Impact strength ( Charpy )	DIN 53453	kJ/m <sup>2</sup>	15
ball indentation hardness (Rockwell)	DIN 53456	MPa	175
<b>THERMIC – ELECTRIC PROPERTIES</b>			
Service temperature (without mech. stress)	-	°C	-40; +70
softening temperature (Vicat)	DIN 53460	°C	102
coefficient of linear thermic expansion	DIN 53752	mm/m.°C	0,7
thermic conductivity at 20°C	DIN 52612	W/(m*K)	0,19
dielectric constant at 50 Hz	DIN 53483	-	3.7
dielectric constant at 0.1 MHz	DIN 53483	-	2.8
dielectric loss factor at 1 MHz	DIN 53483	-	0,035
dielectric strength	DIN VDE 0303	Kv/mm	30
<b>CHEMICAL PROPERTIES</b>			
see table 1 in § 1.3	-	-	-
<b>OPTICAL PROPERTIES</b>			
index of refraction	ISO 489	-	1,49
light transmittance	D 1003	%	92,0
average spectral transmittance:			
-ultraviolet 250-380 mμ	D 307	%	70
-visible 380-720 mμ	D 307	%	92
-infra-red 720-1200 mμ	D 307	%	87
turbidity (Haze)	D1003	%	0,3
light absorbtion	-	%	< 0,05

<sup>4</sup> It is also possible to produce tubes which allows the transmittance of UV rays

<sup>5</sup> The norms indicated in this table are taken from: a) DIN (Das Ist Norm): German Society for Standardisation; b) D (or ASTM): American Society for Testing Materials



## 1.6 Extruded tubes under pressure: synthetic table

TABLE 3: Extruded tubes under pressure

XT TUBES IN PMMA: service pressure at 18 °C									
Outside diameter mm.	Standard length mm.	Packing Unit	Thicknes s						
			1	1,5	2	2,5	3	4	5
5	2000	25	8,00	***	***	***	***	***	***
7	2000	25	6,12	***	***	***	***	***	***
8	2000	25	***	***	9,38	***	***	***	***
10	2000/4000	25	***	6,38	8,00	***	10,50	***	***
12	2000/4000	25	3,82	***	6,94	***	9,38	***	***
13	2000/4000	25	***	5,10	6,51	***	***	***	***
15	2000/4000	25	3,11	***	5,78	6,94	8,00	***	***
16	2000/4000	25	***	***	5,47	***	***	***	***
20	2000/4000	5	2,38	***	4,50	***	6,38	***	***
25	2000/4000	5	***	***	3,68	***	5,28	***	***
30	2000/4000	5	***	***	3,11	***	4,50	5,78	6,94
34	2000/4000	5	***	***	***	***	4,02	***	***
38	2000/4000	5	***	***	***	***	3,64	***	***
40	2000/4000	1	***	***	2,38	***	3,47	4,50	5,47
44	2000/4000	1	***	***	***	***	3,18	***	***
50	2000/4000	1	***	***	1,92	***	2,82	3,68	4,50
60	2000/4000	1	***	***	1,61	***	2,38	3,11	3,82
70	2000/4000	1	***	***	1,39	***	2,05	2,69	3,32
80	2000/4000	1	***	***	1,22	***	1,80	2,38	2,93
90	2000/4000	1	***	***	***	***	1,61	2,12	2,62
100	2000/4000	1	***	***	***	***	1,46	1,92	2,38
110	2000/4000	1	***	***	***	***	1,33	1,75	2,17
120	2000/4000	1	***	***	***	***	1,22	1,61	2,00
133	2000/4000	1	***	***	***	***	1,10	***	1,81
150	2000/4000	1	***	***	***	***	0,98	1,30	1,61
160	2000	1	***	***	***	***	0,92	***	1,51
180	2000/4000	1	***	***	***	***	0,82	1,09	1,35
200	2000/4000	1	***	***	***	***	0,74	0,98	1,22
230	2000/4000	1	***	***	***	***	***	0,85	1,06
250	2000/4000	1	***	***	***	***	***	0,79	0,98

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