



## PLEXIGLAS® CA/EX Tubes and Rods

### Product

PLEXIGLAS® EX tubes and rods are extruded. They are characterized by their optically immaculate, perfectly smooth surfaces free from striation.

Whether white or with a fine satin finish and optimum light diffusion (for details, see also Technical Information on PLEXIGLAS® Satinice), high-quality, design-oriented applications can be realized, for example, in the lighting industry. Impressive lighting effects can be created with frontally illuminated PLEXIGLAS® LED rods.

For further details, please see Technical Information on PLEXIGLAS® LED (EndLighten T) 212-15.

Extruded PLEXIGLAS® tubes and rods can also be manufactured in various colors and/or with increased impact strength.

PLEXIGLAS® CA round rods are made from casted semi-finished products and have high-gloss polished surfaces.

### Properties

In addition to the well-known and proven properties of PLEXIGLAS®, such as

- excellent light transmission and brilliance
- extremely high weather resistance
- easy processability
- high surface hardness
- low weight – half the weight of glass
- 100 % recyclability
- 11 times more break-proof than glass

extruded PLEXIGLAS® tubes and rods offer the following special features:

- outstanding surface optics
- extremely good thickness tolerances
- conformity to food processing regulations (only applies to colorless)
- UV transmittance

Casted rods are:

- polished
- more resistant to solvents

### Applications

These properties make PLEXIGLAS® tubes and rods especially suitable for

- Lights, ambient lighting
- Furniture and trade fair construction as well as shop fitting (e.g. displays)
- Industrial components (e.g. pneumatic dispatch, beverage lines (EX), pneumatic conveying systems)
- Architectural constructions (e.g. facades)

### Processing

PLEXIGLAS® tubes and rods can be processed exactly like standard PLEXIGLAS®. The following processing guidelines for PLEXIGLAS® are available:

- Machining of PLEXIGLAS® (No. 311-1)
- Forming PLEXIGLAS® (No. 311-2)
- Joining PLEXIGLAS® (No. 311-3)
- Surface treatment of PLEXIGLAS® (No. 311-4)
- Tips for processing PLEXIGLAS® solid sheets (No. 311-5)

### Annealing

Annealing is used to eliminate material stresses and to reinforce bonds, i.e. to prevent the formation of cracks. Annealing is done in convection ovens at approx. 80°C for CA and approx. 70°C for EX. The annealing time should be at least 2 hours or longer, followed by slow cooling in a switched-off oven.

### Machining

PLEXIGLAS® CA and EX tubes/rods can be easily milled, drilled, sawed, etc. with suitable tools. They require high cutting speeds and good cooling, since their low thermal conductivity can easily lead to overheating and local thermal stress.

PLEXIGLAS® EX in particular tends to smear when exposed to friction. When drilling, always use water-miscible cooling lubricant, e.g. cooling lubricant emulsion. To eliminate internal stresses, annealing may be necessary for pipes/rods.

### Bonding

Extruded and casted PLEXIGLAS® tubes / rods can be bonded to themselves or to other materials. In any case, annealing is necessary before bonding. Examples of adhesives used include ACRIFIX® 1S 0116 or 1S 0117 for PLEXIGLAS® EX by itself and ACRIFIX® 2R 0190 (as well as ACRIFIX® 1R 0192 for colorless parts) in particular for PLEXIGLAS® CA by itself or CA with EX.

Reannealing after bonding improves the strength and durability of the joint.

### Forming

With appropriate heating, PLEXIGLAS® CA (160°C - 170°C) and PLEXIGLAS® EX (150°C - 160°C) become rubber-elastic. The tubes/rods can then be bent, stretched, expanded or blow molded. Once cooled, they retain their new shape. Care must be taken to ensure the correct forming temperature.

For further information, please refer to Chapter 5 of the brochure "Forming PLEXIGLAS®".

### Tube connections

#### Screw connection

Screw connections are widely used, especially for fluid lines. The fittings are made of metal, but preferably of plastic, e.g. polyamide. The ends of the tubes are connected to the fittings by means of cones, by adhesive bonding or by brief heat treatment.

#### Flange connections

Flange connections are mainly used for larger tube diameters for which there is no ready-made screw connection. If flange and tube are bonded, tubes made of PLEXIGLAS® EX must be annealed, otherwise cracks may occur.

#### Splicing

Splicing involves hot forming the end of the tube and pushing it over the beveled end of the other tube. Afterwards, it can also be shrunk. For outdoor installations, it is recommended to prefabricate the expansion (tulip) in the workshop. Sealing is carried out by filling the tulip edge with the ACRIFIX® 2R 0190 adhesive, by sealing with a PMMA-compatible silicone rubber or by inserting a round rubber. Adhesive bonding has certain disadvantages here: it can only be carried out cleanly in the workshop. In addition, the necessary annealing makes the process cumbersome. Bonding at the installation site is only possible with vertical pipes.

**Permitted internal pressure**

Diameter		Wall thickness	Weight	EX tube
Outside in mm	Inside in mm	mm	kg/m	Permitted internal pressure (bar)
5	3	1	0.015	7.8
6	3.5	1.25	0.022	8.0
6.5	4	1.25	0.025	7.6
7	5	1	0.022	5.9
8	4	2	0.045	9.2
10	7	1.5	0.048	6.2
	6	2	0.060	7.8
12	10	1	0.041	3.6
	8	2	0.075	6.7
13	10	1.5	0.064	4.9
	9	2	0.082	6.3
15	13	1	0.052	2.9
	11	2	0.097	5.6
	10	2.5	0.117	6.7
16	12	2	0.105	5.3
20	18	1	0.071	2.2
	16	2	0.135	4.3
	14	3	0.191	6.2
25	21	2	0.172	3.5
	19	3	0.247	5.1
30	26	2	0.209	2.6
	24	3	0.303	4.3
	22	4	0.389	5.6
	20	5	0.467	6.7
38	32	3	0.392	3.4
40	36	2	0.284	2.2
	34	3	0.415	3.3
	32	4	0.538	4.3
	30	5	0.654	5.3

Diameter		Wall thickness	Weight	EX tube
Outside in mm	Inside in mm	mm	kg/m	Permitted internal pressure (bar)
<b>50</b>	46	2	0.359	1.7
	44	3	0.527	2.6
	42	4	0.688	3.5
	40	5	0.841	4.3
<b>60</b>	56	2	0.433	1.4
	54	3	0.639	2.2
	52	4	0.837	2.9
	50	5	1.028	3.6
<b>70</b>	64	3	0.751	1.9
	62	4	0.986	2.5
	60	5	1.214	3.1
<b>80</b>	74	3	0.863	1.6
	72	4	1.136	2.2
	70	5	1.401	2.7
<b>90</b>	84	3	0.975	1.4
	80	5	1.588	2.4
<b>100</b>	94	3	1.087	1.3
	92	4	1.435	1.7
	90	5	1.775	2.2
<b>110</b>	104	3	1.199	1.1
	100	5	1.962	2.0
<b>120</b>	114	3	1.312	1.0
	110	5	2.149	1.8
<b>133</b>	127	3	1.457	0.9
	123	5	2.391	1.6
<b>150</b>	144	3	1.648	0.8
	142	4	2.182	1.1
	140	5	2.709	1.4
<b>180</b>	172	4	2.631	0.9
<b>200</b>	194	3	2.208	0.5
	192	4	2.929	0.8
	190	5	3.643	1.0

Diameter		Wall thickness	Weight	EX tube
Outside in mm	Inside in mm	mm	kg/m	Permitted internal pressure (bar)
250	242	4	3.679	0.6
	240	5	4.580	0.8
300	292	4	4.426	0.5
	290	5	5.514	0.6
400	392	4	5.922	0.3
	390	5	7.383	0.4
500	492	4	7.417	0.2
	490	5	9.253	0.3

Mechanical properties				
Properties	Standard	Unit of measurement	CA (0F00)	EX (0A070)
Bulk density $\rho$	ISO 1183	g/cm <sup>3</sup>	1.19	1.19
Impact strength $a_{cU}$ per Charpy	ISO 179/1 fu	kJ/m <sup>2</sup>	15	15
Notched impact strength $a_{iN}$ per IZod	ISO 180/1A	kJ/m <sup>2</sup>	1.6	1.6
Tensile strength $\sigma_M$	ISO 527-2/1B/5			
a) -40°C		MPa	110	110
b) 23°C		MPa	80	72
c) 70°C		MPa	40	35
Perm. material tension $\sigma_{perm.}$ (up to 40°C)		MPa	5...10	5...10
Modulus of elasticity $E_t$ (short-term value)		MPa	3300	3300

### Optical properties

Properties	Standard	Unit of measurement	CA (OF00)	EX (OA070)
<b>Optics</b>			Polished	Glossy
<b>Degree of transmission TD65</b>	DIN 5036, part 3	%	~ 92	~ 92
<b>UV transmittance</b>		-	No	Yes
<b>Yellowing</b>	DIN 5036	%		< 0.5
<b>Reflection loss in the visible range (per interface)</b>		%	4	4
<b>Absorption in the visible range</b>		%	< 0.05	< 0.05

### Thermal properties

Properties	Standard	Unit of measurement	CA (OF00)	EX (OA070)
<b>Linear expansion coefficient <math>\alpha</math> for 0...50°C</b>	DIN 53752-A	1/K (mm/m °C)	$7 \cdot 10^{-5}$	$7 \cdot 10^{-5}$
<b>Molding temperature</b>		°C	160 ...175	150 ... 160
<b>Max. surface temperature (IR radiator heating)</b>		°C	200	180
<b>Max. continuous service temperature</b>		°C	80	70
<b>Reforming temperature</b>		°C	> 80	> 80
<b>Ignition temperature</b>	DIN 51794	°C	425	430
<b>Flue gas amount</b>	DIN 4102		Extremely low	Extremely low
<b>Flue gas toxicity</b>	DIN 53436		None	None
<b>Flue gas corrosiveness</b>			None	None
<b>Building material class</b>	DIN 4102		B2	B2
<b>Fire behavior</b>	BS 476, part 7+6 BS 2782, Method 508A DIN EN 13501		Class 3 TP(b)  E	Class 3 TP(b)  E
<b>Vicat softening temperature</b>	ISO 306, Method B50	°C	115	103

Water behavior				
Properties	Standard	Unit of measurement	CA (OF00)	EX (OA070)
<b>Water absorption (24h, 23°C) against dry condition</b> <b>Samples 60 x 60 x 2 mm<sup>3</sup></b>	ISO 62, Method 1	mg	41	38
<b>Weight gain, max., after water storage</b>	ISO 62, Method 1	%	2.1	2.1
<b>Permeation coefficient for</b>				
water vapor			$2.3 \cdot 10^{-10}$	$2.3 \cdot 10^{-10}$
N <sub>2</sub>		g cm	$4.5 \cdot 10^{-15}$	$4.5 \cdot 10^{-15}$
O <sub>2</sub>			$2.0 \cdot 10^{-14}$	$2.0 \cdot 10^{-14}$
CO <sub>2</sub>		cm <sup>2</sup> h Pa	$1.1 \cdot 10^{-13}$	$1.1 \cdot 10^{-13}$
Air			$8.3 \cdot 10^{-15}$	$8.3 \cdot 10^{-15}$

For further details, please refer to the Technical Information on PLEXIGLAS® CA and EX (211-1).

### Tolerances

#### Outside diameter and wall thickness

See Chapter A Ordering Guide for PLEXIGLAS® Tubes and Rods.

Length tolerances		
<b>EX tubes</b>		-0/+5 mm
<b>EX rods</b>	2 - 10 mm	-0/+40 mm
	12 - 50 mm	-0/+15 mm
<b>CA rods</b>		-0/+100 mm

Standard tolerances from production of lengths ≤ 6000 mm.

Cutting tolerances with special cutting service			
Outside diameter in mm	Cutting length 50 - 500 mm	Cutting length 500 - 4,000 mm	Cutting length 500 - 2,000 mm
up to 8	+/- 2.0 mm	+/- 4.0 mm	
10 - 16	+/- 1.0 mm	+/- 2.0 mm	
20 - 160	+/- 0.5 mm	+/- 1.0 mm	
160 - 300		+/- 1.5 mm	
400 - 450			+/- 2.0 mm
500			+/- 3.0 mm

Straightness of tubes	
Diameter in mm	Deviation in mm
Up to 10	10
> 10 - 20	8
> 20 - 30	6.5
> 30 - 50	5
> 50 - 300	3
> 300 - 500	2

Maximum deviation, based on 1,000 mm chord length.



### Delivery forms

PLEXIGLAS® tubes and rods are available in the following formats and thicknesses:

Manufacturing process	Form	OD in mm	Wall thickness in mm	Length in mm
EX	Tube	5 – 500	1 – 5	2,000
EX	Round rod	2 – 50		2,000
CA	Round rod	15 – 100		2,000

Further details can be found in the PLEXIGLAS® Order Guide.

### Storage advice

Extruded tubes with an outside diameter of 300 mm and more must be stored upright to prevent deformation due to the ratio of dead weight/volume.

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