

To manufacture optical components, high-quality, specially selected and tested materials are only used by SOLAR LS. A variety of crystals and glasses are available to meet various customers' requirements and to allow operation over a wide spectral range from the vacuum UV to IR.

### **BK 7, Fused Silica (UV Grade), Fused Silica (IR Grade), Flint Glass.**

Below follows a transmission spectrum together with the tables of the main parameters for materials that are most widely used in SOLAR LS for production of near IR-, visible- and UV-optical components, such as Fused Silica (UV- and IR-grade), borosilicate crown glass BK-7 and Flint glass.

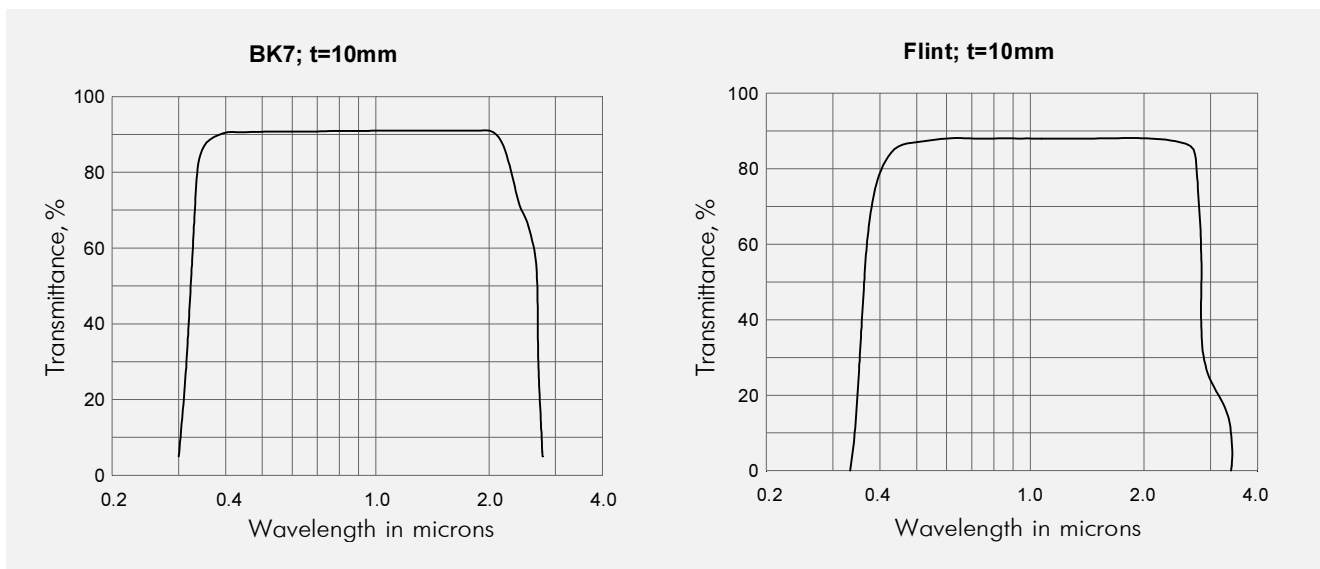
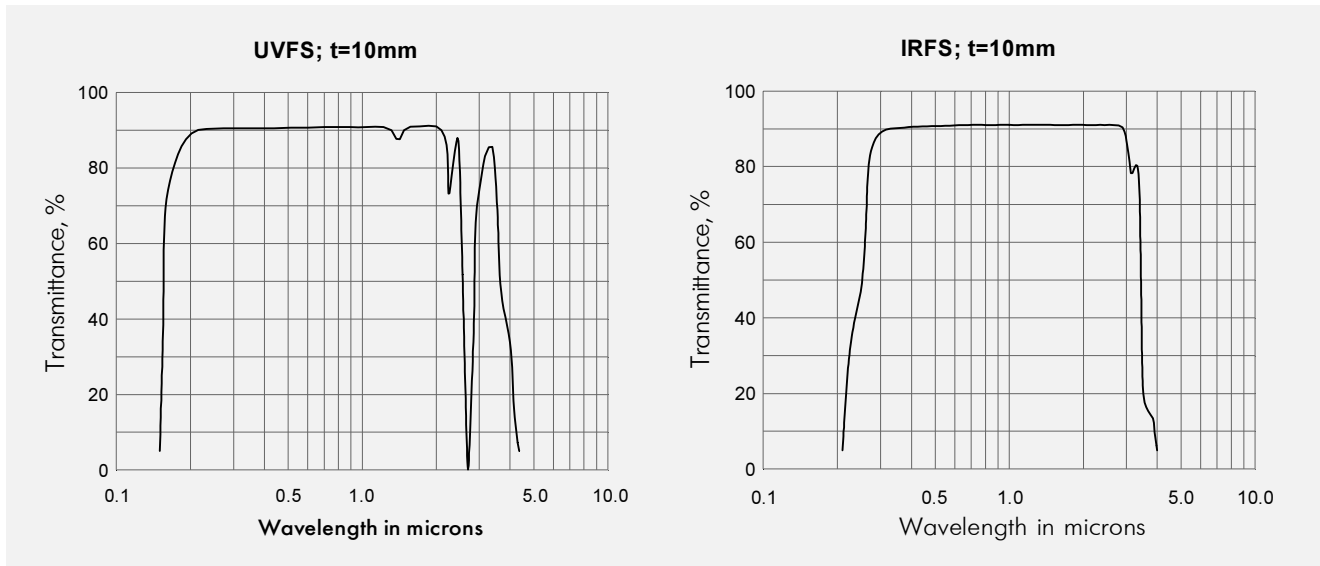
Very high surface quality (SQ:10-5, Flatness  $\lambda/50$ ) can be achieved. The coatings for these materials exhibit very high laser damage thresholds.

#### **PHYSICAL CONSTANTS FOR GLASSES : UV & IR FUSED SILICA, BK7, FLINT GLASS**

<b>Glass</b>	<b>UV FS</b>	<b>IR FS</b>	<b>BK7</b>	<b>Flint</b>
Density ( g/cm <sup>3</sup> )	2.21	2.21	2.52	4.77
Abbe factor ( V <sub>d</sub> )	67.84	67.84	64.07	27.53
Coefficient of linear thermal expansion ( $\alpha \times 10^7$ )	3 to 3.6	3 to 3.6	71	80
0° to 30° ( per °C)				
20° to 120° ( per °C)	3.4 to 5.2	3.4 to 5.2	76	83

#### **REFRACTIVE INDICES**

$\lambda$ , nm	<b>UV FS</b>	<b>IR FS</b>	<b>BK7</b>	<b>Flint Glass</b>
193	1.5572			
248	1.5088			
266	1.4997			
308	1.4857	1.4857		
337	1.4793	1.4793		
347	1.4775	1.4775		
355	1.4761	1.4761	1.5377	1.8292
400	1.4701	1.4701	1.5304	1.8081
488	1.4629	1.4629	1.5218	1.7740
514.5	1.4614	1.4614	1.5201	1.7674
532	1.4606	1.4606	1.5191	1.7640
632.8	1.4571	1.4571	1.5147	1.7497
694	1.4554	1.4554	1.5128	1.7440
800	1.4533	1.4533	1.5103	1.7371
900	1.4517	1.4517	1.5086	1.7326
1064	1.4496	1.4496	1.5062	1.7275
1500	1.4449	1.4449	1.5008	1.7195
2000	1.4374	1.4374	1.4941	1.7125
2500		1.4297	1.4856	1.7053
3000		1.4191		
3500		1.4059		



## BaF<sub>2</sub>, CaF<sub>2</sub>, MgF<sub>2</sub>, LiF-crystals.

These crystals are used to manufacture windows, prisms, lenses to operated over the whole spectral range from the UV-and visible to the near- and middle IR.

CaF<sub>2</sub> and MgF<sub>2</sub> are non-hygroscopic crystals. The quality of the polished faces can be retained for a long-time period without using protective coatings or any additional sealing steps. These crystals are highly resistant to high-energy UV-radiation.

MgF<sub>2</sub> is characterized by a slightly-pronounced birefringence and can be used in manufacturing UV- and IR-polarization components. The difference between  $n_o$  and  $n_e$  at  $\lambda=5 \mu\text{m}$  is, for instance, 0.0091.

LiF is remarkable for its maximum transmittance in the vacuum UV. This crystal is very soft and requires gentle handling. Color centers produced by UV radiation are more readily formed in this crystal, as compared to MgF<sub>2</sub> or CaF<sub>2</sub>.

### PHYSICO-CHEMICAL CHARACTERISTICS FOR FLUORIDE CRYSTALS

	LiF	BaF <sub>2</sub>	CaF <sub>2</sub>	MgF <sub>2</sub>
Density, kg/m <sup>3</sup>	2.601x10 <sup>3</sup>	4.83x10 <sup>3</sup>	3.18x10 <sup>3</sup>	3.176x10 <sup>3</sup>
Crystal Symmetry	Cubic Fm3m	Cubic Fm3m	Cubic Fm3m	Tetragonal P4 <sub>2</sub> /mnm
Lattice Parameters, Å	4.0279	6.196	5.462	a=3.06; c=4.6
Melting Temperature, K	1143	1626	1692	1528
Heat Capacity J/kgK at 283K	1561.7	456	887.6	0.92
Thermal Conductivity W/mK	14.2	7.1	9.71	3.14
Coefficient of linear thermal expansion $\alpha \cdot 10^7$ , ( per °C )	310	184	178	89.5 $\perp$ axis C 140 $\parallel$ axis C
Moos Hardness	3	3	5	6

### REFRACTIVE INDICES FOR FLUORIDE CRYSTALS

$\lambda$ , nm	CaF <sub>2</sub>	LiF	BaF <sub>2</sub>	MgF <sub>2</sub>	
				$n_o$	$n_e$
150		1.4990		1.4633	1.4767
193	1.5098	1.4477	1.5502	1.4296	1.4432
248	1.4733	1.4182	1.5193	1.4039	1.4167
308	1.4516	1.4083	1.4989	1.3904	1.4023
400	1.4394	1.3992	1.4841	1.3837	1.3958
600	1.4334	1.3918	1.4740	1.2763	1.3881
800	1.4305	1.3889	1.4704	1.3751	1.3867
1000	1.4289	1.3871	1.4685	1.3736	1.3852
2000	1.4241	1.3787	1.4645	1.3681	1.3792
3000	1.4171	1.3666	1.4619	1.3601	1.3706
4000	1.4096	1.3494	1.4571	1.3478	1.3575
5000	1.3991	1.3266	1.4509	1.3302	1.3393
6000	1.3857	1.2973	1.4449	1.3071	1.3167
7000	1.3693	1.2556	1.4356	1.2791	1.2917
8000	1.3498	1.2150	1.4257		
9000	1.3271		1.4145		
10000			1.4014		

