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Material Properties

Five Schott Glass Types

The following paragraphs list the most important optical and physical constants for Schott optical glass types BK7, SF11, LaSFN9, BaK1, and F2. These types are used in most Melles Griot simple lens products and prisms. Index of refraction and transmission, as well as the most commonly required chemical characteristics and mechanical constants, are listed. Further numerical data and a more detailed discussion of the various testing processes can be found in the Schott Optical Glass catalog.

The index of refraction data were obtained by using the constants listed below together with the dispersion formula. The constants were determined through the index-of-refraction measurements of a typical melt for each glass type. Note that the dispersion formula is valid only within the wavelength range listed. It can be used to interpolate refractive index at other wavelengths within this range (to a precision of 1×10^{-5} or better), but it should not be used to extrapolate to wavelengths beyond this range. Furthermore, the actual melt-to-melt tolerance on the index of refraction typically is about ± 0.001 .

BK7 Glass

Abbé Constant: 64.17

Density: 2.51 g/cm^3

Young's Modulus: $8.20 \times 10^9 \text{ dynes/mm}^2$

Poisson's Ratio: 0.206

Coefficient of Thermal Expansion (-30° to +70°C): $7.1 \times 10^{-6}/^\circ\text{C}$

Coefficient of Thermal Expansion (20° to 300°C): $8.3 \times 10^{-6}/^\circ\text{C}$

Stress Birefringence, (Yellow Light): 10 nm/cm

Homogeneity within Melt: $\pm 1 \times 10^{-4}$

Striae Grade (MIL-G-174-A): A

Transformation Temperature: 557°C

Climate Resistance: 2

Stain Resistance: 0

Acid Resistance: 1.0

Alkali Resistance: 2.0

Phosphate Resistance: 2.3

Knoop Hardness: 610

Dispersion Constants:

$$B_1 = 1.03961212$$

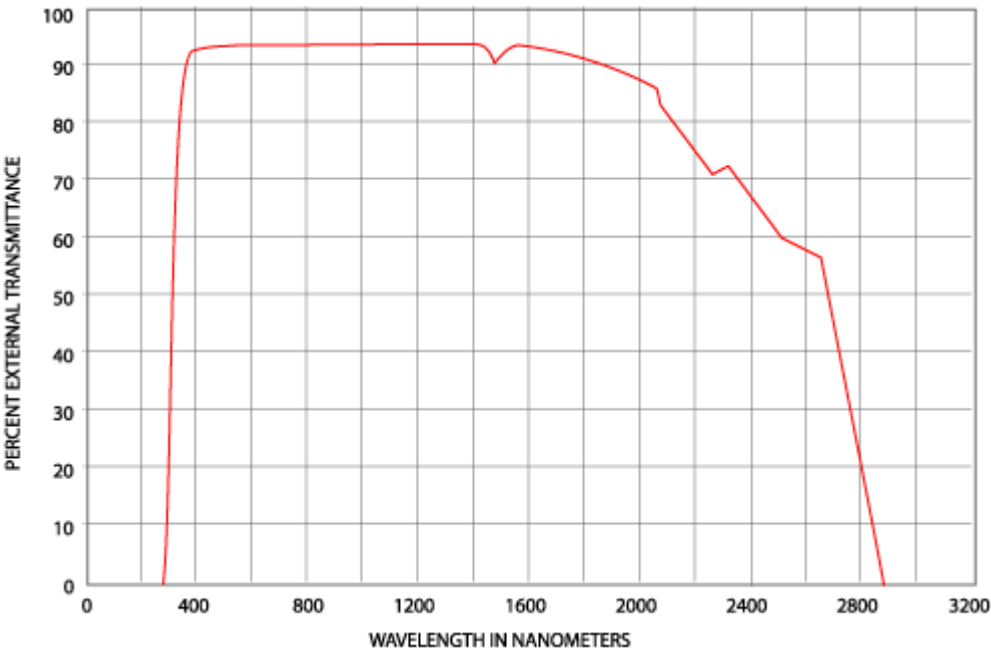
$$B_2 = 2.31792344 \times 10^{-1}$$

$$B_3 = 1.01046945$$

$$C_1 = 6.00069867 \times 10^{-3}$$

$$C_2 = 2.00179144 \times 10^{-2}$$

$C_3 = 1.03560653 \times 10^{-6}$



External transmission for 10-mm-thick BK7 glass

Physical Constants of BK7 Glass

Wavelength (nm)	Refractive Index <i>n</i>	Fraunhofer Designation	Source	Spectral Region
351.1	1.53894	--	Ar laser	UV
363.8	1.53649	--	Ar laser	UV
404.7	1.53024	h	Hg arc	Violet
435.8	1.52668	g	Hg arc	Blue
441.6	1.52611	--	HeCd laser	Blue
457.9	1.52461	--	Ar laser	Blue
465.8	1.52395	--	Ar laser	Blue
472.7	1.52339	--	Ar laser	Blue
476.5	1.52309	--	Ar laser	Blue
480.0	1.52283	F'	Cd arc	Blue
486.1	1.52238	F	H ₂ arc	Blue
488.0	1.52224	--	Ar laser	Blue
496.5	1.52165	--	Ar laser	Green
501.7	1.52130	--	Ar laser	Green
514.5	1.52049	--	Ar laser	Green
532.0	1.51947	--	Nd laser	Green
546.1	1.51872	e	Hg arc	Green
587.6	1.51680	d	He arc	Yellow
589.3	1.51673	D	Na arc	Yellow
632.8	1.51509	--	HeNe laser	Red
643.8	1.51472	C'	Cd arc	Red
656.3	1.51432	C	H ₂ arc	Red
687.8	1.51300	--	HeNe laser	Red

694.3	1.51322	--	Ruby laser	Red
786.0	1.51106	--	--	IR
821.0	1.51037	--	--	IR
830.0	1.51020	--	GaAlAs laser	IR
852.1	1.50980	s	Ce arc	IR
904.0	1.50893	--	GaAs laser	IR
1014.0	1.50731	t	Hg arc	IR
1060.0	1.50669	--	Nd laser	IR
1300.0	1.50370	--	InGaAsP laser	IR
1500.0	1.50127	--	--	IR
1550.0	1.50065	--	--	IR
1970.1	1.49495	--	Hg arc	IR
2325.4	1.48921	--	Hg arc	IR

SF11 Glass

Abbé Constant: 25.76

Density: 4.74 g/cm⁻³

Young's Modulus: 6.60 x 10⁹ dynes/mm²

Poisson's Ratio: 0.235

Coefficient of Thermal Expansion (-30° to +70°C): 6.1 x 10⁻⁶/°C

Coefficient of Thermal Expansion (20° to 300°C): 6.8 x 10⁻⁶/°C

Stress Birefringence, (Yellow Light): 10 nm/cm

Melt-to-Melt Mean Index Tolerance: ±0.001

Homogeneity within Melt: ±1 x 10⁻⁴

Striae Grade (MIL-G-174-A): A

Transformation Temperature: 505°C

Climate Resistance: 1

Stain Resistance: 0

Acid Resistance: 1.0

Alkali Resistance: 1.2

Phosphate Resistance: 1.0

Knoop Hardness: 450

Dispersion Constants:

$$B_1 = 1.73848403$$

$$B_2 = 3.11168974 \times 10^{-1}$$

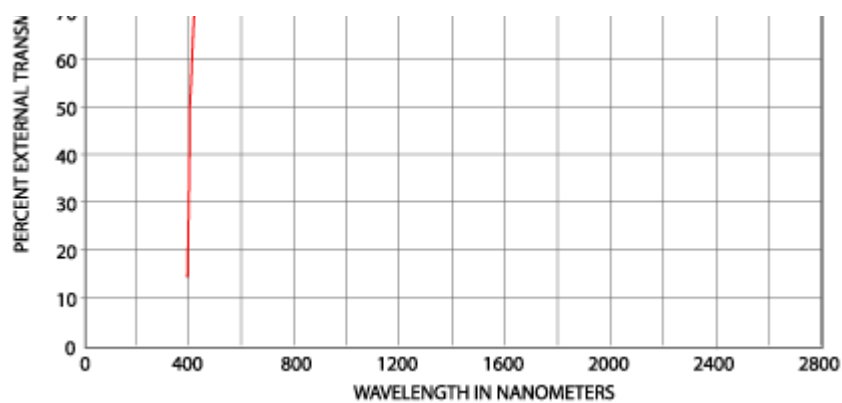
$$B_3 = 1.17490871$$

$$C_1 = 1.36068604 \times 10^{-2}$$

$$C_2 = 6.15960463 \times 10^{-2}$$

$$C_3 = 1.21922711 \times 10^2$$





External transmission for 10-mm-thick SF11 glass

Physical Constants of SF11 Glass

Wavelength (nm)	Refractive Index <i>n</i>	Fraunhofer Designation	Source	Spectral Region
404.7	1.84208	h	Hg arc	Violet
435.8	1.82518	g	Hg arc	Blue
441.6	1.82259	--	HeCd laser	Blue
457.9	1.81596	--	Ar laser	Blue
465.8	1.81307	--	Ar laser	Blue
472.7	1.81070	--	Ar laser	Blue
476.5	1.80946	--	Ar laser	Blue
480.0	1.80834	F'	Cd arc	Blue
486.1	1.80645	F	H ₂ arc	Blue
488.0	1.80590	--	Ar laser	Blue
496.5	1.80347	--	Ar laser	Green
501.7	1.80205	--	Ar laser	Green
514.5	1.79880	--	Ar laser	Green
532.0	1.79479	--	Nd laser	Green
546.1	1.79190	e	Hg arc	Green
587.6	1.78472	d	He arc	Yellow
589.3	1.78446	D	Na arc	Yellow
632.8	1.77862	--	HeNe laser	Red
643.8	1.77734	C'	Cd arc	Red
656.3	1.77599	C	H ₂ arc	Red
694.3	1.77231	--	Ruby laser	Red
786.0	1.76558	--	--	IR
821.0	1.76359	--	--	IR
830.0	1.76311	--	GaAlAs laser	IR
852.1	1.76200	s	Ce arc	IR
904.0	1.75970	--	GaAs laser	IR
1014.0	1.75579	t	Hg arc	IR
1060.0	1.75445	--	Nd laser	IR
1300.0	1.74901	--	InGaAsP laser	IR
1500.0	1.74554	--	--	IR

1550.0	1.74474	--	--	IR
1970.1	1.73843	--	Hg arc	IR
2325.4	1.73294	--	Hg arc	IR

LaSFN9 Glass

Abbé Constant: 32.17

Density: 4.44 g/cm⁻³

Young's Modulus: 1.09 x 10¹⁰ dynes/mm²

Poisson's Ratio: 0.286

Coefficient of Thermal Expansion (-30° to +70°C): 7.4 x 10⁻⁶/°C

Coefficient of Thermal Expansion (20° to 3000°C): 8.4 x 10⁻⁶/°C

Stress Birefringence, (Yellow Light): 10 nm/cm

Melt-to-Melt Mean Index Tolerance: ±0.002

Homogeneity within Melt: ±1 x 10⁻⁴

Striae Grade (MIL-G-174-A): A

Transformation Temperature: 703°C

Climate Resistance: 2

Stain Resistance: 0

Acid Resistance: 2.0

Alkali Resistance: 1.0

Phosphate Resistance: 1.0

Knoop Hardness: 630

Dispersion Constants:

$$B_1 = 1.97888194$$

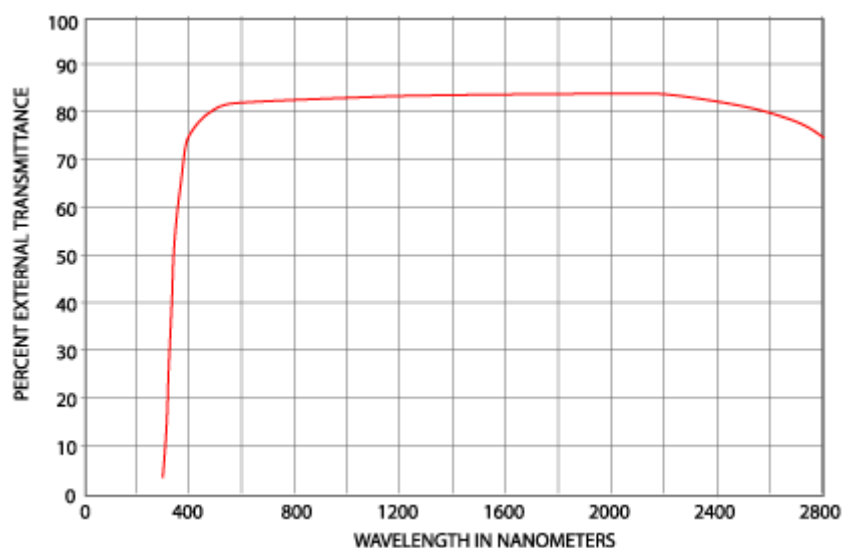
$$B_2 = 3.20435298 \times 10^{-1}$$

$$B_3 = 1.92900751$$

$$C_1 = 1.18537266 \times 10^{-2}$$

$$C_2 = 5.27381770 \times 10^{-2}$$

$$C_3 = 1.66256540 \times 10^2$$



External transmission for 10-mm-thick LaSFN9 glass

Physical Constants of LaSFN9 Glass

Wavelength (nm)	Refractive Index <i>n</i>	Fraunhofer Designation	Source	Spectral Region
404.7	1.89844	h	Hg arc	Violet
435.8	1.88467	g	Hg arc	Blue
441.6	1.88253	--	HeCd laser	Blue
457.9	1.87700	--	Ar laser	Blue
465.8	1.87458	--	Ar laser	Blue
472.7	1.87259	--	Ar laser	Blue
476.5	1.87153	--	Ar laser	Blue
480.0	1.87059	F'	Cd arc	Blue
486.1	1.86899	F	H ₂ arc	Blue
488.0	1.86852	--	Ar laser	Blue
496.5	1.86645	--	Ar laser	Green
501.7	1.86524	--	Ar laser	Green
514.5	1.86245	--	Ar laser	Green
532.0	1.85901	--	Nd laser	Green
546.1	1.85651	e	Hg arc	Green
587.6	1.85025	d	He arc	Yellow
589.3	1.85002	D	Na arc	Yellow
632.8	1.84489	--	HeNe laser	Red
643.8	1.84376	C'	Cd arc	Red
656.3	1.84256	C	H ₂ arc	Red
694.3	1.83928	--	Ruby laser	Red
786.0	1.83323	--	--	IR
821.0	1.83142	--	--	IR
830.0	1.83098	--	GaAlAs laser	IR
852.1	1.82997	s	Ce arc	IR
904.0	1.82785	--	GaAs laser	IR
1014.0	1.82420	t	Hg arc	IR
1060.0	1.82293	--	Nd laser	IR
1300.0	1.81764	--	InGaAsP laser	IR
1500.0	1.81412	--	--	IR
1550.0	1.81329	--	--	IR
1970.1	1.80657	--	Hg arc	IR
2325.4	1.80055	--	Hg arc	IR

BaK1 Glass

Abbé Constant: 57.55

Density: 3.19 g/cm⁻³Young's Modulus: 7.30 x 10⁹ dynes/mm²

Poisson's Ratio: 0.252

Coefficient of Thermal Expansion (20° to +70°C): 7.6 x 10⁻⁶/°C

Coefficient of Thermal Expansion (-30° to +70°C): $7.6 \times 10^{-7}/^{\circ}\text{C}$

Coefficient of Thermal Expansion (20° to 3000°C): $8.6 \times 10^{-6}/^{\circ}\text{C}$

Stress Birefringence, (Yellow Light): 10 nm/cm

Melt-to-Melt Mean Index Tolerance: ± 0.001

Homogeneity within Melt: $\pm 1 \times 10^{-4}$

Striae Grade (MIL-G-174-A): A

Transformation Temperature: 592°C

Climate Resistance: 2

Stain Resistance: 1

Acid Resistance: 3.3

Alkali Resistance: 1.2

Phosphate Resistance: 2.0

Knoop Hardness: 530

Dispersion Constants:

$$B_1 = 1.12365662$$

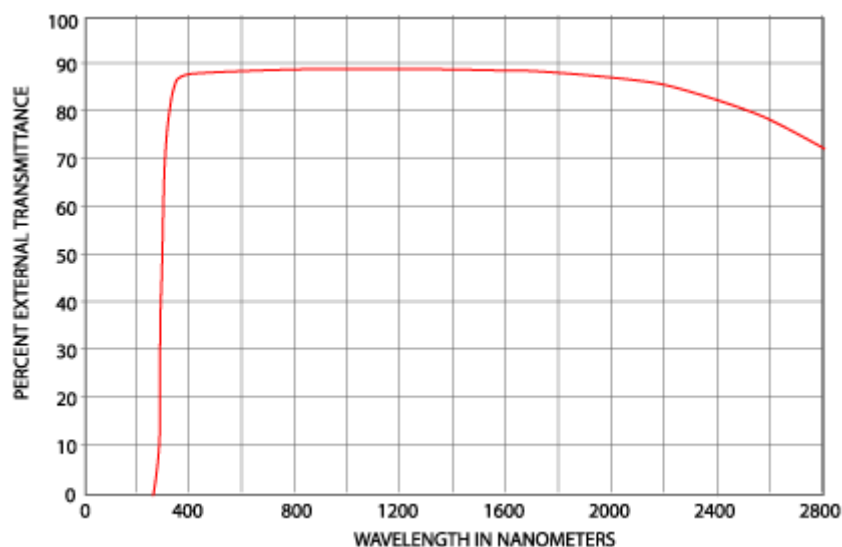
$$B_2 = 3.09276848 \times 10^{-1}$$

$$B_3 = 8.81511957 \times 10^{-1}$$

$$C_1 = 6.44742752 \times 10^{-3}$$

$$C_2 = 2.22284402 \times 10^{-2}$$

$$C_3 = 1.07297751 \times 10^2$$



External transmission for 10-mm-thick LaSFN9 glass

Physical Constants of BAK1 Glass

Wavelength (nm)	Refractive Index n	Fraunhofer Designation	Source	Spectral Region
351.1	1.60062	--	Ar laser	UV
363.8	1.59744	--	Ar laser	UV
404.7	1.58941	h	Hg arc	Violet
435.8	1.58488	g	Hg arc	Blue
441.6	1.58415	--	HeCd laser	Blue
457.9	1.58226	--	Ar laser	Blue
465.8	1.58141	--	Ar laser	Blue
472.7	1.58071	--	Ar laser	Blue

476.5	1.58034	--	Ar laser	Blue
480.0	1.58000	F'	Cd arc	Blue
486.1	1.57943	F	H ₂ arc	Blue
488.0	1.57927	--	Ar laser	Blue
496.5	1.57852	--	Ar laser	Green
501.7	1.57809	--	Ar laser	Green
514.5	1.57707	--	Ar laser	Green
532.0	1.57580	--	Nd laser	Green
546.1	1.57487	e	Hg arc	Green
587.6	1.57250	d	He arc	Yellow
589.3	1.57241	D	Na arc	Yellow
632.8	1.57041	--	HeNe laser	Red
643.8	1.56997	C'	Cd arc	Red
656.3	1.56949	C	H ₂ arc	Red
694.3	1.56816	--	Ruby laser	Red
786.0	1.56564	--	--	IR
821.0	1.56485	--	--	IR
830.0	1.56466	--	GaAlAs laser	IR
852.1	1.56421	s	Ce arc	IR
904.0	1.56325	--	GaAs laser	IR
1014.0	1.56152	t	Hg arc	IR
1060.0	1.56088	--	Nd laser	IR
1300.0	1.55796	--	InGaAsP laser	IR
1500.0	1.55575	--	--	IR
1550.0	1.55520	--	--	IR
1970.1	1.55032	--	Hg arc	IR
2325.4	1.54556	--	Hg arc	IR

F2 Glass

Abbé Constant: 36.37

Density: 3.61 g/cm⁻³

Young's Modulus: 5.70 x 10⁹ dynes/mm²

Poisson's Ratio: 0.220

Coefficient of Thermal Expansion (-30° to +70°C): 8.2x10⁻⁶/°C

Coefficient of Thermal Expansion (20° to 3000°C): 9.2 x 10⁻⁶/°C

Stress Birefringence, (Yellow Light): 10 nm/cm

Melt-to-Melt Mean Index Tolerance: ±0.001

Homogeneity within Melt: ±1 x 10⁻⁴

Striae Grade (MIL-G-174-A): A

Transformation Temperature: 438°C

Climate Resistance: 1

Stain Resistance: 0

Acid Resistance: 1.0

Not Available

Alkali Resistance: 1.3

Phosphate Resistance: 1.3

Knoop Hardness: 420

Dispersion Constants:

$B_1 = 1.34533359$

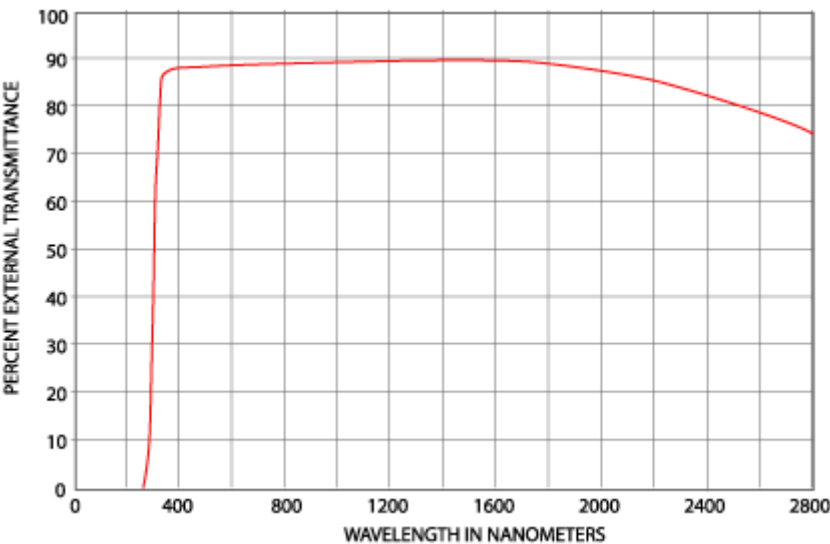
$B_2 = 2.09073176 \times 10^{-1}$

$B_3 = 9.37357162 \times 10^{-1}$

$C_1 = 9.97743871 \times 10^{-3}$

$C_2 = 4.70450767 \times 10^{-2}$

$C_3 = 1.11886764 \times 10^2$



External transmission for 10-mm-thick F2 glass

Physical Constants of F2 Glass

Wavelength (nm)	Refractive Index <i>n</i>	Fraunhofer Designation	Source	Spectral Region
351.1	1.67359	--	Ar laser	UV
363.8	1.66682	--	Ar laser	UV
404.7	1.65064	h	Hg arc	Violet
435.8	1.64202	g	Hg arc	Blue
441.6	1.64067	--	HeCd laser	Blue
457.9	1.63718	--	Ar laser	Blue
465.8	1.63564	--	Ar laser	Blue
472.7	1.63437	--	Ar laser	Blue
476.5	1.63370	--	Ar laser	Blue
480.0	1.63310	F'	Cd arc	Blue
486.1	1.63208	F	H ₂ arc	Blue
488.0	1.63178	--	Ar laser	Blue
496.5	1.63046	--	Ar laser	Green
501.7	1.62969	--	Ar laser	Green
514.5	1.62790	--	Ar laser	Green
532.0	1.62569	--	Nd laser	Green
546.1	1.62408	e	Hg arc	Green

587.6	1.62004	d	He arc	Yellow
589.3	1.61989	D	Na arc	Yellow
632.8	1.61656	--	HeNe laser	Red
643.8	1.61582	C'	Cd arc	Red
656.3	1.61503	C	H ₂ arc	Red
694.3	1.61288	--	Ruby laser	Red
786.0	1.60889	--	--	IR
821.0	1.60768	--	--	IR
830.0	1.60739	--	GaAlAs laser	IR
852.1	1.60671	s	Ce arc	IR
904.0	1.60528	--	GaAs laser	IR
1014.0	1.60279	t	Hg arc	IR
1060.0	1.60190	--	Nd laser	IR
1300.0	1.59813	--	InGaAsP laser	IR
1500.0	1.59550	--	--	IR
1550.0	1.59487	--	--	IR
1970.1	1.58958	--	Hg arc	IR
2325.4	1.58465	--	Hg arc	IR

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