

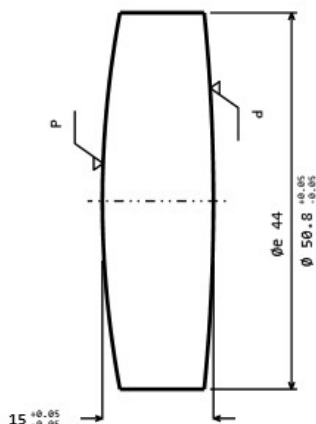


ISO 10110 Cheat Sheet

Indication	Title	Units	Example
0/	Stress Birefringence	nm/cm	0/ 10
1/	Bubbles and Inclusions	Number X Area	1/ 1x.1
2/	Inhomogeneity and Striae	Homogeneity Class; Striae Class	2/ 2; 3
3/	Surface Form Tolerances	Nanometers	3/ 3(1); $\lambda = 632.8\text{nm}$
4/	Centering Tolerances	Arc Minutes (')	4/ 1'
5/	Surface Imperfection Tolerances	A = Digs, C = Coating Defects, L = Scratches, E = Edge Chips	5/ 5x0.20; L1 x 0.004; E0.5
6/	Laser Irradiation Damage Threshold	J/cm ²	6/ 1; 1064; 3

Left Surface, Even Asphere
 2nd Order Term 0.00000E+00
 4th Order Term -7.86463E-08
 6th Order Term -6.80745E-11
 8th Order Term 8.02679E-14

Sag Table: Aperture, Sag
 0.00000E+00
 5.00000E+00 9.22302E-02
 1.00000E+01 3.68653E-01
 1.50000E+01 8.28249E-01
 2.00000E+01 1.46923E+00



Dimensions in Millimeters

Left Surface	Material	Right Surface
R 135.503 CX Even Asphere See Above Øe 44 Chamfer: Ø - .5 Rabs (1064nm) < .25% 3/ 5(.5um PV Form Error) 4/ 1' 5/ - 6/ - Note: 60-40 .2um/mm Slope Error 1mm Integration Window	GLASS: CORNING_7980_0A Nd = 1.458464 Vd = 67.82 Ø/ - 1/ - 2/ -	R 258.175 CX Øe 44 Chamfer: Ø - .5 Rabs (1064nm) < .25% 3/ 3(1) 4/ 1' 5/ - 6/ - Note: 60-40

0/	Stress Birefringence	See Tables
1/	Bubbles and Inclusions	.1mm Bubble (Total cross section in mm squared per 100 cm ²)
2/	Inhomogeneity and Striae	See Tables
3/	Surface Form Tolerances A(B/C)	A: Optical Power or the difference between the actual radius and the target.
	RMSx < D; $\lambda = E$	B: Irregularity describes the deviation from the ideal form
		C: Rotationally invariant irregularity
4/	Centering Tolerances	Angle between the datum and the surface.
5/	Surface Imperfection Tolerances	NxA; CN'xA', LN"xA", EA''' or S-D
6/	Laser Irradiation Damage Threshold	Pulsed or continuous laser

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Material Cheat Sheet

Refractive Index and Dispersion					
Ohara*			Schott**		
Grade	nd	vd	Grade	Refractive Index	Abbe Number
Standard	± 0.0003	± 0.5%	Step 3	± .0005	± .5%
Upon Request	± 0.0002	± 0.3%	Step 2	± .0003	± .3%
			Step 1	± .0002	± .2%
			Step 0.5	± .0001	± .1%
Reporting of Actual Values					
Standard Reporting	± 0.00003	± 0.00002	V-Block Standard	± .00003	± .00002
Precision Reporting	± 0.00001	± 0.000003	V-Block Enhanced	± .00002	± .00001
			Precision Spectrometer	± .000004	± .0000002
*Ohara Guarantee of Quality			**TIE-29 Refractive Index and Dispersion		

Homogeneity				
Ohara*		Schott**	ISO 10110**	Homogeneity (Δn)
Grade	Homogeneity (Δn)	Grade	Grade	
A1	± 1x10 ⁻⁶	H5	5	± 0.5x10 ⁻⁶
		H4	4	± 1x10 ⁻⁶
A2	± 2x10 ⁻⁶	H3	3	± 2x10 ⁻⁶
A5	± 5x10 ⁻⁶	H2	2	± 5x10 ⁻⁶
A20	± 20x10 ⁻⁶	H1	1	± 20x10 ⁻⁶
		S1		
		S0	0	± 50x10 ⁻⁶
*Ohara Guarantee of Quality		**TIE-26 Homogeneity of Optical Glass		

Striae							
Ohara*		Schott**				ISO 10110**	
Grade	Description	Old Schott		New Schott		Grade	≥30nm
		Grade	Description	Grade	Description		
A	No visible striae	VS	No striae visible	VS1/VS2	No Striae in 1/2 directions	5	Extreme low striae content
		A	< 10nm	~< 15nm	Finished Glass	4	≤ 1%
B ¹	Striae is light and scattered	B ¹	~ 15nm	< 30nm	Normal quality on raw glass	3	≤ 2%
C	Striae is heavier than grade B	C	~ 30nm			2	≤ 2%
		D	~ 60nm			1	≤ 10%
*Ohara Guarantee of Quality		¹Standard Grade B			**TIE-25: Striae in Optical Glass		

Stress Birefringence				
Ohara*			Schott**	
Annealing	Class	Stress Birefringence	Grade	Stress Birefringence
Precision	1	5nm/cm	SB02	≤ 2nm/cm
			SB04	≤ 4nm/cm
Fine Anneal (Standard)	2	10nm/cm	SB06	≤ 6nm/cm
Course	3	20nm/cm	SB12	≤ 12nm/cm
			SB20	≤ 20nm/cm
*Ohara Guarantee of Quality			** TIE-27 Stress in Optical Glass	

Corning Fused Silica										
Inclusion Class			Homogeneity ³⁻⁴ [ppm]							
			Grade							
Class	Total Inclusion Cross Section ¹ [mm²]	Maximum Size ² [mm]	AA	A	B	C	D	E	F	G
			≤ 0.5	≤ 1	≤ 1.5	≤ 2	≤ 3	≤ 4	≤ 5	NS ⁵
0	≤ 0.03	0.10	*	*	*	*	*	*	*	*
1	≤ 0.10	0.28		*	*	*	*	*	*	*
2	≤ 0.25	0.50			*	*	*	*	*	*
3	≤ 0.50	0.76				*	*	*	*	*
4	≤ 1.00	1.00				*	*	*	*	*
5	≤ 2.00	1.27				*	*	*	*	*
1. Defines the sum of the cross section in mm² of inclusions per 100 cm³ of glass. Inclusions with a diameter ≤ 0.10 mm are disregarded. 2. Refers to the diameter of the largest single inclusion 3. Index homogeneity: the maximum index variation (relative), measured over the clear aperture of the blank. Index homogeneity is certified using an interferometer at 632.8nm. The numerical homogeneity is reported as the average through the piece thickness. 4. Blanks with a diameter up to 450mm can be analyzed over the full aperture. Larger parts can be analyzed using multiple apertures. The minimum thickness for index homogeneity verification is 20mm. For thinner parts, the parent piece is certified. 5. NS (Not Specified)										

Corning HPFS Data and Properties	Inclusion Class	Homogeneity Grade	Birefringence Lower specifications available upon request [nm/cm]	Striae ISO 10110-4 Class	Metallic Impurities [ppb]	OH Content [ppm]
7979 IR Grade	0,1,2	AA,A,C,F	≤ 5	5	< 100	< 1
7980 Standard Grade**	0-5	AA-F	≤ 5	5	< 1000	800-1000
7980 KrF Grade*	0,1,2	AA,A,C,F	≤ 1	5	< 500	800-1000
7980 ArF Grade*	0,1,2	AA,A,C,F	≤ 1	5	< 100	800-1000
7980 Mirror Grade		NS	≤ 5	1	NS	800-1000
7980 Industrial Grade	NS	NS	≤ 5	1	NS	800-1000
8655 ArF Grade*	0,1,2	AA,A,C,F	≤ 1	5	< 10	< 1

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