OHARA

OPTICAL GLASS

JAN. 2020

OHARA

Contents

S-FPM4 (08 2019)

S-FPM4 has high partial dispersion ratios $\theta_{g,F}$ in the FPM region, and is an optical glass for polished lenses, effective for correction of secondary chromatic aberration.

A glass material that can be used in a wide range of applications, such as interchangeable and automotive lenses.

	S-FPM4	S-FPM3	S-FPM2
Refractive Index n_d	1.52841	1.53775	1.59522
Abbe Number ν_d	76.46	74.70	67.74
Rel. Partial Disp. $\theta_{g,F}$	0.5396	0.5392	0.5442
Dev. of Rel. Disp. $\Delta\theta_{g,F}$	0.0218	0.0186	0.0123
CTE α [10^{-7}/K] (−30°.. +70°C)	123	115	117
CTE α [10^{-7}/K] (+100°.. +300°C)	143	138	135
Coloring λ80/λ5	340/–	345/–	355/–
$RW_{(P)}$	1	1	1
$RA_{(P)}$	3	3	1
$W_{(S)}$	1	1	2
SR	51.3	5.1	51.3
PR	4.3	4.1	4.1
Specific Gravity	3.76	3.64	4.17
Knoop Hardness Hk	360 [4]	390 [4]	390 [4]
Abrasion Aa	506	373	488

S-LAH60MQ (10 2018)

S-LAH60MQ, equivalent to S-LAH60 and S-LAH60V for n_d and ν_d, is an optical glass with high refractive indices which has the smallest dn/dT among current LAH glasses.

S-LAH60MQ can be used for automotive camera lenses but also projectors, photographic interchangeable lenses and various applications.

	S-LAH60MQ	S-LAH60	S-LAH60V
Refractive Index n_d	1.83400	1.83400	1.83400
Abbe Number ν_d	37.17	37.16	37.21
dn/dT rel. D-line, 40–60 °C	–0.1	7.9	9.2
CTE α [10^{-7}/K] (–30 °.. +70 °C)	85	56	58
CTE α [10^{-7}/K] (+100 °.. +300 °C)	98	71	73
Coloring λ80 / λ5	425/340	420/340	430/350
$RW_{(P)}$	1	1	1
$RA_{(P)}$	3	3	3
$W_{(S)}$	3	1	1
SR	51.2	4.2	51.2
PR	1.2	1.0	1.0
Specific Gravity	4.71	4.43	4.43
Knoop Hardness Hk	520 [5]	670 [7]	660 [7]
Abrasion Aa	160	78	57

S-LAL7Q (09 2018)

S-LAL7Q is an optical glass with improved chemical durability in the region of LAL.

S-LAL7Q has very similar refractive indices and abbe number, shows better processability for lens polishing, and lower specific gravity than S-LAL7.

	S-LAL7Q	S-LAL7
Refractive Index n_d	1.65160	1.65160
Refractive Index n_C	1.64819	1.64821
Refractive Index n_F	1.65932	1.65934
Refractive Index n_g	1.66532	1.66537
Abbe Number ν_d	58.54	58.55
dn/dT rel. D-line, 40–60 °C	4.5	2.3
CTE α [10^{-7}/K] (–30°.. +70 °C)	55	70
Coloring λ80 / λ5	365 / –	345 / 275
$RW_{(P)}$	2	3
$RA_{(P)}$	4	5
$W_{(S)}$	3	2-3
SR	52.0	53.0
PR	4.0	4.0
Specific Gravity	3.24	3.73
Knoop Hardness Hk	680 [7]	560 [6]
Abrasion Aa	75	136

S-LAL21 (05 2018)

S-LAL21 is an optical glass with improved chemical durability in the region of LAL-glasses.

Refractive Index n_d	1.70300
Abbe Number ν_d	52.38
CTE α [10^{-7}/K] (–30°.. +70°C)	50
CTE α [10^{-7}/K] (+100°.. 300°C)	61
Coloring λ80/λ5	395/320
Tg [°C]	767
At [°C]	814
$RW_{(P)}$	1
$RA_{(P)}$	1
$W_{(S)}$	2
SR	4.0
PR	1.0
Specific Gravity	3.85
Knoop Hardness Hk	690 [7]
Abrasion Aa	60

S-NBH58 (05 2018)

Though S-NBH58 has high refractive indices with high dispersion, the partial dispersion ratio $\theta_{g,F}$ is low. That's why S-NBH58 could be effective for correcting chromatic aberration by combining with anomalous dispersion glasses, having both low refractive indices and low dispersion.

Refractive Index n_d	1.78880
Abbe Number ν_d	28.43
Rel. Partial Disp. $\theta_{g,F}$	0.6009
CTE α [10^{-7}/K] (−30°.. +70°C)	74
CTE α [10^{-7}/K] (+100°.. 300°C)	95
Coloring λ80/λ5	410/345
Tg [°C]	560
At [°C]	600
$RW_{(P)}$	1
$RA_{(P)}$	1
$W_{(S)}$	2
SR	1.0
PR	1.0
Specific Gravity	3.33
Knoop Hardness Hk	590 [6]
Abrasion Aa	131

S-NPH7 (05 2018)

S-NPH7 is an optical glass which has the smallest dn/dT in the region of NPH, high refractive indices and high dispersion.

Refractive Index n_d	1.77830
Abbe Number ν_d	23.91
dn/dT rel. D-line, 40 – 60 °C	–4.1
CTE α [10^{-7}/K] (–30 °.. +70 °C)	109
CTE α [10^{-7}/K] (+100 °.. 300 °C)	130
Coloring λ80 / λ5	420 / 370
Tg [°C]	569
At [°C]	598
$RW_{(P)}$	1
$RA_{(P)}$	1
$W_{(S)}$	2
SR	1.0
PR	1.0
Specific Gravity	3.30
Knoop Hardness Hk	350 [4]
Abrasion Aa	448

S-LAH98 and S-LAH99 (04 2018)

S-LAH98 and S-LAH99 are optical glasses for polished lenses, effective for higher performance, with increased transmittance, lower cost & lower specific gravity at the region of glasses with high refractive indices and low dispersion, similar to S-LAH79.

	S-LAH98	S-LAH99	S-LAH79
Refractive Index n_d	1.95375	2.00100	2.00330
Abbe Number ν_d	32.32	29.14	28.27
dn/dT rel. D-line, 40–60 °C	4.4	4.5	9.7
CTE α [10^{-7}/K] (–30 °.. +70 °C)	73	75	60
CTE α [10^{-7}/K] (+100 °.. +300 °C)	87	88	71
Tg [°C]	723	725	699
At [°C]	757	761	731
Coloring λ70 / λ5	405 / 355	425 / 360	460 / 370
$RW_{(P)}$	1	1	1
$RA_{(P)}$	1	1	1
$W_{(S)}$	1	1	2
SR	3.0	2.0	1.0
PR	1.0	1.0	1.0
Specific Gravity	4.94	5.02	5.23
Knoop Hardness Hk	650 [7]	650 [7]	700 [7]
Abrasion Aa	61	61	61

S-LAH63Q (11 2017)

S-LAH63Q is an optical glass with high refractive index which has the smallest positive dn/dT at the region of LAH.

Advantages

– smallest positive dn/dT at the region of LAH (D-line 40 °C ~ 60 °C) 1.6
– equivalent to S-LAH63 for n_d and ν_d

	S-LAH63Q	S-LAH63
Refractive Index n_d	1.80440	1.80440
Abbe Number ν_d	39.58	39.59
dn/dT rel. D-line, 40–60 °C	1.6	7.5
CTE α [10^{-7}/K] (–30 °.. +70 °C)	79	58
Tg [°C]	669	607
At [°C]	701	630
Coloring λ80 / λ5	415 / 345	410 / 340
$RW_{(P)}$	1	1
$RA_{(P)}$	3	3
$W_{(S)}$	3	1
SR	51.2	4.2
PR	1.0	1.0
Specific Gravity	4.45	4.34
Knoop Hardness Hk	580 [6]	640 [6]
Abrasion Aa	121	82

S-LAM73 (10 2017)

S-LAM73 has negative dn/dT at the region of LAM. In cars variation of temperature can be large from below zero to more than 50 °C. Usually, automotive camera lenses, have a fixed focal length, so, since many optical glasses have positive dn/dT, by combining these optical glasses with S-LAM73, the fluctuations of refractive index due to temperature change can be adjusted efficiently. Of course, S-LAM73 can be used for not only Automotive camera lenses but also projectors, photographic interchangeable lenses and various applications.

Refractive Index n_d	1.79360
Abbe Number ν_d	37.09
dn/dT rel. D-line, 40–60 °C	–0.8
CTE α [10^{-7}/K] (–30 °.. +70 °C)	89
Tg [°C]	623
At [°C]	658
Coloring λ80 / λ5	415 / 350
$RW_{(P)}$	1
$RA_{(P)}$	4
$W_{(S)}$	3
SR	52.2
PR	2.2
Specific Gravity	4.45
Knoop Hardness Hk	570 [6]
Abrasion Aa	182

S-LAH97 (06 2017)

S-LAH97 is an optical glass for polished lenses. We are successful in the cost reduction of S-YGH51 by removing expensive raw material from S-YGH51. We are pleased to introduce S-LAH97 as an optical glass which can be effective for cost reduction and higher performance of customer's products. S-LAH97 can be used in a wide variety of applications which are Interchangeable lenses for Single-lens reflex cameras, Projectors and so on.

	S-LAH97	S-YGH51
Refractive Index n_d	1.75500	1.75500
Abbe Number ν_d	52.32	52.32
CTE α [10^{-7}/K] (–30 °.. +70 °C)	58	58
Tg [°C]	692	700
At [°C]	709	712
Coloring λ80/λ5	355/–	370/280
$RW_{(P)}$	1	1
$RA_{(P)}$	4	4
$W_{(S)}$	2	1
SR	51.2	51.0
PR	2.0	2.0
Specific Gravity	4.17	4.40
Knoop Hardness Hk	730 [7]	720 [7]
Abrasion Aa	64	61

S-LAL54Q (05 2017)

S-LAL54Q is an optical glass for polished lens which has improved on water resistance, acid resistance and mechanical strength required for Automotive camera lenses and various applications.

Advantages

– Excellent chemical durability

– High Mechanical Strength

– Small CTE – The smallest CTE among OHARA optical glasses

	S-LAL54Q	S-LAL54
Refractive Index n_d	1.65100	1.65100
Abbe Number ν_d	56.24	56.16
CTE α [10^{-7}/K] (–30°.. +70°C)	43	71
CTE α [10^{-7}/K] (–100°.. +300°C)	55	83
Tg [°C]	688	651
At [°C]	718	675
Coloring λ80/λ5	385/–	365/325
$RW_{(P)}$	1	3
$RA_{(P)}$	3	5
$W_{(S)}$	2	5
SR	4.0	53.0
PR	3.0	4.2
Specific Gravity	3.36	3.82
Knoop Hardness Hk	680 [7]	560 [5]
Abrasion Aa	53	171

S-LAH52Q (05 2017)

S-LAH52Q is an optical glass which has extremely large positive dn/dT, can be used not only for automotive camera lenses but also for various applications.

Advantages

– The largest positive dn/dT among OHARA glasses
– Equivalent to S-LAH52 for n_d and ν_d, so different dn/dT can be selected from glasses with the same refractive index.

	S-LAH52Q	S-LAH52
Refractive Index n_d	1.79952	1.79952
Abbe Number ν_d	42.24	42.22
dn/dT rel. D-line, 40–60 °C	10.3	6.7
CTE α [10^{-7}/K] (–30 °.. +70 °C)	60	60
CTE α [10^{-7}/K] (–100 °.. +300 °C)	73	73
Tg [°C]	598	618
At [°C]	622	636
Coloring λ80/λ5	390/335	395/330
$RW_{(P)}$	1	1
$RA_{(P)}$	3	3
$W_{(S)}$	2	1
SR	52.2	51.2
PR	2.0	2.0
Specific Gravity	4.47	4.41
Knoop Hardness Hk	620 [6]	640 [6]
Abrasion Aa	54	82

S-LAL20 (05 2017)

S-LAL20 is an optical glass which has negative dn/dT, can be used not only for automotive camera lenses but also for various applications.

Advantages

– Negative dn/dT at the region of LAL
– The highest refractive index among glasses with negative dn/dT at the region of low dispersion

Refractive Index n_d	1.69930
Abbe Number ν_d	51.11
dn/dT rel. D-line, 40–60 °C	–1.2
CTE α [10^{-7}/K] (–30°.. +70 °C)	90
CTE α [10^{-7}/K] (–100°.. +300 °C)	105
Tg [°C]	628
At [°C]	676
Coloring λ80 / λ5	370 / 310
$RW_{(P)}$	2
$RA_{(P)}$	4
$W_{(S)}$	1
SR	53.1
PR	4.2
Specific Gravity	4.38
Knoop Hardness Hk	490 [5]
Abrasion Aa	243

S-TIH57 (04 2017)

S-TIH57 is an optical glass recommended for polished lens blank applications and can give low cost in the region of higher refractive index than S-TIH53 which is used in a wide variety of applications. We are pleased to introduce S-TIH57 which can contribute cost reduction and high-performance to the lenses in the field of CCTV, FA/Machine Vision, Automotive Cameras and so on.

Refractive Index n_d	1.96300
Abbe Number ν_d	24.11
$n_F - n_C$	0.039935
Rel. Partial Disp. $\theta_{g,F}$	0.6212
CTE α [10^{-7}/K] (–30°.. +70°C)	75
Tg [°C]	672
At [°C]	707
Coloring λ70/λ5	(450)/375
$RW_{(P)}$	1
$RA_{(P)}$	1
$W_{(S)}$	1
SR	3.0
PR	1.0
Specific Gravity	4.20
Knoop Hardness Hk	630 [6]
Abrasion Aa	97

S-LAH96 (12 2016)

S-LAH96 is an optical glass recommended for polished lens blank applications. Compared to S-LAH66 widely used in various applications, S-LAH96 has high partial dispersion ratio $\theta_{g,F}$ and is effective for secondary correction of chromatic aberration. We are pleased to introduce S-LAH96 which enables us to unrealized optical design.

Refractive Index n_d	1.76385
Abbe Number ν_d	48.49
$n_F - n_C$	0.015753
Rel. Partial Disp. $\theta_{g,F}$	0.5589
CTE α [10^{-7}/K] (–30°.. +70°C)	70
Tg [°C]	629
At [°C]	655
Coloring λ70/λ5	400/345
$RW_{(P)}$	1
$RA_{(P)}$	3
$W_{(S)}$	2
SR	5.0
PR	1.0
Specific Gravity	4.54
Knoop Hardness Hk	650 [7]
Abrasion Aa	73

S-LAH95 (09 2016)

S-LAH95 is an optical glass recommended for polished lens blank applications located in the high refractive index and low dispersion region. By reducing usage of expensive raw materials, S-LAH95 provides significant cost reduction. This is the fourth glass that has been developed in the same concept as S-LAH89, S-LAH92 and S-LAH93 that have been already released. We are pleased to introduce S-LAH95 optical glass with these unique properties to provide advantages in technical design and decreased production costs.

Refractive Index n_d	1.90366
Abbe Number ν_d	31.34
n_F-n_C	0.028832
Rel. Partial Disp. $\theta_{g,F}$	0.5963
CTE α [10^{-7}/K] (−30°.. +70°C)	73
Tg [°C]	649
At [°C]	684
Coloring λ70/λ5	(410)/360
$RW_{(P)}$	1
$RA_{(P)}$	1
$W_{(S)}$	1
SR	4.0
PR	1.0
Specific Gravity	4.64
Knoop Hardness Hk	630 [6]
Abrasion Aa	87

S-LAH55VS (04 2016)

S-LAH55V, which is an optical glass that cost reduction was achieved by optimization of glass composition, has been used widely in projectors and in interchangeable lenses/zoom lenses of SLR. This time, we've upgraded S-LAH55V. By re-optimization of this glass composition and freeing of the expensive raw materials contained, further cost reduction and lower specific gravity have been achieved. We are pleased to introduce S-LAH55VS with the unique properties that provide the advantages in higher product performance and lower product price.

Refractive Index n_d	1.83481
Abbe Number ν_d	42.74
$n_F - n_C$	0.019531
Rel. Partial Disp. $\theta_{g,F}$	0.5648
CTE α [10^{-7}/K] (–30°.. +70°C)	63
Tg [°C]	677
At [°C]	709
Coloring λ70/λ5	395/320
$RW_{(P)}$	1
$RA_{(P)}$	2
$W_{(S)}$	2
SR	4.0
PR	1.0
Specific Gravity	4.58
Knoop Hardness Hk	740 [7]
Abrasion Aa	64

OHARA Group

OHARA Inc.	Sagamihara, Japan
OHARA Precision Corp.	Sagamihara, Japan
OHARA Quartz Co., Ltd.	Wakayama, Japan
Taiwan OHARA Optical Co., Ltd.	Taichung, Taiwan
Taiwan OHARA Material Co., Ltd.	Huwei, Taiwan
OHARA Optical (Hong-Kong) Ltd.	Hong-Kong
OHARA Optical (Zhongshan) Ltd.	Tan Zhou, China
NHG OHARA OPTICS (Xiangyang) Co., Ltd.	Hubei, China
OHARA Optical (M) SDN. BHD.	Melaka, Malaysia
OHARA GmbH	Hofheim a. Ts., Germany
OHARA Corp. (East-/West Office)	NJ/CA, USA

Main Products

Optical Glass for Polished Lenses

This catalog showcases 134 different (S-) types of optical glass for use in polished lenses and optical elements. For the purpose of global environmental conservation, OHARA uses no lead or arsenic in these glasses. To distinguish these glasses from others containing lead or arsenic, the names for these environmentally safe glass types begins with S-.

Optical Glass for Molded Aspherical Lenses (Low Tg Optical Glass)

This catalog covers 20 types of optical glass for use in molded aspherical lenses. The glass type designation for these types begins with L-. They are also environmentally friendly, as they do not contain lead or arsenic.

i-Line High Homogeneity Glass

The i-line high homogeneity glass types have excellent internal transmittance, optical homogeneity and minimal solarization (ultraviolet coloring). These glasses are often used in steppers, semiconductor manufacturing equipment and other applications that require high transmission. The name of the i-line glasses finishes with Y. Some of the i-Line glasses are free of lead or arsenic and their glass type designations begin with S-.

Ultra Low Expansion Glass-ceramics (CLEARCERAM™-Z)

CLEARCERAM™-Z is a glass-ceramic with an Ultra-Low Thermal Expansion Coefficient. This material was developed by OHARA based on our knowledge of High Homogeneity melting and Precise Crystallization. This material is produced under tightly controlled conditions and offers outstanding thermal, mechanical and chemical properties. Aside from CLEARCERAM™-Z-Regular, OHARA also offers CLEARCERAM™-Z-HS and CLEARCERAM™-Z-EX.

Shock Resistant and High Hardness Clear Glass-Ceramics (NANOCERAM™)

NANOCERAM™ is glass-ceramic for which we have further evolved OHARA's nanocrystallization technology, thus far recognized in all fields, and achieved superior mechanical properties and high transmittance. New proposals will be possible that cannot be realized with sapphire crystal glass and chemically strengthened glass, such as cover glass for optical devices and mobile devices, which requires shock resistance.

Glass-Ceramic Substrate for DWDM Thin-Film Filters (WMS™-15)

WMS™-15 glass-ceramic substrates are supplied for use in DWDM Thin-Film Filters and other fiber optic products. The coefficient of thermal expansion and the physical and optical properties for this glass-ceramic have been optimized to enable coating manufacturers to produce filters with excellent temperature stability and high transmittance. WMS™-15 glass-ceramic polished substrates have low surface roughness and flatness values.

Fused Silica / Quartz Glass

OHARA produces high purity synthetic fused silica / quartz glasses using the Vapor Phase Axial Deposition (VAD) method. These low OH content materials provide high transmittance and are well suited for use in a wide variety of semiconductor and optical applications, including substrates for liquid crystal projectors and photomasks.

OHARA will continue to develop various types of glass and glass ceramics that answer the growing technological needs in the optoelectronics field. OHARA also provides measurement services of optical properties such as refractive indices, spectral transmission, homogeneity, etc. for many materials. OHARA produces glass in various forms, shapes and sizes for use in decorative, artistic and architectural use. If you have a need for any type of glass or glass ceramic products please contact OHARA's sales department.

Comparative Table of Optical Glasses, Codes and Glass-types

( ) not exactly same

OHARA		SCHOTT		HOYA		HIKARI	
439948	S-FPL55	–	–	437951	(FCD100)	–	–
439950	S-FPL53	–	–	437951	FCD100	–	–
487702	S-FSL5	487704	N-FK5	487704	FC5	487703	J-FK5
497816	S-FPL51	497816	N-PK52A	497816	FCD1 FCD1B	497817	J-FK01
516641	S-BSL7	517642	N-BK7	517642	BSC7	517639	J-BK7
517524	S-NSL36	–	–	517522	E-CF6	517522	J-KF6
518590	S-NSL3	–	–	518590	E-C3	518588	J-K3
528765	S-FPM4	529770	(N-PK51)	–	–	–	–
532489	S-TIL6	–	–	532488	E-FEL6	532488	J-LLF6
538747	S-FPM3	–	–	–	–	–	–
540595	S-BAL12	540597	N-BAK2	–	–	540595	J-BAK2
541472	S-TIL2	–	–	541472	E-FEL2	541470	J-LLF2
548458	S-TIL1	–	–	548458	E-FEL1	548455	J-LLF1
564607	S-BAL41	564608	N-SK11	564608	BACD11	564607	J-SK11

OHARA		SCHOTT		HOYA		HIKARI	
567428	S-TIL26	–	–	567428	E-FL6	567426	J-LF6
569563	S-BAL14	569560	N-BAK4	569560	BAC4	569560	J-BAK4
571508	S-BAL2	–	–	–	–	–	–
571530	S-BAL3	–	–	–	–	–	–
575415	S-TIL27	–	–	–	–	575415	J-LF7
581407	S-TIL25	–	–	581409	E-FL5	581410	J-LF5
583594	S-BAL42	–	–	–	–	583594	J-SK12
589612	S-BAL35	589613	N-SK5	589613	BACD5	589612	J-SK5
593353	S-FTM16	–	–	593354	FF5	593353	J-F16
595677	S-FPM2	–	–	593686	(PCD51) (FCD505) (FCD515)	593679	J-PSKH1
596392	S-TIM8	–	–	596392	E-F8	596392	L-F5
603380	S-TIM5	–	–	603380	E-F5	603380	J-F5

OHARA		SCHOTT		HOYA		HIKARI	
603607	S-BSM14	603606	N-SK14	603607	BACD14	303607	J-SK14
603655	S-PHM53	–	–	606637	(LBC3N)	603654	J-PSK03
606437	S-BAM4	606437	N-BAF4	–	–	606435	J-BAF4
607568	S-BSM2	607567	N-SK2	607567	BACD2	607567	J-SK2
613443	S-NBM51	613445	N-KZFS4	613444	E-ADF10	613445	J-KZFH1
618498	S-BSM28	618498	N-SSK8	–	–	618498	J-SSK8
618634	S-PHM52	618634	N-PSK53A	618634	PCD4	618633	J-PSK02
620363	S-TIM2	620364	N-F2	620363	E-F2	620364	J-F2
620603	S-BSM16	620603	N-SK16	620603	BACD16	620603	J-SK16
623570	S-BSM10	–	–	623569	E-BACD10	623571	J-SK10
623582	S-BSM15	–	–	623581	BACD15	623581	J-SK15
639449	S-BAM12	–	–	–	–	639448	J-BAF12
639554	S-BSM18	–	–	639555	BACD18	639553	J-SK18
640345	S-TIM27	–	–	640346	E-FD7	640346	J-SF7

OHARA		SCHOTT		HOYA		HIKARI	
640601	S-BSM81	640601	N-LAK21	640602	LACL60	640602	J-LAK01
648338	S-TIM22	648338	N-SF2	648338	E-FD2	648337	J-SF2
649530	S-BSM71	–	–	649530	E-BACED20	–	–
651562	S-LAL54	651559	N-LAK22	–	–	651562	J-LAK04
651562	S-LAL54Q	651559	N-LAK22	–	–	651562	J-LAK04
652585	S-LAL7	652585	N-LAK7	652584	LAC7	652586	J-LAK7 J-LAK7R
652585	S-LAL7Q	652585	N-LAK7	652584	LAC7	652586	J-LAK7 J-LAK7R
654397	S-NBH5	654397	N-KZFS5	654396	E-ADF50	–	–
658509	S-BSM25	658509	N-SSK5	658509	BACED5	658508	J-SSK5
667483	S-BAH11	–	–	667483	BAF11	667483	J-BAF11
670473	S-BAH10	670471	N-BAF10	670472	BAF10	670471	J-BAF10
673321	S-TIM25	673323	N-SF5	673322	E-FD5	673322	J-SF5

OHARA		SCHOTT		HOYA		HIKARI	
673383	S-NBH52V	–	–	–	–	–	–
678553	S-LAL12	678552	N-LAK12	678555	LAC12	678554	J-LAK12
689311	S-TIM28	689313	N-SF8	689312	E-FD8	689312	J-SF8
691548	S-LAL9	691547	N-LAK9	691547	LAC9	691549	J-LAK9
694508	S-LAL58	–	–	–	–	–	–
694532	S-LAL13	–	–	694533	LAC13	694532	J-LAK13
697555	S-LAL14	697554	N-LAK14	697555	LAC14	697555	J-LAK14
699301	S-TIM35	699302	N-SF15	699301	E-FD15	699301	J-SF15
699511	S-LAL20	–	–	–	–	–	–
702412	S-BAH27	704394	(N-BASF64)	702412	BAFD7	702410	J-BASF7
703524	S-LAL21	–	–	–	–	–	–
713539	S-LAL8	713538	N-LAK8	713539	LAC8	713540	J-LAK8
717295	S-TIH1	717296	N-SF1	717295	E-FD1	717296	J-SF1
717479	S-LAM3	–	–	717480	LAF3	717480	J-LAF3

OHARA		SCHOTT		HOYA		HIKARI	
720347	S-NBH8	720347	N-KZFS8	–	–	–	–
720460	S-LAM61	–	–	–	–	–	–
720502	S-LAL10	720506	N-LAK10	720503	LAC10	720503	J-LAK10
722292	S-TIH18	–	–	–	–	–	–
723380	S-BAH28	–	–	723380	BAFD8	723380	J-BAS8
728285	S-TIH10	728285	N-SF10	728283	E-FD10	728284	J-SF10
729541	S-LAL19	–	–	729547	(TAC8)	729546	(J-LAK18)
729547	S-LAL18	729545	N-LAK34	729547	TAC8	729546	J-LAK18
734515	S-LAL59	–	–	734511	TAC4	734515	J-LAK09
738323	S-NBH53V	–	–	–	–	–	–
740283	S-TIH3	–	–	–	–	–	–
741278	S-TIH13	–	–	741278	E-FD13	741277	J-SF13
741527	S-LAL61	–	–	741526	TAC2	741528	J-LAK011
743493	S-LAM60	743494	N-LAF35	743492	NBF1	743493	J-LAF010

OHARA		SCHOTT		HOYA		HIKARI	
744448	S-LAM2	744449	N-LAF2	744449	LAF2	744448	J-LAF2
750353	S-LAM7	750348	(N-LAF7)	750350	N-LAF7	750353	J-LAF7
750353	S-NBH51	745523	(N-LAK33A)	752251	(FF8)	–	–
755275	S-TIH4	755274	N-SF4	755275	E-FD4	755276	J-SF4
755523	S-LAH97	755523	N-LAK33B	755523	TAC6	755523	J-LASKH2
757478	S-LAM54	–	–	–	–	757479	J-LAF04
762265	S-TIH14	762265	N-SF14	762266	FD140	762266	J-SF14
762401	S-LAM55	–	–	–	–	762401	J-LAF05
764485	S-LAH96	–	–	–	–	–	–
773496	S-LAH66	773496	N-LAF34	773496	TAF1	773496	J-LASF016
778239	S-NPH7	–	–	–	–	–	–
785257	S-TIH11	785257	N-SF11	785257	FD110	785256	J-SF11
785263	S-TIH23	–	–	–	–	785263	J-SFS3
786442	S-LAH51	786441	N-LAF33	786439	NBFD11	786442	J-LASF01

OHARA		SCHOTT		HOYA		HIKARI	
788474	S-LAH64	788475	N-LAF21	788475	TAF4	788474	J-LASF014
789284	S-NBH58	–	–	–	–	–	–
794371	S-LAM73	–	–	–	–	–	–
800299	S-NBH55	–	–	–	–	–	–
800422	S-LAH52	–	–	800423	NBFD12	800421	J-LASF02
800422	S-LAH52Q	–	–	800423	NBFD12	800421	J-LASF02
801350	S-LAM66	801350	N-LASF45	–	–	801349	J-LAF016
804396	S-LAH63	–	–	805396	NBFD3	804396	J-LASF013
804396	S-LAH63Q	–	–	805396	NBFD3	804396	J-LASF013
804465	S-LAH65VS	–	–	804465	TAF3D	–	–
804466	S-LAH65V	804465	N-LASF44	804465	TAF3	804436	J-LASF015
805254	S-TIH6	805254	N-SF6	805255	FD60	805255	J-SF6
806409	S-LAH53	806406	N-LASF43	806407	NBFD13	806410	J-LASF03
806409	S-LAH53V	806406	N-LASF43	806407	NBFD13	806410	J-LASF03

OHARA		SCHOTT		HOYA		HIKARI	
808228	S-NPH1	–	–	–	–	808227	J-SFH1
808228	S-NPH1W	–	–	808228	FD225	–	–
816466	S-LAH59	–	–	816466	TAF5	816466	J-LASF09
834372	S-LAH60	834373	N-LASF40	834373	NBFD10	834372	J-LASF010
834372	S-LAH60V	834373	N-LASF40	834373	NBFD10	834372	J-LASF010
834372	S-LAH60MQ	834373	N-LASF40	834373	NBFD10	834372	J-LASF010
835427	S-LAH55V	835431	(N-LASF41)	835427	TAFD5F	835427	TJ-LASF05
835427	S-LAH55VS	835431	(N-LASF41)	835427	TAFD5F	835427	TJ-LASF05
847238	S-TIH53	847238	N-SF57	847238	FDS90	847238	J-SF03
847238	S-TIH53W	847238	N-SF57HT	847238	FDS90-SG	–	–
850300	S-NBH57	–	–	–	–	–	–
850323	S-LAH71	850322	N-LASF9	–	–	850324	J-LASF021 J-LASF021HS
852408	S-LAH89	–	–	–	–	–	–
855248	S-NBH56	–	–	–	–	–	–

OHARA		SCHOTT		HOYA		HIKARI	
859227	S-NPH5	–	–	–	–	–	–
883408	S-LAH58	883408	N-LASF31A	883408	TAFD30	883407	J-LASF08
892371	S-LAH92	–	–	900374	(TAFD37)	–	–
893204	S-NPH4	–	–	–	–	–	–
904313	S-LAH95	904313	N-LASF46A N-LASF46B	904313	TAFD25	904313	J-LASFH13 J-LASFH13HS
905350	S-LAH93	–	–	911353	(TAFD35)	903357	(J-LASFH9)
917316	S-LAH88	–	–	954323	(TAFD45)	–	–
923189	S-NPH2	923209	(N-SF66)	923209	(E-FDS1)	–	–
954323	S-LAH98	–	–	–	–	–	–
959175	S-NPH3	–	–	–	–	–	–
963241	S-TIH57	–	–	–	–	–	–
001291	S-LAH99	–	–	001291	TAFD55	–	–
003283	S-LAH79	022291	(LASF35)	–	–	–	–

OHARA		SCHOTT		HOYA		HIKARI		SUMITA	
516641	L-BSL7	516641	P-BK7	–	–	–	–	516641 518635	K-BK7 (KPBK40)
583594	L-BAL42	–	–	583595	M-BACD12	583595	Q-SK52S	–	–
586592	L-BAL42P	–	–	–	–	–	–	–	–
586597	L-BAL43	586595 587596	P-SK57Q1 P-SK57	–	–	586596	Q-SK12S	587596	(K-CSK120)
589612	L-BAL35	589612	P-SK58A	589613	M-BACD5N	589611	Q-SK55S	589612	K-SK5
592610	L-BAL35P	–	–	–	–	–	–	592607	K-PSK100
689311	L-TIM28	689313	P-SF8	689312	M-FD80	–	–	689311	K-SFLD8
695307	L-TIM28P	–	–	–	–	–	–	–	–
693529	L-LAL15	–	–	–	–	693533	(Q-LAK53S)	–	–
694532	L-LAL13	693532	P-LAK35	694532	M-LAC130	697533	(Q-LAK13S)	694531	K-VC80
731405	L-LAM69	–	–	731405	M-LAF81	–	–	–	–
743493	L-LAM60	–	–	743493	M-NBF1	743493	Q-LAF010S	743492	K-LAFN5
765491	L-LAH91	–	–	768492	(M-TAF101)	–	–	766498	(K-LAFK50T)
806409	L-LAH53	806409	P-LASF47	806407	M-NBFD130	806407	Q-LASF03S	806407	K-LASFN1

OHARA		SCHOTT		HOYA		HIKARI		SUMITA	
809404	L-LAH84	809405 810409	P-LASF50 (P-LASF51)	–	–	–	–	810410	(K-VC89)
832401	L-LAH90	–	–	–	–	–	–	–	–
854404	L-LAH85V	–	–	851401	(M-TAFD305)	851401	(Q-LAS-FH58S)	853390 851416	(K-VC90) (K-VC99)
861371	L-LAH94	–	–	882372	(M-TAFD307)	–	–	–	–
903310	L-LAH86	–	–	–	–	–	–	–	–

S-FPL

Glass-type	Code	n_d 587.56	ν_d	$n_F - n_C$	$\theta_{g,F}$	n_e 546.07	ν_e	$n_{F'} - n_{C'}$	$n_{A'}$ 768.19	n_C 656.27	n_{He-Ne} 632.8	n_F 486.13	n_g 435.835
S-FPL51	497816	1.49700	81.54	0.006095	0.5375	1.49845	81.14	0.006143	1.49300	1.49514	1.49571	1.50123	1.50451
S-FPL53	439950	1.43875	94.93	0.004622	0.5340	1.43985	94.49	0.004655	1.43570	1.43733	1.43777	1.44195	1.44442
S-FPL55	439948	1.43875	94.66	0.004635	0.5340	1.43986	94.23	0.004668	1.43569	1.43733	1.43777	1.44196	1.44444

S-FPM

Glass-type	Code	n_d 587.56	ν_d	$n_F - n_C$	$\theta_{g,F}$	n_e 546.07	ν_e	$n_{F'} - n_{C'}$	$n_{A'}$ 768.19	n_C 656.27	n_{He-Ne} 632.8	n_F 486.13	n_g 435.835
S-FPM2	595677	1.59522	67.74	0.008787	0.5442	1.59732	67.37	0.008866	1.58954	1.59255	1.59337	1.60134	1.60612
S-FPM3	538747	1.53775	74.70	0.007199	0.5392	1.53947	74.34	0.007257	1.53304	1.53555	1.53623	1.54275	1.54664
S-FPM4	528765	1.52841	76.46	0.00691	0.5396	1.53006	76.07	0.006968	1.52390	1.52630	1.52695	1.53321	1.53694

S-FSL

Glass-type	Code	n_d 587.56	ν_d	$n_F - n_C$	$\theta_{g,F}$	n_e 546.07	ν_e	$n_{F'} - n_{C'}$	$n_{A'}$ 768.19	n_C 656.27	n_{He-Ne} 632.8	n_F 486.13	n_g 435.835
S-FSL5	487702	1.48749	70.23	0.006941	0.5300	1.48915	70.04	0.006984	1.48282	1.48534	1.48601	1.49228	1.49596

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10⁻⁷/K] −30°~+70°C	α [10⁻⁷/K] 100°~300°C	Knoop-hardn./Grp. Hk	Abrasion Aa	Coloring λ80 (λ70)	Coloring λ5	d [g/cm³]	Glass-type
1.50720	1.51176	1	3	1	52.1	4.0	458	489	131	155	350/4	493	340	290	3.62	S-FPL51
1.44645	1.44986	1	2	3	52.3	4.3	426	456	145	169	320/3	480	330	280	3.62	S-FPL53
1.44647	1.44988	1	2	2	52.1	4.1	435	460	136	166	340/3	470	335	290	3.59	S-FPL55

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10⁻⁷/K] −30°~+70°C	α [10⁻⁷/K] 100°~300°C	Knoop-hardn./Grp. Hk	Abrasion Aa	Coloring λ80 (λ70)	Coloring λ5	d [g/cm³]	Glass-type
1.61008	1.61681	1	1	2	51.3	4.1	571	596	117	135	390/4	521	355	295	4.17	S-FPM2
1.54984	1.55525	1	3	1	5.1	4.1	496	524	115	138	390/4	418	345	–	3.64	S-FPM3
1.54002	1.54522	1	3	1	51.3	4.3	488	520	123	143	360/4	506	340	–	3.76	S-FPM4

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10⁻⁷/K] −30°~+70°C	α [10⁻⁷/K] 100°~300°C	Knoop-hardn./Grp. Hk	Abrasion Aa	Coloring λ80 (λ70)	Coloring λ5	d [g/cm³]	Glass-type
1.49898	1.50406	3	4	1~2	3.0	2.0	500	568	90	95	520/5	117	300	265	2.46	S-FSL5

S-BSL

Glass-type	Code	n_d	ν_d	$n_F - n_C$	$\theta_{g,F}$	n_e	ν_e	$n_{F'} - n_{C'}$	$n_{A'}$	n_C	$n_{He} - n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-BSL7	516641	1.51633	64.14	0.008050	0.5353	1.51825	63.93	0.008107	1.51097	1.51386	1.51462	1.52191	1.52621

S-NSL

Glass-type	Code	n_d	ν_d	$n_F - n_C$	$\theta_{g,F}$	n_e	ν_e	$n_{F'} - n_{C'}$	$n_{A'}$	n_C	$n_{He} - n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-NSL3	518590	1.51823	58.90	0.008798	0.5457	1.52033	58.63	0.008875	1.51250	1.51556	1.51638	1.52435	1.52915
S-NSL36	517524	1.51742	52.43	0.009869	0.5564	1.51976	52.14	0.009968	1.51108	1.51444	1.51536	1.52431	1.52980

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.52977	1.53578	2	1	1~2	1.0	2.0	576	625	72	86	570/6	94	330	285	2.52	S-BSL7

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.53315	1.53999	3	1	1	1.0	1.0	500	553	90	110	510/5	117	340	310	2.48	S-NSL3
1.53444	1.54252	1	1	1	1.0	1.0	464	522	80	93	480/5	113	360	335	2.46	S-NSL36

S-BSM

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	$n_{He}-n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-BSM2	607568	1.60738	56.81	0.010691	0.5483	1.60993	56.53	0.010790	1.60048	1.60414	1.60514	1.61483	1.62070
S-BSM10	623570	1.62280	57.05	0.010916	0.5464	1.62540	56.78	0.011014	1.61573	1.61949	1.62051	1.63041	1.63637
S-BSM14	603607	1.60311	60.64	0.009945	0.5415	1.60548	60.39	0.010027	1.59660	1.60008	1.60101	1.61002	1.61541
S-BSM15	623582	1.62299	58.16	0.010711	0.5458	1.62555	57.89	0.010805	1.61603	1.61974	1.62074	1.63045	1.63630
S-BSM16	620603	1.62041	60.29	0.010290	0.5427	1.62287	60.03	0.010376	1.61368	1.61728	1.61824	1.62757	1.63315
S-BSM18	639554	1.63854	55.38	0.011531	0.5484	1.64129	55.10	0.011638	1.63111	1.63505	1.63612	1.64658	1.65291
S-BSM25	658509	1.65844	50.88	0.012942	0.5560	1.66152	50.59	0.013076	1.65019	1.65455	1.65574	1.66749	1.67469
S-BSM28	618498	1.61772	49.81	0.012401	0.5603	1.62067	49.52	0.012534	1.60984	1.61401	1.61514	1.62641	1.63335
S-BSM71	649530	1.64850	53.02	0.012231	0.5547	1.65141	52.73	0.012353	1.64067	1.64482	1.64595	1.65705	1.66383
S-BSM81	640601	1.64000	60.08	0.010653	0.5370	1.64254	59.88	0.010730	1.63293	1.63673	1.63774	1.64738	1.65310

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α $[10^{-7}/K]$		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.62558	1.63394	1	3	2	5.2	2.2	654	690	65	74	560/6	139	350	300	3.53	S-BSM2
1.64133	1.64980	1	3	2	51.2	1.0	668	709	65	76	550/6	134	350	305	3.60	S-BSM10
1.61987	1.62745	1	4	3	51.2	2.2	663	698	62	73	570/6	126	350	295	3.43	S-BSM14
1.64116	1.64948	2	4	2~3	52.2	3.2	658	685	65	78	560/6	150	360	320	3.60	S-BSM15
1.63778	1.64567	3	5	2~3	53.2	4.2	657	689	67	76	570/6	155	350	305	3.59	S-BSM16
1.65818	1.66720	1	3	2	51.2	2.0	613	655	70	84	570/6	155	350	305	3.69	S-BSM18
1.68074	1.69121	1	2	2	5.2	1.0	638	686	68	82	560/6	136	375	330	3.50	S-BSM25
1.63924	1.64953	2	3	3	51.2	3.0	578	618	84	96	540/5	176	385	340	3.23	S-BSM28
1.66954	1.67943	1	4	2~3	53.2	4.0	651	687	71	83	560/6	170	375	335	3.74	S-BSM71
1.65783	1.66586	4	4	3	53.0	4.0	653	679	58	72	660/7	81	370	305	3.06	S-BSM81

S-BAL

Glass-type	Code	n_d 587.56	ν_d	n_F-n_C	$\theta_{g,F}$	n_e 546.07	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$ 768.19	n_C 656.27	n_{He-Ne} 632.8	n_F 486.13	n_g 435.835
S-BAL2	571508	1.57099	50.80	0.011240	0.5588	1.57366	50.50	0.011359	1.56383	1.56762	1.56865	1.57886	1.58514
S-BAL3	571530	1.57135	52.95	0.010790	0.5553	1.57392	52.65	0.010900	1.56445	1.56810	1.56910	1.57889	1.58489
S-BAL12	540595	1.53996	59.46	0.009081	0.5441	1.54212	59.20	0.009158	1.53404	1.53719	1.53804	1.54627	1.55122
S-BAL14	569563	1.56883	56.36	0.010092	0.5489	1.57124	56.09	0.010185	1.56230	1.56577	1.56671	1.57587	1.58141
S-BAL35	589612	1.58913	61.14	0.009636	0.5407	1.59143	60.88	0.009714	1.58280	1.58619	1.58710	1.59582	1.60103
S-BAL41	564607	1.56384	60.67	0.009294	0.5402	1.56606	60.42	0.009369	1.55774	1.56100	1.56188	1.57029	1.57532
S-BAL42	583594	1.58313	59.38	0.009821	0.5434	1.58547	59.11	0.009905	1.57673	1.58014	1.58106	1.58996	1.59530

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.59045	1.59972	1	1	3	1.0	1.0	540	582	91	109	510/5	174	370	335	2.89	S-BAL2
1.58993	1.59867	2	3	2	1.2	1.0	531	573	95	111	510/5	172	360	330	2.98	S-BAL3
1.55532	1.56232	1	1	1	1.0	2.0	478	527	86	102	520/5	112	330	300	2.75	S-BAL12
1.58604	1.59400	2	1	2~3	1.0	2.0	580	622	80	93	570/6	140	360	325	2.89	S-BAL14
1.60535	1.61268	2	3	2~3	4.2	1.0	669	709	57	67	590/6	116	345	300	3.31	S-BAL35
1.57947	1.58652	2	3	2~3	51.2	3.0	541	577	75	91	600/6	129	340	295	2.78	S-BAL41
1.59972	1.60724	1	2	1~2	1.2	1.0	550	588	66	76	570/6	121	340	290	3.19	S-BAL42

S-BAM

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	$n_{He}-n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-BAM4	606437	1.60562	43.70	0.013857	0.5721	1.60891	43.41	0.014026	1.59695	1.60151	1.60276	1.61536	1.62329
S-BAM12	639449	1.63930	44.87	0.014247	0.5683	1.64268	44.59	0.014414	1.63033	1.63506	1.63635	1.64930	1.65740

S-BAH

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	$n_{He}-n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-BAH10	670473	1.67003	47.23	0.014186	0.5627	1.67340	46.94	0.014345	1.66105	1.66579	1.66709	1.67997	1.68796
S-BAH11	667483	1.66672	48.32	0.013797	0.5609	1.67000	48.04	0.013948	1.65798	1.66259	1.66385	1.67639	1.68412
S-BAH27	702412	1.70154	41.24	0.017012	0.5765	1.70557	40.95	0.017228	1.69094	1.69650	1.69804	1.71351	1.72332
S-BAH28	723380	1.72342	37.95	0.019060	0.5836	1.72794	37.68	0.019320	1.71167	1.71782	1.71952	1.73688	1.74800

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~+70°C	100°~300°C			λ80 (λ70)	λ5		
1.63010	1.64228	1	1	1~2	1.0	1.0	599	641	84	97	520/5	159	380	345	2.91	S-BAM4
1.66433	1.67665	1	1	2	3.2	1.0	608	645	76	91	550/6	154	385	345	3.18	S-BAM12

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~+70°C	100°~300°C			λ80 (λ70)	λ5		
1.69473	1.70663	1	3	2	51.2	1.0	623	669	68	80	560/6	140	390	340	3.48	S-BAH10
1.69067	1.70213	1	3	3	52.2	2.0	629	675	69	82	560/6	153	380	340	3.59	S-BAH11
1.73180	1.74712	1	3	2	4.0	1.0	647	682	64	75	580/6	138	400	350	3.67	S-BAH27
1.75769	–	1	2	1~2	4.0	1.0	643	676	66	73	600/6	131	415	355	3.67	S-BAH28

S-PHM

Glass-type	Code	n_d	ν_d	$n_F - n_C$	$\theta_{g,F}$	n_e	ν_e	$n_{F'} - n_{C'}$	$n_{A'}$	n_C	n_{He-ne}	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-PHM52	618634	1.61800	63.33	0.009758	0.5441	1.62033	63.02	0.009844	1.61167	1.61504	1.61595	1.62479	1.63010
S-PHM53	603655	1.60300	65.44	0.009215	0.5401	1.60520	65.15	0.009289	1.59697	1.60019	1.60106	1.60940	1.61438

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.63451	1.64199	1	4	2	5.0	4.0	587	617	101	120	390/4	468	370	325	3.67	S-PHM52
1.61850	1.62547	1	5	1~2	51.0	4.0	610	644	93	109	390/4	407	360	300	3.51	S-PHM53

S-TIL

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	$n_{He}-n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-TIL1	548458	1.54814	45.79	0.011972	0.5686	1.55098	45.49	0.012112	1.54058	1.54457	1.54566	1.55654	1.56335
S-TIL2	541472	1.54072	47.23	0.011449	0.5651	1.54344	46.94	0.011577	1.53346	1.53730	1.53835	1.54875	1.55522
S-TIL6	532489	1.53172	48.84	0.010887	0.5631	1.53430	48.55	0.011006	1.52479	1.52846	1.52946	1.53934	1.54547
S-TIL25	581407	1.58144	40.75	0.014270	0.5774	1.58482	40.47	0.014451	1.57254	1.57722	1.57850	1.59149	1.59973
S-TIL26	567428	1.56732	42.82	0.013250	0.5731	1.57047	42.54	0.013411	1.55901	1.56339	1.56459	1.57664	1.58423
S-TIL27	575415	1.57501	41.50	0.013854	0.5767	1.57829	41.22	0.014028	1.56635	1.57090	1.57216	1.58476	1.59275

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K] −30°~+70°C	α [10^{-7}/K] 100°~300°C	Knoop-hardn./Grp. Hk	Abrasion Aa	Coloring λ80 (λ70)	Coloring λ5	d [g/cm³]	Glass-type
1.56918	1.57959	3	1	1	1.0	1.0	501	542	86	101	490/5	132	370	340	2.54	S-TIL1
1.56074	1.57052	2	1	2	1.0	1.0	496	538	82	98	500/5	122	370	340	2.52	S-TIL2
1.55069	1.55989	3	1	2~3	1.0	1.0	479	528	82	96	490/5	121	365	335	2.50	S-TIL6
1.60687	1.61979	1	1	1~2	1.0	1.0	588	630	74	88	540/5	117	380	350	2.59	S-TIL25
1.59077	1.60256	1	1	1	1.0	1.0	552	599	79	90	500/5	120	380	345	2.57	S-TIL26
1.59966	1.61218	1	1	2	1.0	1.0	562	599	74	89	540/5	125	380	350	2.58	S-TIL27

S-TIM

Glass-type	Code	n_d 587.56	ν_d	$n_F - n_C$	$\theta_{g,F}$	n_e 546.07	ν_e	$n_{F'} - n_{C'}$	$n_{A'}$ 768.19	n_C 656.27	$n_{He} - n_e$ 632.8	n_F 486.13	n_g 435.835
S-TIM2	620363	1.62004	36.26	0.017099	0.5879	1.62409	35.99	0.017339	1.60952	1.61502	1.61655	1.63212	1.64218
S-TIM5	603380	1.60342	38.03	0.015868	0.5835	1.60718	37.76	0.016082	1.59360	1.59875	1.60017	1.61462	1.62388
S-TIM8	596392	1.59551	39.24	0.015176	0.5803	1.59911	38.97	0.015375	1.58609	1.59103	1.59240	1.60621	1.61501
S-TIM22	648338	1.64769	33.79	0.019167	0.5938	1.65222	33.53	0.019451	1.63600	1.64210	1.64379	1.66126	1.67265
S-TIM25	673321	1.67270	32.10	0.020957	0.5988	1.67765	31.84	0.021280	1.66000	1.66661	1.66846	1.68756	1.70011
S-TIM27	640345	1.63980	34.46	0.018564	0.5922	1.64419	34.20	0.018835	1.62846	1.63438	1.63602	1.65294	1.66393
S-TIM28	689311	1.68893	31.07	0.022170	0.6004	1.69417	30.83	0.022516	1.67553	1.68250	1.68445	1.70467	1.71797
S-TIM35	699301	1.69895	30.13	0.023199	0.6030	1.70442	29.89	0.023567	1.68496	1.69222	1.69426	1.71542	1.72941

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α $[10^{-7}/K]$		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d $[g/cm^3]$	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.65100	1.66728	1	1	2	1.0	1.0	598	634	81	95	550/6	141	390	355	2.69	S-TIM2
1.63196	1.64676	2	1	1~2	1.0	1.2	588	624	83	96	540/5	131	385	350	2.63	S-TIM5
1.62267	1.63661	1	1	2~3	1.0	1.0	585	610	84	104	530/5	135	380	350	2.63	S-TIM8
1.68269	–	1	1	1~2	1.0	1.0	593	624	83	98	560/6	149	395	360	2.79	S-TIM22
1.71126	–	1	1	2	1.0	1.2	608	640	79	95	570/6	146	400	360	2.91	S-TIM25
1.67361	–	1	1	2	1.0	1.0	594	629	80	99	560/6	146	390	360	2.76	S-TIM27
1.72981	–	1	1	1	1.0	1.0	611	637	82	98	550/6	152	405	360	2.98	S-TIM28
1.74189	–	1	1	1~2	1.0	1.0	622	648	75	89	500/5	142	400	360	2.96	S-TIM35

S-TIH

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	$n_{He}-n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-TIH1	717295	1.71736	29.52	0.024303	0.6047	1.72310	29.28	0.024694	1.70275	1.71033	1.71246	1.73463	1.74933
S-TIH3	740283	1.74000	28.30	0.026152	0.6079	1.74617	28.07	0.026584	1.72434	1.73245	1.73474	1.75861	1.77450
S-TIH4	755275	1.75520	27.51	0.027450	0.6103	1.76167	27.29	0.027911	1.73882	1.74730	1.74968	1.77475	1.79150
S-TIH6	805254	1.80518	25.42	0.031669	0.6161	1.81264	25.22	0.032223	1.78643	1.79611	1.79885	1.82777	1.84729
S-TIH10	728285	1.72825	28.46	0.025588	0.6077	1.73429	28.23	0.026009	1.71292	1.72086	1.72310	1.74645	1.76200
S-TIH11	785257	1.78472	25.68	0.030554	0.6161	1.79192	25.47	0.031088	1.76662	1.77596	1.77861	1.80652	1.82534
S-TIH13	741278	1.74077	27.79	0.026657	0.6095	1.74705	27.56	0.027102	1.72485	1.73309	1.73541	1.75975	1.77599
S-TIH14	762265	1.76182	26.52	0.028729	0.6136	1.76859	26.30	0.029221	1.74474	1.75357	1.75606	1.78230	1.79992
S-TIH18	722292	1.72151	29.23	0.024683	0.6053	1.72733	29.00	0.025081	1.70668	1.71437	1.71653	1.73905	1.75399
S-TIH23	785263	1.78470	26.29	0.029847	0.6135	1.79173	26.08	0.030359	1.76697	1.77613	1.77871	1.80597	1.82428
S-TIH53	847238	1.84666	23.78	0.035608	0.6205	1.85504	23.59	0.036247	1.82568	1.83649	1.83956	1.87210	1.89419
S-TIH53W	847238	1.84666	23.78	0.035608	0.6205	1.85504	23.59	0.036247	1.82568	1.83649	1.83956	1.87210	1.89419
S-TIH57	963241	1.96300	24.11	0.039935	0.6212	1.97240	23.92	0.040656	1.93949	1.95160	1.95504	1.99153	2.01634

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm^3]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.76247	–	1	1	1	1.0	1.0	622	653	82	96	550/6	157	405	360	3.06	S-TIH1
1.78876	–	1	1	1	1.0	1.0	615	644	85	100	560/6	173	420	360	3.11	S-TIH3
1.80656	–	1	1	1~2	1.0	1.0	613	640	85	100	570/6	168	415	365	3.15	S-TIH4
1.86494	–	1	1	1~2	1.0	1.0	604	630	89	107	540/5	196	440	365	3.37	S-TIH6
1.77595	–	1	1	1	1.0	1.0	617	642	80	97	570/6	158	410	365	3.06	S-TIH10
1.84239	–	1	1	1	1.0	1.0	602	633	89	103	550/6	180	430	365	3.24	S-TIH11
1.79059	–	1	1	1	1.0	1.0	616	642	83	96	510/5	167	415	365	3.10	S-TIH13
1.81584	–	1	1	2	1.0	1.0	609	634	87	100	550/6	171	420	365	3.17	S-TIH14
1.76735	–	1	1	1~2	1.0	1.0	616	644	83	98	560/6	160	410	360	3.07	S-TIH18
1.84081	–	1	1	2	1.0	1.0	604	635	88	106	540/5	191	435	365	3.30	S-TIH23
1.91429	–	1	1	1	1.0	1.0	624	658	88	104	520/5	188	(420)	370	3.54	S-TIH53
1.91429	–	1	1	1	1.0	1.0	624	658	88	104	520/5	188	(404)	368	3.54	S-TIH53W
2.03893	–	1	1	1	3.0	1.0	672	707	75	91	630/6	102	(450)	375	4.20	S-TIH57

S-LAL

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	$n_{He}-n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-LAL7	652585	1.65160	58.55	0.011129	0.5425	1.65425	58.31	0.011221	1.64432	1.64821	1.64925	1.65934	1.66537
S-LAL7Q	652585	1.65160	58.54	0.011130	0.5390	1.65426	58.34	0.011215	1.64425	1.64819	1.64924	1.65932	1.66532
S-LAL8	713539	1.71300	53.87	0.013236	0.5459	1.71615	53.64	0.013352	1.70438	1.70897	1.71021	1.72221	1.72943
S-LAL9	691548	1.69100	54.82	0.012605	0.5449	1.69401	54.59	0.012714	1.68279	1.68717	1.68835	1.69977	1.70664
S-LAL10	720502	1.72000	50.23	0.014334	0.5521	1.72341	49.98	0.014474	1.71079	1.71567	1.71700	1.73000	1.73792
S-LAL12	678553	1.67790	55.34	0.012250	0.5472	1.68082	55.08	0.012361	1.66998	1.67419	1.67533	1.68644	1.69314
S-LAL13	694532	1.69350	53.21	0.013034	0.5473	1.69661	52.97	0.013152	1.68504	1.68955	1.69076	1.70258	1.70972
S-LAL14	697555	1.69680	55.53	0.012548	0.5434	1.69979	55.31	0.012653	1.68858	1.69297	1.69415	1.70552	1.71234
S-LAL18	729547	1.72916	54.68	0.013335	0.5444	1.73234	54.45	0.013449	1.72046	1.72510	1.72635	1.73844	1.74570
S-LAL19	729541	1.72916	54.09	0.013480	0.5448	1.73237	53.87	0.013596	1.72038	1.72506	1.72632	1.73854	1.74588
S-LAL20	699511	1.69930	51.11	0.013682	0.5552	1.70256	50.82	0.013825	1.69063	1.69520	1.69645	1.70888	1.71647
S-LAL21	703524	1.70300	52.38	0.013422	0.5506	1.70620	52.11	0.013553	1.69440	1.69895	1.70019	1.71237	1.71976
S-LAL54	651562	1.65100	56.16	0.011591	0.5482	1.65376	55.89	0.011697	1.64350	1.64749	1.64856	1.65908	1.66543
S-LAL54Q	651562	1.65100	56.24	0.011576	0.5420	1.65376	56.02	0.011670	1.64341	1.64747	1.64856	1.65905	1.66532

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10⁻⁷/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.67038	1.67892	3	5	2~3	53.0	4.0	617	658	67	81	560/6	141	345	275	3.73	S-LAL7
1.67029	1.67873	2	4	3	52.0	4.0	620	646	55	70	680/7	75	365	–	3.24	S-LAL7Q
1.73545	1.74575	1	4	3	52.0	3.0	643	668	61	74	660/7	81	375	295	3.79	S-LAL8
1.71236	1.72212	1	4	2	52.0	4.0	653	679	61	74	660/7	89	375	295	3.63	S-LAL9
1.74455	1.75597	1	4	2	52.2	3.0	624	657	61	76	650/7	89	380	310	3.86	S-LAL10
1.69872	1.70826	2	5	2	53.0	4.2	652	679	72	86	560/6	166	360	285	4.01	S-LAL12
1.71566	1.72585	1	4	1~2	52.0	3.0	641	666	57	72	650/7	84	375	300	3.60	S-LAL13
1.71800	1.72767	1	4	1~2	52.2	3.0	650	668	57	71	660/7	83	365	285	3.70	S-LAL14
1.75173	1.76203	1	4	1	51.2	2.0	685	699	59	69	720/7	69	365	280	4.18	S-LAL18
1.75199	1.76243	1	4	3	52.0	2.0	644	672	54	69	720/7	65	355	–	3.98	S-LAL19
1.72283	1.73376	2	4	1	53.1	4.2	628	676	90	105	490/5	254	370	310	4.38	S-LAL20
1.72593	1.73649	1	1	2	4.0	1.0	767	814	50	61	690/7	60	395	320	3.85	S-LAL21
1.67073	1.67982	3	5	3	53.0	4.2	651	675	71	83	530/5	170	365	325	3.82	S-LAL54
1.67053	1.67939	1	3	2	4.0	3.0	688	718	43	55	680/7	61	385	–	3.36	S-LAL54Q

S-LAL

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	$n_{He}-n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-LAL58	694508	1.69350	50.81	0.013649	0.5546	1.69675	50.53	0.013789	1.68480	1.68939	1.69065	1.70304	1.71061
S-LAL59	734515	1.73400	51.47	0.014261	0.5486	1.73739	51.24	0.014392	1.72477	1.72968	1.73101	1.74394	1.75176
S-LAL61	741527	1.74100	52.64	0.014078	0.5467	1.74435	52.41	0.014203	1.73186	1.73673	1.73804	1.75080	1.75850

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm^3]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.71696	1.72788	1	4	3	52.2	2.2	676	718	75	86	580/6	158	370	320	4.03	S-LAL58
1.75829	1.76950	1	4	2	52.0	2.0	635	663	55	68	700/7	69	365	280	4.04	S-LAL59
1.76491	1.77589	1	4	1~2	51.0	2.0	653	688	57	70	720/7	71	365	280	4.04	S-LAL61

S-LAM

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	$n_{He}-n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-LAM2	744448	1.74400	44.78	0.016613	0.5655	1.74795	44.50	0.016806	1.73356	1.73905	1.74056	1.75566	1.76506
S-LAM3	717479	1.71700	47.92	0.014961	0.5605	1.72056	47.64	0.015124	1.70754	1.71253	1.71390	1.72749	1.73587
S-LAM7	750353	1.74950	35.28	0.021243	0.5869	1.75453	35.02	0.021544	1.73649	1.74328	1.74517	1.76452	1.77699
S-LAM54	757478	1.75700	47.82	0.015830	0.5565	1.76076	47.57	0.015991	1.74686	1.75223	1.75370	1.76806	1.77687
S-LAM55	762401	1.76200	40.10	0.019003	0.5765	1.76651	39.82	0.019247	1.75020	1.75639	1.75810	1.77539	1.78634
S-LAM60	743493	1.74320	49.34	0.015063	0.5531	1.74678	49.10	0.015210	1.73351	1.73865	1.74005	1.75372	1.76205
S-LAM61	720460	1.72000	46.02	0.015644	0.5635	1.72372	45.75	0.015820	1.71012	1.71533	1.71676	1.73097	1.73979
S-LAM66	801350	1.80100	34.97	0.022907	0.5864	1.80642	34.72	0.023227	1.78691	1.79427	1.79632	1.81718	1.83061
S-LAM73	794371	1.79360	37.09	0.021397	0.5828	1.79867	36.82	0.021692	1.78047	1.78732	1.78923	1.80872	1.82119

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10⁻⁷/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.77304	1.78708	1	4	2~3	52.2	3.0	633	670	74	87	560/6	157	395	340	4.32	S-LAM2
1.74296	1.75531	1	4	2	53.2	4.2	630	661	80	94	510/5	184	385	340	4.25	S-LAM3
1.78787	–	1	1	1	1.0	1.0	628	673	67	79	560/6	140	420	355	3.81	S-LAM7
1.78431	1.79726	1	4	1~2	51.0	2.0	664	687	57	69	700/7	69	390	340	4.08	S-LAM54
1.79580	1.81280	1	4	2	51.2	1.0	632	662	71	84	550/6	145	405	350	4.22	S-LAM55
1.76904	1.78113	1	4	2	52.0	2.0	643	658	54	66	730/7	70	375	330	4.06	S-LAM60
1.74727	1.76042	1	4	2	52.2	2.2	629	665	66	80	560/6	142	395	340	4.10	S-LAM61
1.84236	1.86391	1	3	1~2	4.0	1.0	554	586	79	95	660/7	93	430	350	3.55	S-LAM66
1.83200	–	1	4	3	52.2	2.2	623	658	89	105	570/6	182	415	350	4.45	S-LAM73

S-LAH

Glass-type	Code	n_d	ν_d	$n_F - n_C$	$\theta_{g,F}$	n_e	ν_e	$n_{F'} - n_{C'}$	$n_{A'}$	n_C	n_{He-Ne}	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-LAH51	786442	1.78590	44.20	0.017780	0.5631	1.79012	43.95	0.017979	1.77466	1.78058	1.78221	1.79836	1.80838
S-LAH52	800422	1.79952	42.22	0.018935	0.5672	1.80401	41.97	0.019157	1.78762	1.79388	1.79560	1.81281	1.82355
S-LAH52Q	800422	1.79952	42.24	0.018928	0.5675	1.80402	41.98	0.019154	1.78767	1.79389	1.79561	1.81282	1.82356
S-LAH53	806409	1.80610	40.92	0.019697	0.5701	1.81078	40.67	0.019935	1.79377	1.80025	1.80203	1.81994	1.83117
S-LAH53V	806409	1.80610	40.93	0.019695	0.5713	1.81078	40.67	0.019937	1.79381	1.80026	1.80204	1.81995	1.83121
S-LAH55V	835427	1.83481	42.73	0.019539	0.5648	1.83945	42.47	0.019764	1.82250	1.82898	1.83076	1.84852	1.85956
S-LAH55VS	835427	1.83481	42.74	0.019531	0.5648	1.83945	42.49	0.019756	1.82253	1.82899	1.83077	1.84852	1.85955
S-LAH58	883408	1.88300	40.76	0.021661	0.5667	1.88815	40.52	0.021919	1.86946	1.87656	1.87852	1.89822	1.91050
S-LAH59	816466	1.81600	46.62	0.017503	0.5568	1.82017	46.37	0.017688	1.80488	1.81075	1.81236	1.82825	1.83800
S-LAH60	834372	1.83400	37.16	0.022443	0.5776	1.83932	36.92	0.022736	1.82009	1.82738	1.82939	1.84982	1.86278
S-LAH60MQ	834372	1.83400	37.17	0.022437	0.5786	1.83932	36.92	0.022735	1.82017	1.82739	1.82940	1.84983	1.86281
S-LAH60V	834372	1.83400	37.21	0.022416	0.5807	1.83931	36.95	0.022716	1.82016	1.82740	1.82941	1.84981	1.86283
S-LAH63	804396	1.80440	39.59	0.020320	0.5729	1.80922	39.33	0.020573	1.79172	1.79838	1.80021	1.81870	1.83034
S-LAH63Q	804396	1.80440	39.58	0.020323	0.5762	1.80922	39.31	0.020586	1.79180	1.79840	1.80023	1.81872	1.83043
S-LAH64	788474	1.78800	47.37	0.016636	0.5559	1.79196	47.12	0.016806	1.77737	1.78300	1.78453	1.79963	1.80888

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10⁻⁷/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.81687	1.83175	1	4	1~2	4.0	2.0	617	641	59	72	660/7	80	390	335	4.40	S-LAH51
1.83271	1.84885	1	3	1	51.2	2.0	618	636	60	73	640/6	85	395	330	4.41	S-LAH52
1.83271	1.84883	1	3	2	52.2	2.0	598	622	60	73	620/6	66	390	335	4.47	S-LAH52Q
1.84078	1.85782	1	3	1	4.2	2.0	610	637	59	70	640/6	80	405	340	4.43	S-LAH53
1.84084	1.85798	1	3	1	51.2	2.0	603	638	58	71	650/7	66	400	345	4.41	S-LAH53V
1.86893	1.88539	1	2	4	4.0	1.0	695	718	62	77	740/7	63	400	325	4.73	S-LAH55V
1.86892	1.88534	1	2	2	4.0	1.0	677	709	63	77	740/7	60	395	320	4.58	S-LAH55VS
1.92092	1.93917	1	1	1~2	2.2	1.0	738	765	66	78	710/7	62	(375)	315	5.52	S-LAH58
1.84619	1.86034	1	2	1	3.0	1.0	714	737	63	76	750/7	50	390	290	5.07	S-LAH59
1.87396	1.89403	1	3	1	4.2	1.0	612	632	56	71	670/7	79	420	340	4.43	S-LAH60
1.87401	1.89407	1	3	3	51.2	1.2	655	688	85	98	520/5	160	425	340	4.71	S-LAH60MQ
1.87412	1.89456	1	3	1	51.2	1.0	603	635	58	73	660/7	61	430	350	4.43	S-LAH60V
1.84033	1.85815	1	3	1	4.2	1.0	607	630	58	70	640/6	82	410	340	4.34	S-LAH63
1.84052	1.85862	1	3	3	51.2	1.0	669	701	79	93	580/6	121	415	345	4.45	S-LAH63Q
1.81666	1.83016	1	3	2	4.0	1.0	685	705	61	74	750/7	63	380	315	4.30	S-LAH64

S-LAH

Glass-type	Code	n_d 587.56	ν_d	n_F-n_C	$\theta_{g,F}$	n_e 546.07	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$ 768.19	n_C 656.27	n_{He-Ne} 632.8	n_F 486.13	n_g 435.835
S-LAH65V	804466	1.80400	46.58	0.017259	0.5573	1.80811	46.34	0.017440	1.79300	1.79882	1.80041	1.81608	1.82569
S-LAH65VS	804465	1.80400	46.53	0.017281	0.5577	1.80811	46.28	0.017463	1.79302	1.79882	1.80040	1.81610	1.82573
S-LAH66	773496	1.77250	49.60	0.015576	0.5520	1.77621	49.36	0.015727	1.76248	1.76780	1.76924	1.78337	1.79197
S-LAH71	850323	1.85026	32.27	0.026349	0.5929	1.85649	32.03	0.026744	1.83430	1.84259	1.84491	1.86893	1.88456
S-LAH79	003283	2.00330	28.27	0.035486	0.5980	2.01169	28.07	0.036041	1.98195	1.99301	1.99613	2.02850	2.04972
S-LAH88	917316	1.91650	31.60	0.028999	0.5911	1.92336	31.38	0.029426	1.89884	1.90803	1.91060	1.93703	1.95418
S-LAH89	852408	1.85150	40.78	0.020880	0.5695	1.85646	40.53	0.021134	1.83847	1.84530	1.84719	1.86618	1.87807
S-LAH92	892371	1.89190	37.13	0.024019	0.5780	1.89760	36.88	0.024337	1.87709	1.88482	1.88698	1.90884	1.92273
S-LAH93	905350	1.90525	35.04	0.025838	0.5848	1.91137	34.79	0.026200	1.88944	1.89768	1.89998	1.92351	1.93862
S-LAH95	904313	1.90366	31.34	0.028832	0.5963	1.91048	31.10	0.029272	1.88622	1.89528	1.89782	1.92411	1.94130
S-LAH96	764485	1.76385	48.49	0.015753	0.5589	1.76760	48.21	0.015923	1.75385	1.75913	1.76057	1.77488	1.78369
S-LAH97	755523	1.75500	52.32	0.014431	0.5474	1.75844	52.08	0.014562	1.74565	1.75063	1.75197	1.76506	1.77296
S-LAH98	954323	1.95375	32.32	0.029506	0.5905	1.96073	32.09	0.029940	1.93582	1.94514	1.94775	1.97465	1.99207
S-LAH99	001291	2.00100	29.14	0.034352	0.5997	2.00912	28.92	0.034895	1.98035	1.99105	1.99406	2.02540	2.04600

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~+70°C	100°~300°C			λ80 (λ70)	λ5		
1.83380	1.84786	1	3	3	4.1	1.0	691	711	60	74	730/7	57	385	315	4.72	S-LAH65V
1.83385	1.84792	1	3	2	4.0	1.0	691	720	61	75	730/7	61	380	310	4.46	S-LAH65VS
1.79917	1.81158	1	3	1	51.2	1.0	686	706	62	74	700/7	61	370	305	4.23	S-LAH66
1.89827	–	1	1	2	2.0	1.0	707	752	77	91	590/6	136	(425)	370	4.36	S-LAH71
2.06844	–	1	1	2	1.0	1.0	699	731	60	71	700/7	63	(460)	370	5.23	S-LAH79
1.96920	–	1	2	1	3.2	1.1	616	642	57	71	650/7	69	(400)	355	4.74	S-LAH88
1.88822	–	1	2	2	4.0	1.0	669	702	68	80	660/7	68	(380)	340	4.70	S-LAH89
1.93469	–	1	1	2	4.0	1.0	689	730	75	87	650/7	63	(400)	350	4.87	S-LAH92
1.95176	–	1	1	1	4.0	1.0	677	716	70	86	680/7	60	(410)	355	4.83	S-LAH93
1.95648	–	1	1	1	4.0	1.0	649	684	73	87	630/6	85	(410)	360	4.64	S-LAH95
1.79112	1.80405	1	3	2	5.0	1.0	629	655	70	84	650/7	81	400	345	4.54	S-LAH96
1.77954	1.79082	1	4	2	51.2	2.0	692	709	58	72	730/7	62	355	–	4.17	S-LAH97
2.00732	–	1	1	1	3.0	1.0	723	757	73	87	650/7	55	(405)	355	4.94	S-LAH98
2.06424	–	1	1	1	2.0	1.0	725	761	75	88	650/7	55	(425)	360	5.02	S-LAH99

S-FTM

Glass-type	Code	n_d	ν_d	$n_F - n_C$	$\theta_{g,F}$	n_e	ν_e	$n_{F'} - n_{C'}$	$n_{A'}$	n_C	$n_{He} - n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-FTM16	593353	1.59270	35.31	0.016785	0.5933	1.59667	35.03	0.017031	1.58243	1.58779	1.58929	1.60458	1.61454

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.62334	1.63974	1	1	1~2	1.0	2.0	501	542	90	100	490/5	181	380	350	2.64	S-FTM16

S-NBM

Glass-type	Code	n_d	ν_d	$n_F - n_C$	$\theta_{g,F}$	n_e	ν_e	$n_{F'} - n_{C'}$	$n_{A'}$	n_C	$n_{He} - n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-NBM51	613443	1.61340	44.27	0.013857	0.5633	1.61669	44.02	0.014008	1.60459	1.60925	1.61052	1.62311	1.63091

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.63755	1.64927	1	1	2	1.0	1.0	554	611	65	78	570/6	125	350	320	2.93	S-NBM51

S-NBH

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	$n_{He}-n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-NBH5	654397	1.65412	39.68	0.016484	0.5737	1.65803	39.43	0.016687	1.64379	1.64923	1.65072	1.66571	1.67517
S-NBH8	720347	1.72047	34.71	0.020758	0.5834	1.72538	34.47	0.021042	1.70767	1.71437	1.71622	1.73512	1.74723
S-NBH51	750353	1.74950	35.33	0.021214	0.5818	1.75453	35.10	0.021498	1.73640	1.74326	1.74516	1.76447	1.77681
S-NBH52V	673383	1.67300	38.26	0.017592	0.5757	1.67717	38.01	0.017815	1.66203	1.66779	1.66938	1.68538	1.69551
S-NBH53V	738323	1.73800	32.33	0.022830	0.5900	1.74340	32.10	0.023159	1.72404	1.73132	1.73335	1.75415	1.76762
S-NBH55	800299	1.80000	29.84	0.026806	0.6017	1.80633	29.61	0.027232	1.78388	1.79224	1.79459	1.81904	1.83517
S-NBH56	855248	1.85478	24.80	0.034469	0.6122	1.86290	24.61	0.035057	1.83429	1.84488	1.84787	1.87935	1.90045
S-NBH57	850300	1.85025	30.05	0.028299	0.5979	1.85694	29.82	0.028738	1.83319	1.84204	1.84453	1.87034	1.88726
S-NBH58	789284	1.78880	28.43	0.027747	0.6009	1.79535	28.22	0.027747	1.77207	1.78076	1.78319	1.80850	1.82518

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.68331	1.69791	1	1	2	1.0	1.0	524	575	66	84	580/6	123	370	325	3.02	S-NBH5
1.75777	1.77689	1	1	2	1.0	1.0	508	555	81	100	590/6	153	390	330	3.19	S-NBH8
1.78753	1.80695	1	1	3	1.0	1.0	535	578	73	92	610/6	113	400	330	3.29	S-NBH51
1.70425	1.71994	1	1	1	1.0	1.0	497	538	77	98	600/6	139	360	320	3.01	S-NBH52V
1.77943	1.80114	1	1	2	1.0	1.0	538	582	71	93	600/6	126	385	330	3.19	S-NBH53V
1.84951	–	1	1	2	1.0	1.0	613	663	82	90	560/6	148	435	360	3.68	S-NBH55
1.91944	–	1	1	3	1.0	1.0	578	612	77	94	560/6	138	(395)	360	3.49	S-NBH56
1.90220	–	1	1	1	3.0	1.0	625	679	77	92	560/6	143	(410)	355	4.00	S-NBH57
1.83997	–	1	1	2	1.0	1.0	560	600	74	95	590/6	131	410	345	3.33	S-NBH58

S-NPH

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	n_{He-Ne}	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-NPH1	808228	1.80809	22.76	0.035504	0.6307	1.81643	22.57	0.036174	1.78731	1.79801	1.80105	1.83351	1.85590
S-NPH1W	808228	1.80809	22.76	0.035504	0.6307	1.81643	22.57	0.036174	1.78731	1.79801	1.80105	1.83351	1.85590
S-NPH2	923189	1.92286	18.90	0.048838	0.6495	1.93429	18.74	0.049853	1.89479	1.90916	1.91327	1.95800	1.98972
S-NPH3	959175	1.95906	17.47	0.054895	0.6598	1.97188	17.33	0.056091	1.92780	1.94376	1.94834	1.99866	2.03488
S-NPH4	893204	1.89286	20.36	0.043851	0.6393	1.90314	20.20	0.044721	1.86745	1.88048	1.88420	1.92433	1.95237
S-NPH5	859227	1.85896	22.73	0.037792	0.6284	1.86784	22.54	0.038499	1.83681	1.84821	1.85145	1.88600	1.90975
S-NPH7	778239	1.77830	23.91	0.032549	0.6248	1.78595	23.71	0.033147	1.75917	1.76902	1.77182	1.80157	1.82191

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.87658	–	1	1	1~2	1.0	1.0	552	589	83	104	460/5	320	445	375	3.29	S-NPH1
1.87658	–	1	1	1~2	1.0	1.0	552	589	83	104	460/5	320	420	375	3.29	S-NPH1W
2.01976	–	1	1	1	1.0	1.0	650	676	67	83	450/5	237	(440)	390	3.58	S-NPH2
2.06965	–	1	1	1	1.0	1.0	671	704	59	65	450/5	215	(440)	395	3.59	S-NPH3
1.97853	–	1	1	1	1.0	1.0	638	668	73	88	440/4	268	(410)	380	3.61	S-NPH4
1.93160	–	1	1	1	1.0	1.0	609	651	76	84	470/5	277	(400)	370	3.71	S-NPH5
1.84053	–	1	1	2	1.0	1.0	569	598	109	130	350/4	448	420	370	3.30	S-NPH7

Low Tg

Glass-type	Code	n_d 587.56	ν_d	n_F-n_C	$\theta_{g,F}$	n_e 546.07	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$ 768.19	n_C 656.27	n_{He-ne} 632.8	n_F 486.13	n_g 435.835
L-BSL7	516641	1.51633	64.06	0.008060	0.5333	1.51825	63.87	0.008114	1.51094	1.51385	1.51462	1.52191	1.52620
L-BAL35	589612	1.58913	61.15	0.009634	0.5382	1.59143	60.93	0.009706	1.58276	1.58618	1.58709	1.59581	1.60100
L-BAL35P	592610	1.59208	61.00	0.009707	0.5382	1.59440	60.77	0.009781	1.58566	1.58911	1.59002	1.59881	1.60404
L-BAL42	583594	1.58313	59.38	0.009820	0.5423	1.58547	59.13	0.009901	1.57671	1.58013	1.58106	1.58995	1.59528
L-BAL42P	586592	1.58593	59.24	0.009890	0.5425	1.58829	58.99	0.009972	1.57947	1.58292	1.58385	1.59281	1.59817
L-BAL43	586597	1.58573	59.70	0.009812	0.5415	1.58807	59.45	0.009892	1.57930	1.58274	1.58366	1.59255	1.59786
L-TIM28	689310	1.68948	31.02	0.022225	0.5987	1.69473	30.78	0.022569	1.67605	1.68303	1.68498	1.70525	1.71856
L-TIM28P	695307	1.69453	30.66	0.022656	0.5992	1.69988	30.42	0.023009	1.68086	1.68796	1.68995	1.71061	1.72419
L-LAL13	694532	1.69350	53.18	0.013040	0.5482	1.69661	52.93	0.013160	1.68507	1.68955	1.69076	1.70259	1.70974
L-LAL15	693529	1.69304	52.93	0.013093	0.5467	1.69616	52.70	0.013210	1.68453	1.68906	1.69029	1.70216	1.70932
L-LAM60	743493	1.74320	49.29	0.015077	0.5529	1.74679	49.00	0.015226	1.73354	1.73866	1.74005	1.75373	1.76207
L-LAM69	731405	1.73077	40.51	0.018040	0.5728	1.73505	40.25	0.018262	1.71948	1.72542	1.72705	1.74346	1.75379
L-LAH53	806409	1.80625	40.91	0.019709	0.5691	1.81093	40.66	0.019946	1.79391	1.80039	1.80218	1.82010	1.83132
L-LAH84	808405	1.80835	40.55	0.019936	0.5692	1.81309	40.30	0.020178	1.79590	1.80243	1.80424	1.82237	1.83372

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.52975	1.53574	2	1	3	1.0	1.2	498	549	58	71	560/6	72	330	295	2.38	L-BSL7
1.60528	1.61256	2	4	3	52.2	3.2	527	567	66	81	630/6	100	345	295	2.82	L-BAL35
1.60836	1.61570	2	4	3	52.2	3.2	527	567	66	81	630/6	100	345	295	2.82	L-BAL35P
1.59969	1.60719	1	3	1~2	5.2	2.0	506	538	72	88	590/6	117	340	285	3.05	L-BAL42
1.60262	1.61020	1	3	1~2	5.2	2.0	506	538	72	88	590/6	117	340	285	3.05	L-BAL42P
1.60227	1.60976	1	3	3	51.4	2.0	493	535	72	90	610/6	118	340	285	3.05	L-BAL43
1.73034	–	1	1	1~2	1.0	1.0	504	539	101	130	530/5	217	400	355	2.88	L-TIM28
1.73622	–	1	1	1~2	1.0	1.0	504	539	101	130	530/5	217	400	355	2.88	L-TIM28P
1.71570	1.72592	1	4	2	53.2	4.0	534	575	76	92	620/6	108	360	285	3.69	L-LAL13
1.71528	1.72550	1	4	3	53.0	4.0	525	562	54	72	650/7	82	345	–	3.66	L-LAL15
1.76905	1.78108	1	3	3	51.2	2.0	541	581	74	92	620/6	92	370	310	4.20	L-LAM60
1.76267	1.77858	1	3	2	52.2	3.1	497	529	86	105	630/6	121	410	340	3.24	L-LAM69
1.84090	1.85783	1	3	1	51.2	2.0	574	607	59	72	660/7	83	400	335	4.49	L-LAH53
1.84340	1.86048	1	3	2	51.3	2.2	527	568	64	79	610/6	88	400	335	4.62	L-LAH84

Low Tg

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	$n_{He}-n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
L-LAH85V	854404	1.85400	40.38	0.021151	0.5688	1.85903	40.13	0.021407	1.84079	1.84772	1.84964	1.86887	1.88090
L-LAH90	832401	1.83220	40.10	0.020755	0.5714	1.83713	39.84	0.021011	1.81926	1.82605	1.82792	1.84680	1.85866
L-LAH91	765491	1.76450	49.09	0.015572	0.5528	1.76821	48.85	0.015726	1.75453	1.75981	1.76125	1.77538	1.78399
L-LAH94	861371	1.86100	37.10	0.023209	0.5785	1.86650	36.85	0.023517	1.84667	1.85416	1.85624	1.87737	1.89080

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.89116	1.90923	1	3	4	3.2	1.0	613	653	63	77	650/7	65	(380)	340	5.25	L-LAH85V
1.86881	1.88683	1	3	2	5.2	1.2	607	644	63	74	640/6	80	410	340	4.65	L-LAH90
1.79120	1.80360	1	4	2	52.2	2.0	611	644	57	71	680/7	68	365	275	4.29	L-LAH91
1.90238	–	1	3	3	51.2	2.0	593	628	62	77	660/7	81	(390)	350	4.89	L-LAH94

i-Line

Glass-type	Code	n_d	ν_d	n_F-n_C	$\theta_{g,F}$	n_e	ν_e	$n_{F'}-n_{C'}$	$n_{A'}$	n_C	$n_{He}-n_e$	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
S-FPL51Y	497811	1.49700	81.14	0.006125	0.5381	1.49847	80.74	0.006174	1.49299	1.49513	1.49571	1.50126	1.50455
S-FSL5Y	487703	1.48749	70.36	0.006929	0.5297	1.48915	70.17	0.006971	1.48282	1.48535	1.48601	1.49228	1.49594
BSL7Y	516643	1.51633	64.24	0.008037	0.5344	1.51825	64.04	0.008092	1.51096	1.51386	1.51462	1.52189	1.52619
BAL15Y	557587	1.55671	58.68	0.009488	0.5444	1.55897	58.41	0.009569	1.55053	1.55383	1.55471	1.56331	1.56848
BAL35Y	589612	1.58913	61.23	0.009621	0.5398	1.59143	60.99	0.009697	1.58280	1.58619	1.58710	1.59581	1.60100
BSM51Y	603606	1.60311	60.65	0.009944	0.5407	1.60548	60.40	0.010024	1.59658	1.60007	1.60101	1.61002	1.61539
PBL1Y	548457	1.54814	45.73	0.011986	0.5656	1.55099	45.45	0.012123	1.54058	1.54456	1.54566	1.55655	1.56333
PBL6Y	532490	1.53172	48.95	0.010862	0.5599	1.53430	48.67	0.010977	1.52480	1.52846	1.52946	1.53932	1.54540
PBL25Y	581408	1.58144	40.77	0.014263	0.5739	1.58482	40.49	0.014442	1.57256	1.57722	1.57850	1.59148	1.59967
PBL26Y	567428	1.56732	42.86	0.013238	0.5706	1.57047	42.58	0.013399	1.55904	1.56339	1.56459	1.57663	1.58418
PBL35Y	582409	1.58159	40.86	0.014235	0.5741	1.58497	40.58	0.014415	1.57273	1.57738	1.57866	1.59161	1.59979
PBM2Y	620363	1.62004	36.27	0.017095	0.5825	1.62409	36.01	0.017330	1.60953	1.61502	1.61655	1.63211	1.64207
PBM8Y	596393	1.59551	39.26	0.015169	0.5767	1.59911	38.99	0.015365	1.58611	1.59103	1.59239	1.60620	1.61495
PBM18Y	596387	1.59551	38.77	0.015361	0.5769	1.59915	38.50	0.015561	1.58599	1.59097	1.59236	1.60634	1.61520

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10⁻⁷/K]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass-type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
1.50727	1.51185	1	3	2~3	51.0	4.2	448	471	136	161	380/4	504	310	–	3.66	S-FPL51Y
1.49896	1.50404	3	4	2	3.0	2.0	500	567	89	97	530/5	114	295	270	2.46	S-FSL5Y
1.52973	1.53574	2	1	1	1.0	1.0	577	616	68	81	570/6	91	315	290	2.50	BSL7Y
1.57277	1.58012	1	1	1~2	1.2	1.0	507	547	76	90	560/6	118	325	295	2.90	BAL15Y
1.60530	1.61261	2	3	2~3	4.2	1.0	590	628	57	72	550/6	113	320	285	3.23	BAL35Y
1.61985	1.62743	2	4	3	51.2	2.2	585	617	63	77	570/6	130	325	290	3.36	BSM51Y
1.56911	1.57931	2	1	2	1.0	1.1	406	453	93	106	420/4	127	325	305	2.95	PBL1Y
1.55056	1.55959	2	1	1	1.0	1.0	453	501	83	90	450/5	118	325	305	2.79	PBL6Y
1.60670	1.61928	2	1	1	1.0	2.0	440	468	87	98	460/5	145	335	310	3.23	PBL25Y
1.59065	1.60217	2	1	1	1.0	2.0	432	471	89	100	420/4	140	335	310	3.10	PBL26Y
1.60681	1.61937	1	1	2	1.0	2.0	404	454	91	107	450/5	153	335	310	3.27	PBL35Y
1.65071	1.66635	2	1	1	1.0	2.0	436	470	86	97	420/4	169	345	320	3.61	PBM2Y
1.62249	1.63604	2	1	1	1.0	2.0	445	485	85	96	400/4	154	340	315	3.36	PBM8Y
1.62284	1.63656	1	1	2~3	1.0	2.0	441	478	88	100	410/4	138	340	315	3.37	PBM18Y

1. Designation of OHARA's Optical Glass Types

Each optical glass has its own properties which are closely connected with the key chemical elements contained. OHARA's designation system for optical glasses show in the first or second character the atomic symbols of one or two chemical elements, which are considered to be the most important.

The third letter of the glass type designation refers to the refractive index of each glass type within its glass group: H, M or L for high, middle, or low index. Lastly we assign a one or two digit number to each glass type within a given glass family.

Thus each glass type is represented by three letters plus a one or two digit numbers.

A leading "S-" or "L-" stand for environmentally safe, a "Y" at the end points to i-Line-Glasses, a "W" to types with an outstanding transmittance.

For example, the glass type S-BSL7 is environmentally safe (S-), contains Boron (B) and Silicon (S), shows a low index (L) and is the seventh (7) glass within this BS glass family.

Along with OHARA's glass type designation, each single glass-type is identified by a six-digit-code.

The first three digits represent the refractive index at the helium line (n_d) and the last three digits represent the Abbe number (ν_d).

This six-digit code is internationally recognized within the optical community.

2. Optical Properties

2.1 Refractive Index

When light passes through glass, its speed falls and its travel distance decrease. This is known as optical path length.
From the rate of the speed, refractive index can be calculated. Refractive indices are indicated to five decimal places for 10 spectral lines in accordance with JIS B 7071-1 standard.

The principal indices for the d line (587.56 nm) and the e line (546.07 nm) are indicated to six decimal places.

In refractive index section on the data sheet, the wavelengths of individual spectral lines are stated in nanometers (nm) to the right of the symbol.

Spectral Line Symbol	s	A’	C	He-Ne	d	e	F	g	h	i
Light Source	Cs	K	H	Laser	He	Hg	H	Hg	Hg	Hg
Wavelength [nm]	852.11	768.19	656.27	632.8	587.56	546.07	486.13	435.835	404.656	365.015

Table 1: Wavelengths for refractive index

2.2 Dispersion

Dispersion refers to the phenomenon arising from a variation in the refractive index depending on the wavelength. As principal dispersion, ($n_F - n_C$) and ($n_{F'} - n_{C'}$) is indicated. Abbe numbers ν_d and ν_e are calculated by the following formula:

$$\nu_d = \frac{n_d - 1}{n_F - n_C} \qquad \nu_e = \frac{n_e - 1}{n_{F'} - n_{C'}}$$

The data sheet indicates the dispersion, calculated from the refractive index to six decimal places. Abbe number is indicated to two decimal places, this is the result of the calculation from nd to six decimal places (with seven effective digits) and the principal dispersion to six decimal places.

2.3 Partial Dispersion Ratio, Anomalous Dispersion

For the wavelengths x and y, in order to have effective achromatization, a certain desirable relationship is required between the relative partial dispersion [$\theta_{x,y} = (n_x - n_y)/(n_F - n_C)$] and the ν_d.

As a means of representing the relationship between $\theta_{x,y}$ and ν_d of different glass types the chart of $\theta_{g,F}$ and ν_d is published. In this chart, a large numbers of glass types are distributed along a fixed trend line. The glass types that are in a distance from that line tend to have anomalous dispersion. To represent anomalous dispersion numerically, after plotting 511605 (NSL7) and 620363 (PBM2) on the $\theta_{x,y} - \nu_d$ diagram, the straight line between these two points is called “normal line”.

The difference in vertical direction between position of the glass type and the normal line is listed as $\Delta\theta_{x,y}$.

NSL7 and PBM2 already have been discontinued at OHARA, however, it's been decided to continue to use these 2 glass types as the baseline for representing the anomalous dispersion and should not be changed.

	$\theta_{g,F}$	$\theta_{C,t}$	ν_d
NSL7	0.5436	0.8305	60.49
PBM2	0.5828	0.7168	36.26

Table 2: Reference Glasses for the normal line

2.4 Temperature Coefficient of Refractive Index ($dn/dT_{relative}$)

Refractive index of the glass will change by influence of temperature. The change of refractive index by temperature can be ascertained through the temperature coefficient of refractive index, and is defined as dn/dT from the curve showing the relationship between glass temperature and refractive index.

dn/dT depends on wavelength, and also varies with temperature. Therefore, the Abbe number also changes with temperature. There are two ways of showing the temperature coefficient of refractive index. One is the relative coefficient [$dn/dT_{relative}$] measured in dry air (1013 hPa) at same temperature as the glass, and the other is the absolute coefficient [$dn/dT_{absolute}$] measured under vacuum.

For each glass-type the figures of the relative coefficients [$dn/dT_{relative}$], measured according to method JOGIS-18, are disclosed (see OHARA glass-data-sheets). These coefficients are given at wavelengths 1,013.98 nm (t), 643.85 nm (C'), 632.8 nm (He-Ne laser), 589.29 nm (D), 546.07 nm (e), 479.99 nm (F') and 435.835 nm (g) in a temperature range of –40 °C to +80 °C.

The absolute temperature coefficient of refractive index ($dn/dT_{absolute}$) can be calculated by the formula:

$$dn/dT_{absolute} = dn/dT_{relative} + n \cdot (dn_{air}/dT)$$

dn_{air}/dT is the temperature coefficient of refractive index of air. It's listed in table 3.

Temperature	**dn_{air}/dT [10^{-6} K]**						
	t	**C'**	**He-Ne**	**D**	**e**	**F'**	**g**
–40 °C … –20 °C	–1.34	–1.35	–1.36	–1.36	–1.36	–1.37	–1.38
–20 °C … 0 °C	–1.15	–1.16	–1.16	–1.16	–1.16	–1.17	–1.17
0 °C … +20 °C	–0.99	–1.00	–1.00	–1.00	–1.00	–1.01	–1.01
+20 °C … +40 °C	–0.86	–0.87	–0.87	–0.87	–0.87	–0.88	–0.88
+40 °C … +60 °C	–0.763	–0.77	–0.77	–0.77	–0.77	–0.77	–0.78
+60 °C … +80 °C	–0.67	–0.68	–0.68	–0.68	–0.68	–0.69	–0.69

Table 3: Temperature coefficient of refractive index of air

2.5 Coloring

On the basis of JOGIS-02, coloring can be determined by measuring spectral transmittance, including reflection losses, with test pieces of 10 mm in thickness. The wavelengths corresponding to 80 % transmittance and 5 % transmittance are indicated as Coloring, i.e. as 405/355 in Fig. 1.

The values are grouped in units of 5 nm, using this rounding method: the range 0 nm to 2 nm counts as 0 nm, the range 3 nm to 7 nm counts as 5 nm, the range 8 nm to 10 nm counts as 10 nm.

For glass types with a high refractive index of $n_e \geq 1.85$, the wavelength showing transmittance of 70 % was used instead of 80 %, because the reflection loss is large.

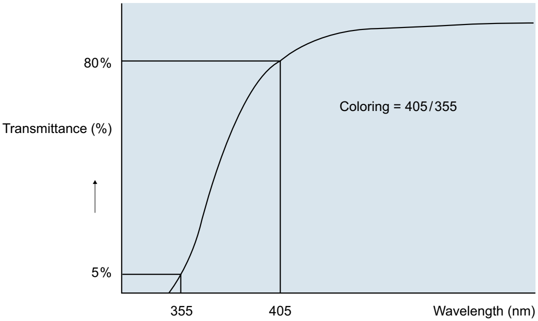


Fig. 1: Coloring, i.e.: 5 % transmittance at 355 nm, 80 % transmittance at 405 nm

2.6 Internal Transmittance $\lambda_{0.80}$ / $\lambda_{0.05}$

As a simplified indicator of coloring, the wavelength values in nm at which the internal transmittance of a 10 mm thick glass sample is 80 % and 5 % are indicated.

2.7 CCI

ISO Colour Contribution Index (ISO/CCI): The color characteristic index calculated by the method referred JIS B7097-1986. CCI is an index indicating the amount of color variation caused by the spectral characteristics of lens comparing with the original color when photographed. In order to refer to the influences caused by the glass material itself, OHARA discloses this index. For more information, please refer to JIS 7097 “Determination of ISO Colour Contribution Index (ISO/CCI) of Camera Lenses”.

3. Chemical Properties

Some optical glasses have poor chemical durability resulting from ingredients to attain distinguished optical characteristics. These glasses may have on the surface some fog or interference film generated from a polishing solution or from vapor or carbon dioxide in the atmosphere while they are processed or preserved. It is called “diming” or “staining”.

It is generally understood that “diming” or “staining” occurs when the glass is eroded by acid and that in this event alkali ions and barium ions are eluted from the glass’ surface and a thin film with a high SiO_2 content is formed and left on the glass’ surface with a refractive index that differs from that of the glass.

This phenomenon varies slightly depending on the state of the glass’ surface and on the conditions of the surrounding environment and has various appearances. This implies the necessity to judge the durability of optical glass from an overall perspective by taking into consideration the test results under different conditions without relying on the result for a single testing method.

For this catalogue, acid resistance and detergent resistance are tested by the method referred to ISO 8424 and ISO 9689 standards in addition to water resistance and acid resistance tested by the powder method, and weather resistance by the surface method.

3.1 Water Resistance $RW_{(p)}$ and Acid Resistance $RA_{(p)}$ (Powder Method)

These tests are conducted using the method in accordance with JOGIS-06.

The glass to be tested is crushed to 425 µm ~ 600 µm grains. A sample of this powder equivalent to the specific gravity in grams is placed on a platinum basket. This is put in a flask of silica glass containing the reagent and boiled for 60 minutes. The sample is then carefully dried and re-weighed to determine the loss of weight (percent) and classified as per Table 4 and 5.

The reagent used for the water resistance test is distilled water (pH 6.5 ~ 7.5). 1/100 N nitric acid is used for the acid resistance test.

Class	**1**	**2**	**3**	**4**	**5**	**6**
Weight loss [%]	< 0.05	≥ 0.05 < 0.10	≥ 0.10 < 0.25	≥ 0.25 < 0.60	≥ 0.60 < 1.10	≥ 1.10

Table 4: Water Resistance

Class	**1**	**2**	**3**	**4**	**5**	**6**
Weight loss [%]	< 0.20	≥ 0.20 < 0.35	≥ 0.35 < 0.65	≥ 0.65 < 1.20	≥ 1.20 < 2.20	≥ 2.20

Table 5: Acid Resistance

3.2 Weathering Resistance $W_{(s)}$ (Surface Method)

This test is carried out by placing freshly polished glass plates in a chamber at +60 °C, 95 % humidity for 24 hours. If the glass surface is severely attacked, another 6 hours test is carried out with new test pieces. A classification into four groups as shown in table 6 is then obtained by inspecting the treated surface through a 50x microscope.

Class	Constant temperature and humidity chamber	Illuminance at being observed	
	Time	1500 lux	100 lux
1	24 h	O	–
2	24 h	X	O
3	24 h	–	X
4	6 h	–	X

Table 6: Classes of Weathering Resistance
O Dimming or staining are observed
X Dimming or staining are not observed

3.3 Acid Resistance (SR)

By the method referred to ISO-8424, the glass samples size 30 x 30 x 3 mm with 6 faces polished in the specified condition, are hung into nitric acid solution (pH 0.3) or acetic acid buffer solution (pH 4.6) at 25 °C for specified time (10 minutes, 100 minutes, 16 hours, 100 hours). After the treatments, the samples are weighed to determine the loss in mass. Calculation of the time (h) required in order to attack a surface layer to a depth of 0.1 μm is done using the following formula:

$$t_{0.1} = \frac{t_e \cdot d \cdot s}{(m_1 - m_2) \cdot 100}$$

$t_{0.1}$ the time [h] decreases a surface layer to a depth of 0.1 μm
t_e the time [h] for attack in the experiment
d the specific gravity [g/cm^3] of the sample
s the surface area [cm^2] of the sample
m_1 the mass [mg] of the sample before the test
m_2 the mass [mg] of the sample after the test

The calculation is carried out by use of the value of the loss of mass which is observed by the minimum test condition (i. e., test solution and test time) for obtaining a loss of mass greater than 1 mg/sample. If the loss of mass is less than 1 mg/sample after 100 hours exposure to pH 0.3, this value shall be accepted.

The acid resistance class SR is obtained by comparison of the pH of the test solution and the time required for the attack to a depth of 0.1 µm with time scales are given in the classification table 7.

Acid resistance class SR	**1**	**2**	**3**	**4**	**5**		**51**	**52**	**53**
pH of the attacking solution	0.3	0.3	0.3	0.3	0.3	4.6	4.6	4.6	4.6
Time $t_{0.1}$ needed to etch to a depth of 0.1 µm [h]	> 100	≤ 100 ≥ 10	< 10 ≥ 1	< 1 ≥ 0.1	< 0.1	> 10	≤ 10 ≥ 1	< 1 ≥ 0.1	< 0.1

Table 7: Classes of Acid Resistance

In addition, changes in the surface of the sample following the treatment are qualitatively evaluated with the naked eye. Additional classification numbers are given according to table 8.

Additional Number	Changes in the Surface
.0	No visible changes
.1	Clear, but irregular surface (wavy, pockmarked)
.2	Interference colors (slight selective leaching)
.3	Tenacious thin whitish layer (stronger selective leaching)
.4	Loosely adhering thick layer (surface crust)

Table 8: Additional number of Acid Resistance

For example, it is indicated that the acid resistance class SR is SR 3.2 for an optical glass which needs 2 hours for the attack to a depth of 0.1 μm by an attacking solution of pH 0.3 and with interference colors after the attack.

3.4 Phosphate Resistance (PR)

The glass samples size 30 x 30 x 3 mm that the 6 faces have been polished in the specified condition, are given into aqueous solution containing 0.01 mol/l purified tripolyphosphate at 50 °C for specified time (15 minutes, 1 hour, 4 hours, 16 hours).

After this treatment, the loss of mass of the sample is determined using an analytical balance. Calculation of the time $t_{0.1}$ decreases a surface layer at a depth of 0.1 μm is made using the same formula which is used for obtaining the acid resistance (SR). In this case, however, the time units are minutes. The phosphate resistance class PR is obtained by comparison of the time required for the attack to a depth of 0.1 μm [min] with time scales given in classification table 9.

Next, changes in the surface of the sample following the treatment are qualitatively evaluated with the naked eye. Additional classification numbers are given to the class number according to table 8 used for obtaining the acid resistance (SR). For example, it is indicated that the phosphate resistance class is PR 2.0 for optical glass which needs 120 minutes for attack to a depth of 0.1 μm, with no visible changes in the surface after the attack.

Phosphate Resistance Class PR	**1**	**2**	**3**	**4**
Time $t_{0.1}$ needed to etch to a depth of 0.1 μm [min]	> 240	≤ 240 ≥ 60	< 60 ≥ 15	< 15

Table 9: Classification of Phosphate Resistance

4. Thermal Properties

4.1 Transformation Temperature (Tg), Yield Point (At)
Transformation Temperature (Tg) refers to the temperature at which the glass transforms from a lower temperature glassy state to a higher temperature super-cooled liquid state. Transformation temperature can be determined from the thermal expansion curve in Figure 2.

The Yield point (At) is shown for the temperature when deformation starts because of the measured pressure (load) exerted on the specimen at the time of measuring expansion, as shown in Figure 2.

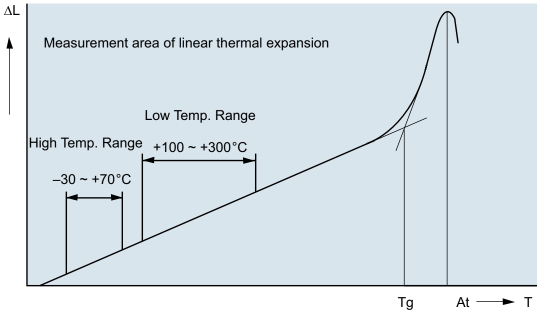


Fig. 2

4.2 Softening Point (SP)

The softening point is the temperature at which glass deforms under its own weight. Viscosity of the glass is $10^{7.65}$ dPa*s at this temperature. The softening point is measured by the Fiber Elongation Method referred to JIS-R3103.

4.3 Annealing Point (AP)

The annealing point corresponds to the maximum temperature in the annealing range at which the internal strain of glass will be substantially eliminated. Viscosity of the glass is 10^{13} dPa*s at this temperature. The annealing point is measured by the Fiber Elongation Method referred to JIS-R3103.

4.4 Linear Coefficient of Thermal Expansion (α)

By the method referred to JOGIS-16 and JOGIS-08, the thermal expansion curve is obtained by measuring a well-annealed glass sample of 4 mm diameter by 50 mm long heated at a rate of 2 °C/min in the low temperature range and at a rate of 4 °C/min in the high temperature range. From the temperature and elongation of the sample glass, the mean linear coefficient of thermal expansion between –30 °C to +70 °C and +100 °C to +300 °C respectively up to 10^{-7}/K is determined and is given in the catalog.

4.5 Thermal Conductivity (k)

The thermal conductivity value of most optical glasses at room temperature is between the range of 1.130 W/(m·K) for S-BSL7 to 0.599 W/(m·K) for S-PHM52 and it is measured using the transient hot wire method. The thermal conductivity of glass at temperature of 35 °C is listed in this catalog. The measurement accuracy is ±5 %.

5. Mechanical Properties

5.1 Knoop Hardness (Hk)

The indentation hardness of optical glass is determined using a micro hardness tester. One face of the specimen with the necessary thickness is polished. The diamond indentor is formed rhombic so that the vertically opposite angle from two axes is 172° 30’ and 130° respectively. The load time is 15 seconds, the load is 0.98 N.

Knoop hardness $Hk = 1.451^* F / l^2$

F Load [N]

l Length of longer diagonal line [mm]

Classification of the Knoop Hardness (rounded to 5) according to JOGIS-09 and the corresponding Group is given in table 10.

Group	1	2	3	4	5	6	7
Knoop Hardness	< 150	≥ 150 < 250	≥ 250 < 350	≥ 350 < 450	≥ 450 < 550	≥ 550 < 650	≥ 650

Table 10: Knoop Hardness and Hardness Group

5.2 Abrasion (Aa)

Abrasion is an indicator of how easy or difficult glass is ground at the processing. In accordance to JOGIS-10 a sample of size 30 x 30 x 10 mm is lapped on a 250 mm diameter cast iron flat, rotating at 60 rpm. The test piece is located 80 mm from the center of the flat and is under a 9.8 N load. 20 ml of water containing 10 g of aluminous abrasive as the lapping material, with mean grain size 20 μm (#800), is supplied evenly to the test piece for 5 minutes. The weight loss of the test piece is then measured. The known weight loss of the standard glass is compared according to the following formula. The values of abrasion are calculated by the method referred to JOGIS and showed to the nearest integer on this catalog.

$$\text{Abrasion} = \frac{\dfrac{\text{wear mass of specimen}}{\text{specific gravity of specimen}}}{\dfrac{\text{wear mass of standard sample}}{\text{specific gravity of standard sample}}} \cdot 100$$

All glass-types released after September 2017 are measured by JOGIS method already.

Now, with this actual release of our catalog, abrasion data of all shown glass-types are measured according JOGIS method.

6. Other Properties

6.1 Photoelastic Constant (β)

Optical glass is usually free of strain, but when mechanical or thermal stress is exerted upon it, glass shows birefringence. Stress F [Pa], optical path difference σ [nm] and thickness of glass d [cm] have the following relationship:

$$\sigma = \beta * d * F$$

The proportional constant β [nm/cm/10^5 Pa] is called the photoelastic constant. The photoelastic constant is a material constant which will change by glass type. By using it, optical path difference can be computed from given stress. Internal stress can also be computed from optical path difference.

6.2 Specific Gravity (d)

Specific gravity d [g/cm^3] is the density value of well-annealed glass referenced against pure water at 4 °C, with the value shown to 2 decimal places. The measurement is performed according to JIS Z8807.

7. Guarantees of Quality

7.1 Refractive Index and Abbe Number

Refractive indices and Abbe number, which are shown for each glass-type, are the representative value of plural melting lots. The individual numbers of the melting lot we deliver, will be within the tolerance specified below:

Optical Glass for Polished Lenses

n_d ±30*10^{-5}

ν_d ±0.5% (rounded to the guaranteed number of digits)

Upon special request, and depending upon the glass types, the following tolerance can be accepted:

n_d ±20*10^{-5}

ν_d ±0.3% (rounded to the guaranteed number of digits)

In the supply of our standard products, melt data is attached and includes the following data:

– Refractive indices	the measurement values of each spectral lines C, d, F, g. These are shown to 5 decimal places (effective number: six digits).
– Abbe number	the calculated value by the measured refractive indices. These are shown to 1 or 2 decimal places.

e.g. S-BSL7

n_d: 1.51633 ±0.00030

ν_d: 61.14 ±0.33

For special requirements, please contact us.

Low Tg Optical Glass for Glass Mold Lenses

RC value: Standard RC value ±30 (Raw material control value)

ν_d ±0.5 % (rounded to the guaranteed number of digits)

When products are supplied, the RC value is given to each melt.-no.

The RC value is Δn_d at 5 decimal places for material after standard annealing (–600 °C per day). The RC value is rounded to 4 decimal places and shows with a unit of 10^{-5}.

ν_d value is reported with to 1 or 2 decimal places concerning the product after annealing as specified in catalog annealing (–200 °C per day).

e.g. L-BSL7

RC value:	–30 ±30
ν_d:	64.14 ±0.33

The standard measurement accuracy for refractive index and dispersion is as follows:

Refractive index:	$\pm 3 * 10^{-5}$
Dispersion:	$\pm 2 * 10^{-5}$

On special request, we shall measure at precision accuracy as follows:

Refractive index:	$\pm 1 * 10^{-5}$
Dispersion:	$\pm 3 * 10^{-6}$

For ultra-precision measurements and reading at spectral lines not described in this catalog, please contact us.

7.2 Homogeneity

For glass used in very precise lens systems it is sometimes necessary to measure the refractive index variation across a blank. In such cases, OHARA pays special attention to each process and can supply high homogeneity glass. The homogeneity is measured by calculating the amount of change (Δn) of the refractive index using computer analysis of the transmitted wavefront of a plane-parallel glass sample with the phase-measuring interferometer. In case that the value of the change amount (Δn) must be guaranteed within $\pm 2*10^{-5}$, measurement of an individual product is conducted and the value of the change amount is guaranteed at six decimal places (10^{-6}).

Note: The homogeneity of our general glass products could exceed $\pm 2*10^{-5}$, depending on glass type, dimensions, shape, etc.

7.3 Stress Birefringence

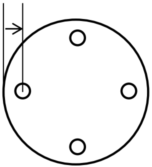
In case that glass retains slight residual strain, this can be observed as optical birefringence. The amount of stress is measured by optical path differences and specified in nm/cm.

On special request, when we measure stress birefringence in detail, a rectangular plate is measured at 4 points located 5 % from the edge at the middle of each side. A disc is measured at 4 points located 5 % from the edge of the diameter. The maximum value of the 4 points is shown as the birefringence value and is categorized based on table 11. For other special forms and shapes the points to be measured will be determined.

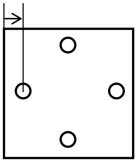
Class	1	2	3	4
Birefringence [nm/cm]	< 5	≥ 5 < 10	≥ 10 < 20	≥ 20

Table 11: Birefringence Classes

5% from the edge of the diameter



5% from the edge at the middle of each side



7.4 Striae

Striae are thread-like veins or cords which are the parts of different chemical components in glass that are visual indications of abruptly varying density. Striae can also be considered as a lack of homogeneity caused by incomplete stirring of the molten glass. Some glasses contain components that evaporate during melting causing layers of varying density, and therefore the appearance of parallel striae.

Striae in glass are detected by means of a striae scope, which consists of a point source of light and a collimating lens. Polished samples are examined from several different angles by the striae scope. They are then compared with the standards which are stated by Japan Optical Glass Manufacturer's Association and graded as in table 12.

Striae Class	Striae Content Using Striaescope
1	No visible striae
2	Striae is light and scattered
3	Striae is heavier than Class 2

Table 12: Striae Classes

7.5 Bubbles and Inclusions

It is most desirable to manufacture bubble-free optical glass, but the existence of bubbles to some extent is inevitable. Bubbles in optical glass vary in size and number from one glass to another due to the many different compositions and production methods. The classification of bubble content is established by specifying in mm^2 the total bubble cross section existing in 100 cm^3 of glass volume. Inclusions such as small stones or crystals are treated as bubbles. Our five bubble classes are shown in table 13.

The classification includes all bubbles and inclusions measuring larger than 0.03 mm.

Bubble Class	1	2	3	4	5
The total cross section of bubbles [mm^2/100 ml]	< 0.03	≥ 0.03 < 0.1	≥ 0.1 < 0.25	≥ 0.25 < 0.50	≥ 0.5

Table 13: Bubble Classes

7.6 Coloring

Variation of coloring between melts is generally within ±10 nm. On special request, we shall report the coloring or the transmission (including reflection losses) of the melt to be supplied by measuring spectral transmission.

7.7 Others

We showed each property as representative value except for 7.1..7.6. Please contact us when you want to know the other value. In addition, please let us know your preferred specification when you place the orders.

8. Forms of Supply

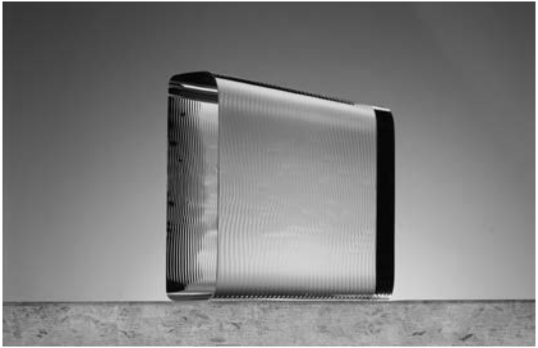
8.1 Glass Blocks

Glass Blocks are made from strip glass by drawing glass out of a furnace in a rectangular in shape. They have slightly rippled fire-polished surfaces (unworked), and are flame cut to the required lengths. The corners are round. Strips are coarse or fine annealed. This is the least expensive form of supply.

Thickness	15 ~ 40 mm
Width and Length	50 ~ 200 mm

The above are standard strip sizes but there are exceptions for certain glass types.

Please contact our sales department with your specific requirements.



8.2 Pressings (Reheat Pressings – RP)

Reheat (RP) are products formed by pressing reheated glass.
Please specify followings:

1) Diameter (including grinding stock)
2) Center Thickness (including grinding stock)
3) Radii of curvature
4) Glass quality (striae, bubble, etc.)
5) Chamfer

The standard diameter range and dimensional tolerance of these blanks are shown in table 14.

Please contact our sales department with your specific requirements.

Diameter [mm]	Outer & Inner Diameter Tolerance (Range) [mm]	Center Thickness Tolerance (Range) [mm]
D ≤ 18	0.2	1.0
18 < D ≤ 30	0.3	0.8
30 < D ≤ 50	0.4	0.6
50 < D ≤ 70	0.6	0.6
70 < D ≤ 100	0.6	0.8
100 < D ≤ 150	0.8	0.8
150 < D ≤ 200	1.0	1.0
200 < D ≤ 250	1.2	1.4

Table 14: Dimensional Tolerances of Pressings

8.3 Saw-cut Centerless Ground Cylindrical Blanks

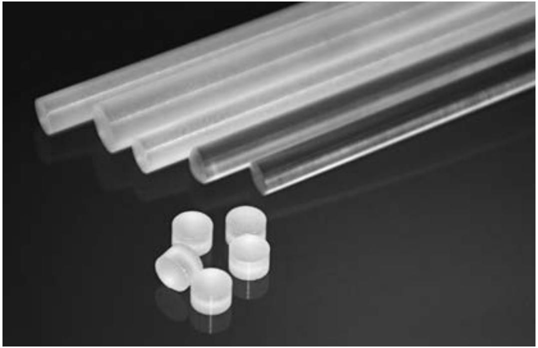
These blanks are cut from a precisely ground rod formed on a centerless grinding machine.

The standard diameter range and the dimensional tolerances of these blanks are shown in table 15.

Please contact our sales department with your specific requirements.

Diameter [mm]	Diameter Tolerance [mm]	Thickness Tolerance [mm]
3 ~ 20	0.03	0.3

Table 15: Tolerances for Saw Cut Centerless Ground Blanks

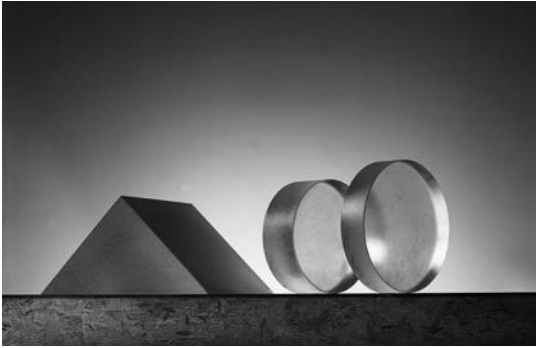


8.4 Dimensional Specified Blanks

Cut blanks can be shaped as disk or as rectangular. They are cut or core drilled from fine annealed strips.

Dedicated by diameter, thickness or length, width, thickness or for prisms: by drawing.

Followings are handled as the Dimensional Specified Blanks
– Circular blanks
– Rectangular blanks
– Prism shaped blanks
– Special shaped blanks
– Fine annealed strips having specified size request



8.5 High Homogeneity Blanks

OHARA utilizes our leading edge technology to provide high homogeneity glasses in various glass types. The homogeneity of the product is confirmed by interferometer after striae inspection.

8.6 Polished Balls

These lenses are polished into a spherical shape. They can be used as lenses or as preforms for glass molding.

For the ball lens dimensions, specifications and other details, please contact us.

8.7 Polished Preforms

Polished preforms are made from reheated pressings or saw cut ground cylindrical blanks and are used for glass moldings.

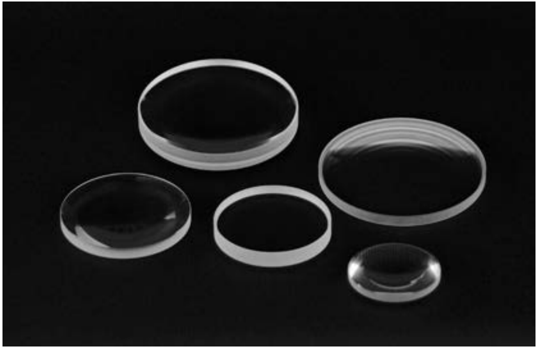
For the dimensions, specifications and other details, please contact our sales department.

8.8 Aspherical Glass Mold Lenses

GMO is the optical glass products such as following.

Using the polished glass blanks which was heated up to high temperature and softened, the shapes of high precision aspherical shape mold tool are press-formed.

For the dimensions, specifications and other details, please contact our sales department.



List of Optical Glasses for Molded Aspherical Lenses

Glasstype	Catalog Value		Controlled value[1]	After molding[2]	Δn_d: before – after molding
	n_d	ν_d	n_d	n_d	Δn_d
L-BSL7	1.51633	64.06	1.51603	1.51480	0.00123
L-BAL35	1.58913	61.15	1.58868	1.58611	0.00257
L-BAL35P	1.59208	61.00	1.59163	1.58906	0.00257
L-BAL42	1.58313	59.38	1.58263	1.58033	0.00230
L-BAL42P	1.58593	59.24	1.58543	1.58313	0.00230
L-BAL43	1.58573	59.70	1.58523	1.58286	0.00237
L-TIM28	1.68948	31.02	1.68848	1.68308	0.00540
L-TIM28P	1.69453	30.66	1.69353	1.68813	0.00540
L-LAL13	1.69350	53.18	1.69280	1.69004	0.00276
L-LAL15	1.69304	52.93	1.69234	1.68863	0.00366
L-LAM60	1.74320	49.29	1.74260	1.73894	0.00366
L-LAM69	1.73077	40.51	1.73017	1.72728	0.00289

(1) n_d is controlled by annealing with cooling rate –600 °C/day

(2) n_d after molding depend on our molding conditions, here annealing with cooling rate –1 °C/sec.

Glasstype	Catalog Value		Controlled value[1]	After molding[2]	Δn_d: before – after molding
	n_d	ν_d	n_d	n_d	Δn_d
L-LAH53	1.80625	40.91	1.80540	1.80141	0.00399
L-LAH84	1.80835	40.55	1.80770	1.80484	0.00286
L-LAH85V	1.85400	40.38	1.85330	1.85035	0.00295
L-LAH90	1.83220	40.10	1.83145	1.82768	0.00377
L-LAH91	1.76450	49.09	1.76385	1.76060	0.00325
L-LAH94	1.86100	37.10	1.86020	1.85603	0.00417

(1) n_d is controlled by annealing with cooling rate –600 °C/day

(2) n_d after molding depend on our molding conditions, here annealing with cooling rate –1 °C/sec.

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Publisher

OHARA GmbH
Im Langgewann 4
65719 Hofheim a. Ts.
GERMANY
Phone +49 6192 9650 50
info@ohara-gmbh.com
www.ohara-gmbh.com

Printed for

OHARA Corp. (East Office)
50 Columbia Road, Branchburg
New Jersey, 08876-3519
USA
Phone +1 908-218-0100
www.oharacorp.com

OHARA Corp. (West Office)
23141 Arroyo Vista, Suite 200
Rancho Santa Margarita
California 92688
USA
Phone +1 949-858-5700
www.oharacorp.com

OHARA OPTICAL (M) SDN. BHD.
Lot 6B & 6C, Merlimau Industrial Estate
Merlimau, 77300 Melaka
MALAYSIA
Phone +606-263 3334, +606-263 3335
+606-263 5696, +606-263 5697

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OHARA INC.