OHARA

OPTICAL GLASS

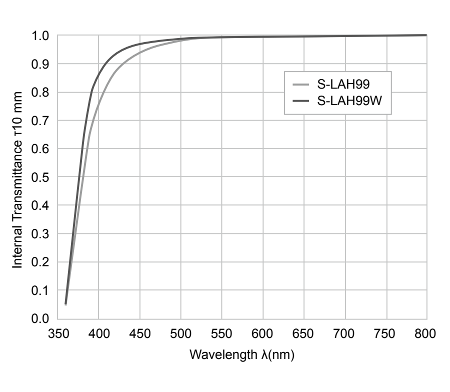
MAY 2023

OHARA

Contents

S-LAH99W (11 2022)

We are pleased to announce the release of a new optical glass type named S-LAH99W, which has improved internal transmittance in the 360–550 nm range while maintaining the high refractive index (n_d 2.001), low specific gravity and excellent polishing characteristics of S-LAH99. This new industry-leading, high index, glass provides an exciting new choice for optical designers and is very well suited for use in applications such Augmented Reality waveguides and other devices.



		S-LAH99W (New Product)
Refractive Index n_d		2.00100
Abbe Number ν_d		29.14
CTE α (10^{-7} K^{-1})	–30～+70°C	75
	+100～+300°C	88
Coloring	λ_{70}	405
	λ_5	360
Chemical Resistance	$RW_{(P)}$	1
	$RA_{(P)}$	1
	$W_{(S)}$	1
	SR	2.0
	PR	1.0
Specific Gravity		5.02
Knoop Hardness Hk		720[7]
Abrasion Aa		55

S-LAL61Q (01 2023)

We are pleased to announce the release of a new optical glass type named S-LAL61Q which has excellent acid resistance by powder method (n_d 1.74 or higher and v_d 50–55) and also maintains the mechanical strength of S-LAL61 which has been used for various applications for many years. This new material has the same optical performance (refractive index and Abbe number) as conventional products and is even easier to handle in lens processing. It also has various lens applications, such as in-vehicle cameras, projectors, and interchangeable lenses for photography.

1. Improved chemical durability (compared to conventional products):
   Acid resistance by powder method: Grade 3
2. Mechanical strength equivalent to S-LAL61:
   Knoop hardness: 710[7]

		S-LAL61Q (New Product)	S-LAL61 (Current Product)
Eco Optical Glass		○	○
Refractive Index n_d		1.74100	1.74100
Abbe Number ν_d		52.60	52.64
CTE α (10^{-7} K^{-1})	–30～+70°C	57	57
	+100～+300°C	74	70
Coloring	λ_{80}	360	365
	λ_5	300	280
Chemical Resistance	$RW_{(P)}$	1	1
	$RA_{(P)}$	3	4
	$W_{(S)}$	3	1～2
	SR	51.0	51.0
	PR	2.0	2.0
Specific Gravity		4.09	4.04
Knoop Hardness Hk		710[7]	720[7]
Abrasion Aa		66	71

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 130 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 130 environmentally safe glass types begins with S-.

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

This catalog covers 17 types of optical glass for use in molded 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-.

Non-browning Optical Glass

Glass colors when exposed to intense radiation. As a result, it cannot be used as an optical component. Non-browning optical glass has strong durability against radiation because of its special composition. It can be a new proposal for solution to optics use in radiation environment.

Synthetic Fused Silica (Quartz Glass)

OHARA's quartz synthetic fused silica is a highly pure and low OH synthetic fused silica. It is made by optical fiber manufacturing technology of conventional VAD (vapor-phase axial deposition) method with own improvements taken for many years and usable to many applications.

In addition to hard resistance and mechanical strength, SK-1300 has excellent optical properties like high ultraviolet transmission and solarization resistance that no other glass has.

SK-1310 has similar optical properties to SK-1300, and furthermore it does not contain any hydroxyl radicals. Therefore, there is no light absorption due to hydroxyl radicals in the infrared region (such as 2.73 μm). It is a revolutionary material that has the highest transmittance as quartz glass over entire ultraviolet, visible and infrared regions.

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 devolved 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.

Lithium-Ion Conductive Glass-Ceramics LICGC™

LICGC™ has unique properties as it is air sable, water insoluble, non-flammable, provides excellent conduction of lithium ions and can be used as a true solid state electrolyte or separator in next-generation batteries, capacitors or other electrochemical devices.

LICGC™ powder, when used as a positive electrode additive in lithium ion secondary batteries, leads to significant improvements in charge/discharge characteristics, and provides enhanced performance at low temperatures.

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	
CODE	G.T.	CODE	G.T.	CODE	G.T.	CODE	G.T.
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-FK01A
516641	S-BSL7	517642	(N-BK7)	517642	BSC7	517641	J-BK7A
517524	S-NSL36	–	–	517522	E-CF6	517522	J-KF6
518590	S-NSL3	522595	(N-K5)	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
552708	S-FPM5	–	–	554718	(FCD500)	–	–

OHARA		SCHOTT		HOYA		HIKARI	
CODE	G.T.	CODE	G.T.	CODE	G.T.	CODE	G.T.
567428	S-TIL26	–	–	567428	E-FL6	567426	J-LF6
569563	S-BAL14	569560	N-BAK4	569560	BAC4	569560	J-BAK4
571530	S-BAL3	–	–	–	–	–	–
575415	S-TIL27	–	–	–	–	575415	J-LF7
581407	S-TIL25	581409	LF5	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 593670 593686	(FCD515) (PCD51) (FCD505)	593679	J-PSKH1
596392	S-TIM8	–	–	596392	E-F8	596392	J-F8
603380	S-TIM5	–	–	603380	E-F5	603380	J-F5
603607	S-BSM14	603606	N-SK14	603607	BACD14	603607	J-SK14
603655	S-PHM53	–	–	(606637)	LBC3N	603654	J-PSK03
606437	S-BAM4	606437	N-BAF4	–	–	606435	J-BAF4

OHARA		SCHOTT		HOYA		HIKARI	
CODE	G.T.	CODE	G.T.	CODE	G.T.	CODE	G.T.
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
618633	S-PHM52Q	618634	N-PSK53A	618634 620639	PCD4 (PCD40)	618633	J-PSK02
618634	S-PHM52	618634	N-PSK53A	618634 620639	PCD4 (PCD40)	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	
CODE	G.T.	CODE	G.T.	CODE	G.T.	CODE	G.T.
640601	S-BSM81	640601	N-LAK21	640602	LACL60	640602	J-LAK01
649530	S-BSM71	–	–	649530	E-BACED20	–	–
651562	S-LAL54Q	651559	N-LAK22	–	–	651562	J-LAK04
652585	S-LAL7Q	652585	N-LAK7	652584	LAC7	652586	J-LAK7
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
673321	S-TIM25	673323	N-SF5	673322	E-FD5	673322	J-SF5
673383	S-NBH52V	–	–	–	–	–	–
678553	S-LAL12 S-LAL12Q	678552	N-LAK12	678555	LAC12	678554	J-LAK12
689311	S-TIM28	689313	N-SF8	689312 690311	E-FD8 (E-FD80)	689312	J-SF8
691548	S-LAL9	691547	N-LAK9	691547	LAC9	691549	J-LAK9

S-FPL
S-FPM
S-FSL
S-BSL
S-NSL
S-BSM
S-BAL
S-BAM
S-BAH
S-PHM
S-TIL
S-TIM
S-TIH

OHARA		SCHOTT		HOYA		HIKARI	
CODE	G.T.	CODE	G.T.	CODE	G.T.	CODE	G.T.
694508	S-LAL58	–	–	–	–	–	–
697555	S-LAL14	697554	N-LAK14	697555	LAC14	697555	J-LAK14
699301	S-TIM35	699302	N-SF15	699301	E-FD15L E-FD15	699301	J-SF15
699511	S-LAL20	–	–	–	–	–	–
702412	S-BAH27	–	–	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-FD1L E-FD1	717296	J-SF1
717479	S-LAM3	–	–	717480	LAF3	717480	J-LAF3
720347	S-NBH8	720347	N-KZFS8	–	–	–	–
720502	S-LAL10	720506	N-LAK10	720503	LAC10	720503	J-LAK10
722292	S-TIH18	–	–	–	–	–	–

OHARA		SCHOTT		HOYA		HIKARI	
CODE	G.T.	CODE	G.T.	CODE	G.T.	CODE	G.T.
723380	S-BAH28	–	–	723380	BAFD8	723380	J-BASF8
728285	S-TIH10	728285	N-SF10	728283	E-FD10L E-FD10	728284	J-SF10
729541	S-LAL19	729545	N-LAK34	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	–	–	730322	(NBFD32)	738323	J-KZFH9
740283	S-TIH3	–	–	–	–	–	–
741278	S-TIH13	–	–	741278	E-FD13	741277	J-SF13
741526	S-LAL61Q	–	–	741526	TAC2	741528	J-LAK011
741527	S-LAL61	–	–	741526	TAC2	741528	J-LAK011
743493	S-LAM60	743494	N-LAF35	743492	NBF1	743493	J-LAF010
744448	S-LAM2	744449	N-LAF2	744449	LAF2	744448	J-LAF2
750353	S-LAM7	749348	(N-LAF7)	750350	E-LAF7	750353	J-LAF7
750353	S-NBH51	754523	(N-LAK33A)	–	–	–	–

OHARA		SCHOTT		HOYA		HIKARI	
CODE	G.T.	CODE	G.T.	CODE	G.T.	CODE	G.T.
755275	S-TIH4	755274	N-SF4	755275	E-FD4 E-FD4L	755276	J-SF4
755523	S-LAH97	755523	N-LAK33B	755523	TAC6	755523	J-LASKH2
762265	S-TIH14	762265	N-SF14	762266	FD140	762266	J-SF14
762401	S-LAM55	–	–	–	–	762401	J-LAF05
764485	S-LAH96	–	–	–	–	–	–
766358	S-NBH59	–	–	–	–	–	–
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
786442	S-LAH51	786441	N-LAF33	786439	(NBFD11)	786442	J-LASF01
788474	S-LAH64	788475	N-LAF21	788475	TAF4	788474	J-LASF014
789284	S-NBH58	–	–	–	–	–	–
794371	S-LAM73	–	–	–	–	–	–
800299	S-NBH55	–	–	–	–	–	–

OHARA		SCHOTT		HOYA		HIKARI	
CODE	G.T.	CODE	G.T.	CODE	G.T.	CODE	G.T.
800422	S-LAH52 S-LAH52Q	–	–	800423	NBFD12	800421	J-LASF02
801350	S-LAM66	801350	N-LASF45	–	–	801349	J-LAF016 J-LAF016HS
804396	S-LAH63Q	–	–	805396	NBFD3	804396	J-LASF013
804465	S-LAH65VS	804465	N-LASF44	804465	TAF3 TAF3D	804466	J-LASF015
804466	S-LAH65V	804465	N-LASF44	804465	TAF3 TAF3D	804466	J-LASF015
805254	S-TIH6	805254	N-SF6	805255	FD60 FD60-W	805255	J-SF6 J-SF6HS
806409	S-LAH53 S-LAH53V	806406	N-LASF43	806407	NBFD13	806410	J-LASF03
808228	S-NPH1	–	–	808228	FD225	808227	J-SFH1
808228	S-NPH1W	–	–	808228	FD225	–	–
816466	S-LAH59	–	–	816466	TAF5	816466	J-LASF09 J-LASF09A

OHARA		SCHOTT		HOYA		HIKARI	
CODE	G.T.	CODE	G.T.	CODE	G.T.	CODE	G.T.
834372	S-LAH60 S-LAH60V S-LAH60MQ	834373	N-LASF40	834373	NBFD10	834372	J-LASF010
835427	S-LAH55V S-LAH55VS	835431	(N-LASF41)	835427	TAFD5F TAFD5G	835427	J-LASF05 J-LASF05HS
847238	S-TIH53 S-TIH53W	847238	N-SF57 N-SF57HT	847238	FDS90 FDS90-SG	847238	J-SF03 J-SF03HS
850300	S-NBH57	–	–	859300	NBFD30	–	–
850323	S-LAH71	850322	N-LASF9	–	–	850324	J-LASF021 J-LASF021HS
852408	S-LAH89	–	–	–	–	–	–
855248	S-NBH56	–	–	855252	(NBFD25)	–	–
859227	S-NPH5	–	–	–	–	–	–
883408	S-LAH58	883408	N-LASF31A	883408	TAFD30	883407	J-LASF08 J-LASF08A
892371	S-LAH92	–	–	900374	(TAFD37) (TAFD37A)	–	–

OHARA		SCHOTT		HOYA		HIKARI	
CODE	G.T.	CODE	G.T.	CODE	G.T.	CODE	G.T.
893204	S-NPH 4	–	–	–	–	–	–
904313	S-LAH95	904313	N-LASF46A N-LASF46B	904313	TAFD25	904313	J-LASFH13 J-LASFH13HS
905350	S-LAH93	–	–	911353	(TAFD35)	–	–
917316	S-LAH88	–	–	–	–	–	–
923189	S-NPH2	–	–	923209	(E-FDS1-W) (E-FDS1)	–	–
954323	S-LAH98	–	–	954323	TAFD45	954323	J-LASFH21
959175	S-NPH3	–	–	–	–	–	–
963241	S-TIH57	–	–	–	–	–	–
001291	S-LAH99 S-LAH99W	–	–	001291	TAFD55 TAFD55-W	001291	J-LASFH16
003283	S-LAH79	–	–	–	–	–	–

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	587596	(K-CSK120)
586592	L-BAL42P	–	–	–	–	–	–	–	–
586597	L-BAL43	586595 587596	P-SK57Q1 P-SK57	583595	(M-BACD12)	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
693529	L-LAL15	693532	(P-LAK35)	694532	(M-LAC130)	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)

OHARA		SCHOTT		HOYA		HIKARI		SUMITA	
806409	L-LAH53	806409	P-LASF47	806407	M-NBFD130	806407	Q-LASF03S	806407	K-LASFN1
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)	–	–	–	–

S-FPL

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-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	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-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-FPM5	552708	1.55200	70.70	0.007808	0.5421	1.55386	70.33	0.007875	1.54692	1.54963	1.55036	1.55743	1.56167

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		
1.50720	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]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass type
									−30°~+70°C	100°~300°C			λ80 (λ70)	λ5		
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
1.56517	1.57111	1	2	1	52.1	4.0	474	503	109	129	410/4	413	335	282	3.74	S-FPM5

S-FSL

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-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

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-Ne}	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-Ne}	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		
1.49898	1.50406	3	4	1~2	3.0	2.0	500	568	90	95	520/5	117	300	265	2.46	S-FSL5

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 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-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	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-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-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		
1.58993	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
1.59972	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-Ne}	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-Ne}	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
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	Abrasion 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	Abrasion Aa	Coloring		d [g/cm³]	Glass type
									−30°~+70°C	100°~300°C			λ80 (λ70)	λ5		
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 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-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-PHM52Q	618633	1.61800	63.32	0.009760	0.5426	1.62033	63.02	0.009843	1.61164	1.61503	1.61594	1.62479	1.63008
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
1.63448	1.64195	1	3	1	51.0	4.0	577	614	88	103	420/4	313	357	322	3.51	S-PHM52Q
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-Ne}	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]		Knoop-hardn./ Grp. Hk	Abra-sion Aa	Coloring		d [g/cm³]	Glass type
									−30°~ +70°C	100°~ 300°C			λ80 (λ70)	λ5		
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-Ne} 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-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/cm³]	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
1.71126	–	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-Ne}	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-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/cm³]	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
1.91429	–	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	640/6	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-Ne}	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
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-LAL12Q	678553	1.67790	55.35	0.012248	0.5434	1.68082	55.12	0.012351	1.66990	1.67417	1.67532	1.68642	1.69307
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-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
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

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		
1.67029	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	670/7	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
1.69860	1.70803	1	3	2	51.0	3.0	689	717	49	59	700/7	62	363	308	3.59	S-LAL12Q
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	700/7	60	395	320	3.85	S-LAL21
1.67053	1.67939	1	3	2	4.0	3.0	688	718	43	55	670/7	61	385	–	3.36	S-LAL54Q
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	680/7	69	365	280	4.04	S-LAL59

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-Ne}	n_F	n_g
		587.56				546.07			768.19	656.27	632.8	486.13	435.835
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
S-LAL61Q	741526	1.74100	52.60	0.014087	0.5479	1.74436	52.36	0.014216	1.73189	1.73673	1.73804	1.75082	1.75854

n_h	n_i	$RW_{(P)}$	$RA_{(P)}$	$W_{(S)}$	SR	PR	Tg [°C]	At [°C]	α [10^{-7}/K]		Knoop-hardn./Grp. Hk	Abrasion Aa	Coloring		d [g/cm³]	Glass type
									−30°~+70°C	100°~300°C			λ80 (λ70)	λ5		
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
1.76497	1.77598	1	3	3	51.0	2.0	689	710	57	74	710/7	66	360	300	4.09	S-LAL61Q

S-LAM

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-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-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
1.79580	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	700/7	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-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
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

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	650/7	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	720/7	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	740/7	50	390	290	5.07	S-LAH59
1.87396	1.89403	1	3	1	4.2	1.0	612	632	56	71	660/7	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
1.84052	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
1.83380	1.84786	1	3	3	4.1	1.0	691	711	60	74	730/7	57	385	315	4.72	S-LAH65V

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-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
S-LAH99W	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		
1.83385	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	670/7	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	700/7	63	(400)	350	4.87	S-LAH92
1.95176	–	1	1	1	4.0	1.0	677	716	70	86	690/7	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	690/7	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	730/7	55	(405)	355	4.94	S-LAH98
2.06424	–	1	1	1	2.0	1.0	725	761	75	88	720/7	55	(425)	360	5.02	S-LAH99
2.06424	–	1	1	1	2.0	1.0	725	761	75	88	720/7	55	(405)	360	5.02	S-LAH99W

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-Ne}	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-Ne}	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-Ne}	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
S-NBH59	766358	1.76634	35.82	0.021393	0.5792	1.77141	35.59	0.021677	1.75313	1.76004	1.76196	1.78143	1.79382

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	Abra-sion Aa	Coloring λ80 (λ70)	Coloring λ5	d [g/cm³]	Glass type
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
1.80453	1.82378	1	1	3	1.0	1.0	526	572	82	103	610/6	135	366	322	3.47	S-NBH59

S-NPH

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-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	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
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-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	640/6	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	600/6	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
1.71570	1.72592	1	4	2	53.2	4.0	534	575	76	92	640/6	108	360	285	3.69	L-LAL13
1.71528	1.72550	1	4	3	53.0	4.0	525	562	54	72	660/7	82	345	–	3.66	L-LAL15
1.76905	1.78108	1	3	3	51.2	2.0	541	581	74	92	670/7	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	640/6	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-Ne}	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	670/7	65	(380)	340	5.25	L-LAH85V
1.86881	1.88683	1	3	2	5.2	1.2	607	644	63	74	660/7	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	650/7	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-Ne}	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 Optical Glass Types

Each optical glass has its own properties which are closely connected to the key chemical elements contained therein. In OHARA's glass type designation system the first or second characters include the atomic symbols of one or two important chemical elements for that glass type. 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 typically represented by three letters plus a one or two digit number. The prefix "S-" stands for environmentally safe and the prefix "L-" is used for low transformation temperature (Tg) glass types. The suffix "Y" is used for i-Line-glass types and the suffix "W" is used for glasses with improved transmittance. For example, the glass type S-BSL 7 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 (v_d). This six digit code is internationally recognized within the optical community.

2. Optical Properties

2.1 Refractive index

When light enters the glass, it slows down compared to in a vacuum or in air. The refractive index of optical glass is usually expressed as the speed ratio of light in the air to the medium (glass sample). The refractive index is measured by sending a predetermined wavelength of light into the sample and measuring the angle of the emitted light bent by refraction, according to JIS B 7071-1. In this catalog, the values up to 5 digits after the decimal point are displayed for the 10 spectral lines shown in Table 1.

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: Wavelengthes for refractive index

2.2 Dispersion and Abbe number

Dispersion refers to the phenomenon arising from a variation in the refractive index depending on the wavelength. Here, $n_F - n_C$ and $n_{F'} - n_{C'}$ are displayed as the main dispersion. The Abbe number is an index of the magnitude of the variance and is also called the inverse dispersion rate. The larger the variance, the smaller the Abbe number. The Abbe numbers ν_d and ν_e are calculated using the following formulas, respectively:

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

The glass type 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 and the principal dispersion to six decimal places.

Two decimal places: This is the result of calculation from nd to six decimal places (with seven effective digits) and the principal dispersion to six decimal places (with four or more effective digits).

2.3 Partial dispersion ratio $\theta_{x,\,y}$ and anomalous dispersion $\Delta\theta_{x,\,y}$

Anomalous dispersion refers to how far away a glass is from the trend line between the partial dispersion ratio $\theta_{x,\,y} = (n_x - n_y)/(n_F - n_C)$ for wavelengths x and y and the Abbe number ν_d. In optical design, glass with anomalous dispersion is required to enable color correction of the secondary spectrum.

Therefore, we have released the $\theta_{g,\,F} - \nu_d$ diagram and the $\theta_{C,\,t} - \nu_d$ diagram as means to show the relationship between $\theta_{x,\,y}$ and ν_d of each glass type. In order to numerically express the anomalous dispersibility, 511605 (NSL 7) and 620363 (PBM 2) are used as reference glasses, and the straight line connecting these two glass types is considered the “normal” line. The difference between the “normal” line and the vertical coordinates $\theta_{x,\,y}$ of each glass type is calculated as anomalous dispersion $\Delta\theta_{x,\,y}$ (Fig. 1). In this catalog, the partial dispersion ratio is $\theta_{g,\,F}$ and $\theta_{C,\,t}$, and the anomalous dispersion is $\Delta\theta_{g,\,F}$ and $\Delta\theta_{C,\,t}$.

Although NSL 7 and PBM 2 are not currently produced by Ohara, the conventional NSL 7 and PBM 2 values (Table 2) are used as the reference values.

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

Table 2: Reference Glasses for the normal line

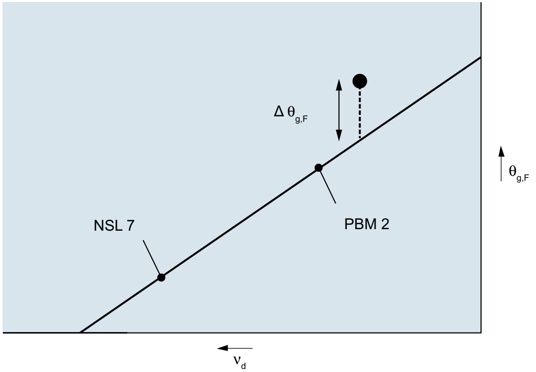


Fig. 1: Normal line

2.4 Temperature coefficient of refractive index $\Delta n_{rel} / \Delta T$

The refractive index of glass changes with temperature. The amount of change in the refractive index due to temperature changes is expressed as the temperature coefficient of the refractive index, and is defined by $\Delta n / \Delta T$ from the curve showing the relationship between the glass temperature and the refractive index. $\Delta n / \Delta T$ changes depending on the measurement wavelength and temperature range, so the Abbe number also changes with temperature.

There are two ways of showing the temperature coefficient of refractive index; one is the relative coefficient, $\Delta n_{rel} / \Delta T$ (10^{-6} K^{-1}) measured in dry air (1013 hPa) at same temperature as the glass, and the other is the absolute coefficient, $\Delta n_{abs} / \Delta T$ (10^{-6} K^{-1}) measured under vacuum.

For each glass type the figures of the relative coefficients [$\Delta n_{rel} / \Delta T$], measured according to method JOGIS-18, are disclosed. In this catalog, the values for temperature range of +40 to +60 °C for the wavelength of D line (589.29 nm) are displayed. The temperature coefficient of absolute refractive index (10^{-6} K^{-1}) can be roughly calculated using the following formula:

$$\frac{\Delta n_{abs}}{\Delta T} = \frac{\Delta n_{rel}}{\Delta T} + n \cdot \frac{\Delta n_{air}}{\Delta T}$$

n: Refractive index of glass sample (in air, 25 °C)
$\Delta n_{air} / \Delta T$: Temperature coefficient of refractive index of air (10^{-6} K^{-1})/ D line from +40 °C to +60 °C $-0.77 \cdot 10^{-6}$ K^{-1}

2.5 Coloring

Coloring refers to the degree of coloration of the optical glass and is determined by measuring the spectral transmittance, including reflection losses, for a glass sample with a thickness of 10 mm, according to JOGIS-02.

From the spectral transmittance curve (Fig. 2), the wavelengths showing the transmittance of 80 % and 5 %, respectively, are rounded and displayed in 5 nm units. We use 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 example, if the wavelength with 80 % transmittance is 403 nm and the wavelength with 5 % transmittance is 357 nm, the coloring is shown as 405/355.

For glass types with a high refractive index, $n_d \geq 1.84$, the reflection loss is large, so the wavelength showing transmittance of 70 % is used, instead of 80 %, and the value is shown in parenthesis, for example (415).

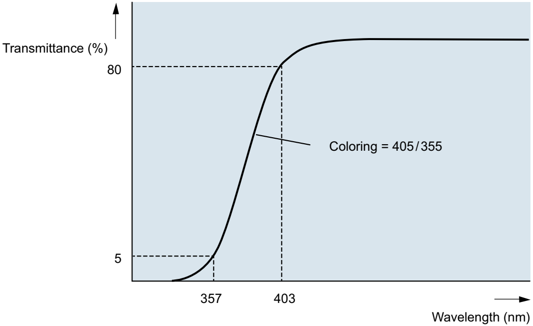


Fig. 2

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

Internal transmittance refers to the spectral transmittance through the glass, excluding reflection losses at the surface interfaces between the optical glass and the air, and indicates the transparency of the glass.

We measure the spectral transmittance, excluding the reflection losses, of glass samples with different distances through which the transmitted light passes, and list the internal transmittance values (τ10 mm) for 10 mm thick glass samples, in accordance with with JOGIS-17.

The internal transmittance $\lambda_{0.80}/\lambda_{0.05}$ displays the wavelength [nm] indicating the internal transmittance of 80 % and 5 %, and serves as an indicator of coloring.

2.7 CCI

CCI (Color Contribution Index) is an index for predicting how much the color of a photograph, taken using a certain lens system changes compared to the original color, due to the spectral characteristics of the lens. It is indicated by a set of 3 numbers for blue (B) / green (G) / red (R). Ohara uses this index to predict how much the color will change as a single glass element. For the measurement method, refer to JIS B 7097 "How to express the color characteristics of a photographic lens by the ISO color characteristic index (ISO/CCI)". The numbers shown are calculated using the sum of the values of the internal transmittance of the glass sample every 10 nm and the average color film weighted spectral sensitivity, described in JIS. For example, B/G/R of 0/3/5, is shown in Fig. 3 in trilinear coordinates.

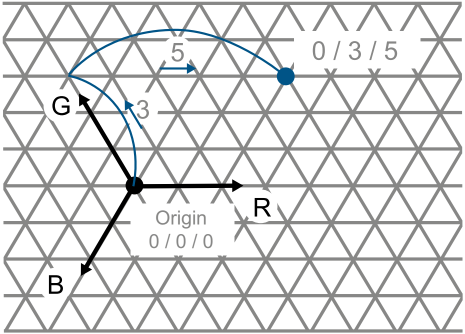


Fig. 3

3. Chemical Properties

Some optical glasses are not very chemically durable due to the components utilized in order to obtain the desired optical properties. Some glass types undergo surface deterioration and elution and “white discoloration” or “blue discoloration” may occur due to chemical reactions that occur during the fabrication processes, such as polishing or cleaning, or in storage.

“White discoloration” is a chemical reaction with carbon dioxide in the atmosphere, where alkaline water droplets erode the glass due to ion exchange between hydrogen ions of water droplets adhering to the glass surface and the soluble cations in the glass. This phenomenon may be observed as a white haze. “Blue discoloration” is a chemical reaction by which a thin layer with a refractive index different from that of the mother glass is formed on the glass surface. This is caused by ion exchange between hydrogen ions of water or acid coming in contact with the glass surface and the soluble cations in the glass. This phenomenon may be observed as an interference color.

Such chemical reactions may also be influenced by the surface condition of the glass, the surrounding environmental conditions, and other factors. In order to accurately determine the durability of optical glass, it is necessary to comprehensively test the materials under various conditions.

In this catalog, the results of the following methods are shown: water resistance $RW_{(P)}$ and acid resistance $RA_{(P)}$ by the powder method, weather resistance $W_{(S)}$ by the surface method, acid resistance SR, and detergent resistance PR.

3.1 Water resistance $RW_{(P)}$ and acid resistance $RA_{(P)}$ by powder method

Water resistance $RW_{(P)}$ is a measure of the likelihood of “white discoloration”, and acid resistance $RA_{(P)}$ is a measure of the likelihood of “blue discoloration”, occuring on the surface of the glass.

These tests are conducted in accordance with the methods in 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 3 and 4.

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 3: 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 4: Acid Resistance

3.2 Weather resistance $W_{(S)}$ by surface method

Surface method weather resistance $W_{(S)}$ is a measure of the likelihood of “white discoloration” occuring on the surface of the glass.

The test method used is as follows: expose a glass sample size 30 x 30 x 3 mm polished on two sides, in a temperature and humidity chamber at 60 °C and 95 % relative humidity for 24 hours, and then observe the polished surface with a 50x microscope.

Glass types showing discoloration when observed at both 1500 lux and 100 lux illuminance are tested again, using a new glass sample for 6 hours, and then same observed and graded.

The classes are shown in Table 5.

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

Table 5: Classes of Weathering Resistance
O Dimming or staining aren’t observed
X Dimming or staining are observed

3.3 Acid resistance (SR)

Acid-resistant SR is a measure of the likelihood of “blue discoloration” or elution occuring on the surface of the glass using an acidic solution.

The test method is based on ISO 8424. The glass samples size 30 x 30 x 3 mm with 6 faces polished, 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).

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 erosion fluid and the time required for the attack to a depth of 0.1 µm (h) with time scales given in the classification Table 6.

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 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 $t_{0.1}$ to decrease a surface layer at 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 6: Classes of Acid Resistance

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 7: Additional number of Acid Resistance

3.4 Phosphate resistance (PR)

Detergent resistance PR is a measure of the ease of the surface of glass being influenced by the detergent used in the cleaning process.

The test method is based on ISO 9689. A 30 x 30 x 3 mm glass sample with 6 polished surfaces is hung in a 0.01 mol/l purified $Na_5P_3O_{10}$ aqueous solution (*) at a temperature of 50 °C for the specified times (15 minutes, 1 hour, 4 hours or 16 hours). After this treatment, the sample is weighed and the mass loss is determined. We calculate the time (min) required to erode the 0.1 µm thick glass layer from the formula used for acid resistance.

(*) $Na_5P_3O_{10}$ (sodium tripolyphosphate) is one of the inorganic materials (cleaning aids) contained in detergents, and it can produce a chemical reaction on the surface of the glass.

For this calculation, the value obtained under the minimum test conditions where the mass loss per sample is 1 mg or more is used. Detergent resistance class PR is determined according to Table 8 from the time (minute) required for 0.1 µm erosion.

As with acid resistance SR test, changes in the conditions of polished surface of the sample are observed and numbered according to the classification in Table 8.

Phosphate Resistance Class PR	**1**	**2**	**3**	**4**
Time [min] to decrease a surface layer at a depth of 0.1 µm	> 240	≤ 240 ≥ 60	< 60 ≥ 15	< 15

Table 8: Classification of Phosphate Resistance

4. Thermal Properties

The thermal properties of optical glass are required for use in the various heating and cooling operations involved in glass processing and coating. In this catalog, the measured values of transformation temperature Tg, yield point At, softening point SP, annealing point AP, average linear expansion coefficient α, and thermal conductivity λ are shown.

4.1 Transformation Temperature (Tg), Yield Point (At)

The transformation point is one of the state changes of glass, and refers to the temperature at which the glass transforms from an amorphous "solid" to a supercooled "liquid", and the expansion characteristics change at this temperature.

The yield point is the temperature at which the glass sample softens and begins to deform due to the applied load, and the expansion characteristics change at this temperature.

The measurement method is performed in accordance with JOGIS-08, and the values are determined using thermal expansion curve (Fig. 4). The transition point Tg is the temperature corresponding to the intersection of the extension lines of the two straight lines before and after the curve slope changes significantly, and the yield point At is the temperature at which the elongation (ΔL) of the sample is maximized.

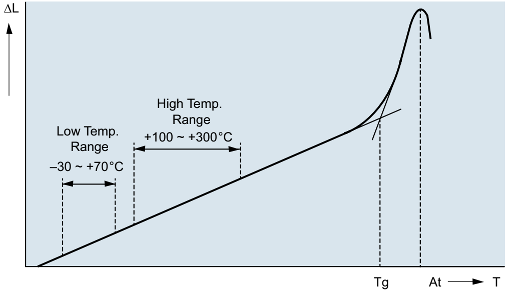


Fig. 4

4.2 Softening point (SP)

The softening point is the temperature at which glass deforms under its own weight and is the lower limit temperature for glass molding and pressing. The glass viscosity is $10^{7.65}$ dPa · s {poise} 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 is the temperature at which the internal strain of the glass is substantially eliminated in 15 minutes, which corresponds to the upper limit temperature in the slow cooling region. The viscosity of the glass is 10^{13} dPa · s {poise} at this temperature. The annealing point is measured by the Fiber Elongation Method in JIS-R3103.

4.4 Linear coefficient of thermal expansion (α)

The average coefficient of linear expansion is the rate of elongation of a glass sample between two specified temperatures per 1 K. The average coefficient of linear expansion is measured via the method referred to in JOGIS-16 and JOGIS-08. The thermal expansion curve is obtained by measuring a well annealed glass sample, size 4.5 mm diameter by 50 mm long, heated at a rate of 2 K/minute in the low temperature range and at a rate of 4 K/minute in the high temperature range. From the temperature and elongation of the glass sample, the mean linear coefficient of thermal expansion between –30 °C to + 70 °C and + 100 °C to + 300 °C is determined and shown up to the first integer in units of 10^{-7} K^{-1}.

4.5 Thermal conductivity (λ)

Thermal conductivity is a numerical value that indicates the ease with which heat can be transferred within a single substance. It is the amount of heat that flows in a unit time, through the unit area of the plate, when there is a temperature difference between both ends of the plate. The measurement method uses the transient hot wire method, and the value of the glass sample at 35 °C is displayed to three decimal places.

5. Mechanical Properties

The mechanical properties of optical glass are indicators of the strength and processability of the glass type. In this catalog, Knoop hardness Hk, and abrasion Aa, are listed.

5.1 Knoop hardness (Hk)

Knoop hardness is an index that indicates the indentation hardness of an optical glass and is determined using a micro hardness tester. Knoop hardness is measured via the method shown in JOGIS-09. We press the diamond square cone indenters (opposite edges 172.5° and 130°) against the flat polished surface of the glass sample for 15 seconds with a load of 0.98 N using a microhardness meter. The length of the longer diagonal of the permanent dent generated at this time is measured, and the Knoop hardness is calculated using the following formula:

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

F Load [N]

l Length of longer diagonal line [mm]

In this catalog, the measured values are rounded to the first integer and the grades classified according to Table 9.

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

Table 9: Knoop Hardness and Hardness Group

5.2 Abrasion (Aa)

Abrasion is an indicator of the ease of removing material when processing glass. 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 formula below. The values of abrasion are calculated and shown to the nearest integer as the abrasion data.

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

6. Other Properties

6.1 Photoelastic constant (β)

Optical glass is usually isotropic, with its optical properties (refractive indices, scattering, transmission, etc.) independent of its orientation. However, when mechanical or thermal stress is exerted upon it, distortion or stress occurs in the glass and it shows birefringence. Stress F [Pa], optical path difference σ [nm] and thickness of glass d [cm] has the following relationship:

$$\sigma = \beta \cdot d \cdot F$$

The proportionality constant β is called the photoelastic constant, and in this catalog, the optical path length difference is measured by the e-line (546.07 nm) and displayed in units of (nm/(cm · 10^5 Pa)). The photoelastic constant is different for each glass type and it is possible to calculate the optical path difference from the given stress and the internal stress.

6.2 Specific gravity (d)

Specific gravity d [g/cm^3] is the density value of well annealed glass referenced against pure water at 1 atm at 4 °C. The measurement method is in accordance with JIS Z 8807. We weigh a glass sample in air and water, and divide the density obtained by the density of water to calculate the specific gravity. The density for pure water at 1 atm 4 °C is 0.999975 g/cm^3, therefore density = specific gravity. The values are shown to two decimal places.

7. Guarantees of Quality

7.1 Refractive Index and Abbe Number

Refractive indices and Abbe number, which are given in this catalog, are the representative value of plural melting lots. The values of the melting lot delivered 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 ν_d — 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: 64.14 ±0.33

For special requirements, other than above mentioned, please contact us.

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.

This RC value is Δn_d at 5 decimal places concerning the material that underwent OHARA's standard annealing (–600 °C per day). The RC value is rounded to 4 decimal places and shows with a unit of 10^{-5}.

And it comes with a report of the ν_d value 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 pay special attention to each process and can supply high homogeneity glass. The homogeneity is measured by calculating the PV value of refractive index fluctuation width (excluding linear change component of refractive index) using computer analysis of the transmitted wavefront of a plano-parallel glass sample with a phase-measuring interferometer. In cases where the value of the refractive index variation (PV) must be guaranteed within $4*10^{-5}$, 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 standard glass products could exceed PV $4*10^{-5}$, depending on glass type, dimensions, shape, etc.

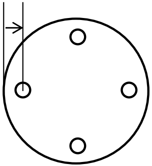
7.3 Stress Birefringence

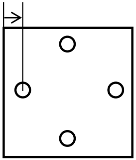
In case that glass retains residual strain, this can be observed as optical birefringence. The amount of stress is measured by optical path differences and specified in nm/cm.

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 10. 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 10: Birefringence Classes





7.4 Striae

Striae are thread-like veins or cords which are the parts of different chemical components in glass.

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 11.

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

Table 11: Striae Classes

7.5 Bubble and Inclusion

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. The bubble classes are shown in table 12.

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 12: Bubble Classes

7.6 Coloring

Variation of coloring between melting lots is generally within ±10 nm. On special request, we shall report the coloring or the transmission 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

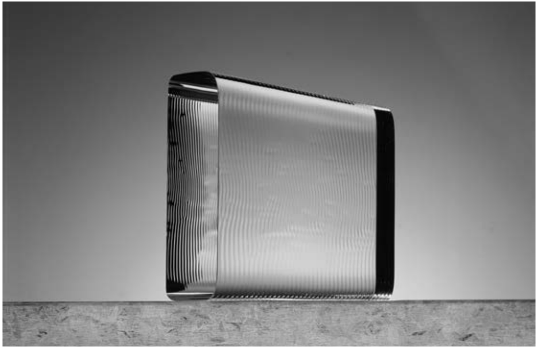
8.1 Glass Blocks

Strip Glass is made by drawing glass out of a furnace. Strips are rectangular in shape, 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 Reheat Pressings

Reheat pressings are product molded in heat press to shapes suitable for spherical polished lenses and prisms. 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 13.

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 13: Dimensional Tolerances of Pressings

8.3 Saw-cut Centerless Ground Cylindrical Blanks

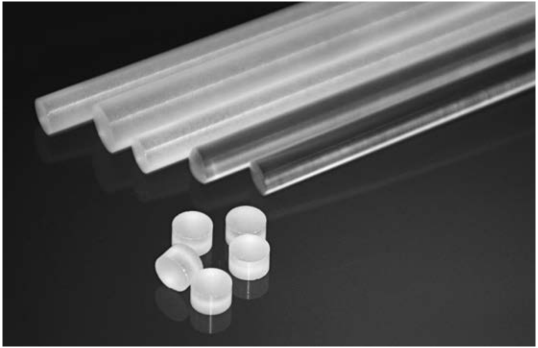
These blanks are cut from a precisely ground rod formed on a centerless grinding machine.

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

Please contact our sales department with your specific requirements.

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

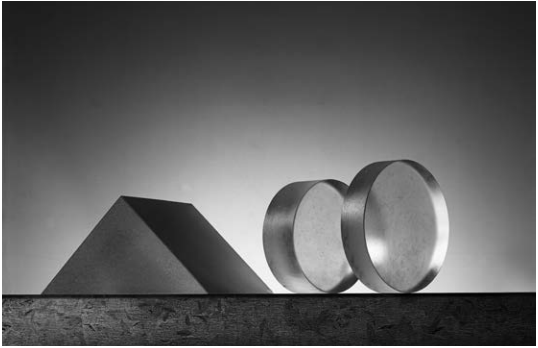
Table 14: Tolerances for Saw-cut Centerless Ground Blanks



8.4 Dimensional Specified Blanks

Followings are handled as 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. Polished balls can be used as lenses or as preform for glass mold lens.

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

8.7 Polished Preforms

Polished preforms are the product polished spherically in a suitable shape to be processed into aspherical glass mold lenses.

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

8.8 Polished Lenses

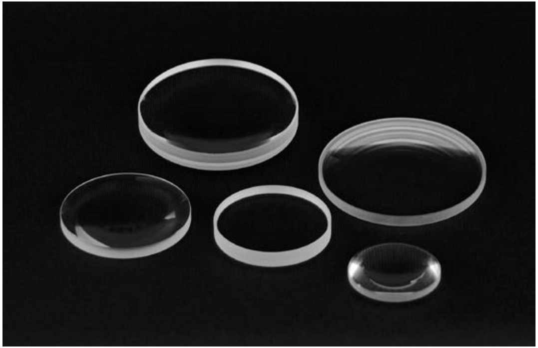
The lenses have been subjected to double side polishing, centering and coating.

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

8.9 Aspherical Glass Mold Lenses

Glass mold lenses are the product fabricated by heating and softening polished preforms and transferring it in an ultra-high accuracy aspheric mold, and then supplied after centering and coating.

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



Appendix 1: List of Optical Glass for Glass Mold Lenses

For wider variations of the glass choice, we have increased our line up of Optical Glasses for Glass Mold Lenses, please refer to below table, where

Glass types	Catalog value		Controlled value	After molding	Difference between before and 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-LAL13	1.69350	53.18	1.69280	1.69004	0.00276

(1) Controlled value: The refractive index is controlled by annealing with cooling rate –600 °C/day.
(2) The refractive index values obtained with an average cooling rate of 1.0 °C/s after molding under our molding machine and molding conditions.

Glass types	Catalog value		Controlled value	After molding	Difference between before and after molding
	n_d	v_d	n_d	n_d	Δn_d
L-LAL15	1.69304	52.93	1.69234	1.68863	0.00371
L-LAM60	1.74320	49.29	1.74260	1.73894	0.00366
L-LAM69	1.73077	40.51	1.73017	1.72728	0.00289
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

Appendix 2: ν_d-tolerance List

This list shows standard tolerance of Abbe-number vd ±0.5%. Upon special request, depending on the glass type, special tolerance ±0.3% can be accepted.

In addition, the range of the tolerance may depend on glass type, please refer to following table:

Classification	
A	Catalog center value can be available
B	Irregular tolerance can be available
C	Please contact our sales representatives

Glass type	ν_d	ν_d ±0.5%	Classification	ν_d ±0.3%
S-FPL51	81.54	±0.41	A	±0.25
S-FPL53	94.93	±0.48	A	±0.29
S-FPL55	94.66	±0.48	A	±0.29
S-FPM 2	67.74	±0.34	A	±0.21
S-FPM 3	74.70	±0.38	A	±0.23
S-FPM 4	76.46	±0.39	C	–
S-FPM 5	70.70	±0.36	C	–
S-FSL 5	70.23	±0.36	A	±0.22
S-BSL 7	64.14	±0.33	A	±0.20
S-BSM 2	56.81	±0.29	A	±0.18
S-BSM10	57.05	±0.29	A	±0.18
S-BSM14	60.64	±0.31	B	+0.22/–0.16
S-BSM15	58.16	±0.30	A	±0.18
S-BSM16	60.29	±0.31	B	+0.26/–0.12
S-BSM18	55.38	±0.28	A	±0.17
S-BSM25	50.88	±0.26	A	±0.16
S-BSM28	49.81	±0.25	A	±0.15
S-BSM71	53.02	±0.27	A	±0.16

Glass type	ν_d	ν_d ±0.5 %	Classification	ν_d ±0.3 %
S-BSM81	60.08	±0.31	A	±0.19
S-NSL 3	58.90	±0.30	B	+0.33/–0.03
S-NSL36	52.43	±0.27	B	+0.10/–0.22
S-BAL 3	52.95	±0.27	A	±0.16
S-BAL12	59.46	±0.30	A	±0.18
S-BAL14	56.36	±0.29	A	±0.17
S-BAL35	61.14	±0.31	A	±0.19
S-BAL42	59.38	±0.30	A	±0.18
S-BAM 4	43.70	±0.22	B	+0.24/–0.04
S-BAM12	44.87	±0.23	A	±0.14
S-BAH11	48.32	±0.25	A	±0.15
S-BAH27	41.24	±0.21	B	+0.04/–0.22
S-BAH28	37.95	±0.19	A	±0.12
S-PHM52	63.33	±0.32	B	+0.17/–0.21
S-PHM52Q	63.32	±0.32	C	–
S-PHM53	65.44	±0.33	A	±0.20
S-TIL 1	45.79	±0.23	A	±0.14
S-TIL 2	47.23	±0.24	A	±0.14

Glass type	ν_d	ν_d ±0.5%	Classification	ν_d ±0.3%
S-TIL 6	48.84	±0.25	A	±0.15
S-TIL25	40.75	±0.21	B	+0.08/–0.18
S-TIL26	42.82	±0.22	A	±0.13
S-TIL27	41.50	±0.21	A	±0.13
S-TIM 2	36.26	±0.19	A	±0.11
S-TIM 5	38.03	±0.20	A	±0.12
S-TIM 8	39.24	±0.20	B	+0.17/–0.07
S-TIM25	32.10	±0.17	A	±0.10
S-TIM27	34.46	±0.18	A	±0.11
S-TIM28	31.07	±0.16	A	±0.10
S-TIM35	30.13	±0.16	A	±0.10
S-TIH 1	29.52	±0.15	B	+0.04/–0.14
S-TIH 3	28.30	±0.15	A	±0.09
S-TIH 4	27.51	±0.14	A	±0.09
S-TIH 6	25.42	±0.13	A	±0.08
S-TIH10	28.46	±0.15	A	±0.09
S-TIH11	25.68	±0.13	A	±0.08
S-TIH13	27.79	±0.14	A	±0.09

Glass type	ν_d	ν_d ±0.5%	Classification	ν_d ±0.3%
S-TIH14	26.52	±0.14	A	±0.08
S-TIH18	29.23	±0.15	A	±0.09
S-TIH53	23.78	±0.12	B	+0.17/+0.01
S-TIH53W	23.78	±0.12	B	+0.16/–0.00
S-TIH57	24.11	±0.13	C	–
S-LAL 7Q	58.54	±0.30	A	±0.18
S-LAL 8	53.87	±0.27	B	+0.22/–0.12
S-LAL 9	54.82	±0.28	A	±0.17
S-LAL10	50.23	±0.26	B	+0.06/–0.26
S-LAL12	55.34	±0.28	B	+0.12/–0.22
S-LAL12Q	55.35	±0.28	C	–
S-LAL14	55.53	±0.28	B	+0.08/–0.26
S-LAL18	54.68	±0.28	B	+0.07/–0.27
S-LAL19	54.09	±0.28	C	–
S-LAL20	51.11	±0.26	A	±0.16
S-LAL21	52.38	±0.27	C	–
S-LAL54Q	56.24	±0.29	A	±0.17
S-LAL58	50.81	±0.26	A	±0.16

Glass type	ν_d	ν_d ±0.5%	Classification	ν_d ±0.3%
S-LAL59	51.47	±0.26	A	±0.16
S-LAL61	52.64	±0.27	A	±0.16
S-LAL61Q	52.60	±0.27	C	–
S-LAM 2	44.78	±0.23	A	±0.14
S-LAM 3	47.92	±0.24	A	±0.15
S-LAM 7	35.28	±0.18	A	±0.11
S-LAM55	40.10	±0.21	A	±0.13
S-LAM60	49.34	±0.25	A	±0.15
S-LAM66	34.97	±0.18	A	±0.11
S-LAM73	37.09	±0.19	C	–
S-LAH51	44.20	±0.23	A	±0.14
S-LAH52	42.22	±0.22	B	+0.08/–0.18
S-LAH52Q	42.24	±0.22	C	–
S-LAH53	40.92	±0.21	B	+0.05/–0.21
S-LAH53V	40.93	±0.21	A	±0.13
S-LAH55V	42.73	±0.22	A	±0.13
S-LAH55VS	42.74	±0.22	A	±0.13
S-LAH58	40.76	±0.21	A	±0.13

Glass type	ν_d	ν_d ±0.5%	Classification	ν_d ±0.3%
S-LAH59	46.62	±0.24	B	+0.11/–0.17
S-LAH60	37.16	±0.19	A	±0.12
S-LAH60V	37.21	±0.19	A	±0.12
S-LAH60MQ	37.17	±0.19	A	±0.12
S-LAH63Q	39.58	±0.20	A	±0.12
S-LAH64	47.37	±0.24	A	±0.15
S-LAH65V	46.58	±0.24	A	±0.14
S-LAH65VS	46.53	±0.24	A	±0.14
S-LAH66	49.60	±0.25	B	+0.08/–0.22
S-LAH71	32.27	±0.17	A	±0.10
S-LAH79	28.27	±0.15	A	±0.09
S-LAH88	31.60	±0.16	A	±0.10
S-LAH89	40.78	±0.21	A	±0.13
S-LAH92	37.13	±0.19	A	±0.12
S-LAH93	35.04	±0.18	A	±0.11
S-LAH95	31.34	±0.16	C	–
S-LAH96	48.49	±0.25	A	±0.15
S-LAH97	52.32	±0.27	A	±0.16

Glass type	ν_d	ν_d ±0.5 %	Classification	ν_d ±0.3 %
S-LAH98	32.32	±0.17	A	±0.10
S-LAH99	29.14	±0.15	A	±0.09
S-LAH99W	29.14	±0.15	C	–
S-FTM16	35.31	±0.18	A	±0.11
S-NBM51	44.27	±0.23	B	+0.22/–0.06
S-NBH 5	39.68	±0.20	B	+0.17/–0.07
S-NBH 8	34.71	±0.18	A	±0.11
S-NBH51	35.33	±0.18	A	±0.11
S-NBH52V	38.26	±0.20	A	±0.12
S-NBH53V	32.33	±0.17	A	±0.10
S-NBH55	29.84	±0.15	A	±0.09
S-NBH56	24.80	±0.13	A	±0.08
S-NBH57	30.05	±0.16	A	±0.10
S-NBH58	28.43	±0.15	A	±0.09
S-NBH59	35.82	±0.18	C	–
S-NPH 1	22.76	±0.12	A	±0.07
S-NPH 1W	22.76	±0.12	A	±0.07
S-NPH 2	18.90	±0.10	A	±0.06

Glass type	ν_d	ν_d ±0.5%	Classification	ν_d ±0.3%
S-NPH 3	17.47	±0.09	A	±0.06
S-NPH 4	20.36	±0.11	A	±0.07
S-NPH 5	22.73	±0.12	A	±0.07
S-NPH 7	23.91	±0.12	A	±0.08
L-BSL 7	64.06	±0.33	B	+0.29/–0.11
L-BAL35	61.15	±0.31	A	±0.19
L-BAL35P	61.00	±0.31	C	–
L-BAL42	59.38	±0.30	B	+0.31/–0.05
L-BAL42P	59.24	±0.30	B	+0.23/–0.13
L-BAL43	59.70	±0.30	A	±0.18
L-TIM28	31.02	±0.16	A	±0.10
L-LAL13	53.18	±0.27	B	+0.08/–0.24
L-LAL15	52.93	±0.27	B	+0.11/–0.21
L-LAM60	49.29	±0.25	A	±0.15
L-LAM69	40.51	±0.21	B	+0.19/–0.07
L-LAH53	40.91	±0.21	A	±0.13
L-LAH84	40.55	±0.21	B	+0.11/–0.15
L-LAH85V	40.38	±0.21	A	±0.13

Glass type	ν_d	ν_d ±0.5 %	Classification	ν_d ±0.3 %
L-LAH90	40.10	±0.21	A	±0.13
L-LAH91	49.09	±0.25	A	±0.15
L-LAH94	37.10	±0.19	A	±0.12
S-FPL51Y	81.14	±0.41	B	+0.40/–0.10
S-FSL 5Y	70.36	±0.36	A	±0.22
BSL 7Y	64.24	±0.33	A	±0.20
BAL15Y	58.68	±0.30	A	±0.18
BAL35Y	61.23	±0.31	A	±0.19
BSM51Y	60.65	±0.31	A	±0.19
PBL 1Y	45.73	±0.23	A	±0.14
PBL 6Y	48.95	±0.25	A	±0.15
PBL25Y	40.77	±0.21	A	±0.13
PBL26Y	42.86	±0.22	C	–
PBL35Y	40.86	±0.21	C	–
PBM 2Y	36.27	±0.19	A	±0.11
PBM 8Y	39.26	±0.20	A	±0.12
PBM18Y	38.77	±0.20	A	±0.12

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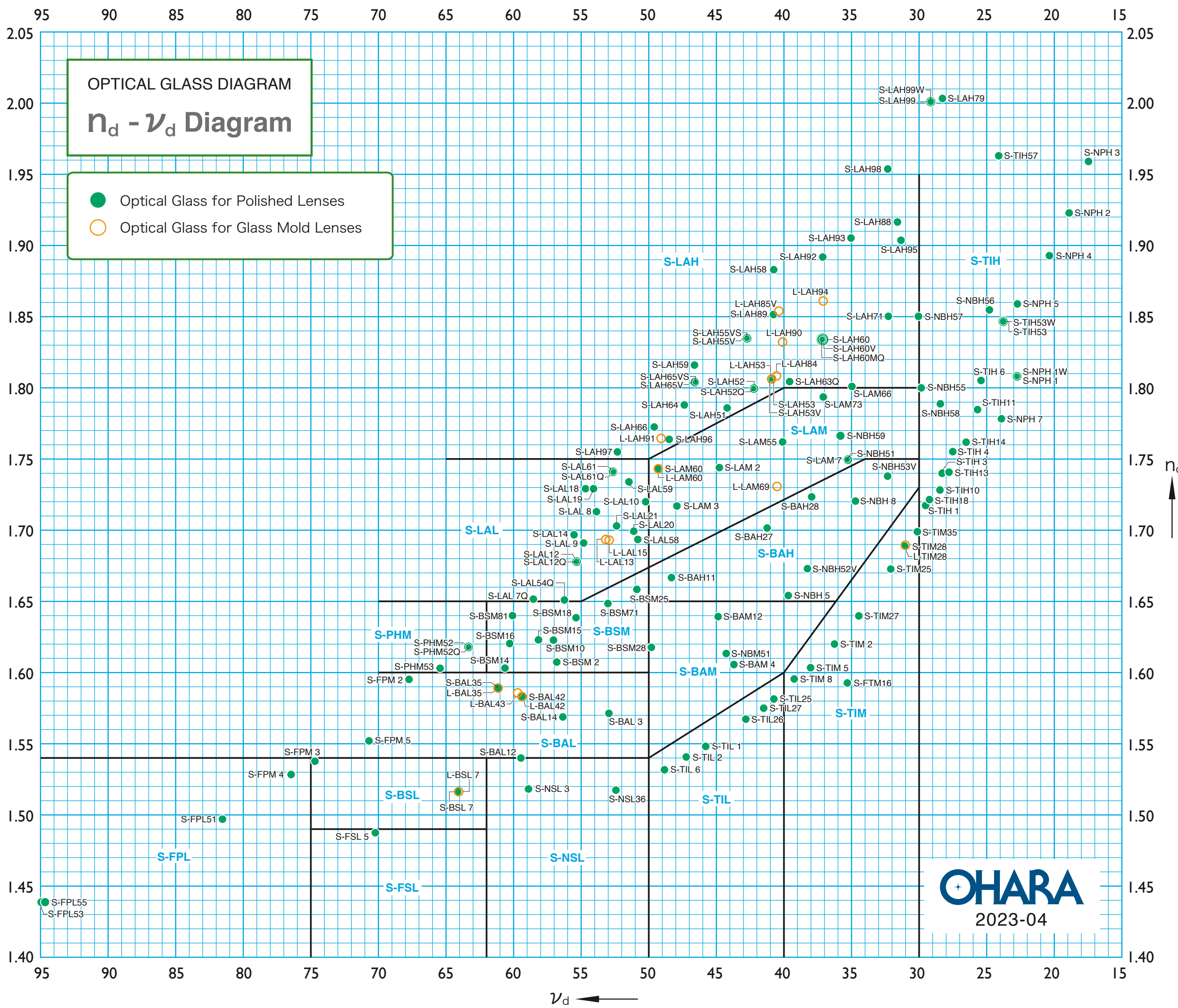
MAY 2023

OHARA INC.



OPTICAL GLASS DIAGRAM
n_d - ν_d Diagram
Optical Glass for Polished Lenses
Optical Glass for Glass Mold Lenses
OHARA
2023-04
n_d
ν_d
95
90
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80
75
70
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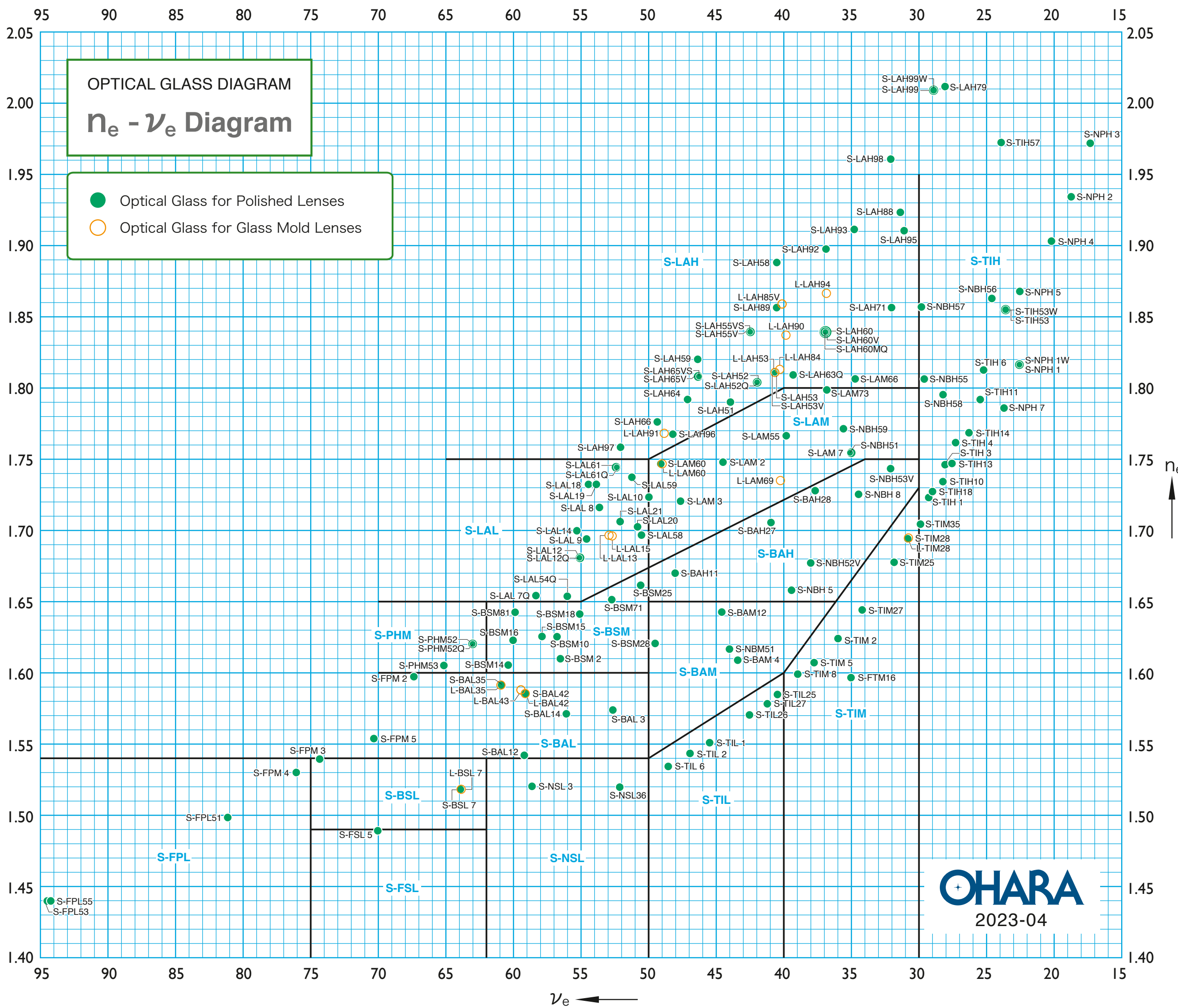
1.50
1.45
1.40
S-LAH
S-LAL
S-LAM
S-BAH
S-BAM
S-BSM
S-PHM
S-BAL
S-BSL
S-FPL
S-FSL
S-NSL
S-TIL
S-TIM
S-TIH
S-LAH99W
S-LAH99
S-LAH79
S-TIH57
S-NPH 3
S-LAH98
S-NPH 2
S-LAH88
S-LAH93
S-LAH95
S-LAH92
S-NPH 4
S-LAH58
L-LAH94
S-NBH56
S-NPH 5
L-LAH85V
S-LAH89
S-LAH71
S-NBH57
S-TIH53W
S-TIH53
S-LAH55VS
S-LAH55V
L-LAH90
S-LAH60
S-LAH60V
S-LAH60MQ
S-LAH59
L-LAH53
L-LAH84
S-TIH 6
S-NPH 1W
S-NPH 1
S-LAH65VS
S-LAH65V
S-LAH52
S-LAH52Q
S-LAH63Q
S-NBH55
S-LAM66
S-LAH64
S-LAH53
S-LAH53V
S-LAM73
S-NBH58
S-TIH11
S-LAH51
S-NPH 7
S-LAH66
L-LAH91
S-LAH96
S-LAM55
S-NBH59
S-TIH14
S-LAH97
S-LAM 7
S-NBH51
S-TIH 4
S-TIH 3
S-LAL61
S-LAL61Q
S-LAM60
L-LAM60
S-LAM 2
S-NBH53V
S-TIH13
S-LAL18
S-LAL19
S-LAL59
L-LAM69
S-TIH10
S-LAL10
S-BAH28
S-NBH 8
S-TIH18
S-LAL 8
S-LAM 3
S-TIH 1
S-LAL21
S-LAL20
S-TIM35
S-LAL14
S-LAL 9
S-LAL58
S-BAH27
S-TIM28
L-TIM28
S-LAL12
S-LAL12Q
L-LAL15
L-LAL13
S-NBH52V
S-TIM25
S-BAH11
S-LAL54Q
S-LAL 7Q
S-BSM25
S-NBH 5
S-BSM81
S-BSM18
S-BSM71
S-BAM12
S-TIM27
S-BSM16
S-BSM15
S-PHM52
S-PHM52Q
S-BSM10
S-BSM28
S-TIM 2
S-NBM51
S-BSM14
S-BSM 2
S-BAM 4
S-PHM53
S-TIM 5
S-FPM 2
S-BAL35
L-BAL35
S-TIM 8
S-FTM16
S-BAL42
L-BAL42
L-BAL43
S-TIL25
S-TIL27
S-BAL14
S-BAL 3
S-TIL26
S-FPM 5
S-TIL 1
S-FPM 3
S-BAL12
S-TIL 2
S-TIL 6
S-FPM 4
L-BSL 7
S-NSL 3
S-NSL36
S-BSL 7
S-FPL51
S-FSL 5
S-FPL55
S-FPL53


OPTICAL GLASS DIAGRAM
ne - νe Diagram
Optical Glass for Polished Lenses
Optical Glass for Glass Mold Lenses
S-LAH
S-LAM
S-LAL
S-BAH
S-BSM
S-PHM
S-BAM
S-BAL
S-BSL
S-FPL
S-FSL
S-NSL
S-TIL
S-TIM
S-TIH
S-LAH99W
S-LAH99
S-LAH79
S-TIH57
S-NPH 3
S-LAH98
S-NPH 2
S-LAH88
S-LAH93
S-LAH95
S-LAH92
S-NPH 4
S-LAH58
L-LAH94
S-NBH56
S-NPH 5
L-LAH85V
S-LAH89
S-LAH71
S-NBH57
S-TIH53W
S-TIH53
S-LAH55VS
S-LAH55V
L-LAH90
S-LAH60
S-LAH60V
S-LAH60MQ
S-LAH59
L-LAH53
L-LAH84
S-TIH 6
S-NPH 1W
S-NPH 1
S-LAH65VS
S-LAH65V
S-LAH52
S-LAH52Q
S-LAH63Q
S-LAM66
S-NBH55
S-LAH64
S-LAH53
S-LAH53V
S-LAM73
S-TIH11
S-NBH58
S-NPH 7
S-LAH51
S-LAH66
L-LAH91
S-LAH96
S-LAM55
S-NBH59
S-TIH14
S-TIH 4
S-LAH97
S-LAM 7
S-NBH51
S-TIH 3
S-LAL61
S-LAL61Q
S-LAM60
L-LAM60
S-LAM 2
S-TIH13
S-NBH53V
S-LAL18
S-LAL59
L-LAM69
S-TIH10
S-LAL19
S-LAL10
S-BAH28
S-NBH 8
S-TIH18
S-LAM 3
S-TIH 1
S-LAL 8
S-LAL21
S-LAL20
S-TIM35
S-LAL14
S-LAL 9
S-LAL58
S-BAH27
S-TIM28
L-TIM28
S-LAL12
S-LAL12Q
L-LAL15
L-LAL13
S-NBH52V
S-TIM25
S-BAH11
S-LAL54Q
S-BSM25
S-NBH 5
S-LAL 7Q
S-BSM71
S-BSM81
S-BSM18
S-BAM12
S-TIM27
S-BSM15
S-PHM52
S-PHM52Q
S-BSM16
S-BSM10
S-BSM28
S-TIM 2
S-NBM51
S-BSM 2
S-BAM 4
S-TIM 5
S-PHM53
S-BSM14
S-TIM 8
S-FTM16
S-FPM 2
S-BAL35
L-BAL35
S-BAL42
L-BAL43
L-BAL42
S-TIL25
S-TIL27
S-BAL14
S-BAL 3
S-TIL26
S-FPM 5
S-TIL 1
S-FPM 3
S-BAL12
S-TIL 2
S-TIL 6
S-FPM 4
L-BSL 7
S-NSL 3
S-NSL36
S-BSL 7
S-FPL51
S-FSL 5
S-FPL55
S-FPL53
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