Low Temperature Sealing Glass 1

Low temperature sealing glass is a composite material made by blending matrix powder glass with a low softening temperature and specially synthesized ceramic filler powder. The sealing temperature and coefficient of thermal expansion (CTE) of sealing glass can be adjusted by changing the kind and blending ratio of the glass and filler.

LS-2010 is widely used for DIP and QFP made of alumina (CTE: approximately 70 × 10^{-7}/K).

LS-1401S's low sealing temperature of 380˚C makes it suitable for SMD packages for quartz oscillators.

LS-3051S is used for sealing low-expansion ceramics such as AIN (CTE: approximately 45 × 10^{-7}/K).

LS-1301 and BF-0901 are suitable for sealing silicon (CTE: approximately 35 × 10^{-7}/K).

Properties

Usage			Alumina		AIN, Mullite, Silicon		
Properties/Glass Code			**LS-1401S**	**LS-2010**	**LS-3051S**	**LS-1301**	**BF-0901**
Sealing temperature		˚C	380	435	430	450	560
Dielectric constant	1MHz, 25˚C		45.0	12.5	16	45.5	11.1
tan δ	1MHz, 25˚C	$\times 10^{-4}$	38	34	41	60	19
Coefficient of thermal expansion	30-250˚C	$\times 10^{-7}$/K	71*1	65	51	41	49*2
Transformation point		˚C	258	313	303	315	430
Softening point		˚C	355	400	390	390	528
Density		$\times 10^{3}$kg/m^{3}	7.02	5.67	5.95	6.77	4.69
Volume resistivity Log ρ	150˚C	Ω·cm	6.2	12.4	12.7	12.0	13.3
Thermal conductivity		W/m·K	0.98	1.45	1.24	0.84	1.47
Specific heat		$\times 10^{3}$J/kg·K	0.34	0.41	0.38	0.35	0.46
Acid durability	20% H_2SO_4, 70˚C, 1min	mg/cm^2	—	0.8	1.1	0.1	—
	10% H_2SO_4, 20˚C, 10min	mg/cm^2	—	0.5	0.9	0.1	—
	10% HCl, 20˚C, 10min	mg/cm^2	—	1.9	2.7	0.5	—
	10% HNO_3, 20˚C, 10min	mg/cm^2	—	120	120	123	—
Color			Black	Dark brown	Black	Black	Green
Glass type			$PbO{\cdot}B_2O_3$(COM)*3				$Bi_2O_3{\cdot}B_2O_3$ (COM)*3

*1 This figure was measured at 30 to 200˚C.
*2 This figure was measured at 30 to 300˚C.
*3 COM: Composite sealing glass
Please contact us about other types of Pb-free glass.

Application Examples

1. Printing and Drying (except LS-1401S)

The paste for printing is prepared by adding vehicle to the powder glass and mixing them well.

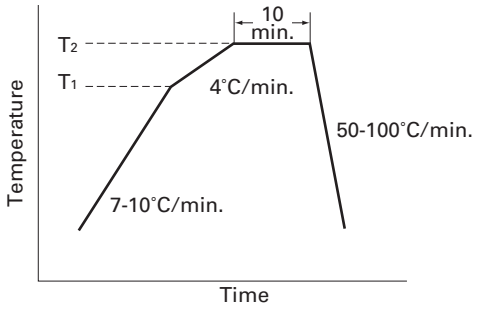
The vehicle is obtained by dissolving a low molecular weight acrylic resin in terpineol at a concentration of 5%. The paste obtained is printed on ceramic parts with an 80-100 mesh stainless screen. Printing and drying are repeated in order to increase the glass thickness of the film layer.

Drying is carried out at 120°C for 10-20 minutes.

2. Pre-firing

In order to eliminate the resin in the film layer pre-firing is done in an oxidizing atmosphere such as oxygen or air. Decomposition and firing of the resin takes place most actively at 320-380°C, so gradual heating is necessary in this temperature range.

Sintering of the powder glass is also carried out.



Glass Code	T_1 (°C)	T_2 (°C)
LS-1401S	250	350
LS-2010	320	390
LS-3051S	310	380
LS-1301	310	400
BF-0901	350	530

Fig. 1 Pre-firing profile

3. Lead-Frame Attaching

Lead-frame attaching is carried out in the air, and maintain the attaching temperature (T) for 5 to 7 minutes. When a heater block is used, the surface temperature of the block is kept higher than the attaching temperature by 30-50°C. Soak time is 1 to 2 minutes.

Glass Code	T (°C)
LS-2010	435
LS-3051S	430
LS-1301	450

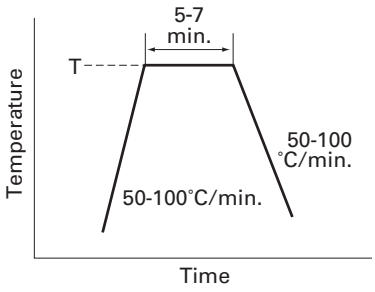


Fig. 2 L/A profile

4. Sealing

Sealing is carried out in either an air or a nitrogen atmosphere. Soak time is approximately 10 minutes and temperature is the same as lead-frame attaching temperature. Heating up rate is 50 to 100°C/min. and cool down rate is 20 to 40°C/min.

Low Temperature Sealing Glass 2

Low temperature sealing glass is a composite material made by blending matrix powder glass with a low softening temperature and specially synthesized ceramic filler powder. By changing the blending ratio and the kinds of glass and ceramics used, it is possible to change its sealing temperature and coefficient of thermal expansion.

- Composite sealing glass has a short sealing time and excellent ability to seal glass and metal.
- Devitrifiable glass can be re-fired without deformation.
- When a devitrifiable glass is heated, crystals form in the resulting melt, which then solidifies to produce a highly heat-resistant seal.

Properties

Properties/Glass Code			LS-3075	LS-3081	LS-0118	LS-0206	LS-7105	BF-0606
Sealing temperature		°C	450	410	430	450	450	485
Coefficient of thermal expansion	30-250°C	$\times 10^{-7}$/K	36.5	74	72.5	72	85*1	73*1
Density		$\times 10^{3}$kg/m^{3}	6.91	6.89	7.05	6.82	6.37	6.05
Transformation point		°C	300	300	317	325	—	365
Deformation point		°C	330	320	337	353	—	393
Softening point		°C	—	365	390	410	400	450
Volume resistivity Log ρ	150°C	Ω·cm	10.8	12.2	11.2	13.2	10.4	12.0
Color			Black	Black	Black	Black	Black	Green
Glass type			$PbO \cdot B_2O_3$ (COM)*2	$PbO \cdot B_2O_3$ (COM)*2			$PbO \cdot ZnO \cdot B_2O_3$ (DEV)*3	$Bi_2O_3 \cdot B_2O_3$ (COM)*2
Application			Alkali-free glass	Window glass, 50 Alloy, 426 Alloy				

* 1 This figure was measured at 30 to 300°C.
* 2 COM : Composite sealing glass
* 3 DEV : Devitrifiable sealing glass

Please contact us about other types of Pb-free glass.

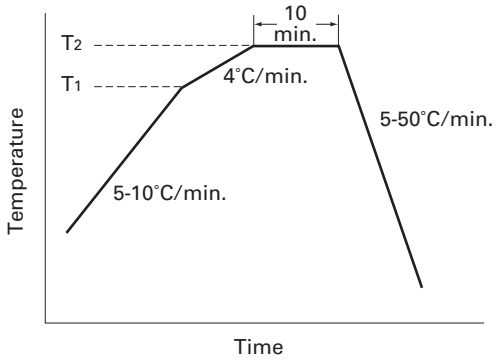
Application Examples

1. Printing and Drying

The paste for printing is prepared by adding a vehicle to the sealant and mixing them well. The vehicle is obtained by dissolving acrylic resin in terpineol at a concentration of 5%. The paste obtained is printed on the substrates with 80-100 mesh stainless screen. Drying is carried out at 120°C for 10-20 minutes.

2. Pre-firing

In order to eliminate the resin in the film layers, pre-firing is done in an oxidizing atmosphere such as oxygen or air. Decomposition and firing of resin take place most actively at 320-380°C, so gradual heating is necessary in this temperature range.

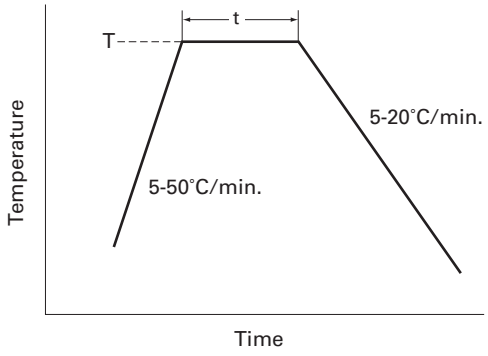


Glass Code	T_1 (°C)	T_2 (°C)
LS-3075	320	380
BF-0606	350	450
LS-3081	320	380
LS-0118	320	380
LS-0206	320	400
LS-7105	320	390

Fig. 1 Pre-firing profile

3. Sealing

Sealing is carried out in either an air or a nitrogen atmosphere.



Glass Code	T (°C)	t (min.)
LS-3075	450	10
BF-0606	485	10
LS-3081	410	10
LS-0118	430	10
LS-0206	450	15
LS-7105	450	20

Fig. 2 Sealing profile

Granulated Glass for Metal Packages

Granulated glass is used extensively for sealing stems and leads, and for part support in metal packages. Owing to their free flow characteristics, they have excellent workability in the tablet forming process.

Glass for matching seals is used with Kovar stems and leads, while those for compression seals are used with iron or stainless steel stems and leads of iron-nickel, iron-chrome alloys or Kovar.

Glass for part support is used for stand-off.

Properties

Usage			Seal							Part Support	
			Compression Seal			Matching Seal				Stand Off	
Glass Code			**ST-W/K**	**ST-4W/K**	**FN-13W/K**	**BH-W/K**	**BH-7W/K**	**BH-8W/K**	**BH-14W/K**	**ST-4F/K**	**BH-FW/K**
Particle size	D_{50}	μ m	135	130	110	135	135	135	135	120	125
	D_{99}	μ m	265	250	215	265	265	265	265	235	245
Firing temperature: T_1		˚C	650-660		680-690		700-710	670-680	730-750	650-660	750-800
Sealing temperature: T_2		˚C	960			980		930	980	960	1050
Coefficient of thermal expansion	30-380˚C	$\times 10^{-7}$/K	95	95	75.5	45.5	49.5	62.5	31.5	94	57
Density		$\times 10^3$kg/m^3	2.60	2.60	2.51	2.28	2.32	2.41	2.13	2.65	2.83
Transformation point		˚C	450	460	510	470	505	510	—	460	515
Deformation point		˚C	510	520	570	550	565	570	—	520	635
Strain point		˚C	420	427	480	435	472	475	—	—	—
Annealing point		˚C	460	472	517	480	513	520	—	—	—
Softening point		˚C	663	672	687	698	715	685	782	—	—
Working point		˚C	980	1030	990	1050	1130	990	1090	—	—
Dielectric constant	1MHz, 25˚C		6.4	6.5	6.3	5.0	5.5	5.8	4.0	6.7	6.4
tan δ	1MHz, 25˚C	$\times 10^{-4}$	22	21	32	30	39	37	3	24	31
Volume resistivity Log ρ	150˚C	Ω·cm	11.4	11.2	11.2	11.5	10.8	11.1	15.5	11.4	—
	250˚C	Ω·cm	8.8	8.7	8.7	8.8	8.2	8.5	12.3	8.8	—
	350˚C	Ω·cm	6.9	7.0	7.0	7.0	6.4	6.8	10.2	7.0	—
Young's modulus		GPa	68	68	—	57	57	—	—	—	—
Poisson's ratio			0.21	0.21	—	0.22	0.22	—	—	—	—
Glass type			$Na_2O \cdot BaO \cdot SiO_2$		$Na_2O \cdot Al_2O_3 \cdot B_2O_3 \cdot SiO_2$					$Na_2O \cdot BaO \cdot SiO_2$	$Na_2O \cdot Al_2O_3 \cdot B_2O_3 \cdot SiO_2$
Application			Fe,Fe-Ni,Fe-Cr,Fe-Ni-Cr		Fe Kovar	Kovar Mo				Fe	Kovar

ST-4F/K, BH-FW/K: Composite glass
Please contact us about color variations.

Application Examples

1. Pressing

The mold pressure of 8-10MPa is suitable for making preforms. The preforms manufactured under this condition have enough green strength for handling and the organic binder decomposes easily during the pre-firing process.

2. Pre-firing

Pre-firing is carried out in an oxidizing atmosphere such as oxygen or air. Pre-firing temperature should be applied to the temperature T_1 in the property table on the opposite page.

Decomposition and firing of the organic binder take place most actively at 150-530°C, so gradual heating is necessary in this temperature range.

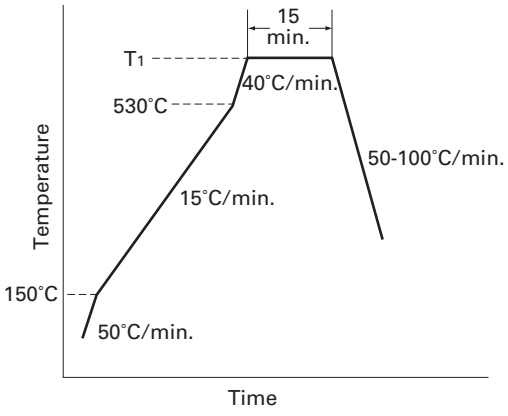


Fig. 1 Pre-firing profile

3. Sealing

Sealing is carried out in a nitrogen atmosphere. Sealing temperature should be applied to the temperature T_2 in the property table on the opposite page.

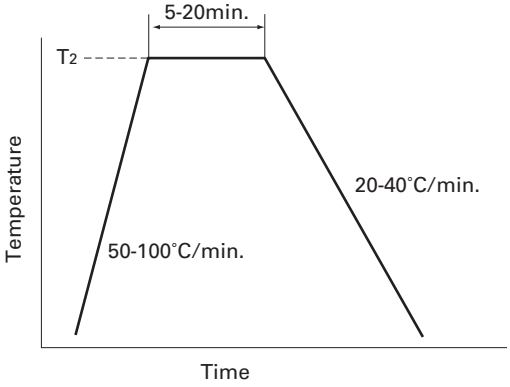


Fig. 2 Sealing profile

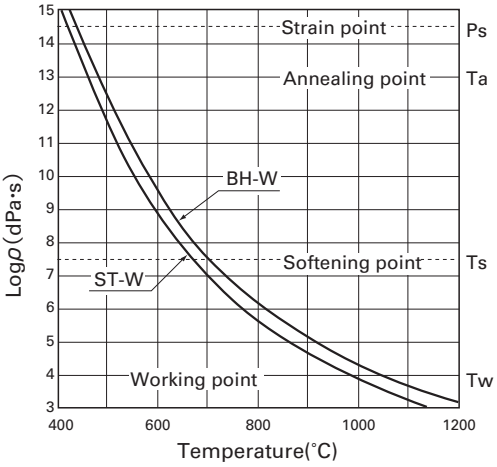


Fig. 3 Viscosity

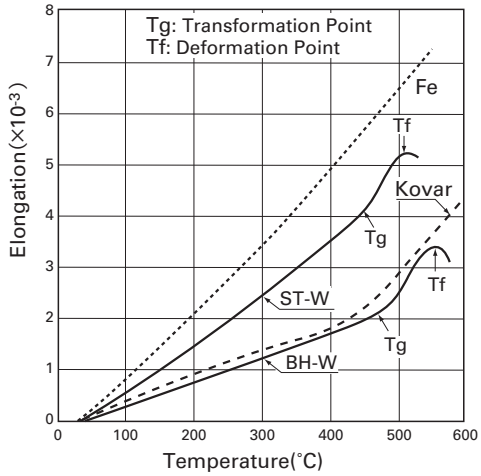


Fig. 4 Thermal expansion

Passivation Glass

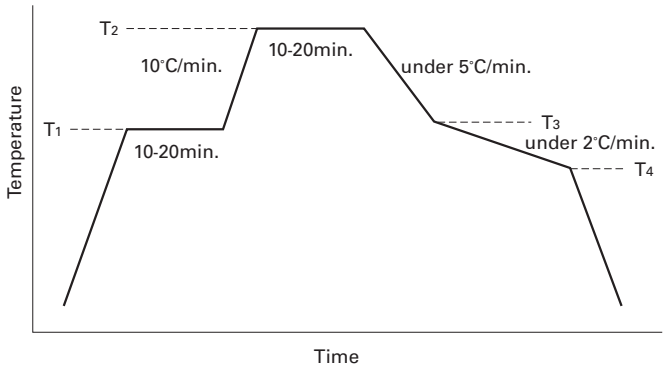
Zinc-borosilicate passivation glass is applicable for use in manufacturing highly reliable devices because no change occurs to surface charge density in BT treatment when applied with DC bias and heating.
Lead silicate glass and lead borosilicate passivation glass have excellent chemical durability and can be applied to transistors, thyristors, and diodes with nickel-plated electrodes.
Various particle sizes are available upon request.

Properties

Properties/Glass Code			GP-014	GP-031	GP-5210	GP-180	GP-190	GP-200
Grind type*1			350	350	350	S	S	S
Coefficient of thermal expansion	30-300°C	$\times10^{-7}$/K	43	36	33	44.5	43.5	44
Transformation point		°C	550	535	550	590	620	595
Softening point		°C	650	635	650	775	810	780
Density		$\times10^{3}$kg/m^{3}	3.78	3.93	3.84	3.87	3.81	3.78
Alkali content	Na_2O	ppm	≦20	≦20	≦20	≦30	≦30	≦30
	K_2O	ppm	≦10	≦10	≦10	≦10	≦10	≦10
	Li_2O	ppm	≦5	≦5	≦10	≦10	≦10	≦10
Application (Reverse breakdown voltage level)*2			Low	Low	High	Medium	High	Medium
Surface charge density: NFB*3		$\times10^{11}$/cm^{2}	0–+1	0–+1	+6–+7	+7–+8	+15–+16	+6–+7
Glass type			$ZnO{\cdot}B_2O_3{\cdot}SiO_2$	$ZnO{\cdot}B_2O_3{\cdot}SiO_2{\cdot}PbO$		$PbO{\cdot}SiO_2{\cdot}Al_2O_3$		

∗1 350: Dmax 44μm, D_{50} 16μm S: Dmax 44μm, D_{50} 7.5μm
∗2 Selection guide depending on your device level.
∗3 Silicon side

Firing Profile



Glass Code	T1 (°C)	T2 (°C)	T3 (°C)	T4 (°C)
GP-014	590	680-690	590	540
GP-031	570	700-720	570	520
GP-5210	590	720-730	590	540
GP-180	650	800-820	630	580
GP-190	670	860-870	650	600
GP-200	650	810-820	630	580
GP-230	670	855-865	650	600
GP-605	660	850-860	630	580
GP-620	670	850-860	650	600
GP-350	520	710-720	520	450
GP-370	570	750-760	570	450
GP-380	600	770-780	560	510
GP-390	600	770-780	570	520

*You may not be able to obtain sufficient firing, crystallizing status, and electrical characteristics, in case your firing profile is not within our recommendation.

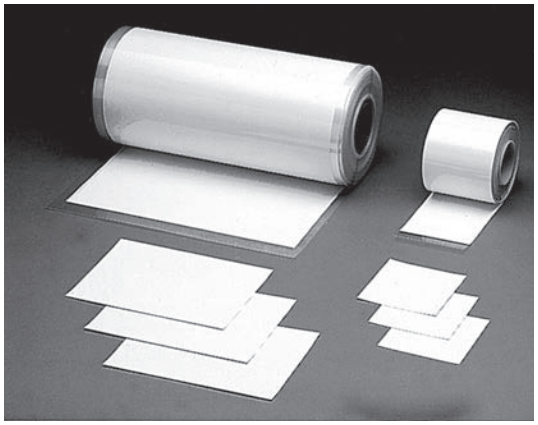
GP-230	**GP-605**	**GP-620**	**GP-350**	**GP-370**	**GP-380**	**GP-390**
S	S	S	S	S	S	S
41.5	44	43	46.5	42.0	44.5	43
610	590	620	470	475	535	540
830	790	810	645	680	740	740
3.58	3.84	3.76	3.53	3.32	3.61	3.54
≦30	≦30	≦30	≦30	≦30	≦30	≦30
≦10	≦10	≦10	≦30	≦10	≦10	≦10
≦10	≦10	≦10	≦10	≦10	≦10	≦10
Medium	High	High	Low	Medium	Medium	High
+7–+8	+11–+12	+14–+15	+2–+3	+5–+6	+6–+7	+14–+15
			$PbO{\cdot}B_2O_3{\cdot}SiO_2{\cdot}Al_2O_3$			

Composite Powder for Low Temperature Cofired Ceramics

Composite powder for low temperature cofired ceramics is a composite material that is made by uniformly blending glass and ceramic fillers. Firing can be conducted at a low temperature in the range of 870-900°C, which allows the use of highly conductive elements such as gold and silver paste to create a screen print circuit pattern with high electric properties.

- MLS-25M is a vitreous material with a low CTE* and a low dielectric constant.
- MLS-25E is a vitreous material with a very low dielectric constant.
- MLS-41 is a devitrifiable material with a high dielectric constant.
- MLS-23K is a new product with a low dielectric constant and low tan δ .
- MLS-26 is a devitrifiable material with high mechanical strength.
- MLS-63 is a devitrifiable material with high mechanical strength and low tan δ .

*CTE : coefficient of thermal expansion



Green sheets

Properties

Properties/Glass Code			MLS-25M	MLS-25E	MLS-41	MLS-23K	MLS-26	MLS-63
Bending strength		MPa	157	125	250	150	320	400
Dielectric constant	1MHz, 25°C		4.9	3.9	17.0	3.9	7.1	8.0
	15GHz, 25°C		4.8	3.9	19.0	4.0	6.7	7.9
tan δ	1MHz, 25°C	$\times 10^{-4}$	25	5	20	5	4	5
	15GHz, 25°C	$\times 10^{-4}$	47	21	50	15	58	11
Coefficient of thermal expansion	30-380°C	$\times 10^{-7}$/K	42	60	84	65	58	87
Density*		$\times 10^{3}$kg/m^{3}	2.52	2.29	4.36	2.24	3.02	3.52
Transformation point		°C	500	500	700	525	625	725
Volume resistivity Log ρ	150°C	Ω·cm	13.5	>14	—	>13.8	12	>14
Thermal conductivity		W/m·K	1.9	1.7	3.1	1.7	3.9	4.1
Particle size	D_{50}	μm	3.3	3.5	1.1	1.0	2.6	1.6
	D_{max}	μm	20	20	10	15	15	10
Glass type			$SiO_2 \cdot B_2O_3$		$Nd_2O_3 \cdot TiO_2 \cdot SiO_2$	$SiO_2 \cdot B_2O_3$	$SiO_2 \cdot CaO \cdot Al_2O_3$	

*Powder theoretical density

Application Examples

Method

1. Casting and Printing

Glass-ceramic powder, binder resin, solvent, and plasticizer are thoroughly mixed and cast into a 50-300 µm thick green sheet using the doctor blade method. Individual sheets are cut into appropriate sizes from the green sheet and punched with via holes and then screen-printed with a circuit pattern.

2. Lamination

Green sheets are laminated at 50-100°C and under 10-35 MPa pressure.

3. Firing

Firing is carried out in the air.

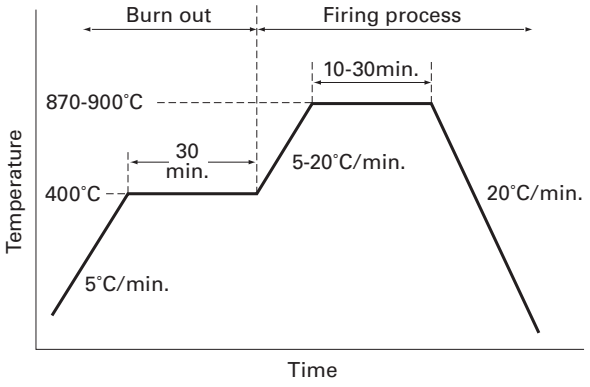
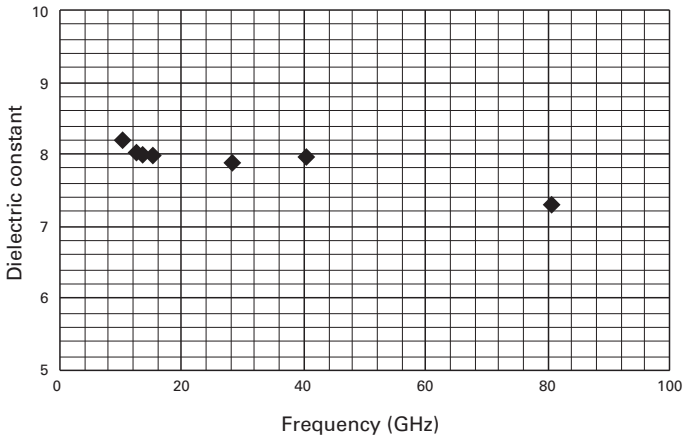


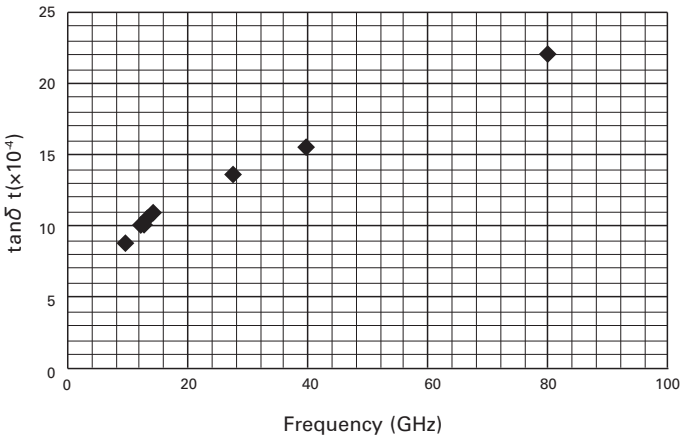
Fig. 1 Firing profile

High Frequency Dielectric Properties of MLS-63

Dielectric constant



tan *δ*



Powder Glass for Coating, Binding, and Sealing

Powder glass is used to coat a wide variety of substrates and elements. Please make your selection using the coefficient of thermal expansion and softening point as a guide. Powder glass is also used as a binder for thick film paste, conductive paste of solar cells, and ceramic chip devices.
Please make your selection using glass type and softening point as a guide.

Properties

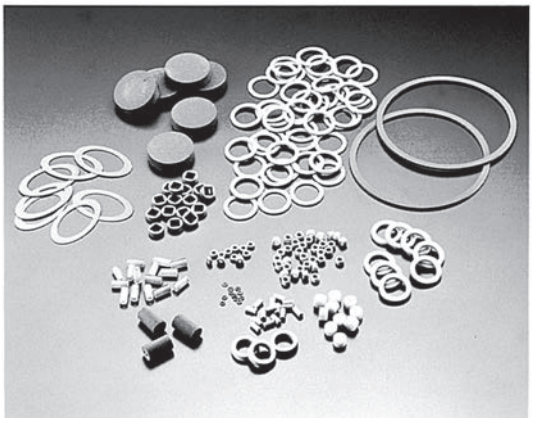
Properties/Glass Code			GA-1	GA-4	GA-8	GA-9	GA-12	GA-13	GA-21	GA-34*	GA-44	GA-47
Coefficient of thermal expansion		× 10^{-7}/K	60	63	81	90	73	66	83	45	117	37
Density		× 10^{3}kg/m^{3}	4.03	2.70	5.38	5.77	2.95	3.04	5.74	3.93	3.02	2.36
Transformation point		˚C	445	475	400	360	460	660	375	535	630	645
Deformation point		˚C	505	545	430	385	505	715	402	560	—	715
Softening point		˚C	595	625	490	430	560	850	450	635	—	—
Dielectric constant	1MHz,25˚C		8.8	6.2	11.7	14.7	6.7	7.2	—	—	8.5	5.2
tan δ	1MHz,25˚C	× 10^{-4}	12	20	26	17	17	15	—	—	40	8
Volume resistivity Log ρ	250˚C	Ω·cm	13.1	10.8	12.2	11.3	10.4	14.1	—	—	—	—
	350˚C	Ω·cm	11.0	8.0	9.5	—	8.3	12.0	—	—	—	—
Main composition (Glass type)			PbO· B_2O_3· SiO_2	Na_2O· B_2O_3· SiO_2	PbO· B_2O_3· SiO_2	PbO· B_2O_3· SiO_2	Na_2O· ZnO· B_2O_3	CaO· BaO· SiO_2	PbO· B_2O_3· SiO_2	PbO·ZnO· B_2O_3· SiO_2 (devitrifiable)	MgO· B_2O_3· SiO_2 (devitrifiable)	Al_2O_3· B_2O_3· SiO_2
Color			White,Black	White	White	White	White	White	White	Pale Purple	White	White

Properties/Glass Code			GA-50	GA-55	GA-59	GA-60	LS-0500	BG-0600	BG-0700	BG-0800	BG-0900	BG-1300
Coefficient of thermal expansion		× 10^{-7}/K	24	87	38	96	83	109	112	98	96	70
Density		× 10^{3}kg/m^{3}	2.15	4.54	3.80	2.88	3.06	6.96	7.29	5.76	6.74	5.23
Transformation point		˚C	495	700	550	640	495	365	350	435	390	497
Deformation point		˚C	600	730	—	—	535	395	385	475	420	546
Softening point		˚C	825	—	645	—	585	430	410	510	460	615
Dielectric constant	1MHz,25˚C		4.1	26.0	—	7.2	7.6	23.6	25.8	16.2	22.4	13.4
tan δ	1MHz,25˚C	× 10^{-4}	20	25	—	35	138	19	27	29	17	17
Volume resistivity Log ρ	250˚C	Ω·cm	12.4	—	—	—	9.2	9.3	8.7	10.9	9.7	11.5
	350˚C	Ω·cm	—	—	—	—	7.4	7.4	6.8	8.8	7.9	9.4
Main composition (Glass type)			B_2O_3· SiO_2	Nd_2O_3· TiO_2· SiO_2 (devitrifiable)	ZnO· B_2O_3· SiO_2 (devitrifiable)	MgO· B_2O_3· SiO_2 (devitrifiable)	Na_2O· B_2O_3· SiO_2	Bi_2O_3· B_2O_3	Bi_2O_3· B_2O_3	Bi_2O_3· B_2O_3	Bi_2O_3· B_2O_3	Bi_2O_3· SiO_2
Color			White	Pale Green	Pale Purple	White	White	Green	Green	White	Green	Light Brown

∗ We recommend GA-59 as a Pb-free alternative for GA-34 (low expansion type glass).
Please contact us about other types of Pb-free glass.

Tablet

Tablets are preformed and made of sintered powder glass.



Features

- A broad lineup of products offering glass matching virtually every application.
- Comes in sintered form that is easy to handle and eliminates the need for paste preparation and other preprocessing.
- Can be applied to fine holes and deep grooves that are difficult to fill in with paste.

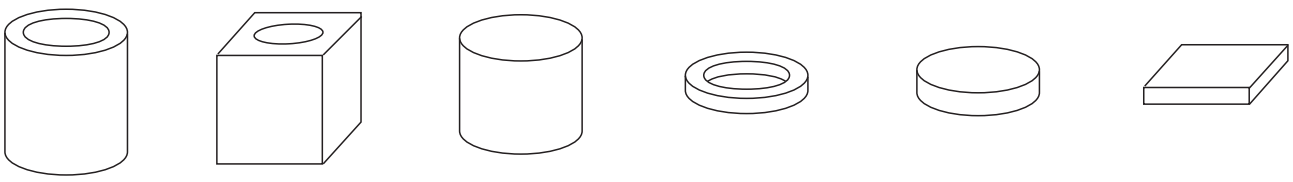
Please contact us about optimal glass selection, forms and sizes. The table below shows examples of glass selections available.

Selection of Sealing Glass (example)

Application	Working point (°C)		
	Less than 500	500-600	700-1000
Kovar, AℓN	LS-1301	BF-0901	BH-7
Alumina	LS-2010	BF-0606	GA-1
Window glass	LS-0118	GA-8	—
Forsterite	—	GA-9	GA-11
Fe, Fe-Ni	BG-0600	BG-0800	ST-4

For further information on properties, see p.24-27regarding glass which has sealing temperature less than 500°C and see p.28 or 34 for others.

Forms (example)



Example of Dimensions

(Unit : mm)

Form	Outer diameter	Inner diameter	Height
Ring	15.5	13.5	1.0
	0.6	0.2	0.2
Cylinder	4.0	2.0	5.0
Disc	3.0	—	0.8

Please contact us about other forms and dimensions.

Glass Paste

Glass pastes are made by homogeneously dispersing powder glass upon the vehicle.

- A broad lineup of products offering glass paste for virtually every application
- Can be applied directly to paste application process.
- PLS-3123 and PLS-3124 form excellent moisture-protective and laser-trimmable overglaze. These overcoat pastes are ideal for network resistors.
- PLS-3150B1 has excellent acid durability that prevents discoloration after the electrode plating.

Please contact us about optimal glass selection, viscosity, and other information. The table below shows only few examples of glass selections available.

Properties

Application		Thick Film Hybrid IC Substrates for Ag/Pd, Ag/Pt Circuit		Chip Resistors	Chip Resistors	Various Ceramics
		Overglaze		Secondary Coating	Overglaze	Overglaze, Sealing, Bonding
Glass Code		**PLS-3123**	**PLS-3124**	**PLS-3150B1**	**PLS-3901**	**PLS-3143**
Temperature Firing conditions Soak time at peak		510°C Fireable in air 10 minutes		580-620°C Fireable in air 10 minutes	610°C Fireable in air 10 minutes	850°C or more Fireable in air 10 minutes
Screen		165-325mesh				
Film thickness after firing	μm	10-50				
Color		Green		Black	White	White (Semi-translucent after firing)
Viscosity	Pa·s	90	180	230	110	150
Coefficient of thermal expansion	$\times 10^{-7}$/K	67		70	67 (30-300°C)	66
Softening point	°C	530		585	590	840
Thinner				Terpineol		
Feature		Forms moisture protective and highly hermetic glass film. Used widely for hybrid ICs in automobile	High viscosity type of PLS-3123	Excellent acid durability		
Type		Pb			Pb-free	

Please contact us about other types of Pb-free glass.

Application Examples

1. Printing
The paste is printed on a substrate by the screen printing method. Adjustment of printing conditions is suggested, referring to the following table based on the purpose.

2. Leveling
In order to achieve a smooth surface, the prints are leveled at room temperature for 5 to 10 minutes.

3. Drying
The prints are dried at a temperature of 100 to 150°C for 10 to 15 minutes.

4. Firing
The prints are fired using a belt furnace or a batch furnace. A heating rate of 20 to 50°C/min. is recommended for burning out the organic materials in the paste. A suitable cooling rate is 20 to 50°C/min. to prevent the substrate and the glassy film from thermal cracking.

● **Reference: Factors which affect print quality**

	Improving print resolution	Increasing film thickness	Decreasing film thickness
Squeegee hardness	hard	soft	hard
Squeegee angles	increase	reduce	increase
Squeegee speed	slow	fast	slow
Squeegee pressure	low	low	high
Screen mesh	fine	wide	fine
Screen emulsion	thin	thick	thin
Screen gap	small	large	small
Paste viscosity	high	high	low

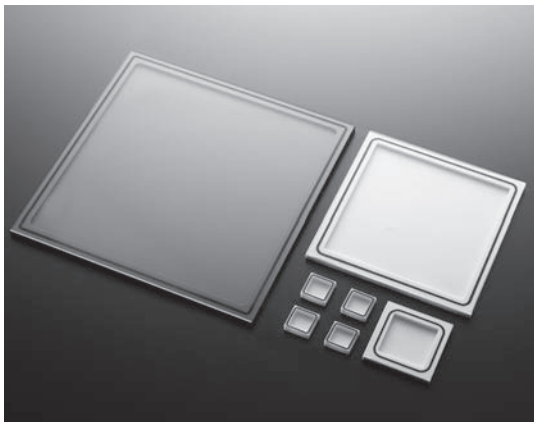
Caution

- It is necessary to store the paste in a cool, dark place to prevent deterioration.
- The paste, stored for a long time, needs to be stirred well with a stainless-steel spatula before use.
- Adjust viscosity as necessary.
- Vapor from the paste is hazardous to the health. Be sure printing worksite is adequately ventilated.
- When the skin is stained with paste, it must be cleaned at once.

Glass Frit for Laser-Sealing

Glass frit for laser-sealing achieves hermetic sealing of glass substrates or glass and cavities.* Laser-sealing is available for package sealing, providing less thermal damage to internal devices. Our glass frit is suitable for the technology utilized for hermetic sealing applications that requires high reliability.

*Alumina, LTCC, Silicon

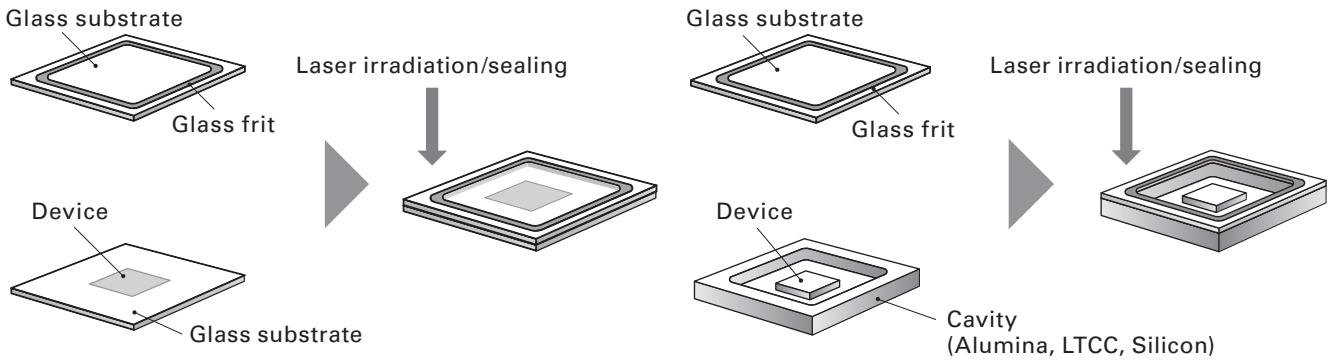


Application examples

Features

- Prevents thermal damage to internal devices
- High reliability of hermetic sealing
- Glass lid with glass frit is available.
- Applicable to our glass substrate materials

Laser-Sealing Process



Applications

- Micro Electro Mechanical Systems (MEMS) packages
- Deep UV LED packages
- Hermetic sealing for packages
- OLED devices
- Perovskite Solar Cells

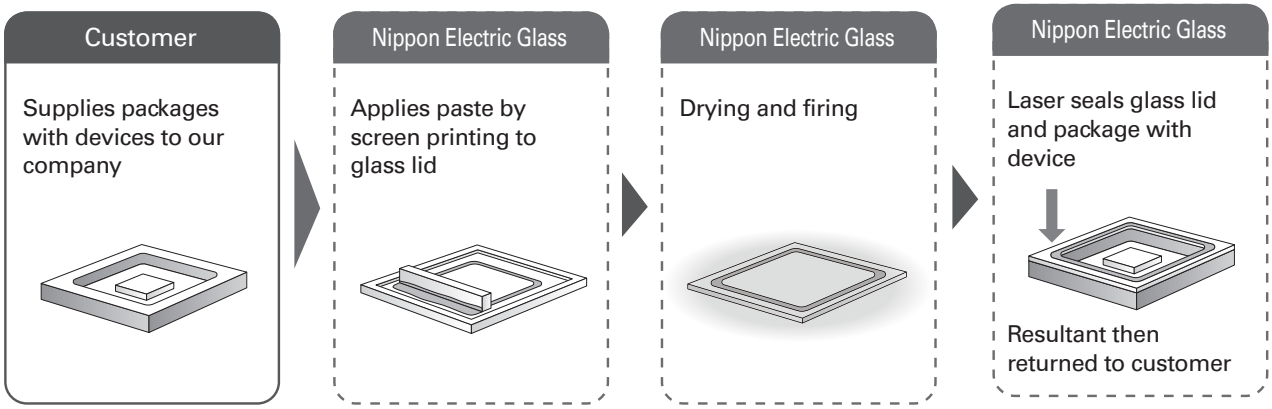
Available Materials and Sizes

Cavity Material	Package/Substrate Size	Glass Lid Thickness
LTCC	up to 60mm	up to 1mm
Alumina	up to 60mm	up to 0.5mm
Glass	up to 200mm	up to 1mm
Silicon	up to 10mm	up to 0.2mm

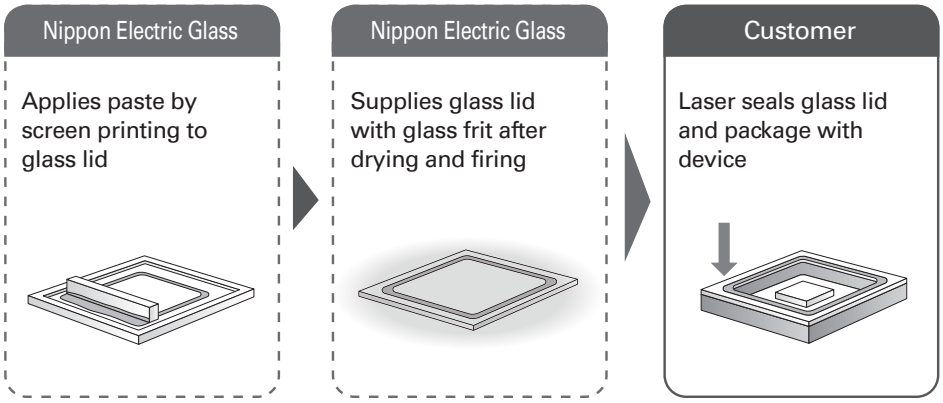
Supply Forms and Processes

- Our general supply methods are given below.
- Customers can simplify the process.

1. We (Nippon Electric Glass) supply laser-sealed packages to customers.



**2. We supply glass lids with glass frit printed and fired.
Customers conduct laser sealing on their own.**



- Customers can select the optimal glass lid with fired glass frit from our various glass lids with a wide CTE range.