LUMIGLAS® Safety sight glass

Lumistar Special Glass Technology Co., Ltd.

DIN7080 DIN8902 JIS B8286 JIS B8211

Safety sight glass

Borosilicate

Aluminosilicate glass

Alkali-resistant mica glass

Gauge glasses

Reflex gauge glasses

Transparent gauge glasses

Circular gauge glasses

Company Profile

Lumistar Special Glass lechnology Co., Ltd. is a professional enterprise thati produces safety glass windows and water level gauge glass windows. Our products includeI DIN7080 safety glass sight glass, DIN7081 water level gauge glass, JIS B8286 pressure vessel sight glass, high-pressure resistant aluminum silicate glass, alkali resistantI glass sight glass, alkali resistant water level gauge glass sight glass, sapphire glasssight glass, optical quartz glass, bullet proof glass, and explosion proof glass. We focus on the application of high-tech glass industry and can provide customers with pressure vessel sight glasses, pipeline sight glasses, and various matching explosion-proof spotlights that comply with DIN28120, DIN28121, ASME B16.5, JIS BIstandards.

Our company has successively won honors such as National High tech Enterprise. Jiangsu Private Science and Technology Enterprise, and Jiangsu lnnovative Small and Medium sized Enterprise. lt has strong capabilities in the development and innovation of new product technologies. Lumistar's mirror products are renowned in the industry for their quality and safety performance. Sharp eyed equipment manufacturing companies around the world have recognized one thing: Lumistar's mirrors from Nanjing, China are 100% risk-free ! The various types of glass we produce can withstand the harshest working conditions, whether it is high-temperature and high-pressure steam boilers or various strong acid and alkali chemical environments. Lumistar's glass can easily withstand high temperatures, pressures, and corrosion!

Lumistar Special Glass Technology Go., Ltd. is a professional enterprise that produces safety glass windows and water level gauge glass windows. Our products include DIN7080 safety glass sight glass, DIN7081 water level gauge glass, JIS B8286 pressure vessel sight glass, high-pressure resistant aluminum silicate glass, alkali resistant glass sight glass, alkali resistant water level gauge glass sight glass, sapphire glass sight glass, optical quartz glass, bulletproof.

LUMIGLAS®

Borosilicate gauge glasses
long and circular types

The quality of a sight (gauge) glass depends mainly on the chemical composition and mechanical strength of the glass material.

Constant glass quality is provided through glass analyses and acid/alkali tests. The mechanical strength is attained through thermal prestressing.

Liquid level gauges

The gauge glass is the most important component of the liquid level gauge.

LUMIGLAS gauge glasses are suit-able for installation in liquid levelgauges of almost any make.

We manufacture our gauge glasses our-selves and use exclusively "extra-hard" borosilicate glass which is subse-quently heat-treated.

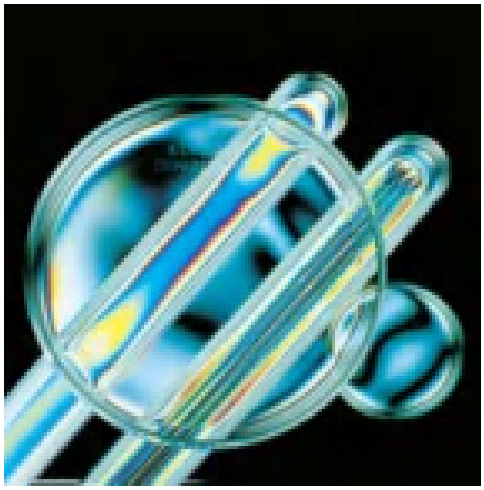
LUMIGLAS gauge glasses have high me-chanical strength and are exceptionally resistant to alkalis, acids and boiler wa-ter (within the service limitation). Ourglass testing laboratory carries out continuously quality control tests: purity ofglass, flaws in glass, dimensional accuracy, etc. This ensures the high quality standard of LUMIGLAS gauge glasses. We manufacture reflex and transparent glasses according to the most variedinternational standards.

Fields of application:

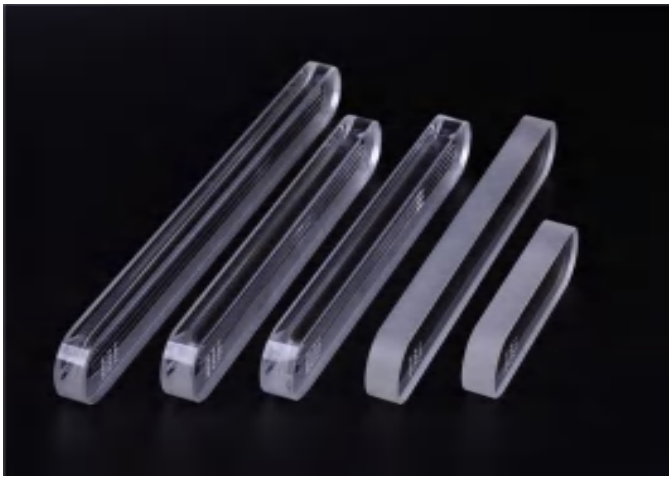
- Oil refineries
- Petro-chemical plants
- Pharmaceutical manufacture
- Chemical processing
- Mechanical engineering, especially

manufacture of boilers and storage vessels

- Foodstuffs and beverages industry
- Water engineering
- Paper and cellulose industry
- Textile industry
- Marine engineering
- Nuclear engineering



Stress-optical view of thermally prestressed circular and long gauge glasses inpolarized light



LUMIGLAS transparent glass (above) and reflex glass (underneath)

Circular gauge glasses made from borosilicate glass "extra-hard"

LUMIGLAS®

Reflex and transparent gauge glasses

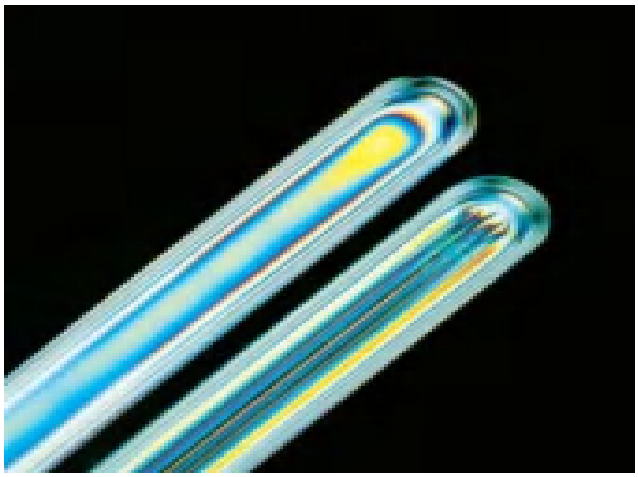
made of borosilicate glass"extra-hard",long types

Reflex glasses

The side facing the medium chamber is provided with moulded grooves set at 90° angles. The moulding process increases the resistance of the glass grooves to wear; the "skin" which the glass attains during moulding gives it maximum smoothness and hardness.This makes it extremely resistant to the attack of boiler water.

Applications:

Up to 35 bar saturated steam, reflex glasses provide the optimum solution: they are corrosion resistant and provide an absolutely clear indication. Reflex glasses can be used with all media except steam at service conditions up to 400 bar or temperatures up to 400 °C.



LUMIGLAS transparent glass (left side) and reflex glass (right) in polarized light

Transparent glasses

LUMIGLAS transparent glasses are also manufactured from “ extra-hard” borosilicate glass. The surfaces on both sides are finely ground and polished to ensure optimal transparency.

Applications:

In steam service above 35 bar and with media with a high pH-value. LUMIGLAS transparent glasses must be protected by a mica shield on the side facing the medium chamber. Transparent glasses should always be chosen for contaminated, viscous or corrosive media. With in the given service limitations they may be used for all media ex-LUMIGLAS package units for gauge glasses, sealing gaskets and cushion gasketscept steam at pressures up to 340 baror temperatures up to 400°C.

Packing

LUMIGLAS gauge glasses are packed in individual cardboard boxes. In addition to the glass, each package contains a LUMIGLAS sealing gasket and cushion gasket and forms a complete unit ready for installation.

Note

Only LUMIGLAS original parts guaranteea trouble free operation of the gauge glasses. Therefore it is recommended to use only original spare parts for gauge glasses, mica shields, sealing gasketsand cushion gaskets.

Standards

We manufacture reflex and transparent glasses in series to the following stan-dards:

OeNORM M 7354 (long gauge glasses)DIN 7081 (long gauge plate glasses) JIS B 8211 (Japanese Industrial Standard) OMV-Spez. H 2009 (OMV-AG, Vienna)MIL-G-16356 D (US-Navy-Ships)

Esso Eng. Spec. 123 (Esso Research &Engineering Co. – New Jersey)

S..O..D. Spec. 123 (Standard Oil Devel-opment Company – New Jersey)

BS 3463 (British Standard Institution).

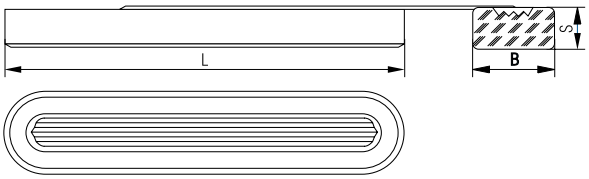
Quality control

LUMIGLAS reflex and transparent glassesare subject to continuous control during manufacture in order to guarantee exact dimensions, stress conditions, material composition and resistance to bending strain.

LUMIGLAS®

Reflex and transparent gauge glasses
technical datas

Reflex glasses A, B, H



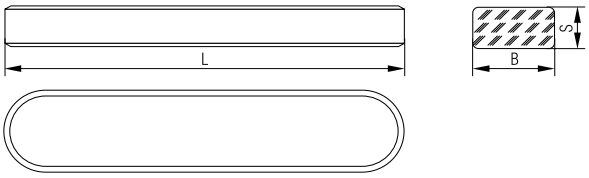
Overall dimension (mm)

Size	Type A			Weight g/piece	Type B			Weight g/piece	Type H			Weight g/piece
	L	B	S		L	B	D		L	B	S	
0	–	–	–	–	95	34	17	110	–	–	–	–
I	115	30	17	118	115	34	17	132	115	34	22	176
II	140	30	17	146	140	34	17	162	140	34	22	214
III	165	30	17	176	165	34	17	195	165	34	22	254
IV	190	30	17	200	190	34	17	228	190	34	22	294
V	220	30	17	237	220	34	17	264	220	34	22	344
VI	250	30	17	265	250	34	17	301	250	34	22	392
VII	280	30	17	303	280	34	17	338	280	34	22	445
VIII	320	30	17	334	320	34	17	387	320	34	22	503
IX	340	30	17	359	340	34	17	410	340	34	22	536
X	–	–	–	–	370	34	17	461	–	–	–	–

KLINGER gauge glasses ***Applicational range reflex glasses***	Type A 1)		Type B 1)		Type H	
	bar	°C	bar	°C	bar	°C
For media with no significant glass attack, e..g.oils, hydrocarbons	400 150 0–10	120 400 430	265 180 0–10	120 400 430	300 200 0–10	120 400 430
For media with significant glass attack, e..g.saturated steam, HPHW, alkalis	35	243	35	243	2) 42	253

1)Glass types to OeNORM M 7354 or DIN 7081.
2)For steam pressures above 35 bar we recommend the use of transparent glasses with mica shields.

Transparent glasses
A, B, H, TA, 28



Overall dimension (mm)

Size	Type A			Weight g/piece	Type B			Weight g/piece	Type H			Weight g/piece	Type TA 28			Weight g/piece
	L	B	S		L	B	D		L	B	S		L	B	S	
I	115	30	17	122	115	34	17	137	–	–	–	–	113	27,6	16,8	114
II	140	30	17	152	140	34	17	172	140	34	22	218	–	–	–	–
III	165	30	17	176	165	34	17	204	165	34	22	260	163	27,6	16,8	168
IV	190	30	17	211	190	34	17	238	190	34	22	302	188	27,6	16,8	194
V	220	30	17	250	220	34	17	280	220	34	22	357	218	27,6	16,8	226
VI	250	30	17	280	250	34	17	317	250	34	22	400	248	27,6	16,8	258
VII	280	30	17	314	280	34	17	356	280	34	22	460	278	27,6	16,8	290
VIII	320	30	17	360	320	34	17	407	320	34	22	530	318	27,6	16,8	334
IX	340	30	17	387	340	34	17	430	340	34	22	562	338	27,6	16,8	356
X	–	–	–	–	370	34	17	480	–	–	–	–	–	–	–	–

LUMIGLAS gauge glasses ***Applicational range transparent glasses***	Type A 1)		Type B 1)		TypeH		Type TA 28 4)	
	bar	°C	bar	°C	bar	°C	bar	°C
For media with no significant glass attack, e..g.oils, hydrocarbons	240 160 0-10	120 400 430	290 200 0-10	120 400 430	340 230 0-10	120 400 430	– – –	– – –
For media with significant glass attack, e..g.saturated steam, HPHW, alkalis	2) 35 70	243 300	2) 35 85	243 300	2) 42 85	253 300	3) 120 180	324 356

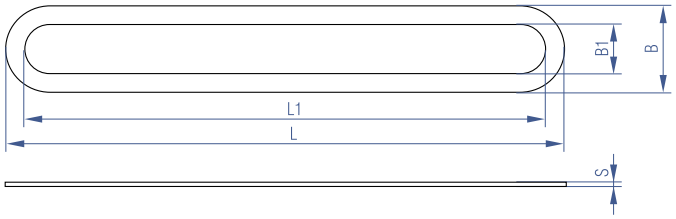
1)Glass types to OeNORM M 7354 or DIN 7081.
2)For steam pressures above 35 bar we recommend the use of transparent glasses with mica shields.
3)For steam pressures above 120 bar only TA 28 glasses. size I. may be used.
4)TA glasses may only be used with mica shields.

4All measurements in mm
In the interest of technical progress, designs and dimensions are subject to modification

LUMIGLAS®

Sealing and cushion gaskets & mica shields
for reflex and transparent gauge glasses

Sealing gasket, cushion gasket made from asbestos-free material

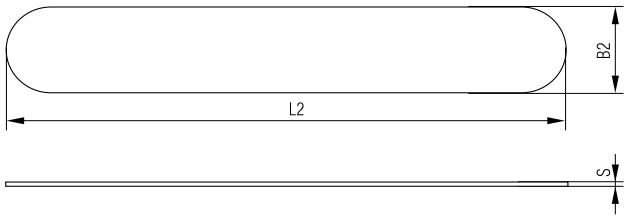


Overall dimension (mm)

Size	Type A				Type B/H				Sealing gasket and protective gasket 1) TA 28				Cushion gasket 2) TA 28			
	L	L1	B	B1	L	L1	B	B1	L	L1	B	B1	L	L1	B	B1
0	95	70	30	15	95	70	34	15	–	–	–	–	–	–	–	–
I	115	90	30	15	115	90	34	15	133	97	47	19	112	97	27	17
II	140	115	30	15	140	115	34	15	–	–	–	–	–	–	–	–
III	165	140	30	15	165	140	34	15	183	147	47	19	162	147	27	17
IV	190	165	30	15	190	165	34	15	208	172	47	19	187	172	27	17
V	220	195	30	15	220	195	34	15	238	202	47	19	217	202	27	17
VI	250	225	30	15	250	225	34	15	268	232	47	19	247	232	27	17
VII	280	255	30	15	280	255	34	15	298	262	47	19	277	262	27	17
VIII	320	295	30	15	320	295	34	15	338	302	47	19	317	302	27	17
IX	340	315	30	15	340	315	34	15	358	322	47	19	337	322	27	17

Sealing and cushion gaskets s = 1,5 mm 1)Protective gasket s = 0,5 mm 2)Cushion gasket s = 0,5 mm

Mica shields



Overall dimension (mm)

Size	Type A		Type B/H		Type TA 28	
	L2	B2	L2	B2	L2	B2
0	95	30	95	34	–	–
I	115	30	115	34	133	47 [1])
II	140	30	140	34	–	–
III	165	30	165	34	183	47 [2])
IV	190	30	190	34	208	47 [2])
V	220	30	220	34	238	47 [2])
VI	250	30	250	34	268	47 [2])
VII	280	30	280	34	298	47 [2])
VIII	320	30	320	34	338	47 [2])
IX	340	30	340	34	358	47 [2])

0s=0,15 – 0,20 [1]) s=0,60 [2]) s=0,30 – 0,40

Material

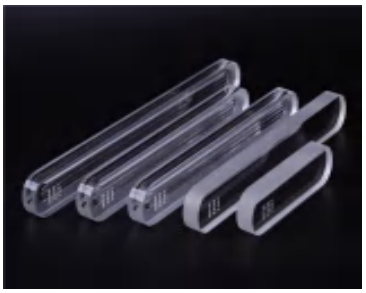
A and B micas: stained first quality TA
28 micas: stained A quality

KEL-F shield

Size like mica shields
Type B/H standard thickness = 1 mm

LUMIGLAS®

Reflex and transparent gauge glasses
technical datas according to OeNORM 7354 and DIN 7081



LUMIGLAS packing for gauge glasses,sealing gaskets and cushion gaskets

Material:
Borosilicate glass, thermally pre-stressed, optically tested, properties aslaid down in DIN and OeNORM.

Resistance to bending strain:
=120 N/mm².

Mean coefficient of linear expansion:
α20/300 ≤ $4.5 \cdot 10^{-6} \cdot k^{-1}$; tested to DIN 523328.

Transition temperature:
tg=550.°C, tested to DIN 52324.

Chemical resistance

Alkali resistance:
alkali class 2, tested to ISO 695.

Water resistance:
hydrolytic class 1, tested ISO 719.

Acid resistance:
acid class 1, tested to DIN 12116.

Quality components
The quality of gauge glass depends onits:

- **chemical composition**

The chemical composition as well as the coefficient of expansion is continuously checked through glass analyses.

- **mechanical strength**

Optimum mechanical strength of a gauge glass is attained through heattreatment (pre-stressing) in which-asin the hardening of steel – the glass is brought to a high temperature and quickly cooled down in a stream of air. This procedure increases the bending and shock resistance of the gauge glass to the value demanded by standards.The thermal pre-stressing of a gauge glass can be checked by means of a po- larizing filter: as may be seen in the pic-tures on page 2 and 3, the stress lines are visible on the outer walls of thegauge glass as interference colours. A non-pre-stressed glass does not display these stress lines.

- **dimensional accuracy**

We check the dimensional accuracy of every glass using special instruments.

Mica protection
The mica shield must be supported by aglass with a perfectly flat surface. Therefor only transparent (plate) glasses can be mica-protected; this is not possible for glasses provided with reflex grooves.As already mentioned, gauge glasses must be mica protected on the side fac-ing the medium when used with steamat pressures over 35 bar or with mediawhich cause rapid wear of glass.

Mica is a naturally-occurring sub-stance. Only high-quality mica offers the desired gauge glass protection. Pu-rity-wise our micas meet the require-ments of ISO 2185: “ stained first qual-ity” up to 70 b ar and “ stained A quality” abo ve 70 bar. Minimum light transmitta ncy is 1200 lux and it guaran-tees o ptimum readability o f the liquid. level. LUMIGLAS mica shields are individually packed to protect them again stscratching. An exact, multilanguage installation and maintenance leaflet is contained in each package.

Problems of glass wear
Gauge glasses in liquid level gauges on steam boilers are exposed to very high mechanical and chemical stresses. The interface between steam and water is

Above all, the condensate running down the gauge glasses leave straces of abrasion.

Boiler water is always chemically reated water from which mineral substances have been extracted.The demineralised water tends, however, to increase its mineral content and extractsthis from glass. This chemical attack onthe glass is largely determined by pressure, temperature and pH-value of the boiler water.

With unprotected gauge glasses, steam pressures should not exceed 35 bar norshould it exeed the pH-value of 10, if an economic service life is required.This limiting pH-value applies for feed-water at about 20°C. It should be noted that the pH-value decreases with in-creasing temperature 1.5 pH degrees at a temperature rise up to 300 °C.

Areas ofapplication:

- Observation of processes in industrial ovens, driers, filters, strainers, agitators and mixers.
- Observation of vessels such astanks, boilers, silos ...
- Supervision of transportation of materials, e. g. in the solid state or liquids such as condensate or cooling fluid.
- Indication of liquid level e. g. of oil level in large gear boxes or of the medium level in impregnation or pouring plants, high capacity transformers, washing plants ...

LUMIGLAS®

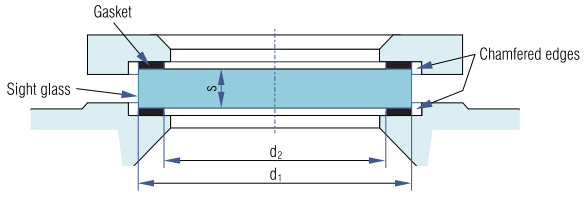
Circular sight glasses
made from borosilicate glass “ extra-hard ”

From our standard range

Glass		Permiss. PB**) bar	Gasket		
Diameter mm	Thickness mm		O.D. mm	I.D. mm	Thickness mm
31,75	12,7	175	*)	*)	*)
40	12	50	42	30	1,5
45	10	40	47	32	1,5
45	12	50	47	32	1,5
50	10	25	52	35	1,5
50	12	40	52	35	1,5
60	10	16	62	45	1,5
60	12	25	62	45	1,5
60	15	40	62	45	1,5
63	10	16	65	48	2
63	12	25	65	48	2
63	15	40	65	48	2
70	12	25	72	55	2
80	12	16	82	65	2
80	15	25	82	65	2
80	20	40	82	65	2
90	10	10	92	75	2
100	10	8	102	80	2
100	15	16	102	80	2
100	20	25	102	80	2
100	25	40	102	80	2
110	20	25	112	90	2
120	10	8	122	100	2
125	15	10	127	100	2
125	20	16	127	100	2
125	25	25	127	100	2
150	15	8	152	125	2
150	20	10	152	125	2
150	25	16	152	125	2
150	30	25	152	125	2
170	15	8	172	140	2
175	20	10	177	150	2
175	25	16	177	150	2
175	30	25	177	150	2
200	20	8	202	175	2

■ Dimensions not in DIN 7080 or OeNORMM7353
) Gasket set and micas for high-pressure steam gauges
*) PB=working pressure (gauge)

Calculation of the correct glass thickness



$$s = 0{,}55 \cdot d_m \sqrt{\frac{p \cdot S}{10 \cdot \sigma_{bB}}}$$

s: Theoretical minimum thickness in mm

d_m: $\frac{d_1 + d_2}{2}$ Mean diameter of gasket

d1: O..D. of glasses and gasket

d2: I..D. of gasket

p: Max. permissible working pressure (gauge) in bar

σ_{bB}: Minimum bending strength in N/mm²

S: Safety factor

Technical datas

Material:
Borosilicate glass, thermally prestressed, optically tested, properties aslaid down in DIN and OeNORM.
Extract from the OeNORM: “ Chemical prestressing of glasses is not permissible. For safety reasons soda-lime glasses may not be used. ”

Resistance to bending strain:
≥ 160 N/mm²

Mean coefficient of linear expansion:
$\alpha_{20/300} \leq 4.5.10^{-6}.K^{-1}$, tested to DIN 52328.

Transition temperature:
t_g=550 °C, tested to DIN 52324.

Chemical resistance

Alkali resistance:
alkali class 2, tested to ISO 675.

Water resistance:
hydrolytic class 1, tested ISO 719.

Acid resistance:
acid class 1, tested to DIN 12116.

moulded – ground – polished – thermally prestressed

Temperatur resistance:
suitable for temperatures from – 273 °C to + 300°C, size 31.75/12.7 up to 356 °C

Allmeasurementsinmm

LUMIGLAS®

Fluid Control

Circular sight glasses

made from borosilicate glass “ extra-hard ”

LUMIGLAS Package unit:

Sight glasses are packed in individual cardboard boxes. In addition to the glass, each package contains a LUMIGLAS sealing gasket and cushion gasket and forms a complete unit ready for installation. Handy, shock proof package.

Standards

We manufacture reflex and transparent glasses in series acc. to the following standards: OeNOR M M7353 (Austrian Standard)DIN 7080 (German Standard) BS 3463 (British Standard Institution) .JIS 8211 (Japanese Industrial Standard)

At request we supply circular sight glasses in any desired dimension.

Dimensionals tolerances:

Glass ∅	DIN 7080 OeNORM M 7353	LUMIGLAS house standard
31,75 mm to 125 mm 150 to 200 mm	– ±.0,5 mm ±.0,8 mm	± 0,13 mm ± 0,5 mm ± 0,5 mm
Glass thickness		
12,7 mm 10 to 20 mm above 20 mm	– ±.0,5 mm ±.0,8 mm	± 0,05 mm ± 0,5 mm ± 0,5 mm

Lumiglas®

Ultra-low temperature glass /
Ultra-low temperature high-pressure glass

Lumistar Company specializes in the production of ultra-low temperature glass viewports. The basic mystery of ultra-low temperature glass resisting ultra-low temperatures that the glass has a very low expansion coefficient. A large amount of rare earth metal elements such as alumina, zirconia, yttria, and ytia are added to the chemical composition of the glass, forming high mechanical strength and compression resistance, while also having good optical transmittance. The products are widely used petrochemical projects such as Zhongmei Hulunbuir, Jinxin Chemical, China Petroleum , CNOOC, Sinopec, coal chemical, deep-sea exploration equipment, university laboratories, ultra-high pressure extraction devices, etc.

The ultra-high pressure glass grades produced by Lumistar Company are:

LMX8603, LMX5016, LMX205, LMX9901 four series of ultra-low temperature high pressure glass grades.
LMX8603, it is recommended to use the environment of -100°C.
LMX5016, it is recommended to use in the environment of -150.
LMX205, it is recommended to use in the environment of -196.
LMX9901, it is recommended to use in the of -273°C.

Lumiglas®

The engineers of Lumistar Technology have developed a set of high-precision calculation formulas that can accurately calculate the thickness of glass and the temperature of temper, thus accurately controlling the pressure resistance of glass, and can customize the required ultra-low temperature high-pressure glass view mirror specifications according to customer needs.

Ultra-low temperature high-pressure resistant glass view mirror

Name: Ultra-low temperature high-pressure resistant glass view mirror
Material: CDW273
Executive standard: QB-LMX-CDW "-low temperature glass" DIN7080-2005 unrestricted low temperature borosilicate
Round glass view mirror

Density (@ 18 ° C)	3.42g/cm^3
Hardness	8.0Mohs'
Modulus of elasticity (Young's)	11450 N/mm^2
Bending strength	420-460 Mpa
Poisson's ratio	0.28
Coefficient of linear expansion(20-350℃)	40~63x10^{-6}cm/cm.℃
Index of refraction (@ 380 -780 nm)	1.672
Melting point	1670℃
Softening point	950℃
Thermal shock temperature	300℃
Low temperature performance	-273℃—— +600℃
Impact resistance	≥10J
Experimental pressure	≥1.0-70.0Mpa
Water resistance	IS0719 HGB 1级
Acid resistance	IS01776 HGB A1级
Alkali resistance	IS0695 class A1级

Lumiglas®

Ultra-high pressure sapphire glass;
Ultra-high pressure sapphire glass tube

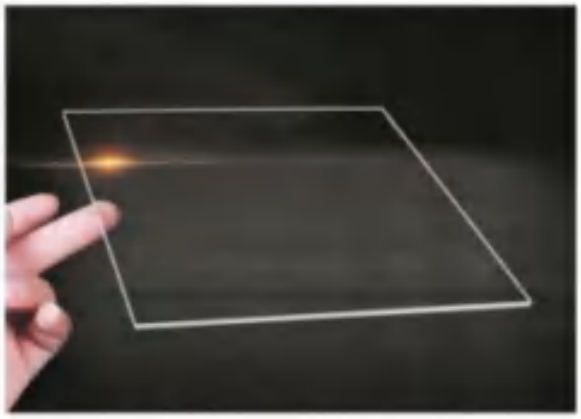
Lumistar specializes in the production of sapphire glass and high pressure sapphire glass tubes.

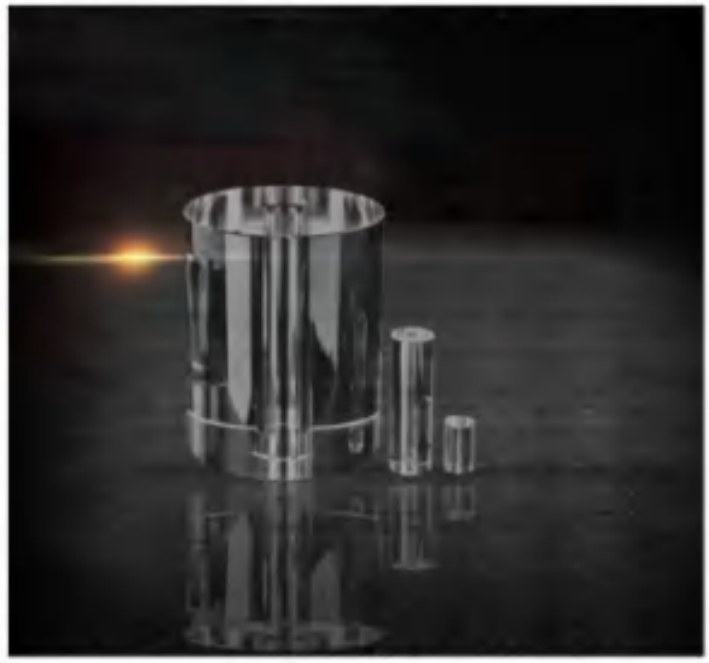
Sapphire has excellent optical properties, capable of transmitting deep ultraviolet, visible light, near infrared, and mid-wave infrared light from 0.18 to 5.5um.

Sapphire has outstanding mechanical strength, with a flexural strength of up to 850MPa, making the preferred material for high-temperature and high-pressure glass view windows. Lumistar can calculate various pressure strengths under different temperature curves for users.

Lumistar can design and manufacture all kinds of high temperature and high pressure sapphire glass windows, sapphire glass tubes, pressure resistance to meet the pressure requirements of high vacuum to ultra-high pressure $1E^{-13}$ to 150MPa, and can also be coated with waterproof film, oilproof film, AR anti-reflection film and so on according to the needs of users.

Maximum specifications available: diameter 400mm.





Ultra-high pressure sapphire glass tube

Lumiglas®

Sapphire performance

General performance	Chemical Formula	Al_2O_3
	Crystal System	Trigonal
	Class	Hexagonal-scalenohedral
	Melting Temperature	2050°C
Thermal performance	Thermal Expansion	Parallel to C-axis: $6.7x10^{-6}$
		Perpendicular to C-axis: $5.0X\ 10^{-6}$
	Specific Heat	0.18 Cal/gm°K(25°C)
Mechanical properties	Density	3.99-4.10g/cm^3
	Hardness	9 Moh's Scale
		(Hv)≥1700kg/mm^2
	Modulus Of Elasticity	340-380Gpa
	Compressive Strength	2.1Gpa
	Tensile Strength	0.19Gpa
Optical performance	Index of Refraction	Parallel to C-axis: 1.769
		Perpendicular to C-axis:1.76
	Index of IR Transmission	3-5.5um≥90% (coated with anti-reflective film)
Electrical performance	Electrical Resistance	10^{11} /cm
		10^6 /cm
		10^3 /cm
	Dieleetrie Constant	7.5-10
Chemical performance	Corrosion Resistance	Can not be corroded by acid or alkaliat normal temperature, only can becorroded by HF at 300°C

Lumiglas®

High pressure glass burst disk for oil well cementing

Executive standard: Q/LMX5817 "High pressure glass burst disc"

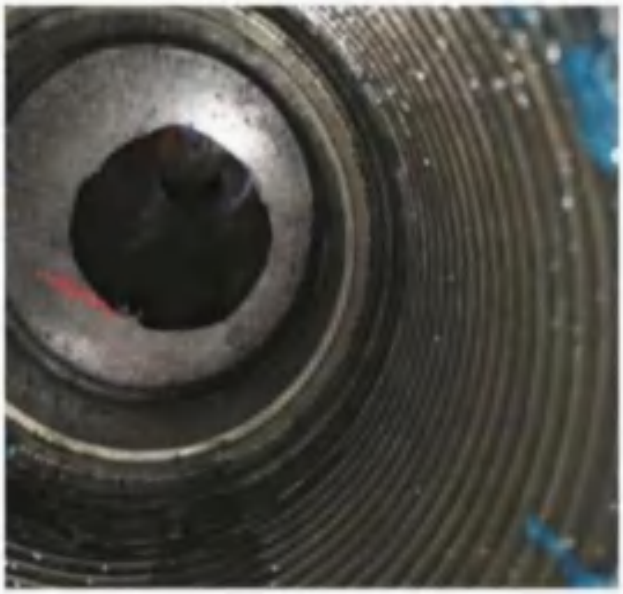
Material: LMX35
Bursting bending strength: 530-610 MPa
Softening point: 975 ℃
Density: 3.42 g/cm^3
Young's modulus: 11450 N/mm^2
Maximum service temperature: 500 ℃
Thermal shock: 300 ℃
Refractive index: 1.6720
Impact energy resistance:4--30 J
Expansion coefficient: 48--63*10^{-7}K/cm.C
Bursting bending strength: 680-720 MPa
Suitable for bursting pressure range: 50--120 MPa
Fragment size: ≤8*8 mm
Maximumcible diameter: ≤ φ250 mm
Standard sizes: D129 D142 D144 D145 D136 D153, D245, etc.
Non-standard sizes can be customized.
Main users: China National Petroleum Corporation, Sinopec, CNOOC companies, and manufacturers of oil well cementing tools.
Manufacturer: Lumistar Special Glass Technology Co., Ltd.

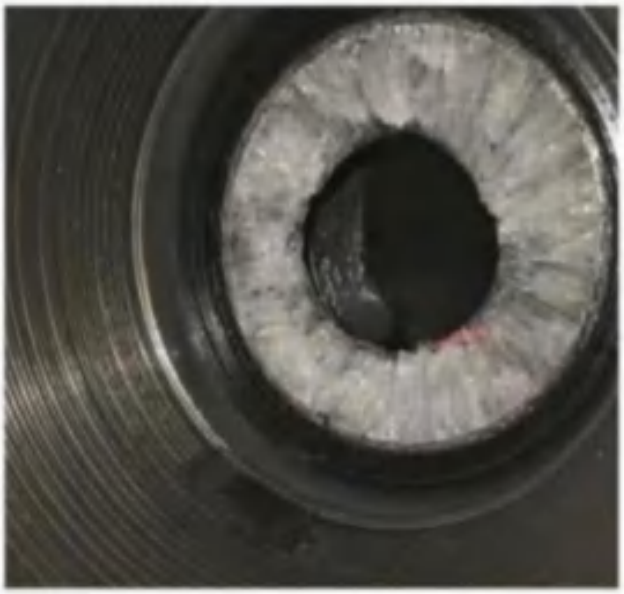
Lumiglas®

High pressure glass burst disk for oil well cementing

Executive standard: Q/LMX5817 "High pressure glass burst disc"

Material: LMX56
Bursting bending strength: 430-500 MPa
Softening point: 915 ℃
Density: 2.62 g/cm^3
Young's modulus: 8450 N/mm^2
Maximum service temperature: 500 ℃
Thermal shock: 300 ℃
Refractive index: 1.5472
Impact energy resistance:4--20 J
Expansion coefficient: 45--48*10-7K/cm.C
Bursting bending strength: 430-500 MPa
Suitable for bursting pressure range: 15--70 MPa
Fragment size: ≤5*5 mm
Maximumcible diameter: ≤ φ250 mm
Standard sizes: D129 D142 D144 D145 D136 D153, D245, etc.
Non-standard sizes can be customized.
Main users: China National Petroleum Corporation, Sinopec, CNOOC companies, and manufacturers of oil well cementing tools.
Manufacturer: Lumistar Special Glass Technology Co., Ltd.





Lumiglas®

Pipeline view mirror acid and alkali resistant fluorine polymer protective film

Product features:

Heat Resistance:
PFA can be used continuously at temperatures up to 260℃

High Elongation:
Excellent elongation at high temperature, greatly reducing the rate of film breakage in the composite process of hot forming.

Chemical Resistance:
It is stable to almost all chemical reagents and solvents. It also has low permeability to liquids, gases, moisture and organic vapors

Cementable surface:
The treated film surface can be hot-pressed with a variety of substrates to achieve very good bonding effect.

Product features:

Project	Unit	Numerical	Test method
Thickness	μm	12.5-500	
Wide format	mm	50-1200	
specific gravity		2.12-2.17	ASTM D1505
Melting point	℃	300-310	DSC
Continuous use temperature	℃	260	
Tensile strength (MD/TD)	Mpa	>20	ASTM D882
Elongation at break (MD/TD)	%	>200	ASTM D882
Oxygen index	Vol%	>95	ASTM D2863
Dyeing value	Dyn	>40	
Transparency	%	≥90	

Pipeline viewports, pressure vessel viewports, medium and low pressure level gauges , etc., in the working conditions containing hydrofluoric acid potassium hydroxide, sodium hydroxide and other media, all silicate glass viewports will be seriously corroded. The leakage, fire and explosion caused by corrosion of glass viewports are common.

Lumistar engineers have developed high-performance acid and alkali resistant fluorine-based polymer protective films for users in such harsh working. It is perfectly applied in the medium environment containing hydrofluoric acid fluorine ions, potassium and sodium alkaline ions, which seriously corrode glass below 25 ℃. High transparency, long life, antiscouring.

Protective film thickness: 0.25mm, customized according to the specifications of the's glass viewport.

Lumiglas®

High temperature resistant explosion-proof glass、Ultra-high temperature quartz glass

Casting plant; steel plant; aluminum plant special
anti-iron water splash high temperature explosion-proof glass

1. Mechanical strength:

1.1 Density: 2.6 g/cm^3
1.2 Elastic modulus: 93*103pa
1.3 Bending strength: 35 Mpa

2. Thermal performance:

2.1 Average linear thermal expansion coefficient: a(20-700℃) = (0 ± 0.5) * 10-6/k
2.2 Temperature difference performance of the same piece (RTD) ≤ 760℃
2.3 Thermal shock resistance performance: Tes max ≤ 760℃ no rupture occurred

3. Using unit:

Nanjing Iron and Steel, Maanshan Iron and Steel, Shanghai Baosteel, Tonghua Iron and Steel, Jianlong Iron and Steel Ganglu Iron and Steel and many other iron and steel plants prevent the splash of molten iron from exploding.

4、Chemical performanceechanical strength:

4.1 Alkali resistance DIN12116 HGB1
4.2 Alkali resistance DINISO719 HGB2

5. Scope of application:

Iron and steel mills, aluminum mills, and foundries are protected from molten iron splashes, observation window in the central control room.

6. Machinable shape:

Steel plant, aluminum plant, casting plant to prevent molten iron splash, central control room observation window.

7. Material:

Quartz glass resistant to ultra-high temperatures (transparent light brown).

8. Maximum size:

2100*1220, 1954*1100, basic thickness 4mm, 5mm

9. Operating temperature:

850℃、1000℃、1350℃

Lumiglas®

Pressure vessel mirror glass JSB8286 ("Pressure vessel observation mirror")

Executive standard:

GB/T23259-2009 "Pressure Vessel Viewing Glass"
HG/T4284-2011 "Borosilicate Glass Viewing Window for Pressure Piping"
HG/T4285-2011 "Round Sodium Calcium Glass Viewing Window for Pressure Vels"

Heat resistance temperature: Borosilicate material: -120°C~ 280°C;
Soda lime glass material: -40°C~ 150°C;
Bending strength: 160Mpa;
Thermal shock: Borosilicate 250°C, Soda 150°C;
Transmittance: Borosilicate >85-92%, Soda lime: 80-89%;
Water resistance: Grade 1;
Acid resistance: Grade A1;
Alkali resistance: Grade A2;
Pressure resistance performance: Borosilicate glass 0.6~4.0Mpa,
Soda lime glass 0.6~4.0Mpa.

Executive standard:

Diameter > 150mm, pressure > 2.5Mpa, it is recommended to use high-pressure aluminum silicate glass, if there is an ionic medium, it is necessary to coat PTFE. If there are alkaline ions or the temperature exceeds 280°C, is necessary to add mica protection or use the company's produced alkali-resistant zirconia-yttria aluminum silicate glass, also known as mica.

Mirror glass size specifications and working pressure						
Mirror glass diameter d/mm	Mirror glass diameter d/mm	Maximum allowable working pressure/Mpa				
		0.6	1.0	1.6	2.5	4.0
		Mirror thickness s/mm				
65	50	-	-	10	12	15
80	65	-	-	12	15	20
100	80	-	-	15	20	25
125	100	-	15	20	25	
150	125	-	20	25	30	
175	150	-	20	25	30	
200	175	-	25	30		
225	200	25	30			
250	225	25	30			

GB/T23259-2009 "Pressure Vessel Viewing Glass"

Lumiglas®

Ultra-high pressure aluminosilicate glass

Aluminum silicate glass is a kind of alkali-free pressure-resistant glass. The glass mirror cast by alkali-free aluminum silicate glass excellent high-pressure resistance performance, which is a special glass for various boilers, high-pressure reactors, petrochemical and submarines. It has good chemical stability, electrical insulation flexural strength, and high-pressure resistance. Its flexural strength is 2-3 times that of borosilicate glass. Our company is a highly specialized of aluminum silicate glass in China! Aluminum silicate glass is composed of RO-AI203-Si02, where RO represents divalent metal ox such as magnesium oxide, calcium oxide, barium oxide, and zinc oxide. Since the components do not contain alkali metal ions, it is named alkali-free silicate glass.

Product performance index:

Bending strength: 260~300 Mpa
Coefficient of thermal expansion: 42~46*10^{-7}/C
Product density: 2.62 g/cm^3
Softening temperature: >920℃
Service temperature: ≤375℃
Thermal shock temperature: ≤300℃
Minimum service temperature: -196℃
Maximum service temperature: 500℃
Glass temperature Tg(℃): 715
Sagging temperature TS(℃): 791
Young's modulus E(10^7Pa): 8450
Poisson's ratio μ: 0.24
Transparency: 400~2500nm≥90%(5mm)
Refractive index: 1.5472
Explosion-proof performance:
10mm≥10J, 15mm≥20J, 20mm≥40J.
Pressure resistance performance: 1.0-70.0 Mpa
Executive standard: JC/T891-2016

Common thickness:
12.7mm, 16mm, 17mm, 19mm, 21mm
(various non-standard thicknesses can be customized)

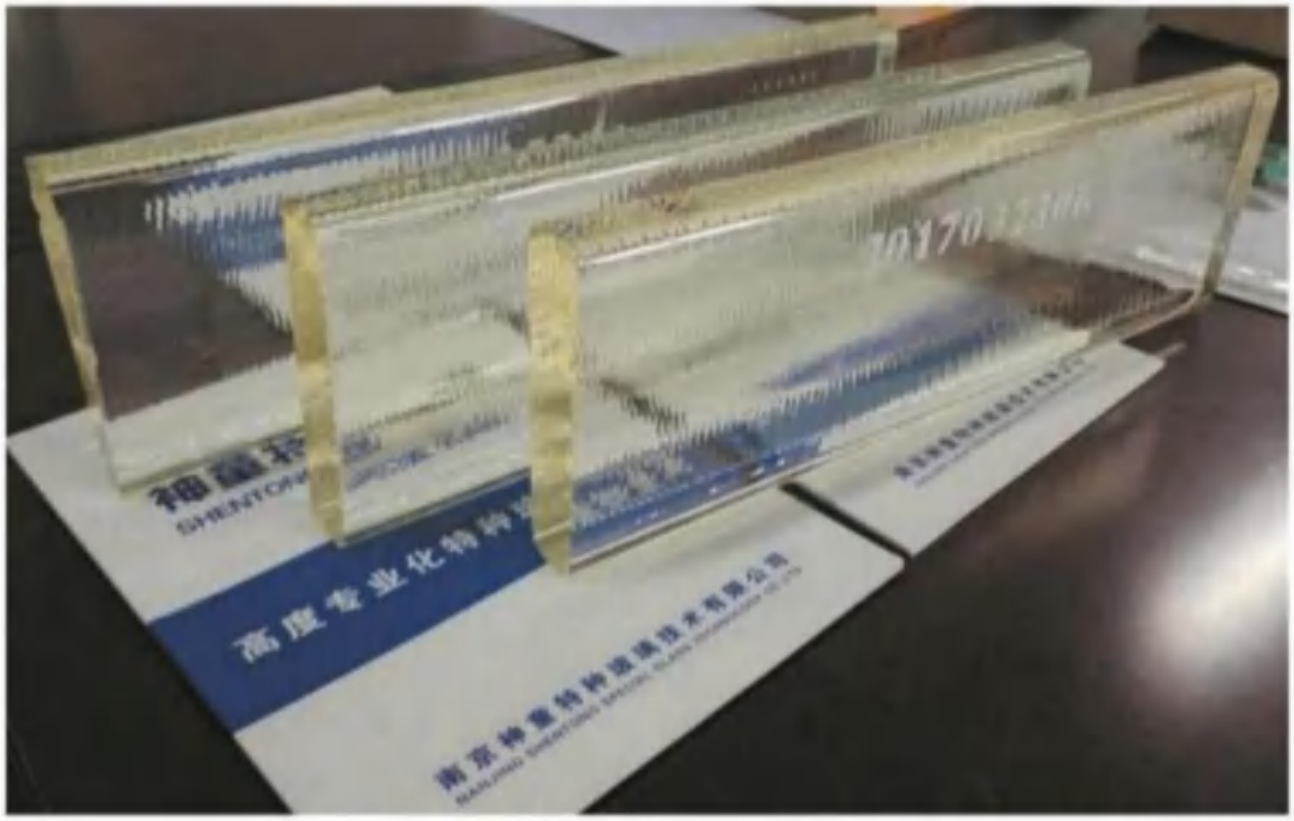
Common size:
80*24*17 80*4*21 108*24*17 108*24*21 118*24*21 130*24*21 130*26*19
115*34*17 130*4*17 140*34*17 160*34*17 165*34*17 190*34*17 218*34*17
220*34*17 250*34*17 280*34*17 320*34*17 340*34*7 370*34*17 400*34*17
Other non-standard sizes are produced according to customer requirements

Lumiglas®

Super high pressure alkali-resistant mica glass (garnet-yttrium-lanthanum-aluminum-silicate glass)

For a long time, the glass sight window of pressure vessels and boiler steam drums has been a safety hazard and technical problem for users manufacturers of high-pressure level gauges due to its lack of resistance to alkaline corrosion. The using unit can only protect the glass from alkaline ion corrosion by adding mica pad in front of the glass sight window. The clarity of the glass with mica pads is seriously reduced, and both scientific researchers and users are eager to a technical glass that can withstand high temperature and pressure and resist alkaline ion corrosion without the need for mica protection.

The price of natural mica sheets, which mainly produced in India, has shown an upward trend year by year. Mica mines are non-renewable, and long-term disorderly mining has led to a decline in mica quality. Affected by international politics and economy, it has brought considerable economic pressure and technical difficulties to the using units such as petrochemical and plants. At present, international companies such as Japan's BBK and NBK have successively developed alkali-resistant glass that can replace mica protection and can be for a long time under PH values of 10-14, and it does not accumulate dirt. Since it belongs to a high-tech product, the selling of Japanese companies is quite high, and they implement a ban on sales to Chinese companies. The development of high-end pressure vessel sight windows and high-pressure water level ga in China is seriously restricted.



Lumiglas®

Lumistar Special Glass Technology Co., Ltd. has invested a huge amount of funds, hired famous experts and scholars in the domesticicate industry, and cooperated with scientific research institutions to overcome technical problems. From the design of product for mulations, the selection of raw materials, melting processes, anne processes, cutting processes, grinding and polishing processes, and tempering processes, it has taken more than two years of scientific and technological research and development. From sample trial, pilot production, and mass production, it has lasted for two and a half years. Without any melting experience to refer to, it has overcome many difficulties and successfully out mass production in March 2017. After testing by the National Glass Fiber Quality Supervision and Inspection Center (Nanjing Glass Fiber Institute), the fully reaches the technical level of foreign similar products! In terms of ultra-high temperature tempering technology, Lumistar Company is even better than foreign similar products. At, the products have been mass-produced and supplied to large domestic in strument manufacturers such as Tieling Iron Light, Changchun Boiler Instrument Co., Ltd., Shanghai Xhen, Dandong Tongbo Group, Hubei Huaxing, Wuhan Hyde Long, National Nuclear Power Research Institute, Sen Song Pharmaceutical, Dongyang, Siemens, and Valmet Paper Machinery, and the users' feedback is very good.

Lumiglas®

The mystery of alkali-resistant glass is that the basic raw material for making glass, silica, is an acidic substance, which will undergo acid-base reaction when it encounters an alkaline solution.

Lumistar scientific researchers have significantly reduced the content of silica and added a large amount of rare earth alkaline oxides, including lanthanum oxide, yttrium oxide, aluminum oxide, zirconia and other refractory alkaline earth metal oxides. Through scientific, the technical indicators such as the material structure density, flexural strength, and hardness of the glass have been greatly improved. The Young's modulus has reached 1780*107Pa, the alkali corrosion rate ≤ 0.004mg/cm2, the flexural strength has reached 40~450Mpa, and the pressure resistance performance has also been improved by 2~3 times compared with high-pressure aluminum silicate glass, which meets various pressure vessel windows below 600℃ high temperature and high pressure alkali corrosion.

The alkali resistance performance and mechanical performance index of alkali-resistant m glass are compared with aluminum silicate glass and PYR EX7740 glass, which shows excellent technical advantages.

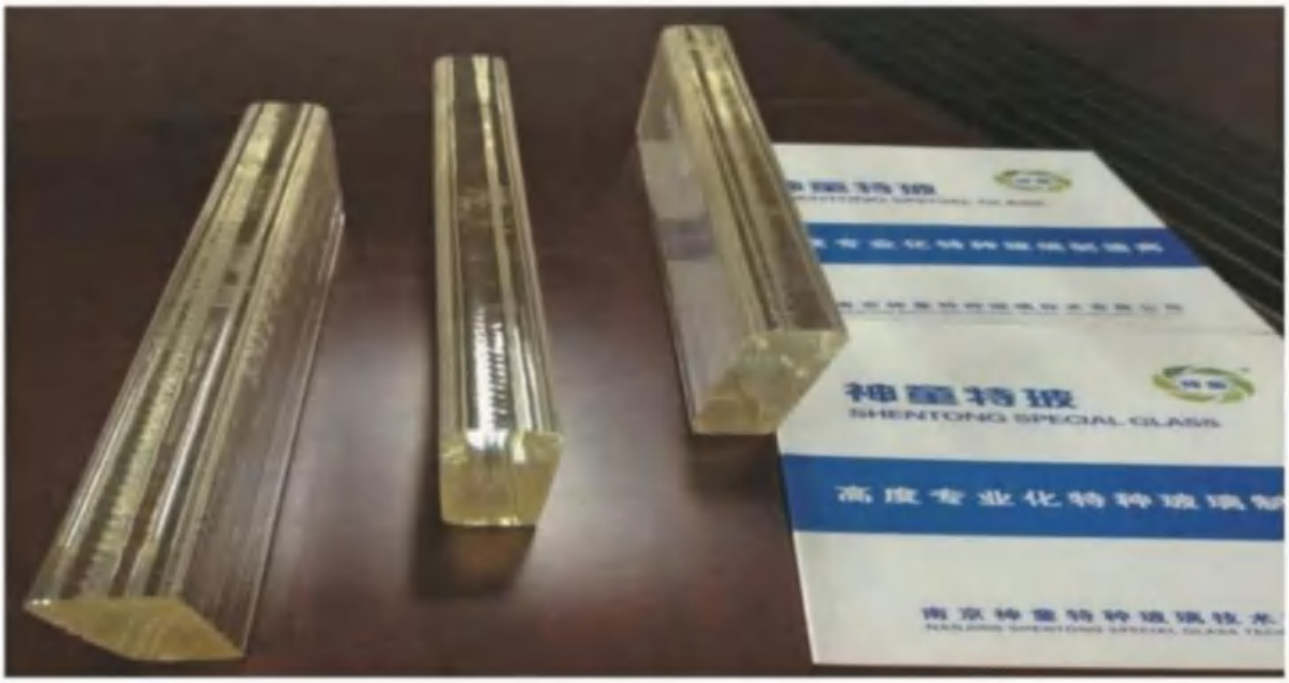
Lumiglas®

Comparison of corrosion performance data of mica and aluminum-silicate glass, borosilicate glass

	NO	1.Alkali resistant glass		2.Aiuminosilicate	3. PYERX7740 Borosilicate glass
		2nd generation	First generation		
Composition ratio	SiO_2	22.8	35	57	72
	Al_2O_3	19.0	19	16	5.0
	Y_2O_3	25.2	22.5	0	0
	La_2O_3	20.0	12.5	0	0
	TiO_2	6.4	1.94	0	0
	ZrO_2	6.6	3.5	0	0
	MgO	0	0	0	0
	BaO	0	0.93	0	0
	ZnO	0	1.23	0	0
	B_2O_3	0	0.93	5.0	14
	Sb_2O_3	0	0.95	0	0
	Other	0	0	23	9
Physical and chemical properties	specific gravity	3.92g/cm^3	3.42g/cm^3	2.62g/cm^3	2.23g/cm^3
	Alkaline corrosion amount	3.6mg/dm^2	6.7mg/dm^2	142mg/dm^2	174mg/dm^2
		0.20mm/Year	3.5mm/Year	21.7mm/Year	53.1mm/Year
	Mechanical strength	374-450 N/mm^2	370-450 N/mm^2	240-300N/mm^2	100-170N/mm^2
	Expansion coefficient	58*10^7/°C	63*10^7/°C	48*10^7/°C	33*10^7/°C

It can be seen from the above figure that the alkali resistance of the alkali-resistant mica glass is 800 times that of aluminum-silica glass and 1750 times that of the borosilicate glass, which has excellent performance.

The successful development of Lumixingali-resistant glass will save tens of millions of dollars in mica sheet purchase costs for domestic enterprises, especially for petrochemical and power plant users, and provide strong support and guarantee for the manufacturers of various high-pressure vessels and high-pressure water level gauges, which will alleviate the import economic pressure of various manufacturers and greatly enhance comprehensive competitive advantage of China's high-pressure power station equipment export !



Lumistar Special Glass Technology Co., Ltd., Nanjing Shentong Special Glass Technology Co., Ltd. through:

ISO9001: 2015 quality management system,
ISO14001-2004 environmental management system,
GJB9001C-017 military equipment quality management system,
EJ/T9001-2014 nuclear industry quality management system and other multi-system certifications.

Lumiglas®

The decrease in alkali resistance is 800 to 1750 times that of existing glass.

Looking AR features:

1.Alkali corrosion resistance
Comparing the alkali corrosion loss, it is about 800 times of aluminum silicate glass and about 750 times of silicate glass, which shows how good the alkali corrosionresistance is.
2.Mechanical strength
The flexural strength is 270N/mm² (27kgf/mm²), showing excellent mechanical strength compared to glass.
3.Heat resistance
The maximum use temperature is 500°C, showing excellent heat resistance compared to existing glass.

Looking AR applications and benefits:

●Advantages of using the observation type level gauge

(1) Since the alkaline corrosion is very small at 0.020/year, the level gauge does not require a mica plate, greatly reducing the leakage caused by the mica plate.
(2) Therefore, there is almost no to replace consumables such as mica, glass, and gas gaskets and related maintenance, resulting in a significant reduction in costs.
(3) In addition, by the mica plate, it is also possible to remove the dirt caused by the peeling of the mica plate, thus achieving clear water surface monitoring.
(4) In addition, even after regular inspection, Looking-AR can be reused. (Please check for scratches, dirt, corrosion, and transparency to ensure perfect condition

●Advantages of using a reflective water level gauge for a reflective boiler:

At present, reflective water level gauges are used for boilers with a pressure 2.5 MPa or less.
Since the reflective type does not use a mica plate due to the characteristics of the glass shape, the glass is replaced discarded when it is corroded and leaks.
Therefore, by using Looking-AR, the frequency of glass replacement and maintenance is significantly reduced (no maintenance is required for least 1 to 2 years before inspection), and the cost can also be significantly reduced.

*Looking-AR is a glass developed to improve alkali resistance, and it is slightly inferior to traditional glass in acid resistance, so please avoid long use with acidic liquids.

Looking AR types (shape and size):

●Boiler water level gauge and chemical (alkaline wave) level gauge glass.

Type (shape)	Our D defect product number (size)	Size (unit/mm)			Bias in inspection
		l	w	t	
Flat reflective flat transmissive	No. 10 *	400	34	17	Order production
	No. 9	340	34	17	
	No. 8	320	34	17	
	No. S7 *	300	34	17	Order production
	No. 7	280	34	17	
	No. 6	250	34	17	
	No. 5	220	34	17	
	No. S4 *	200	34	17	Order production
	No. 4 *	190	34	17	Order production
	No. 3 *	165	34	17	Order production

●Sodium silicate glass (for alkaline liquids).

Type (shape)	Size (unit/mm)		Bias in inspection
	d	t	
Circular perspective	φ20~φ80	10~25	The size that this can do can also be explained. Please be careful.

note：
(1) For orders from Looking-AR, please check with the manufacturer for stock status and delivery forecast.
(2) Regarding the order, please provide the conditions of use (pressure, temperature, fluid name, etc.).

Lumiglas®

A revolutionary glass that is 100% ARl resistant

In general, glass has excellent durability to chemicals, but very weak properties to high-temperature steam, hot water, and alkaline solutions.

Therefore, when glass is used in a direct-view level gauge (water level gauge), a durable transparent fluororesin sheet or mica plate is installed on the contact surface to prevent glass corrosion.

However, this method comes with the added burden of having to replace the fluororesin board or mica plate after a certain period of time.

A new type of glass that performs well in terms of strength and heat resistance and is not subject to alkali corrosion.

●Mechanical properties of R-king AR

Type of glass / Compare items	Look for AR	Aluminosilicate	Low expansion borosilicate (heat-resistant glass)	borate
Specific gravity	3.50	2.58	2.23	2.31
Coefficient of thermal expansion x10^{-7}/℃	50.0	38.0	32.5	45.0
Refractive index	1.672	1.532	1.474	1.484
Poisson's ratio	0.28	0.16	0.20	0.23
Torque x10*N/mm^2 (x10*kgt/mm^2)	11.15（11.15）	7.54（7.54）	6.68（6.68）	7.54（7.54）
Flexural strength N/mm^2(kgt/mm^2)	270（27）	200（20）	120（12）	150（15）
Maximum operating temperature ℃	500	400	300	250
Measurement of heat resistance deg	220	220	220	190
Mohs hardness kgt/cm^2	685	657	418	375
Distortion points ℃	733	625	515	485

●Chemical properties of Lu-King-AR (alkali resistance/comparison with other glasses)

Glass	Corrosion Quantity (Alkali Resistance)		
Looking AR	0.004 mg/cm^2	(Calculated value) 0.020mm/Year	According to the acid number of our company
Aluminosilicate	3.2 mg/cm^2	(Calculated value) 21.7mm/Year	According to the manufacturer's data
Low expansion borosilicate glass (Birex)	7.0 mg/cm^2	(Calculated value) 53.1mm/Year	JIS BB2110 has a specification value of less than 7.0 mg/cm^2
Borate	7.0 mg/cm^2	(Calculated value) 53.1mm/Year	

【Testconditions】

Liquid NaOH300mg/8.50kgf/cm, 262°Cx5hours (Corrosion resistance test using Oitokureep of J1SB8211)

* The values of Rooking-AR in the table are test values and are not necessarily guaranteed values for user use.

Lumiglas®

Lumiglas®

V-tank high-pressure level gauge glass

High-pressure aluminum-silicon

High-pressure aluminum-silicon

High-pressure aluminum-silicon

Multi-system certification

Strict quality control

Stay safe

V-tank high-pressure level gauge glass

Mica-free

Ultra-high temperature tempering

Alkali and acid resistant

Lumiglas®

Alkali-resistant glass is mainly composed of Si-A1-La-Y-Zr and other alkali metal oxides through scientific proportioning, of which the content of K20+Na20 is ≤ 0.08%, which belongs to the rare earth zirconium, yttrium, lanthanum, alkali-free aluminosilicate glass system has excellent physical and chemical properties such as high temperature resistance, high pressure resistance, acid and alkali resistance after high temperature tempering treatment, and is an excellent window material for various high-pressure glass windows. It is mainly used in the glass window of the high-pressure water level gauge on various high-temperature and high-pressure steam packs in power plants, petrochemicals, nuclear power plants, deep-sea exploration equipment, etc.

Physical properties:

1. Softening point: 1050°C
2. Expansion coefficient (0--300°C): 48--63*10-6K
3. Density: 3.93g/cm^3
4. Annealing point: 850°C
5. Maximum operating temperature: 600°C
6. Flex index (refractive index): 1.670
7. Bending strength: 370~450Mpa
8. Acid resistance: A1 grade, alkali resistance, A1 grade
9. Alkali corrosion resistance: ≤0.004mg/cm^2
10. Pressure resistance: level gauge: 25-40Mpa

Sight glass:

1.0-200Mpa ultra-high pressure sight mirror can be manufactured according to user needs.

Main uses:

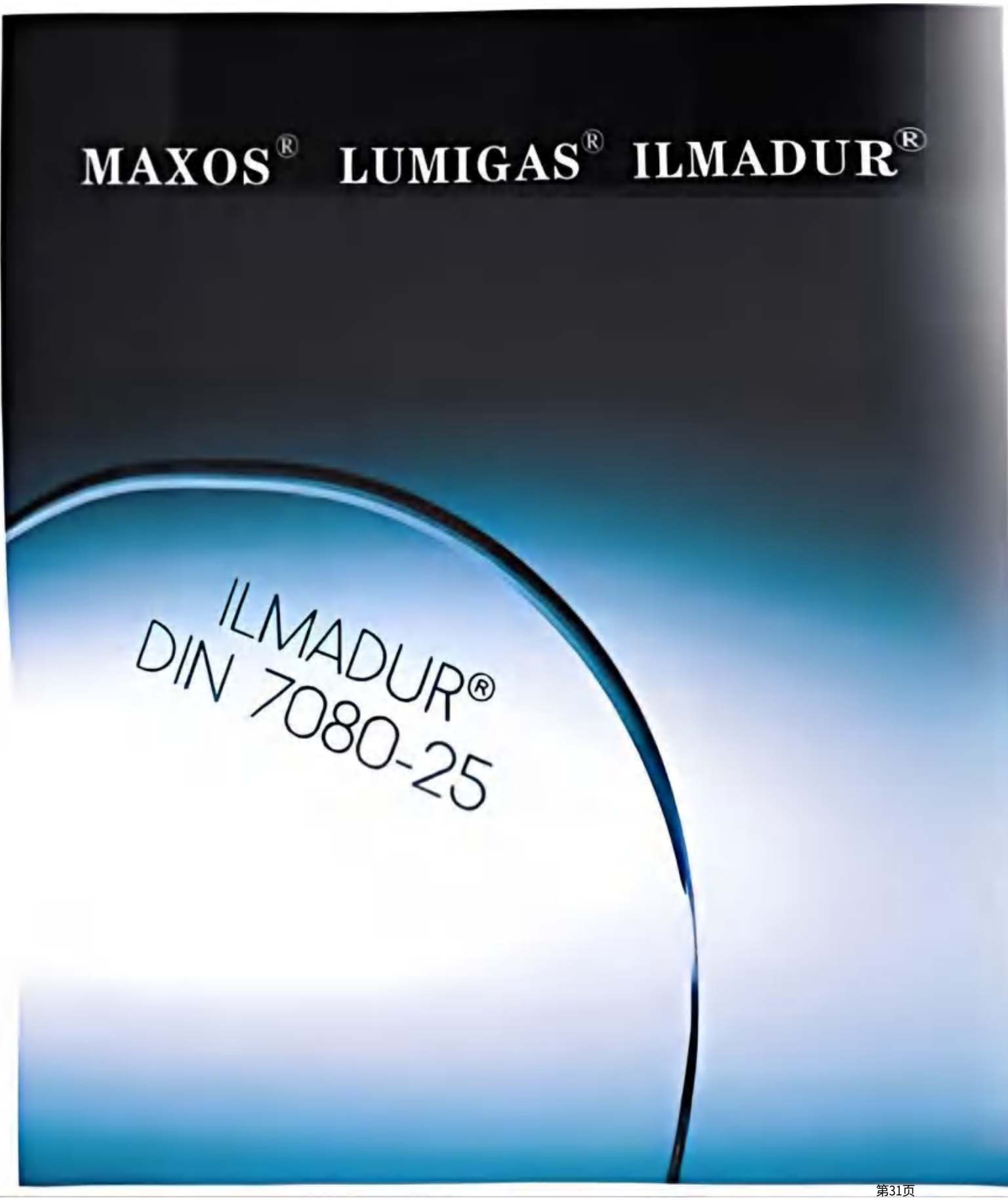
Alkali resistance, high temperature resistance, high pressure resistance, petrochemical pipeline sight glass, high-pressure steam drum water level gauge window, high-pressure liquid level gauge window, high-pressure window.

Supporting accessories:

Graphite pads, protective belts.

Lumiglas®

DIN7080/7081 glass mirror



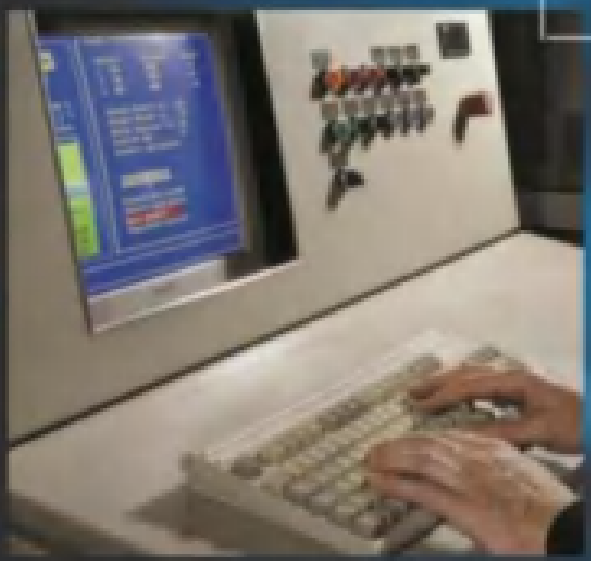
Lumiglas®

ILMADUR® sight and gauge glasses for your application: best proc esses for best quality

Leading technology right from the beginning: our I-420 borosilicate glass is produced from strictly controlled raw materials that pass through a high-tech melting process in one of Europe's most modern melting tanks. The result is a glass with high thermal stability, excellent transparency and extreme resistance to chemicals.

The modern rotary table press gives our sight glasses their shapes.

Nothing escapes the watchful eyes of our specialists. They check every individual glass after every stage of the production.



Our sight glasses are subjected to a very special thermal treatment so that they can withstand the stresses they will later be exposed to in use. In the toughening facility, their normal tensile bending strength is increased by a factor of 2 at least. Custom software controls the

Sight glasses viewed in polarised light: The sequence of colours in the visual inspection shows that the desired compressive prestress has been reached.

Lumiglas®

In order to achieve the high final quality we demand, high parallelism and flatness with minimum surface roughness are an absolute "must".
To achieve this, the blanks are ground twice between the diamond pellets of our automatic twin-disc grinding and lapping machines before they are carefully polished.

Trained staff carry out another visual inspection. The surfaces must be perfect, the dimensions exact. Every scratch, every inaccuracy could put the strength and hence the safety of the product at risk. We therefore measure the surface roughness constantly and check dimensions and tolerances.

Loading test:
Sight glasses from every toughening batch are tested in the very latest testing apparatus.

Before they are carefully and safely packaged, every TGI sight glass is printed with its own code so that we can trace its history in our database –

Lumiglas®

ILMADUR® sight and gauge glasses made from 1-420 borosilicate glass

We developed and patented the specia! “ 1-420 ” glass sothat we would have a material ideally suited to producin particularly high-quality sight glasses, Our “ 1-420 ” glass combines the best properties that good sight ghasses need: freedom from bubbies and cords toguarantee high optical quality and thus a good view even in the case of thicker safety glass, This glass is extremely resistant, making it ideal for tough industrial applications involving boilerwatereve n with ph-values greater than 10 and chemical substances like acids or alkalis, And the specifie thermal toughening in conjunction with the inherent high thermal shock resistance means that our ILMADUR° sight glasses are especially safe, especially durable.

We offer a comprehensive range of top-qunlity sight glasses manufactured from this material: round sight glasses to DIN7080 and gauge glasses to DiN 7081 plus custom sight glasses to meet your individual specifications, Full details of ourrange of produets can bfound on the following pages.

Incidentally, we also manufacture other technologically exacting products from this special glass, e.g. lenses, reflectors and diffusers for further processing and applications in lighting engineering.

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ILMADUR® sight and gauge glasses made from 1-420 borosilicate glass

Chemical composition:

77%	by wt.	SiO_2
11%	by wt.	B_2O_3
5%	by wt.	NaO
4%	by wt.	ALO_3
1%	by wt.	K_2O
1%	by wt.	ZrO_2

Chemical properties:

●Water resistance
tested to DIN ISO 719 (at 98 °C):
HGB 1 with a typical consumption of 0.03 ml hydrochloric acid [c(HCl)=0.01 mo/l] per one gram glass grit

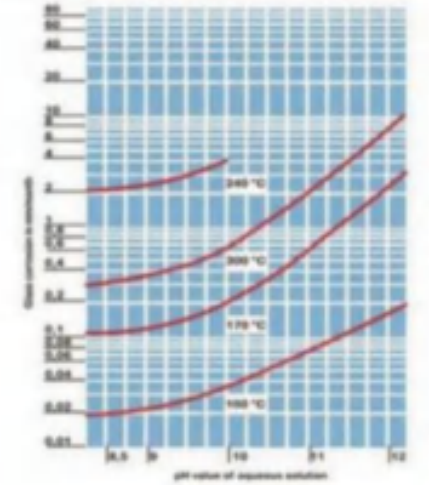
●Water resistance
tested to DIN ISO 720 (at 121 °C):
HGB 1 with a typical consumption of 0.03 ml hydrochloric acid [c(HCl)=0.01 mo/l] per one gram glass grit

●Alkali resistance
tested to DIN ISO 695:
class A2 with a typical mass loss of 100 mg/dm²

●Acid resistance
tested to DIN 12 116:
class S1

●Acid resistance
tested to DIN ISO 1776 with a typical alkali delivery of 50 µg Na_2O/dm^2

●Glass corrosion by boiler water



The glass corrosion, in this case for unprotected sight glasses, essentially depends on the pH value and the temperafure of the boiler water.

Physical properties:

●Mean linear thermal expansion:
$\alpha(20°C...300°C)=4.2\pm0.1x10^{-6}K^{-1}$

●Density at 20°C: $\rho=2.28g/cm^3$

●Mean thermal conductivity (20°C...300°C)$\lambda=1.4\ Wm^{-1}K^{-1}$

●Working point:
V_{f1} =1225°C at a viscosity of η_{f1} =10^4 dPa·s

●Littleton/Softening point:
V_{f2} =810°C at a viscosity of η_{f2} =$10^{7.6}$ dPa·s

●Annealing point:
V_{f3} =580°C at a viscosity of η_{f3} =10^{13} dPa·s

●Annealing point:
V_{f4} =520°C at a viscosity of η_{f4} =$10^{14.7}$ dPa·s

●Transformation temperature:
t =560°C

●Max. permissible service temperature:
500°C for the material (280 °C for toughened sight glasses)

●Modulus ofelasticity:
E=66 GPa

●Poisson number:
µ= 0.20 · 10^3 N/mm²

Electrical properties:

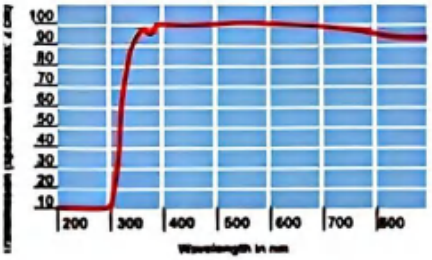
●Volume resistivity
at 25°C=6.6 x 10^{13} Ω cm
at 300°C=1.4 x 10^6 Ω cm

●Dielectric propertiesat 25°C and 1 MHz:
Dicleetric constant ε_f = 4.6
Loss factor tan δ = 1.4 x10^{-2}

Optical properties:

●Volume resistivity
λ = 587.6 nm n_D = 1.4816
λ = 480.0 nm n_F = 1.4869
λ = 546.0 nm n_E = 1.4831
λ = 644.0 nm n_c = 1.4802

Transmission curve



Where properties and compositions are specified without tolerances, they represent rounded long-temm mean values that are subject tominimal fuctuations due to the manufacturing process.

Lumiglas®

ILMADUR® round sight glasses to DIN 7080

Our range of products embraces allthe sizes in DIN 7080 and a few morethat are requested by customers. If you cannot find the size you need in the table on the right, simply contactus. We can make just about anything possible!

Mechanical properties

- Tensile bending strength: ≥ 160 N/mm²
- Compressive prestress: ≥ 100 N/mm²

The thermal toughening increases thetensile bending strength by a factor of 2.5 at least. That guarantees the levelof safety demanded of sight glasses according to DIN 7080.

Thermal properties andservice conditions conditionsooervice

- Max. service temperature: 300 °C Where the operating temperature exceeds 280 °C a permanent drop in the prestress is to be expected unless suitable measures are taken. The actual maximum permissible load on a sight glass always depends on the specific service conditions in situ (pressure,temperature, nature of medium, type of apparatus).
- Thermal shock resistance: ∆ T min. 265 K

Finishes

- Surfaces: polished
- Lateral Surfaces: plain moulded or ground (for manufactoring reasons beveled 1,5°)
- Edges: beveled

Dimensional tolerances to DIN 7080

- Diameter (d_1):

$d_1 \leq 125$ mm	±0.5mm
$125\text{mm} \leq d_1 \leq 200\text{mm}$	±0.8mm
$d_1 > 200$ mm	±1.0mm

- Thickness (s):

$s \leq 20$ mm	+0.5mm/-0.25mm
$s > 20$ mm	+0.8mm/-0.40mm

- Flatness (e):

$d_1 \leq 100$ mm	0.05mm
$100\text{mm} \leq d_1 \leq 150\text{mm}$	0.08mm
$150\text{mm} \leq d_1 \leq 200\text{mm}$	0.12mm
$d_1 > 200$ mm	0.15mm

- Parallelism (p):

$d_1 \leq 100$ mm	0.20mm
$100\text{mm} < d_1 \leq 200\text{mm}$	0.25mm
$d_1 > 200$ mm	0.30mm

Calculation of glass thickness

We calculate the glass thickness to DIN7080, even for the sizes in our range notineluded in the DIN standard.
The Timoshenko equation serves as abasis for this:

$$s \geq c \cdot d_m \sqrt{\frac{\rho \cdot S}{10 \cdot \sigma}}$$

s = glass thickness in mm

$$dm = \frac{d_1 + d_2}{2} \text{ in mm}$$

ρ = maximum permissible operating pressure in bar

S = factor of safety = 5

σ = minimum value of compressive prestress in N/mm²

c = correction factor = 0.55

Lumiglas®

ILMADUR® round sight glasses to DIN 7080

RANGE OF PRODUCTS

Dimensions d_1 x s mm	Inner diameter gasket d_3 mm	Permissible operating pressure (bar)	Part No.
30 x 15 •	20	200	42 610 001
35 x 7 •	25	25	42 610 005
40 x 12 •	30	50	42 610 010
45 x 10	32	40	42 610 015
45 x 12	32	50	42 610 016
50 x 10	35	25	42 610 020
50 x 12	35	40	42 610 021
55 x 10 •	40	25	42 610 025
60 x 10	45	16	42 610 030
60 x 12	45	25	42 610 031
60 x 15	45	40	42 610 035
63 x 8 •	48	8	42 610 040
63 x 10	48	16	42 610 041
63 x 12	48	25	42 610 042
63 x 15	48	40	42 610 045
70 x 12 •	55	16	42 610 050
70 x 15 •	55	25	42 610 055
80 x 10 •	65	10	42 610 060
80 x 12	65	16	42 610 061
80 x 15	65	25	42 610 062
80 x 20	65	40	42 610 063
90 x 10 •	70	8	42 610 070

Dimensions d_1 x s mm	Inner diameter gasket d_3 mm	Permissible operating pressure (bar)	Part No.
95 x 15 •	75	16	42 610 075
100 x 10 •	80	7	42 610 080
100 x 15	80	16	42 610 083
100 x 20	80	25	42 610 085
100 x 25	80	40	42 610 086
113 x 15 •	88	10	42 637 113
125 x 15	100	10	42 610 090
125 x 20	100	16	42 610 092
125 x 25	100	25	42 610 094
125 x 30 •	100	40	42 610 096
135 x 25	110	25	42 610 097
150 x 15 •	125	8	42 610 101
150 x 20	125	10	42 610 103
150 x 25	125	16	42 610 105
150 x 30	125	25	42 610 107
175 x 20	150	10	42 610 110
175 x 25	150	16	42 610 112
175 x 30	150	25	42 610 115
200 x 20	175	8	42 610 120
200 x 25	175	10	42 610 122
200 x 30	175	16	42 610 125
250 x 25	225	8	42 610 130
250 x 30	225	10	42 610 132
265 x 30	240	8	42 610 134

Lumiglas®

ILMADUR® level gauge glasses to DIN 7081

We can offer two basic versions oflevel gauge glasses, according DIN7081 and MIL-standard:
- Refex glasses, which enable the level of a liquid to be read off easilyand safely even from a distance, and - Transparent glasses, which we canalso supply in “ High Pressure" quality for higher operating pressures.
If you cannot find the size you needin the following tables on the right,simply contact us. We can make just about anything possible!

Mechanical properties

●Tensile bending strength
Standard: ≥ 150 N/mm²
High Pressure: ≥ 180 N/mm²

●Compressive prestress
Standard: ≥ 80 N/mm²
High Pressure: ≥ 100 N/mm²

The thermal toughening inereases the tensile bending strength by a factor of 2 at least. That guarantees the safety demanded of level gauge glasses according to DIN 7081.

Thermal properties andservice conditionsrooerties andservice

●Max. service temperature:
300 °CWhere the operating temperature exceeds 280 °C a permanent drop in the prestress is to be expected unless suitable measures are taken.

●Unprotected level gauge glasses:
35 bar at 243 °C

●Transparent level gauge glasses protected with mica:
103 bar at 320 °C

●Transparent level gauge glassesin contact with media without signi-ficant glass corrosion:
180 bar at 400 °C

●High Pressure transparent levelgauge glasses:
415 bar at 35 °C

Where the operating temperature exceeds 280 °C a permanent drop in the prestress is to be expected unless sutable measures are taken.
The actual maximum permissible load on a sight glass always depencon the specific service conditions in situ (pressure, temperature, nature on medium, type of apparatus).

●Thermal shock resistance:
Δ T min. 265 K

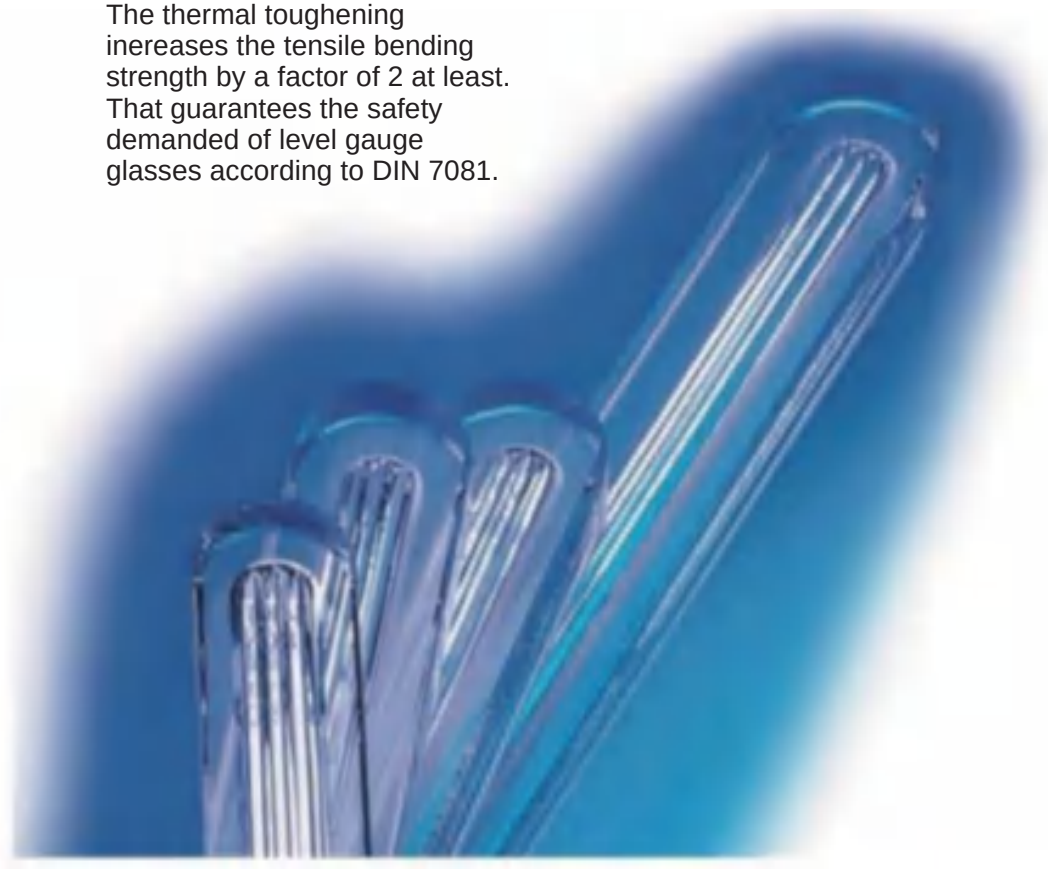
Finishes

●Surfaces:
polished

●Lateral Surfaces:
plain moulded or ground
(for manufactoring reasons beveled 1,5°)

●Edges:
beveled at an angle of 30° or 45°

●Width ofsealing surface:
min. 5 mm for 30 mm wide level gauge glasses,
min. 6 mm for 34 mm wide level gauge glasses



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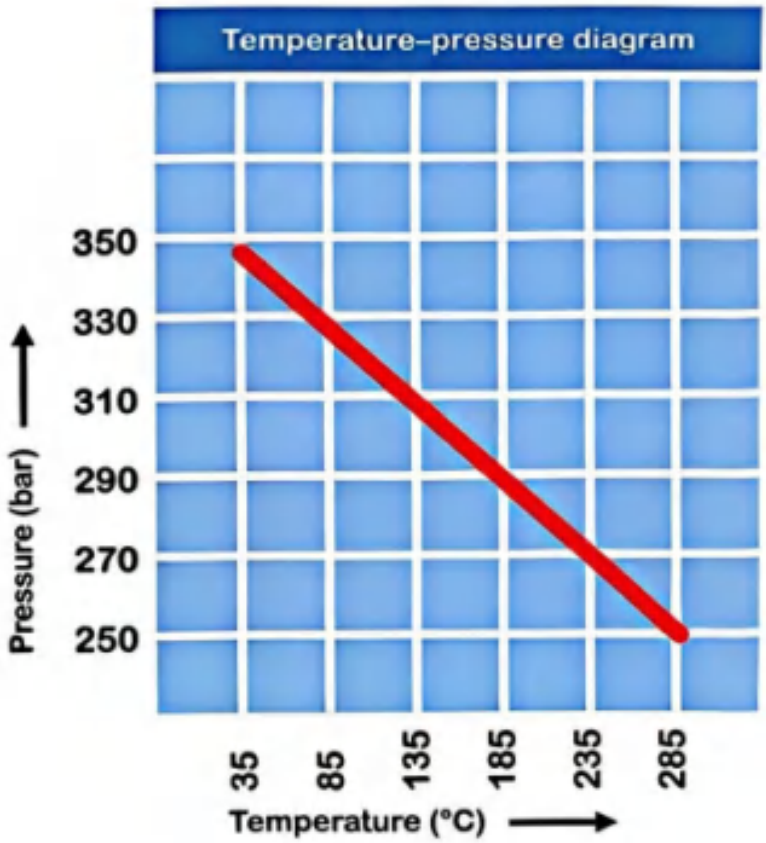
ILMADUR® level gauge glasses to DIN 7081

Applications		
Max. service temperature: 300 °C		
	Pressure(bar)	Temperature(°C)
Unprotected level gauge glasses subjected to saturated steam or hot water	35	243
Transparent level gauge glasses protected by micasubjected to saturated steam or hot water	103	320*
For media without a technically signifcant glass corrosion effect	180	400*

* Where the operating temperature exceeds 280 °C a permanent drop in the prestress is to be expected unless suitable measures are taken.

The actual maximum permissible load on a sight glass always depends on the specific service conditionsin situ (pressure, temperature, nature of medium, type of armature).



Temperature-pressure diagram for transparent level gauge glasses and media without a technically significant glass corrosion effect

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ILMADUR® level gauge glasses to DIN 7081

RANGE OF PRODUCTS

Standard						High Pressure		
Reflex			Transparent			Transparent		
Size	Dimensions l x b x s / mm	Part No.	Size	Dimensions l x b x s / mm	Part No.	Size	Dimensions l x b x s / mm	Part No.
0	95 x 34 x 17 *	42 601 200	0	95 x 34 x 17 *	42 601 400	0	95 x 34 x 17,5 *	42 610 400 00 03
1	115 x 34 x 17 *	42 601 205	1	115 x 34 x 17 *	42 601 405	1	115 x 34 x 17,5 *	42 610 405 00 03
2	140 x 34 x 17	42 601 210	2	140 x 34 x 17	42 601 410	2	140 x 34 x 17,5 *	42 610 410 00 03
3	165 x 34 x 17	42 601 215	3	165 x 34 x 17	42 601 415	3	165 x 34 x 17,5 *	42 610 415 00 03
4	190 x 34 x 17	42 601 220	4	190 x 34 x 17	42 601 420	4	190 x 34 x 17,5 *	42 610 420 00 03
5	220 x 34 x 17	42 601 225	5	220 x 34 x 17	42 601 425	5	220 x 34 x 17,5 *	42 610 425 00 03
6	250 x 34 x 17	42 601 230	6	250 x 34 x 17	42 601 430	6	250 x 34 x 17,5 *	42 610 430 00 03
7	280 x 34 x 17	42 601 235	7	280 x 34 x 17	42 601 435	7	280 x 34 x 17,5 *	42 610 435 00 03
8	320 x 34 x 17	42 601 240	8	320 x 34 x 17	42 601 440	8	320 x 34 x 17,5 *	42 610 440 00 03
9	340 x 34 x 17	42 601 245	9	340 x 34 x 17	42 601 445	9	340 x 34 x 17,5 *	42 610 445 00 03
10	370 x 34 x 17	42 601 250	10	370 x 34 x 17	42 601 450	10	370 x 34 x 17,5 *	42 610 450 00 03
11	400 x 34 x 17	42 601 255	11	400 x 34 x 17	42 601 455	11	400 x 34 x 17,5 *	42 610 455 00 03
1	115 x 30 x 17 *	42 601 605	1	115 x 30 x 17 *	42 601 805	1	115 x 30 x 17,5 *	42 610 805 00 03
2	140 x 30 x 17	42 601 610	2	140 x 30 x 17	42 601 810	2	140 x 30 x 17,5 *	42 610 810 00 03
3	165 x 30 x 17	42 601 615	3	165 x 30 x 17	42 601 815	3	165 x 30 x 17,5 *	42 610 815 00 03
4	190 x 30 x 17	42 601 620	4	190 x 30 x 17	42 601 820	4	190 x 30 x 17,5 *	42 610 820 00 03
5	220 x 30 x 17	42 601 625	5	220 x 30 x 17	42 601 825	5	220 x 30 x 17,5 *	42 610 825 00 03
6	250 x 30 x 17	42 601 630	6	250 x 30 x 17	42 601 830	6	250 x 30 x 17,5 *	42 610 830 00 03
7	280 x 30 x 17	42 601 635	7	280 x 30 x 17	42 601 835	7	280 x 30 x 17,5 *	42 610 835 00 03
8	320 x 30 x 17	42 601 640	8	320 x 30 x 17	42 601 840	8	320 x 30 x 17,5 *	42 610 840 00 03
9	340 x 30 x 17	42 601 645	9	340 x 30 x 17	42 601 845	9	340 x 30 x 17,5 *	42 610 845 00 03

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ILMADUR® level gauge glasses -imperial sizes

RANGE OF PRODUCTS

Standard						High Pressure		
Reflex			Transparent			Transparent		
J	Dimensions l x b x s / mm	Part No.	J	Dimensions l x b x s / mm	Part No.	J	Dimensions l x b x s / mm	Part No.
0	3.750 x 1.347 x 0.688	42 620 200	0	3.750 x 1.347 x 0.688	42 620 400	0	3.750 x 1.347 x 0.688	42 620 400 00 03
1	4.5 x 1.347 x 0.688	42 620 205	1	4.5 x 1.347 x 0.688	42 620 405	1	4.5 x 1.347 x 0.688	42 620 405 00 03
2	5.5 x 1.347 x 0.688	42 620 210	2	5.5 x 1.347 x 0.688	42 620 410	2	5.5 x 1.347 x 0.688	42 620 410 00 03
3	6.5 x 1.347 x 0.688	42 620 215	3	6.5 x 1.347 x 0.688	42 620 415	3	6.5 x 1.347 x 0.688	42 620 415 00 03
4	7.5 x 1.347 x 0.688	42 620 220	4	7.5 x 1.347 x 0.688	42 620 420	4	7.5 x 1.347 x 0.688	42 620 420 00 03
5	8.625 x 1.347 x 0.688	42 620 225	5	8.625 x 1.347 x 0.688	42 620 425	5	8.625 x 1.347 x 0.688	42 620 425 00 03
6	9.875 x 1.347 x 0.688	42 620 230	6	9.875 x 1.347 x 0.688	42 620 430	6	9.875 x 1.347 x 0.688	42 620 430 00 03
7	11 x 1.347 x 0.688	42 620 235	7	11 x 1.347 x 0.688	42 620 435	7	11 x 1.347 x 0.688	42 620 435 00 03
8	12.625 x 1.347 x 0.688	42 620 240	8	12.625 x 1.347 x 0.688	42 620 440	8	12.625 x 1.347 x 0.688	42 620 440 00 03
9	13.375 x 1.347 x 0.688	42 620 245	9	13.375 x 1.347 x 0.688	42 620 445	9	13.375 x 1.347 x 0.688	42 620 445 00 03

Dimensional and shape tolerances

■ Level gauge glass width 34 mm

(in mm)	Standard	High Pressure
Length (l)	+ 0/-1,5	+ 0/-1,5
Width (b)	+ 0,2/-0,8	+ 0,2/-0,8
Thickness (s)	+ 0,5/-0,5	+ 0/-0,1
Flatness (e)		
l ≤ 165	0,05	0,05
165 < l ≤ 220	0,08	0,05
l > 220	0,13	0,05
Parallelism	≤ 0,08	≤ 0,08

■ Level gauge glass width 30 mm

(in mm)	Standard	High Pressure
Length (l)		
≤ 220	± 0,8	± 0,8
≥ 250	± 1,0	± 1,0
Width (b)	± 0,8	± 0,8
Thickness (s)	± 0,5	+ 0/-0,1
Flatness (e)		
l ≤ 165	0,05	0,05
165 < l ≤ 220	0,08	0,05
l > 220	0,13	0,05
Parallelism	≤ 0,08	≤ 0,08

■ Imperial Size

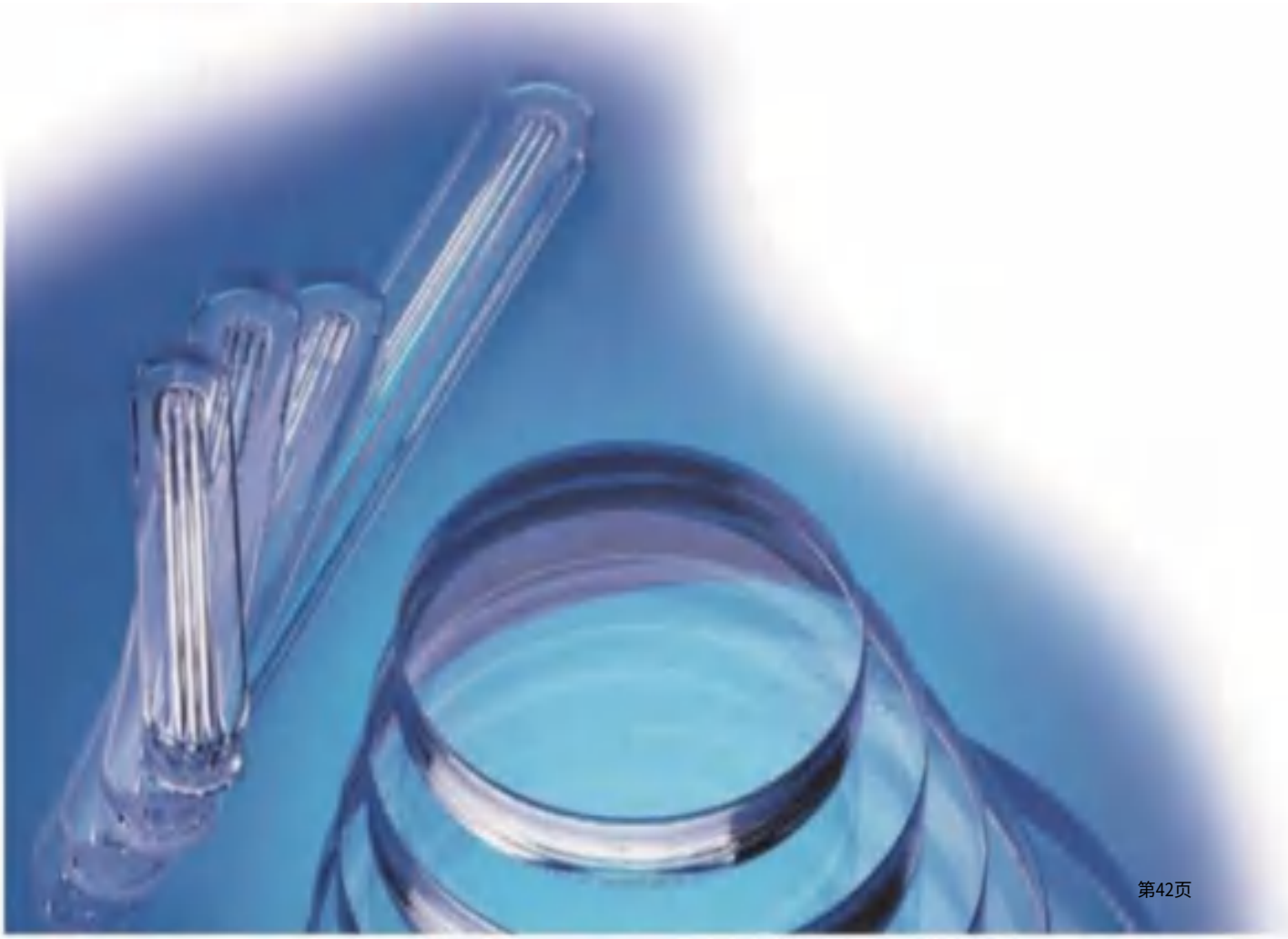
(in inch)	Standard	High Pressure
Length (l)	-0.031	-0.031
Width (b)	-0.04	-0.040
Thickness (s)	-0.032	-0.004
Flatness (e)		
l ≤ 6.5	0.002	0.002
7.5 < l ≤ 8.6	0.003	0.002
9.875 < l ≤ 13.375	0.005	0.002
Parallelism	≤ 0.003	≤ 0.003

Lumiglas®

Custom sight and level gauge glasses for your special requiren

Experience shows that our ILMADUR® sight glasses to DIN7080 and level gauge glasses to 7081 cover the majority of applications and requirements. However, if you have specific requirements for a particular application, simply contact us. Following detailed discussions we can supply you with (almost) any type of custom sight glass.

For example, if you need dimensions other than those in our range of sizes, we - as a full-service supplier-can provide you with suitable alternatives. Or we can propose suitable special glasses, especially when thermal, chemical or pressure loads exceed the applications specified in the DIN standard. It is always your specifc technical application parameters that determine the material, geometry and production of your custom glasses, Our specialists will be pleased to advise you. Together we develop your individual solution and devise a sensible method of implementation. And we of course provide you with the necessary test certifcates. We look forward to receiving your inquiry.



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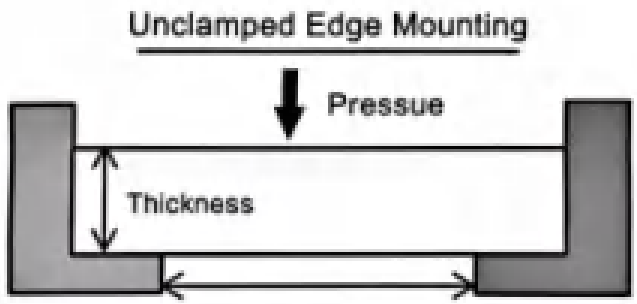
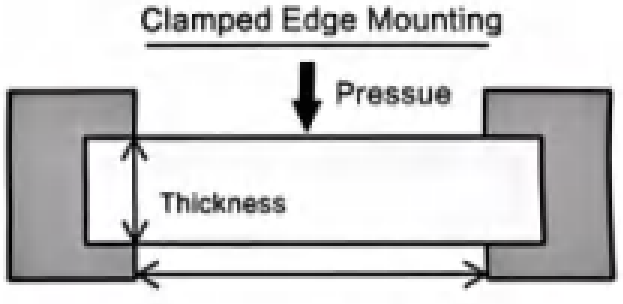
Formula for calculating glass withstand pressure





Formula for calculating the pressure resistance of the round sight glass

Japanese JS calculation formula:

$$t = 5 \cdot \sqrt{\frac{\pi \cdot P \cdot D^2}{4 \delta x}}$$

German DIN calculation formula:

$$S \geq C * d_m \sqrt{\frac{p * s}{10 * \sigma}}$$

Formula for calculating the withstand voltage of rectangular sight glasses

German Calculation Formula:

$$S = C_X C_E x B x \sqrt{\frac{P x S}{10 x K}} \ [mm]$$

In the Japanese formula:

5	5 times the safety factor
π	3.14
t	The minimum thickness of the glass plate，Units (mm)
P	Pressure bar
σ	Flexural strength(kg/mm²)
X	0.1 coefficient

Note:
The reference values for the flexural strength of the material are as follows:
Borosilicate glass: 1600kg/mm²
Aluminosilicate glass: 2800Kg/mm²
Alkali-resistant glass: 4500kg/mm²
Sapphire glass: 8500kg/mm²

In the German formula:

S=glass thickness in mm

$dm = \frac{d_1 + d_2}{2}$ in mm

P=maximum permissible operating pressure in bar

S=factor of safety=5

σ=minimum value of compressive prestress in N/mm²

C=correction factor =0.55

Note: In the German calculation formula：
σ is Mpa

In the German formula:

s	Glass thickness
C	coefficient=0.4
CE	(B/L) B = width [mm] L = length [mm]
P	Withstand pressure (bar)
S	safety = 5
K	Flexural strength (Mpa)

Untempered = 40(N/mm²)
Tempering=100(N/mm²)

Note:
The reference values for the flexural strength of the material are as follows:
Borosilicate glass: 160N/mm²
Aluminosilicate glass: 280N/mm²
Alkali-resistant glass: 450N/mm²
Sapphire glass: 850N/mm²

Rectangular glass aspect ratio and correspondence coefficient selection

B/L	C_E
0.1	1.56
0.2	1.53
0.3	1.49
0.4	1.45
0.5	1.40
0.6	1.34
0.7	1.19
0.8	1.29
0.9	1.29
1.0	1.25

Lumiglas®

Optical quartz glass

Lumiglas®

HPFS® 7979,7980 and 8655 Fused Silica

Dedication to technology leadership and world-class metrology capabilities play a major role in Corning's ability to produce leading edge materials. Corning is committed to ensuring that its customers are provided qualifed, authentic products.

Corning has a minimum of 25 years of measurement experience and provides a certifcate of compliance for each sale of product to verify the authenticity of ourHPFS° Fused Silica Materials.

Fused Silica is offered in many different grades to support various product applications. Glass codes 7980,7979, and 8655 are high purity non-crystalline silica glasses with excellent optical qualities.

Product characteristics include extraordinary low refractive index variations leading to state-of-the-art homogeneity values, lowest birefringence values, large size capabilities, exceptional transmittance from the deep ultraviolet through the infrared region, and an ultra-low thermal expansion coeffcient; all of which are critical to our customers' demanding needs.

HPFS® Summary of Key Attributes

Attribute	Fused Silica						
	7980 Standard Grade	7980 KrF Grade	7980 ArF Grade	7980 Mirror Grade	7980 Industrial Grade	7979 IR Grade	8655 ArF Grade
Visible Transmittance	■	■	■	■	■	■	■
UV Transmittance	■	■	■				■
Infrared Transmittance						■	■
Homogeneity Certified in Use-Axis AA, A, C, F (By Size)	■	■	■			■	■
Inclusion Class Certified 0, 1, 2, 5	■	■	■	■		■	■
Striae Certified ISO 10110-4 Class 5 (None)	■	■	■	■		■	■
Homogeneity Certified in Off-Axis AA, A, C, F (By Size)	■	■	■			■	■
Low Birefringence	■	■	■	■		■	■
UV Laser Resistant (Data available upon request)		■	■				■
Economical (No certification of any properties except visible transmission. Tooling applications.)					■		

Quality Grade Selection Chart

For Mirror Grade - see chart on next page

Inclusion Class			Homogeneity[3,4] [ppm] Grade							
Class	Total Inclusion Cross Section[1] [mm²]	Maximum Size[2] [mm]	AA ≤ 0.5	A ≤ 1	B ≤ 1.5	C ≤ 2	D ≤ 3	E ≤ 4	F ≤ 5	G NS[5]
0	≤0.03	0.10	■	■	■	■	■	■	■	■
1	≤0.10	0.28		■	■	■	■	■	■	■
2	≤0.25	0.50			■	■	■	■	■	■
3	≤0.50	0.76				■	■	■	■	■
4	≤1.00	1.00				■	■	■	■	■
5	≤2.00	1.27				■	■	■	■	■

1. Defines the sum of the cross section in mm² of inclusions per 100 cm³ of glass. incluslons with a diameter ⩽ 0.10 mm are disregarded
2. Refers to the diameter of the largest single inclusion.
3. index homogeneity: the maximum index variation (relative), measured over the clear aperture of the blank.
4. index homogeneity is certifed using an interferometer at 632.8 nm. The numerical homogeneity is reported as the average through the piece thickness, Blanks with a diameter up to 450 mm can be analyzed over the full aperture. Larger prats can be analyzed using multiple overlapping apertures. The minimum thickness for index homogeneity verifcation is 20 mm. For thinner parts, the parent piece is certifed.
5. NS (Not Specifed)

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HPFS® Data and Properties

	Inciusion Class	Homogeneity Grade	Birefringence lower specifications avalable upon request [nm/cm]	Striae ISO 10110-4 Class	Metallic impurities [ppb]	OH Content [ppm]
7979 IR Grade	0,1,2	AA,A,C,F	≤5	5	<100	<1
7980 Standard Grade**	0-5	AA-F	≤5	5	<1000	800-1000
7980 KrF Grade*	0,1,2	AA,A,C,F	≤1	5	<500	800-1000
7980 ArF Grade*	0,1,2	AA,A,C,F	≤1	5	<100	800-1000
7980 Minor Grade	See below	NS	≤5	1	NS	800-1000
7980 industrial Grade	NS	NS	≤5	1	NS	800-1000
8655 ArF Grade*	0,1,2	AA,A,C,F	≤1	5	<10	<1

* No visilble fluorescence when exposed to deuterlum source from 215 nm - 400 nm. Material contains hydrogen to minimize absorption under UV exposures.
** HPFS' 7980 Standard Fluorescence-free Grade available upon request.

Mechanical Properties

Unless otherwise stated, all values @ 25 °C	
Elastic (Young's) Modulus	73 GPa
Shear Modulus	31 GPa
Modulus of Rupture, abraded	52.4 MPa
Bulk Modulus	35.9 GPa
Poisson's Ratio	0.16
Density	2.20 g/cm^3
Knoop Hardness (100g load)	522 kg/mm^2
Tensile Strength	54 MPa
Compressive Strength	1.14 GPa

Thermal Properties

Glass Code:	7980	7979	8655	Viscosity
Softening Point*	1585°C	1627°C	1627°C	$10^{7.6}$ poises
Annealing Point*	1042°C	1180°C	1180°C	10^{13} poises
Strain Point*	893°C	1068°C	1068°C	$10^{14.5}$ poises
Specifc Heat	0.770 J(g K)			
Thermal Conductivity	1.38 W/(m k)			
Thermal Diffusivity	0.0075 cm^2/s			
Thermal Expansion** (ppm/C):				
5°C to 35°C	0.52 x 10^{-6}			
0°C to 200°C	0.57 x 10^{-6}			
-100°C to +200°C	0.48 x 10^{-6}			
ASTM Procedures -°C-598, **E-228				

Mirror Quality Grade Selection Chart

Mirror Grade: inclusion Classes			
Critical Zone:	Blank Dimenslons (Diameter or Diagonal)		
	<508 mm (20")	508 -1143 mm (20-45")	1143 -2286 mm (45-90")
Max Mean Diameter	0.524 mm (0.010")	0.762 mm (0.030")	1.524 mm (0.060")
Max. Avg. #/mm^3 (#/in^3)	2 ppm (0.04)	3 ppm (0.05)	5 ppm (0.08)
Non-Critical Zone:	Blank Dimenslons (Diameter or Diagonal)		
	<508 mm (20")	508 -1143 mm (20-45")	1143 -2286 mm (45-90")
Max Mean Diameter	1.016 mm (0.040")	1.524 mm (0.060")	3.81 mm (0.150")
Max. Avg. #/mm^3 (#/in^3)	3 ppm (0.05)	3 ppm (0.05)	9 ppm (0.15)

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Refractive Index and Dispersion: HPFS® 7980

Conditons: 22 °C, 760 mm Hg, N_2				
Wavelength [Vacuum] [nm]	Refractive index[2] n	Thermal Coefficient[2] $\Delta n/\Delta T$[3][ppm/C]	Polynomial Dispersion Equation Constants[1], 22 °C	
1128,950	1.448866	9.6	A_0	2.104025406E+00
1014,260 n_t	1.450241	9.6	A_1	-1.456000330E-04
852,344 n_s	1.452463	9.7	A_2	-9.049135390E-03
706,714 n_r	1.455144	9.9	A_3	8.801830992E-03
656,454 n_C	1.456364	9.9	A_4	8.435237228E-05
632,990	1.457016	10.0	A_5	1.681656789E-06
587,725 n_d	1.458461	10.1	A_6	-1.675425449E-08
546,227 n_e	1.460076	10.2	A_7	8.326602461E-10
486,269 n_F	1.463123	10.4	Sellmeier Dispersion Equation Constants[2], 22 °C	
435,957 n_g	1.466691	10.6		
404,770 n_h	1.469615	10.8	A_1	0.68374049400
365,119 n_i	1.474539	11.2	A_2	0.42032361300
334,244	1.479764	11.6	A_3	0.58502748000
312,657	1.484493	12.0		
253,728	1.505522	13.9	B_1	0.00460352869
228,872	1.521154	15.5	B_2	0.01339688560
21,506	1.533722	17.0	B_3	64.49327320000
206,266	1.542665	18.1	$\Delta n/\Delta T$ Dispersion Equation Constants[2], 20-25 °C	
194,227	1.558918	20.3		
184,950	1.575017	22.7	C_0	9.390590
			C_1	0.235290
			C_2	-1.318560E-03
			C_3	3.028870E-04
			Other Optical Properties	
			nF'-nC'	0.006797
			Stress Coeffcient	35.0 nm/cm MPa
			Abbe Constants:	
			V_e	67.6
			V_d	67.8

*1 Polynomial Equation: $n^2=A_0 + A_1\lambda^4 + A_2\lambda^2 + A_3\lambda^{-2} + A_4\lambda^{-4} + A_5\lambda^{-6} + A_6\lambda^{-8} + A_7\lambda^{-10}$ with λ in μm
*2 Sellmeier Equation: $n^2 -1 = A_1\lambda^2/(\lambda^2 - B,) + A_2\lambda^2/(\lambda^2 - B_2) + A_3\lambda^2/(\lambda^2 - B_3)$with λ in μm
*3 Δn/ΔT Equation: $\Delta n/\Delta T^3[ppm/C] = C_0 + C_1\lambda^{-2} + C_2\lambda^{-4} + C_3\lambda^{-6}$ with λ in μm
The above dispersion equaions were fit to the refractive indices of 20 wavelengths from 1129 nm to 185 nm.

Lumiglas®

Refractive Index and Dispersion: HPFS® 8655 and 7979

Conditons: 22 ℃, 760 mm Hg, N_2				
Wavelength [Vacuum] [nm]	Refractive index[2] n	Thermal Coefficient[2] $\Delta n/\Delta T$[3][ppm/C]	Sellmeier Dispersion Equation Constants[1], 20 ℃	
2326.050	1.433027	8.7	A_1	7.033574317E-02
2058.650	1.437307	9.3	A_2	7.241205497E-01
1970.630	1.438601	9.6	A_3	3.097807778E-01
1813.570	1.440776	9.1	A_4	9.309957497E-01
1530.000	1.444337	9.7	B_1	-2.301552288E-03
1128.950	1.448930	9.7	B_2	6.272886117E-03
1014.26 n_t	1.450304	9.6	B_3	1.415449740E-02
852.344 n_s	1.452526	9.5	B_4	1.016434845E+02
780.237	1.453731	9.5	Sellmeier Dispersion Equation Constants[1], 20 ℃	
706.714 n_r	1.455205	9.9		
656.454 n_C	1.456425	10.1	A_1	3.550277875E-02
644.025 n_C	1.456763	1.1	A_2	7.353314507E-01
632.990	1.457077	9.9	A_3	3.334560303E-01
587.725 n_d	1.458522	10.2	A_4	9.269506614E-01
546.227 n_e	1.460135	10.5	B_1	4.826183477E-03
486.269 n_F	1.463183	10.4	B_2	5.808687673E-03
480.126 n_F	1.463561	10.4	B_3	1.399572492E-02
435,957 n_g	1.466751	10.7	B_4	1.012182926E+02
404,770 n_h	1.469674	10.9	Sellmeier Dispersion Equation Constants[1], 20 ℃	
388.975	1.471446	10.9		
365.119 n_I	1.474599	11.3	A_1	2.623483282E-02
340.463	1.478646	11.6	A_2	7.306029048E-01
334.244	1.479824	11.7	A_3	3.475321572E-01
312.657	1.484554	12.0	A_4	9.216052441E-01
296.814	1.488798	12.5	B_1	-5.783959035E-03
289.444	1.491056	12.5	B_2	5.600103210E-03
253.728	1.505585	14.0	B_3	1.389808930E-02
228.872	1.521218	15.3	B_4	1.006578079E+02
226.572	1.523018	15.9	$\Delta n/\Delta T$ Dispersion Equation Constants[2], 20-25 ℃	
214.506	1.533786	16.8		
213.923	1.534371	17.0	B_1	9.545124E+00
206.266	1.542731	18.2	B_2	-9.835579E-02
202.613	1.547213	18.3	B_3	2.003170E-01
194.227	1.558985	20.4	B_4	2.209816E-03
184.950	1.575091	22.1	B_5	1.980644E-04
			Other Optical Properties	
			nF'-nC'	0.006797
			Stress Coeffcient	35.0 nm/cm MPa
			Abbe Constants:	
			V_e	67.6
			V_d	67.8

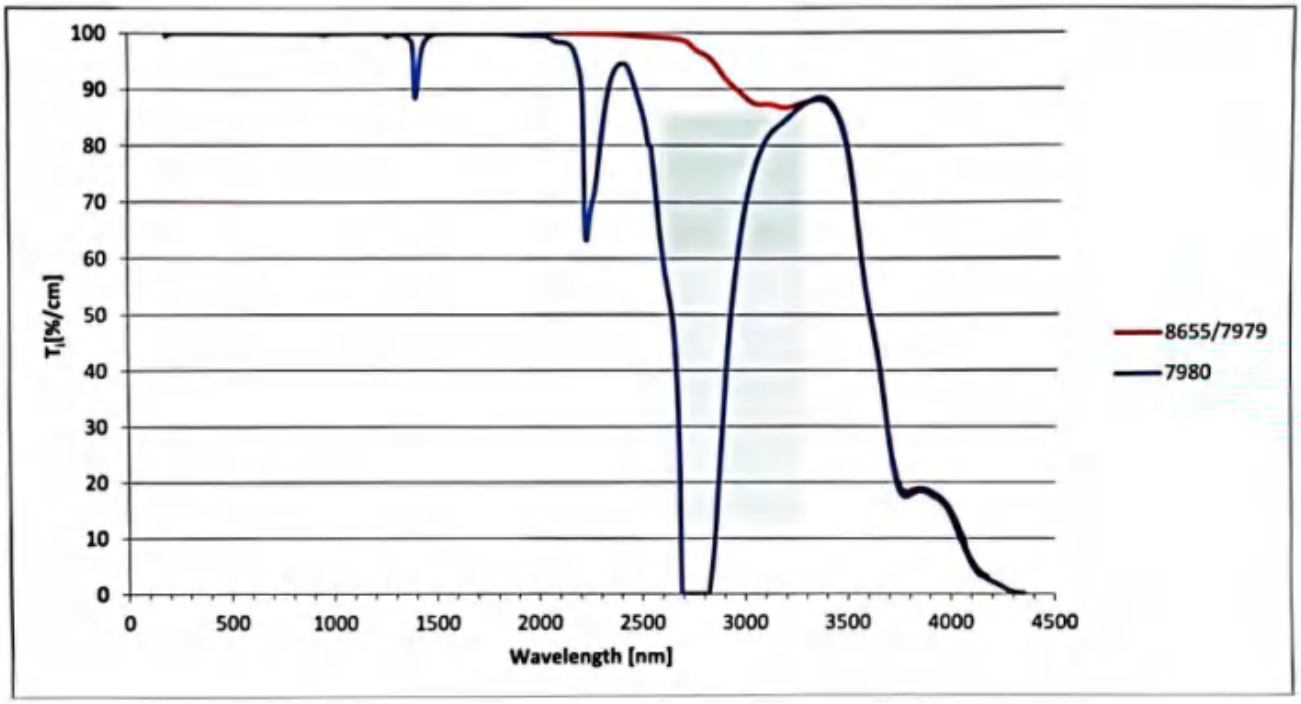
*1 Sellmeier Equation: $n^2 -1 = A_1\lambda^2/(\lambda^2 - B_1) + A_2\lambda^2/(\lambda^2 - B_2) + A_3\lambda^2/(\lambda^2 - B_3) + A_4\lambda^2/(\lambda^2 - B_4)$ with λ in μm

*2 Δn/ΔT Equation: $\Delta n/\Delta T[ppm/C] = D_0 + D_1\lambda^{-2} + D_2\lambda^{-4} + D_3\lambda^{-6}$ with λ in μm

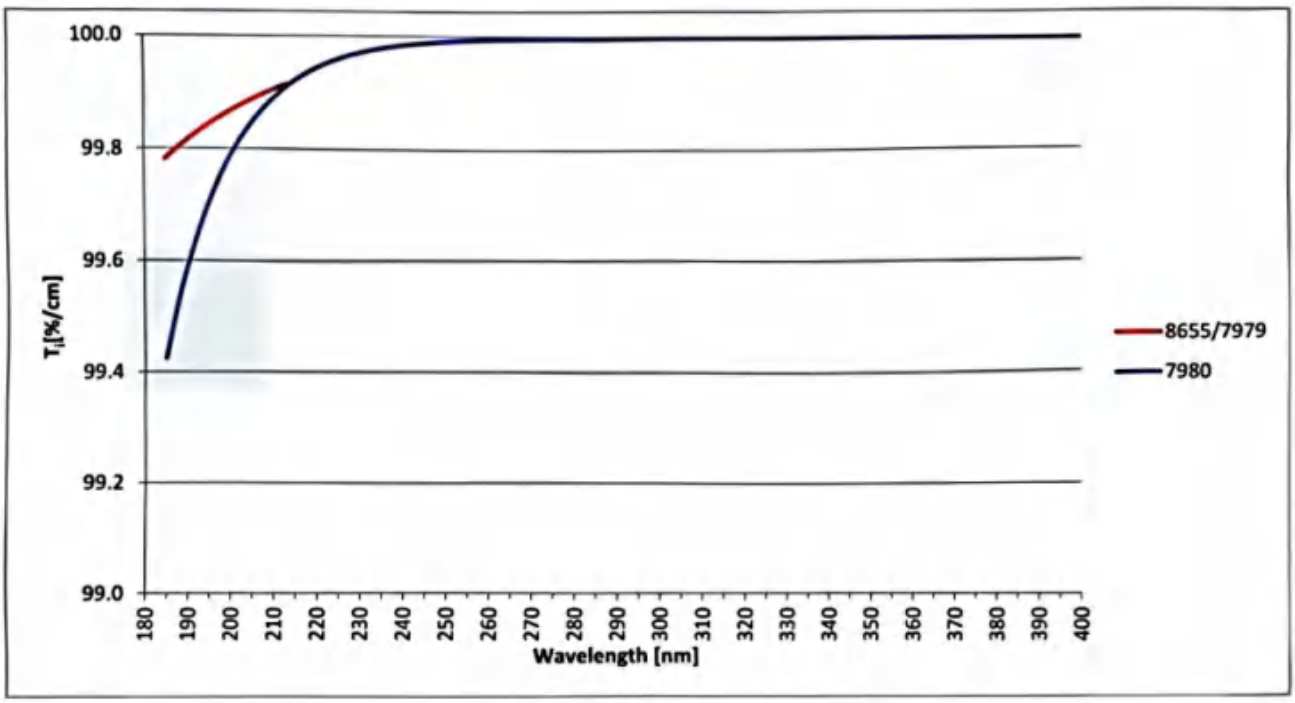
The above dispersion equaions were fit to the refractive indices of 35 wavelengths from 2326 nm to 185 nm.

Lumiglas®

Broad Spectrum Internal Transmittance



UV Internal Transmittance



HPFS* 7980 Standard Grade meets high T_1 2 88.00 %/cm @185 nm. (Equivalent toT_e > 80.00 %/cm @185 nm)
HPFS* 7980 KrF Grade meets high T_1 ⩾ 99.90 %/cm @248 nm.
HPFS* 7980 ArF Grade meets high T_1 ⩾99,50 %/cm @193 nm.
HPFS* 8655 Grade meets high T_1 ⩾ 99.75 %/mm @193 nm.
HPFS* 8655 Grade Typical initial absorption k: ⩽0.0001/cm at 193 nm.
Higher transmittance is available upon request.

Lumiglas®

Electromagnetic shielding glass

Organic PC screen shielding glass

Types: 80 mesh, 100 mesh, 120 mesh, 165 mesh, 200 mesh, 250 mesh, 300 mesh

Terminal optional process: copper edging, silver edge, conductive foam

Value-added features: AG anti-glare anti-reflection glass, AR anti-reflection and anti-reflection glass, bonding

Peculiarity: high shielding efficiency, high hardness, strong environmental adaptability, to meet the national military standard GJB 151B-2013 "military equipment and subsystem electromagnetic emission and sensitivity requirements and measurements" indicators.

Applications:
Military ships, warships, aircraft, radar stations, high-speed railways, communications and other fields.

Organic PC screen shielding glass

Lumiglas®

Electrically heated wire mesh shielding glass

Types: 80 mesh, 100 mesh, 120 mesh, 165 mesh, 200 mesh, 250 mesh, 300 mesh

Terminal optional process: copper edging

Value-added features: AG anti-glare anti-reflection glass, AR anti-reflection and anti-reflection glass, bonding

Peculiarity: It meets the dual functional requirements of heating, anti-fogging, defrosting and high electromagnetic shielding efficiency, and meets the indicators of the national military standard GJB 151B-2013 "Requirements and Measurement of Electromagnetic Emission and Sensitivity of Military Equipment and Subsystems".

Applications:
De-icing and frost protection for aircraft, ships, automobiles or observation posts in cold areas are effective.

Organic PC screen shielding glass

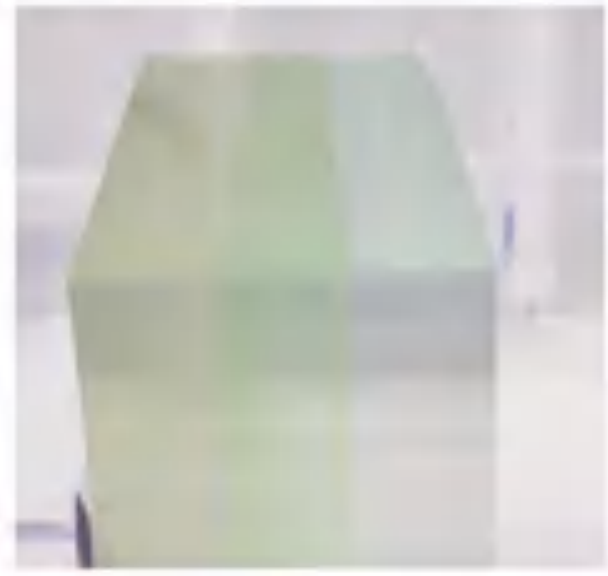
Lumiglas®

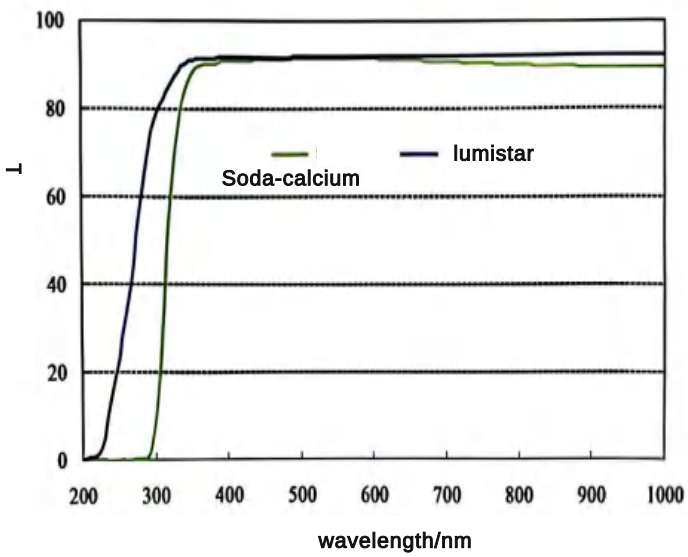
LMX92 glass

Product Specifications:

①Ultra-thin glass: 0.2, 0.25, 0.3, 0.33, 0.4mm
②Thin glass: 0.55-2.0mm
③Special glass: 2.0~6.0mm Supply size: 1100x1300mm

LMX92 glass ultra-white ultra-transparent color is the nearest C product





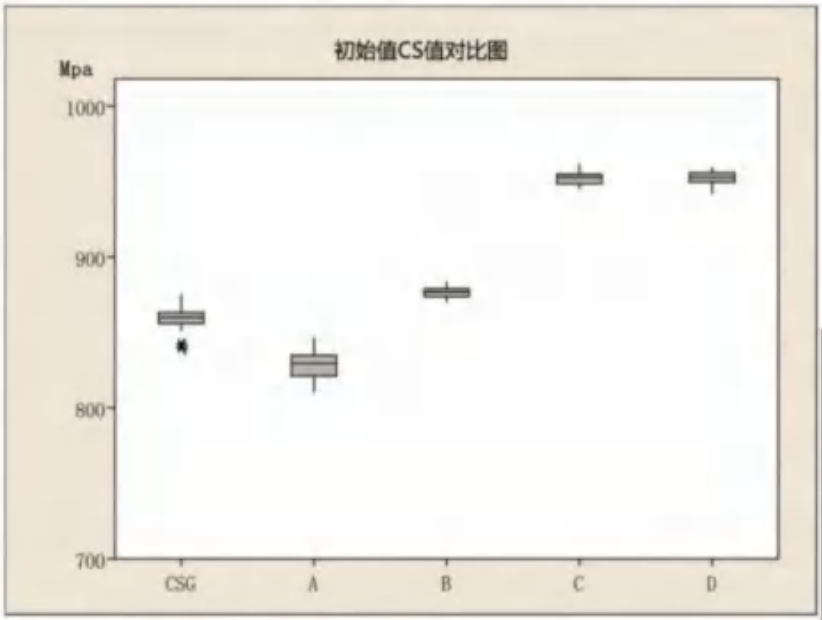
Ultra-thin LMX92 glass, the color is ultra-white and ultra-transparent, the transmittance in the visible band is basically more than 92%, and the white ink printing color is pure and reliable.

Key performance parameters

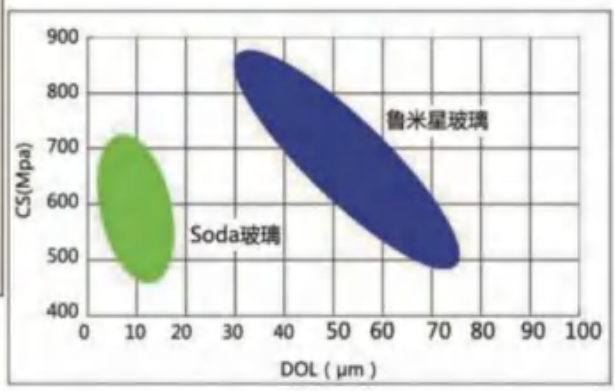
Thicknesss pecification (mm)	Cs(Mpa)	DoL (μm)	4PB (Mpa)	Falling Ball (J)	Surface hardness	Warpage (mm)
0.55	＞650	＞35	＞600	2D≥0.2	＞8H	2D＜0.2
0.7	＞700	＞38	＞600	2D≥0.35 2.5D≥0.25	＞8H	2D≥0.15 2.5D≥0.25
0.8	＞700	＞38	＞600	2D≥0.2 2.5D≥0.3	＞8H	2D≥0.15 2.5D≥0.2

Lumiglas®

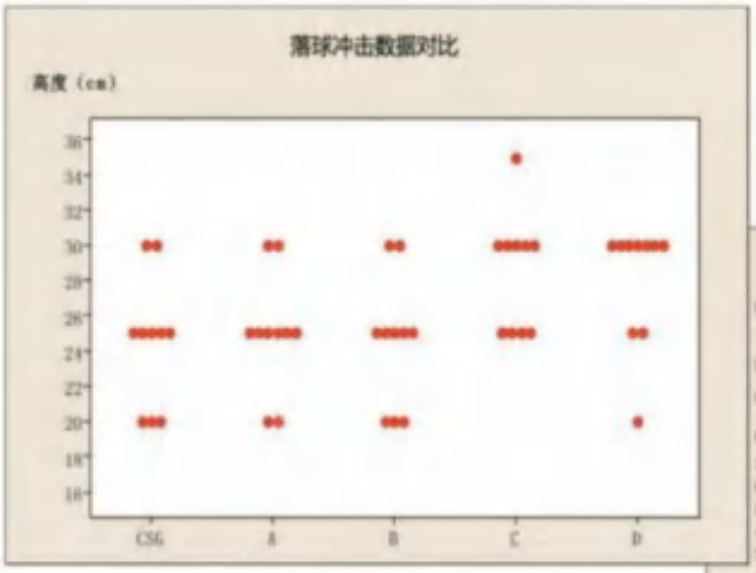
CS/Do1 contrast



1. The initial CS value of Lumicin product reaches 890MPa, DoL=40 μm, and the recommended Dol is 37-43um.
2. The comprehensive strength of LMX92 glass is 6 times that of ordinary soda-lime glass.

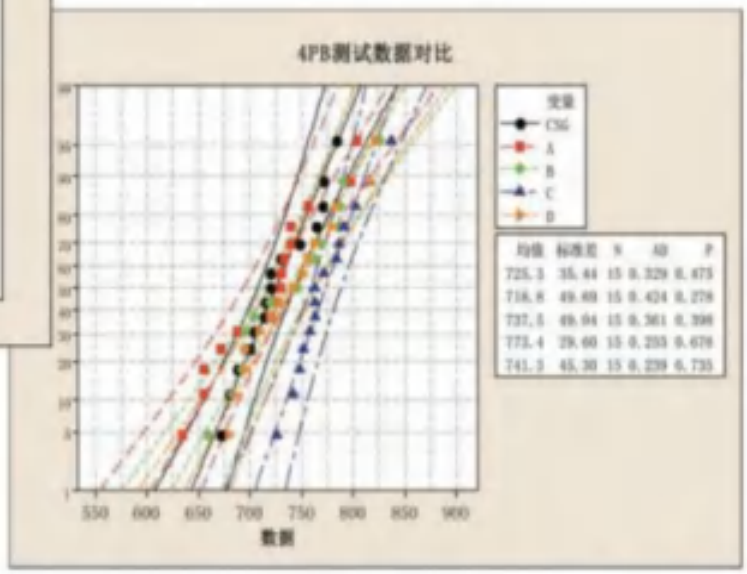


Impact resistance



LMX glass has excellent impact and bending resistance.

Bending resistance



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Physical and chemical properties of LMX92 glass

performance		unit	Aluminosilicate glass
Mechanical properties	density	g/cm³	2.47
	Young's modulus	GPa	74
	Shear modulus	GPa	29
	Poisson's ratio	-	0.219
	Vickers hardness (before tempering)	Kgf/mm²	605
	Vickers hardness (tempered)	Kgf/mm²	685
Thermal properties	Coefficient of thermal expansion	x10-7/°C	95(20~120℃) 98(100~300°C)
	Softening point	°C	853
	Annealing point	°C	611
	Strain point	°C	558
Electrical performance	Volume resistivity	log(Ω·cm)	10.4(50HZ)
	Dielectric constant	F/m	7.96(50HZ)
Optical performance	refractive index	ÿ -	ÿ 1.51
	Photoelastic coefficient	nm/cm/MPa	27.5
	Transmittance	340-780nm	ÿ >92%

Chemical resistance	endure NaOH(mg/cm^2)	5%NaOH;95+0.5°/6h	1.01
	endure HCl(mg/cm^2)	5%HCI;95+0.5℃/24h	0.06
	$NH_4F.HF$(mg/cm^2)	10%NH4F.HF: 20+0.5°C/20min	0.98
	endure HF(mg/cm^2)	10%HF;20+0.5℃/20min	6.52
	Water resistance	DIN ISO 719	0

Lumiglas®

Ultraviolet glass

There are two main types of ultraviolet glass produced by the company:

anti-ultraviolet glass and transmissive ultraviolet glass.

Anti-ultraviolet glass can effectively block (UV-A, UV-B, UV-C) in the 280nm-380nm wavelength band with a blocking rate of more than 90%, mainly used for radiation protection needs in various industries, anti-aging protection of valuables and human protection in various radiation places, etc., the company can produce various sizes and specifications of UV ultraviolet blocking glass. Meet the needs of customers. The company has developed UV image frame glass, UV lamp protective glass cover, welding mask glass, various UV production line outer protective glass, outdoor advertising protection with UV glass and so on. We are committed to the needs of our customers, and we will develop products that you are satisfied with as long as you have them.

Transmitted ultraviolet glass is mainly able to transmit 254, 310, 365 and other ultraviolet bands, code: ZWB1, ZWB2, ZWB3 (UG11, UG1, UG5) (254nml310nm365nm), and can filter out (absorb) visible light at the same time. The products are mainly used in geological survey, non-destructive testing, medical analysis instruments, ultraviolet light source color filters, etc.

Lumiglas®

Infrared temperature measurement window

Infrared window, also known as infrared temperature measurement window, distribution cabinet window, infrared imaging window, and power detection window, is an optical window that can transmit ultraviolet, visible light and infrared rays. It is mainly used in LV, MV, HV switch cabinets, metal armored cabinets, infrared thermal imagers, missile observation windows, motor junction boxes, etc. On the basis of the processing and production of various optical components, Lumixing Special Glass Technology Co., Ltd. has successfully mass-produced the infrared window used for infrared nondestructive testing. The infrared window can be directly installed on the shell of the closed electrical cabinet, and the infrared thermal imager that has been widely used in the power system can easily carry out various non-destructive tests on the internal equipment of the electrical cabinet, and successfully solve the problem that the closed electrical cabinet cannot be monitored and repaired in real time.

Lumiglas®

Key features:

Intuitive: ultraviolet light, visible light, infrared light (0.15um-14um), suitable for all infrared thermal imagers, infrared spot pyrometers, ultraviolet thermal imagers;

Safety: The use of infrared window can reduce the damage caused by electromagnetic radiation, high pressure, high temperature and so on;

Speed: It only takes a few minutes to install and transform the electrical cabinet, and it is convenient to open the protective cover after installation, which can quickly observe many targets and monitor the internal status;

Cost-saving: With the infrared window, users can carry out inspection and maintenance without interrupting or interfering with the operation of the equipment; No special maintenance is required.

Lumiglas®

Infrared window series:

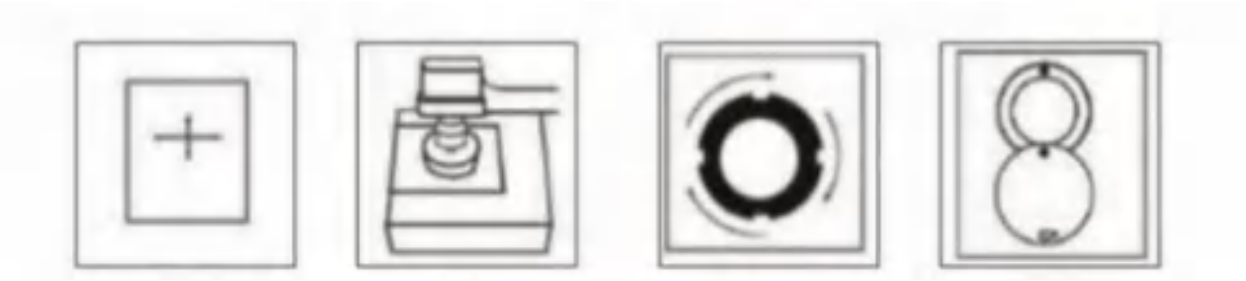
A Series: Infrared transmittance>90%
B Series: IR Transmittance>70%

Common specifications

	LMX-60	LMX-75	LMX-80	LMX-100
a	55mm	70mm	75mm	93mm
b	66mm	75mm	80mm	100mm
c	76mm	89mm	95mm	114mm
d	86mm	100mm	106mm	125mm
a:Visible diameter b:Crystal diameter c:Diameter of the opening d:Overall diameter				

Scope of application:
Medium and high voltage switchgear, metal armored cabinet, urban ring main
Unit power plant fan, pump, coal mill and other motor junction boxes;
high-Voltage junction box;
GIS high-voltage equipment;
motor control center;
Other sites that need infrared detection in a closed environment.

Installation Method:



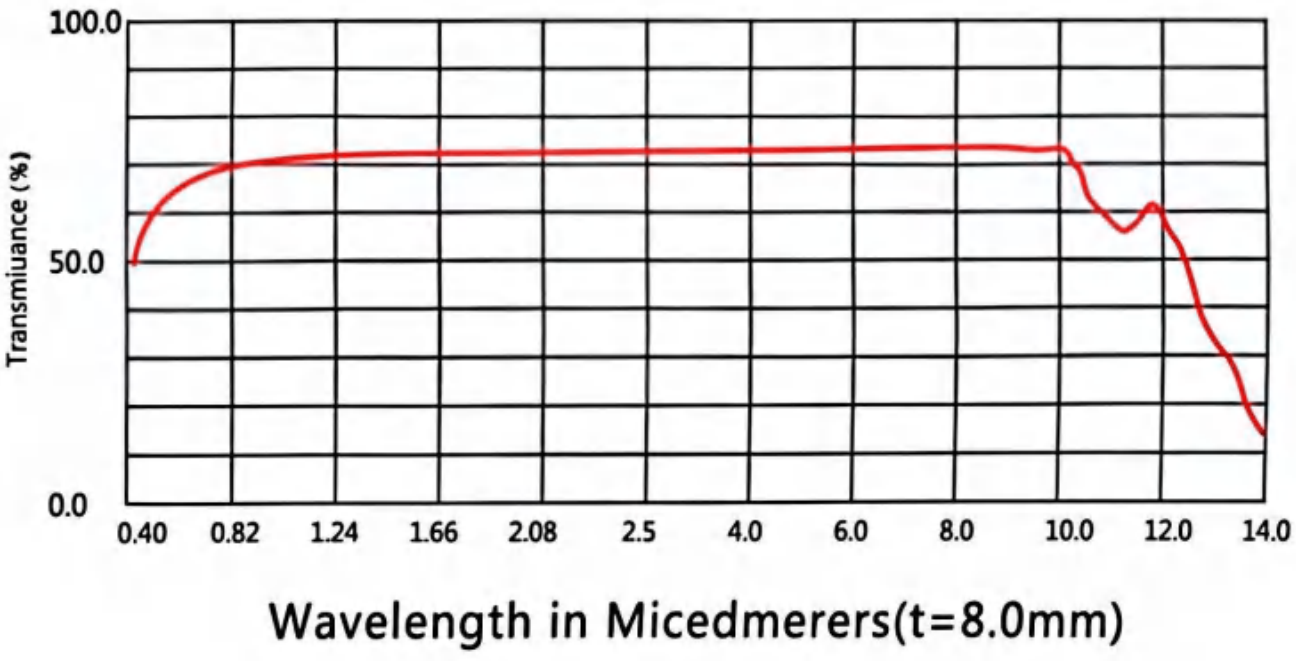
Locate→ The opening→ Install→ Observe→

Lumiglas®

Infrared crystals - zinc sulfide glass

CVD zinc sulfide (ZnS-CVD) infrared transmission bandwidth is large, low absorption, low scattering, high chemical stability and thermal stability, in the thermal band of 8um~13um, to achieve the maximum transmittance and minimum absorption, is widely used as medium and long wave infrared observation window material and infrared lens group material.

Density (g/cm^3)	4.09
Melting point (°C)	1830
Chemical Purity (%)	99.9996
Knoop hardness(kg/mm^3)	160
Young's modulus (GPa)	74.5
Modulus of fracture (MPa)	60
Transmission Range (um)	1-13

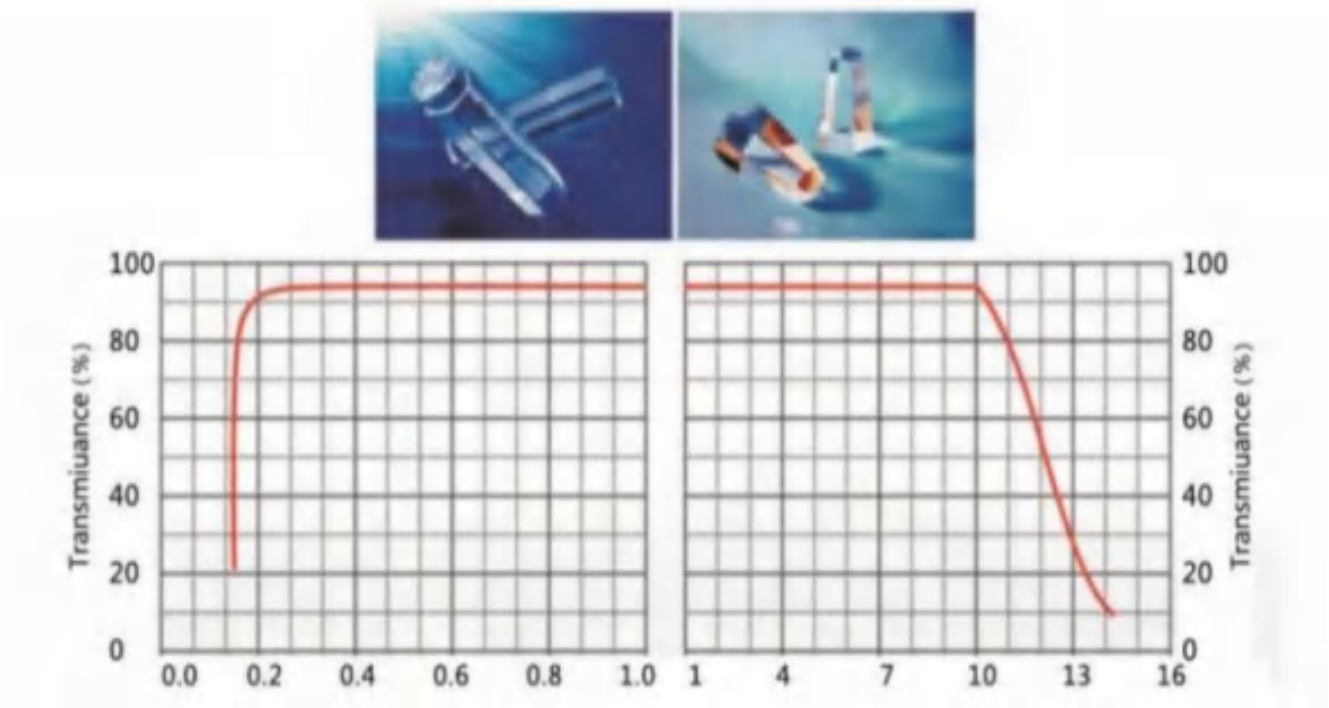


Lumiglas®

Infrared crystals - barium fluoride glass

BaF2 crystal has good optical transmittance and can be used as an ultraviolet and infrared optical window in the spectral range of 0.15um-12.5um. At the same time, it has excellent scintillation performance and has become an important crystal material in the fields of high-energy physics, nuclear physics, and nuclear medicine.

Key performance indicators	
Transmittance range (μm)	0.15~12.5
Transmittance	>90% (0.35~9μm,3mm)
Refractive index (2.58 μm)	1.4626
Reflection loss (2.58 μm)	6.8% (both faces)
Radiation length (cm)	2.06
Emission Peak (nm)	310(slow); 220(fast)
Attenuation Constant (ns)	620(slow); 0.6(fast)
Light output relative to Nal [Nal(TI)=100%]	20%(slow); 4%(fast)
K-hardness(kg/mm²)	82 with 500g indenter
Solubility at 23°C (g/100gH20)	0.17
Cleavage planes	(111)
Density (g/cm³)	4.89
Melting point (°C)	1280



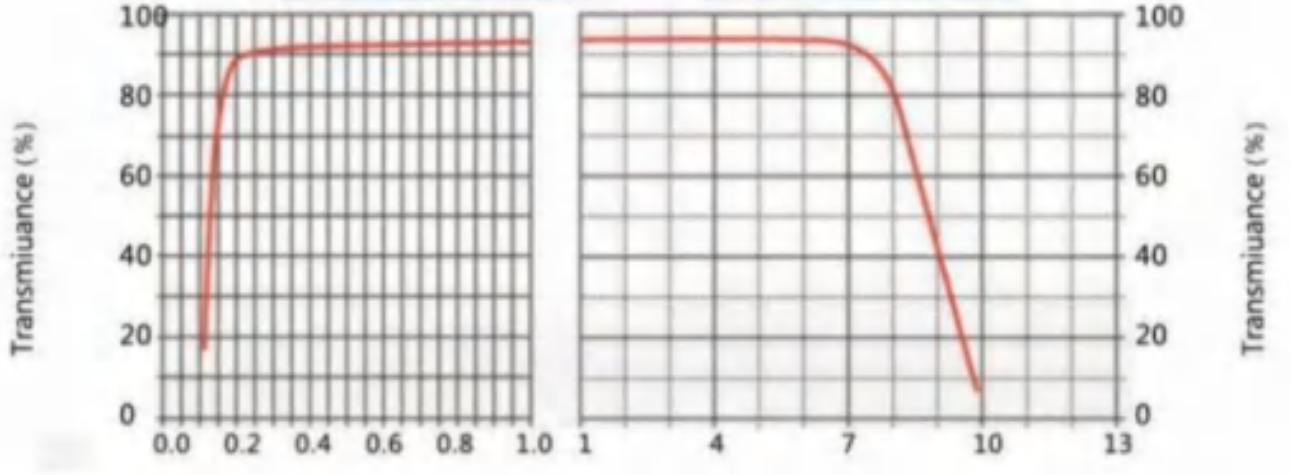
Barium fluoride (BaF2) crystal transmittance curve Wavelength (μm)

Lumiglas®

Infrared crystals - calcium fluoride glass

CaF2 crystals have excellent optical and thermomechanical properties. In the spectral range of 0.13um~9.0um, it can be used as window, lens and prism material. Due to its optical isotropy, low absorption and low refractive index, CaF2 crystals show unique advantages in the field of high-power laser and ultraviolet laser optics.

Key performance indicators	
Transmittance range (μm)	0.13~9.0
Transmittance	>90% (0.3~9μm,3mm)
Refractive index (5 μm)	1.39908
Coefficient of expansion (°C-1)	18.85x10-6
K-hardness(kg/mm²)	158.3(100)
Elastic coefficient	C11=164;C12=53;C44=33.7
Young's Modulus (Gpa)	75.79
Poisson's ratio	0.28
Solubility (9/100gH20·20°C)	0.0017
Cleavage planes	(111)
Density (g/cm³)	3.18
Melting point (°C)	1360



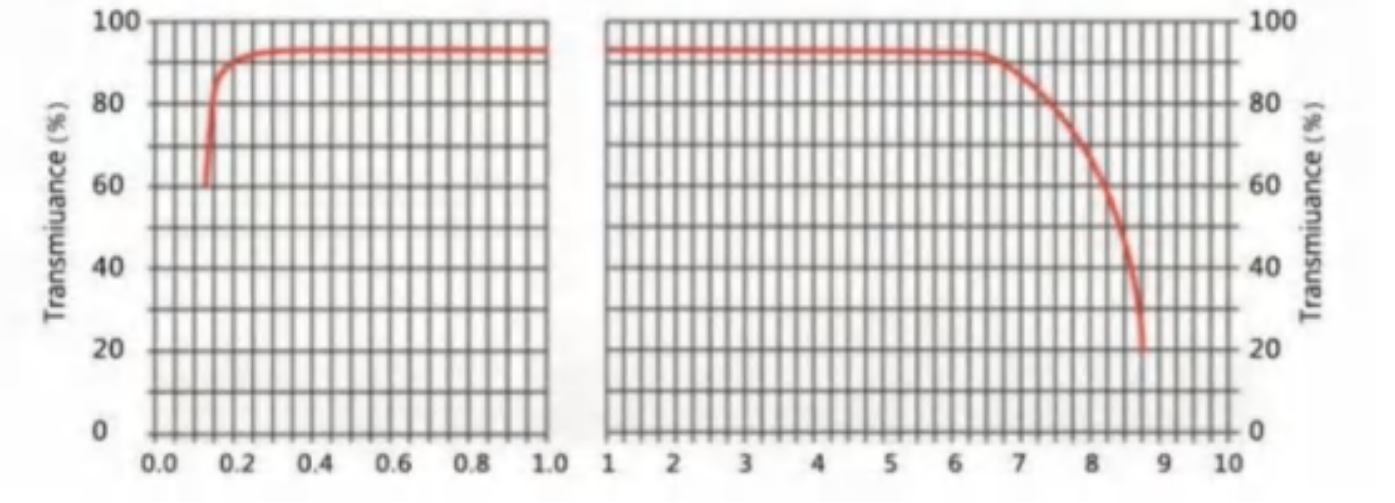
Calcium fluoride (CaF2) crystal transmittance curve Wavelength (μm)

Lumiglas®

Infrared crystal - lithium fluoride glass

Lithium fluoride crystals have excellent optical properties. Its transmittance range is 0.11um~7um, and it is used as a window, prism and lens in vacuum ultraviolet, ultraviolet, visible light and infrared optical systems. Due to their lattice structure, LiF crystals can also be used as X-ray diffraction elements.

Key performance indicators	
Transmittance range (μm)	0.11~7.0
Refractive index	1.3943 (at 0.5um)
Reflection loss 0.5 μm	5.3% (both faces)
K-hardness(kg/mm²)	99.1 (100)
Elastic coefficient	C11=97.4,C12=40.4,C44=55.4
Solubility (9/100gH20·18°C)	0.27
Cleavage planes	(100)
Density (g/cm³)	2.639
Melting point (°C)	870



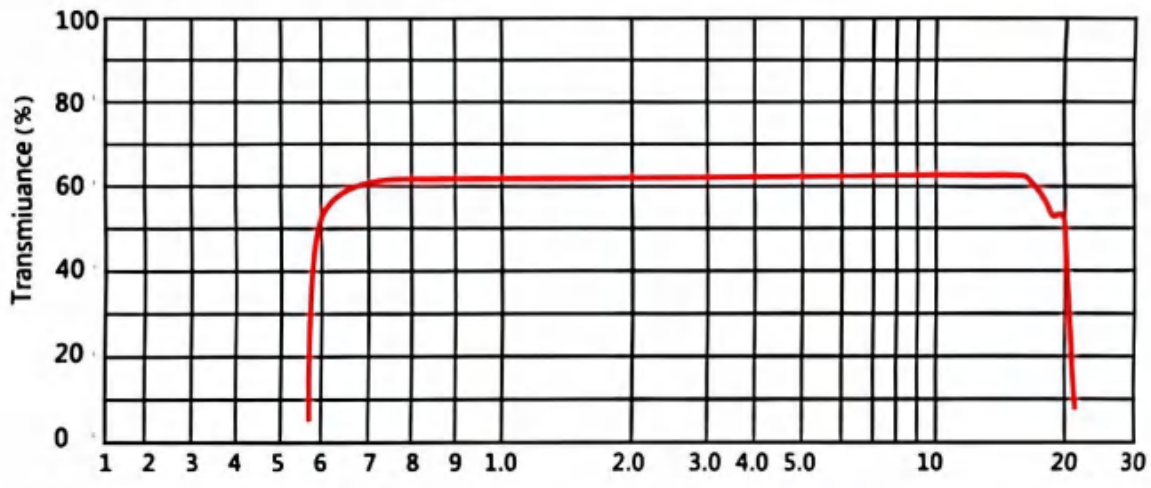
Lithium fluoride LiF crystal transmittance curve Wavelength (μm)

Lumiglas®

Infrared crystals - zinc selenide glass

CVD zinc selenide (ZnSe-CVD) has stable physical and chemical properties, a wide spectral transmission range, high transmittance, low absorption of infrared wavelengths, and can transmit visible light, which is used to make visible long-wave infrared lenses, windows, output coupling mirrors and beam expanders.

Key performance indicators	
Optical properties: bulk absorption coefficient @ 10.6 μm	0.0005/cm
Refractive index temperature change @ 10.6 μm	61x10-6/°C
Refractive index inhomogeneity @ 632.8nm	<6x10-6
Melting point (°C)	1520
Density (g/cm^3)	5.27g/mm^3
Knoop hardness kg/mm^3	112
Young's modulus GPa	67.2
Modulus of fracture MPa	55.2
Transmission range μm	0.5~20

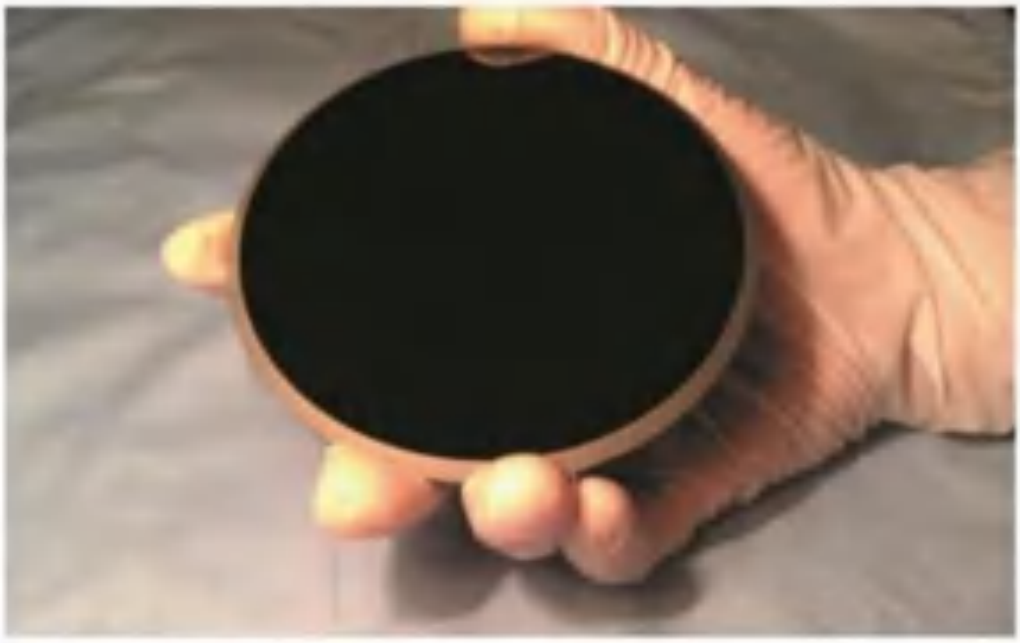


Zinc Selenide Wavelength (μm)

Lumiglas®

Infrared fret - germanium glass

Germanium crystals of 2-14 microns have good light transmittance and are widely used in thermal imaging systems for windows and optical components. The germanium glass used on the window of the infrared thermal imager and infrared thermometer is mainly considered to be only 40-50% in the 8-14um wavelength band without coating,while the transmittance can reach 90% after the anti-reflection coating is plated.Moreover,most customers will also require DLC diamond-like carbon film to be plated in germanium glass,which is used to strengthen the hardness of germanium glass and play a certain explosion-proof effect.



Physicalÿ

Element symbols	GE
Atomic coefficients	32
Melting point	937°C
Density	5.33g/cm^3
Rate of thermal expansion	6.1*10^{-6}
Young's modulus (GPa)	103
Static bending strength (MPa)	≥75
Poisson's ratio	0.28

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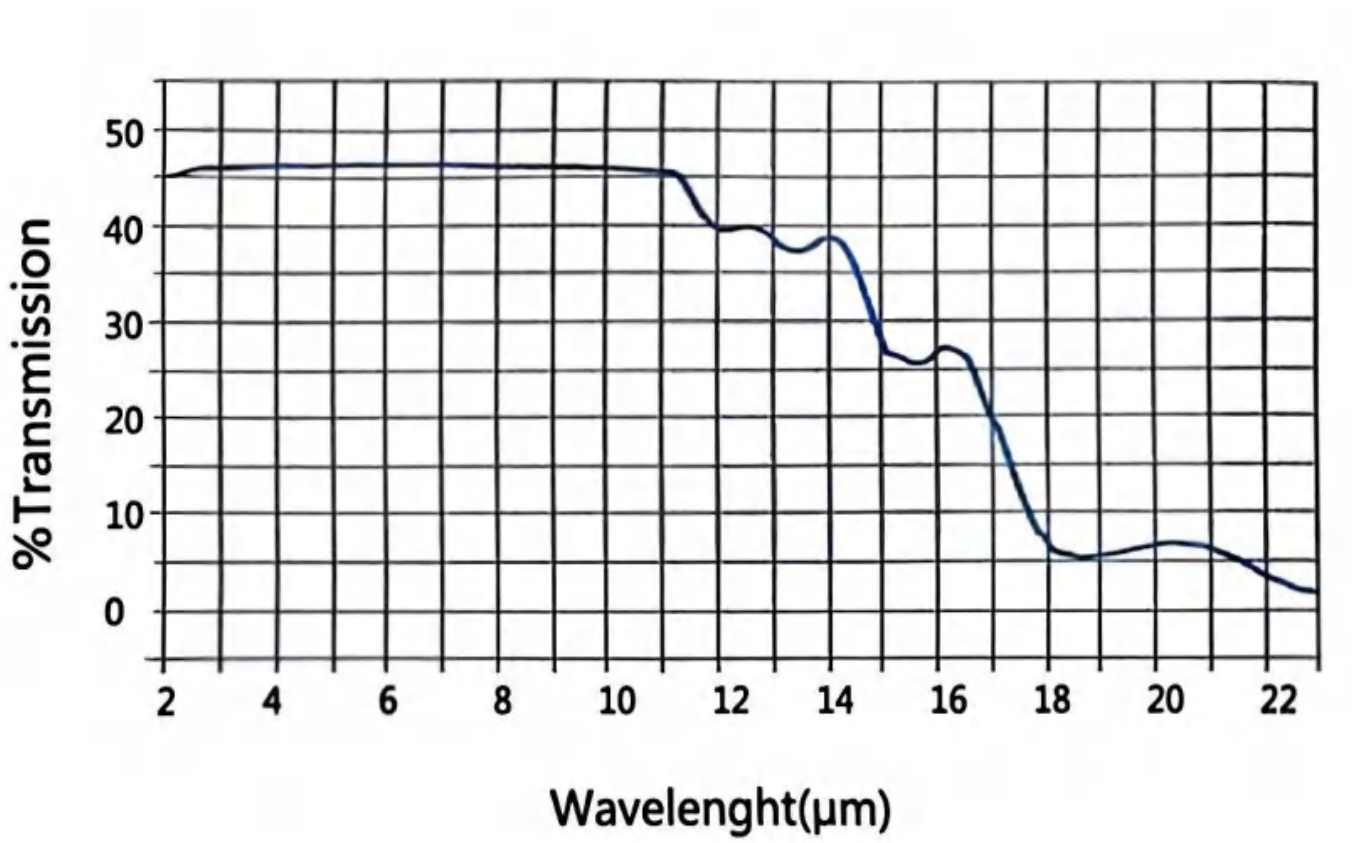
Optical performance

Wavelength (μm)	Refractive index (20 °C) Nd
3.5	4.0302
4.0	4.0226
5.0	4.0141
6.0	4.0094
7.0	4.0069
8.0	4.0047
9.0	4.0034
10.0	4.0028
10.6	4.0027



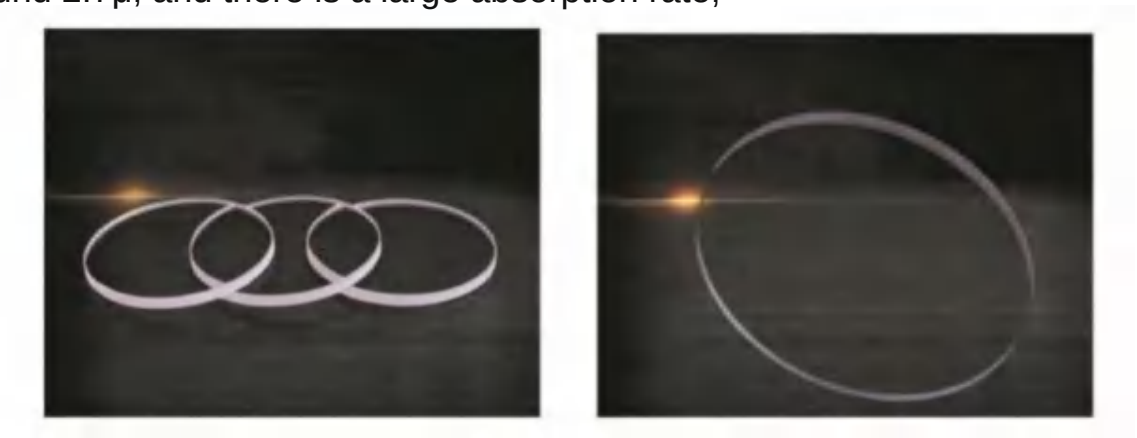
Lumiglas®

Optical quartz glass

Quartz glass is an indispensable optical material for the manufacture of prisms, lenses, and light systems that require high stability to work in harsh environments. It is widely used in space technology, detection and tracking systems, spectroscopic instruments and various window materials for high-temperature work, quartz glass has the following grades:

1. Far ultraviolet optical quartz glass (JGS1):

It is directly melted into high-quality optical quartz glass with liquid silicon tetrachloride in a high-purity hydroxide flame. This kind of glass can be completely bubble-free, has excellent ultraviolet transmission performance, especially in the short-wave ultraviolet region, its transmittance is far better than all other glasses, and the transmittance at 185nm can reach 85%, which is an excellent optical material in the 185-2500nm wavelength range. Because this glass contains OH groups, the infrared transmittance is poor, especially around 2.7μ, and there is a large absorption rate;



2. Ultraviolet optical quartz glass (JGS2):

It is an optical quartz glass made by melting high-grade crystal powder with a hydrogen and oxygen flame. It is a good material in the 220-2500nm wavelength range;

3. Infrared optical quartz glass (JGS3):

It is an optical material made by melting high-grade crystal powder in a vacuum pressure furnace. It has high infrared transmission performance, and the transmittance of 1-3um is as high as 90%. Its application band range is 260-3500nm;

4. Full transmissibility optical quartz glass:

It is a quartz glass made of high-purity raw materials without hydrogen heat source, and its application band range is 200-3500nm, ultraviolet 240nm, infrared 2730nm have no absorption peak.

Lumiglas®

Optical sapphire lenses

Sapphire (AI203) has an outstanding surface hardness and can only be scratched by a handful of materials other than its own. The high rigidity makes it possible to make optical components thinner than other substrates. Sapphire is chemically inactive and insoluble in water, common acids and bases up to 1000 °C.

Sapphire has a very excellent transmittance in the ultraviolet to mid-wave infrared (190nm-4.5 um) and is commonly used in infrared laser systems, with an ordinary refractive index of 1.754 and an unusual refractive index of 1.747 at 1.064 um.

High-quality artificial sapphire crystal material has good light transmittance in the 0.20~5.50um band, infrared transmittance almost does not change with temperature, ultraviolet ray, visible light transmittance is also very high, so it is commonly used to replace other optical materials to make optical components, infrared optical windows, and is widely used in infrared and far infrared military equipment, because the hardness of sapphire is second only to diamond, and its structural strength is very high, As a result, sapphire windows made by enhancing light transmittance can be thinner than windows in general media, making them ideal for demanding applications.

Technical requirements	Commercial grade	Precision grade	High precision grade
Size range	1-600mm	2-600mm	2-600mm
Diameter tolerance	±0.1mm	±0.025mm	±0.1mm
Thickness tolerance	±0.1mm	±0.025mm	±0.1mm
Parallel deviation	±3'	±15"	±2"
Surface quality	60-40	40-20	20-10
Surface accuracy	1.0λ	λ/10	λ/20
Surface accuracy	0.1-0.5mm*45°		
Materials	Sapphire		