



# Borosilicate gauge glasses

Reflex gauge glasses

Transparent gauge glasses

Circular gauge glasses



# 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 pre-stressing.*

## **Liquid level gauges**

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

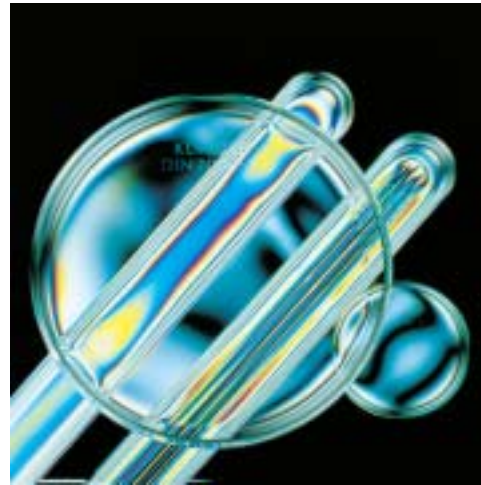
**KLINGER gauge glasses are suitable for installation in liquid level gauges of almost any make.**

*We manufacture our gauge glasses ourselves and use exclusively "extra-hard" borosilicate glass which is subsequently heat-treated.*

*KLINGER gauge glasses have high mechanical strength and are exceptionally resistant to alkalis, acids and boiler water (within the service limitation). Our glass testing laboratory carries out continuously quality control tests: purity of glass, flaws in glass, dimensional accuracy, etc. This ensures the high quality standard of KLINGER gauge glasses. We manufacture reflex and transparent glasses according to the most varied international 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 pre-stressed circular and long gauge glasses in polarized light*



*KLINGER transparent glass (above) and reflex glass (underneath)*



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

# 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.

## Transparent glasses

KLINGER 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. KLINGER 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. Within the given service limitations they may be used for all media except steam at pressures up to 340 bar or temperatures up to 400 °C.

### Packing

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

### Note

Only KLINGER original parts guarantee a trouble free operation of the gauge glasses. Therefore it is recommended to use only original spare parts for gauge



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



KLINGER package units for gauge glasses, sealing gaskets and cushion gaskets

glasses, mica shields, sealing gaskets and cushion gaskets.

### Standards

We manufacture reflex and transparent glasses in series to the following standards:

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 Development Company – New Jersey)

BS 3463 (British Standard Institution).

### Quality control

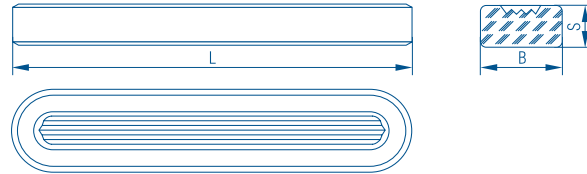
KLINGER reflex and transparent glasses are subject to continuous control during manufacture in order to guarantee exact dimensions, stress conditions, material composition and resistance to bending strain.



# Reflex and transparent gauge glasses

## technical datas

### Reflex glasses A, B, H



#### Overall dimension (mm)

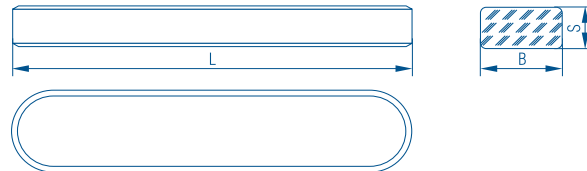
Size	Type A			Weight g/piece	Type B			Weight g/piece	Type H			Weight g/piece
	L	B	S		L	B	D		L	B	S	
0	–	–	–	–	95	34	17	110	–	–	–	–
I	115	30	17	118	115	34	17	132	115	34	22	176
II	140	30	17	146	140	34	17	162	140	34	22	214
III	165	30	17	176	165	34	17	195	165	34	22	254
IV	190	30	17	200	190	34	17	228	190	34	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	120	265	120	300	120
	150	400	180	400	200	400
	0–10	430	0–10	430	0–10	430
For media with significant glass attack, e.g. saturated steam, HPHW, alkalis	2)		2)		2)	
	35	243	35	243	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	–	–	–	–	–	–	–	–

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

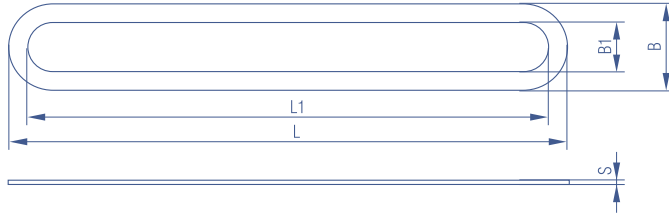
3) For steam pressures above 120 bar only TA 28 glasses. size I. may be used.

4) TA glasses may only be used with mica shields.

# Sealing and cushion gaskets & mica shields

for reflex and transparent gauge glasses

## Sealing gasket, cushion gasket made from asbestos-free material

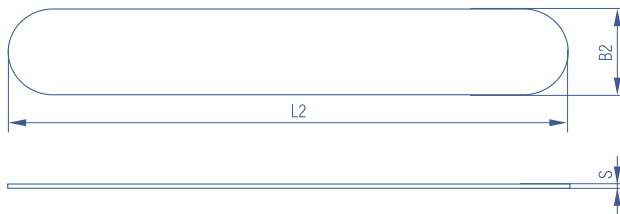


Overall dimension (mm)

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 <sup>1)</sup>
II	140	30	140	34	–	–
III	165	30	165	34	183	47 <sup>2)</sup>
IV	190	30	190	34	208	47 <sup>2)</sup>
V	220	30	220	34	238	47 <sup>2)</sup>
VI	250	30	250	34	268	47 <sup>2)</sup>
VII	280	30	280	34	298	47 <sup>2)</sup>
VIII	320	30	320	34	338	47 <sup>2)</sup>
IX	340	30	340	34	358	47 <sup>2)</sup>

$s=0,15-0,20$

$s=0,15-0,20$

<sup>1)</sup>  $s=0,60$     <sup>2)</sup>  $s=0,30-0,40$

## 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





# Reflex and transparent gauge glasses

technical datas according to OeNORM 7354 and DIN 7081



*KLINGER packing for gauge glasses, sealing gaskets and cushion gaskets*

## **Material:**

*Borosilicate glass, thermally pre-stressed, optically tested, properties as laid down in DIN and OeNORM.*

**Resistance to bending strain:**  
*=120 N/mm<sup>2</sup>.*

## **Mean coefficient of linear expansion:**

*$\alpha$  20/300  $\leq$  4.5 · 10<sup>-6</sup> · K<sup>-1</sup>; tested to DIN 523328.*

## **Transition temperature:**

*t<sub>g</sub>=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.*

## **Quality components**

*The quality of gauge glass depends on its:*

### • **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 heat treatment (pre-stressing) in which – as in 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 polarizing filter: as may be seen in the pictures on page 2 and 3, the stress lines are visible on the outer walls of the gauge 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 a glass with a perfectly flat surface. Therefore 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 facing the medium when used with steam at pressures over 35 bar or with media which cause rapid wear of glass.*

*Mica is a naturally-occurring substance. Only high-quality mica offers the desired gauge glass protection. Purity-wise our micas meet the requirements of ISO 2185: “stained first quality” up to 70 bar and “stained A quality” above 70 bar. Minimum light transmittancy is 1200 lux and it guarantees optimum readability of the liquid*

*level. KLINGER mica shields are individually packed to protect them against scratching. An exact, multi-language 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 continuously in motion: water evaporates, condensate forms.*

*Above all, the condensate running down the gauge glasses leaves traces of abrasion.*

*Boiler water is always chemically treated water from which mineral substances have been extracted. The demineralised water tends, however, to increase its mineral content and extracts this from glass. This chemical attack on the 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 nor should it exceed 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 increasing temperature – 1.5 pH degrees at a temperature rise up to 300 °C.*

## **Areas of application:**

- Observation of processes in industrial ovens, driers, filters, strainers, agitators and mixers.
- Observation of vessels such as tanks, boilers, silos ...
- Supervision of transportation of materials, e.g. in the solid state or liquids such as condensate or cooling fluids.
- 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 ...

# Circular sight glasses

made from borosilicate glass “extra-hard”

## From our standard range

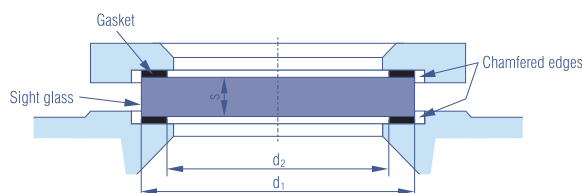
Glass		Permiss. PB**) bar	Gasket		
Diameter mm	Thickness mm		O.D. mm	I.D. mm	Thickness mm
31,75	12,7	175	*)	*)	*)
40	12	50	42	30	1,5
45	10	40	47	32	1,5
45	12	50	47	32	1,5
50	10	25	52	35	1,5
50	12	40	52	35	1,5
60	10	16	62	45	1,5
60	12	25	62	45	1,5
60	15	40	62	45	1,5
63	10	16	65	48	2
63	12	25	65	48	2
63	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 OeNORM M7353

\*) 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

$d_1$ : O.D. of glasses and gasket

$d_2$ : I.D. of gasket

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

$\sigma_{bB}$ : Minimum bending strength in N/mm<sup>2</sup>

S: Safety factor



## Technical datas

### Material:

Borosilicate glass, thermally pre-stressed, optically tested, properties as laid down in DIN and OeNORM.

Extract from the OeNORM: “Chemical pre-stressing of glasses is not permissible. For safety reasons soda-lime glasses may not be used.”

### Resistance to bending strain:

≥ 160 N/mm<sup>2</sup>

### Mean coefficient of linear expansion:

$\alpha_{20/300} \leq 4,5 \cdot 10^{-6} \cdot K^{-1}$ , tested to DIN 52328.

### Transition temperature:

$t_g = 550^\circ C$ , 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 pre-stressed

### Temperatur resistance:

suitable for temperatures from  $-273^\circ C$  to  $+300^\circ C$ , size 31.75/12.7 up to  $356^\circ C$

# Circular sight glasses

made from borosilicate glass “extra-hard”

### **KLINGER Package unit:**

Sight glasses are packed in individual cardboard boxes. In addition to the glass, each package contains a KLINGER 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:

OeNORM M 7353 (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	KLINGER house standard
31,75 mm to 125 mm	– ±0,5 mm	±0,13 mm ±0,5 mm
150 to 200 mm	±0,8 mm	±0,5 mm
Glass thickness		
12,7 mm	–	±0,05 mm
10 to 20 mm	±0,5 mm	±0,5 mm
above 20 mm	±0,8 mm	±0,5 mm