

MAXOS®

SAFETY SIGHT AND LEVEL GAUGE GLASSES
SPECIAL-TEMPERED

MADE IN GERMANY



MAXOS®: CLEAR VIEW WITH SAFETY

Sight glasses from Auer Lighting resist the most extreme influences and always provide decisive insights. Auer Lighting manufactures the MAXOS® safety sight glasses from the unique SUPRAX® 8488 borosilicate glass, which is well known for its chemical resistance – especially against alkali and acid. The purity and chemical composition also enables superior thermal prestressing.

Automated production guarantees extremely tight tolerances. All standard dimensions are available on short notice. Looking for special dimensions? Upon customer request, we also realize this very flexibly with our computer-controlled processing systems.

Ideal visibility even under high pressure

It's all about the inner values

Our safety sight glasses are ideal as level indicators and for visual control of flows in pipes and containers. The extreme resistance of the glasses to temperatures and pressure loads guarantees fast and reliable monitoring of individual devices and systems.

MAXOS® safety sight glasses are manufactured in line with national and international standards and regulations. The MAXOS® range comprises a complete offer of thermally prestressed (tempered) safety sight discs and longform level gauge glasses in dimensions and thicknesses for the various pressure and temperature ranges. MAXOS® safety sight and level gauge glasses are used at process pressures up to 400 bar, temperatures up to 300 °C and media with pH values from 2–13.

Application areas

Chemistry, pharmaceuticals and petrochemistry
Food production
Pressure vessels
Power plants
Iron and steel production
Paper production
Bio reactors
Crude oil production

Available standards

DIN 7080/7081
BS 3463
JIS B 8211
MIL – G – 16356



SUPRAX[®] 8488 Borosilicate glass

The SUPRAX[®] 8488 product range includes disc sight glasses, reflex and transparent level gauge glasses (also as high-pressure).

The specially developed SUPRAX[®] 8488 borosilicate glass used for the MAXOS[®] sight glasses guarantees a superior chemical resistance. The low expansion of the glass combined with thermal prestressing creates a high resistance to sudden temperatures changes.

Technical properties

Coefficient of expansion α 20 °C/300 °C	$4.1 \times 10^{-6} \text{ K}^{-1}$
Max. operating temperature	300 °C/572 °F
Thermal shock resistance as per ISO 720	ΔT 230 °C
Transformation temperature	545 °C
Glass temperature for the viscosities	$10^{13.0}$ 560 °C 1040 °F
dPas (Poise)	$10^{7.6}$ 800 °C 1472 °F
	$10^{4.0}$ 1210 °C 2210 °F
Density at 25 °C	2.3 g/cm ³
Modulus of elasticity	$67 \times 10^9 \text{ N/mm}^2$
Poisson's ratio μ	0.20
Thermal conductivity λ at 90 °C	$1.2 \frac{\text{W}}{\text{m}\cdot\text{K}}$
Refractive index n_d ($\lambda = 587.6 \text{ nm}$)	1.482
Photoelastic parameter K	$3.2 \times 10^{-6} \text{ mm}^2/\text{N}$

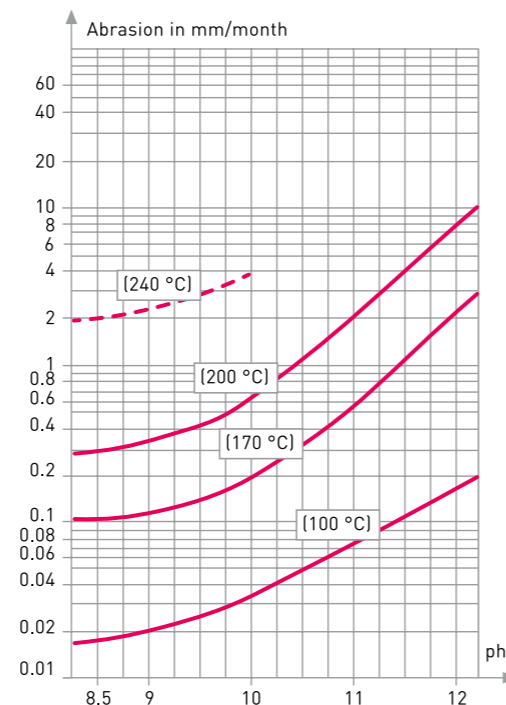
Chemical characteristics	Hydrolytic resistance	Acid resistance	Alkali resistance
Test acc. to	DIN ISO 720 ¹⁾	DIN ISO 1776 ²⁾	DIN ISO 695 ³⁾
Max. abrasion acc. to DIN ISO	0.1	<100 $\mu\text{g Na}_2\text{O}$ each 100 cm ²	>75–175 mg each 100 cm ²
MAXOS [®] Max. abrasion	0.050	<60 $\mu\text{g Na}_2\text{O}$ each 100 cm ²	<100 mg each 100 cm ²
MAXOS [®]	HGA 1	–	Class A2

It depends on the proportion: The high amount of silicon dioxide (SiO₂) and boric acid (B₂O₃) characterizes this type as a glass former. The proportion of boric acid influences the glass properties in a specific way: We use a proportion of only 11.5 %. This makes it more stable in comparison to glasses with an even higher boric acid content. In addition, the embedding in the structural network ensures extremely high chemical resistance.

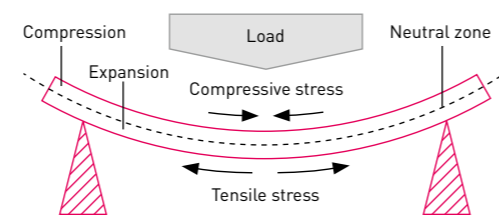
¹⁾ DIN ISO 720 Test procedure with classification: Water resistance of glass grains at 121 °C

²⁾ DIN ISO 1776 Flame spectrometry method: Resistance to hydrochloric acid at 100 °C

³⁾ DIN ISO 695 Test procedure with classification: Resistance to a boiling aqueous mixed alkaline solution



Abrasion of MAXOS[®] glass in aqueous phase at different temperatures as a function of the pH-value.



The homogeneous distribution of the thermal prestressing ensures increased breaking strength.

Aluminosilicate glass

Aluminosilicate glass is available in round and transparent versions.

Aluminosilicate glass is typically used wherever pressure loads occur at temperatures above 300 °C. The aluminosilicate glass from German production is characterized by a particularly high temperature resistance of up to 375 °C.

Technical properties

Expansion coefficient α 20 °C/300 °C	$4.8 \times 10^{-6} \text{ K}^{-1}$
Max. operating temperature	375 °C/707 °F
Thermal shock resistance as per ISO 718	ΔT 230 °C
Max. operating pressure	225 bar/3,263 psi
Surface pressure prestressing	$\geq 90 \text{ N/mm}^2/13,000 \text{ psi}$

Chemical properties

Water resistance	ISO 719 ⁴⁾	Class 1
Acid resistance	ISO 12116 ⁵⁾	Class 3
Alkaline solution resistance	ISO 695 ³⁾	Class 3

Aluminosilicate transparent level gauge glasses

Size	Length (l)		Dimensions Width (b)		Thickness (h)		Max. flatness tolerance	
	mm	inch	mm	inch	mm	inch	mm	inch
1	115	4.500	34	1.339	17	0.669	0.05	0.002
3	165	6.500	34	1.339	17	0.669	0.05	0.002
5	220	8.625	34	1.339	17	0.669	0.08	0.003
6	250	9.874	34	1.339	17	0.669	0.13	0.005
7	280	11.000	34	1.339	17	0.669	0.13	0.005
8	320	12.625	34	1.339	17	0.669	0.13	0.005
9	340	13.374	34	1.339	17	0.669	0.13	0.005
Tolerances	+ 0	+ 0	+ 0.2	+ 0.008	+ 0.5	+ 0.020		
	- 1.5	- 0.059	- 0.8	- 0.031	- 0.5	- 0.020		

Aluminosilicate disc sight glasses

Dimensions $d_1 \times s$ (mm)	Inspection aperture d_2 (mm)	Permissible pressure in bar	Dimensions $d_1 \times s$ (inch)	Inspection aperture d_2 (inch)	Permissible pressure in psi
31.60 x 12.75	18.6	210	1.244 x 0.502	0.732	3046
33.12 x 12.95	20.12	210	1.304 x 0.510	0.792	3046
34.00 x 17.00	21	210	1.339 x 0.669	0.827	3046

A suitable mica protection can additionally protect the glass from aggressive media such as alkaline solutions and acids.

⁴⁾ DIN ISO 719 Test procedure with classification: Water resistance of glass grains at 98 °C

⁵⁾ DIN ISO 12116 Test procedure with classification: Resistance to a boiling aqueous hydrochloric acid solution

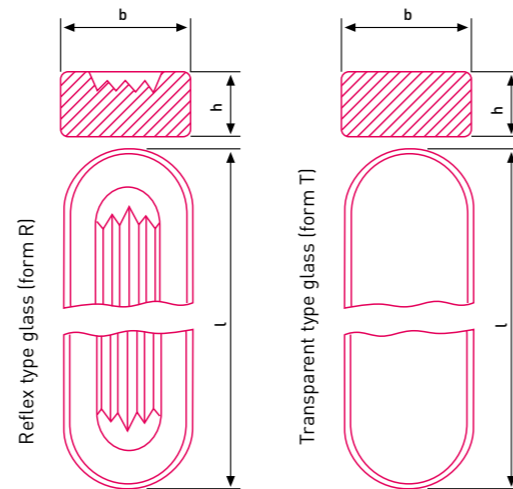
MAXOS[®] level gauge glasses

Long form reflex and transparent

Bending strength is determined by the surface compressive stress and the inherent resistance of the glass. The inherent resistance is heavily dependent upon the surface quality.

For safety reasons, the stress to the glasses caused by internal forces, thermal stress and vessel pressure have to be totally absorbed by the surface compressive stress so that a tensile stress of the glass surface is prevented.

Application conditions	Maximum permissible pressure		Maximum permissible temperature	
	bar	psi	°C	°F
Saturated steam or hot water in direct contact with reflex or transparent sight glasses	35	500	243	470
Saturated steam or hot water in contact with transparent sight glasses protected with mica	103	1,500	320	608
Non-corrosive, non-steam service and no technically significant glass attack, with reflex or transparent glasses	280	4,000	38	100
Transparent sight glasses in contact with medias with no technically significant glass attack	345	5,000	38	100
High pressure transparent sight glasses in special gauges	414	6,000	38	100

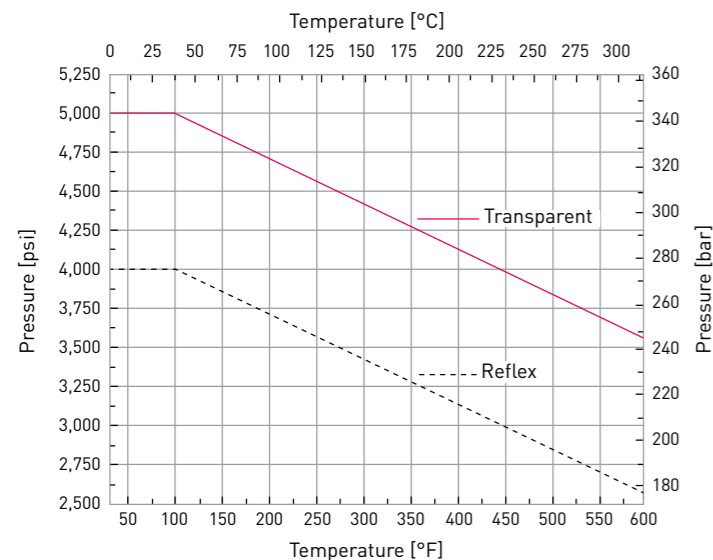


Temperature

Thermal shock resistance ΔT 230 °C
 Max. permissible temperature 300 °C (572 °F)
 Protected with mica 320 °C (608 °F)



Special tempered MAXOS[®] glass under polarized light



Surface compressive stress

Standard level gauge glasses
 $\geq 90 \text{ N/mm}^2$ 13,000 psi
 Typically measured values
 100 N/mm^2 14,500 psi

High-pressure level gauge glasses
 $\geq 100 \text{ N/mm}^2$ 14,500 psi
 Typically measured values
 110 N/mm^2 16,000 psi

Parallelism

Standard level gauge glasses
 $\leq 0.13 \text{ mm}$ 0.005 inches

High-pressure level gauge glasses
 $\leq 0.05 \text{ mm}$ 0.002 inches

Bending strength

Standard level gauge glasses
 $\geq 150 \text{ N/mm}^2$ 21,000 psi
 Typically measured values
 170 N/mm^2 25,000 psi

High-pressure level gauge glasses
 $\geq 180 \text{ N/mm}^2$ 26,000 psi
 Typically measured values
 200 N/mm^2 29,000 psi

Standard product range (width 34 mm)

Size	Length (l)		Width (b)		Thickness (h)		Max. flatness tolerance				
	mm	inch	mm	inch	mm	inch	Standard	High pressure	Standard	High pressure	
0	95	3.740	34	1.339	17	0.669	0.05	0.002	-	-	
1	115	4.500	34	1.339	17	0.669	0.05	0.002	0.05	0.002	
2	140	5.500	34	1.339	17	0.669	0.05	0.002	0.05	0.002	
3	165	6.500	34	1.339	17	0.669	0.05	0.002	0.05	0.002	
4	190	7.500	34	1.339	17	0.669	0.08	0.003	0.05	0.002	
5	220	8.625	34	1.339	17	0.669	0.08	0.003	0.05	0.002	
6	250	9.874	34	1.339	17	0.669	0.13	0.005	0.05	0.002	
7	280	11.000	34	1.339	17	0.669	0.13	0.005	0.05	0.002	
8	320	12.625	34	1.339	17	0.669	0.13	0.005	0.05	0.002	
9	340	13.374	34	1.339	17	0.669	0.13	0.005	0.05	0.002	
10	370	14.566	34	1.339	17	0.669	0.13	0.005	-	-	
11	400	15.748	34	1.339	17	0.669	0.13	0.005	-	-	
Tolerances	+ 0	+ 0	+ 0.2	+ 0.008	+ 0.5	+ 0.020					High pressure is valid only for transparent glasses.
	- 1.5	- 0.059	- 0.8	- 0.031	- 0.5	- 0.020					

Standard product range (width 30 mm)

Size	Length (l)	Dimensions	Thickness (h)	Max. flatness tolerance
	mm	Width (b)	mm	mm
1	115	30	17	0.05
2	140	30	17	0.05
3	165	30	17	0.05
4	190	30	17	0.05
5	220	30	17	0.08
6	250	30	17	0.08
7	280	30	17	0.13
8	320	30	17	0.13
9	340	30	17	0.13
Tolerances	Up to 250 \pm 0.8	+ 0.5	+ 0.5	
	Above 250 \pm 1.0	- 0.8	- 0.5	

Special dimensions for reflex and transparent available upon request, e. g. thickness 21 mm

When to use which type of glass?

Reflex level gauge glasses

Reflex level gauge glasses are installed in gauges that have a housing closed at the back. The incident light is refracted by the reflective grooves of the glass in the media-carrying area of the fitting. The area in which the liquid medium is located is thus shown as a dark bar – in contrast to the silvery gaseous area.

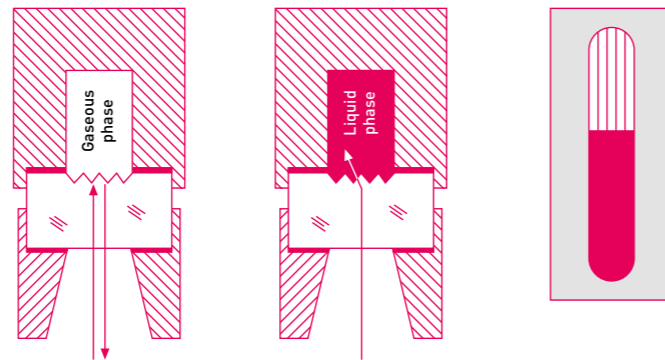


Diagram:
Course of the light beams in the gaseous and liquid range

Transparent level gauge glasses

These glasses are mainly used in gauges open on both sides for high pressure applications. The incident light (daylight or that of a luminaire) passes through both sight glasses between which the medium is located. The level is visible as a line or through the medium itself. With aggressive media or when using saturated steam, the transparent level gauge glasses should also be provided with mica protection.

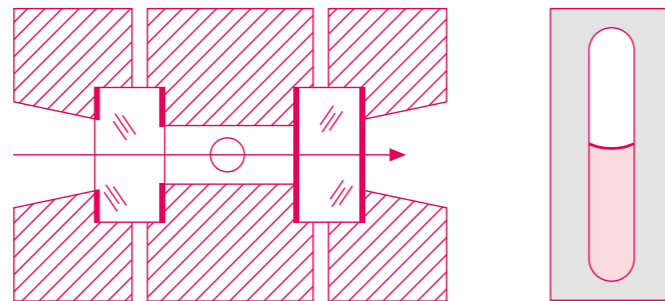


Diagram:
Course of the beams

Manufacturing process

The mechanical strength and pressure resistance of MAXOS® safety level gauge glasses depends on many factors: Decisive factors include thermal prestressing, homogeneity of the glass, parallelism, exact dimensions and a flawless surface. At Auer Lighting, a state-of-the-art glass melting process ensures a homogeneous SUPRAX® 8488 borosilicate glass that is nearly free of streaks and bubbles. Through high-quality grinding and polishing processes we achieve particularly flat and plano-parallel surfaces. The prestressing that occurs during thermal tempering is decisive for the strength of the glass.

Auer Lighting ensures all measurement and dimensional tolerances by process-integrated tests. All processing steps can be traced back through encoding on the glass.



MAXOS[®] disc sight glasses

Technical characteristics

Bending strength	≥ 160 N/mm ²	23,000 psi
Surface compressive stress	≥ 100–140 N/mm ²	14,500–20,000 psi
Parallelism	≤ 0.20 mm	0.008 inches
Flatness ¹	Diameter:	up to 100 mm ≤ 0.05
		above 100 to 150 mm ≤ 0.08
		above 150 to 200 mm ≤ 0.12
		above 200 mm ≤ 0.15
Thermal shock resistance	ΔT 230 °C	
Max. permissible temperature	300 °C	572 °F
Protected with mica	320 °C	608 °F

¹Measurements of flatness are taken only in the sealing area

Dimensional tolerances acc. to DIN 7080

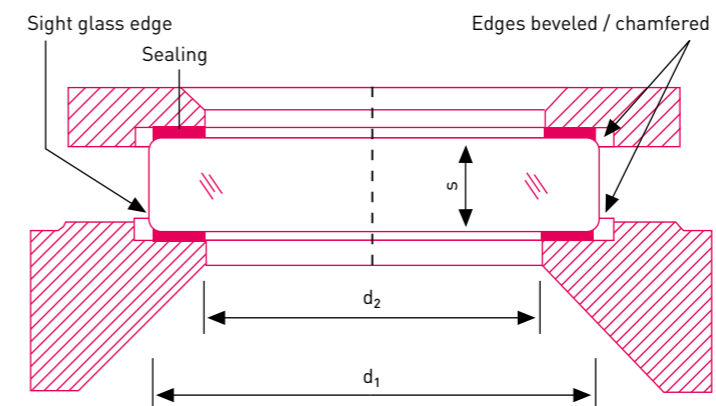
Diameter

up to 150 mm	± 0.5 mm
150 to 200 mm	± 0.8 mm
above 200 mm	± 1.0 mm

Thickness

up to 20 mm	+ 0.50 mm /– 0.25 mm
above 20 mm	+ 0.80 mm /– 0.40 mm

Calculation of glass thickness acc. to DIN 7080



$$s \geq 0.55 \cdot d_m \sqrt{\frac{p \cdot S}{10 \cdot \sigma_{DV \text{ perm.}}}}$$

s Theoretical minimum glass thickness in mm

$d_m = \frac{d_1 + d_2}{2}$ Mean sealing diameter in mm

d_1 Glass and sealing outer diameter in mm

d_2 Sealing inside diameter in mm

p Permissible pressure in bar

$\sigma_{DV \text{ perm.}}$ Min. value of surface compressive stress in N/mm²

S Safety factor = 5

Ex. calculation for $d_1 = \varnothing 100 \text{ mm}$

Calculation of the minimum glass thickness

S	=	5 $\sigma_{DV \text{ perm.}}$ = 100 N/mm ²
p	=	10.00 bar
d_1	=	100.00 mm
d_2	=	80.00 mm
s	≥	11.07 mm

Calculation of the permissible pressure

S	=	5 $\sigma_{DV \text{ perm.}}$ = 100 N/mm ²
s	=	15.00 mm
d_1	=	100.00 mm
d_2	=	80.00 mm
p	=	18.37 bar



All MAXOS[®] disc sight glasses are marked with a production code number

MAXOS® disc sight glasses

Standard product range as per DIN 7080

Dimensions d ₁ x s (mm)	Inspection aperture d ₂ (mm)	Permissible pressure in bar	Dimensions d ₁ x s (inch)	Inspection aperture d ₂ (inch)	Permissible pressure in psi
45 x 10	32	40	1.772 x 0.394	1.260	580
45 x 12	32	50	1.772 x 0.472	1.260	725
50 x 10	35	25	1.969 x 0.394	1.378	363
50 x 12	35	40	1.969 x 0.472	1.378	580
60 x 10	45	16	2.362 x 0.394	1.772	232
60 x 12	45	25	2.362 x 0.472	1.772	363
60 x 15	45	40	2.362 x 0.591	1.772	580
63 x 10	48	16	2.480 x 0.394	1.890	232
63 x 12	48	25	2.480 x 0.472	1.890	363
63 x 15	48	40	2.480 x 0.591	1.890	580
80 x 12	65	16	3.150 x 0.472	2.559	232
80 x 15	65	25	3.150 x 0.591	2.559	363
80 x 20	65	40	3.150 x 0.787	2.559	580
100 x 15	80	16	3.937 x 0.591	3.150	232
100 x 20	80	25	3.937 x 0.787	3.150	363
100 x 25	80	40	3.937 x 0.984	3.150	580
125 x 15	100	10	4.921 x 0.591	3.937	145
125 x 20	100	16	4.921 x 0.787	3.937	232
125 x 25	100	25	4.921 x 0.984	3.937	363
135 x 25	110	25	5.315 x 0.984	4.331	363
150 x 20	125	10	5.906 x 0.787	4.921	145
150 x 25	125	16	5.906 x 0.984	4.921	232
150 x 30	125	25	5.906 x 1.181	4.921	363
175 x 20	150	10	6.890 x 0.787	5.906	145
175 x 25	150	16	6.890 x 0.984	5.906	232
175 x 30	150	25	6.890 x 1.181	5.906	363
200 x 20	175	8	7.874 x 0.787	6.890	116
200 x 25	175	10	7.874 x 0.984	6.890	145
200 x 30	175	16	7.874 x 1.181	6.890	232
250 x 25	225	8	9.843 x 0.984	8.858	116
250 x 30	225	10	9.843 x 1.181	8.858	145
265 x 30	240	8	10.433 x 1.181	9.449	116



MAXOS[®] disc sight glasses in special sizes

Dimensions d ₁ x s (mm)	Inspection aperture d ₂ (mm)	Permissible pressure in bar	Dimensions d ₁ x s (inch)	Inspection aperture d ₂ (inch)	Permissible pressure in psi
24 x 10	14	150	0.945 x 0.394	0.551	2175
30 x 12	16,6	150	1.181 x 0.472	0.654	2175
30 x 15	16,6	200	1.181 x 0.591	0.654	2900
31.6 x 12.75	20	150	1.244 x 0.502	0.787	2175
33 x 14	20	150	1.299 x 0.551	0.787	2175
34 x 17	24	200	1.339 x 0.669	0.945	2900
35 x 7	25	25	1.378 x 0.276	0.984	363
40 x 10	30	40	1.575 x 0.394	1.181	580
40 x 12	30	50	1.575 x 0.472	1.181	725
44 x 10	32	40	1.732 x 0.394	1.260	580
44 x 12	32	50	1.732 x 0.472	1.260	725
55 x 6,5	40	6	2.165 x 0.256	1.575	87
55 x 10	40	25	2.165 x 0.394	1.575	363
60 x 20	45	95	2.362 x 0.787	1.772	1377
63 x 8	48	8	2.480 x 0.315	1.890	116
65 x 10	50	12	2.559 x 0.394	1.969	174
65 x 15	50	40	2.559 x 0.591	1.969	580
70 x 12	55	16	2.756 x 0.472	2.165	232
70 x 15	55	25	2.756 x 0.591	2.165	363
75 x 12	60	16	2.953 x 0.472	2.362	232
80 x 10	65	10	3.150 x 0.394	2.559	145
86 x 12	71	10	3.386 x 0.472	2.795	145
90 x 10	70	8	3.543 x 0.394	2.756	116
92 x 10	72	8	3.622 x 0.394	2.835	116
94 x 12	79	10	3.701 x 0.472	3.110	145
95 x 10	75	6	3.740 x 0.394	2.953	87
95 x 15	75	16	3.740 x 0.591	2.953	232
100 x 10	80	7	3.937 x 0.394	3.150	101
100 x 12	80	10	3.937 x 0.472	3.150	145
105 x 15	80	16	4.134 x 0.591	3.150	232
110 x 12,5	85	10	4.331 x 0.492	3.346	145
110 x 20	90	25	4.331 x 0.787	3.543	363
113 x 15	88	10	4.449 x 0.591	3.465	145
115 x 15	90	10	4.528 x 0.591	3.543	145
120 x 10	100	4	4.724 x 0.394	3.937	58
120 x 15	100	10	4.724 x 0.591	3.937	145
120 x 18	100	16	4.724 x 0.709	3.937	232
125 x 30	100	40	4.921 x 1.181	3.937	580
130 x 15	105	10	5.118 x 0.591	4.134	145
135 x 15	110	8	5.315 x 0.591	4.331	116
140 x 15	115	8	5.512 x 0.591	4.528	116
150 x 10	125	2	5.906 x 0.394	4.921	29
150 x 15	125	8	5.906 x 0.591	4.921	116
160 x 20	135	12	6.299 x 0.787	5.315	174
170 x 15	145	5	6.693 x 0.591	5.709	73
170 x 20	145	8	6.693 x 0.787	5.709	116
210 x 25	185	10	8.268 x 0.984	7.283	145
250 x 20	225	4	9.843 x 0.787	8.858	58

Sight glasses in individual sizes

Our range of SUPRAX[®] and aluminosilicate sight glasses covers all known standard dimensions and specification requirements. Do you need individual sizes? We will be happy realize this for you – even for small quantities. We offer you the right glass type and dimensions for your specific requirements and advise you purposefully even in the event of extraordinary challenges. Fast implementation and high customer satisfaction are our top priorities. Our technical experts will be happy to help you if you have any questions about applications at extreme pressures and temperatures as well as unusual media.

Quality certificates

Quality and safety are our top priorities. In order to prove this, we can at any time provide corresponding test certificates for our MAXOS[®] safety sight glasses upon customer request. We prove the conformity according to various industrial standards with test reports 2.2 and inspection certificates 3.1 as per EN 10204. In addition, we can provide our worldwide customers with certificates of food safety, compliance with FDA standards and IHK certificates of origin or individual manufacturer declarations.

Handling

Our safety sight glasses are manufactured and tested with a high level of precision and care. Until installation in a fitting, we recommend that the glass be kept in its original packaging. Contact with sharp-edged and rigid materials should be avoided, as should movement of the glass on work bench or other work space. Under certain circumstances, this can lead to damage in the form of scratches. When installing in the sight glass fitting, chips and damage to the chamfers of the sight glass need to be avoided as this can significantly reduce the pressure load.





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