SOLUTIONS IN GLASS

BOROSILICATE GLASS

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GVB SOLUTIONS IN GLASS

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INDEX

03 OUR PRODUCT AND US
- TECHNICAL BOROSILICATE GLASS 3.3

04 TUBING
- ORDER INFORMATION TUBES

12 RODS
- ORDER INFORMATION RODS
- ORDER ARTICLE : PROFILE RODS PROFILE AND CAPILLARY

15 GENERAL DESCRIPTION
- THERMAL, PHYSICAL, MECHANICAL, AND ELECTRIC PROPERTIES
- OPTICAL PROPERTIES
- CHEMICAL PROPERTIES
- CHEMICAL COMPOSITION
- HOW TO COOL THE GLASS AFTER ANNEALING TEMPERATURE
- HEAT STABILITY
- PRESSURE RESISTANCE OF TUBES AND CAPILLARY TUBES
- TECHNICAL TERMS OF DELIVERY

INDEX

23 GROUND JOINTS

- COMPONENTS AND PARTS MADE OF BOROSILICATE GLASS 3.3

26 SCREWTHREAD TUBES

- SCREWTHREAD TUBES OF BOROSILICATE GLASS 3.3

28 NEW BOROPLATE FLOATED BOROSILICATE GLASS

- GENERAL DESCRIPTION
- ORDER INFORMATION
- OPTICAL PROPERTIES
- THERMAL, PHYSICAL, MECHANICAL, AND ELECTRIC PROPERTIES
- CHEMICAL PROPERTIES
- CHEMICAL COMPOSITION
- HOW TO COOL THE GLASS AFTER ANNEALING TEMPERATURE
- HEAT STABILITY
- IMPACT STRENGTH AND SHOCK RESISTANCE

OUR PRODUCT AND US

Technical borosilicate glass 3.3

You are in need of components made of borosilicate glass 3.3 for your products?

Borosilicate glass 3.3 is a high-quality and versatile material which, thanks to its high thermal and chemical resistance, its smooth and pore-free surface, its perfect transparency, its catalytic neutrality and its high corrosion resistance, can also be used in long-term operation in areas where the highest demands are placed on the products in terms of thermal and chemical stability as well as neutrality towards the substances or preparations that come into contact with them.

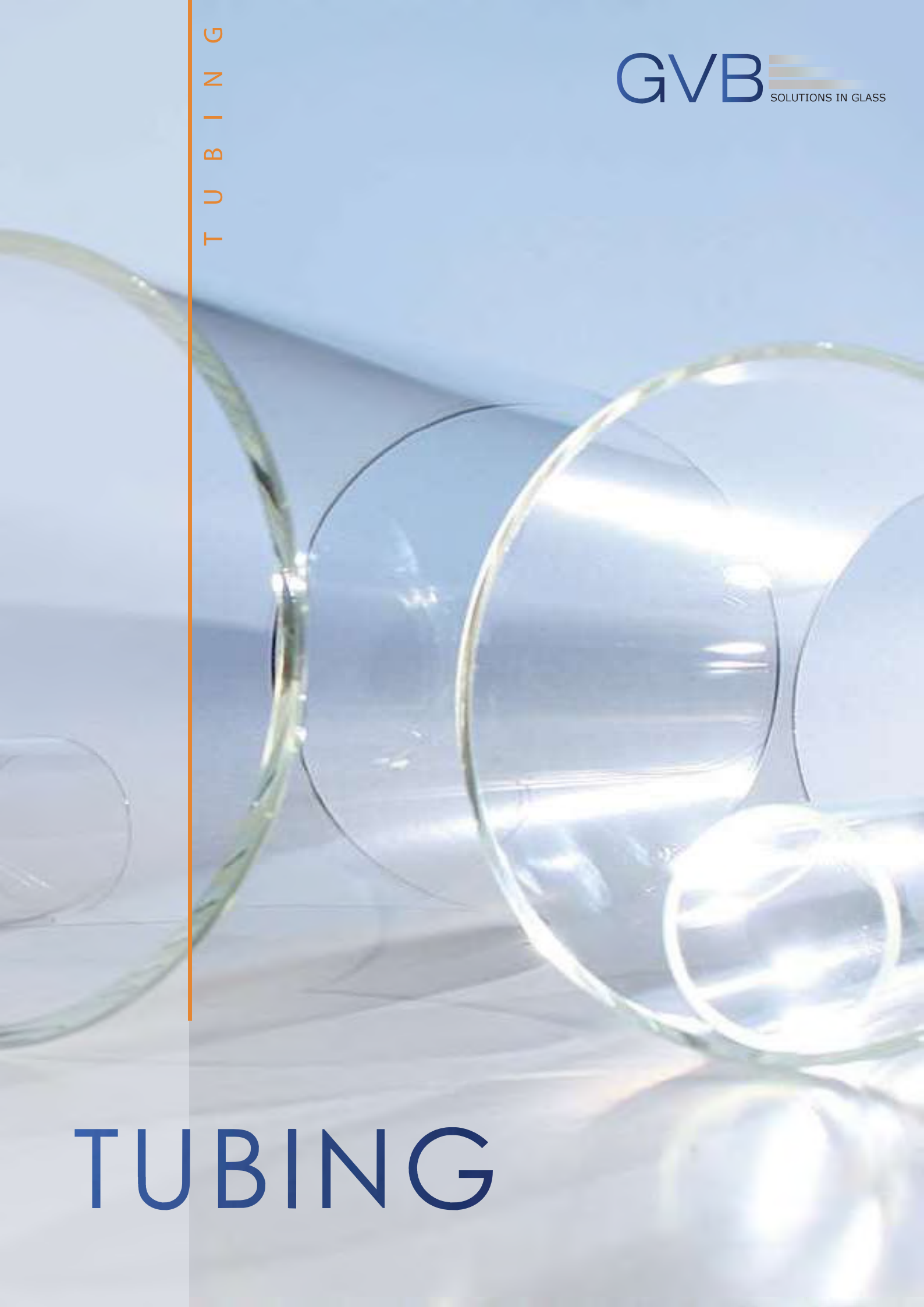
Tubes, rods, profiles and capillaries made of borosilicate glass 3.3 are used, for example, in the production of laboratory glassware, industrial apparatus, in testing facilities, as decorative glass as well as in pipelines and solar collectors, to name just a few examples.

We are dedicated in supporting you to find the right glass for your application quickly and easily.

GVB - Solutions in Glass offers you a wide range of cylindrical and flat borosilicate glass. In addition, we also supply components such as standard ground joints and threads in a wide variety of sizes. Our team members are specialists in technical glass: they will advise you on suitable product variants and, of course, keep an eye on the cost-benefit factor for you.

We offer you an extensive stock range as well as customised products, individual advice and flexible delivery schedules. In doing so, we guarantee you an approved and consistently high quality.

You would like individual advice? Please contact us:
www.g-v-b.de



GVB SOLUTIONS IN GLASS

TUBING

TUBING

ORDER INFORMATION TUBES

Outer Diameter		Wall Thickness	Weight per Tube	Packing Unit		Order No.
						Nr.
mm		mm	g	Amount of Tubes	Weight app. kg	
4	± 0,15	0,8 ± 0,04	27	400	10,8	2080004
5	± 0,15	0,8 ± 0,04	35	256	9,0	2080005
6	± 0,15	1,0 ± 0,04	53	170	9,0	2080006
		1,5 ± 0,10	71	170	12,1	3080006
7	± 0,15	1,0 ± 0,04	63	121	7,6	2080007
		1,5 ± 0,10	87	121	10,5	3080007
8	± 0,15	1,0 ± 0,04	74	100	7,4	2080008
		1,5 ± 0,10	102	100	10,2	3080008
9	± 0,15	1,0 ± 0,04	84	81	6,8	2080009
		1,5 ± 0,10	118	81	9,6	3080009
10	± 0,15	1,0 ± 0,04	95	64	6,1	1080010
		1,5 ± 0,10	134	64	8,6	2080010
		2,2 ± 0,15	180	64	11,5	3080010
		3,5 ± 0,25	239	64	15,3	4080010
11	± 0,18	1,0 ± 0,04	105	121	12,7	1080011
		1,5 ± 0,10	150	121	18,2	2080011
		2,2 ± 0,15	203	50	10,2	3080011
12	± 0,18	1,0 ± 0,04	116	100	11,6	1080012
		1,5 ± 0,10	166	100	16,6	2080012
		2,2 ± 0,15	227	49	11,1	3080012
		3,5 ± 0,25	313	49	15,3	4080012
13	± 0,18	1,0 ± 0,04	126	81	10,2	1080013
		1,5 ± 0,10	181	81	14,7	2080013
		2,2 ± 0,15	250	81	20,3	3080013
14	± 0,18	1,0 ± 0,04	137	64	8,8	1080014
		1,5 ± 0,10	197	64	12,6	2080014
		2,2 ± 0,15	273	64	17,5	3080014
15	± 0,18	1,2 ± 0,05	174	49	8,5	1080015
		1,8 ± 0,10	250	49	12,3	2080015
		2,5 ± 0,15	328	49	16,1	3080015
16	± 0,18	1,2 ± 0,05	187	49	9,2	1080016
		1,8 ± 0,10	269	49	13,2	2080016
		2,5 ± 0,15	355	49	17,4	3080016
		3,5 ± 0,40	460	49	22,5	4080016

ORDER INFORMATION TUBES

Outer Diameter		Wall Thickness	Weight per Tube	Packing Unit		Order No.
	mm	mm	g	Amount of Tubes	Weight app. kg	
17	± 0,18	1,2 ± 0,05	199	36	7,2	1080017
		1,8 ± 0,10	288	36	10,4	2080017
		2,5 ± 0,15	381	36	13,7	3080017
18	± 0,18	1,2 ± 0,05	212	36	7,6	1080018
		1,8 ± 0,10	306	36	11,0	2080018
		2,5 ± 0,15	407	36	14,7	3080018
19	± 0,18	1,2 ± 0,05	224	64	14,3	1080019
		1,8 ± 0,10	325	64	20,8	2080019
		2,5 ± 0,15	433	36	15,6	3080019
20	± 0,25	1,2 ± 0,05	237	49	11,6	1080020
		1,8 ± 0,10	344	49	16,9	2080020
		2,5 ± 0,15	460	49	22,5	3080020
		4,0 ± 0,40	673	36	24,2	4080020
22	± 0,25	1,2 ± 0,05	262	36	9,4	1080022
		1,8 ± 0,10	382	36	13,8	2080022
		2,5 ± 0,15	512	36	18,4	3080022
24	± 0,25	1,2 ± 0,05	288	36	10,4	1080024
		1,8 ± 0,10	420	36	15,1	2080024
		2,5 ± 0,15	565	36	20,3	3080024
		4,0 ± 0,40	841	25	21,0	4080024
26	± 0,25	1,4 ± 0,05	362	36	13,0	1080026
		2,0 ± 0,10	504	36	18,1	2080026
		2,8 ± 0,15	683	36	24,6	3080026
28	± 0,25	1,4 ± 0,05	391	25	9,8	1080028
		2,0 ± 0,10	546	25	13,7	2080028
		2,8 ± 0,15	741	25	18,5	3080028
		4,0 ± 0,40	1006	16	16,1	4080028
30	± 0,35	1,4 ± 0,10	421	36	15,2	1080030
		2,0 ± 0,15	588	36	21,2	2080030
		2,8 ± 0,20	800	25	20,0	3080030
		4,0 ± 0,40	1093	16	17,5	4080030
32	± 0,35	1,4 ± 0,10	450	25	11,3	1080032
		2,0 ± 0,15	631	25	15,8	2080032
		2,8 ± 0,20	859	25	21,5	3080032
		4,0 ± 0,40	1175	16	18,8	4080032

ORDER INFORMATION TUBES

Outer Diameter		Wall Thickness	Weight per Tube	Packing Unit		Order No.
	mm	mm	g	Amount of Tubes	Weight app. kg	Nr.
33	± 0,35	2,0 ± 0,15	652	27	17,6	2080033
34	± 0,35	1,4 ± 0,10	480	16	7,7	1080034
		2,0 ± 0,15	673	16	10,8	2080034
		2,8 ± 0,20	918	16	14,7	3080034
36	± 0,40	1,4 ± 0,10	509	16	8,1	1080036
		2,0 ± 0,15	715	16	11,4	2080036
		2,8 ± 0,20	977	16	15,6	3080036
		4,0 ± 0,40	1345	16	21,5	4080036
38	± 0,40	1,4 ± 0,10	538	16	8,6	1080038
		2,0 ± 0,15	757	16	12,1	2080038
		2,8 ± 0,20	1036	16	16,6	3080038
40	± 0,55	1,6 ± 0,10	646	16	10,3	1080040
		2,3 ± 0,20	911	16	14,6	2080040
		3,2 ± 0,30	1237	16	19,8	3080040
		5,0 ± 0,40	1845	9	16,6	4080040
42	± 0,55	1,6 ± 0,10	679	16	10,9	1080042
		2,3 ± 0,20	960	16	15,4	2080042
		3,2 ± 0,30	1305	16	20,9	3080042
44	± 0,55	1,6 ± 0,10	713	16	11,4	1080044
		2,3 ± 0,20	1008	16	16,1	2080044
		3,2 ± 0,30	1372	16	22,0	3080044
		4,5 ± 0,40	1867	9	16,8	4080044
45	± 0,65	5,0 ± 0,40	2111	9	19,0	2080045
46	± 0,65	1,6 ± 0,10	747	16	12,0	1080046
		2,3 ± 0,20	1056	16	16,9	2080046
		3,2 ± 0,30	1439	16	23,0	3080046
48	± 0,65	1,6 ± 0,10	780	9	7,0	1080048
		2,3 ± 0,20	1105	9	9,9	2080048
		3,2 ± 0,30	1507	9	13,6	3080048
50	± 0,70	1,8 ± 0,15	912	12	10,9	1080050
		2,5 ± 0,20	1248	12	15,0	2080050
		3,5 ± 0,30	1710	9	15,4	3080050
		5,0 ± 0,40	2364	9	21,3	4080050
		7,0 ± 0,60	3174	9	28,6	5080050

ORDER INFORMATION TUBES

Outer Diameter		Wall Thickness	Weight per Tube	Packing Unit		Order No.
						Nr.
mm		mm	g	Amount of Tubes	Weight app. kg	
52	± 0,70	1,8 ± 0,15	950	12	11,4	1080052
		2,5 ± 0,20	1300	12	15,6	2080052
		3,5 ± 0,30	1784	9	16,1	3080052
		5,0 ± 0,40	2478	9	22,3	4080052
54	± 0,70	1,8 ± 0,15	987	9	8,9	1080052
		2,5 ± 0,20	1353	9	12,2	2080052
		3,5 ± 0,30	1857	9	16,7	3080052
		5,0 ± 0,40	2575	9	23,2	4080052
55	± 0,70	5,0 ± 0,40	2627	9	23,6	2080055
56	± 0,70	1,8 ± 0,15	1025	12	12,3	1080056
		2,5 ± 0,20	1406	12	16,9	2080056
		3,5 ± 0,30	1931	9	17,4	3080056
		5,0 ± 0,40	2680	9	24,1	4080056
58	± 0,70	1,8 ± 0,15	1063	12	12,8	1080058
		2,5 ± 0,20	1458	12	17,5	2080058
		3,5 ± 0,30	2005	4	8,0	3080058
		5,0 ± 0,40	2794	4	11,2	4080058
60	± 0,80	2,2 ± 0,20	1336	12	16,0	1080060
		3,2 ± 0,25	1910	12	22,9	2080060
		4,2 ± 0,40	2463	4	9,9	3080060
		5,0 ± 0,40	2890	4	11,6	4080060
		7,0 ± 0,60	3912	4	15,6	5080060
		9,0 ± 0,70	4840	4	19,4	6080060
65	± 0,90	2,2 ± 0,20	1452	8	11,6	1080065
		3,2 ± 0,25	2078	8	16,6	2080065
		4,2 ± 0,40	2683	8	21,5	3080065
		5,0 ± 0,40	3153	4	12,6	4080065
70	± 0,90	2,2 ± 0,20	1567	8	12,5	1080070
		3,2 ± 0,25	2246	8	18,0	2080070
		4,2 ± 0,40	2904	8	23,2	3080070
		5,0 ± 0,40	3415	4	13,7	4080070
		7,0 ± 0,60	4650	4	18,6	5080070
		9,0 ± 0,70	5788	4	23,2	6080070

ORDER INFORMATION TUBES

Outer Diameter		Wall Thickness	Weight per Tube	Packing Unit		Order No.
mm		mm	g	Amount of Tubes	Weight app. kg	Nr.
75	± 0,90	2,2 ± 0,20	1683	4	6,7	1080075
		3,2 ± 0,25	2414	4	9,7	2080075
		4,2 ± 0,40	3125	4	12,5	3080075
		5,0 ± 0,40	3678	4	14,7	4080075
80	± 1,20	2,5 ± 0,20	2036	4	8,1	1080080
		3,5 ± 0,30	2814	4	11,3	2080080
		5,0 ± 0,50	3941	4	15,8	3080080
		9,0 ± 0,80	6737	4	26,9	4080080
85	± 1,20	2,5 ± 0,20	2167	4	8,7	1080085
		3,5 ± 0,30	2998	4	12,0	2080085
		5,0 ± 0,50	4203	4	16,8	3080085
90	± 1,20	2,5 ± 0,20	2299	4	9,2	1080090
		3,5 ± 0,30	3181	4	12,7	2080090
		5,0 ± 0,50	4466	4	17,9	3080090
		7,0 ± 0,70	6126	4	24,5	4080090
		9,0 ± 0,80	7686	4	30,7	5080090
95	± 1,50	2,5 ± 0,20	2430	4	9,7	1080095
		3,5 ± 0,30	3365	4	13,5	2080095
		5,0 ± 0,50	4729	4	18,9	3080095
100	± 1,50	2,5 ± 0,20	2561	3	7,7	1080100
		3,0 ± 0,20	3058	3	9,2	2080100
		3,5 ± 0,30	3549	3	10,6	3080100
		5,0 ± 0,50	4992	3	15,0	4080100
		7,0 ± 0,70	6864	3	20,6	5080100
		9,0 ± 0,80	8635	3	25,9	6080100
105	± 1,50	3,0 ± 0,30	3216	3	9,6	1080105
		5,0 ± 0,50	5254	3	15,8	2080105
110	± 1,50	3,0 ± 0,30	3373	3	10,1	1080110
		5,0 ± 0,50	5517	3	16,6	2080110
		7,0 ± 0,80	7602	3	22,8	3080110
115	± 1,50	3,0 ± 0,30	3531	3	10,6	1080115
		5,0 ± 0,50	5780	3	17,30	2080115
		7,0 ± 0,80	7971	3	23,90	3080115

ORDER INFORMATION TUBES

Outer Diameter		Wall Thickness	Weight per Tube	Packing Unit		Order No.
						Nr.
mm		mm	g	Amount of Tubes	Weight app. kg	
120	± 1,50	3,0 ± 0,40	3689	3	11,1	1080120
		5,0 ± 0,60	6042	3	18,1	2080120
		7,0 ± 0,80	8340	3	25,0	3080120
		9,0 ± 0,90	10533	1	10,5	4080120
125	± 1,50	3,0 ± 0,40	3846	3	11,5	1080125
		5,0 ± 0,60	6305	3	18,9	2080125
		9,0 ± 0,90	11008	1	11,0	3080125
130	± 1,60	3,0 ± 0,50	4004	2	8,0	1080130
		5,0 ± 0,60	6568	2	13,1	2080130
		7,0 ± 0,90	9078	2	18,2	3080130
		9,0 ± 0,90	11482	1	11,5	4080130
135	± 1,60	3,0 ± 0,50	4161	2	8,3	1080135
		5,0 ± 0,60	6831	2	13,7	2080135
		7,0 ± 0,90	9447	2	18,9	3080135
140	± 1,70	3,0 ± 0,50	4319	2	8,6	1080140
		5,0 ± 0,60	7093	2	14,2	2080140
		7,0 ± 0,90	9816	2	19,6	3080140
145	± 1,70	3,0 ± 0,50	4477	2	9,0	1080145
		5,0 ± 0,60	7356	2	14,7	2080145
150	± 1,80	3,0 ± 0,50	4634	1	4,6	1080150
		5,0 ± 0,60	7619	1	7,6	2080150
		7,0 ± 0,90	10554	1	10,6	3080150
		9,0 ± 1,00	13380	1	13,4	4080150
155	± 1,80	5,0 ± 0,70	7881	1	7,9	2080155
160	± 1,80	5,0 ± 0,70	8144	1	8,1	2080160
		7,0 ± 1,00	11292	1	11,3	3080160
165	± 1,80	5,0 ± 0,70	8407	1	8,4	2080165
		7,0 ± 1,00	11661	1	11,7	3080165
170	± 1,80	5,0 ± 0,70	8699	1	8,7	1080170
		7,0 ± 1,00	12030	1	12,0	2080170
		9,0 ± 1,10	15278	1	15,3	3080170
180	± 2,00	5,0 ± 0,70	9226	1	9,2	1080180
		7,0 ± 1,00	12768	1	12,8	2080180
		9,0 ± 1,20	16227	1	16,2	3080180

ORDER INFORMATION TUBES

Outer Diameter		Wall Thickness	Weight per Tube	Packing Unit		Order No.
						Nr.
mm		mm	g	Amount of Tubes	Weight app. kg	
190	± 2,10	5,0 ± 0,50	9753	1	9,8	2080190
		7,0 ± 0,80	13506	1	13,5	3080190
200	± 2,40	5,0 ± 0,80	10280	1	10,3	2080200
		7,0 ± 1,00	14244	1	14,2	3080200
215	± 2,50	7,0 ± 1,10	15377	1	15,4	3080215
225	± 2,70	7,0 ± 1,10	16116	1	16,1	3080225
240	± 2,90	7,0 ± 1,10	17255	1	17,2	3080240
250	± 3,00	5,0 ± 0,80	12937	1	12,9	2080250
270	± 2,90	5,0 ± 0,70	13917	1	13,9	2080270

RODS

GVB SOLUTIONS IN GLASS

RODS

ORDER INFORMATION RODS

Diameter		Weight per Rod	Packing Unit		Oder No.
	mm	g	Amount of Rods	Weight app. Kg	Nr.
3	± 0,15	24	700	16,8	9000003
4	± 0,15	42	400	16,8	9000004
5	± 0,15	66	256	16,9	9000005
6	± 0,15	95	170	16,2	9000006
7	± 0,15	129	121	15,6	9000007
8	± 0,25	168	100	16,8	9000008
9	± 0,25	213	81	17,3	9000009
10	± 0,25	263	64	16,8	9000010
11	± 0,25	318	50	15,9	9000011
12	± 0,25	378	49	18,5	9000012
13	± 0,35	444	36	16,0	9000013
14	± 0,35	515	25	12,9	9000014
15	± 0,35	591	25	14,8	9000015
16	± 0,35	673	16	10,8	9000016
18	± 0,45	851	16	13,6	9000018
20	± 0,45	1051	16	16,8	9000020
22	± 0,50	1272	9	11,4	9000022
24	± 0,50	1513	9	13,6	9000024
26	± 0,60	1776	9	16,0	9000026
28	± 0,90	2060	4	8,2	9000028
30	± 0,90	2364	4	9,5	9000030

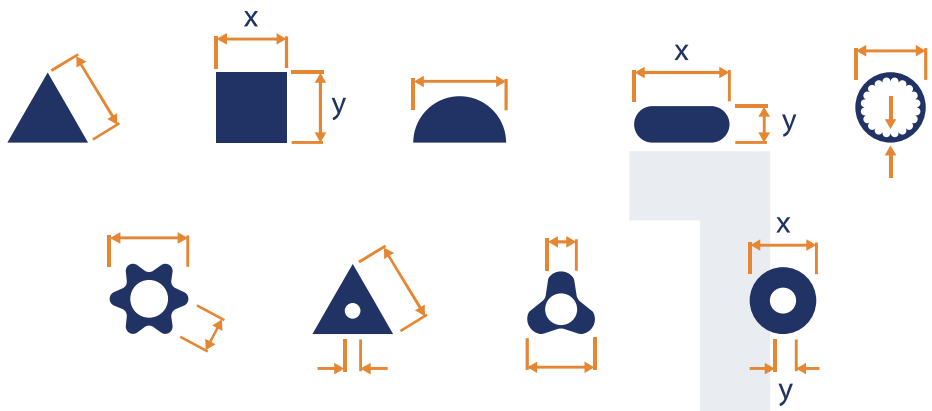
ORDER INFORMATION RODS

Diameter		Weight per Rod	Packing Unit		Oder No.
mm		g	Amount of Rods	Weight app. Kg	Nr.
32	± 1,00	2690	4	10,8	9000032
34	± 1,70	3037	4	12,1	9000034
36	± 1,70	3405	4	13,6	9000036
38	± 1,70	3794	4	15,2	9000038
40	± 2,00	4203	4	16,8	9000040

- Further dimensions upon request.
- All listed amounts of pieces and weights are average values.

ORDER ARTICLE : PROFILE RODS PROFILE TUBES AND CAPILLARY

These articles are offered in different dimensions and can be ordered from the factory on request



GENERAL DESCRIPTION

Boroclear is a colorless, machine produced borosilicate glass 3.3.

It belongs to the world-wide acknowledged and internationally defined group of borosilicate glasses class 3.3 according to standard **DIN ISO 3585** and is completely compatible with other glasses which comply with this standard.

Boroclear can be supplied as tube and rod. Granulates can be supplied upon request within short term.
The favourable relation between price and features, the good machinery as well as the precision of the tubes and rods make Boroclear a material for many different applications.

It is known as very insensitive during quick changes of temperatures. Due to the low thermal expansion, Boroclear is an excellent material for the application in laboratories, for building chemical constructions, for the pharmaceutical field, as well as for artificial handicraft.

Boroclear is corrosion-resistant, and even in combination with aggressive chemicals it is absolutely neutral. It is very resistant against water, acids, as well as halogens. Furthermore, this material offers a good resistance against lyes. Boroclear reacts very positively to life environment and is absolutely unexceptionable from the ecological point of view.

For the production the latest technologies are applied and a permanent process control ensures the high quality of the products.

The glassworks Kavalier is certified according to **EN ISO 9002.**

TÜV NORD

CERTIFICATE

Management system as per
EN ISO 9001 : 2015

In accordance with TÜV NORD CERT procedures, it is hereby certified that

KAVALIERGLASS, a.s.
Křižová 1018/6, Smichov
150 00 Praha 5
Czech Republic

with the sites acc. to the annex

KAVALIER

applies a management system in line with the above standard for the following scope

Design and production of glass products for household, laboratory, technical and pharmaceutical use, decorative glass and glass tubes, including production of metal glass moulds. Products made of flat glass shaped.
Development and production of automatic machines and equipment, moulds and tools, production of small metal products.
Production of plastic products. Production of cardboard.

Certificate Registration No. 04 100 940602
Audit Report No. 623 174/900

Valid from 2018-11-05
Valid until 2021-11-04
Initial certification 1994

Certification Body
at TÜV NORD CERT GmbH

Praha, 2018-10-23

This certification was conducted in accordance with the TÜV NORD CERT auditing and certification procedures and is subject to regular surveillance audits.
The annex (1 page) is the integral part of the certificate.
TÜV NORD CERT GmbH Langemarckstraße 20 45141 Essen www.tuev-nord-cert.com

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KAVALIER

THERMAL, PHYSICAL, MECHANICAL, AND ELECTRIC PROPERTIES

The physical properties of this glass are specified with standard **ISO 3585** and are exactly evaluated with international standard testing methods.

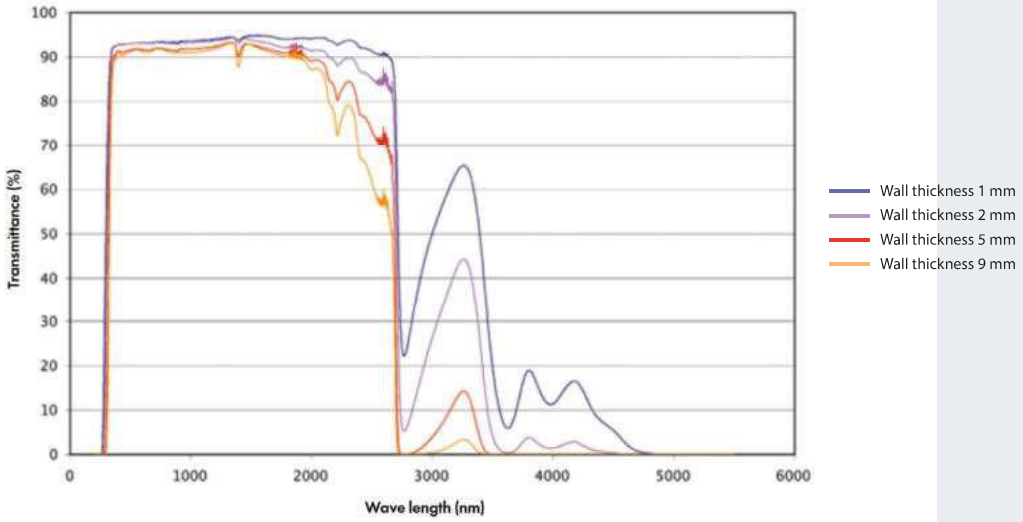
Item	Value	Unit
Average linear expansion coefficient (20 - 300 °C acc. ISO 7991, DIN 52328)	$3,3 \cdot 10^{-6}$	K^{-1}
Transformation temperature Tg (ISO 7884-8)	525	°C
Viscosity Temperatures		
$10^{14,7}$ dPa·s (Lower Cooling Temperature, ISO 7884-7)	510	°C
10^{13} dPa·s (Upper Cooling Point, ISO 7884-7)	560	°C
$10^{7,6}$ dPa·s (Softening Temperature, ISO 7884-2, 7884-6)	825	°C
10^{4} dPa·s (Processing Temperature, ISO 7884-2, 7884-5)	1260	°C
Max. Working Temperature, Recommended for short use	500	°C
Density at (20°C)	2,23	g/cm^3
Elasticity Module	$64\text{-}10^3$	MPa
Possion-Number	0,20	
Thermal Conductivity (20 - 100 °C)	1,2	$W - m^{-1} - K^{-1}$
Thermal Capacity (20 - 100 °C)	$0,98 - 10^3$	$J - kg - K^{-1}$
Spec. Electric Resistance in damp-proof medium (20 °C)	$10^{13} - 10^{15}$	Ohm - cm
Permitivity (20 °C, 1 MHz)	4,6	
Loss Angle	$4,9 - 10^{13}$	

OPTICAL PROPERTIES

Boroclear is transparent and clear, it does not show substantial absorption within the visible spectrum. Due to the permeability of ultra-violet rays, these products can be used for photo-chemical reactions.

Refraction index (at 589,3 nm)	1,472
Photo-Elastic Constant B	3,6 10^{-6}MPa^{-1}

The light permeability of Boroclear is illustrated in the following diagram.



CHEMICAL PROPERTIES

Boroclear is resistant against water and acids and their compound as well as against chlorine, iodine, and bromine. Even after a long period chemical resistance is better than those of most metals and many other materials.

The influence of water is very low. Boroclear forms on its surface a thin layer of quartz glass which further reduces the influence.

At higher temperatures and concentration, silicic acid, hot phosphate acids as well as alcalic solutions attack the surface.

Water Resistance (according ISO 719)	HGB 1
Acid Resistance (according ISO 1776)	Class S1
Lye Resistance (according ISO 695)	Class A2

CHEMICAL COMPOSITION

SiO_2	ca. 80,6 Weight Percentage
B_2O_3	ca. 13,0 Weight Percentage
Al_2O_3	ca. 2,4 Weight Percentage
$Na_2O + K_2O$	ca. 4,0 Weight Percentage

HOW TO COOL THE GLASS AFTER ANNEALING TEMPERATURE

To avoid permanent stresses during processing Boroclear is soaked well on transformation temperature. The time is dependent on the wall thickness of the parts.

We recommend the following values for heating, holing the temperature, and cooling the glass:

Wall Thickness mm	Heating	Holding Time	Cooling		
	Tg	Tg	Tg - 490 °C	490 - 440 °C	440 - Rt °C
3	140 °C/min	5 min	14 °C/min	28 °C/min	140 °C/min
6	30 °C/min	10 min	3 °C/min	6 °C/min	30 °C/min
9	15 °C/min	18 min	1,5 °C/min	3 °C/min	15 °C/min
12	8 °C/min	30 min	0,6 °C/min	1,6 °C/min	8 °C/min

Taking into account the chemical resistance of the glass, the annealing time should be as short as possible. If for one article several annealings should become necessary during the production process, the total time of all annealings at Tg should not exceed two hours.

HEAT STABILITY

The heat stability of tubes and rods depends on the wall thickness, the form, the size of parts, the areas which are warmed up, the status of the surface, the final treatment and the existing stresses. The following values are recommended:

Wall Thickness mm	Heat Stability app. K
1	303
3	175
5	136
7	115

PRESSURE RESISTANCE OF TUBES AND CAPILLARY TUBES

For simple applications the pressure resistance of tubes and capillary tubes can be calculated as follows.

Calculation of the pressure resistance (p in bar) for a given wall thickness (Wd in mm) and given outer diameter

(Ad in mm):

$$p = \frac{Wd * 20 * K/S}{Ad - Wd}$$

Calculation of wall thickness (Wd in mm) at given pressure resistance (p in bar) and outer diameter

(Ad in mm):

$$Wd = \frac{Ad * p}{20 * (\frac{K}{S}) + p}$$

The characteristic value of solidity (K/S) of borosilicate glass 3.3 is 7 N mm-2 (according to standard EN 1595 compressed air reservoir of borosilicate glass 3.3; general principles for the calculation, production, and examination). Furthermore, the pressure resistance is affected by the following influences:

- Processing of Ends
- Quality of Surface
- Temperature Difference between Inner and Outer Wall
- Meeting the Assembling requirements according to the Regulations for Compressed Air Reservoir

Furthermore, the following publications should be taken into account:

- AD-Merkblatt B1, issue 6.86 (cylinders and ball work pans with inner pressure burden)
- AD-Merkblatt N4, issue 6.86 (compressed air reservoir made of glass, encl. 1); issue 6.85 (evaluation of defects in walls of compressed air reservoirs made of glass)

TECHNICAL TERMS OF DELIVERY

Length and End Finisch	Diameter mm	Length mm	End Finisch
Tubes	4 - ≤ 7	1500 +10 - 0	not flame Polished
	>7 - ≤ 10	1500 +10 - 0	not flame Polished
	>10 - ≤ 48	1500 +10 - 0	flame Polished
	>48 - ≤ 190	1500 +10 - 0	flame Polished
Rods, Capilary Tubes	3 - 6	1500 ± 20	not flame Polished
	7 - 17	1500 ± 10	not flame Polished
	17 - 30	1500 ± 30	not flame Polished

- Special lengths can be produced up to 3000 mm depending on the diameter.
- Special diameters can be produced according to customer specifications. Minimum purchase quantity 500 kg.

Out of Roundness

Tubing	Maximum 0.7 % of the outside diameter
Rod	Maximum 1.5 % of the outside diameter
Capillary	Maximum 1 % of the outside diameter

Difference in wall thickness

The difference between the maximum and minimum wall thickness at arbitrary point of a tube may not exceed 11 % of the wall nominal thickness.

Deflection

Tubes	Outside Diameter	4-<6 mm	max.4,0 mm/1500 mm
	Outside Diameter	≥6-<30 mm	max 1,5 mm/1000 mm
	Outside Diameter	≥30 -<100 mm	max. 2,0 mm/1400 mm
	Outside Diameter	≥100 - ≤ 180 mm	max. 2,5 mm/1400 mm
	Outside Diameter	≥190 - ≤ 250 mm	max. 3,0 mm/1400 mm
Rods, Capillary	0,6 %	the Rod Length for Diameter	≤ 6 mm
	0,5 %	the Rod Length for Diameter	>6- ≤ 16 mm
	0,15 %	the Rod Length for Diameter	>16- ≤ 30 mm

TECHNICAL TERMS OF DELIVERY

Stones und Tails

Stones	Stones / 1 kg of glass
Size < 0,3 mm	permitted
Size ≥ 0,3 - < 1,0 mm	max. 2
Size ≥ 1,0 - ≤ 2,0 mm	max. 1
Size > 2,0 mm	prohibited

Tails	Tails / 1 kg of glass
Size < 0,3 mm	permitted
Size ≥ 0,3 - < 1,0 mm	max. 4
Size ≥ 1,0 - ≤ 3,0 mm	max. 2
Size > 3,0 mm	prohibited

The grain size is considered as corresponding to Stones or Tail size

Bubbles

	≥ 20 mm are allowed.
Length	>20 mm maximal 0,8 m (length of bubbles) of 10 m length of tube. The so called „length of bubbles" is the total amount of the length of all bubbles larger than 20 mm.
	Tubes diameter with Ø ≤ 100 mm maximal 1 mm
Width	Tubes diameter with Ø > 100 mm maximal 2 mm
	Rods and capillaries maximum 0,3 mm

TECHNICAL TERMS OF DELIVERY

Stresses

Tubes

Outside diameter in mm	Ø < 40	40 ≤ Ø ≤ 60	Ø > 60
Internal stress over the tube length	3,0 MPa 102,9 nm/cm	3,5 MPa 120,05 nm/cm	2,5 MPa 85,75 nm/cm
Internal stress at the edge	4,0 MPa 137,2 nm/cm	3,5 MPa 120,05 nm/cm	2,5 MPa 85,75 nm/cm

Rods are not normally annealed, however, rods 18 - 30 mm diameter can be delivered annealed, if requested by the customer.

Profiles, and capillary tubes are not annealed.

GVB SOLUTIONS IN GLASS

GROUND JOINTS

GROUND JOINTS

COMPONENTS AND PARTS MADE OF BOROSILICATE GLASS 3.3

Borosilikatglas 3.3 – Ground Joints according to DIN 12249

Joint – Sockets		Joint – Cones	
NS	Order-Nr.	NS	Order-Nr.
5/13	283630101-S	5/13	283630001-S
7/16	283630102-S	7/16	283630002-S
10/19	283630103-S	10/19	283630003-S
12/21	283630104-S	12/21	283630004-S
14/23	283630105-S	14/23	283630005-S
19/26	283630106-S	19/26	283630006-S
24/29	283630107-S	24/29	283630007-S
29/32	283630108-S	29/32	283630008-S
34/35	283630109-S	34/35	283630009-S
40/38	283630110-S	40/38	2836300010-S
45/40	283630111-S	45/40	2836300011-S
50/42	283630112-S	50/42	2836300012-S

COMPONENTS AND PARTS MADE OF BOROSILICATE GLASS 3.3

Borosilikatglas 3.3 – Ground Joints according to DIN 12244

KS – Ground Joint (Ball)		KS – Ground Joint (Cup)	
KS	Order-Nr.	KS	Order-Nr.
13/2	2846300213	13/2	2836300213
13/5	2846300513	13/5	2836300513
19	2846300019	19	2836300019
29	2846300029	29	2836300029
35	2846300035	35	2836300035
40	2846300040	40	2836300040

Further Information

- Please contact us to receive an individual offer.
- Minimum order value: 100 € net. For orders < 100 € net we charge a handling fee of 20 €.
- The costs for the outer packing and for transportation are charged at self-cost rates.
- Only our terms of delivery apply.
- Other dimensions and components on request.

GVB SOLUTIONS IN GLASS

SCREWTHREAD TUBES

SCREWTHREAD TUBES

SCREWTHREAD TUBES OF BOROSILICATE GLASS 3.3

Borosilikatglas 3.3 – Screwthread according to DIN 12216

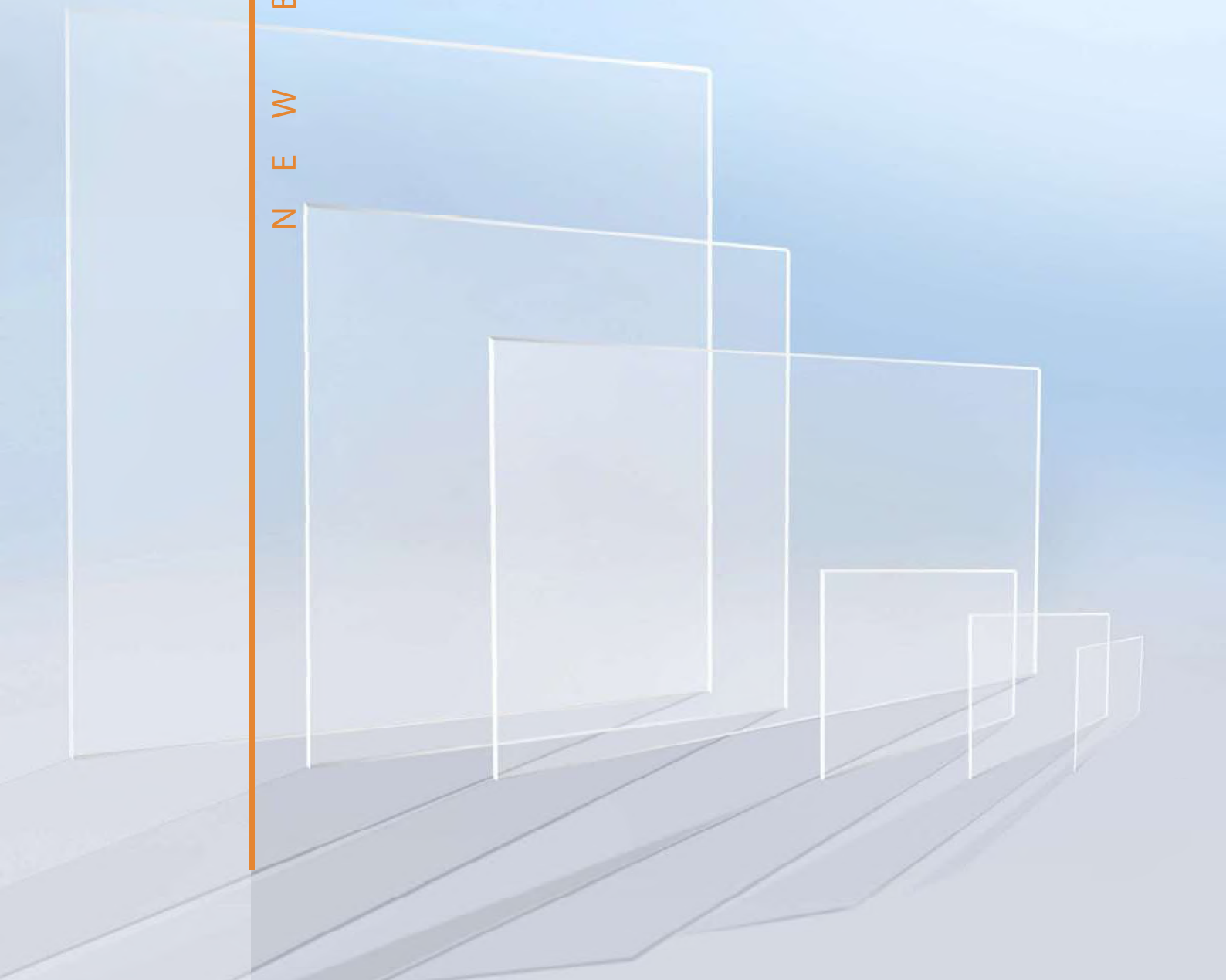
Description	Order-Nr.	PU
Screwthread GL 14	283630117-S	10 St.
Screwthread GL 16	283630118-S	10 St.
Screwthread GL 25	283630119-S	10 St.
Screwthread GL 32	283630120-S	10 St.
Screwthread GL 45	283630121-S	1 St.

Further Information

- Please contact us to receive an individual offer.
- Minimum order value: 100 € net. For orders < 100 € net we charge a handling fee of 20 €.
- The costs for the outer packing and for transportation are charged at self-cost rates.
- Only our terms of delivery apply.
- Other dimensions and components on request.

GVB SOLUTIONS IN GLASS

NEW BOROPLATE



NEW BOROPLATE

FLOATED BOROSILICATE

GENERAL DESCRIPTION

New Boroplate is a colorless, floated borosilicate glass 3.3.

It belongs to the world-wide acknowledged and internationally defined group of borosilicate glasses class 3.3 according to standard DIN ISO 3585 and is completely compatible with other glasses which comply with this standard.

The favourable price performance ratio and the good physical and chemical properties make New Boroplate to a general applicable material.

New Boroplate is corrosion-resistant, and even in combination with aggressive chemicals it is absolutely neutral.

It is very resistant against water, acids, as well as halogens. The low thermal expansion and the high thermal resistance mark this kind of glass for operational areas where appear high temperatures and temperature differences. For this reason, New Boroplate is used for the following products:

- Cityscape for efficient luminaries with a high heat emission
- For subsequent treatment
- In the chemical industry
- For glassblower applications in connection with Boroclear (tube and rod)
- Etc.

ORDER INFORMATION

Thickness mm	Tolerances mm	Length mm	Width mm	Size approx. m2
2,0	±0,25	1200±5,0	800±5,0	0,977
2,0	±0,25	1150±5,0	850±5,0	0,977
3,0	±0,25	1150±5,0	850±5,0	0,977
3,3	±0,25	1150±5,0	850±5,0	0,977
4,0	±0,25	1150±5,0	850±5,0	0,977
5,0	±0,25	1150±5,0	850±5,0	0,977
6,0	±0,25	1150±5,0	850±5,0	0,977
6,0	±0,25	1200±5,0	800±5,0	0,977
7,0	±0,35	1150±5,0	850±5,0	0,77
7,0	±0,35	1200±5,0	600±5,0	0,72

ORDER INFORMATION

Thickness mm	Tolerances mm	Length mm	Width mm	Size approx. m2
8,0	±0,35	1150±5,0	850±5,0	0,977
10,0	±0,35	1150±5,0	850±5,0	0,977
10,0	±0,25	1200±5,0	800±5,0	0,96

Thickness mm	Plates per case approx.
2,0	128
3,0	90
3,3	83
4,0	69
5,0	56
6,0	47
8,0	36
10,0	29

- One case contains app. 550 - 650 kg
- All prices are understood excluding insurance, VAT, packaging and transportation
- Only our terms of delivery will apply
- **Transport and packing:**
    - Pallet
    - Costs for packaging and transportation are charged at self-cost rates

OPTICAL PROPERTIES

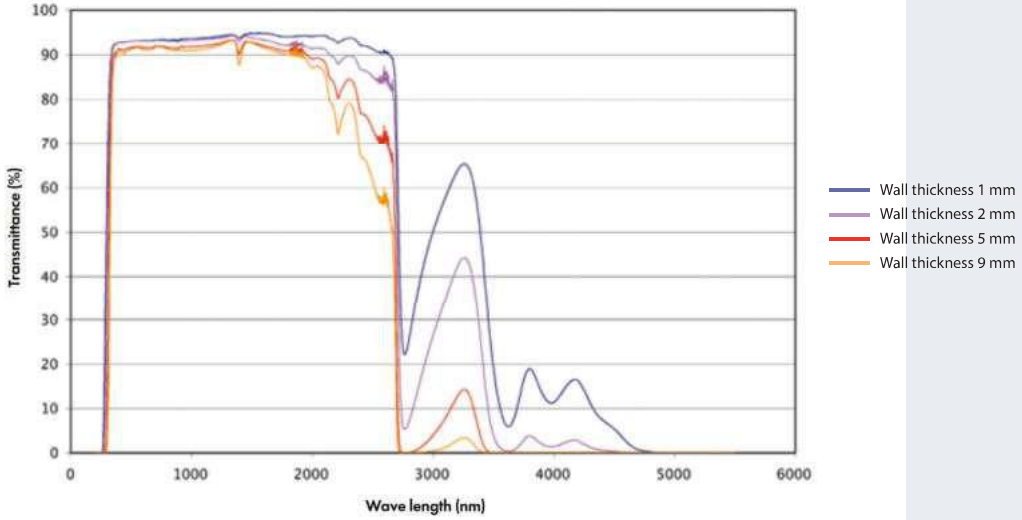
New Boroplate is transparent and clear, it does not show substantial absorption within the visible spectrum. Due to the permeability of ultra-violet rays, these products can be used for photo-chemical reactions.

Refraction index (at 589,3 nm) 1,472

Photo-elastic constant B 3,6 10^{-6} MPa^{-1}

The light permeability of New Boroplate is illustrated in the following diagram

Spectrum transmissivity



THERMAL, PHYSICAL, MECHANICAL, AND ELECTRIC PROPERTIES

The physical properties of this glass are specified with standard ISO 3585 and are exactly evaluated with international standard testing methods.

Item	Value	Unit
Average linear expansion coefficient (20 - 300 °C nach ISO 7991, DIN 52328)	$3{,}3\times10^{-6}$	K^{-1}
transformation temperature Tg (ISO 7884-8)	516	°C

Viscosity temperatures

$10^{14,7}$ dPa s (lower cooling temperature, ISO 7884-7)	510	°C
$10^{13,2}$ dPa s (upper cooling point, ISO 7884-7)	560	°C
$10^{7,5}$ dPa s (softening temperature, ISO 7884-2, 7884-6)	820	°C
10^{4} dPa s (processing temperature, ISO 7884-2, 7884-5)	1252	°C
Max. working temperature, recommended for short use (<10h)	500	°C
Long term use temperature (>10h)	450	°C
Density at (20°C)	2,23	g/cm3
Elasticity module	6,4 103	kg/mm2

THERMAL, PHYSICAL, MECHANICAL, AND ELECTRIC PROPERTIES

Item	Value	Unit
Possion-number	25	MPa
Knoop's hardness (HK 0,1/20 DIN ISO 9385)	418	
Modulus of elasticity	$64\ 10^{3}$	Mpa
Possion-number	0,20	
Tk 100	250	°C
Thermal conductivity (20 - 100 °C)	1,2	$Wm^{-1}K^{-1}$
Thermal capacity (20 - 100 °C)	0,98	$J\ kg\ K^{-1}$
Spec. electric resistance in damp-proof medium (20 °C)	10^{13} - 10^{15}	Ωcm
Permitivity (20 °C, 1 MHz)	4,6	
Loss angle	$4,9\ 10^{-3}$	

CHEMICAL PROPERTIES

Boroclear is resistant against water and acids and their compound as well as against chlorine, iodine, and bromine. Even after a long period chemical resistance is better than those of most metals and many other materials.

At higher temperatures and concentration, hydrofluoric acid, hot phosphate acids as well as alkali solutions attack the surface.

Water resistance	(according ISO 719)	Water class 1
Acid resistance	(according ISO 1776)	Acid class 1 - 2
lye resistance	(according ISO 695)	Leaching class 2

CHEMICAL COMPOSITION

SiO_2	app. 80,4 Weight percentage
B_2O_3	app. 13,0 Weight percentage
Al_2O_3	app. 2,4 Weight percentage
$Na_2O + K_2O$	app. 4,2 Weight percentage

HOW TO COOL THE GLASS AFTER ANNEALING TEMPERATURE

To avoid permanent stresses during processing New Boroplate is soaked well on transformation temperature. The time is dependent on the wall thickness of the parts.

We recommend the following values for heating, holing the temperature, and cooling the glass:

Wall thickness (mm)	Heating	Holding time	Cooling		
	on Tg	at Tg	Tg - 490 °C	490 - 440 °C	440 - Rt °C
3	140 °C/min	50 min	14 °C/min	28 °C/min	140 °C/min
6	30 °C/min	10 min	3 °C/min	6 °C/min	30 °C/min
9	150 °C/min	18 min	1,5 °C/min	3 °C/min	15 °C/min
12	80 °C/min	30 min	0,6 °C/min	1,6 °C/min	8 °C/min

Taking into account the chemical resistance of the glass, the annealing time should be as short as possible. If for one article several annealings should become necessary during the production process, the total time of all annealings at Tg should not be exceed two hours.

HEAT STABILITY

The heat stability of New Boroplate depends on the wall thickness, the form, the size of parts, the areas which are warmed up, the status of the surface, the final treatment and the existing stresses. The following values are recommended:

Wall thickness mm	Heat stability app. °C
<4,0	175
4,0 - 5,5	160
5,5 - 15,0	150
>15	125

Stresses

Not tempered.

IMPACT STRENGTH AND SHOCK RESISTANCE

When specifying the strength of glass and glass ceramics, their special material properties must be taken into account.

In the technical sense, glasses are elastic and brittle materials in which flow processes do not occur. This means that This results in the appearance of notches, cracks and scratches when in contact with a second hard material.

In these surface injuries, glass breakage can occur due to the mechanical stress of the glass, since plastic flow is not possible, as is the case, for example, with metals.

As a consequence of this behavior, the high strength of glass is practically meaningless.

It is reduced by the effect of use-related, unavoidable surface defects to a practical value range of 20 - 200 N/mm2 bending strength.

Glass strength is therefore not a material constant. It depends on:

- The state of processing.
- The state of use.
- The course and duration of force application.
- The area of force application.
- The aggressive environment.
- The effect of temperature.

GVB SOLUTIONS IN GLASS

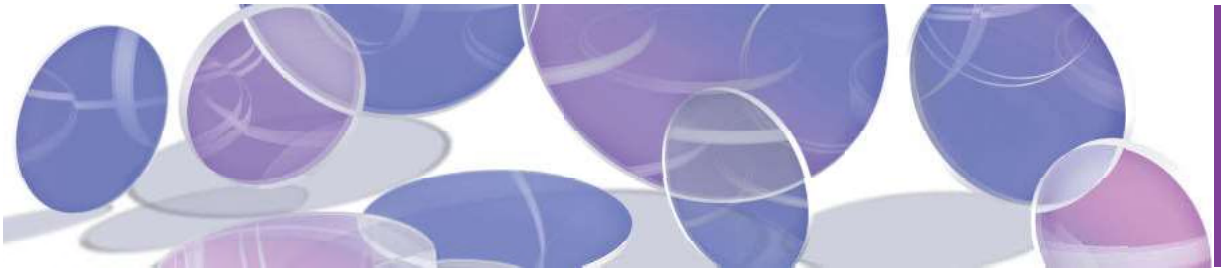
We also offer:

COLOURED GLASS

PRODUCT FINISHING

QUARTZ GLASS

OPTICAL GLASS



www.g-v-b.de

GVB SOLUTIONS IN GLASS

Your satisfaction is our future

Your GVB team

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