



SCHOTT
glass made of ideas

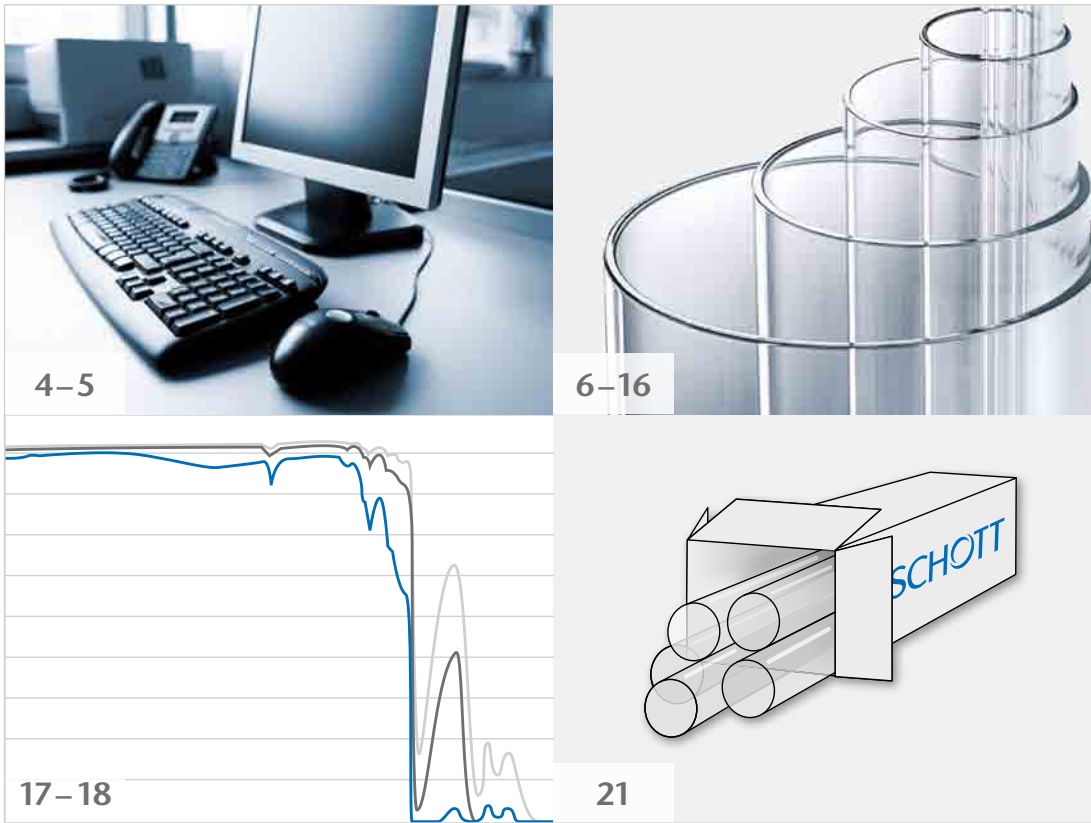
DURAN®

Tubing, Capillary and Rod of
Borosilicate Glass 3.3

SCHOTT is an international technology group with more than 125 years of experience in the areas of specialty glasses, materials and advanced technologies. With our high-quality products and intelligent solutions, we contribute to our customers' success and make SCHOTT part of everyone's life.

With a production capacity of more than 140,000 tons and production sites in Europe, South America and Asia, SCHOTT Tubing is one of the world's leading manufacturers of glass tubes, rods and profiles. Approximately 60 glass types are produced in large external diameters and a variety of lengths based on site-overlapping strategies in development, production and quality assurance. SCHOTT Tubing provides customized products and services for international growth markets such as pharmaceuticals and electronics as well as industrial and environmental engineering.

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DURAN® Borosilicate Glass 3.3

Gives you an advantage in both quality and service



DURAN® in the Laboratory

- Highly resistant to thermal shock and heat
- Resistant to water, strong acids, alkali and saline solutions
- Fulfills all major standards (e.g. DIN ISO 3585 and ASTM E438 Type I, Class A)
- Established brand for glassblowing items in the laboratory sector

DURAN® for Lighting

- High optical and cosmetic quality, therefore no unwanted reflections or refractions
- Tight geometric tolerances allow for stable manufacturing processes and easy assembly
- Especially low thermal expansion, high resistance to thermal shock and high chemical resistance make it optimally suited for use in adverse conditions
- Can be tempered upon request (DURATAN®)



DURAN® for Engineered Systems and Plants

- A wide range of dimensions and variable lengths helps to reduce and/or eliminate the need for subsequent dilation or part assembly
- High geometrical accuracy and excellent optical properties allow easy assembly, high functionality in service and low levels of maintenance
- Exceptionally corrosion resistant, chemically inert and will not burn
- Longstanding glass know-how for engineered systems and plants (heat exchangers, ozone generators, chemical plant engineering)

Scientific Services

The Scientific Services department of SCHOTT is available to customers for all questions concerning glass properties, processing and the various applications of DURAN® tubing, rod and capillary.

Equipped with its own chemical and physics laboratories this team of qualified experts is optimally suited to handle any question.

This means that our customers do not just get innovative solutions regarding the glass itself but we can also provide valuable input and knowledge to help solve problems within existing manufacturing processes. All you have to do is ask!

Do you have a new product idea?

We have the know-how! Contact us!

Scientific Services

Our services at a glance:

- Problem solving analysis for manufacturing processes
- Technical Advice for specific applications
- Know-how transfer available through workshops and lectures

Direct contact:

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Ordering around the clock






DURAN® can be conveniently and easily ordered online around the clock. The comprehensive and secure login functions at www.schott.com/tubing/ecom make ordering easy. Stock of inventory, price transparency and anticipated delivery date are only some of the helpful functions available.

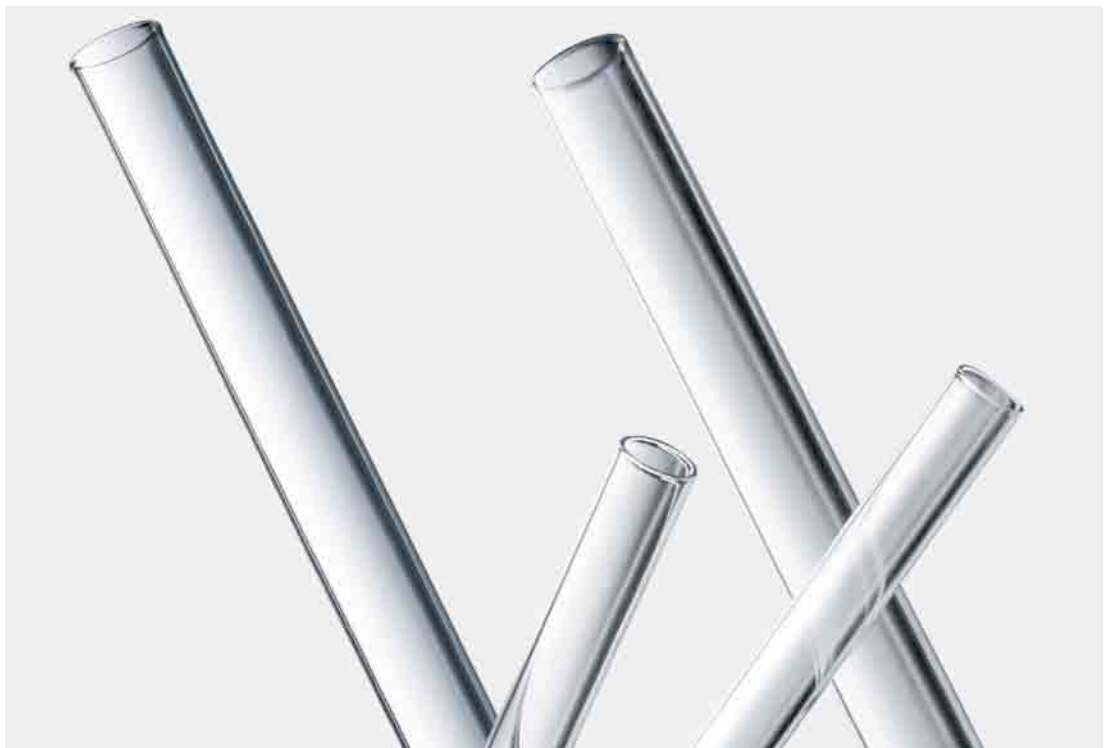
Further information and individual login data are available by phone +49 (0) 9633/80-100 or by email at customerservice.tubing@schott.com.



All dimensions shown in this brochure
can be ordered online:
www.schott.com/tubing/ecom






DURAN® Tubing

Outside Diameter	Wall Thickness	Weight per Tube Length approx. 1500mm	Carton Contents		Pallet Load	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg	 Number of cartons	Weight approx. kg
3 ±0.14	0.7 ±0.04	17	941	16.0	27	432.0
4 ±0.14	0.8 ±0.04	27	555	15.0	36	540.0
5 ±0.14	0.8 ±0.04	35	343	12.0	45	540.0
6 ±0.14	1.0 ±0.04	53	245	13.0	36	468.0
	1.5 ±0.08	71	211	15.0	36	540.0
7 ±0.14	1.0 ±0.04	63	190	12.0	45	540.0
	1.5 ±0.08	87	172	15.0	36	540.0
8 ±0.14	1.0 ±0.04	74	149	11.0	45	495.0
	1.5 ±0.08	102	147	15.0	36	540.0








DURAN®

Tubing

Outside Diameter	Wall Thickness	Weight per Tube Length approx. 1500mm	Carton Contents		Pallet Load	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg	 Number of cartons	Weight approx. kg
9 ±0.14	1.0 ±0.04	84	119	10.0	45	450.0
	1.5 ±0.08	118	119	14.0	36	504.0
10 ±0.14	1.0 ±0.04	95	95	9.0	45	405.0
	1.5 ±0.08	134	90	12.0	45	540.0
	2.2 ±0.12	180	56	10.0	45	450.0
11 ±0.18	1.0 ±0.04	105	86	9.0	45	405.0
	1.5 ±0.10	150	73	11.0	45	495.0
	2.2 ±0.12	203	42	8.5	45	382.5
12 ±0.18	1.0 ±0.04	116	130	15.0	35	525.0
	1.5 ±0.10	165	67	11.0	45	495.0
	2.2 ±0.12	226	42	9.5	45	427.5
13 ±0.18	1.0 ±0.04	126	119	15.0	35	525.0
	1.5 ±0.10	181	55	10.0	45	450.0
	2.2 ±0.12	250	36	9.0	45	405.0
14 ±0.18	1.0 ±0.04	137	110	15.0	35	525.0
	1.5 ±0.10	197	46	9.0	45	405.0
	2.2 ±0.12	273	30	8.2	45	369.0
15 ±0.18	1.2 ±0.05	174	86	15.0	35	525.0
	1.8 ±0.09	250	56	14.0	35	490.0
	2.5 ±0.13	328	25	8.2	45	369.0
16 ±0.18	1.2 ±0.05	187	81	15.0	35	525.0
	1.8 ±0.09	268	49	13.1	35	458.5
	2.5 ±0.13	354	25	8.8	45	396.0
17 ±0.18	1.2 ±0.05	199	75	15.0	35	525.0
	1.8 ±0.09	287	49	14.0	35	490.0
	2.5 ±0.13	381	25	9.5	45	427.5
18 ±0.18	1.2 ±0.05	212	66	14.0	35	490.0
	1.8 ±0.09	306	49	15.0	35	525.0
	2.5 ±0.13	407	20	8.1	45	364.5
19 ±0.18	1.2 ±0.05	224	63	14.0	35	490.0
	1.8 ±0.09	325	42	13.7	35	479.5
	2.5 ±0.13	433	36	15.6	35	546.0
20 ±0.25	1.2 ±0.05	237	55	13.0	35	455.0
	1.8 ±0.10	344	36	12.4	35	434.0
	2.5 ±0.15	460	20	9.2	45	414.0






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Tubing

Outside Diameter	Wall Thickness	Weight per Tube Length approx. 1500mm	Carton Contents		Pallet Load	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg	 Number of cartons	Weight approx. kg
22 ±0.25	1.2 ±0.05	262	42	11.0	35	385.0
	1.8 ±0.10	382	30	11.5	35	402.5
	2.5 ±0.15	512	30	15.4	35	539.0
24 ±0.25	1.2 ±0.05	287	36	10.3	35	360.5
	1.8 ±0.10	420	25	10.5	35	367.5
	2.5 ±0.15	565	25	14.0	45	490.0
26 ±0.25	1.4 ±0.05	362	30	10.9	35	381.5
	2.0 ±0.10	504	25	12.6	35	441.0
	2.8 ±0.15	682	20	13.6	35	476.0
28 ±0.25	1.4 ±0.05	391	25	9.8	35	343.0
	2.0 ±0.10	546	20	11.0	35	385.0
	2.8 ±0.15	741	20	14.8	35	518.0
30 ±0.35	1.4 ±0.08	421	36	15.2	20	304.0
	2.0 ±0.10	588	16	9.4	35	329.0
	2.8 ±0.15	800	16	12.8	35	448.0
32 ±0.35	1.4 ±0.08	450	25	11.3	20	226.0
	2.0 ±0.10	630	16	10.1	35	353.5
	2.8 ±0.15	859	16	13.8	35	483.0
33 ±0.35	2.0 ±0.10	651	25	16.2	20	324.0
34 ±0.35	1.4 ±0.08	479	25	12.1	20	242.0
	2.0 ±0.10	672	16	10.8	35	378.0
	2.8 ±0.15	918	16	14.8	35	518.0
36 ±0.40	1.4 ±0.08	509	25	12.6	20	252.0
	2.0 ±0.10	714	25	18.0	20	360.0
	2.8 ±0.15	976	12	11.7	35	409.5
38 ±0.40	1.4 ±0.08	538	20	10.8	20	216.0
	2.0 ±0.10	756	20	15.0	20	300.0
	2.8 ±0.15	1 035	9	9.4	35	329.0
40 ±0.55	1.6 ±0.08	645	16	10.2	20	204.0
	2.3 ±0.12	911	16	14.6	20	292.0
	3.2 ±0.20	1 237	9	11.2	35	392.0
	5.0 ±0.40	1 838	9	16.5	28	462.0
42 ±0.55	1.6 ±0.08	679	16	10.9	20	218.0
	2.3 ±0.12	959	16	15.3	20	306.0
	3.2 ±0.20	1 304	9	11.7	35	409.5

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Tubing






Outside Diameter	Wall Thickness	Weight per Tube Length approx. 1500mm	Carton Contents		Pallet Load	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg	 Number of cartons	Weight approx. kg
44 ±0.55	1.6 ±0.08	713	16	11.4	20	228.0
	2.3 ±0.12	1 007	16	16.0	20	320.0
	3.2 ±0.20	1 371	9	12.4	35	434.0
45 ±0.65	5.0 ±0.40	2 101	9	18.9	28	529.2
46 ±0.65	1.6 ±0.08	746	16	11.9	20	238.0
	2.3 ±0.12	1 056	9	9.5	35	332.5
	3.2 ±0.20	1 439	9	13.0	35	455.0
48 ±0.65	1.6 ±0.08	780	16	12.4	20	248.0
	2.3 ±0.12	1 104	16	17.6	20	352.0
	3.2 ±0.20	1 506	6	9.0	35	315.0



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Tubing



Outside Diameter	Wall Thickness	Weight per Tube Length approx. 1500mm	Carton Contents		Pallet Load	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg	 Number of cartons	Weight approx. kg
50 ±0.70	1.8 ±0.12	911	12	10.9	20	218.0
	2.5 ±0.15	1 247	12	15.0	20	300.0
	3.5 ±0.25	1 709	12	20.5	20	410.0
	5.0 ±0.30	2 363	6	14.1	35	493.5
	7.0 ±0.50	3 161	6	19.0	28	532.0
	9.0 ±0.65	3 876	6	23.2	21	487.2
52 ±0.70	1.8 ±0.12	949	9	8.5	20	170.0
	2.5 ±0.18	1 300	9	11.7	20	234.0
	3.5 ±0.25	1 783	9	16.0	20	320.0
54 ±0.70	1.8 ±0.12	987	9	8.9	20	178.0
	2.5 ±0.18	1 352	9	12.2	20	244.0
	3.5 ±0.25	1 856	9	16.7	20	334.0
55 ±0.70	5.0 ±0.35	2 626	4	10.5	35	367.5
56 ±0.70	1.8 ±0.12	1 025	9	9.2	20	184.0
	2.5 ±0.18	1 405	9	12.6	20	252.0
	3.5 ±0.25	1 930	9	17.5	20	350.0
58 ±0.70	1.8 ±0.12	1 063	9	9.6	20	192.0
	2.5 ±0.18	1 457	9	13.1	20	262.0
	3.5 ±0.25	2 004	9	18.0	20	360.0




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Tubing

Outside Diameter	Wall Thickness	Weight per Tube Length approx. 1500mm	Carton Contents		Pallet Load	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg	 Number of cartons	Weight approx. kg
60 ±0.80	2.2 ±0.18	1 336	9	12.0	20	240.0
	3.2 ±0.20	1 910	9	17.2	20	344.0
	4.2 ±0.30	2 462	4	9,8	35	343.0
	5.0 ±0.35	2 888	4	11.5	35	402.5
	7.0 ±0.50	3 897	4	15.6	35	546.0
	9.0 ±0.65	4 821	4	19.3	28	540.4
65 ±0.80	2.2 ±0.18	1 451	8	11.7	20	234.0
	3.2 ±0.20	2 077	4	8,3	35	290.5
	4.2 ±0.30	2 682	4	10.7	35	374.5
	5.0 ±0.35	3 151	4	12.6	35	441.0
70 ±0.90	2.2 ±0.18	1 567	8	12.5	15	187.5
	3.2 ±0.20	2 245	4	9.0	35	315.0
	4.2 ±0.30	2 903	4	11.6	35	406.0
	5.0 ±0.35	3 414	4	13.6	35	476.0
	7.0 ±0.50	4 632	4	18.5	35	647.5
	9.0 ±0.65	5 766	4	23.1	21	485.1
75 ±0.90	2.2 ±0.18	1 682	8	13.5	15	202.5
	3.2 ±0.20	2 413	4	9.7	20	194.0
	4.2 ±0.30	3 123	4	12.5	20	250.0
	5.0 ±0.35	3 676	4	14.7	20	294.0
80 ±1.20	2.5 ±0.18	2 035	4	8.2	20	164.0
	3.5 ±0.25	2 812	4	11.3	20	226.0
	5.0 ±0.40	3 939	4	15.8	20	316.0
	9.0 ±0.70	6 712	4	26.8	20	536.0
85 ±1.20	2.5 ±0.18	2 166	4	8.7	20	174.0
	3.5 ±0.25	2 996	4	12.0	20	240.0
	5.0 ±0.40	4 201	4	16.8	20	336.0
90 ±1.20	2.5 ±0.18	2 298	4	9.2	20	184.0
	3.5 ±0.25	3 180	4	12.7	20	254.0
	5.0 ±0.40	4 464	4	17.9	20	358.0
	7.0 ±0.50	6 102	3	18.3	15	274.5
	9.0 ±0.70	7 657	3	23.0	15	345.0
95 ±1.40	2.5 ±0.18	2 429	4	9.7	20	194.0
	3.5 ±0.25	3 364	4	13.4	20	268.0
	5.0 ±0.40	4 726	4	18.9	20	378.0






DURAN®

Tubing

Outside Diameter	Wall Thickness	Weight per Tube Length approx. 1500mm	Carton Contents		Pallet Load		
 mm	 mm	 g	 Number of Tubes	Weight approx. kg	 Number of cartons	Weight approx. kg	
100	±1.40	2.5 ±0.18	2 560	4	10.3	20	206.0
		3.0 ±0.20	3 056	4	12.1	9	108.9
		3.5 ±0.25	3 547	3	10.7	12	128.4
		5.0 ±0.40	4 989	3	15.0	12	180.0
		7.0 ±0.50	6 838	3	20.5	12	246.0
		9.0 ±0.70	8 602	3	25.8	12	309.6
105	±1.50	3.0 ±0.20	3 214	3	9.6	12	115.2
		5.0 ±0.40	5 252	3	15.8	12	189.6
110	±1.50	3.0 ±0.30	3 372	3	10.1	12	121.2
		5.0 ±0.50	5 514	3	16.5	12	198.0
		7.0 ±0.70	7 573	3	22.7	12	272.4
115	±1.50	3.0 ±0.30	3 529	4	14.1	9	126.9
		5.0 ±0.50	5 777	2	11.6	15	174.0
		7.0 ±0.70	7 940	2	15.9	15	238.5
120	±1.50	3.0 ±0.30	3 687	4	14.7	9	132.3
		5.0 ±0.50	6 039	2	12.1	15	181.5
		7.0 ±0.70	8 308	2	16.6	15	249.0
		9.0 ±0.90	10 493	2	21.0	15	315.0
125	±1.50	5.0 ±0.50	6 302	2	12.6	15	189.0
		9.0 ±0.90	10 965	2	21.9	15	328.5
130	±1.60	3.0 ±0.30	4 002	4	16.0	9	144.0
		5.0 ±0.50	6 565	2	13.1	15	196.5
		7.0 ±0.70	9 043	2	18.1	15	271.5
		9.0 ±0.90	11 438	2	22.9	15	343.5
135	±1.60	5.0 ±0.50	6 827	2	13.7	15	205.5
		7.0 ±0.70	9 411	2	18.8	15	282.0
140	±1.70	3.0 ±0.30	4 317	4	17.3	9	155.7
		5.0 ±0.50	7 090	2	14.2	15	213.0
		7.0 ±0.70	9 779	2	19.6	15	294.0
145	±1.70	5.0 ±0.50	7 352	2	14.7	15	220.5






DURAN®

Tubing

Outside Diameter	Wall Thickness	Weight per Tube Length approx. 1500mm	Carton Contents		Pallet Load	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg	 Number of cartons	Weight approx. kg
150 ±1.80	3.0 ±0.30	4 632	2	9.3	12	111.6
	5.0 ±0.50	7 615	2	15.2	12	182.4
	7.0 ±0.70	10 514	2	21.0	12	252.0
	9.0 ±0.90	13 329	2	26.7	12	320.4
155 ±1.80	5.0 ±0.50	7 877	2	15.8	12	189.6
160 ±1.80	5.0 ±0.50	8 140	2	16.3	12	195.6
	7.0 ±0.80	11 249	2	22.5	12	270.0
165 ±1.80	5.0 ±0.50	8 403	2	16.8	12	201.6
	7.0 ±0.80	11 617	2	23.2	12	278.4
170 ±1.80	5.0 ±0.50	8 665	2	17.3	12	207.6
	7.0 ±0.80	11 984	2	24.0	12	288.0
	9.0 ±1.00	15 219	1	15.2	20	304.0
180 ±2.00	5.0 ±0.50	9 190	1	9.2	20	184.0
	7.0 ±0.80	12 720	1	12.7	20	254.0
	9.0 ±1.10	16 165	1	16.2	20	324.0



DURAN® Tubing

Outside Diameter	Wall Thickness	Weight per Tube Length approx. 1500mm	Carton Contents	Pallet Load		
 mm	 mm	 g	 Number of Tubes Weight approx. kg	 Number of cartons Weight approx. kg		
190 ±2.10	5.0 ±0.50	9 716	1	9.7	20	194.0
	7.0 ±0.80	13 455	1	13.5	20	270.0
200 ±2.40	5.0 ±0.80	10 241	1	10.2	20	204.0
	7.0 ±1.00	14 190	1	14.2	20	284.0
	9.0 ±1.20	18 055	1	18.1	20	362.0
215 ±2.50	7.0 ±1.10	15 293	1	15.3	9	137.7
	9.0 ±1.20	19 473	1	19.5	9	175.5
225 ±2.70	7.0 ±1.10	16 028	1	16.0	9	144.0
	9.0 ±1.30	20 418	1	20.4	9	183.6
240 ±2.90	9.0 ±1.30	21 836	1	21.8	9	196.2
250 ±3.00	5.0 ±0.80	12 867	1	12.9	9	116.1
	7.0 ±1.10	17 866	1	17.9	9	161.1
	9.0 ±1.30	22 782	1	22.8	9	205.2
270 ±3.00	5.0 ±0.80	13 917	1	13.9	9	125.1
	7.0 ±1.10	19 337	1	19.3	9	173.7
	9.0 ±1.30	24 672	1	24.7	9	222.3
300 ±3.80	5.0 ±0.80	15 492	1	15.5	9	139.5
	7.0 ±1.20	21 542	1	21.5	9	193.5
	9.0 ±1.40	27 508	1	27.5	9	247.5
315 ±3.90	7.0 ±1.20	22 645	1	22.6	9	203.4
	9.0 ±1.40	28 926	1	28.9	9	260.1
325 ±4.00	9.0 ±1.40	29 871	1	29.9	4	119.6
	10.0 ±1.40	33 085	1	33.0	9	297.0
350 ±4.00	5.0 ±0.80	18 118	1	18.1	4	72.4
365 ±4.50	7.0 ±1.40	26 321	1	26.3	4	105.2
400 ±5.00	6.0 ±1.50	24 829	1	24.8	4	99.2
415 ±5.00	7.0 ±1.50	29 997	1	30.0	4	120.0
420 ±5.00	10.0 ±2.00	43 063	1	43.1	4	172.4





Standard length: 1500 mm

Special lengths of tubing (depending on outside diameter and wall thickness) are available upon request between 1000 and 10000 mm.

Glass cut to a length of 0.3 mm and longer available on inquiry.

DURAN®

Capillary

Outside Diameter	Inside Diameter	Weight per Tube Length approx. 1500mm	Carton Contents	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg
4 ±0.18	0.8 ±0.08	40	250	10.0
	0.4 ±0.08	65	154	10.0
5 ±0.18	0.6 ±0.08	65	154	10.0
	0.8 ±0.08	64	156	10.0
	1.2 ±0.08	62	161	10.0
6 ±0.18	0.4 ±0.08	94	104	10.0
	0.8 ±0.08	93	108	10.0
	1.2 ±0.08	91	110	10.0
	1.7 ±0.10	87	115	10.0
	2.2 ±0.10	82	122	10.0
7 ±0.20	2.7 ±0.10	75	133	10.0
	0.8 ±0.08	127	79	10.0
	1.2 ±0.08	125	80	10.0
	1.7 ±0.10	121	83	10.0
	2.2 ±0.10	116	86	10.0
8 ±0.20	2.7 ±0.10	110	91	10.0
	3.0 ±0.10	105	95	10.0
	0.8 ±0.08	166	60	10.0
	1.2 ±0.08	164	61	10.0
	1.7 ±0.10	160	63	10.0
9 ±0.20	2.2 ±0.10	155	65	10.0
	2.7 ±0.10	149	67	10.0
	3.0 ±0.10	144	69	10.0
	0.8 ±0.08	211	47	10.0
	1.2 ±0.08	209	48	10.0
9 ±0.20	1.7 ±0.10	205	49	10.0
	2.2 ±0.10	200	50	10.0
	2.7 ±0.10	194	52	10.0
	3.0 ±0.10	189	53	10.0



Quantity of capillaries per pallet:



Number of cartons: 55

Weight: ca. 550.0 kg

Standard length: 1500 mm

DURAN®

Rod

Diameter	Weight/Length Length approx. 1500mm	Carton Contents		Pallet Load		
		Number of Rods	Weight approx. kg	Number of cartons	Weight approx. kg	
 mm	 g					
3	±0.14	24	529	12.5	44	550.0
4	±0.14	42	298	12.5	44	550.0
5	±0.14	66	183	12.0	44	528.0
6	±0.14	95	140	13.2	44	580.8
7	±0.14	129	98	12.6	44	554.4
8	±0.20	168	80	13.4	44	589.6
9	±0.20	213	63	13.4	44	589.6
10	±0.20	263	45	11.8	44	519.2
12	±0.20	378	35	13.2	44	580.8
14	±0.30	515	24	12.4	44	545.6
16	±0.30	672	20	13.4	36	482.4
18	±0.40	851	20	17.0	27	459.0
20	±0.40	1 050	16	16.8	27	453.6
22	±0.45	1 271	12	15.3	36	550.8
24	±0.45	1 512	12	18.2	27	491.4
26	±0.55	1 775	9	16.0	27	432.0
28	±0.80	2 059	9	18.5	27	449.5
30	±0.80	2 363	6	14.2	36	511.2



Standard length: 1500 mm

DURAN® Borosilicate Glass 3.3

Physical and Chemical Properties

Physical Properties		
Coefficient of mean linear thermal expansion α (20°C; 300°C) acc. to DIN ISO 7991		$3.3 \cdot 10^{-6} \text{ K}^{-1}$
Transformation temperature T_g		525 °C
Temperature of the glass at viscosity η in dPa · s:	10^{13} (annealing point) $10^{7.6}$ (softening point) 10^4 (working point)	560 °C 825 °C 1260 °C
Density ρ at 25 °C		$2.23 \text{ g} \cdot \text{cm}^{-3}$
Modulus of elasticity E (Young's modulus)		$63 \cdot 10^3 \text{ N} \cdot \text{mm}^{-2}$
Poisson's ratio μ		0.20
Thermal Conductivity λ_w at 90 °C		$1.2 \text{ W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$
Temperature for the specific electrical resistance of $10^8 \Omega \cdot \text{cm}$ (DIN 52 326) $t_{k 100}$		250 °C
Logarithm of the electric volume resistivity ($\Omega \cdot \text{cm}$)	at 250 °C at 350 °C	8 6.5
Dielectric properties (1 MHz, 25 °C)	Dielectric constant (permittivity) ϵ Dielectric loss factor (dissipation factor) $\tan \delta$	4.6 $37 \cdot 10^{-4}$
Refractive index ($\lambda = 587.6 \text{ nm}$) n_d		1.473
Stress-optical coefficient (DIN 52 314) K		$4.0 \cdot 10^{-6} \text{ mm}^2 \cdot \text{N}^{-1}$

Chemical Composition				
SiO_2	B_2O_3	$\text{Na}_2\text{O} + \text{K}_2\text{O}$	Al_2O_3	
81	13	4	2	

main components in approx. weight %

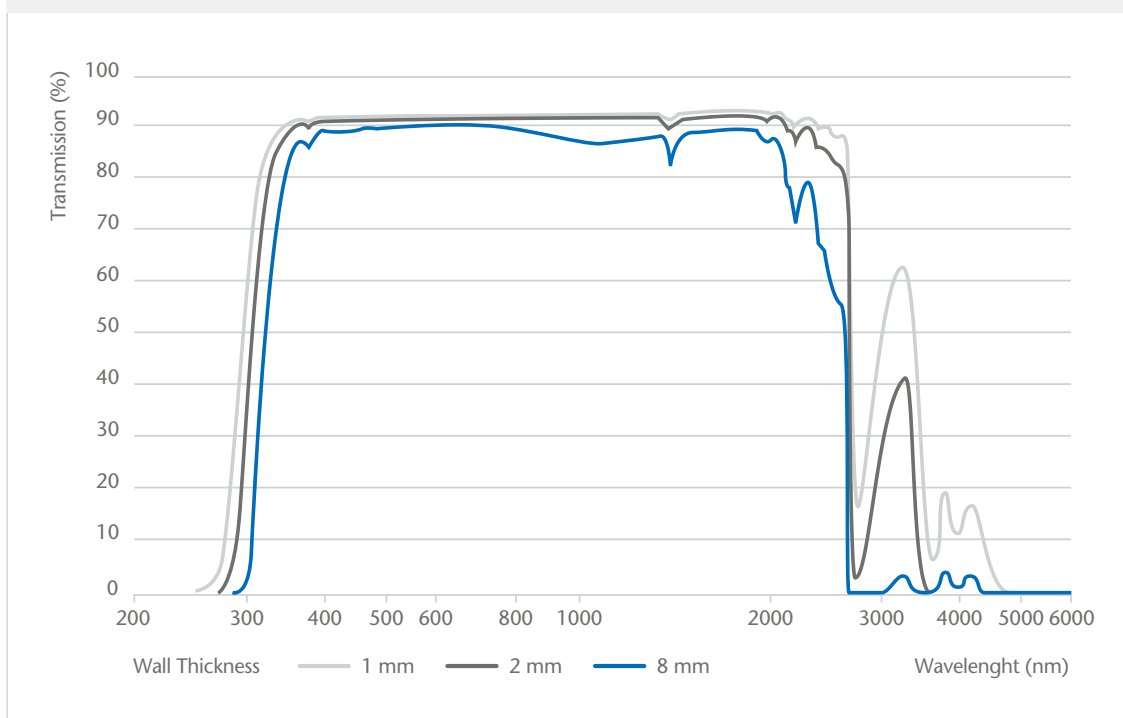
DURAN® Borosilicate Glass 3.3

Physical and Chemical Properties

Chemical Resistance

Hydrolytic Class (DIN ISO 719)	HGB 1
Acid Class (DIN 12116)	Class S 1
Alkali Class (DIN ISO 695)	Class A 2

Transmission



DURAN® Borosilicate Glass 3.3 is highly resistant to water, neutral and acid solutions, concentrated acids and acid mixtures; as well as chlorine, bromine, iodine and organic substances. Hydrofluoric acid, hot phosphoric acid and alkaline solutions do attack the glass surface but this is dependent on their concentration and temperature. Therefore, with these chemicals the use of DURAN® should be checked for each individual case.

DURAN® Borosilicate Glass 3.3

Tips on Processing

The excellent properties of DURAN® tubing, rod and capillary provide for good workability when forming and cutting the glass when using the normal techniques associated with technical glass.

Stress-free Annealing

To eliminate temporary stress as a result of the working process, the glass should be well heated to a maximum temperature of 550 °C and kept at this level for a maximum of 30 minutes. For a thinner wall only a fraction of this period is necessary. The chart below states the recommended cooling rate for the subsequent annealing:

Wall Thickness in mm	Temperature Range		
	550 to 480 °C	480 to 400 °C	400 to 20 °C
3	~ 12 °C/min	~ 24 °C/min	up to ~ 480 °C/min
6	~ 3 °C/min	~ 6 °C/min	up to ~ 120 °C/min
12	~ 0.8 °C/min	~ 1.6 °C/min	up to ~ 32 °C/min

If an article needs to be annealed several times, the sum of all annealing periods at 550 °C should not exceed 2 hours.

Resistance to Thermal Shock

According to DIN ISO 718, resistance to thermal shock is the difference in temperature between the hot test sample and the cold water bath (room temperature) at which 50 % of all test samples show a tendency to crack when quickly immersed. Listed below are some benchmarks to illustrate the resistance to thermal shock of tubing, rod and capillary made from DURAN® Borosilicate glass 3.3.

Tubes	Rod
OD 50.5 / WT 5.00 mm: ~ 220 °C	Diameter 24.0 mm: ~ 140 °C
OD 133.0 / WT 7.00 mm: ~ 180 °C	
OD 120.0 / WT 8.00 mm: ~ 180 °C	

The resistance of tubing and rod to thermal shock depends on many different factors. Some of these are the wall thickness, shape and size of the chilled surface, the state of the surface, the stress already present in the glass, and the end finish. It is recommended not to exceed a temperature difference of 120 °C.

DURAN® Borosilicate Glass 3.3

Tips on Processing

Pressure Resistance of Tubing made of DURAN® Borosilicate Glass 3.3

The following formulas apply to stress-free tubing and cylindrical hollow bodies with a circular profile, uniform wall thickness with open ends, free from thermal load, under internal positive pressure and external negative pressure.

Calculation of Pressure Resistance (p)

$$p = \frac{WT \cdot 20 \cdot \frac{K}{S}}{OD - WT}$$

Calculation of the Wall Thickness (WT)

$$WT = \frac{OD \cdot p}{20 \cdot \frac{K}{S} + p}$$

OD = Outside Diameter in mm

WT = Wall Thickness in mm

p = Pressure Resistance in bar

$\frac{K}{S} = 7 \frac{N}{mm^2}$ = permissible load according to standard DIN EN 1595: Pressure Equipment made from Borosilicate Glass 3.3 – General Rules for Design, Manufacture and Testing

Other points to be considered:

- AD 2000-leaflet N 4, edition 2000-10:
Pressure vessels made of glass, with encl. 1, edition 2000-10:
Evaluation of faults in walls of glass pressure containers
- AD 2000-leaflet B 1, edition 2000-10:
Cylindrical and spherical shells under internal pressure overload

According to DIN EN 1595 "Pressure Equipment made from Borosilicate Glass 3.3 – General Rules for Design, Manufacture and Testing", DURAN® is an approved material and may be used for the construction of pressure equipment.

DURAN® Borosilicate Glass 3.3

Packing

Standard: Cartons

Available upon request: DENSOPACK®
(up to Outside Diameter 50 mm)

DENSOPACK®

Tightly packed and covered with shrink
film = effective transport protection



Technical Terms of Supply

Detailed information on permissible faults, definition of faults, testing methods and testing units are available upon request. Reduced tolerances are also available upon request. In case of quality complaints the relevant "Technical Terms of Supply" for the application apply to all sales and are binding unless separate written agreements with respect to quality have been entered into.

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Subject to technical alterations.

We thank our customers and partners for their kind assistance in providing product samples and photos.

Tubing

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