

SCHOTT DURAN®





Tubing, Capillary and Rod of Borosilicate Glass 3.3

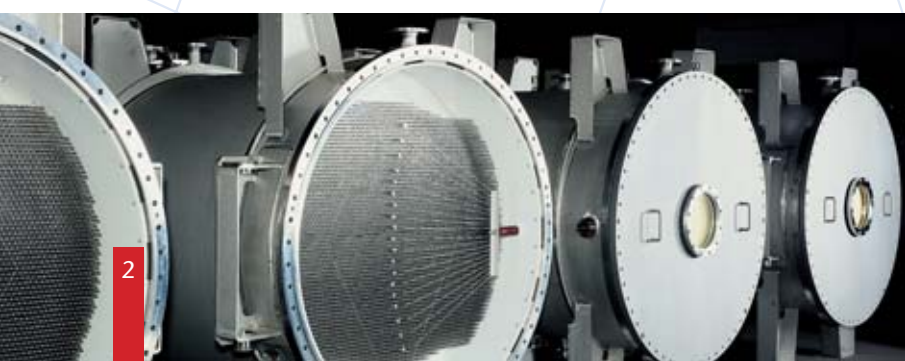


SCHOTT
glass made of ideas







SCHOTT DURAN®: Tubing

Outside Diameter	Wall Thickness	Weight per Length (Length approx. 1500 mm)	Carton Contents	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg
3 ±0.15	0.7 ±0.04	17	941	16.0
4 ±0.15	0.8 ±0.04	27	555	15.0
5 ±0.15	0.8 ±0.04	35	343	12.0
6 ±0.15	1.0 ±0.04 1.5 ±0.10	53 71	245 211	13.0 15.0
7 ±0.15	1.0 ±0.04 1.5 ±0.10	63 87	190 172	12.0 15.0
8 ±0.15	1.0 ±0.04 1.5 ±0.10	74 102	149 147	11.0 15.0
9 ±0.15	1.0 ±0.04 1.5 ±0.10	84 118	119 119	10.0 14.0
10 ±0.15	1.0 ±0.04 1.5 ±0.10 2.2 ±0.15	95 134 180	95 90 56	9.0 12.0 10.0
11 ±0.20	1.0 ±0.04 1.5 ±0.10 2.2 ±0.15	105 150 203	86 73 42	9.0 11.0 8.5
12 ±0.20	1.0 ±0.04 1.5 ±0.10 2.2 ±0.15	116 165 226	130 67 42	15.0 11.0 9.5
13 ±0.20	1.0 ±0.04 1.5 ±0.10 2.2 ±0.15	126 181 250	119 55 36	15.0 10.0 9.0







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Outside Diameter	Wall Thickness	Weight per Length (Length approx. 1500 mm)	Carton Contents	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg
14 ±0.20	1.0 ±0.04	137	110	15.0
	1.5 ±0.10	197	46	9.0
	2.2 ±0.15	273	30	8.2
15 ±0.20	1.2 ±0.05	174	86	15.0
	1.8 ±0.10	250	56	14.0
	2.5 ±0.15	328	25	8.2
16 ±0.20	1.2 ±0.05	187	81	15.0
	1.8 ±0.10	268	49	13.1
	2.5 ±0.15	354	25	8.8
17 ±0.20	1.2 ±0.05	199	75	15.0
	1.8 ±0.10	287	49	14.0
	2.5 ±0.15	381	25	9.5
18 ±0.20	1.2 ±0.05	212	66	14.0
	1.8 ±0.10	306	49	15.0
	2.5 ±0.15	407	20	8.1
19 ±0.20	1.2 ±0.05	224	63	14.0
	1.8 ±0.10	325	42	13.7
	2.5 ±0.15	433	36	15.6
20 ±0.25	1.2 ±0.05	237	55	13.0
	1.8 ±0.10	344	36	12.4
	2.5 ±0.15	460	20	9.2
22 ±0.25	1.2 ±0.05	262	42	11.0
	1.8 ±0.10	382	30	11.5
	2.5 ±0.15	512	30	15.4
24 ±0.25	1.2 ±0.05	287	36	10.3
	1.8 ±0.10	420	25	10.5
	2.5 ±0.15	565	25	14.0
26 ±0.25	1.4 ±0.05	362	30	10.9
	2.0 ±0.10	504	25	12.6
	2.8 ±0.15	682	12	8.2
28 ±0.25	1.4 ±0.05	391	25	9.8
	2.0 ±0.10	546	20	11.0
	2.8 ±0.15	741	20	14.8










SCHOTT DURAN®: Tubing

Outside Diameter	Wall Thickness	Weight per Length (Length approx. 1500 mm)	Carton Contents	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg
30 ±0.40	1.4 ±0.10	421	36	15.2
	2.0 ±0.15	588	16	9.4
	2.8 ±0.20	800	16	12.8
32 ±0.40	1.4 ±0.10	450	25	11.3
	2.0 ±0.15	630	16	10.1
	2.8 ±0.20	859	16	13.8
33 ±0.40	2.0 ±0.15	651	25	16.2
34 ±0.40	1.4 ±0.10	479	25	12.1
	2.0 ±0.15	672	16	10.8
	2.8 ±0.20	918	16	14.8
36 ±0.45	1.4 ±0.10	509	25	12.6
	2.0 ±0.15	714	25	18.0
	2.8 ±0.20	976	12	11.7
38 ±0.45	1.4 ±0.10	538	20	10.8
	2.0 ±0.15	756	20	15.0
	2.8 ±0.20	1 035	9	9.4
40 ±0.60	1.6 ±0.10	645	16	10.2
	2.3 ±0.20	911	16	14.6
	3.2 ±0.30	1 237	9	11.2
	5.0 ±0.40	1 838	9	16.5
42 ±0.60	1.6 ±0.10	679	16	10.9
	2.3 ±0.20	959	16	15.3
	3.2 ±0.30	1 304	9	11.7
44 ±0.60	1.6 ±0.10	713	16	11.4
	2.3 ±0.20	1 007	16	16.0
	3.2 ±0.30	1 371	9	12.4
45 ±0.70	5.0 ±0.40	2 101	9	18.9
46 ±0.70	1.6 ±0.10	746	16	11.9
	2.3 ±0.20	1 056	9	9.5
	3.2 ±0.30	1 439	9	13.0







SCHOTT DURAN®: Tubing

Outside Diameter	Wall Thickness	Weight per Length (Length approx. 1500 mm)	Carton Contents	
 mm	 mm	 g	 Number of Tubes	 Weight approx. kg
48 ±0.70	1.6 ±0.10	780	16	12.4
	2.3 ±0.20	1 104	16	17.6
	3.2 ±0.30	1 506	6	9.0
50 ±0.70	1.8 ±0.15	911	12	10.9
	2.5 ±0.20	1 247	12	15.0
	3.5 ±0.30	1 709	12	20.5
	5.0 ±0.40	2 363	6	14.1
	7.0 ±0.60	3 161	6	19.0
52 ±0.80	9.0 ±0.70	3 876	6	23.2
	1.8 ±0.15	949	9	8.5
	2.5 ±0.20	1 300	9	11.7
54 ±0.80	3.5 ±0.30	1 783	9	16.0
	1.8 ±0.15	987	9	8.9
54 ±0.80	2.5 ±0.20	1 352	9	12.2
	3.5 ±0.30	1 856	9	16.7
55 ±0.80	5.0 ±0.40	2 626	4	10.5
56 ±0.80	1.8 ±0.15	1 025	9	9.2
	2.5 ±0.20	1 405	9	12.6
	3.5 ±0.30	1 930	9	17.5
58 ±0.80	1.8 ±0.15	1 063	9	9.6
	2.5 ±0.20	1 457	9	13.1
	3.5 ±0.30	2 004	9	18.0
60 ±0.90	2.2 ±0.20	1 336	9	12.0
	3.2 ±0.25	1 910	9	17.2
	4.2 ±0.40	2 462	4	9.8
	5.0 ±0.40	2 888	4	11.5
	7.0 ±0.60	3 897	4	15.6
65 ±0.90	9.0 ±0.70	4 821	4	19.3
	2.2 ±0.20	1 451	8	11.7
	3.2 ±0.25	2 077	4	8.3
	4.2 ±0.40	2 682	4	10.7
	5.0 ±0.40	3 151	4	12.6








SCHOTT DURAN®: Tubing

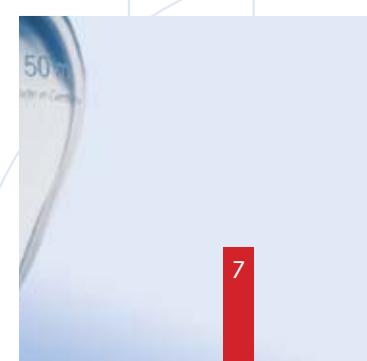
Outside Diameter	Wall Thickness	Weight per Length (Length approx. 1500 mm)	Carton Contents	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg
70 ±1.00	2.2 ±0.20	1 567	8	12.5
	3.2 ±0.25	2 245	4	9.0
	4.2 ±0.40	2 903	4	11.6
	5.0 ±0.40	3 414	4	13.6
	7.0 ±0.60	4 632	4	18.5
75 ±1.00	9.0 ±0.70	5 766	4	23.1
	2.2 ±0.20	1 682	8	13.5
	3.2 ±0.25	2 413	4	9.7
	4.2 ±0.40	3 123	4	12.5
80 ±1.30	5.0 ±0.40	3 676	4	14.7
	2.5 ±0.20	2 035	4	8.2
	3.5 ±0.30	2 812	4	11.3
85 ±1.30	5.0 ±0.50	3 939	4	15.8
	9.0 ±0.80	6 712	4	26.8
	2.5 ±0.20	2 166	4	8.7
90 ±1.30	3.5 ±0.30	2 996	4	12.0
	5.0 ±0.50	4 201	4	16.8
	2.5 ±0.20	2 298	4	9.2
	3.5 ±0.30	3 180	4	12.7
95 ±1.50	5.0 ±0.50	4 464	4	17.9
	7.0 ±0.70	6 102	3	18.3
	9.0 ±0.80	7 657	3	23.0
	2.5 ±0.20	2 429	4	9.7
100 ±1.50	3.5 ±0.30	3 364	4	13.4
	5.0 ±0.50	4 726	4	18.9
	2.5 ±0.20	2 560	4	10.3
	3.0 ±0.20	3 056	4	12.1
	3.5 ±0.30	3 547	3	10.7
105 ±1.70	5.0 ±0.50	4 989	3	15.0
	7.0 ±0.70	6 838	3	20.5
	9.0 ±0.80	8 602	3	25.8
105 ±1.70	3.0 ±0.40	3 214	3	9.6
	5.0 ±0.70	5 252	3	15.8



SCHOTT DURAN®: Tubing







Outside Diameter	Wall Thickness	Weight per Length (Length approx. 1500 mm)	Carton Contents	
 mm	 mm	 g	 Number of Tubes	 Weight approx. kg
110	±1.70	3.0 ±0.50	3	10.1
		5.0 ±0.70	3	16.5
		7.0 ±0.80	3	22.7
115	±1.70	3.0 ±0.50	4	14.1
		5.0 ±0.70	2	11.6
120	±1.70	7.0 ±0.80	2	15.9
		3.0 ±0.50	4	14.7
		5.0 ±0.70	2	12.1
125	±1.70	7.0 ±0.80	2	16.6
		9.0 ±0.90	2	21.0
		5.0 ±0.70	2	12.6
130	±1.80	9.0 ±0.90	2	21.9
		3.0 ±0.60	4	16.0
		5.0 ±0.70	2	13.1
135	±1.80	7.0 ±0.90	2	18.1
		9.0 ±0.90	2	22.9
		5.0 ±0.70	2	13.7
140	±1.90	7.0 ±0.90	2	18.8
		3.0 ±0.60	4	17.3
		5.0 ±0.70	2	14.2
145	±1.90	7.0 ±0.90	2	19.6
		5.0 ±0.70	2	14.7
		3.0 ±0.60	4	9.3
150	±2,00	5.0 ±0.70	2	15.2
		3.0 ±0.60	2	9.3
		5.0 ±0.70	2	15.2
155	±2.00	7.0 ±0.90	2	21.0
		9.0 ±1.00	2	26.7
		5.0 ±0.70	2	15.8



SCHOTT DURAN®: Tubing



Outside Diameter	Wall Thickness	Weight per Length (Length approx. 1500 mm)	Carton Contents	
 mm	 mm	 g	 Number of Tubes	Weight approx. kg
160 ±2.00	5.0 ±0.70	8 140	2	16.3
	7.0 ±1.00	11 249	2	22.5
165 ±2.00	5.0 ±0.70	8 403	2	16.8
	7.0 ±1.00	11 617	2	23.2
170 ±2.00	5.0 ±0.70	8 665	2	17.3
	7.0 ±1.00	11 984	2	24.0
	9.0 ±1.10	15 219	1	15.2
180 ±2.20	5.0 ±0.70	9 190	1	9.2
	7.0 ±1.00	12 720	1	12.7
	9.0 ±1.20	16 165	1	16.2
190 ±2.30	5.0 ±0.80	9 716	1	9.7
	7.0 ±1.00	13 455	1	13.5
200 ±2.40	5.0 ±0.80	10 241	1	10.2
	7.0 ±1.00	14 190	1	14.2
	9.0 ±1.20	18 055	1	18.1
215 ±2.50	7.0 ±1.10	15 293	1	15.3
	9.0 ±1.20	19 473	1	19.5
225 ±2.70	7.0 ±1.10	16 028	1	16.0
	9.0 ±1.30	20 418	1	20.4
240 ±2.90	9.0 ±1.30	21 836	1	21.8
250 ±3.00	5.0 ±0.80	12 867	1	12.9
	7.0 ±1.10	17 866	1	17.9
	9.0 ±1.30	22 782	1	22.8
270 ±3.00	5.0 ±0.80	13 917	1	13.9
	7.0 ±1.10	19 337	1	19.3
	9.0 ±1.30	24 672	1	24.7

SCHOTT DURAN®: Tubing

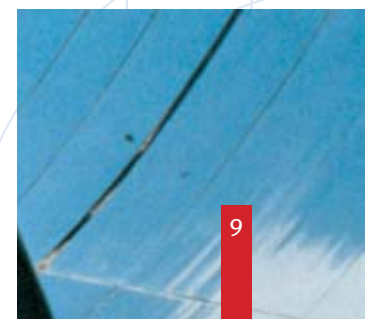


Outside Diameter	Wall Thickness	Weight per Length (Length approx. 1500 mm)	Carton Contents	
mm	mm	g	Number of Tubes	Weight approx. kg
300 ±3.80	5.0 ±0.80	15 492	1	15.5
	7.0 ±1.20	21 542	1	21.5
	9.0 ±1.40	27 508	1	27.5
315 ±3.90	7.0 ±1.20	22 645	1	22.6
	9.0 ±1.40	28 926	1	28.9
325 ±4.00	9.0 ±1.40	29 871	1	29.9
	10.0 ±1.40	33 085	1	33.0

Additional sizes available on request as special production.




Tubing for Water Level Indicators

Outside Diameter	Wall Thickness	Weight per Length (Length approx. 2000 mm)	Carton Contents	
mm	mm	g	Number of Tubes	Weight approx. kg
9.5 ±0.18	1.50 ±0.10	168	100	16.8
11.5 ±0.18	1.50 ±0.10	210	64	13.4
12.5 ±0.18	1.50 ±0.10	231	49	11.3
13.5 ±0.18	1.75 ±0.10	288	49	14.1
14.5 ±0.18	2.25 ±0.15	386	36	13.9
15.5 ±0.18	2.25 ±0.15	418	25	10.4
18.5 ±0.18	2.25 ±0.15	512	25	12.8
19.5 ±0.18	2.25 ±0.15	544	25	13.6
20.5 ±0.25	2.50 ±0.15	630	16	10.1
24.5 ±0.25	2.50 ±0.15	770	16	12.3
29.5 ±0.30	2.75 ±0.20	1 030	9	9.3
34.5 ±0.45	2.75 ±0.20	1 223	9	11.0
39.5 ±0.45	3.00 ±0.20	1 533	9	13.8




SCHOTT DURAN®:

Capillary

Outside Diameter mm	Inside Diameter mm	Weight per Length (Length approx. 1500 mm) g	Carton Contents	
			Number of Capillaries	Weight approx. kg
4 ±0.20	0.8 ±0.08	40	250	10
	0.4 ±0.08	65	154	10
5 ±0.20	0.6 ±0.08	65	154	10
	0.8 ±0.08	64	156	10
	1.2 ±0.08	62	161	10
6 ±0.20	0.4 ±0.08	94	104	10
	0.8 ±0.08	93	108	10
	1.2 ±0.08	91	110	10
	1.7 ±0.10	87	115	10
	2.2 ±0.10	82	122	10
7 ±0.25	2.7 ±0.10	75	133	10
	0.8 ±0.08	127	79	10
	1.2 ±0.08	125	80	10
	1.7 ±0.10	121	83	10
	2.2 ±0.10	116	86	10
8 ±0.25	2.7 ±0.10	110	91	10
	3.0 ±0.10	105	95	10
	0.8 ±0.08	166	60	10
	1.2 ±0.08	164	61	10
	1.7 ±0.10	160	63	10
9 ±0.25	2.2 ±0.10	155	65	10
	2.7 ±0.10	149	67	10
	3.0 ±0.10	144	69	10
	0.8 ±0.08	211	47	10
	1.2 ±0.08	209	48	10
9 ±0.25	1.7 ±0.10	205	49	10
	2.2 ±0.10	200	50	10
	2.7 ±0.10	194	52	10
	3.0 ±0.10	189	53	10

Rod

Diameter mm	Weight/Length (Length approx. 1500 mm) g	Carton Contents	
		Number of Rods	Weight kg
3 ±0.15	24	529	12.5
4 ±0.15	42	298	12.5
5 ±0.15	66	183	12.0
6 ±0.15	95	140	13.2
7 ±0.15	129	98	12.6
8 ±0.25	168	80	13.4
9 ±0.25	213	63	13.4
10 ±0.25	263	45	11.8
12 ±0.25	378	35	13.2
14 ±0.35	515	24	12.4
16 ±0.35	672	20	13.4
18 ±0.45	851	20	17.0
20 ±0.45	1 050	16	16.8
22 ±0.50	1 271	12	15.3
24 ±0.50	1 512	12	18.2
26 ±0.60	1 775	9	16.0
28 ±0.90	2 059	9	18.5
30 ±0.90	2 363	6	14.2

Supplies are effected in cartons.

DENSOPACK® packaging upon request (different weight).

All standard dimensions are available at short notice. All carton contents and weights mentioned are approximate. Special sizes deviating from the standard range in outside diameter, wall thickness, inside diameter, tolerance or length can be produced upon request. Tubing in the outside diameter range 8–40 mm can be coated for scratch protection.



The Glass

DURAN® is a special borosilicate glass of the first hydrolytic class. Its invention was one of Otto Schott's great achievements. Laboratory and chemical plant technology would be unthinkable without DURAN® tubing, capillary and rod, which provide the basis for custom-made solutions to specific problems.

The Advantages

Products made from DURAN® are well-known for their stability, good workability and high thermal shock resistance. DURAN® has a very low rate of thermal expansion which makes it an excellent material for laboratory glassware and for use in large-scale technological plants in the chemical apparatus industry. Products made from DURAN® are resistant to corrosion and remain absolutely neutral, even to aggressive chemicals, in nearly all fields of chemistry. This gives them a great advantage over other materials. Borosilicate glass is extremely resistant to water, acids, salt solutions, organic substances and halogen. Tubing, capillary and rod of DURAN® also have a high alkali resistance. For physical and chemical properties, please see technical data on the following pages.

The large range of tubing, capillary and rod provides a very high level of precision in all dimensions. These products are also available in the form of thermally prestressed components for use in demanding conditions.

The Quality

As with every SCHOTT product, DURAN® tubing, capillary and rod are manufactured using the latest technology. Products made from DURAN® Borosilicate Glass 3.3 by SCHOTT correspond to the main international standards (for example, ISO 3585 and ASTM E438 Type I, Class A). The entire production process is electronically controlled and comprehensively monitored by a Quality Assurance System. SCHOTT is certified according to DIN EN ISO 9001 by TÜV CERT.

The corresponding quality criteria are described in the Technical Terms of Supply.

Further Processing

There are widespread fields of application for DURAN® tubing, capillary and rod. The main area of use is in the laboratory and chemical industries, ranging from simple test tubes to filter apparatus and diverse types of cooling and distilling plants.

Tubing, capillary and rod of DURAN® Borosilicate Glass 3.3 are also to be found in large-scale chemical and sewage plants, in pipeline construction, in measuring and controlling techniques, and increasingly in environmental technology, for example in solar collectors and waste gas desulphurization plants. Other technical fields of application are, for example, heat exchangers, flameproof tubes and flowmeters.

In the craft sector this glass is used to produce unique works of art, from a simple candlestick to filigree wine and champagne glasses.

The Manufacturer

SCHOTT manufactures special glass tubing, capillary and rod in a wide range of glass types and dimensions for a multitude of applications. With an annual production of approx. 67,000 tons, SCHOTT is one of the leading manufacturers of special glass tubing worldwide. Glass processors in more than 70 countries all over the world appreciate their long-standing experience, know-how and quality. Alongside the most modern melting and production methods for special glass, SCHOTT also offers the highest standards of precision in the processing sector: one of their particular talents lies in the field of highly-automatic finish grinding for tubing and rod in small diameters. In order to help you find the optimum solution, we would be pleased to work together with you and answer any questions you may have concerning further processing for glass tubing and rod.

SCHOTT DURAN®:

Physical and Chemical Properties

Physical Data

Coefficient of mean linear thermal expansion α (20°C; 300°C) acc. to ISO 7991		$3.3 \cdot 10^{-6} \text{ K}^{-1}$
Transformation temperature T_g		525 °C
Temperature of the glass	10^{13} (annealing point)	560 °C
at viscosity η in dPa · s:	$10^{7.6}$ (softening point)	825 °C
	10^4 (working point)	1260 °C
Maximum short-time working temperature		500 °C
Density ρ at 25 °C		2.23 g · 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 52326) $t_{k 100}$		250 °C
Logarithm of the electric volume resistivity ($\Omega \cdot \text{cm}$)	at 250 °C	8
	at 350 °C	6.5
Dielectric properties (1 MHz, 25 °C)		
Dielectric constant (permittivity) ϵ		4.6
Dielectric loss factor (dissipation factor) $\tan \delta$		$37 \cdot 10^{-4}$
Refractive index ($\lambda = 587.6 \text{ nm}$) n_d		1.473
Stress-optical coefficient (DIN 52314) K		$4.0 \cdot 10^{-6} \text{ mm}^2 \cdot \text{N}^{-1}$



Pressure Resistance of DURAN® Tubing and Capillary

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

Calculation of pressure resistance (p)
for a given Wall Thickness (WT)
and a given Outside Diameter (OD):

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

Calculation of the Wall Thickness (WT)
at a given pressure resistance (p)
and a given Outside Diameter (OD):

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

OD = Outside Diameter in mm
p = Pressure Resistance in bar

WT = Wall Thickness in mm

$\frac{K}{S}$ = Permissible Load = $7 \frac{\text{N}}{\text{mm}^2}$

According to EN 1595 *Pressure equipment made from Borosilicate Glass 3.3 – General rules for design, manufacture and testing*, DURAN® Borosilicate Glass is an approved material and may be used for the construction of pressure equipment. The pressure equipment producer assumes full responsibility for the choice of correct quality tubing, design and manufacture.



Pressure resistance (p) is also influenced by the following:

- Difference in temperature between inside and outside wall
- Surface Quality
- End Finish
- Observance of Conditions of Installation as per Pressure Vessel Regulations
- Tubing Length

Exact calculations are available on request.

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*

Resistance to Thermal Shock

According to ISO 718, the 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. Resistance to thermal shock of tubing, capillary and rod is dependent on the wall thickness, the shape and size of the quenched area, the state of the surface, the stress which may be present and the end finish. Fast, uneven heating or cooling can easily lead to breakage as a result of tensile strength. It is recommended not to exceed a temperature difference of 120 °C. For large wall thicknesses, this temperature is limited to lower values. Listed below are some measured values to illustrate the resistance to thermal shock of DURAN® Borosilicate Glass 3.3 tubing and rod. These should be used only as reference values as considerable differences between tubing/rod of the same dimensions are possible.

Tubing

OD 50.5/WT 5.00 mm: 220 °C
 OD 133.0/WT 7.00 mm: 180 °C
 OD 120.0/WT 8.00 mm: 180 °C

Rod

Diam. 24.0 mm: 140 °C





SCHOTT DURAN®: Physical and Chemical Properties

Chemical Composition (main components in approx. weight %)

SiO ₂	B ₂ O ₃	Na ₂ O + K ₂ O	Al ₂ O ₃
81	13	4	2

Chemical Resistance

Hydrolytic Class (ISO 719)	HGB 1
Acid Class (DIN 12 116)	S 1
Alkali Class (ISO 695)	A 2

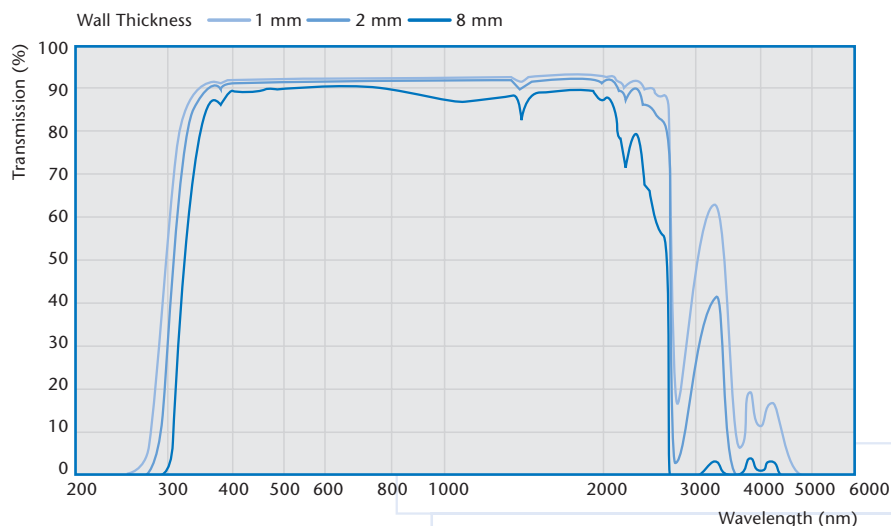
DURAN® Borosilicate Glass 3.3 is highly resistant to water, neutral and acid solutions, concentrated acids and acid mixtures, and to chlorine, bromine, iodine and organic substances. The chemical resistance of this glass is superior to that of most metals and other materials, even when exposed to long processing periods and temperatures above 100 °C.

A slight release of mainly monovalent ions takes place after exposure of the glass to water or acids. A very thin layer of impervious silica gel is subsequently formed on the surface of the glass which in turn slows down further attack. Acid, hot phosphoric acid and alkaline solutions attack the glass surface as a function of concentration and temperature.





Transmission



Hints on Processing

The excellent properties of DURAN® tubing, capillary and rod provide for good workability when forming and cutting the glass with the normal techniques for technical glass. 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. In order not to affect the chemical stability of the glass, annealing time should be kept as short as possible. We recommend the annealing temperatures given in the table below:

Annealing Schedule

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. DURAN® products can be fused stress-free with borosilicate glasses of the same type and can be processed and annealed at the same temperatures. Printing on DURAN® tubing, capillary and rod can be done with silver copper diffusion and screen-printing dyes.



SCHOTT DURAN®: Quality Data

Length

The standard length is:

for Tubing	1500 ^{+10 mm} _{- 0 mm}
for Capillary and Rod	1500 ±30 mm
for Tubing for Water Level Indicators	2000 ^{+10 mm} _{- 0 mm}

Special lengths of tubing, ranging from 1000 to 7500 mm, are available on request depending on the outside diameter.

Glass cuttings are also available in lengths from 0.3 to 1000 mm (OD max. 40 mm) on request.

Circularity

Circularity according to ISO 1101 is dependent on the Outside Diameter (OD)¹⁾.

The following maximum values have been laid down:

Tubing	
OD < 200 mm	t _{max} 0.7 % of nominal OD
OD ≥ 200 – 325 mm	t _{max} 1.0 % of nominal OD
Capillary	
OD < 10 mm	t _{max} 1.0 % of nominal OD
Rod	
OD < 20 mm	t _{max} 1.0 % of nominal OD
OD ≥ 20 – 30 mm	t _{max} 1.5 % of nominal OD

¹⁾Note: The term "Out-of-round" or "Ovality" used in practice means the difference between maximum and minimum OD in a measuring plane vertical to the tubing length axis. The value is twice as high as the circularity value.

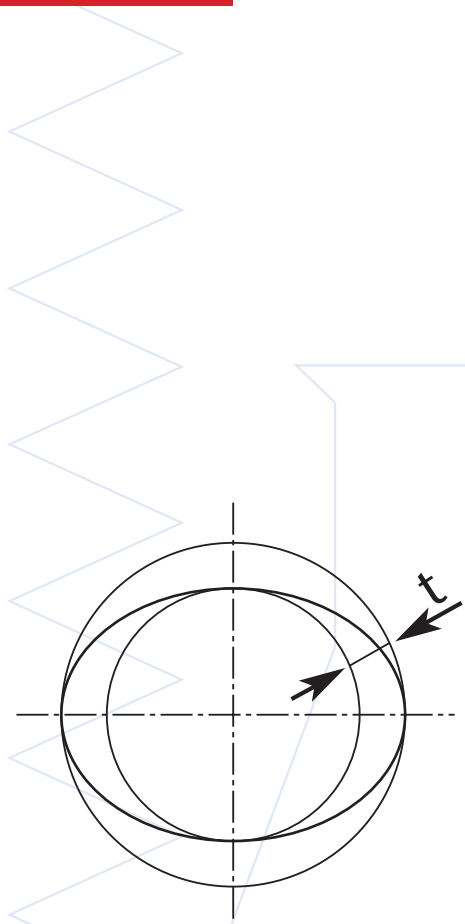
Siding

Siding greater than 12 % of the nominal Wall Thickness within one cross section is not permitted.

Straightness

Values for Straightness according to ISO 1101 are as follows:

OD 3 – < 6 mm	max. 4.0 mm / 1500 mm
OD ≥ 6 – < 30 mm	max. 1.5 mm / 1000 mm
OD ≥ 30 – < 100 mm	max. 2.0 mm / 1400 mm
OD ≥ 100 – < 200 mm	max. 2.5 mm / 1400 mm
OD ≥ 200 mm	max. 3.0 mm / 1400 mm



Stress

	WT < 2 mm	WT 2 – 4 mm	WT > 4 mm
Longitudinal Stress (MPa)	3.0	2.0	1.5
Edge Stress (MPa)	4.0	3.0	2.5

OD = Outside Diameter WT = Wall Thickness

Stones and Knots

Stones	Stones/kg 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	not permitted
Knots	Knots/kg 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	not permitted

The size of the stone or knot is measured by the size of the core.

Airlines

Length

The aggregate airline length is the sum of all airlines ≥ 15 mm length.

The permitted aggregate airline length is 0.8 m/10 m tubing.

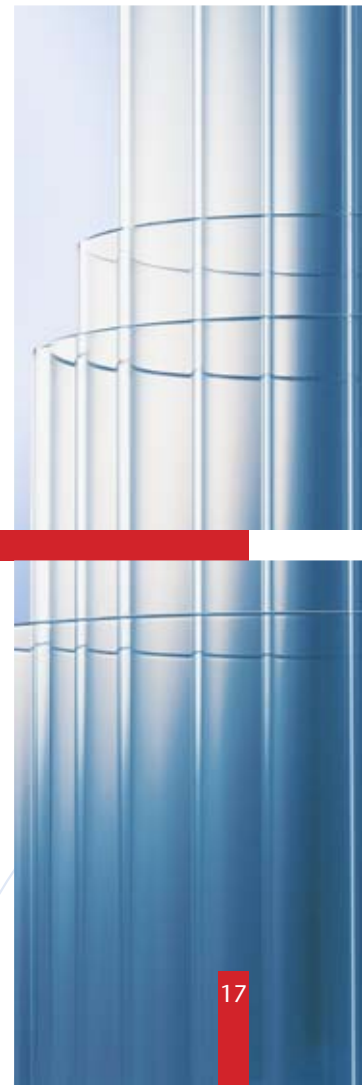
Airlines < 15 mm (seeds): max. 20/kg glass

Width

Airlines wider than 1.0 mm are not permitted for OD ≤ 100 mm.

Airlines wider than 2.0 mm are not permitted for OD > 100 mm.

Airlines wider than 4.0 mm are not permitted for OD > 300 mm.



SCHOTT DURAN®: Quality Data

End Executions and Square Cut for Standard Range

End Executions

	Outside Diameter (OD) in mm	Wall thickness (WT) in mm	End executions
Tubing	< 4.00	-	Untreated
	4.00 – 5.99	-	Sealed
	≥ 6.00	< 0.70 0.70 – 8.99 ≥ 9.00	Edge down in Normally fused ** Plain cut
Capillary	< 4.00	-	Untreated
	4.00 – 9.00	-	Sealed
Rod	3.00 – 30.00	-	Untreated

**Bead Thickness approx. 0.1 mm

Further end executions are possible upon request.

Square Cut for Tubing

Outside Diameter (OD) Range in mm	Limited Value in mm
< 6	not rated
6 – 59	WT ≤ 3.2: 2.5
	WT > 3.2: 3.5
60 – 99	3.0
100 – 199	4.0
≥ 200	5.0

Packaging

Standard: Cartons

On request: DENSOPACK®

Glass tubes are layered into bundles with a square or rectangular cross-section. They are packed into the geometrically tightest space and then covered at each end with transparent shrink film. This means that no movement of the tubing is possible during transport, so that the pack is more stable and resilient. The shrink film at each end of the bundle closes each tube and provides the very best protection against contamination.

DENSOPACK® is available up to an outside diameter of 50 mm.



Technical Terms of Supply

Detailed information on permissible faults, definition of faults, testing methods and testing units is available on request. In case of quality complaints the "Technical Terms of Supply for Special Glass Tubing for DURAN® standard applications" or, where applicable individual agreements, are binding.



The Product Range for Technical Applications

SCHOTT AR-Glas®

Special glass tubing (Hydrolytic Class 3) for the manufacture of pharmaceutical primary packaging (e.g. for solid oral medicines), for the field of medicine (e.g. disposables and pipettes) and for the cosmetic and food industries, tubes and rod for technical applications (e.g. solar collectors), and for the production of various glassblown products.

SCHOTT CONTURAX®

Special glass profiles for decorative and technical lighting, interior decorating, and use in commercial art; for further processing into perfume vials in the cosmetics industry.

SCHOTT DURAN®

Chemically and thermally highly resistant borosilicate glass tubing, capillary and rod (Hydrolytic Class 1) for a variety of applications, e.g. for the manufacture of glass apparatus, equipment and technical fittings; glass tubing and rod for special technical fields of application (e.g. explosion-proof light fittings, heat exchanger tubing, solar collectors), for processing into vials for medical and pharmaceutical applications and the field of commercial art.

SCHOTT DURATAN®

Thermally prestressed (tempered) DURAN®. Thermal prestressing noticeably improves the shock resistance of the glass.

Main field of application: Explosion-proof light fittings.

SCHOTT DUROBAX®

Chemically highly resistant special glass tubing (Hydrolytic Class 1), especially suited for processing into pipettes, test tubes and glass syringes.

In addition to these glass types we produce approx. 50 other special glasses – especially formulated to help you find solutions to your technical problems.

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

SCHOTT ILLAX®

Chemically highly resistant special glass tubing (Hydrolytic Class 2) for the manufacture of double tip ampoules, vials and other pharmaceutical primary containers. ILLAX for technical application, e.g. for the production of adhesive anchors (glass dowels).

Aluminosilicate Glasses

Special glass tubing which is resistant to high temperatures, is alkali-free and can be fused to molybdenum, used in particular for the production of halogen lamps for automotive and general lighting purposes.

Lead glasses

Electrically highly insulating with a low melting point, special glass tube cuttings are used for the hermetic sealing of electronic components for the production of microdiodes.

Tubing
SCHOTT North America, Inc.
555 Taxter Road
Elmsford, NY 10523
USA
Phone: +1 (914) 831-2200
Fax: +1 (914) 831-2201
www.us.schott.com/tubing

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