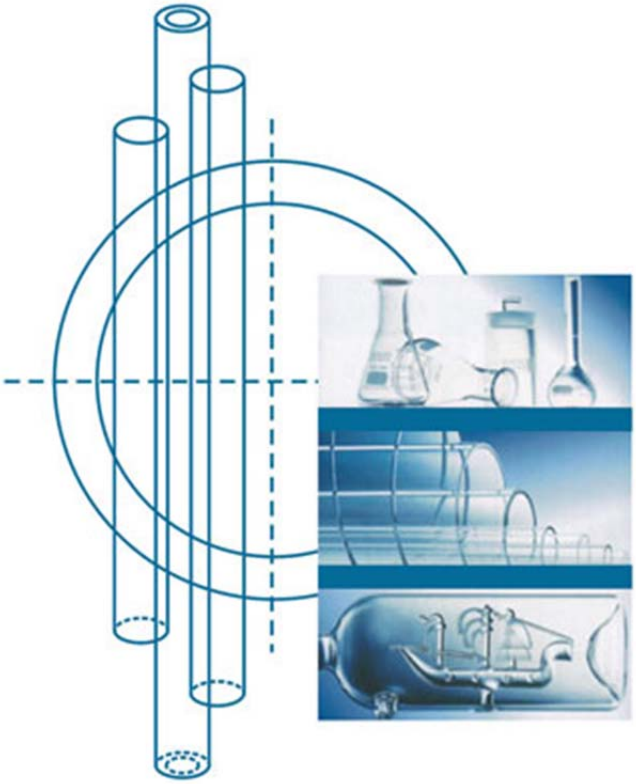


Duran

Tubing, Capillary and Rod of Borosilicate Glass 3.3

VIDRASA
VIDRIO EN TUBO Y VARILLA S.A.

Duran (borosilicate 3.3): Tubing

Outside Diameter		Wall Thickness		Weight per Tube	Carton Contents	
						
mm		mm		g/1500 mm	Number of Tubes	Weight approx. Kg
3	±0.14	0.7	±0.04	17	941	16.0
4	±0.14	0.8	±0.04	27	555	15.0
5	±0.14	0.8	±0.04	35	343	12.0
6	±0.14	1.0	±0.04	53	245	13.0
		1.5	±0.08	71	211	15.0
7	±0.14	1.0	±0.04	63	190	12.0
		1.5	±0.08	87	172	15.0
8	±0.14	1.0	±0.04	74	149	11.0
		1.5	±0.08	102	147	15.0
9	±0.14	1.0	±0.04	84	119	10.0
		1.5	±0.08	118	119	14.0
10	±0.14	1.0	±0.04	95	95	9.0
		1.5	±0.08	134	90	12.0
		2.2	±0.12	180	56	10.0
11	±0.18	1.0	±0.04	105	86	9.0
		1.5	±0.10	150	73	11.0
		2.2	±0.12	203	42	8.5
12	±0.18	1.0	±0.04	116	130	15.0
		1.5	±0.10	165	67	11.0
		2.2	±0.12	226	42	9.5
13	±0.18	1.0	±0.04	126	119	15.0
		1.5	±0.10	181	55	10.0
		2.2	±0.12	250	36	9.0
14	±0.18	1.0	±0.04	137	110	15.0
		1.5	±0.10	197	46	9.0
		2.2	±0.12	273	30	8.2
15	±0.18	1.2	±0.05	174	86	15.0
		1.8	±0.09	250	56	14.0
		2.5	±0.13	328	25	8.2
16	±0.18	1.2	±0.05	187	81	15.0
		1.8	±0.09	268	49	13.1
		2.5	±0.13	354	25	8.8
17	±0.18	1.2	±0.05	199	75	15.0
		1.8	±0.09	287	49	14.0
		2.5	±0.13	381	25	9.5
18	±0.18	1.2	±0.05	212	66	14.0
		1.8	±0.09	306	49	15.0
		2.5	±0.13	407	20	8.1
19	±0.18	1.2	±0.05	224	63	14.0
		1.8	±0.09	325	42	13.7
		2.5	±0.13	433	36	15.6

Duran (borosilicate 3.3): Tubing

Outside Diameter		Wall Thickness		Weight per Tube	Carton Contents	
mm		mm		g/1500 mm	Number of Tubes	Weight approx. Kg
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	20	13.6
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
30	±0.35	1.4	±0.08	421	36	15.2
		2.0	±0.10	588	16	9.4
		2.8	±0.15	800	16	12.8
32	±0.35	1.4	±0.08	450	25	11.3
		2.0	±0.10	630	16	10.1
		2.8	±0.15	859	16	13.8
33	±0.35	2.0	±0.10	651	25	16.2
34	±0.35	1.4	±0.08	479	25	12.1
		2.0	±0.10	672	16	10.8
		2.8	±0.15	918	16	14.8
36	±0.40	1.4	±0.08	509	25	12.6
		2.0	±0.10	714	25	18.0
		2.8	±0.15	976	12	11.7
38	±0.40	1.4	±0.08	538	20	10.8
		2.0	±0.10	756	20	15.0
		2.8	±0.15	1035	9	9.4
40	±0.55	1.6	±0.08	645	16	10.2
		2.3	±0.12	911	16	14.6
		3.2	±0.20	1237	9	11.2
		5.0	±0.40	1838	9	16.5
42	±0.55	1.6	±0.08	679	16	10.9
		2.3	±0.12	959	16	15.3
		3.2	±0.20	1304	9	11.7
44	±0.55	1.6	±0.08	713	16	11.4
		2.3	±0.12	1007	16	16.0
		3.2	±0.20	1371	9	12.4

Duran (borosilicate 3.3): Tubing

Outside Diameter		Wall Thickness		Weight per Tube	Carton Contents	
mm		mm		g/1500 mm	Number of Tubes	Weight approx. Kg
45	±0.65	5.0	±0.40	2101	9	18.9
46	±0.65	1.6	±0.08	746	16	11.9
		2.3	±0.12	1056	9	9.5
		3.2	±0.20	1439	9	13.0
48	±0.65	1.6	±0.08	780	16	12.4
		2.3	±0.12	1104	16	17.6
		3.2	±0.20	1506	6	9.0
50	±0.70	1.8	±0.12	911	12	10.9
		2.5	±0.15	1247	12	15.0
		3.5	±0.25	1709	12	20.5
		5.0	±0.30	2363	6	14.1
		7.0	±0.50	3161	6	19.0
		9.0	±0.65	3876	6	23.2
52	±0.70	1.8	±0.12	949	9	8.5
		2.5	±0.18	1300	9	11.7
		3.5	±0.25	1783	9	16.0
54	±0.70	1.8	±0.12	987	9	8.9
		2.5	±0.18	1352	9	12.2
		3.5	±0.25	1856	9	16.7
55	±0.70	5.0	±0.35	2626	4	10.5
56	±0.70	1.8	±0.12	1025	9	9.2
		2.5	±0.18	1405	9	12.6
		3.5	±0.25	1930	9	17.5
58	±0.70	1.8	±0.12	1063	9	9.6
		2.5	±0.18	1457	9	13.1
		3.5	±0.25	2004	9	18.0
60	±0.80	2.2	±0.18	1336	9	12.0
		3.2	±0.20	1910	9	17.2
		4.2	±0.30	2462	4	9.8
		5.0	±0.35	2888	4	11.5
		7.0	±0.50	3897	4	15.6
		9.0	±0.65	4821	4	19.3
65	±0.80	2.2	±0.18	1451	8	11.7
		3.2	±0.20	2077	4	8.3
		4.2	±0.30	2682	4	10.7
		5.0	±0.35	3151	4	12.6
70	±0.90	2.2	±0.18	1567	8	12.5
		3.2	±0.20	2245	4	9.0
		4.2	±0.30	2903	4	11.6
		5.0	±0.35	3414	4	13.6
		7.0	±0.50	4632	4	18.5
		9.0	±0.65	5766	4	23.1

Duran (borosilicate 3.3): Tubing

Outside Diameter		Wall Thickness		Weight per Tube	Carton Contents	
mm		mm		g/1500 mm	Number of Tubes	Weight approx. Kg
75	±0.90	2.2	±0.18	1682	8	13.5
		3.2	±0.20	2413	4	9.7
		4.2	±0.30	3123	4	12.5
		5.0	±0.35	3676	4	14.7
80	±1.20	2.5	±0.18	2035	4	8.2
		3.5	±0.25	2812	4	11.3
		5.0	±0.40	3939	4	15.8
		9.0	±0.70	6712	4	26.8
85	±1.20	2.5	±0.18	2166	4	8.7
		3.5	±0.25	2996	4	12.0
		5.0	±0.40	4201	4	16.8
90	±1.20	2.5	±0.18	2298	4	9.2
		3.5	±0.25	3180	4	12.7
		5.0	±0.40	4464	4	17.9
		7.0	±0.50	6102	3	18.3
		9.0	±0.70	7657	3	23.0
95	±1.40	2.5	±0.18	2429	4	9.7
		3.5	±0.25	3364	4	13.4
		5.0	±0.40	4726	4	18.9
100	±1.40	2.5	±0.18	2560	4	10.3
		3.0	±0.20	3056	4	12.1
		3.5	±0.25	3547	3	10.7
		5.0	±0.40	4989	3	15.0
		7.0	±0.50	6838	3	20.5
		9.0	±0.70	8602	3	25.8
105	±1.50	3.0	±0.20	3214	3	9.6
		5.0	±0.40	5252	3	15.8
110	±1.50	3.0	±0.30	3372	3	10.1
		5.0	±0.50	5514	3	16.5
		7.0	±0.70	7573	3	22.7
115	±1.50	3.0	±0.30	3529	4	14.1
		5.0	±0.50	5777	2	11.6
		7.0	±0.70	7940	2	15.9
120	±1.50	3.0	±0.30	3687	4	14.7
		5.0	±0.50	6039	2	12.1
		7.0	±0.70	8308	2	16.6
		9.0	±0.90	10493	2	21.0
125	±1.50	5.0	±0.50	6302	2	12.6
		9.0	±0.90	10965	2	21.9

Duran (borosilicate 3.3): Tubing

Outside Diameter		Wall Thickness		Weight per Tube	Carton Contents	
mm		mm		g/1500 mm	Number of Tubes	Weight approx. Kg
130	±1.60	3.0	±0.30	4002	4	16.0
		5.0	±0.50	6565	2	13.1
		7.0	±0.70	9043	2	18.1
		9.0	±0.90	11438	2	22.9
135	±1.60	5.0	±0.50	6827	2	13.7
		7.0	±0.70	9411	2	18.8
140	±1.70	3.0	±0.30	4317	4	17.3
		5.0	±0.50	7090	2	14.2
		7.0	±0.70	9779	2	19.6
145	±1.70	5.0	±0.50	7352	2	14.7
150	±1.80	3.0	±0.30	4632	2	9.3
		5.0	±0.50	7615	2	15.2
		7.0	±0.70	10514	2	21.0
		9.0	±0.90	13329	2	26.7
155	±1.80	5.0	±0.50	7877	2	15.8
160	±1.80	5.0	±0.50	8140	2	16.3
		7.0	±0.80	11249	2	22.5
165	±1.80	5.0	±0.50	8403	2	16.8
		7.0	±0.80	11617	2	23.2
170	±1.80	5.0	±0.50	8665	2	17.3
		7.0	±0.80	11984	2	24.0
		9.0	±1.00	15219	1	15.2
180	±2.00	5.0	±0.50	9190	1	9.2
		7.0	±0.80	12720	1	12.7
		9.0	±1.10	16165	1	16.2
190	±2.10	5.0	±0.50	9716	1	9.7
		7.0	±0.80	13455	1	13.5
200	±2.40	5.0	±0.80	10241	1	10.2
		7.0	±1.00	14190	1	14.2
		9.0	±1.20	18055	1	18.1
215	±2.50	7.0	±1.10	15293	1	15.3
		9.0	±1.20	19473	1	19.5
225	±2.70	7.0	±1.10	16028	1	16.0
		9.0	±1.30	20418	1	20.4
240	±2.90	9.0	±1.30	21836	1	21.8
250	±3.00	5.0	±0.80	12867	1	12.9
		7.0	±1.10	17866	1	17.9
		9.0	±1.30	22782	1	22.8
270	±3.00	5.0	±0.80	13917	1	13.9
		7.0	±1.10	19337	1	19.3
		9.0	±1.30	24672	1	24.7

Duran (borosilicate 3.3): Tubing

Outside Diameter		Wall Thickness		Weight per Tube	Carton Contents	
mm		mm		g/1500 mm	Number of Tubes	Weight approx. Kg
300	±3.80	5.0	±0.80	15492	1	15.5
		7.0	±1.20	21542	1	21.5
		9.0	±1.40	27508	1	27.5
315	±3.90	7.0	±1.20	22645	1	22.6
		9.0	±1.40	28926	1	28.9
325	±4.00	9.0	±1.40	29871	1	29.9
		10.0	±1.40	33085	1	33.0
350	±4.00	5.0	±0.80	18118	1	18.1
365	±4.50	7.0	±1.40	26321	1	26.3
400	±5.00	6.0	±1.50	24829	1	24.8
415	±5.00	7.0	±1.50	29997	1	30.0
420	±5.00	9.5	±1.50	40960	1	41.0

Tube length approx. 1500 mm.
All carton contents and weights are approximate.
Special sizes can be produced upon request.

Duran (borosilicate 3.3): Tubing for Water Level Indicators

Outside Diameter		Wall Thickness		Weight per Tube	Carton Contents	
mm		mm		g/2000 mm	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	11.2
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	20	10.2
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	1030	9	9.3
34.5	±0.45	2.75	±0.20	1223	9	11.0
39.5	±0.45	3.00	±0.20	1533	9	13.8

The length of Tubing for Water Level Indicators is 2000 mm.
All carton contents and weights are approximate.

Duran (borosilicate 3.3): Capillary

Outside Diameter		Inside Diameter		Weight per Tube	Carton Contents	
						
mm		mm		g/1500 mm	Number of Capillaries	Weight approx. Kg
4	±0.18	0.8	±0.08	40	250	10
5	±0.18	0.4	±0.08	65	154	10
		0.6	±0.08	65	154	10
		0.8	±0.08	64	156	10
		1.2	±0.08	62	161	10
6	±0.18	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
		2.7	±0.10	75	133	10
7	±0.20	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
		2.7	±0.10	110	91	10
		3.0	±0.10	105	95	10
8	±0.20	0.8	±0.08	166	60	10
		1.2	±0.08	164	61	10
		1.7	±0.10	160	63	10
		2.2	±0.10	155	65	10
		2.7	±0.10	149	67	10
		3.0	±0.10	144	69	10
9	±0.20	0.8	±0.08	211	47	10
		1.2	±0.08	209	48	10
		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

Capillary length approx. 1500 mm.
All carton contents and weights are approximate.

Duran (borosilicate 3.3): Rod

Diameter		Carton Contents		Diameter		Carton Contents	
mm		Number of Rods	Weight approx. Kg	mm		Number of Rods	Weight approx. Kg
3	±0.14	529	12.5	14	±0.30	24	12.4
4	±0.14	298	12.5	16	±0.30	20	13.4
5	±0.14	183	12.0	18	±0.40	20	17.0
6	±0.14	140	13.2	20	±0.40	16	16.8
7	±0.14	98	12.6	22	±0.45	12	15.3
8	±0.20	80	13.4	24	±0.45	12	18.2
9	±0.20	63	13.4	26	±0.55	9	16.0
10	±0.20	45	11.8	28	±0.80	9	18.5
12	±0.20	35	13.2	30	±0.80	6	14.2

Rod length approx. 1500 mm.
All carton contents and weights are approximate.
Special sizes can be produced upon request.

Duran (borosilicate 3.3): The Glass

The Glass

Duran is a special borosilicate glass of the first hydrolytic class. 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. Duran has a medium coefficient of linear expansion of 3.3.

The Advantages

Products made from Duran are well-known for their stability, good workability and high thermal shock resistance. This type of glass 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. Duran 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 more details, you can consult the Physical and Chemical Properties.

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 prestressed components for use in demanding conditions.

The Quality

Tubing, capillary and rod of Duran are manufactures using the latest technology. Products made from this type of glass correspond to the main international standards. The entire production process is electronically controlled and comprehensively monitored by a Quality Assurance System. The corresponding quality criteria are describes in the Technical Data.

The Fields of Application

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 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 desulphurisation plants. Other technical fields of application are, for example, heat exchangers, flameproof tubes and flow meters.

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

Duran (borosilicate 3.3): Physical and Chemical Properties

Physical Data

Coefficient of mean linear thermal expansion α (20°C; 300°C)	$3.3 \cdot 10^{-6}\ K^{-1}$
Transformation temperature T_g	525 °C
Glass temperature at viscosity η in dPa·s:	
10^{13} annealing point	560 °C
$10^{7.6}$ softening point	825 °C
10^{4} working point	1260 °C
Maximum short-time working temperature	500 °C
Density ρ at 25 °C	$2.23\ g \cdot cm^{-3}$
Modulus of elasticity E (Young's modulus)	$63 \cdot 10^{3}\ N \cdot mm^{-2}$
Poisson's ratio μ	0.20
Thermal conductivity λ_w at 90 °C	$1.2\ W \cdot m^{-1} \cdot K^{-1}$
Temperature for the specific electrical resistance of $10^8\ \Omega \cdot cm$ $t_{k\,100}$	250 °C
Logarithm of the electric volume resistivity ($\Omega \cdot cm$) 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 δ	$37 \cdot 10^{-4}$
Refractive index (λ = 587.6 nm) n_d	1.473
Stress-optical coefficient K	$4.0 \cdot 10^{-6}\ mm^2 \cdot N^{-1}$

Chemical Composition (main components in approx. weight %)

SiO_2	B_2O_3	$Na_2O + K_2O$	Al_2O_3
80.4	13.0	4.2	2.4

Pressure Resistance of Duran Tubing and Capillary

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

$$p = \frac{Ep \cdot 20 \cdot \frac{R}{S}}{De - Ep}$$

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

$$Ep = \frac{De \cdot p}{20 \cdot \frac{R}{S} + p}$$

De = Outside Diameter, in mm
Ep = Wall Thickness, in mm
P = Pressure resistance in bar
R/S = Resistance Parameter in $N \cdot mm^{-2}$

Resistance parameter for Duran: K/S = 7 N/mm^2

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

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

Resistance to Thermal Shock

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 tubing and rod. These should be used only as reference values as considerable differences between tubing/rod of the same dimensions are possible.

Tubing	Rod
OD 50.5/WT 5.00 mm: 220 °C	Diam. 24.0 mm: 140 °C
OD 133.0/WT 7.00 mm: 180 °C	
OD 120.0/WT 8.00 mm: 180 °C	

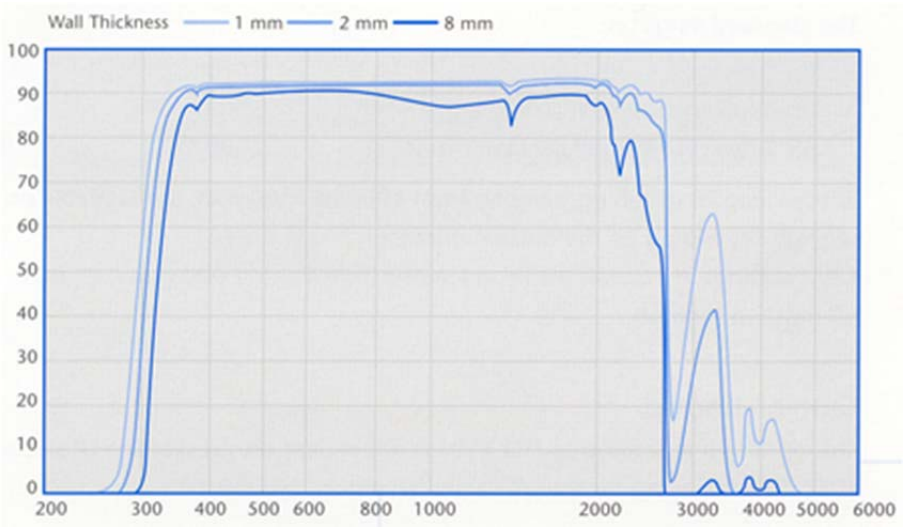
Chemical Resistance

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

Duran is highly resistant to water, neutral and acid solutions, concentrated acids and acid mixtures, and to chorine, 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 clown 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.

Duran (borosilicate 3.3): Technical Data

Length

The standard lengths are as follows:

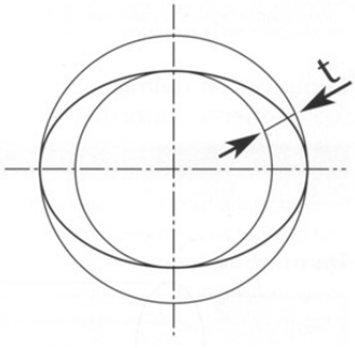
Tubing	1500 +10/-0 mm
Capillary and Rod	1500 ±30 mm
Tubing for Water Level Indicators	2000 +10/-0 mm

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

Out-of-Round

Out-of-Round is dependent on the Outside Diameter (OD). The following maximum values have been laid down:

Tubing	Maximum value *t*
OD < 200 mm	0.7 % of nominal OD
OD ≥ 200 - 325 mm	1.0 % of nominal OD
Capillary	**Maximum value *t***
OD < 10 mm	1.0 % of nominal OD
Rod	**Maximum value *t***
OD < 20 mm	1.0 % of nominal OD
OD ≥ 20 - 30 mm	1.5 % of nominal OD



Straightness

Values of Straightness 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

WT: Wall Thickness

Stones and Knots

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

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 mm	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 mm	not permitted

Airlines

Length

The aggregate airline length is the sum of all airlines ≥ 20 mm length.
The permitted aggregate airline length is 0.8 m / 10 m tubing.

Airlines < 20 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.

Packaging

The products are provided in carton boxes.

End Finishes and Square-Cut for Standard-Range

Tubing	End Finishing	Square-Cut
OD 3 - 5 mm	untreated	
OD 6 - 38 mm	plain cut and fused**	max. 2.5 mm
OD 40 - 60 mm		
WT ≤ 3.2 mm	plain cut and fused **	max. 2.5 mm
WT > 3.2 mm	plain cut	max. 3.5 mm
OD 65 - 325 mm (except WT > 9.0 mm)	plain cut and fused **	OD 65 - 100 mm max. 3.0 mm OD 100 - 200 mm max. 4.0 mm OD > 200 mm max. 5.0 mm
Capillary		
fused		
Rod		
untreated		

*** End finish when fused: bead thickness = approx. 0.1 mm (normal seal)*

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