SCHOTT AR-Glas®

Tubing and Rod of Special Glass

SCHOTT
glass made of ideas

SCHOTT AR-Glas®: Tubing

Outside Diameter		Wall Thickness		Weight per Length (Length approx. 1500 mm)	Carton Contents	
mm		mm		g	Number of Tubes	Weight approx. kg
4	±0.09	**0.50**	±0.02	21	582	12.0
	±0.09	**0.70**	±0.03	27	551	15.0
	±0.12	**0.90**	±0.03	33	548	18.0
5	±0.09	**0.50**	±0.02	27	378	10.0
	±0.09	**0.70**	±0.03	36	367	13.0
	±0.12	**0.90**	±0.03	44	386	17.0
6	±0.10	**0.50**	±0.02	33	618	20.0
	±0.10	**0.70**	±0.03	44	252	11.0
	±0.10	**0.90**	±0.03	54	278	15.0
	±0.12	**1.10**	±0.03	64	252	16.0
7	±0.10	**0.50**	±0.02	38	418	16.0
	±0.10	**0.70**	±0.03	52	193	10.0
	±0.10	**0.90**	±0.03	65	186	12.0
	±0.12	**1.10**	±0.03	77	196	15.0
8	±0.10	**0.50**	±0.02	44	340	15.0
	±0.10	**0.70**	±0.03	60	332	20.0
	±0.10	**0.90**	±0.03	76	146	11.0
	±0.12	**1.10**	±0.03	90	155	14.0
9	±0.12	**0.50**	±0.02	50	280	14.0
	±0.12	**0.70**	±0.03	69	278	19.0
	±0.12	**0.90**	±0.03	86	255	22.0
	±0.14	**1.10**	±0.03	103	117	12.0
10	±0.12	**0.60**	±0.03	67	226	15.0
	±0.12	**0.80**	±0.03	87	219	19.0
	±0.14	**1.00**	±0.03	106	217	23.0
	±0.15	**1.20**	±0.04	125	97	12.0
11	±0.12	**0.60**	±0.03	74	163	12.0
	±0.12	**0.80**	±0.03	96	187	18.0
	±0.14	**1.00**	±0.03	118	170	20.0
	±0.15	**1.20**	±0.04	139	166	23.0
12	±0.12	**0.60**	±0.03	81	149	12.0
	±0.12	**0.80**	±0.03	106	152	16.0
	±0.14	**1.00**	±0.03	130	154	20.0
	±0.15	**1.20**	±0.04	153	151	23.0
13	±0.12	**0.60**	±0.03	88	131	11.5
	±0.12	**0.80**	±0.03	115	131	15.0
	±0.14	**1.00**	±0.03	142	134	19.0
	±0.15	**1.20**	±0.04	167	126	21.0

SCHOTT AR-Glas®: Tubing

Outside Diameter		Wall Thickness		Weight per Length (Length approx. 1500 mm)	Carton Contents	
mm		mm		g	Number of Tubes	Weight approx. kg
14	±0.12	**0.60**	±0.03	95	211	20.0
	±0.12	**0.80**	±0.03	125	113	14.0
	±0.14	**1.00**	±0.03	154	111	17.0
	±0.15	**1.20**	±0.04	182	111	20.0
15	±0.14	**0.60**	±0.03	102	196	20.0
	±0.14	**0.80**	±0.03	134	90	12.0
	±0.14	**1.00**	±0.04	166	97	16.0
	±0.18	**1.20**	±0.04	196	97	19.0
16	±0.14	**0.60**	±0.03	109	165	18.0
	±0.14	**0.80**	±0.03	144	168	24.0
	±0.14	**1.00**	±0.04	177	85	15.0
	±0.18	**1.20**	±0.04	210	86	18.0
17	±0.14	**0.80**	±0.03	153	72	11.0
	±0.14	**1.00**	±0.04	189	74	14.0
18	±0.18	**0.80**	±0.03	163	135	22.0
	±0.19	**1.00**	±0.04	201	70	14.0
	±0.19	**1.20**	±0.04	238	67	16.0
	±0.23	**1.50**	±0.05	293	69	20.0
19	±0.18	**0.80**	±0.03	172	122	21.0
	±0.19	**1.00**	±0.04	213	61	13.0
	±0.23	**1.50**	±0.05	310	58	18.0
20	±0.19	**0.80**	±0.04	182	100	18.0
	±0.19	**1.00**	±0.04	224	103	23.0
	±0.19	**1.20**	±0.05	267	56	15.0
21	±0.19	**0.80**	±0.04	191	95	18.0
	±0.19	**1.00**	±0.04	236	93	22.0
22	±0.19	**0.80**	±0.04	201	80	16.0
	±0.19	**1.00**	±0.04	248	89	22.0
	±0.19	**1.20**	±0.05	295	82	24.0
23	±0.19	**0.80**	±0.04	209	82	17.0
	±0.19	**1.00**	±0.04	260	73	19.0
	±0.23	**1.50**	±0.05	381	42	16.0

SCHOTT AR-Glas®: Tubing

Outside Diameter mm		Wall Thickness mm		Weight per Length (Length approx. 1500 mm) g	Carton Contents Number of Tubes	Carton Contents Weight approx. kg
24	±0.19	**1.00**	±0.04	272	74	20.0
	±0.19	**1.20**	±0.05	323	65	21.0
	±0.23	**1.50**	±0.05	399	38	15.0
25	±0.19	**0.80**	±0.04	229	66	15.0
	±0.24	**1.50**	±0.05	417	34	14.0
26	±0.19	**1.00**	±0.04	296	58	17.0
	±0.24	**1.20**	±0.05	352	63	22.0
	±0.24	**1.50**	±0.05	433	32	13.8
28	±0.19	**1.00**	±0.04	319	55	17.5
	±0.24	**1.20**	±0.05	380	53	20.0
	±0.24	**1.50**	±0.05	468	26	12.2
30	±0.24	**1.20**	±0.05	407	42	17.1
	±0.29	**1.50**	±0.06	503	42	21.1
32	±0.24	**1.20**	±0.05	435	36	15.7
	±0.29	**1.50**	±0.06	539	36	19.4
34	±0.24	**1.20**	±0.05	463	30	13.9
	±0.29	**1.50**	±0.06	574	30	17.2
36	±0.40	**1.20**	±0.06	492	25	12.3
	±0.40	**1.50**	±0.07	609	25	15.2
38	±0.40	**1.20**	±0.06	522	25	13.0
	±0.40	**1.50**	±0.07	645	25	16.1
40	±0.50	**1.20**	±0.08	550	20	11.0
	±0.50	**1.50**	±0.08	680	20	13.6

In addition to the above dimensions, other lengths and outside diameters up to 70 mm are available on request.

Tubing in the outside diameter range 5–30 mm can be coated for scratch protection (minimum order quantity 5 t). Order quantities of 1 t or more for outside diameters ≥ 10 mm can be supplied in DENSOPACK® packaging.

SCHOTT AR-Glas®: Rod[1)]

Diameter	Carton Contents		Diameter	Carton Contents	
mm	Number of Rods	Weight approx. kg	mm	Number of Rods	Weight approx. kg
3 ±0.10	509	13.5	10 ±0.25	49	14.4
4 ±0.15	308	14.5	12 ±0.25	33	14.0
5 ±0.15	217	16.0	14 ±0.30	24	13.8
6 ±0.15	141	15.0	16 ±0.35	20	15.1
7 ±0.20	104	15.0	20 ±0.50	16	18.8
8 ±0.20	79	15.0	25 ±0.70	9	16.6
9 ±0.20	60	14.3			

[1)] Rod length approx. 1500 mm

All dimensions of tubing and rod listed in this brochure are available at short notice. All carton contents and weights are approximate.

Clear Advantages: SCHOTT AR-Glas®

The Glass

AR-Glas® is a clear glass of Hydrolytic Class 3, and belongs to the soda lime group of glasses, with a high alkali and alkaline earth oxide content.

The Advantages

The outstanding properties of AR-Glas® are its multiple application possibilities, the good price/performance ratio, good workability and the accuracy of its dimensions. All the standard dimensions listed here are available at short notice.

The Quality

The quality of the products is ensured by the use of the most modern manufacturing technology and the DIN EN ISO 9001 quality assurance system, certified by TÜV certificate. The quality features are described in the relevant technical data sheets.

The Fields of Application

AR-Glas® has a wide range of applications, and is processed, for example, into pipettes, vials and test tubes. Many other laboratory articles and other technical products (e.g. solar collectors) are also made of AR-Glas®, and it is also used in the decorative glass industry for the manufacture of Christmas decorations.

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. 65,000 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 AR-Glas®: Physical and Chemical Properties

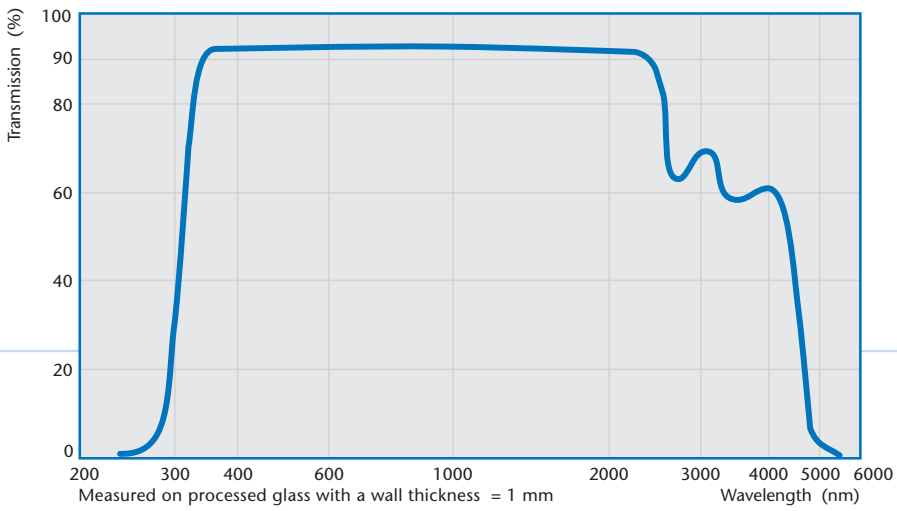
Physical Data

Coefficient of mean linear thermal expansion α (20 °C; 300 °C) acc. to ISO 7991		$9.1 \cdot 10^{-6}\ K^{-1}$
Transformation temperature T_g		525 °C
Temperature of the glass at viscosity η in dPa · s:	10^{13} (annealing point)	530 °C
	$10^{7.6}$ (softening point)	720 °C
	10^{4} (working point)	1 040 °C
Density ρ at 25 °C		$2.50\ g \cdot cm^{-3}$
Modulus of elasticity E (Young's modulus)		$73 \cdot 10^{3}\ N \cdot mm^{-2}$
Poisson's-Ratio μ		0.22
Thermal conductivity λ_W at 90 °C		$1.1\ W \cdot m^{-1} \cdot K^{-1}$
Temperature for the specific electrical resistance of $10^8\ \Omega \cdot cm$ (DIN 52 326) $t_{k\,100}$		200 °C
Logarithm of the electric volume resistivity ($\Omega \cdot cm$)	at 250 °C	7.1
	at 350 °C	5.7
Dielectric properties (1 MHz, 25 °C)		
Dielectric constant (permittivity) ε		7.2
Dielectric loss factor (dissipation factor) tan δ		$70 \cdot 10^{-4}$
Refractive index (λ = 587.6 nm) n_d		1.514
Stress-optical coefficient (DIN 52 314) K		$2.7 \cdot 10^{-6}\ mm^2 \cdot N^{-1}$

Chemical Composition (main components in approx. weight %)

SiO_2	B_2O_3	K_2O	Al_2O_3	Na_2O	BaO	CaO	MgO
69	1	3	4	13	2	5	3

Transmission



Resistance to Thermal Shock

Resistance to thermal shock is not an exactly defined physical value (for more details see ISO 718); it depends on the measuring method, the shape, the wall thickness and the surface and end properties of the glass object in question. Rapid temperature changes cause high temporary stress in the glass, meaning that rapid local cooling processes are very dangerous, since in this case a thin outer layer of the glass is placed under tensile stress over the still hot inner core. Glass is much more susceptible to tensile stress than to compressive stress.

Chemical Resistance

Hydrolytic Class (ISO 719)	HGB 3
Acid Class (DIN 12 116)	S 1
Alkali Class (ISO 695)	A 2

SCHOTT AR-Glas®: Quality Data

Outside Diameter and Wall Thickness

Outside diameter (OD) and wall thickness (WT) in accordance with the tables on pages 2–5.
In addition to the listed range, tubing with an OD of up to 70 mm and rod with a diameter of up to 30 mm, plus other wall thicknesses, are available on request.

Length

Standard lengths are as follows:

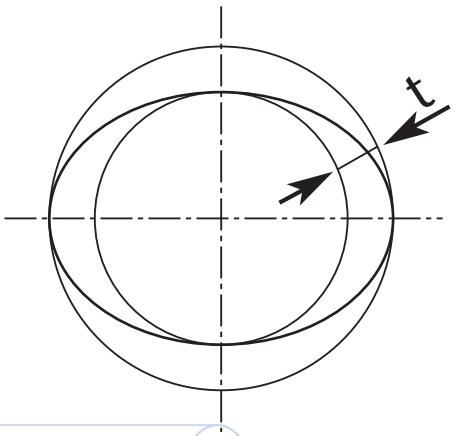
Tubing	1500 +5/–0 mm
Rod	1500 ± 20 mm

Special lengths from 1200 to 4000 mm for tubing in the outside diameter range from 18 to 38 mm are available on request.

Circularity

Circularity according to ISO 1101 depends on the nominal outside diameter OD[3)]. The following maximum values have been laid down:

OD	Maximum value t
< 25 mm	0.3 % of OD
25 – 35 mm	0.5 % of OD
> 35 mm	0.6 % of OD



[3)]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

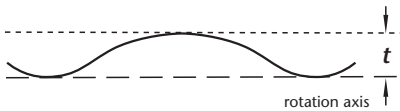
Siding is the difference between the maximum and minimum wall thickness in a measured plane.

Maximum siding value
6 % of the wall thickness

SCHOTT AR-Glas®: Quality Data

Straightness

Straightness according to ISO 1101 is based on the following maximum values:

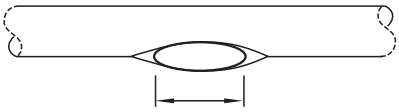


OD	Maximum value t
4 – 6 mm	3.0 mm/1500 mm
> 6 mm	0.8 mm/1000 mm

Stress

Longitudinal stress	max. 4.0 MPa
Edge stress	max. 4.5 MPa

Stones and Knots



Stones are opaque inclusions, knots are transparent inclusions. Stones and knots with a core diameter of ≥ 0.5 mm are regarded as faults. (Detailed information on permissible faults, definition of faults, testing methods and testing units is available on request.)

Airlines

Airlines are an elongated, gaseous inclusion along the length of the tubing, which is generally not visible to the naked eye.

The aggregate airline length is defined by adding together the length of all airlines > 15 mm (or in the case of two or more overlapping airlines, the distance between the extremities of the airlines concerned). A cumulative airline length of > 0.9 m per 10 m of tubing is regarded as a fault. (Detailed information on permissible faults, definition of faults, testing methods and testing units is available on request.)

SCHOTT AR-Glas®: Quality Data

Scratches

A scratch represents a slight surface defect which neither penetrates the depth of the wall, nor permeates it in any way and therefore has an insignificant effect on the mechanical stability.

Tubing of 5–30 mm outside diameter can be coated for protection against scratches.

End Executions

Tubing [2]	
End execution: plain cut and fused	
Standard: vial fusing with a fusing thickness of 0.15 mm	
Other tubing end versions:	Fusing Thickness
Slightly fused	0.05 mm
Medium fusing	0.10 mm
Heavy fusing	0.20 mm
Rod	
Untreated	

[2] *Other versions are also available on request.*

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.

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 relevant “Technical Terms of Supply” for the particular application or, where applicable individual agreements, are binding.

The Product Range

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, tubing 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 applications (e.g. explosion-proof light fittings, heat exchanger tubing, solar collectors), for processing into vials for medical and pharmaceutical applications and for 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.

SCHOTT FIOLAX®-clear and SCHOTT FIOLAX®-amber

Chemically highly resistant special glass tubing (Hydrolytic Class 1) for processing into ampoules, vials and other pharmaceutical primary packaging.

SCHOTT ILLAX®

Chemically highly resistant special glass tubing (Hydrolytic Class 2) for the manufacture of double tip ampoules, vials and other pharmaceutical primary packaging. 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 semiconductors for the production of microdiodes and for electrotechnical applications.

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

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