

HIGH PURITY

SYLVANIA's proprietary four-step sand purification process ensures consistently pure fused quartz tubing.

SUPERIOR SERVICE

Manufacturing flexibility, backed by an experienced and conscientious staff, makes SYLVANIA an industry leader in customer service.



Grades and Applications

SYLVANIA grade fused quartz tubing is used in a variety of high temperature lighting applications. Various grades and chemical compositions are available to best meet the needs of each specific application. Additional fused quartz tubing grades, not shown below, are available including SG25 equivalents, UV Stop tubing, and graded quartz-sealing rod.

Grades	Description	Application
SG25N	Clear Quartz ≥ 100 ppm OH	General Use* (High OH)
SG25A	Clear Quartz ≤ 5 ppm OH	Mercury, Tungsten Halogen
SG25B	Clear Quartz ≤ 1 ppm OH	Metal Halide
SG25C	Clear Quartz ≤ 0.5 ppm OH	Low OH - Customer specified
SG26BZ	Ozone Free ≤ 1 ppm OH	Germicidal Lamps

* Often used for Germicidal sleeve tubing

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Process and Capabilities

SYLVANIA manufactures grades SG25 and SG26 in the range of **6mm – 45mm OD**. Within various OD ranges, the wall thickness capabilities are as follows:

Wall Thickness Capability (mm)	OD Range (mm)
1.00	8.00 – 28.00
1.50	11.00 – 43.00
2.00	12.00 – 45.00
2.50	20.00 – 40.00
3.00	25.00 – 45.00

Additional fused quartz capabilities, not shown here, are available including heavy wall tubing and small diameter tubing (<6mm). Each of our facilities begins with high purity silica sand that is melted and drawn into fused quartz tubing to meet specified dimensional tolerances.

Cutting Capabilities

SYLVANIA uses a wet cut process to provide cut lengths to the tolerances shown below. The cut tubes are then washed, dried and inspected before the product is packaged and shipped to the customer.

Length	Type of Cut	Tolerance
1000 – 2000mm	SNAP	± 10mm
500 – 999 mm	SAW	± 2mm
250 – 499 mm	SAW	± 1mm
35 – 249 mm	SAW	± 0.5mm

Dimensional Tolerances

SYLVANIA's standard tolerances are as shown in the table below. Tighter tolerances may be available upon request.

OD Capability Range	ID	Maximum Ovality	Wall Thickness	Maximum Siding	Maximum Bow	Maximum Length
6 – 45mm	2.5%	2.0%	±10%	10.0%	1mm / m	2 m

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Attribute Quality Criteria

Standard attributes are listed below with standard quality criteria shown. Special criteria may be met upon request.

Attribute	Quality Criteria
Airline	<ul style="list-style-type: none"> ➤ Open to OD or ID – None permitted ➤ Closed – Disregard if diameter or width ≤ 0.1mm <ul style="list-style-type: none"> • 0.2mm maximum width • 305mm maximum length • 0.2 x tube length = maximum aggregate length
Inclusions	<ul style="list-style-type: none"> ➤ Foreign matter, devitrification, metal, quartz chips visible to unaided vision that are attached to the tube <ul style="list-style-type: none"> • Exposed on ID – none permitted • Exposed on OD – 0.5mm maximum dimension • Within Wall – 4.0 maximum number per tube
Scratches	<ul style="list-style-type: none"> ➤ Narrow lines of abrasion ≤ 0.2mm wide ➤ Length-aggregate-limit = $\frac{1}{2}$ tube length ➤ Circumference-limit = 1 x tube circumference ➤ Maximum width = 0.2mm ➤ Maximum length = 152mm each
Scuffs	<ul style="list-style-type: none"> ➤ Broad bands of surface abrasions ➤ Maximum aggregate length = 0.5 x tube length ➤ Maximum width = 0.8mm
Checks	<ul style="list-style-type: none"> ➤ Very small fissures into tube wall as seen by bright reflections with end lighting ➤ None allowed
Cut Quality	<ul style="list-style-type: none"> ➤ Cracks not allowed ➤ Slant cut – 0.5mm maximum from plane perpendicular to tube axis ➤ Chips – maximum $\frac{1}{2}$ wall thickness <ul style="list-style-type: none"> • Maximum chip size = 1mm x 2mm
Cleanliness	<ul style="list-style-type: none"> ➤ Water spots, haze, loose foreign material – none, except normal shipping contamination

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Cleaning and Handling

Good cleaning and handling practices are important to maximize the life of the fused quartz tubing, by minimizing divitrification caused by non-silica contaminants. For proper cleaning the following steps should be taken:

1. DI Water Rinse – rinsing removes contaminants that can cause preferential etching of scratches or scuffs
2. Acid Wash – acid washed in either 5% by weight HF for 2-3 minutes or 5% NH_4HF_2 for 10-15 minutes
3. Hot DI Water Rinse – initial rinsing with hot de-ionized (DI) or distilled water
4. Hot DI Water Spray – the hot DI spray completes the rinsing process
5. Drip Dry – drip-drying is used to minimize contaminants that can be introduced with forced drying
6. Special Handling – clean tubes should be handled with clean cotton gloves

Elemental Analysis / Purity

SYLVANIA produces consistently pure fused quartz. Flame atomic absorption and inductively coupled plasma analytical methods are routinely used to ensure the quality of the starting, in-process, and finished fused quartz materials. Typical chemical analyses (ppm wt) are as follows:

	<i>Al</i>	<i>Fe</i>	<i>Na</i>	<i>K</i>	<i>Li</i>	<i>Ca</i>	<i>Mg</i>	<i>Cu</i>	<i>Mn</i>	<i>Cr</i>	<i>B</i>	<i>Zr</i>	<i>Ti</i>
SG25	15	0.3	0.6	0.6	0.6	0.6	<0.1	<0.1	<0.1	<0.1	<1.0	1.0	.9
SG26	15	0.3	0.7	0.6	0.7	0.6	<0.2	<0.2	<0.1	<0.1	<1.0	2.0	100

Chemical Properties & Permeability

Fused quartz is impermeable to most gases. Ionic and molecular diffusion rates are very low. However, at high temperatures, hydrogen diffusion into a lamp's atmosphere can cause disruption of the tungsten-halogen cycle, or hard starting and short life in electric discharge lamps. The following are diffusion coefficients at 1000°C in $\text{cm}^2/\text{sec} \times 10^6$.

<i>Element</i>	<i>Diffusion Coefficient</i>
Helium	55.0
Hydrogen	7.3
Sodium	7.9
Lithium	1.2
Potassium	0.2

*References: J. Chem. Phys., Phys. Chem. Glasses, J. Am. Ceramic Society, and Frischat, "Ionic Diffusion in Oxide Glasses"

Fused quartz also has the highest chemical stability of all the glasses. It does not react with most materials, even at temperatures as high as 1000°C. This makes it ideal for lighting applications.

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Thermal Properties

Fused quartz is useful in lighting due to its superior thermal shock resistance to that of other glasses and even most ceramics. To optimize useful life at high temperatures, fused quartz should be cleaned just prior to use. Surface contaminants, especially the alkalis, will cause the surface to devitrify, or recrystallize, to a crystalline form of quartz known as cristobalite.

Property	Applicable Condition	Measure
Coefficient of Thermal Expansion	20 – 300°C	5.5×10^{-7} cm/cm/°C
Annealing Point	$10^{13.2}$ poise	1200°C
Strain Point	$10^{14.6}$ poise	1100°C
Thermal Conductivity	25°C	0.00323 cal/cm-sec-°C
Specific Heat	25°C	0.184 cal/g-°C

Viscosity is a measure of the rate at which a glass will deform or flow at a given temperature and stress. Fused quartz has the highest viscosity of all glasses. This is important to high temperature lighting applications.

Mechanical Properties

The mechanical properties of fused quartz is as follows:

Property	Measures
Density	2.20 g/cc
Hardness (KHN₅₀)	590 kg/mm ²
Modulus of Elasticity	73 GPa
Modulus of Rigidity	31 GPa
Poisson's Ratio	0.17

*The design tensile strength is usually recommended as 1000psi.

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Electrical Properties

Fused quartz has low electrical conductivity, low dielectric loss and a high dielectric strength, making it ideal for electrical insulation applications.

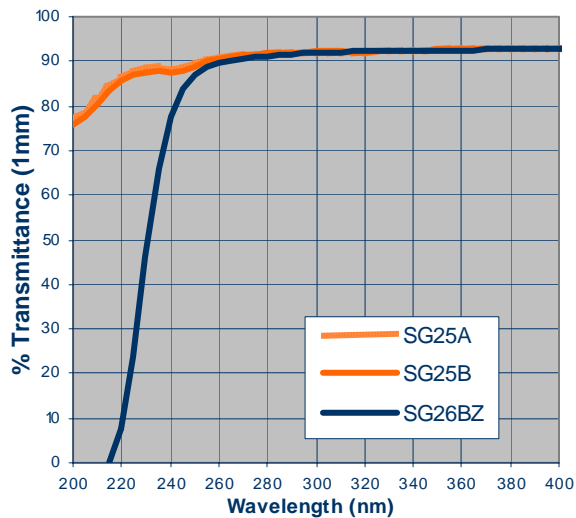
Property	Measures*
Electrical Resistivity	$10^{18} \Omega\text{-cm}$
Dielectric Strength	50 k-volts/mm
Dielectric Constant	3.75
Dissipation Factor	$<1 \times 10^{-4}$
Dielectric Loss Factor	$<1 \times 10^{-4}$

*Properties at 20°C and 1MHz

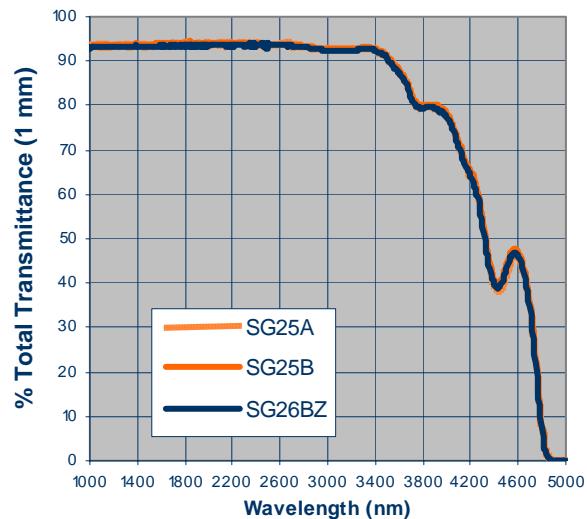
Optical Properties

UV Transmission is a key factor for determining the optimal application for each fused quartz grade. Where clear fused quartz grades are suitable for general lighting applications, the doped fused quartz grades have particular transmission properties to meet the needs of specialty applications. Common applications are Ozone Free quartz (SG26BZ) for Germicidal lamps and UV Stop quartz (Ovisil 482) as shrouds in Metal Halide lamps.

Fused Quartz Optical Transmittance



Fused Quartz Optical Transmittance



* For fused quartz, the transmission (T2) at other thicknesses is given by: $\ln(T2) = (t2/t1)\ln(T1/0.92) + \ln(0.92)$, where T1 is the transmission at thickness t1.

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Packaging

SYLVANIA has several packaging configurations to meet the needs of the customer. Special packaging may also be available upon request.

Long Length (snap cut)

- Typically packed in cartons of 41, 52, 64 or 76" lengths using bundles or foam inserts between layers.
- Tote pack is also available.

Cut Piece

- For cut pieces > 164mm a cell pack is used.
- For cut pieces ≤ 164mm a tray pack configuration is used. These can be stretch wrapped on pallets or packed in totes.

Quality Assurance

SYLVANIA is a certified **ISO 9002** supplier, and manufactures quartz tubing under strict quality control measures from the incoming sand through the final inspection and packaging of the product. From the label there is complete traceability of that product throughout each critical manufacturing step.

Process Step	Quality Assurance Measures
Incoming Sand	<ul style="list-style-type: none">➤ Supplier certification➤ Spot check chemical acids, water check
Sand Treatment	<ul style="list-style-type: none">➤ Chemical analysis of each lot➤ Lot number assigned
Tube Draw	<ul style="list-style-type: none">➤ Dimensional data collected➤ Control charts➤ Visual
Cut / Inspect / Pack	<ul style="list-style-type: none">➤ Dimensions➤ Visual➤ Chemical analysis
Label Traceability	<ul style="list-style-type: none">➤ Certificate of Compliance (upon request)➤ When / Who inspected and packed➤ Exact manufacturing date / time➤ Sand lot number

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How to Order

Fused quartz tubing should be ordered by specifying the following criteria.

1. Size

- ID x OD x Length (in millimeters)
- Wall thickness is computed by: $(OD - ID) / 2$.
- Refer to wall capability table on Page 2 if necessary.

2. Grade

- Specific grade should be indicated as follows:

Grade	Description
A	< 5ppm OH Saw Cut
AS	< 5ppm OH Snap Cut
B	< 1ppm OH Saw Cut
BS	< 1ppm OH Snap Cut
AZ	< 5ppm OH Ozone Free Saw Cut
AZS	< 5ppm OH Ozone Free Snap Cut
BZ	< 1ppm OH Ozone Free Saw Cut
BZS	< 1ppm OH Ozone Free Snap Cut
N	> 100ppm OH Saw Cut
NS	> 100ppm OH Snap Cut

3. Quantity

- Minimum order quantities are equivalent to 125kg or 275lbs.
- The kilograms per piece can be calculated with the following formula:

$$(OD + ID) \times (OD - ID) \times (L) \times (1.7278 \times 10^{-6})$$

where:

- OD = outside diameter (mm)
- ID = inside diameter (mm)
- L = length (mm)

4. Contact Us

- Contact our Marketing office listed below or email us at adminpmc@sylvania.com.

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