

## Large Diameter Tubes

### Characteristics

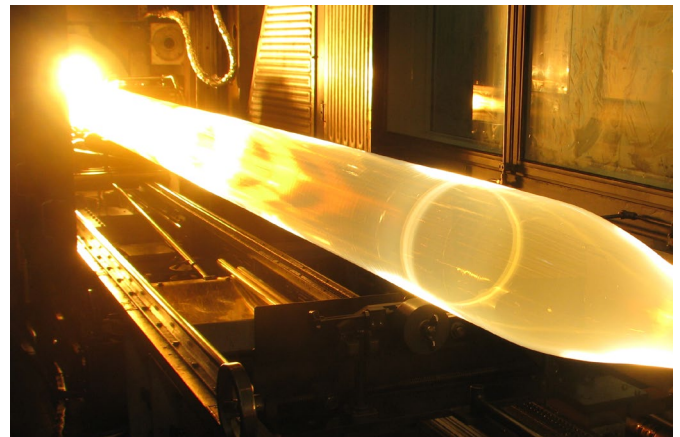
- Outstanding visual properties
- Tight geometrical tolerances
- No waviness and low siding

### Applications

- Process chambers, tubes and parts for semiconductor and industrial applications

### Products

- HSQ® 300, 330 (S), 700; HSQ®-T
- Diameter range: 55 – 470 mm
- Typical length between 1000 – 3000 mm (other dimensions possible on request)



### Dimensions

#### Standard OD tolerances (mm)

Outer diameter (OD)	Wall thickness (W)	Standard OD Tolerance ±	Length
55 – 95	2.0 – 10.0	1.00	100 – 5000
> 95 – 100	2.0 – 10.0	1.10	
> 100 – 120	2.0 – 10.0	1.20	
> 120 – 130	2.0 – 10.0	1.30	
> 130 – 160	2.0 – 10.0	1.40	
> 160 – 210	2.0 – 12.0	1.50	200 – 5000
> 210 – 240	3.0 – 12.0	1.60	
> 240 – 280	3.0 – 13.0	1.60	
> 280 – 310	3.0 – 13.0	1.80	
> 310 – 470	3.5 – 13.0	2.00 for W < 10 2.50 for W ≥ 10	

#### Tight OD tolerances (mm)

Outer diameter (OD)	Wall thickness (W)	Tight OD Tolerance ±	Length
55 – 120	2.0 – 6.0	0.70	100 – 5000
> 120 – 210	2.0 – 6.0	0.80	200 – 5000
> 210 – 310	3.0 – 6.0	1.00	
> 310 – 340	3.5 – 6.0	1.00	
> 340 – 470	3.5 – 6.0	1.50	

#### Super tight OD tolerances (mm)

Outer diameter (OD)	Wall thickness (W)	Super tight OD Tolerance ±	Length
55 – 120	2.0 – 5.0	0.50	100 – 3000
> 120 – 210	2.0 – 5.0	0.50	200 – 3000
> 210 – 310	3.0 – 5.0	0.80	
> 310 – 340	3.5 – 5.0	0.80	
> 340 – 470	3.5 – 5.0	1.00	

#### Standard and tight wall thickness and siding tolerances (mm)

Wall thickness W	Standard W tolerance ±	Tight W tolerance ±	Standard Siding* tolerance	Tight Siding* tolerance
2.0 – 3.0	0.50	0.40	0.80	0.40
> 3.0 – 4.0	0.60	0.40		
> 4.0 – 4.5	0.70	0.50		
> 4.5 – 5.0	0.80	0.50		
> 5.0 – 6.0	0.90	0.60		
> 6.0 – 6.5	1.00	0.70		
> 6.5 – 7.0	1.10	0.70		
> 7.0 – 8.0	1.20	0.80		
> 8.0 – 8.5	1.30	1.00	1.00	0.60
> 8.5 – 9.0	1.40	1.00		
> 9.0 – 10.0	1.50	1.10		
> 10.0 – 10.5	1.60	1.20		
> 10.5 – 11.0	1.70	1.20		
> 11.0 – 12.0	1.80	1.30		
> 12.0 – 12.5	1.90	1.40		
> 12.5 – 13.0	2.00	1.40		

Other dimensions and tolerances upon request.

## Mechanical Data

Density	2.203 g/cm <sup>3</sup>
Mohs Hardness	5.5...6.5
Micro Hardness	8600...9800 N/mm <sup>2</sup>
Knoop Hardness	5800...6100 N/mm <sup>2</sup>
Modulus of Elasticize (at 20°C)	$7.25 \times 10^4$ N/mm <sup>2</sup>
Modulus of Torsion	$3.0 \times 10^4$ N/mm <sup>2</sup>
Poisson's Ratio	0.17
Compressive Strength	~ 1150 N/mm <sup>2</sup>
Tensile Strength	~ 50 N/mm <sup>2</sup>
Bending Strength	~ 67 N/mm <sup>2</sup>
Torsional Strength	~ 30 N/mm <sup>2</sup>
Sound Velocity	5720 m/s

## Electrical Data

Resistivity [ $\Omega \times \text{cm}$ ]	
20°C	$10^{18}$
400°C	$10^{10}$
800°C	$6.3 \times 10^6$
1200°C	$1.3 \times 10^5$
Dielectric strength [kV/mm] (sample thickness $\geq 5$ mm)	
20°C	25...40
500°C	4...5
Dielectric loss angle (tg $\delta$ )	
1 kHz	$5.0 \times 10^{-4}$
1 MHz	$1.0 \times 10^{-4}$
$3 \times 10^{10}$ Hz	$4.0 \times 10^{-4}$
Dielectric constant ( $\epsilon$ )	
20°C 0...10 <sup>6</sup> Hz	3.70
23°C 9...10 <sup>8</sup> Hz	3.77
23°C $3 \times 10^{10}$ Hz	3.81

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## Thermal Data

	electrically fused	flame fused	synthetic
Softening temperature	1710°C	1660°C	1600°C
Annealing temperature	1220°C	1160°C	1100°C
Strain temperature	1125°C	1070°C	1000°C
Max. working temperature			
continuous	1160°C	1110°C	950°C
short-term	1300°C	1250°C	1200°C

Mean specific heat [J/kg × K]	
0...100°C	772
0...500°C	964
0...900°C	1052

Heat conductivity [W/m × K]	
20°C	1.38
100°C	1.47
200°C	1.55
300°C	1.67
400°C	1.84
950°C	2.68

Mean thermal expansion coefficient K <sup>-1</sup>	
-50...0°C	$2.7 \times 10^{-7}$
0...100°C	$5.1 \times 10^{-7}$
0...200°C	$5.8 \times 10^{-7}$
0...300°C	$5.9 \times 10^{-7}$
0...600°C	$5.4 \times 10^{-7}$
0...900°C	$4.8 \times 10^{-7}$

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