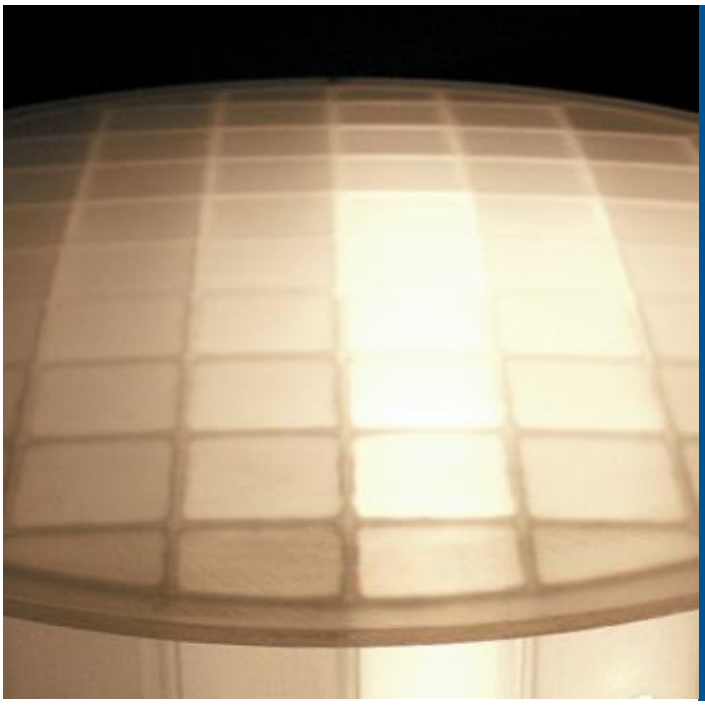
ULE® Corning Code 7972
Ultra Low Expansion Glass
Advanced Optics and Materials



ULE® Corning Code 7972 Ultra Low Expansion Glass is a titania silicate glass with unique characteristics that have made it the material of choice in applications ranging from machine tool reference blocks to solid and lightweight mirror blanks for large astronomical telescopes and space satellite applications. It is formed as 1.5-meter boules from which virtually any size or shape product can be made.

Near Zero Thermal Expansion *is the key attribute for which system designers specify Corning ULE®. This material offers superior dimensional stability ~*

- *Coefficient of thermal expansion (CTE) is nominally zero at room temperature*
- *Expansivity can be adjusted to provide zero CTE at other temperatures when needed for specific applications*
- *High homogeneity of CTE within boules enables efficient material utilization*
- *CTE is nondestructively measured on all ULE® boules, enabling precision engineering and analysis of the thermal response of products in the end use environment*

Fabrication Flexibility *is the key to product design freedom. Corning utilizes several key manufacturing processes which enable the production of a variety of products ~*

- *Monolithic solids from a few centimeters to over 8 meters in diameter*
- *Lightweight fusion bonded structures offering up to 80% weight reduction over the same sized solid*
- *Ultralightweight frit bonded structures with up to 95% weight reduction are possible using a proprietary glass ceramic frit designed to closely match the thermal expansion of ULE® glass.*

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CTE Variation and Inclusion Quality Grades

Mean Linear Coefficient of Thermal Expansion (CTE)

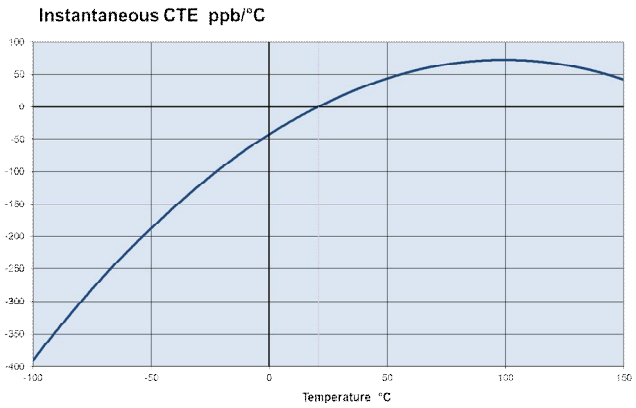
The guaranteed maximum limits for the mean linear CTE are as follows:

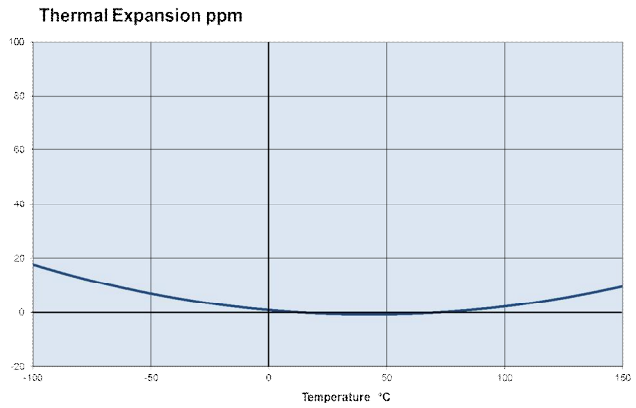
The mean linear CTE shall be **0 ± 30 ppb/°C** from 5°C to 35°C with a 95% confidence level.

Quality Grade Selection Chart

	Maximum CTE Variation (ppb/°C)		Optical Retardation	Inclusions	*Special grades and sizes available on request*	
Grade	**Radial Range**	**Axial Range**	**Birefringence (nm/cm)**	**Inclusion Quality**	**Diameter < 20"**	**Diameter 20" to 56"**
Premium Grade	10	10	10	Inclusion max mean diameter: Inclusions per cubic inch: Avg. no. of inclusions per cu. in.:	0.040" 4 0.1	N/A
Mirror Grade	15	15	20	**Critical Zone:** Inclusion max mean diameter: Inclusions per cubic inch: Avg. no. of inclusions per cu. in.:	0.040" 4 0.1	0.080" 6 0.2
				Non-Critical Zone: Inclusion max mean diameter: Inclusions per cubic inch: Avg. no. of inclusions per cu. in.:	0.100" N/S 0.2	0.250" N/S 0.6
Standard Grade	15	15	20	Inclusion max mean diameter : Inclusions per cubic inch: Avg. no. of inclusions per cu. in.:	0.100" N/S 0.2	0.250" N/S 0.6
Tooling Grade	N/A	N/A	N/A	N/A	Contact Corning for availability.	

- CTE verification is performed using a non-destructive ultrasonic method.
- Excellent long term dimensional stability is exhibited at room temperature. No residual figure change is observed when taking an optic from 350°C to water quench.
- There has been no measurable delayed elastic effect. This is an important consideration when large strain is present during fabrication or when environmental loading is present, such as during gravity release or dynamic control of active optics.
- No measurable hysteresis results from thermal cycling.





Thermal Properties

Mean Linear Coefficient of Thermal Expansion 5°C to 35°C (α)	0 ± 30 x 10^{-9}/K [0 ± 30 ppb/°C]	Mean Specific Heat (C_p)	767 J/(kg * °C) [0.183 cal/(g *°C)]
Thermal Conductivity (K)	1.31 w/(m *°C) [1.13 kcal/(m * h * °C)]	Strain Point	890°C [1634°F]
Thermal Diffusivity (D)	0.0079 cm^2/s	Annealing Point	1000°C [1832°F]
D.C. Volume Resistivity, 200°C 100Hz (R)	$10^{11.6}$ ohm * cm	Softening Point (estimated)	1490°C [2714°F]

Mechanical Properties

Poisson's Ratio (v)	0.17	Specific Stiffness (E/ρ)	3.12 x 10^6 m [1.23 x 10^8 in]
Ultimate Tensile Stress (MOR)	49.8 MPa [7220 psi]	Shear Modulus (G)	29.0 GPa [4.20 x 10^6 psi]
Knoop Hardness, 200g load	460 kg/mm^2	Bulk Modulus (K)	34.1 GPa [4.95 x 10^6 psi]
Density (ρ)	2.21 g/cm^3 [0.079 lb/in^3]	Elastic Modulus (E)	67.6 GPa [9.80 x 10^6 psi]

Optical Properties

Stress Optical Coefficient	4.15 (nm/cm)/(kg/cm^2) [0.292 (nm/cm)/psi]	Abbé Number (v_d)		53.1
Refractive index	n_F (486 nm) 1.4892	dn/dt		
(nominal CTE Material)	n_D (589 nm) 1.4828		20-40°C	10.68 x 10^{-6}/°C
	n_C (656 nm) 1.4801		40-60°C	11.24 x 10^{-6}/°C

Chemical Durability

- Excellent resistance to weathering
- Exhibits virtually no surface clouding or electrical surface leakage when subjected to attack by water, sulfur dioxide, and other atmospheric gases.
- High resistance to attack by nearly all chemical agents.

Solution at 95°C	**Test Duration**	**Weight Loss** mg/cm^2
5% HCl	24h	< 0.01
5% NaOH	6h	0.9
0.02N Na_2CO_3	6h	0.02
5% H_2SO_4	24h	< 0.01
H_2O	24h	< 0.01

Unless otherwise stated, all values @ 25°C

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Worldwide Accessibility

We are here to help you specify the best product for your application.
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