

## Germanium for Infrared Optics

GeIR/0403

### Physical Data & Typical Characteristics

<b>Mechanical</b>	Density (298 K)	$5,323 (\pm 0,001) \times 10^3 \text{ kg/m}^3$	
	Coefficient of compressibility	$< 1,4 \times 10^{-11}$	$\text{Pa}^{-1}$
	Young's modulus (298 K)	$10 \dots 15,5 \times 10^{10}$	Pa
	Torsion modulus (298 K)	$6,8 (\pm 0,2) \times 10^{10}$	Pa
	Tensile fracture strength (298 K)	$95 (\pm 16) \times 10^6$	Pa
	Microhardness $H_K$ (25 g load)	$780 (\pm 79) \times 10^6$	$\text{kg/m}^2$
	Microhardness HV (50 g load)	$845 (\pm 30)$	$\text{HV}_{0,05}$
	<b>Thermal</b>	Melting point	1210,4
Specific heat (273 to 373 K)		310	J/g.K
Latent heat of fusion		$36,945 \times 10^3$	J/mol
Linear thermal expansion coefficient (300 K)		$5,90 \times 10^{-6}$	$\text{K}^{-1}$
Thermal conductivity (300 K)		60	W/m.K
<b>Electro Magnetic</b>		Dielectric constant $\epsilon$ (300 K)	16,2
	Magnetic susceptibility $\chi_m$ (300 K)	$-7,09 \times 10^{-6}$	
<b>Optical</b>	Refractive index n (293 K) $\lambda$ ( $\mu\text{m}$ )		$n (\pm 0,000 30)$
		8	4,005 41
		9	4,004 12
		10	4,003 19
		11	4,002 48
		12	4,001 94
		13	4,001 51
		14	4,001 16
	Temperature coefficient of refractive index $dn/dt$ at 293-298 K	$0,0004 \pm 0,00002$	$\text{K}^{-1}$
	Refractive index variation within a component		
	monocrystalline		$0,1 - 1 \times 10^{-4}$
	polycrystalline		$0,5 - 2 \times 10^{-4}$
	Absorption coefficient at 293 K (laser calorimetry at 10,6 $\mu\text{m}$ ) typically		
	monocrystalline		$\leq 0,020 \text{ cm}^{-1}$
polycrystalline		$0,020 - 0,035 \text{ cm}^{-1}$	
<b>Specifications</b>	<b>Form</b>		
	Crystal structure	monocrystalline Polycrystalline	similar to ASTM F47-88 etching: 5-6 min. In 1HF-3HNO <sub>3</sub>
	<b>Electrical</b> (293 K)		
	Conductivity type	n	thermoelectric effect ASTM F42-88, method A
	Resistivity	as requested ( $\hat{\rho}$ )	four point probe Method ASTM F43-88

\* standard range: 5 –40 Ohm cm; other doping levels and tighter resistivity ranges are available upon request

**Optical** (293 K)

Transmittance	$\lambda$ in $\mu\text{m}$	Transmission %
	2	46
	3	46
	4	46
	5	46
	6	46
	7	46
	8	46
	9	46
	10	46
	11	45
	12	39,5
	13	40,5
	14	40,5

Uncoated plano disc polished both sides, thickness 5 mm; double beam IR spectrophotometer: Perkin Elmer 782; similar to ASTM F120-75, air reference method, slit dimension: 12 x 5 mm

**Formats** **Formats**

Lens blanks  
Contoured window blanks  
Special shapes upon request

**Sizes and Tolerances** (293 K)

Sizes: diameter or diagonal (rectangular windows)

polycrystalline	up to 400 mm
monocrystalline	up to 350 mm

Tolerances as requested. Other wise, standard tolerances will be offered.

Rim finishing	break all edges up to 0,8 mm from the edges applied to all lens, blanks and to discs with diameter > 100 mm
Edge thickness variation (TV)	better than or equal to 100 $\mu\text{m}$
Flatness	better than or equal to 40 $\mu\text{m}$
Squareness	length to width: better than $\pm 10$ min
Surface finish	roughness maximum 2,2 $\mu\text{m}$ RA (RA= arithmetic average)

**Packing** Germanium blanks are heat sealed between a tough plastic sheet and a firm-supporting base and packed in cardboard boxes filled with shock absorbing material.

**Additional Information** Contoured plano-plano window blanks machined to final dimensions, i.e. final length, width, rounded corners and bevels available optionally. Special demands outside the scope of above-mentioned specifications and limits upon request.



001