

## Beryllium X-ray windows

### STANDARD SPECIFICATIONS - NGK BERYLLIUM WINDOWS

#### Standard Chemical Composition

Element	Composition
Beryllium	98 % minimum

#### Standard Size and Tolerances

Form	Dimensions	Dimensional Tolerances
Disc	Ø 10 mm - 90 mm	Diameter Tolerance: ± 0.2 mm
Rectangular or Square Plate	Width: 10 - 120 mm Length max.: 120 mm	Width / Length Tolerance: ± 0.2 mm (Dimensions greater than 75 mm: ± 0.5 mm)

Thickness	Thickness Tolerances
0.03 – 0.10 mm	± 0.01 mm
0.10 – 0.3 mm	± 0.05 mm
0.3 – 2.0 mm	± 0.1 mm

- For higher purity and/or non-standard dimensions/tolerances, please contact us.
- Beryllium windows can be surface-treated to meet specific requirements. Please contact us.

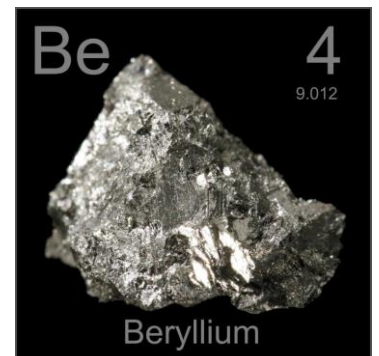


### BERYLLIUM PROPERTIES

Fourth element of the periodic table, divalent element of the alkaline-earth metal group, metal with a silvery gray appearance

#### An unique combination of properties

- Light weight, low density (beryllium is 1/3 lighter than aluminium)
- High specific stiffness (about 6 times of steel) and elasticity
- Excellent heat resistance (Beryllium has the highest melting point of all light metals)
- Excellent acoustic velocity and transparency of the sound (Pure beryllium diaphragms are used in top-of-the-range audio equipment)
- Excellent X-ray transmissivity. Beryllium also is non-magnetic
- Excellent optical reflectivity. Beryllium is used for mirrors of laser scanners
- Excellent thermal and electrical conductivity



### Security • Reliability • Performance



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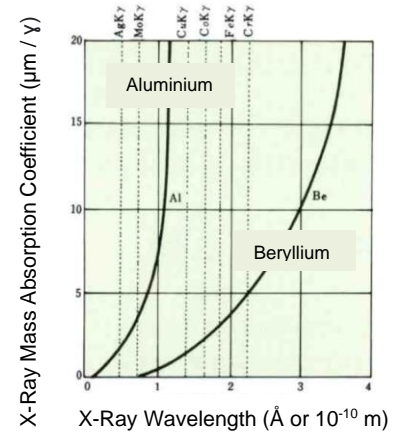
## Properties of beryllium in comparison with aluminium and iron

Properties	Beryllium Be	Aluminium Al	Iron Fe
Atomic Number	4	13	26
Atomic Weight	9.013	26.98	55.85
Crystal Structure	Hexagonal Close-Packed	Face-Centred Cubic	Body-Centred Cubic and Face-Centred Cubic
Density (g/cm <sup>3</sup> )	1.84	2.69	7.86
Modulus of Elasticity (kN/mm <sup>2</sup> )	275	75	205
Melting Point (°C)	1285	660	1530
Specific Heat (J/(kg.K))	1779	921	461
Thermal Conductivity (W/ (m*K))	180	222	75
Thermal Expansion Coefficient (/K)	11.6 x 10 <sup>-6</sup>	23.6 x 10 <sup>-6</sup>	11.7 x 10 <sup>-6</sup>
Acoustic Velocity (m/s)	12600	6420	5950
Tensile Strength (N/mm <sup>2</sup> )	275 – 635	100- 490	600 - 650
Yield Strength (N/mm <sup>2</sup> )	205 – 410	100 - 410	205 – 235
Elongation (%)	1 - 20	30	50 - 60

## Benefits of beryllium in radiography

- Excellent X-ray transmissivity: the absorption coefficient of beryllium is low, i.e. the transmissivity capacity is high.  
See graph ( $\mu$  : Linear Absorption Coefficient -  $\gamma$  : Density) :  
For a given wavelength (for example 1 Angström = 0.1 nm), the absorption coefficient of X-rays is much lower for Beryllium (Be) compared to Aluminium (Al). This confirms that the transmissivity rate of X-rays is much more better for Be versus Al. X-rays are very short electromagnetic waves (0.001 up to 2.5 Å). They can pass through air or matter. They hardly penetrate high density materials. The low density of beryllium gives it excellent transmissivity.
- Low secondary radiation due to X-ray irradiation.
- X-rays are produced in vacuum tubes and exit through beryllium windows. The vacuum tightness of beryllium also is an important advantage (Leak amount of He gas  $\leq 5 \times 10^{-11}$  (Pa.m<sup>3</sup>/s))

## X-Ray Mass Absorption Coefficient



## EXAMPLES OF APPLICATION OF BERYLLIUM WINDOWS

Medical examination (CT scanner, radiology, mammography, etc.)



Chemicals analysis, security screening of luggages, X-ray diffraction etc.



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