Beryllium (Be) – A Lightweight, Strong, and Toxic Alkaline Earth Metal

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1. General Information

- Symbol: Be
- Atomic Number: 4
- Atomic Mass: 9.0122 u
- Group: 2 (Alkaline Earth Metals)
- Period: 2
- Block: s-block
- Electron Configuration: $1s^2\ 2s^2$
- Valence Electrons: 2
- Phase at Room Temperature: Solid

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2. Isotopes of Beryllium

Isotope	Protons	Neutrons	Abundance
^{9}Be	4	5	100%

- ^{9}Be is the only stable isotope.

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3. Physical Properties

- Color: Silvery-white
- Density: 1.85 g/cm³ (low for metals)
- Melting Point: 1,287°C
- Boiling Point: 2,471°C
- State at STP: Solid
- Hardness: Brittle but strong.

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4. Chemical Properties

- Resistant to Oxidation – Forms a thin oxide layer that prevents further corrosion.
- Reacts with Acids – Produces beryllium salts and hydrogen gas.
- Non-Magnetic and Non-Sparking
- Toxicity: Beryllium and its compounds are highly toxic if inhaled.

Reaction with Acid:

$$Be + 2HCl \rightarrow BeCl_2 + H_2$$

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5. Occurrence and Abundance

- Rare in Earth’s Crust: 2-6 parts per million (ppm).
- Found in:
  - Minerals: Beryl ($Be_3Al_2Si_6O_{18}$), Bertrandite.

- Gemstones: Emerald and Aquamarine (forms of beryl).

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6. Production and Extraction

Source	Method
Beryl ($Be_3Al_2Si_6O_{18}$)	Extraction through heating and chemical processing.
Bertrandite	Leaching with sulfuric acid.

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7. Uses of Beryllium

Application	Description
Aerospace and Defense	Lightweight components for satellites and aircraft.
Nuclear Reactors	Moderator and reflector in nuclear reactors.
Electronics	Used in X-ray windows and electronic connectors.
Medical Devices	X-ray equipment and imaging technology.
Alloys (Copper-Beryllium)	Strong, non-sparking tools and springs.
Optics	High-performance mirrors and telescopes.

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8. Unique Properties of Beryllium

- High Strength-to-Weight Ratio – Ideal for aerospace applications.
- Transparent to X-Rays – Used in medical imaging devices.
- High Thermal Conductivity – Efficient at dissipating heat.
- Stiffness: High modulus of elasticity (one of the highest for metals).

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9. Beryllium Alloys

- Copper-Beryllium (CuBe): Strong, hard, and corrosion-resistant.
- Nickel-Beryllium: Used for resistance to wear and stress.

10. Safety and Toxicity

- Inhalation Hazard: Beryllium dust and fumes can cause berylliosis (chronic lung disease).
- Toxicity: Harmful if ingested or inhaled.
- Handling Precautions:
  - Use protective equipment.
  - Avoid creating dust or inhaling particles.
  - Work in ventilated environments.

Fun Facts About Beryllium:

- Beryllium is lighter than aluminum but stronger than steel.
- Emeralds are a form of beryl, containing traces of chromium or vanadium.
- James Webb Space Telescope’s mirrors are made of beryllium for its lightweight and stability at low temperatures.