

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
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⁹ Be	4	5	100%
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- ⁹Be is the only stable isotope.
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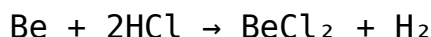
3. Physical Properties

- 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:



5. Occurrence and Abundance

- Rare in Earth's Crust: 2-6 parts per million (ppm).
- Found in:
 - Minerals: Beryl (Be₃Al₂Si₆O₁₈), Bertrandite.

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

6. Production and Extraction

Source	Method
Beryl ($\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$)	Extraction through heating and chemical processing.
Bertrandite	Leaching with sulfuric acid.

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.

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.