

Critical Applications of Beryllium

The combination of light weight with high strength at extreme temperatures makes Beryllium metal and aluminium beryllium alloys ideal for use in high performance aerospace applications such as components of rockets, satellites and aircraft.

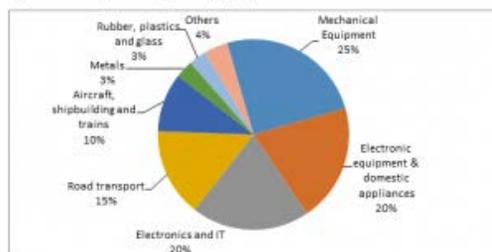
The reliability of Copper Beryllium alloys enable electronic and electrical connector terminals for critical systems like aircraft and medical electronics, automobile Air Bag Systems and Anti-Lock Brake Systems and fire extinguisher systems.

Transparency to x-radiation makes pure Beryllium metal essential in security equipment and high-resolution medical imaging technology, such as mammography to detect breast cancer.

The high strength, conductivity and non-magnetic properties of Beryllium make it invaluable for oil & gas drilling sensor and guidance systems.

The non-sparking, non magnetic properties of Beryllium-containing alloys are used in tools for high explosion risk environments such as oil refineries, chemical plants and medical anaesthetics

Figure 1: End-use of beryllium in Europe in 2012 (by weight)



Source: BeST2013

80% of the beryllium used in the EU goes into copper beryllium alloys (0.1 – 2.0%), that are used to exploit an unmatched combination of physical properties to produce highly reliable components of systems that protect lives and where failure could be either life-threatening or would provide lower performance and reduced quality of life.

Copper beryllium alloys are used for the manufacture of high performance electrically conductive terminals such as:

- Extreme reliability automobile connectors for air-bag crash sensor and deployment systems, anti-lock brake systems and many other life safety applications;
- Life saving medical applications such as the connections in medical operating theatre and monitoring equipment;
- Critical connections and relays in electrical, electronic and telecommunications equipment where failure would disrupt the communications of emergency services like firefighters and police;
- No-fail aircraft electrical and electronic connectors which enable fly-by-wire commercial airliners to achieve previously impossible fuel efficiencies, and critical aircraft components such as altimeter diaphragms;
- Extremely long service life fire sprinkler water control valve springs that must react to fires after decades of inactivity to save lives and control fire

damage;

- Household appliance temperature and other function controls that provide reliability and safety to consumers while minimizing energy and water use; and
- Relays used for telephone exchanges and controlling industrial, domestic and automobile electrical equipment.

Copper beryllium alloys are used for the manufacture of mechanical components such as:

- The final metal-to-metal seal that successfully capped the failed Macondo well in the Gulf of Mexico was a large ring of copper beryllium which was used for its known high reliability in such applications
- Non magnetic equipment components used in oil & gas exploration, production and directional drilling equipment to improve extraction efficiencies and reduce land despoliation at drill sites by reducing the number and footprint of drill sites,
- Mineral mining equipment bearings that operate longer underground coal,
- Mine detection and minesweeping systems that keep the global forces safe,
- Undersea fiber optic cable signal amplification "repeater" housings that carry more simultaneous transmissions than ever conceived of in the original cable systems,
- Low friction high strength aircraft landing gear bearings, control rod ends and wing aileron / flap bearing bushings that allow significant weight loss to reportedly lower global fuel consumption by 24 billion litres per year, and reduces associated carbon dioxide emissions by over 11 million metric tons per year,
- High thermal efficiency, reduced icing, aircraft components such as pitot tubes to provide enhanced aircraft safety for passengers,
- Electrode holders and components of welding robots for automated automobile and appliance welding allowing better working environments for factory workers,
- Property modifier for aluminum and magnesium castings with enhanced properties that reduce weight to achieve fuel and pollution reduction in automobiles and trucks,
- Plastic and metal casting moulds with enhanced thermal efficiency that improve productivity and provide plastic products with enhanced tolerances

Beryllium in the form of master alloys containing 1 – 14% beryllium with aluminium, copper and nickel are added to metals and alloys to provide:

- Physical properties such as strength, ductility, fatigue strength for producing car body panels, seat frames, car steering components and wheels;
- Fluidity or the ability to cast precise, complex shapes in many industrial applications e.g robotics, welding; and
- Magnesium loss prevention: Reduces burn off of magnesium by >50% when aluminium smelters add magnesium to make high performance alloys for use in beverage can alloys and aircraft skins.

20% of the beryllium used is in the form of pure metal, as a metal matrix containing over 50% beryllium

- X-Ray transparent windows used to control and focus X-Ray beams in all medical, scientific and analytical devices incorporating X-Ray sources, providing finer resolution thereby allowing earlier cancer detection in mammography and other medical interventions to save lives,
- Gyroscope gimbals and yokes for use in guidance, navigational and targeting systems used on aircraft, armored vehicle and marine missile systems providing levels of precision that give our forces tactical advantages and minimize collateral damage,
- Satellite mounted directional control devices for astronomical and other telescopes and instruments to provide accurate GPS locations signals and a wealth of scientific, agricultural and climatic data to help mankind live better and sustain the planet,
- Satellite structural components that reduce weight, provide unmatched rigidity at deep space low temperatures and enable longer, more capable space missions,
- Mirrors for terrestrial and space mounted astronomical telescopes that expand our knowledge of the universe,
- World leading science and technology programs like JET, CERN and ITER depend upon beryllium metal for critical components that cannot be substituted by any other material,
- Beryllium is critical for the success of the multi-national ITER fusion energy project located in Cadaraches, France that offers the opportunity to

provide sustainable energy sourced from non-radioactive nuclear fusion,

- Medical isotope production nuclear reactors in Belgium, Holland and the USA produce critical isotopes for treatment of many types of cancer as a result of the unique neutron beam reflective capabilities of beryllium,

Beryllium Oxide Ceramics are used to produce components with extremely high thermal conductivity while providing electrical insulation, a unique combination of properties exploited for use in the manufacture of such equipment as:

- Substrates for mounting high powered civil aviation radar systems and power amplifiers that need cooling to prevent self destruction, and for mobile telephone infrastructure equipment,
- Medical excimer laser beam focusing and control components, allowing surgeons unprecedented fine control of the high energy laser beam during surgery. Throughout the medical arena, beryllium is indispensable for use in mammography, medical imaging equipment and robotic surgical devices. Lasers constructed with beryllia ceramic are providing the gift of restored or improved sight to millions around the world. Beryllium-containing ceramics are integral components in high-end cancer therapy machines, medical lasers for DNA analysis and equipment for skin resurfacing, non-invasive surgery, kidney stone removal, detection of blindness and HIV testing.