HRP Training Aid: Metals and Alloys—Any Form

DESCRIPTION — ECCN

Beryllium metal, alloys, compounds, or manufactures (any form) 1C230
Bismuth (any form) 1C229
Calcium (any form) 1C227
Hafnium metal, alloys, and compounds (any form) 1C231
Magnesium (high purity) (any form) 1C228
Zirconium metal, alloys, compounds, or manufactures (any form) 1C234

KEY POINTS

- Some metals, including calcium, magnesium, bismuth, beryllium, hafnium, and zirconium, are controlled in any form they appear and are controlled for content and purity, not for shape, form, or dimensions
- Can be part of a finished product, semi-fabricated part, powder, plate, sheet, or raw form

INDEX — PAGE

Applications

Be aware of facilities/programs with a history of the activities listed below.

Beryllium

- Neutron reflector or moderator
- Window material in X-ray generators and detectors
- Aerospace structural and precision instrumentation (e.g., inertial guidance systems, space telescopes, targeting systems, gyroscopes)

Bismuth

- Precursor for nuclear explosive device initiators; reactor physics research; fuel reprocessing
- Low melting fuse in fire sensing and protection systems such as sprinklers
- Cosmetics and pharmaceuticals, such as antiseptics and antacids
- Shields in radiation therapy
- Electromagnetic and radiofrequency shielding of electronics
- Lead replacement (e.g., bird shot, lubricating greases, pigments, solders)

Calcium

- Production of plutonium and uranium metal for nuclear weapons
- Most non-nuclear commercial/industrial uses do not require high-purity calcium
  - Used to remove impurities from various ferrous and nonferrous alloys
  - Alloying agent for aluminum, beryllium, copper, lead, and magnesium alloys
  - Used in batteries used to power artillery fuses

Hafnium

- Control rods/neutron absorbers in nuclear reactors
- Aerospace applications, such as superalloys for space rocket engines (e.g., SpaceX) and gas turbines
- Optical coatings; semiconductor industry; electrodes in plasma cutting; electronic equipment

Applications

Magnesium

- Production of plutonium and uranium metal for nuclear weapons
- Cladding of Magnox reactor fuel
- High-purity magnesium, irrespective of boron content, is used in production of pure metals such as beryllium, titanium, and zirconium
- High-purity magnesium alloys are used for aircraft and missile construction
- Lower-purity magnesium is used for
  - Flares and pyrotechnics
  - Medicine
  - Incendiary bombs
  - Additive to solid rocket propellants

Zirconium

- Nuclear reactor fuel cladding and other reactor internal components
- Structural material in chemical plants processing highly corrosive chemicals such as acetic acid

Beryllium

(metal, alloys, compounds, waste, or scrap)

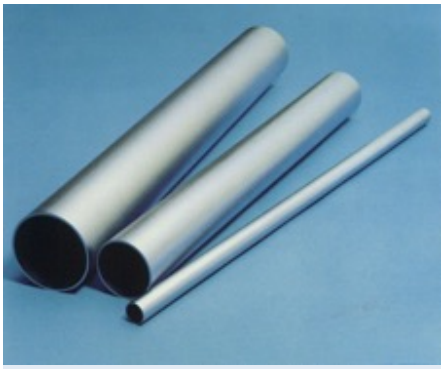
ECCN 1C230

- **Control:** >50% beryllium by weight
- Appearance
  - Silver/steel gray matte
  - Very lightweight with a high resistance to deformation
- Packaging and labeling
  - The solid metal is safe, but lung disease (berylliosis) can occur when beryllium dust or fumes are inhaled
  - Beryllium and its compounds, except for beryllium nitrate, require a shipping label of "poison" and are in Packing Group II or III

Beryllium–copper alloy is very common, but <2% beryllium is not controlled

Beryllium–aluminum Grade #140 alloy tubes
60% beryllium and
40% aluminum
Controlled by ECCN 1C230 (beryllium >50%)

Beryllium–aluminum alloy block



Beryllium tubes

Bismuth
ECCN 1C229

- Control: ≥99.99% bismuth by weight and <10 ppm silver by weight
- Appearance
  - Grayish white (like silver) with pink tinge and bright metallic luster
  - Four basic forms: ingots, needles, pellets, powders
- Packaging and labeling
  - Powder may be packaged in glass, plastic bags, or plastic jars. Jars are packaged in steel cans surrounded by a cushioning material
  - Small quantities of pellets packaged in plastic bottles
  - Large quantities of ingots usually packaged in wooden crates
  - Large quantities of needles shipped in large drums lined with sealed plastic bags

Beryllium–aluminum alloy block

Beryllium–aluminum alloy block

Drum with bismuth metal

Needles

Plastic bag of bismuth powder

Crate with bismuth metal

Calcium
ECCN 1C227

- **Control:** <1,000 ppm impurities other than magnesium and <10 ppm boron
- Appearance
  - Silver/steel gray matte
  - Turns red-brown when exposed to air or nitrogen
- Packaging and labeling
  - Calcium is highly reactive and reacts with water to form hydrogen
  - Powders or small pieces could spontaneously combust in air and must be labeled "dangerous when wet" and "flammable solid"
  - UN Number (unique for calcium): 1401
  - CAS# 7440-70-2

Calcium metal

Hafnium

(metal, alloys, compounds, waste, or scrap)

ECCN 1C231

- Control: >60% hafnium by weight
- Appearance
  - Silver/steel gray matte
  - Ductile and has the density of zirconium and steel
- Packaging and labeling
  - Metal powder, thin sheets, and coiled wire are flame hazards and require "flammable solid" or "spontaneously combustible" international shipping labels

Hafnium rolls

Hafnium ingots on pallet

Hafnium metal

Magnesium (high purity)
ECCN 1C228

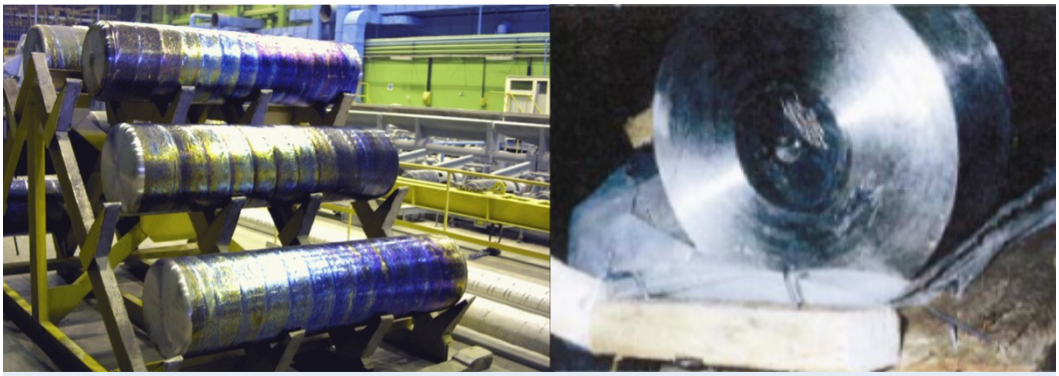
- Control: <200 ppm impurities other than calcium and <10 ppm boron
- Appearance
  - Silver/steel gray matte
  - Tarnishes when exposed to air
- Packaging and labeling
  - Magnesium is highly reactive and reacts with water to form hydrogen
  - Powders or small pieces could spontaneously combust in air and must be labeled "dangerous when wet" and "flammable solid"
  - UN number (unique for magnesium): 1869
  - CAS# 7439-95-4

Various forms of magnesium metal

Cardboard box and fiber drum used for shipping magnesium

Zirconium
(metal, alloys, compounds, waste, or scrap)
ECCN 1C234

- Control: >50% zirconium by weight and <1 part to 500 parts zirconium by weight
- Appearance
  - Silver/steel gray matte
  - Can also have a dark gray mottled surface
  - Crystal bar with distinctive coloring and bumpy surface
- Packaging and labeling
  - Metal powder, thin sheets, and coiled wire are flame hazards and require "flammable solid" or "spontaneously combustible" international shipping labels
  - UN numbers (unique for zirconium):
    - 1308—Zirconium suspended in liquid
    - 1932—Zirconium scrap
    - 2009—Zirconium, dry
    - 2858—Zirconium, dry



Zirconium ingots

Zirconium crystal bar

DOE/NNSA High Risk Property

https://hrp.doe.gov

https://ecap.doe.gov

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