SECTION 1: Identification

1.1 GHS Product identifier

Product name Plutonium

1.2 Other means of identification

Product number -
Other names -

1.3 Recommended use of the chemical and restrictions on use

Identified uses Radionuclides (radioactive materials)
Uses advised against no data available

SECTION 2: Hazard identification

2.1 Classification of the substance or mixture

no data available

2.2 GHS label elements, including precautionary statements

Pictogram(s) no data available
Signal word no data available
Hazard statement(s) no data available
Precautionary statement(s)
Prevention no data available
Response no data available
Storage no data available
Disposal no data available

2.3 Other hazards which do not result in classification

no data available

SECTION 3: Composition/information on ingredients

3.1 Substances

Chemical name	Common names and synonyms	CAS number	EC number	Concentration
Plutonium	Plutonium	7440-07-5	231-117-7	100%

SECTION 4: First-aid measures

4.1 Description of necessary first-aid measures

If inhaled

Move the victim into fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration and consult a doctor immediately. Do not use mouth to mouth resuscitation if the victim ingested or inhaled the chemical.

Following skin contact

Take off contaminated clothing immediately. Wash off with soap and plenty of water. Consult a doctor.

Following eye contact

Rinse with pure water for at least 15 minutes. Consult a doctor.

Following ingestion

Rinse mouth with water. Do not induce vomiting. Never give anything by mouth to an unconscious person. Call a doctor or Poison Control Center immediately.

4.2 Most important symptoms/effects, acute and delayed

no data available

4.3 Indication of immediate medical attention and special treatment needed, if necessary

Immediate First Aid/ Ensure that adequate decontamination has been carried out as needed. If patient is not breathing, start artificial respiration, preferably with a demand valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR if necessary. Immediately flush contaminated eyes with gently flowing water. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (Head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. Radiological Threats: Radiological Dispersal Devices or Weapons

SECTION 5: Fire-fighting measures

5.1 Suitable extinguishing media

Plutonium fires should not be approached without protective clothing and respirators unless the fire is enclosed in a glove box. The most effective agent for extinguishing plutonium fires has been found to be magnesium oxide sand. Glove boxes which contain pyrophoric forms of plutonium should also contain an amount of magnesium oxide adequate for extinguishment. The burning plutonium should be completely covered with the sand to as great a depth as possible. ... Argon is a very effective extinguishing agent, providing the oxygen content in the atmosphere is maintained at 4% or less. .... This is an important point, since it is nearly impossible to reduce the oxygen content to 4% or less during argon flooding in most fume hoods. Argon may be used effectively to cool the burning plutonium prior to application of the magnesium oxide sand. ... Typical foam or dry chemical agents are not effective extinguishing agents. Fusible salt agents have been shown to be effective on small-scale plutonium fires. However, the expansion which accompanies the oxidation of plutonium has caused the fusible salt coating to crack, allowing the plutonium to re-ignite.

5.2 Specific hazards arising from the chemical

no data available

5.3 Special protective actions for fire-fighters

Wear self-contained breathing apparatus for firefighting if necessary.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing mist, gas or vapours.Avoid contacting with skin and eye. Use personal protective equipment.Wear chemical impermeable gloves. Ensure adequate ventilation.Remove all sources of ignition. Evacuate personnel to safe areas.Keep people away from and upwind of spill/leak.

6.2 Environmental precautions

Prevent further spillage or leakage if it is safe to do so. Do not let the chemical enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Decontamination is most successful when the material can be recycled for use in a nuclear facility since the need to prove releasability (cleanliness) is eliminated. Nevertheless, cleaning material for unrestricted release is also possible in some cases. It may also be possible to decontaminate an item enough to change its classification from TRU/transuranic/ waste to LLW /low-level waste/, thereby allowing immediate disposal of the item, while a relatively small quantity of decontamination waste is stored as TRU waste. Electropolishing to remove the thinnest metal surface has been very effective and produces a relatively small waste volume, especially when one of the wetted sponge units is used rather than an emersion tank. Surface scabbling has been used in decontamination of concrete, and various abrasive blasting methods have also been effective. Strippable and self-stripping coatings may be used to decontaminate surfaces, even though the primary application of strippable coatings has been in preventing contamination of surfaces. Plutonium compounds

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Handling in a well ventilated place. Wear suitable protective clothing. Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Use non-sparking tools. Prevent fire caused by electrostatic discharge steam.

7.2 Conditions for safe storage, including any incompatibilities

Storage Recommendations for Plutonium Metal and Dioxide. Metal and oxide are both suitable storage forms for plutonium (100 years). Organics (plastics, elastomers) must be excluded from the primary container for both forms. Converting between metal and oxide is not recommended (negative impact of waste, cost, environmental safety and health risk). Plutonium metal and dioxide

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational Exposure limit values

no data available

Biological limit values

no data available

8.2 Appropriate engineering controls

Ensure adequate ventilation. Handle in accordance with good industrial hygiene and safety practice. Set up emergency exits and the risk-elimination area.

8.3 Individual protection measures, such as personal protective equipment (PPE)

Eye/face protection

Wear tightly fitting safety goggles with side-shields conforming to EN 166(EU) or NIOSH (US).

Skin protection

Wear fire/flame resistant and impervious clothing. Handle with gloves. Gloves must be inspected prior to use. Wash and dry hands. The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Respiratory protection

If the exposure limits are exceeded, irritation or other symptoms are experienced, use a full-face respirator.

Thermal hazards

no data available

SECTION 9: Physical and chemical properties and safety characteristics

Physical state	no data available
Colour	Silver, white metal, monoclinic /Plutonium metal/
Odour	no data available
Melting point/freezing point	640 deg C /Plutonium metal/
Boiling point or initial boiling point and boiling range	3228 deg C /Plutonium metal/
Flammability	no data available
Lower and upper explosion limit/flammability limit	no data available
Flash point	no data available
Auto-ignition temperature	no data available
Decomposition temperature	no data available
pH	no data available
Kinematic viscosity	no data available
Solubility	Soluble in hydrochloric acid; insol in nitric acid and concentrated hydrogen sulfide /Plutonium metal/
Partition coefficient n-octanol/water	no data available
Vapour pressure	no data available
Density and/or relative density	19.7 g/cu cm /Plutonium metal/
Relative vapour density	no data available
Particle characteristics	no data available

SECTION 10: Stability and reactivity

10.1 Reactivity

no data available

10.2 Chemical stability

no data available

10.3 Possibility of hazardous reactions

no data available

10.4 Conditions to avoid

no data available

10.5 Incompatible materials

Pyrophoric plutonium metal has been defined as that metal which will ignite spontaneously in air at a temperature of 150 deg C (320 deg F) or below in the absence of external heat, shock, or friction (Finely divided plutonium metal would be considered pyrophoric while massive plutonium would be nonpyrophoric. ...The most numerous forms of pyrophoric plutonium are chips, lathe turnings, and casting crucible skulls. Plutonium hydride and sesquioxide (Pu_2O_3) are probably the most commonly occurring pyrophoric compounds. Plutonium carbide, oxycarbide, nitride, and oxide phases with compositions between the sesquioxide and dioxide are potentially pyrophoric. Known pyrophoric alloys include Pu-U and Pu-Ce. Pyrophoric plutonium

10.6 Hazardous decomposition products

no data available

SECTION 11: Toxicological information

Acute toxicity

- Oral: no data available
- Inhalation: no data available
- Dermal: no data available

Skin corrosion/irritation

no data available

Serious eye damage/irritation

no data available

Respiratory or skin sensitization

no data available

Germ cell mutagenicity

no data available

Carcinogenicity

There is sufficient evidence in humans that inhalation of plutonium-239 aerosols causes lung cancer, liver cancer and bone sarcoma. Exposure to plutonium-239 also entails exposure to plutonium-240 and other isotopes. Plutonium-239

Reproductive toxicity

no data available

STOT-single exposure

no data available

STOT-repeated exposure

no data available

Aspiration hazard

no data available

SECTION 12: Ecological information

12.1 Toxicity

- Toxicity to fish: no data available
- Toxicity to daphnia and other aquatic invertebrates: no data available
- Toxicity to algae: no data available
- Toxicity to microorganisms: no data available

12.2 Persistence and degradability

no data available

12.3 Bioaccumulative potential

Bioconcentration factors of 1.6X10+4 and 2X10+3 in brown macroalgae and <500 and 40 in fish muscle were reported for plutonium-239+240(1). Bioconcentration factors of 1,000 for mollusks and algae, 100 in crustacea, and 10 for fish have been reported for plutonium(2). Plutonium was found to accumulated in bones of fish, rather than in muscle tissue(2).

12.4 Mobility in soil

Plutonium is generally immobile in soil(1,2). This is due to the insolubility of PuO2, the predominant form of plutonium found in fallout particles, and the interaction of Pu(IV) hydrolysis products with soil, minerals, and organic, surfaces(2). PuO2 remains within the top few centimeters of soil(1). Only a small fraction (<0.1%) of plutonium in soils is soluble and may be mobile in soils and taken up by plants(2). The mobility of plutonium in soils may be due to the presence of complexing agents or valence states other than Pu(IV), that are less likely to undergo hydrolysis, forming insoluble plutonium compounds(2). Partition coefficients (Kd) ranging from 8X10+4 to 1.5X10+5 were determined for (239+240)Pu in arctic surface sediments from the Kara Sea(3). The behavior of plutonium in soil is pH dependent(4). In the pH range of 2 to 8.5 soluble plutonium is essentially completely sorbed, while in the range of pH 8.5-12 sorption decreased, with a minimum sorption (approx. 85%) observed at pH 12(4). Above pH 12.5, essentially complete sorption was observed(4). Distribution coefficients for soluble plutonium in Savannah River soil was found to be a function of pH and oxidation state(4). Plutonium sorption was >95% complete (Kd>100) starting at pH 2.5 for Pu(III) and Pu(IV) and at pH 7 for Pu(V)(4). At pH 6-7 sorption reached a maximum (Kd approx. 10,000) for Pu(III) and Pu(IV) and at pH 8 for Pu(VI) (Kd approx. 1,000)(4). At pH 12 the Kd values were >100 for all three oxidation states(4). In a study using 13 soils plutonium sorption was found to be high, with 62% of the measurements showing sorption of 99% or higher and the lowest sorption measured was 87%(4). A Kd of 1.4X10+5 L/kg was estimated for plutonium for suspended solids in the surface Mediterranean coastal waters(5). Kd values ranging from 1X10+5 to 7X10+5 L/kg were reported for plutonium for suspended particulate in the Savannah River Estuary, GA(6).

12.5 Other adverse effects

no data available

SECTION 13: Disposal considerations

13.1 Disposal methods

Product

The material can be disposed of by removal to a licensed chemical destruction plant or by controlled incineration with flue gas scrubbing. Do not contaminate water, foodstuffs, feed or seed by storage or disposal. Do not discharge to sewer systems.

Contaminated packaging

Containers can be triply rinsed (or equivalent) and offered for recycling or reconditioning. Alternatively, the packaging can be punctured to make it unusable for other purposes and then be disposed of in a sanitary landfill. Controlled incineration with flue gas scrubbing is possible for combustible packaging materials.

SECTION 14: Transport information

14.1 UN Number

ADR/RID: no data available IMDG: no data available IATA: no data available

14.2 UN Proper Shipping Name

ADR/RID: no data available IMDG: no data available IATA: no data available

14.3 Transport hazard class(es)

ADR/RID: no data available IMDG: no data available IATA: no data available

14.4 Packing group, if applicable

ADR/RID: no data available IMDG: no data available IATA: no data available

14.5 Environmental hazards

ADR/RID: No IMDG: No IATA: No

14.6 Special precautions for user

no data available

14.7 Transport in bulk according to IMO instruments

no data available

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations specific for the product in question

Chemical name	Common names and synonyms	CAS number	EC number
Plutonium	Plutonium	7440-07-5	231-117-7
European Inventory of Existing Commercial Chemical Substances (EINECS)			Listed.
EC Inventory			Listed.
United States Toxic Substances Control Act (TSCA) Inventory			Not Listed.
China Catalog of Hazardous chemicals 2015			Not Listed.
New Zealand Inventory of Chemicals (NZIoC)			Not Listed.
Philippines Inventory of Chemicals and Chemical Substances (PICCS)			Not Listed.
Vietnam National Chemical Inventory			Not Listed.
Chinese Chemical Inventory of Existing Chemical Substances (China IECSC)			Not Listed.
Korea Existing Chemicals List (KECL)			Not Listed.

SECTION 16: Other information

Information on revision

Creation Date	July 15, 2019
Revision Date	July 15, 2019

Abbreviations and acronyms

- CAS: Chemical Abstracts Service
- ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road
- RID: Regulation concerning the International Carriage of Dangerous Goods by Rail
- IMDG: International Maritime Dangerous Goods
- IATA: International Air Transportation Association
- TWA: Time Weighted Average
- STEL: Short term exposure limit
- LC50: Lethal Concentration 50%
- LD50: Lethal Dose 50%
- EC50: Effective Concentration 50%

References

- IPCS - The International Chemical Safety Cards (ICSC), website: http://www.ilo.org/dyn/icsc/showcard.home
- HSDB - Hazardous Substances Data Bank, website: https://toxnet.nlm.nih.gov/newtoxnet/hsdb.htm
- IARC - International Agency for Research on Cancer, website: http://www.iarc.fr/
- eChemPortal - The Global Portal to Information on Chemical Substances by OECD, website: http://www.echemportal.org/echemportal/index?pageID=0&request_locale=en
- CAMEO Chemicals, website: http://cameochemicals.noaa.gov/search/simple
- ChemIDplus, website: http://chem.sis.nlm.nih.gov/chemidplus/chemidlite.jsp
- ERG - Emergency Response Guidebook by U.S. Department of Transportation, website: http://www.phmsa.dot.gov/hazmat/library/erg
- Germany GESTIS-database on hazard substance, website: http://www.dguv.de/ifa/gestis/gestis-stoffdatenbank/index-2.jsp
- ECHA - European Chemicals Agency, website: https://echa.europa.eu/