Printing date 07/17/2021

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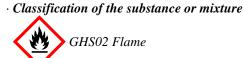
1 Identification

- · Product name
- · Trade name: <u>Ruthenium powder (99.95%)</u>
- Item number: 44-4300
- · CAS Number:
- 7440-18-8
- *EC number:* 231-127-1
- Details of the supplier of the safety data sheet
 Manufacturer/Supplier: Strem Chemicals, Inc.
 Mulliken Way NEWBURYPORT, MA 01950 USA

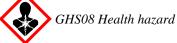
info@strem.com

- · Information department: Technical Department
- Emergency telephone number: EMERGENCY: CHEMTREC: + 1 (800) 424-9300 During normal opening times: +1 (978) 499-1600

2 Hazard(s) identification



Flam. Sol. 2 H228 Flammable solid.



STOT RE 2 H373 May cause damage to organs through prolonged or repeated exposure.

- · Label elements
- · GHS label elements
- The substance is classified and labeled according to the Globally Harmonized System (GHS).
- · Hazard pictograms



· Signal word Warning

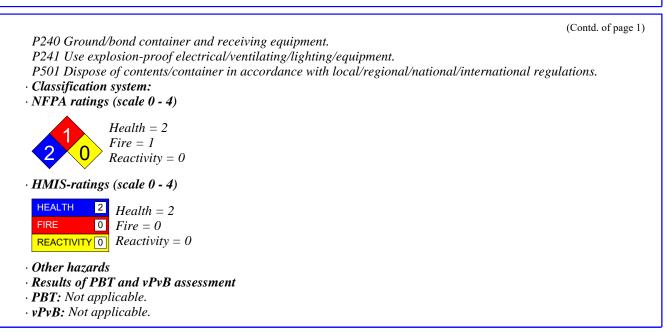
Hazard-determining components of labeling: ruthenium
Hazard statements H228 Flammable solid. H373 May cause damage to organs through prolonged or repeated exposure.
Precautionary statements P210 Keep away from heat/sparks/open flames/hot surfaces. No smoking. P260 Do not breathe dust/fume/gas/mist/vapors/spray. P280 Wear protective gloves/protective clothing/eye protection/face protection.

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3 Composition/information on ingredients

- · Chemical characterization: Substances
- · CAS No. Description
- 7440-18-8 ruthenium
- *Identification number(s)* • *EC number: 231-127-1*

4 First-aid measures

· Description of first aid measures

• General information:

Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.

- · After inhalation: Supply fresh air; consult doctor in case of complaints.
- · After skin contact: Generally the product does not irritate the skin.
- After eye contact: Rinse opened eye for several minutes under running water.
- · After swallowing: If symptoms persist consult doctor.
- · Information for doctor:
- Most important symptoms and effects, both acute and delayed No further relevant information available.
- \cdot Indication of any immediate medical attention and special treatment needed
- No further relevant information available.

5 Fire-fighting measures

- · Extinguishing media
- Suitable extinguishing agents: Use fire fighting measures that suit the environment.
- \cdot Special hazards arising from the substance or mixture
- During heating or in case of fire poisonous gases are produced.

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Safety Data Sheet according to OSHA HCS

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- · Advice for firefighters
- · Protective equipment: Mouth respiratory protective device.

6 Accidental release measures

- Personal precautions, protective equipment and emergency procedures Mount respiratory protective device.
- Wear protective equipment. Keep unprotected persons away.
- Environmental precautions: No special measures required. • Methods and material for containment and cleaning up:
- Dispose contaminated material as waste according to item 13. Ensure adequate ventilation.
- · Reference to other sections
- See Section 7 for information on safe handling.
- See Section 8 for information on personal protection equipment.
- See Section 13 for disposal information.
- · Protective Action Criteria for Chemicals

• PAC-1:

30 mg/m3

· PAC-2:

· PAC-3:

330 mg/m3

2,000 mg/m3

7 Handling and storage

- · Handling:
- · Precautions for safe handling Ensure good ventilation/exhaustion at the workplace.
- · Information about protection against explosions and fires:
- Keep ignition sources away Do not smoke. Protect against electrostatic charges.
- Keep respiratory protective device available.
- · Conditions for safe storage, including any incompatibilities
- · Storage:
- Requirements to be met by storerooms and receptacles: No special requirements.
- Information about storage in one common storage facility: Not required.
- Further information about storage conditions: Keep receptacle tightly sealed.
- · Specific end use(s) No further relevant information available.

8 Exposure controls/personal protection

· Additional information about design of technical systems: No further data; see item 7.

- · Control parameters
- Components with limit values that require monitoring at the workplace: Not required.

• Additional information: The lists that were valid during the creation were used as basis.

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Trade name: Ruthenium powder (99.95%)

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- · Exposure controls
- · Personal protective equipment:
- General protective and hygienic measures: Keep away from foodstuffs, beverages and feed. Wash hands before breaks and at the end of work. Store protective clothing separately.
- · Breathing equipment: A NIOSH approved respirator in accordance with 29 CFR 1910.134.
- · Protection of hands:



Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation. Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.

Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation • *Material of gloves*

- The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and
- varies from manufacturer to manufacturer.
- · Penetration time of glove material

The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

• Eye protection:



Tightly sealed goggles

9 Physical and chemical properties

Information on basic physical and chemical properties		
· General Information		
· Appearance:		
Form:	Powder	
Color:	Grey	
· Odor:	Odorless	
· Odor threshold:	Not determined.	
· pH-value:	Not applicable.	
· Change in condition		
Melting point/Melting range:	Undetermined.	
Boiling point/Boiling range:	82 °C (180 °F)	
· Flash point:	1 °C (34 °F)	
· Flammability (solid, gaseous):	Flammable.	
· Ignition temperature:	465 °C (869 °F)	
• Decomposition temperature:	Not determined.	
· Auto igniting:	Not determined.	
		(Contd. on page

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Trade name: Ruthenium powder (99.95%)

		(Contd. of page
• Danger of explosion:	Not determined.	
· Explosion limits:		
<i>Lower:</i>	2 Vol %	
Upper:	13 Vol %	
· Vapor pressure:	Not applicable.	
• Density at 20 •C (68 •F):	12.3 g/cm ³ (102.6435 lbs/gal)	
· Relative density	Not determined.	
· Vapor density	Not applicable.	
· Evaporation rate	Not applicable.	
· Solubility in / Miscibility with		
Water:	Insoluble.	
· Partition coefficient (n-octanol/w	ater): Not determined.	
· Viscosity:		
Dynamic:	Not applicable.	
Kinematic:	Not applicable.	
· Solvent content:		
Organic solvents:	0.0 %	
VOC content:	0.0 g/l / 0.00 lb/gl	
Solids content:	100.0 %	
• Other information	No further relevant information available.	

10 Stability and reactivity

- · Reactivity No further relevant information available.
- · Chemical stability
- Thermal decomposition / conditions to be avoided: No decomposition if used according to specifications.
- · Possibility of hazardous reactions No dangerous reactions known.
- · Conditions to avoid No further relevant information available.
- · Incompatible materials: No further relevant information available.
- · Hazardous decomposition products: No dangerous decomposition products known.

11 Toxicological information

- · Information on toxicological effects
- · Acute toxicity:
- Primary irritant effect:
- on the skin: No irritant effect.
- on the eye: No irritating effect.
- Sensitization: No sensitizing effects known.
- · Additional toxicological information:

· Carcinogenic categories

· IARC (International Agency for Research on Cancer)

Substance is not listed.

· NTP (National Toxicology Program)

Substance is not listed.

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Trade name: Ruthenium powder (99.95%)

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· OSHA-Ca (Occupational Safety & Health Administration)

Substance is not listed.

12 Ecological information

- · Toxicity
- Aquatic toxicity: No further relevant information available.
- *Persistence and degradability No further relevant information available.*
- · Behavior in environmental systems:
- · Bioaccumulative potential No further relevant information available.
- \cdot **Mobility in soil** No further relevant information available.
- · Additional ecological information:
- · General notes: Not known to be hazardous to water.
- · Results of PBT and vPvB assessment
- · **PBT:** Not applicable.
- · **vPvB:** Not applicable.
- · Other adverse effects No further relevant information available.

13 Disposal considerations

· Waste treatment methods

- *Recommendation: Must not be disposed of together with household garbage. Do not allow product to reach sewage system.*
- · Uncleaned packagings:
- Recommendation: Disposal must be made according to official regulations.

· UN-Number	
· DOT, IMDG, IATA	UN3089
· UN proper shipping name	
$\cdot DOT$	Metal powders, flammable, n.o.s.
· IMDG, IATA	METAL POWDER, FLAMMABLE, N.O.S.
· Transport hazard class(es)	
·DOT	
· Class	4.1 Flammable solids, self-reactive substances and sol
Cuiso	desensitised explosives

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rade name: Ruthenium powder (99.95%)		
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· IMDG		
· Class · Label	4 4.1	
·IATA		
· Class · Label	4.1 Flammable solids, self-reactive substances and solid desensitised explosives	
· Packing group · DOT, IMDG, IATA	4.1 III	
• Environmental hazards: • Marine pollutant:	No	
 Special precautions for user EMS Number: Segregation groups 	Not applicable. F-G,S-G Heavy metals and their salts (including their organometallic compounds), powdered metals	
 Stowage Category Handling Code Segregation Code 	A H1 Keep as dry as reasonably practicable SG17 Stow "separated from" class 5.1 SG25 Stow "separated from" goods of classes 2.1 and 3. SG26 In addition: from goods of classes 2.1 and 3 when stowed on deck of a containership a minimum distance of two container spaces athwartship shall be maintained, when stowed on ro-ro ships a distance of 6 m athwartship shall be maintained.	
• Transport in bulk according to Annex I MARPOL73/78 and the IBC Code	II of Not applicable.	
• Transport/Additional information:		
· IMDG · Limited quantities (LQ) · Excepted quantities (EQ)	5 kg Code: E1 Maximum net quantity per inner packaging: 30 g Maximum net quantity per outer packaging: 1000 g	
· UN "Model Regulation":	UN 3089 METAL POWDERS, FLAMMABLE, N.O.S., 4.1, III	

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Trade name: Ruthenium powder (99.95%)

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15 Regulatory information

- \cdot Safety, health and environmental regulations/legislation specific for the substance or mixture \cdot Sara
- Section 355 (extremely hazardous substances):

Substance is not listed.

• Section 313 (Specific toxic chemical listings):

Substance is not listed.

· TSCA (Toxic Substances Control Act):

Substance is listed.

· Proposition 65

 \cdot Chemicals known to cause cancer:

Substance is not listed.

· Chemicals known to cause reproductive toxicity for females:

Substance is not listed.

· Chemicals known to cause reproductive toxicity for males:

Substance is not listed.

· Chemicals known to cause developmental toxicity:

Substance is not listed.

· Carcinogenic categories

· EPA (Environmental Protection Agency)

Substance is not listed.

· TLV (Threshold Limit Value established by ACGIH)

Substance is not listed.

 \cdot NIOSH-Ca (National Institute for Occupational Safety and Health)

Substance is not listed.

· GHS label elements

The substance is classified and labeled according to the Globally Harmonized System (GHS). • *Hazard pictograms*



· Signal word Warning

Hazard-determining components of labeling: ruthenium
Hazard statements H228 Flammable solid. H373 May cause damage to organs through prolonged or repeated exposure.
Precautionary statements P210 Keep away from heat/sparks/open flames/hot surfaces. No smoking. P260 Do not breathe dust/fume/gas/mist/vapors/spray. P280 Wear protective gloves/protective clothing/eye protection/face protection. P240 Ground/bond container and receiving equipment.

P241 Use explosion-proof electrical/ventilating/lighting/equipment.

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Trade name: Ruthenium powder (99.95%)

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P501 Dispose of contents/container in accordance with local/regional/national/international regulations. • *Chemical safety assessment:* A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

- · Department issuing SDS: Technical Department.
- · Contact: Technical Director
- · Date of preparation / last revision 07/17/2021 / -
- · Abbreviations and acronyms: ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road) IMDG: International Maritime Code for Dangerous Goods DOT: US Department of Transportation IATA: International Air Transport Association ACGIH: American Conference of Governmental Industrial Hygienists EINECS: European Inventory of Existing Commercial Chemical Substances CAS: Chemical Abstracts Service (division of the American Chemical Society) NFPA: National Fire Protection Association (USA) HMIS: Hazardous Materials Identification System (USA) VOC: Volatile Organic Compounds (USA, EU) PBT: Persistent, Bioaccumulative and Toxic vPvB: very Persistent and very Bioaccumulative NIOSH: National Institute for Occupational Safety OSHA: Occupational Safety & Health TLV: Threshold Limit Value PEL: Permissible Exposure Limit REL: Recommended Exposure Limit Flam. Sol. 2: Flammable solids – Category 2 STOT RE 2: Specific target organ toxicity (repeated exposure) – Category 2