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| PAGE 1 of 7 | <p style="text-align: center;">PLATINUM METALS REFINERY</p>  |
| REVISION N ^o : 8 | WORK PROCEDURE TASK: SAFETY DATA SHEET - RUTHENIUM |
| | SECTION: VAULTS |
| | DOCUMENT N ^o : PMR-MSDS-RUTHENIUM |

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SAFETY DATA SHEET

PRODUCT NAME: RUTHENIUM POWDER

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Identification of the preparation:

Product name: Ruthenium powder **Product code:** RU METAL

Chemical name: Ruthenium **Formula:** Ru

Recommended uses: Manufacture of Ruthenium chemicals for use in catalysts, as metal and/or in alloys for electrical contacts, sputtering targets.

Company Identification:

Impala Platinum Limited – Refineries

Corner East Geduld Road & Cowles Street

P O Box 222, Springs 1560, South Africa

Tel.: +27 (0)11 360 3111, Fax: +27 (0)11 360 3202

www.implats.co.za *jamie.welman@implats.co.za

Emergency telephone no.: Impala Platinum Refineries +27 (0)11 360 3777

Poison Centre - Tygerberg Hospital, Belville, Cape +27 (0)21 931 6129

2. HAZARD IDENTIFICATION

Low toxicity

WARNING

Harmful -if swallowed, - in contact with skin, - if inhaled

The product may cause adverse health effects with high-level dust generation, inhalation or prolonged skin contact. May form ruthenium salts on contact with acids.



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Additional Labeling:

Each container should be labeled as follows:

Before use read Safety Data Sheet

If dissolved, ensure adequate enclosure or ventilation; do not breathe mists and avoid solution contact with eyes, skin and clothing – may cause sensitization or allergic reaction

If melted do not breathe furnace fumes

3. COMPOSITION / INFORMATION ON INGREDIENTS

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|--------------------------|----------------------|----------------|-----------|
| Major components: | Typical wt %: | CAS #: | 7440-18-8 |
| Ruthenium | 99.90-99.99% | EINECS Number: | 231-127-1 |

4. FIRST AID MEASURES

Inhalation: If over exposure occurs leave exposure area immediately. If other than minor symptoms are displayed seek immediate medical attention

Ingestion: If poisoning occurs, contact a Doctor or Poisons Information Centre on +27-21-931-6129. Do not induce vomiting. Give a glass of water to drink. Seek urgent medical attention.

Skin: Gently flush affected areas with soap and water. Seek medical attention if irritation develops.

Eyes: Flush gently with running water for at least 15 minutes. Seek medical attention if irritation develops.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media: does not burn

Extinguishing media not be used: not applicable

Special exposure hazards: may evolve toxic fumes in fire. Remain upwind and notify those downwind of hazard

Special protective equipment for fire-fighters: wear full protective equipment including Self Contained Breathing Apparatus (SCBA) if combating fire

NOTE: Unlike some finely divided Ruthenium powder supplied by other companies, the material supplied by Impala Platinum is non-flammable and therefore DOES NOT present a fire hazard.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: If spilt (bulk) wear goggles and PVC or rubber gloves. Where a dust inhalation hazard exists (i.e. when used in large quantities) wear a Class P1 (particulate) respirator.

Environmental precautions: Prevent this material from entering into surface waters.

Methods for cleaning-up: SOLID – sweep up and place in sealed container. SOLUTION - Absorb with moist sand or similar and place in sealed containers for reprocessing or recovery.

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7. HANDLING AND STORAGE

Handling: Avoid inhalation of dust or fumes. Avoid contact with skin or eyes. Use local ventilation which is adequate to limit exposure to levels not exceeding occupational exposure limits. Activities generating dust should be avoided.

Storage: Store in tightly sealed containers in a cool, dry and well-ventilated area removed from oxidizing agents, acids and foodstuffs. Ensure containers are adequately labeled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Occupational Exposure Limit: (ACGIH, edition 2008)

TLV-TWA): 10mg/m³ (inhalable particles); 3mg/m³ (respirable particles) based on "particulates not otherwise classified"

Respiratory protection: Use an appropriate and approved respirator for toxic dust or fume if airborne concentration is likely to exceed the occupational exposure limits.

Hand protection: Wear suitable gloves (PVC or rubber)

Eye protection: Wear dust-proof goggles.

Skin protection: Safety shoes, overalls or similar full-body work clothes should be worn and laundered daily. This protective clothing should not be worn at home.

Personal Hygiene: Practice good housekeeping and personal hygiene procedures. No eating, drinking or smoking in work area. Wash hands thoroughly before eating, drinking or smoking. Avoid ingestion, inhalation and skin and eye contact. Medical examinations, monitoring, record keeping and hygiene facilities are recommended.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Pale gray metallic powder

Odour: Odourless

pH: not applicable

Boiling point / boiling range: 4150°C; 7502°F

Melting point / melting range: 2334°C; 4233°F

Flash point: not applicable

Flammability (solid, gas): non-flammable

Autoflammability: not applicable

Explosive properties: not applicable

Oxidizing properties: not applicable

Vapour pressure: unknown

Relative density: 2.1 - 2.8 (variable)

Solubility : - hydrosolubility: insoluble in water

liposolubility (solvent-oil): insoluble in solvent-oil

Partition coefficient (n-octanol/water): not applicable

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10. STABILITY AND REACTIVITY

The material is stable under normal circumstances

Conditions to avoid: Exposure to high temperatures (> 1000°C), generation of dust.

Incompatible materials: Avoid contact with acids or strong oxidizing agents.

Hazardous decomposition products: Ruthenium tetroxide formed with strong oxidizing agents

11. TOXICOLOGICAL INFORMATION

ACUTE TOXICITY

Ingestion: Ruthenium powder is **non-toxic**. May cause irritation of the gastro-intestinal tract.

Ruthenium **salts** may be more toxic

SKIN IRRITATION / CORROSION

Non-irritant: Low irritant. Prolonged and repeated exposure to dust/powder may result in irritation due to mechanical action. Possible sensitizer. Direct contact with ruthenium **salts** may result in irritation and skin sensitization.

EYE DAMAGE / IRRITATION

Irritant: Exposure may result in eye irritation, lachrymation, burning sensation and conjunctivitis and possible corneal burns with prolonged contact.

RESPIRATORY OR SKIN SENSITIZATION

Non-irritant: Ruthenium metal is unlikely to cause irritation except as a dust. Ruthenium **salts** are irritating to eyes, skin and mucous membranes and may cause sensitization. **Ruthenium tetroxide** can cause severe eye damage.

REPRODUCTIVE CELL MUTAGENICITY

The effects of Ruthenium **salts** have not been fully investigated.

CARCINOGENICITY

Non-carcinogenic: Ruthenium **salts** are listed as a non-carcinogenic in (all U.S.):

- i) in the National Toxicity Program (NTP) Report on Carcinogens
- ii) in the International Agency for Research on Cancer (IARC) monographs
- iii) by the Occupational Safety and Health Administration (OSHA)

Water-soluble Ruthenium compounds have caused tumours in laboratory animals.

REPRODUCTIVE TOXICITY

Rhodium chloride has caused mutations in bacteria and tumours in laboratory animals. However, the effects have not been fully investigated. Pregnant women should avoid contact with Ruthenium **salts**.

SPECIFIC TARGET ORGAN TOXICITY – Single exposure

Ruthenium **salts** may cause possible damage to the respiratory tract, GI tract, skin, eyes, teeth and immune system. However, the effects have not been fully investigated.

SPECIFIC TARGET ORGAN TOXICITY – Repeated exposure

Ruthenium **salts** may cause possible damage to the respiratory tract, GI tract, skin, eyes, teeth and immune system. However, the effects have not been fully investigated.

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ASPIRATION HAZARD

Inhalation: Low irritant. Inhalation of dusts may result in upper respiratory tract irritation. Ruthenium metal poses a low hazard but Ruthenium **salts** are potential irritants and sensitizers.

12. ECOLOGICAL INFORMATION

Due to the very low solubility of Ruthenium powder it does not directly pose any ecological threat. However, if converted to soluble Ruthenium salts it may have the following effects:

Accumulation:

- **Persistence:** hazard of ruthenium persistency in the environment
- **Bioaccumulative potential:** hazard of ruthenium accumulation
- **Biomagnification:** potential hazard of ruthenium magnification
- **Biodegradability:** no information available

Ecotoxicity:

- **Aquatic organisms: Potentially toxic** to aquatic organisms. May cause long term adverse effects in the aquatic environment.
- **Soil organisms:** unknown; no information available
- **Plants and terrestrial animals:** unknown; no information available

Other adverse effects:

- **Ozone depletion potential:** does not contain ozone depleting substances
- **Photochemical ozone creation potential:** not applicable
- **Global warming potential:** not applicable
- **Effects on waste water treatment plants:** unknown; no information available

The environmental effects of Ruthenium and its compounds have not been fully evaluated.

13. DISPOSAL CONSIDERATIONS

Disposer must comply with state and local laws. This material can be metallurgically recycled by Impala Platinum, South Africa, which is a pre-authorized facility for the environmentally sound recovery of metals.

14. TRANSPORT INFORMATION

NOT REGULATED FOR TRANSPORT PURPOSES

- Packing :** in plastic bottles sealed in tins which in turn are sealed in boxes
- UN-Nr.:** not applicable
- IMDG-Code:** not applicable
- ICAO / IATA :** not applicable
- RID / ADR :** not applicable

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| 15. REGULATORY INFORMATION |
| <p>United States: CERCLA Sections 102a/103 (40 CFR 302.4): Not regulated</p> <p>Canada: WHMIS Classification: D2B (toxic material)</p> <p>EU/EC Classification: X_n (Harmful); not classified in Annex I of Directive 67/548/EEC (will change with implementation of GHS/REACH)</p> |

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| 16. OTHER INFORMATION : |
| <p>Hazard Information References :</p> <p>RTECS : Registry of toxic effects of Chemical Substances, NIOSH, edition January 1999</p> <p>Sax's Dangerous Properties of Industrial Materials (8th edition), R J Lewis Sr.</p> <p>Screening of Platinum Group Metals; Pt, Rh, Pd SWECO VIAK Screening Report 2007:2 (For Swedish Environmental Protection Agency)</p> <p>ECOTOX database; http://cfpub.epa.gov/ecotox</p> <p>The buyer assumes all risks with the use and handling of the material.</p> <p>The seller assumes no responsibility or liability in connection with the information supplied in this sheet or for any damage or injury caused by the material; reasonable safety procedures should be followed.</p> <p>The seller assumes no responsibility for injury or damage caused by use of the material even if reasonable safety procedures are followed. The information contained in this sheet is developed from what is believed to be accurate and reliable sources but the seller makes no warranties, either expressed or implied, and assumes no responsibility for the accuracy or completeness of the data contained herein.</p> |