

Occupational Health Guideline for Soluble Rhodium Salts (as Rhodium)

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

APPLICABILITY

The general guidelines contained in this document apply to all soluble rhodium salts. Physical and chemical properties of one specific compound are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION—Hydrated rhodium trichloride

- Formula: $\text{RhCl}_3 \cdot x\text{H}_2\text{O}$
- Synonyms: Soluble rhodium trichloride; rhodium chloride
- Appearance and odor: Red-brown, odorless solid or liquid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for soluble rhodium salts is 0.001 milligram of soluble rhodium salts (as rhodium) per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

Soluble rhodium salts may affect the body if they are inhaled or if they come in contact with the eyes or skin. They may also affect the body if they are swallowed.

• Effects of overexposure

1. *Short-term Exposure:* None known in humans
2. *Long-term Exposure:* None known in humans
3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms

and suspects that they are caused by exposure to soluble rhodium salts.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to soluble rhodium salts at potentially hazardous levels:

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from soluble rhodium salts exposure.

—Eye disease: Rhodium chloride has caused eye damage in animals. Persons with pre-existing eye disorders may be more susceptible to the effects of this agent.

—Kidney disease: Although rhodium is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Central nervous system disorders: Rhodium trichloride has caused central nervous system damage in animals. Individuals with pre-existing central nervous system disorders may be more susceptible.

2. *Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

Toxicologic data on the soluble salts of rhodium are meager; however, solutions of salts splashed in the eye may cause mild irritation. Rhodium trichloride was found to have chemotherapeutic action against certain viruses in mice, but no mention was made of toxicity. The LD₅₀ for rhodium trichloride in rabbits by intravenous injection was 215 mg/kg; the clinical signs presented shortly after injection were increasing lethargy and waning respiration. There were no abnormal findings at autopsy, and the rapid onset of death suggested central nervous system effects. A solution of rhodium chloride in a rabbit eye gave a delayed injurious reaction; a 0.1-M solution adjusted to pH 7.2 with ammonium hydroxide was placed for 10 minutes in a rabbit eye after the corneal epithelium had been removed; an orange color-

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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ation of the cornea occurred, which faded to faint yellow within 8 weeks. During the first 2 to 3 weeks, the cornea was slightly hazy; in the third week white opacities gradually developed, and finally there was extensive opacification and vascularization. Systemic effects have not been reported from industrial exposure.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data—Hydrated rhodium trichloride

1. Molecular weight: Greater than 209
2. Boiling point (760 mm Hg): 800 C (1472 F) (sublimes)
3. Specific gravity (water = 1): Greater than 1
4. Vapor density (air = 1 at boiling point of soluble rhodium salts): Not applicable
5. Melting point: 100 C (212 F) (decomposes)
6. Vapor pressure at 20 C (68 F): Less than 0.1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Very soluble
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: At temperatures above 100 C (212 F), some decomposition may occur.
2. Incompatibilities: None
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride or chlorine) may be released when rhodium trichloride decomposes.
4. Special precautions: None

• Flammability

1. Not combustible

• Warning properties

The only rhodium salt for which information is available concerning toxic effects on the eye is rhodium chloride. Grant states that "rhodium chloride has been tested on a rabbit's eye and was found to give a peculiar delayed injurious reaction. A 0.1-M clear, dark-red solution prepared and adjusted to pH 7.2 with ammonium hydroxide was applied for 10 minutes to the eye after the corneal epithelium had been removed by scraping. This exposure caused orange coloration of the cornea, fading to faint yellow in the course of 2 months. During the first 2 to 3 weeks the cornea was not opaque, but was slightly hazy. In the third week, however, irregular white opacities gradually developed. Ultimately the cornea became extensively opacified and vascularized."

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30

minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

Sampling and analyses may be performed by collection of soluble rhodium salts on a filter, followed by treatment with nitric acid and perchloric acid, solution in acid, and atomic absorption spectrophotometric analysis. An analytical method for soluble rhodium salts is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4). Analytical Methods for Set M" (order number PB 265 029).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with soluble rhodium salts or liquids containing soluble rhodium salts.
- Clothing contaminated with soluble rhodium salts should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of soluble rhodium salts from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the soluble rhodium salts, the person performing the operation should be informed of soluble rhodium salts' hazardous properties.
- Non-impervious clothing which becomes contaminated with soluble rhodium salts should be removed promptly and not reworn until the soluble rhodium salts are removed from the clothing.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where soluble rhodium salts or liquids containing soluble rhodium salts may contact the eyes.

SANITATION

- Skin that becomes contaminated with soluble rhodium salts should be promptly washed or showered to remove any soluble rhodium salts.
- Eating and smoking should not be permitted in areas where soluble rhodium salts or liquids containing soluble rhodium salts are handled, processed, or stored.
- Employees who handle soluble rhodium salts or liquids containing soluble rhodium salts should wash their hands thoroughly before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to soluble rhodium salts may occur and control methods which may be effective in each case:

Operation	Controls
Liberation during refining and extraction of metal from platinum ores	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use in electroplating baths for finishing scientific instruments, camera fittings, radio equipment, and jewelry; use in laboratory for research	General dilution ventilation; local exhaust ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If soluble rhodium salts or liquids containing soluble rhodium salts get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention.

• Skin Exposure

If soluble rhodium salts or liquids containing soluble rhodium salts get on the skin, flush the contaminated skin with water. If soluble rhodium salts or liquids containing soluble rhodium salts penetrate through the clothing, remove the clothing and flush the skin with water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of soluble rhodium salts, move the exposed person to fresh air at once. If

breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When soluble rhodium salts or liquids containing soluble rhodium salts have been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

- If soluble rhodium salts are spilled, the following steps should be taken:

1. Ventilate area of spill.
2. Collect spilled material in the most convenient and safe manner for reclamation or for disposal in a secured sanitary landfill. Liquid containing soluble rhodium salts should be absorbed in vermiculite, dry sand, earth, or a similar material.

- Waste disposal method:

Soluble rhodium salts may be disposed of in sealed containers in a secured sanitary landfill.

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RESPIRATORY PROTECTION FOR SOLUBLE RHODIUM SALTS (AS RHODIUM)

Condition	Minimum Respiratory Protection* Required Above 0.001 mg/m ³
Particulate Concentration	
0.01 mg/m ³ or less	Any high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
0.05 mg/m ³ or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
1 mg/m ³ or less	A powered air-purifying respirator with a high efficiency particulate filter. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
2 mg/m ³ or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 2 mg/m ³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

*Only NIOSH-approved or MSHA-approved equipment should be used.