

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** RHODIUM, SOLUBLE SALTS ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance RHODIUM, SOLUBLE SALTS.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of soluble rhodium salts (as rhodium) not in excess of 0.001 milligram per cubic meter (mg/M3), averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z-1.

(2) "Action level" means one half of the permissible exposure for soluble rhodium salts.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which soluble rhodium salts is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of soluble rhodium salts at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of soluble rhodium salts.

(2) A written record of the determination shall be made and shall contain at least the following information:

- (i) Any information, observations, or calculations which may indicate employee exposure to soluble rhodium salts;
- (ii) Any measurements of soluble rhodium salts taken;
- (iii) Any employee complaints of symptoms which may be attributable to exposure to soluble rhodium salts; and
- (iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to soluble rhodium salts at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to soluble rhodium salts at or above the action level, the employer shall:

- (i) Identify all employees who may be exposed at or above the action level; and
- (ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to soluble rhodium salts at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to soluble rhodium salts above the permissible exposure, the employer shall:

- (i) Measure the exposure monthly of the employee so exposed; and
- (ii) Institute control measures as required by paragraph (d) of this section; and
- (iii) Individually notify, in writing, within five days, every employee who is found to be exposed to soluble rhodium salts above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to soluble rhodium salts

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement. (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (See Appendix B (iv) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

Table 1

Concentration

Required Accuracy

Above permissible exposure

$\pm$ 25%

At or below permissible exposure

and above the action level

$\pm$ 35%

At or below the action level

$\pm$ 50%

(d) Compliance. (1) No employee shall be exposed to soluble rhodium salts above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of soluble rhodium salts shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not technically feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of soluble rhodium salts.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of soluble rhodium salts to at or below the permissible exposure; or

(iv) For operations which require entry into tanks or closed vessels; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2 RESPIRATORY PROTECTION FOR SOLUBLE RHODIUM SALTS (AS RHODIUM)

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION

Particulate Concentration	
0.01 mg/M3 or less	Any high efficiency particulate filter respirator. ----- Any supplied-air respirator. ----- Any self-contained breathing apparatus. -----
0.05 mg/M3 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/M3 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/M3 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/M3 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. -----

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

Fire Fighting Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) Fire and safety. The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for soluble rhodium salts.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees 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. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that clothing contaminated with soluble rhodium salts is placed in closed containers for storage until it can be discarded or until the employer provides 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 employer shall inform the person performing the operation of the hazardous properties of soluble rhodium salts.

(3) Employers shall ensure that non-impervious clothing which becomes contaminated with soluble rhodium salts be removed promptly and not reworn until the soluble rhodium salts are removed from the clothing.

(4) Employers shall provide and ensure that employees use safety goggles (cup-cover type dust and splash safety goggles) which comply with § 1910.133 (a)(2)-(a)(6) where eye contact with soluble rhodium salts or liquids containing soluble rhodium salts may occur.

(g) Spills and disposal. In the event that soluble rhodium salts are spilled, the employer shall immediately provide available ventilation and then clean up the spill.

(h) Sanitation. (1) Employers shall ensure that employees whose skin becomes contaminated with soluble rhodium salts promptly wash or shower to remove any soluble rhodium salts from the skin.

(2) Employers shall ensure that employees do not eat or smoke in areas where soluble rhodium salts or liquids containing soluble rhodium salts are handled, processed or stored.

(3) Employers shall ensure that employees who handle soluble rhodium salts or liquids containing soluble rhodium salts wash their hands thoroughly before eating, smoking or using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which soluble rhodium salts is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to soluble rhodium salts above the action level or employees who may have skin or eye contact with soluble rhodium salts or solutions containing soluble rhodium salts, or

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

employees who work where a spill of soluble rhodium salts may occur, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for soluble rhodium salts (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to soluble rhodium salts.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to soluble rhodium salts which are listed in Appendix A of the section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to soluble rhodium salts.

(j) Medical surveillance. (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to soluble rhodium salts or liquids containing soluble rhodium salts or airborne concentrations of soluble rhodium salts at or above the action level information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease

(ii) Eye disease

(iii) Central nervous system disorders

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section or any of the signs or symptoms of exposure to soluble rhodium salts which are listed in Appendix A which the employee suspects are caused by exposure to soluble rhodium salts.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for soluble rhodium salts;

(ii) A description of the affected employee's duties as they relate to his exposure to soluble rhodium salts;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating: (A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to soluble rhodium salts or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to soluble rhodium salts including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to soluble rhodium salts.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to soluble rhodium salts or liquids containing soluble rhodium salts or airborne concentrations of soluble rhodium salts in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to soluble rhodium salts.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) Recordkeeping. (1) Exposure determination. (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) This record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) Exposure measurements. (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to soluble rhodium salts.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to soluble rhodium salts which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number and exposure of the employee monitored.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) Mechanical ventilation. (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3) of this section.

(ii) This record shall include:

- (A) Date of measurement;
- (B) Type of measurement taken;
- (C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

- (A) Date of training;
- (B) Name and social security number of employee trained;
- (C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) Medical surveillance. (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to soluble rhodium salts;

(C) A copy of information provided to the physician pursuant to paragraph (j)(4)(ii), (iii), (iv), (v), and (vi) of this section.

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) Access to records. (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(1) Employee observation of measurement. (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to soluble rhodium salts which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to soluble rhodium salts requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

- (i) Receive an explanation of the measurement procedure.
- (ii) Visually observe all steps related to the measurement of the airborne concentration of soluble rhodium salts that are being performed at the place of exposure; and
- (iii) Record the results obtained.

NOTE: The information contained in the following appendixes is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR SOLUBLE RHODIUM SALTS

I. SUBSTANCE IDENTIFICATION

- A. Substance: Soluble rhodium salts
- B. Permissible Exposure: 0.001 milligrams of soluble rhodium salts per cubic meter of air (mg/M3), averaged over an eight-hour work shift.
- C. Appearance and Odor: Rhodium trichloride is a red-brown odorless solid or liquid

II. HEALTH HAZARD DATA

- A. Comments: Soluble rhodium salts have not been shown to be an industrial hazard; however, minor toxic effects have been shown to occur in animals under extreme conditions.
- B. Ways in which the chemical affects your body: Soluble rhodium salts might affect your body if you inhale them or if they come in contact with your eyes or skin. They might also affect your body if you swallow them.
- C. Effects of Overexposure:
 - 1. Short-term Exposure: None known in humans.
 - 2. Long-term Exposure: None known in humans.
 - 3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to soluble rhodium salts.

-III. EMERGENCY FIRST AID PROCEDURES

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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

- B. Skin Exposure: If soluble rhodium salts or liquids containing soluble rhodium salts get on your skin, flush the contaminated skin with water. If soluble rhodium salts or liquids containing soluble rhodium salts penetrate through your clothing, remove the clothing and flush the skin with water. If irritation is present after washing, get medical attention.
- C. Breathing: If you or any other 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.
- D. Swallowing: When soluble rhodium salts or liquids containing soluble rhodium salts have been swallowed, 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.
- E. Rescue: Move 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 yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to soluble rhodium salts. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you experience difficulty breathing while wearing a respirator, tell your employer.
- B. Protective Clothing: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent repeated or prolonged skin contact with solid soluble rhodium salts or solutions containing soluble rhodium salts. Replace or repair impervious clothing that has developed leaks.
- C. Eye Protection: You must wear dust-resistant safety goggles where there is any possibility of solid soluble rhodium salts contacting your eyes. You must wear splash-proof safety goggles where there is any possibility of solutions containing soluble rhodium salts contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

- A. Soluble rhodium salts must be stored in tightly closed containers in a well-ventilated area.
- B. You must promptly remove any non-impervious clothing that becomes contaminated with soluble rhodium salts and this clothing must not be reworn until the soluble rhodium salts are removed from the clothing.
- D. If your skin becomes contaminated with soluble rhodium salts, you must promptly wash or shower to remove the soluble rhodium salts from your skin.
- E. You must not eat or smoke in areas where solid soluble rhodium salts or solutions containing soluble rhodium salts are handled, processed or stored.
- F. If you handled solid soluble rhodium salts or solution containing soluble rhodium salts, you must wash your hands thoroughly with water before eating, smoking or using toilet facilities.
- G. Eye flushing facilities, where provided, must be readily available and you should know where they are and how to operate them.
- H. Ask your supervisor where soluble rhodium salts are used in your work area and for any additional safety and health rules.

VI. ACCESS TO INFORMATION

- A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for soluble rhodium salts. In addition, your employer must instruct you in the safe use of soluble rhodium salts, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to soluble rhodium salts. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and of the actions which are being taken to reduce your exposure.
- C. Your employer is required to keep records of exposure determinations, exposure measurements, and medical surveillance. Your employer is required to make records of exposure determinations and your exposure measurements available to you or your representative upon your request. Your employer is required to release your medical records to your physician upon your written request.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR SOLUBLE RHODIUM SALTS

(The standard for soluble rhodium salts should not be interpreted to apply only

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

listed below for which substance specific information has been provided.)

- I. PHYSICAL AND CHEMICAL DATA (Hydrated Rhodium Trichloride)
 - A. Substance Identification
 1. Synonyms: Soluble rhodium trichloride
 2. Formula: $\text{RhCl}_3 \cdot x\text{H}_2\text{O}$
 3. Molecular weight: Greater than 209
 - B. Physical Data
 1. Boiling point (760 mm Hg): 800 C (1472 F) (sublimes)
 2. Specific gravity (water = 1): Greater than 1
 3. Vapor density (air = 1 at boiling point of soluble rhodium salts): Not applicable
 4. Melting point: 100 C (212 F) (decomposes)
 5. Vapor pressure at 20 C (68 F): Less than 0.1 mm Hg
 6. Solubility in water, % by weight at 20 C (68 F): Very soluble
 7. Evaporation rate (butyl acetate = 1): Not applicable
 8. Appearance and odor: Red-brown odorless solid or liquid
- II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA (Hydrated Rhodium Trichloride)
 - A. Fire
 1. Not combustible
 - B. 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.
- III. SPILL AND DISPOSAL PROCEDURES
 - A. 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.
 - B. Persons not wearing protective equipment should be restricted from areas of spills until cleanup has been completed.
 - C. Waste disposal methods: Soluble rhodium salts may be disposed of in sealed containers in a secured sanitary landfill.
- IV. MONITORING AND MEASUREMENT PROCEDURES
 - A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 8-hour exposure may be determined from a single eight-hour sample or two (2) 4-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). Sampling and analyses may be

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or by collection of the particulates using a high efficiency membrane filter with subsequent chemical analyses. The method of measurement must determine the concentration of soluble rhodium salts to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of soluble rhodium salts to plus or minus 25%.

C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set M" (Order number XXXXXXXXXX).

D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. Store soluble rhodium salts in tightly closed containers in a well ventilated area.

B. Employers should advise employees of all areas and operations where exposure to soluble rhodium salts could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to soluble rhodium salts is likely to occur are: during their production and their use as intermediates in the refining of rhodium; in laboratory use; and in the preparation of electroplating baths.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. 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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

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 coloration 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.

III. SIGNS AND SYMPTOMS

By analogy to effects caused in animals it may cause mild eye irritation and central nervous system damage.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Flush eyes and skin with water. If swallowed and the person is conscious, immediately administer water orally and induce vomiting. Give artificial resuscitation if indicated. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

The soluble salts of rhodium appear to be relatively nontoxic. Injury to the eyes of animals has been reported. It is important that the physician become familiar with plant operating conditions in which exposure to rhodium occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

Routine medical histories and physical examinations are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from rhodium exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

2. 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.
3. Central Nervous System Disorders -- Rhodium trichloride has caused central nervous system damage in animals. Individuals with preexisting central nervous system disorders may be more susceptible.

C. PERIODIC EXAMINATIONS

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Rhodium as Rh," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 222.
2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1125-1131.
3. Browning, Ethel: Toxicity and Metabolism of Industrial Metals (2d ed.), Butterworths, London, 1969, pp. 278-279.
4. Grant, W. Morton: Toxicology of the Eye (2d ed.), Charles C. Thomas, Illinois, 1974, p. 887.
5. Landolt, R.R., et al: "Studies on the Toxicity of Rhodium Trichloride in Rats and Rabbits," Toxicology and Applied Pharmacology, 21:589-590, 1972.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

REFERENCES AND SOURCES
SOLUBLE RHODIUM SALTS

1910.93

- (f) Personal Protective Equipment, and, (h) Sanitation
Eye: Grant, "Toxicology of the Eye;" "Documentation of TLV's;"
Hamilton and Hardy, "Industrial Toxicology"
Skin: Hamilton and Hardy, "Industrial Toxicology;" Sax, "Dangerous
Properties of Industrial Materials;" "Documentation of
TLV's;" Schwartz et al., "Occupational Diseases of the Skin;"
Campbell et al., "Dermal Irritancy of Metal Compounds,"
Arch. Environ. Health, Vol. 30, April 1975, p. 168 - 70; Hunter,
"Diseases of Occupations"
Ingestion: Sax, "Dangerous Properties of Industrial Materials;"
"Documentation of TLV's;" Browning, "Metabolism and Toxicology
of Industrial Metals"

COMMENTS

Eye - Classification: 2 and 6

Output statement numbers: 10 and 12 combined

Exceptions: None

Grant reports 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 ten minutes to the eye after the corneal epithelium had been removed by scraping. This exposure caused orange discoloration of the cornea, fading to faint yellow in the course of two months. During the first two to three 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."

The Documentation of TLV's bases the TLV of rhodium on the similarity of the substance to platinum. According to Hamilton and Hardy, the dusts and mists of complex platinum salts may cause inflammatory changes of the conjunctivae following contact with the eye. Grant notes that dusts of soluble platinum salts cause a "burning sensation in the eyes, lachrymation and conjunctival hyperemia, sometimes associated with photophobia which suggests that the corneal epithelium may be involved." He continues, "flooding the surface of the eye of normal albino rabbits with 2% to 5% solutions of platinum chloride for 10 minutes causes only slight temporary irritation and no discoloration, but if the epithelium is first removed to permit penetration, the cornea stains light brown . . . (but) with 10 days the stain disappears and the epithelium regenerates."

It is concluded that eye contact with the soluble salts of rhodium should be prevented. However, it is not felt that the data justifies the requirement for eye wash fountains. The compounds are, therefore, assigned classifications of 2 and 6.

Skin - Classification: 2 and 6

Output statement numbers: 2, 7a, 17g, 17i, 20a

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

Exceptions: None

Most sources of information simply state that there are no significant experimental data nor reports indicating trouble from rhodium and its salts in man. According to Hamilton and Hardy, however, "nitro compounds, amines, carbonyls, and carbonyl halides are listed by Stockinger (1963) as typical compounds of rhodium, iridium and ruthenium. All of these chemicals are potentially hazardous independent of their metal component." Sax agrees with this latter statement by referring the reader generally to sulfides, nitrates, and fluorides.

Under "fluorides," Sax states "inorganic fluorides are generally highly irritant and toxic." He lists them as acute local irritants of high toxic hazard and as chronic local irritants of slight toxic hazard. Local effects are given as unknown or are unlisted for the other groups.

The Documentation of TLV's bases the TLV of rhodium on the similarity of the substance to platinum and proposes a 0.001 mg/m³ TLV for soluble rhodium salts "to prevent possible allergic effects." Schwartz notes the development of sensitivity to platinum chloride in a chemist who suffered a generalized eruption from contact with a small amount of the substance. Campbell et al. found that PtCl₂ was safe for human skin contact while PtCl₄ was not. Hunter reports "in mild cases (of contact with platinum salts) there was an erythema or urticaria of the hands and forearms . . . (and) in more severe cases the face and neck were involved also."

Though specific data on the effects of these compounds are sparse, there is sufficient indication of their potential to cause local effects to warrant at least classifications of 2 and 6, however statement 5b is not considered to be justified.

Ingestion - Classification: 2 and 6

Output statement numbers: 19, 20a

Exceptions: None

Sax considers fluorides to be of high toxic hazard by ingestion. Nitrates are noted as being of moderate hazard and, it is noted, that "small, repeated doses may lead to weakness, general depression, headache and mental impairment." Sulfites are also listed as a moderate hazard.

As noted above, the Documentation of TLV's bases the TLV of rhodium on its similarity to platinum. Browning reports, "the complex salts (of platinum) act on the nervous system - the action of these salts is not due to separate components (platinum and base) but to that of the molecule as a whole on sensitive tissue."

Specific data on the hazards of ingestion of these compounds do not exist. Nevertheless, it is evident that regardless of whether one assumed that the components of these salts act separately or together, there is sufficient indication that these compounds are potentially toxic. They are, therefore, assigned classifications of 2 and 6, with statement 19 applied to both soluble rhodium salts and liquids containing soluble rhodium salts.

SUBSTANCE TECHNICAL GUIDELINES

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

The references cited for this document include:

Kirk - Othmer, "Encyclopedia of Chemical Technology," 2nd edition,
Vol. 15, p. 872 (K-O)

"Gmelin's Handbuch der Anorganischen Chemie," Vol. 64, p. 56 (Gmelin)

"Lange's Handbook of Chemistry," 11th edition (Lange)

Sources of data items used:

- I. A. 1. Synonyms: Gmelin
2. Formula: Gmelin; Lange
3. Molecular weight: Lange
- B. 1. Boiling point: Lange
2. Specific gravity: ADL
3. Vapor density: Not applicable
4. Melting point: Lange
5. Vapor pressure: ADL
6. Solubility in water: Gmelin
7. Evaporation rate: Not applicable
8. Appearance and odor: Gmelin
- II. A. 1. Fire data: Not applicable
- B. 1. Conditions contributing to instability: Gmelin
2. Incompatibilities: None
3. Hazardous decomposition products: Gmelin
4. Special precautions: None
- III. A. Steps if released or spilled: ADL
C. Waste disposal method: ADL
- V. Miscellaneous precautions

USE/EXPOSURE AND CONTROL DOCUMENT

Sources used in the preparation of this document include:

Browning, E., "Toxicity of Industrial Metals," Butterworth and Company,
2nd edition, 1969 (Browning)

"Documentation of Threshold Limit Values," American Conference of Govern-
mental Industrial Hygienists, 1971 (ACGIH)

"Handbook of Chemistry and Physics," CRC Press, Cleveland, Ohio, 54th
edition, 1973 (CRC Handbook)

Hawley, G. G. - editor, "The Condensed Chemical Dictionary," Van Nostrand -
Reinhold Company, 8th edition, 1971 (Hawley)

Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience
Publishers, Division of John Wiley and Sons, Inc., 2nd edition, 1968
(K-O)

References for Specific Use/Exposure

- 1. K-O, CRC Handbook
- 2. Browning, CRC Handbook
- 3. K-O

References for Specific Control Methods

Browning, ACGIH and Contractor Estimates were the references used in all
of the Specific Control Methods.

RESPIRATOR TABLE DOCUMENTATION

-SUBSTANCE: Soluble rhodium salts

D. O. L. Standard: 0.001 mg/M3

WARNING PROPERTIES:

Eye Irritation Level: The only rhodium salt for which information is
available concerning the toxic effects on the eye is rhodium chloride.
Grant states that "rhodium chloride has been tested on a rabbit's

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

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 ten 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 two months. During the first two to three 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."

IDLH: There is no indication from experimental data or industrial experience that rhodium and its salts produce toxic effects in man. Therefore, since there is no evidence of an IDLH concentration, respirators have been selected on the basis of the protection factor afforded by each device.

Other Toxicological Information: Both the Documentation of TLV's and the ILO state that there are no significant experimental data nor reports of industrial exposures indicating any toxic effects of rhodium and its salts in humans. The TLV (0.001 mg/M3) is based on an analogy with platinum, and is "proposed to prevent possible allergic effects."

NOTE: Acute toxicological information is needed if an accurate IDLH is to be set.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

USE/EXPOSURE AND CONTROL DOCUMENT
SOLUBLE RHODIUM SALTS

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of the dust or skin contact with the liquid solution of one or more soluble rhodium salts during extraction as by-products in the refining of rhodium metal from platinum ores. Rhodium sulfate ($\text{Rh}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$), sodium rhodium chloride (Na_3RhCl_6), ammonium rhodium nitrate ($(\text{NH}_4)_3\text{Rh}(\text{NO}_2)_6$) and ammonium rhodium chloride ($(\text{NH}_4)_3\text{RhCl}_6$) are salts typically found in these refining processes.	A, B	General dilution ventilation; local exhaust ventilation; personal protective equipment (gloves and goggles)
2.	Inhalation of rhodium sulfate ($\text{Rh}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$) or rhodium phosphate ($\text{Rh}(\text{PO}_4)$) dust during use in the preparation of electroplating baths for finishing scientific instruments, camera fittings, radio equipment and jewelry	A	General dilution ventilation; local exhaust ventilation
3.	Inhalation of dust during the manufacture of various soluble rhodium salts for laboratory use. The most important of these salts are rhodium phosphate ($\text{Rh}(\text{PO}_4)$), potassium hexacyanorhodate ($\text{K}_3\text{Rh}(\text{CN})_6$), sodium hexachlororhodate (K_2RhCl_6), rhodium nitrate ($\text{Rh}(\text{NO}_3)_3 \cdot 2\text{H}_2\text{O}$) and sodium hexanitrorhodate ($\text{Na}_3\text{Rh}(\text{NO}_2)_6$)	A	General dilution ventilation; local exhaust ventilation

A -- Inhalation

B -- Skin and eye contact resulting
in localized irritation

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for RHODIUM, SOLUBLE SALTS

- C -- Ingestion
- D -- Skin contact resulting in
absorption and subsequent
systemic poisoning

----- JES2 JOB STATISTICS -----

1,131 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

