

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** CHROMIC ACID AND CHROMATES ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for CHROMIC ACID AND CHROMATES

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 CHROMIC ACID AND CHROMATES.

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.

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(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of chromic acid and chromates (as CrO₃) not in excess of 0.1 milligram per cubic meter (mg/M³) at any time, during a work shift, as stated in § 1910.1000, Table Z-2.

(2) "Action level" means one half of the permissible exposure for chromic acid and chromates.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which chromic acid or chromates are released into the workplace air shall determine if any employee may be exposed to airborne concentrations of chromic acid and chromates 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 chromic acid and chromates.

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

(i) Any information, observations, or calculations which may indicate employee exposure to chromic acid or chromates;

(ii) Any measurements of chromic acid or chromates taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to chromic acid or chromates; 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 chromic acid and chromates 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 exposure of the employee during a work shift.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to chromic acid and chromates 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 chromic acid and chromates 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 chromic acid and chromates 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.

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to chromic acid and chromates 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 chromic acid and

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chromates 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 samples which represents the employee's maximum exposure at any time during a 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
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Above permissible exposure	$\pm 25\%$
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At or below permissible exposure	
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and above the action level	$\pm 35\%$
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At or below the action level	$\pm 50\%$
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(d) Compliance. (1) No employee shall be exposed to chromic acid and chromates above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of chromic acid and chromates 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. (i) 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 chromic acid and chromates.

(ii) Open-surface tank operations shall be performed in accordance with § 1910.94(d).

(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

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- (ii) In work situations in which engineering and work practice controls are technically not feasible; or
 - (iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of chromic acid and chromates 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 CHROMIC ACID AND CHROMATES

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
5 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
30 mg/M3 or less	A powered air-purifying respirator with a full facepiece and a high efficiency particulate filter. 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 30 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.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	A high efficiency particulate filter respirator. Any escape self-contained breathing apparatus.

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- I. Ask your supervisor where chromic acid and chromates 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 chromic acid and chromates. In addition, your employer must instruct you in the safe use of chromic acid and chromates, emergency procedures, and the correct use of protective equipment.
 - B. Your employer is required to determine whether you are being exposed to chromic acid and chromates. 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 CHROMIC ACID AND CHROMATES

The standard for chromic acid and chromates should not be interpreted to apply listed below for which substance specific information has been provided.)

I. PHYSICAL AND CHEMICAL DATA (Chromic acid)

- A. Substance Identification
 - 1. Synonyms: Chromic anhydride; chromium trioxide
 - 2. Formula: CrO_3
 - 3. Molecular weight: 100
- B. Physical Data
 - 1. Boiling point (760 mm Hg): Decomposes when it melts
 - 2. Specific gravity (water = 1): 2.7
 - 3. Vapor density (air = 1 at boiling point of chromic acid): Not applicable
 - 4. Melting point: 197 C (387 F) decomposes
 - 5. Vapor pressure at 20 C (68 F): Data not available (very low)
 - 6. Solubility in water, % by weight at 20 C (68 F): 63
 - 7. Evaporation rate (butyl acetate = 1): Not applicable
 - 8. Appearance and odor: Dark red odorless solid

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II. PHYSICAL AND CHEMICAL DATA (Sodium dichromate)

A. Substance Identification

1. Synonyms: Sodium bichromate; (dihydrate)
2. Formula: $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$
3. Molecular weight: 298

B. Physical Data

1. Boiling point (760 mm Hg): 400 C (752 F) decomposes
2. Specific gravity (water = 1): 2.34
3. Vapor density (air = 1 at boiling point of sodium dichromate): Not applicable
4. Melting point: 357 C (674 F) (loses water at 85 C (185 F))
5. Vapor pressure at 20 C (68 F): Zero (except for water of crystallization)
6. Solubility in water, % by weight at 20 C (68 F): 236
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance and odor: Red-orange odorless solid

III. PHYSICAL AND CHEMICAL DATA (Potassium chromate)

A. Substance Identification

1. Synonyms: Chromate of potash
2. Formula: K_2CrO_4
3. Molecular weight: 194

B. Physical Data

1. Boiling point (760 mm hg): Data not available
2. Specific gravity (water = 1): 2.7
3. Vapor density (air = 1 at boiling point of potassium chromate): Not applicable
4. Melting point: 971 C (1780 F)
5. Vapor pressure at 20 C (68 F): Zero
6. Solubility in water, % by weight at 20 C (68 F): 39
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance and odor: Yellow odorless solid

IV. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA (Chromic acid and chromates)

A. Fire

1. Chromic acid is not combustible in itself but is a powerful oxidizing material. It will ignite on contact with acetic acid and alcohol.
2. Special Fire Fighting procedures: Use water; however, the decomposing material will form a hot viscous foam and caution should be exercised against the possibility of a steam explosion.

B. Reactivity

1. Conditions contributing to instability: None
2. Incompatibilities: Contact with any combustible, organic or other readily oxidizable materials such as paper, wood, sulfur, aluminum, plastics, etc. may cause fires and explosions.
3. Hazardous decomposition products: None.
4. Special precautions: Chromic acid and chromates will attack most metals, cloth, leather, plastics, rubbers and coatings and may cause spontaneous ignition.

V. SPILL AND DISPOSAL PROCEDURES (Chromic acid and chromates)

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- A. If chromic acid or chromates are spilled, the following steps should be taken:
 - 1. Ventilate area of spill.
 - 2. Collect spilled material in the most convenient and safe manner and deposit in sealed containers for reclamation, or for disposal in a secured sanitary landfill. Liquid containing chromic acid and chromates 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: Chromic acid and chromates may be disposed of in sealed containers in a secured sanitary landfill.

VI. MONITORING AND MEASUREMENT PROCEDURES

- A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentrations of chromic acid and chromates in the employee's breathing zone. Short time samples (as defined in Table Z-2) should be used to determine the exposure. A minimum of three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure. Sampling and analyses may be performed by instruments such as: detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or by collection of particulates using a high efficiency membrane filter with subsequent chemical analysis. The method of measurement must determine the concentration of chromic acid and chromates 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. When sampling for peak exposure evaluations, more than three (3) measurements should be taken during the work shift so that increased confidence may be placed in the judgement that the employee has or has not, in fact, been exposed in excess of the permissible limit. 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 chromic acid and chromates 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 O" (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

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competent industrial hygienist or other technically qualified person.

VII. MISCELLANEOUS PRECAUTIONS

- A. Store chromic acid and chromates in tightly closed containers in a well ventilated area.
- B. Employers should advise employees of all areas and operations where exposure to chromic acid and chromates could occur.

VIII. COMMON OPERATIONS

Common operations in which exposure to chromic acid and chromates is likely to occur are: During their production; during their use for chrome plating, anodizing aluminum, preparation of catalysts, bleaching of wax, metal and leather finishing, preparation of chromium pigments; during their use as oxidizing agents in organic synthesis; during the preparation of metallic chromium; and in the preparation of corrosion inhibitors, pigments, and photoplates.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Chromic acid mist and chromate dusts are severe irritants of the nasopharynx, larynx, lungs, and skin. Chromium compounds especially the hexavalent compounds are associated with a high incidence of lung cancer in humans. Administered subcutaneously to rabbits and guinea pigs, chromates produce kidney damage, with albuminuria and cylindruria; fatal nephritis occurred in a human treated with chromic acid to cauterize a wound. Workers exposed to chromic acid or chromates in concentrations of 0.11 to 0.15 mg/M3 developed ulcers of the nasal septum, and irritation of the conjunctiva, pharynx and larynx, as well as asthmatic bronchitis. A worker exposed to unmeasured but massive amounts of chromic acid mist for 4 days developed severe frontal headache, wheezing, dyspnea, cough, and pain on inspiration; after 6 months there was still chest pain on inspiration and cough. In an industrial plant where the airborne chromic acid concentrations measured from 0.18 to 1.4 mg/M3, moderate irritation of the nasal septum and turbinates was observed after 2 weeks of exposure, ulceration of the septum after 4 weeks, and perforation of the septum after 8 weeks. A worker exposed to an unmeasured concentration of chromic acid mist for 5 years developed jaundice, and was found to be excreting significant amounts of chromium; liver function in 4 other workers with high urinary chromium excretion was mildly to moderately impaired. Other studies of chromate workers have not found any unusual incidence of liver diseases or other systemic diseases except for lung cancer. Erosion and discoloration of the teeth has been attributed to chromic acid exposure.

Blood changes were observed in chromate plant workers including leucocytosis or leucopenia, monocytosis, and eosinophilia. A marked increased incidence of bronchogenic carcinoma occurs in workers exposed

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to chromate dust. The latent period is relatively short, suggesting the presence of a potent carcinogen. Calcium chromate and zinc chromate have been demonstrated to be carcinogenic in rats, and the risk of lung cancer is reportedly increased in chrome pigment workers. Papillomata of the oral cavity and larynx were found in 15 of 77 chrome platers exposed for an average of 6.6 years to chromic acid mist at air concentrations of chromium of 0.4 mg/M3. There are no reports of increased lung cancer from exposure to chromic acid alone. A concentrated solution of chromic acid in the eye causes severe corneal injury; chronic exposure to the mist causes conjunctivitis. Chrome ulcer, a penetrating lesion of the skin, occurs chiefly on the hands and forearms where there has been a break in the epidermis and is believed to be due to a direct necrotizing effect of the chromate ion. The ulcer is relatively painless, heals slowly, and produces a characteristic depressed scar. Prolonged exposure to chromic acid mist causes dermatitis which varies from a dry erythematous eruption to a weeping eczematous condition. Cutaneous sensitization to chromate compounds is a common problem in industrial practice.

III. SIGNS AND SYMPTOMS

Symptoms of respiratory irritation including cough, dyspnea, wheezing and chest pain; irritation, ulceration, and perforation of nasal septum; liver and kidney damage have been reported but are apparently rare; leucocytosis or leucopenia, monocytosis, eosinophilia; eye injury from splashes of chromic acid; conjunctivitis from exposure to chromic acid mist or chromate dust; penetrating ulcers of the skin; sensitization dermatitis; lung cancer.

IV. SPECIAL TESTS

Increased levels of chromium in the urine are indicative of occupational exposure, but should be interpreted with caution.

V. TREATMENT

Remove from exposure. Immediately flush eyes with water and wash skin with soap or mild detergent and water. If swallowed and the person is conscious, immediately administer water orally and induce vomiting. Give artificial resuscitation if indicated. If exposed to high environmental levels, consideration should be given to hospitalization and observation for the possible delayed onset of pulmonary edema. The use of corticosteroids should be considered. Ointments containing 10 percent calcium disodium edetate, a chelating agent, may be of value for the treatment of ulceration of the skin and nasal septum.

-VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Chromic acid and chromates may cause severe tissue injury to the respiratory tract including perforation of the nasal septum. It may

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also cause skin ulcers and is a potent skin sensitizer and once sensitized the patient should not be re-exposed. Exposure is associated with a high incidence of lung cancer. A concentrated solution of chromic acid splashed in the eye causes severe eye damage. It is important that the physician become familiar with plant operating conditions in which exposure to chromic acid and chromates occur. 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

The following medical procedures must be made available to each employee who is exposed to chromic acid and chromates:

1. A complete history and physical examination -- The purpose is to detect preexisting conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of asthma, allergies, or known sensitization to chromic acid or chromates would be expected to be at increased risk from exposure. Examination of the respiratory system, blood, liver, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.
2. A complete blood count -- Chromates have been shown to cause blood changes in humans. A complete blood count must be performed, including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin and hematocrit.
3. 14" x 17" chest roentgenogram -- Chromates may cause human lung damage and are associated with a high incidence of lung cancer. Surveillance of the lungs is indicated.
4. FVC and FEV (1 sec) -- Chromates are reported to cause decreased pulmonary function. Periodic surveillance is indicated.
5. Sputum cytology -- Chromates are associated with a high incidence of lung cancer in humans.
6. Urinalysis -- Since chromates may cause kidney damage, a urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscope on centrifuged sediment.

C. PERIODIC EXAMINATIONS

The above medical examinations are to be repeated on an annual basis. Emphasis should be placed on observation for changes in the

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mucous membranes of the upper respiratory tract, ulceration of skin, and surveillance for malignancy of the respiratory tract and lungs.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Chromic Acid and Chromates," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 55-56.
2. Hygienic Guide Series: "Chromic Acid," American Industrial Hygiene Association Quarterly, 17:233-234, 1956.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1017-1022.
4. National Institute for Occupational Safety and Health, U.S. Department of Health, Education and Welfare: Criteria for a Recommended Standard...Occupational Exposure to Chromic Acid, HEW Publication No. HSM 73-11021, U.S. Government Printing Office, Washington, D.C., 1973.
5. Browning, Ethel: Toxicity of Industrial Metals (2d ed.), Butterworths, London, 1969, pp. 119-131.
6. Manufacturing Chemists Association, Inc.: Chemical Safety Data Sheet, SD-44, Chromic Acid, Washington, D.C., 1952, pp. 5-6, 10-12.
7. Grant, W. Morton: Toxicology of the Eye (2d ed.), Charles C. Thomas, Springfield, Illinois, 1974, pp. 289-290.
8. Committee on Medical and Biologic Effects of Environmental Pollutants, Division of Medical Sciences, National Research Council: Chromium, National Academy of Sciences, Washington, D.C., 1974, pp. 35-73, 125-145.
9. Enterline, P.E.: "Respiratory Cancer Among Chromate Workers," Journal of Occupational Medicine, 16:523-526, 1974.
10. Mancuso, T.F.: "Occupational Cancer and Other Health Hazards in a Chromate Plant: A Medical Appraisal II. Clinical and Toxicologic Aspects," Industrial Medicine and Surgery, 20:393-407, 1951.
11. International Labour Office: Encyclopaedia of Occupational Health and Safety, Vol. I, A-K, McGraw Hill Book Company, New York, 1974, pp. 294-297.
12. National Institute for Occupational Safety and Health, Office of Occupational Health Surveillance and Biometrics, U.S. Department of Health, Education and Welfare: Background Information on Chromate Pigments, Rockville, Md., August 22, 1975.

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REFERENCES AND SOURCES
CHROMIC ACID AND CHROMATES

1910.93

- (f) Personal Protective Equipment, and, (h) Sanitation
- Eye: "Chromic Acid, Chromates," Manufacturing Chemists' Association; Grant, "Toxicology of the Eye;" Jacobs, "Poisons, Hazards and Solvents"
- Skin: "Chromic Acid, Chromates," Manufacturing Chemists' Association; Hunter, "Diseases of Occupations;" "Encyclopedia of Occupational Health and Safety," ILO; Schwartz, "Occupational Diseases of the Skin;" Jacobs, "Poisons, Hazards and Solvents"
- Ingestion: "Chromic Acid, Chromates," MCA; Sax, "Dangerous Properties of Industrial Materials;" Gleason, "Clinical Properties of Commercial Products;" Jacobs, "Poisons, Hazards, and Solvents;" Mancuso, T. F., "Occ. Cancer and Other Health Hazards in a Chromate Plant: A Medical Appraisal, II, Clinical and Toxicologic Aspects." Ind. Med. and Surgery, Vol. 20, No. 9, Sept 1951

COMMENTS

Eye - Classification: 1 and 5

Output statement numbers: 9 and 11 combined, 13

Exceptions: None

According to the Manufacturing Chemists' Association, in contact with the eyes, a concentrated solution of chromic acid (CrO_3) will result in loss of sight, while the chromates and a dilute solution of CrO_3 cause irritation and conjunctivitis. Grant reports that contact with solid chromic acid or by a concentrated solution by a splash in the eye causes severe corneal injury characterized by infiltration, vascularization and opacification of the cornea. He continues that chronic exposure to the spray or dust causes ocular changes as "chronic conjunctival inflammation and a band of discoloration in the palpebral tissue in the superficial layers of the cornea." Jacobs adds that small epithelial defects in the interpalpebral operative have been observed. The dichromates are said to cause a swelling of the corneal stroma. Grant states that contamination with potassium dichromate causes a "soft, transparent bulging of the lower half of the cornea, with opacity along the upper edge of the bulge," and though the cornea gradually regains its normal shape, there persists "irregular astigmatism and anesthesia of the affected area." He adds that "sodium dichromate tested in a 0.08 M solution, . . . by application to the corneas of rabbits after removal of the epithelium has been reported to produce a rather severe reaction," graded 70 on a scale of 100. He comments that sodium chromate of identical concentration produces injury of equal severity and that crystals of the chromate applied for 2.5 minutes to intact corneas caused localized endothelial injury and blue stromal edema of slight degree but no gross bulging of the cornea.

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It is evident that chromic acid and the chromates can be severely injurious to the eyes. They are, therefore, assigned classifications of 1 and 5.

Skin - Classification: 1 and 5

Output statement numbers: 1, 5b, 7a, 8a, 14g, 14i, 15, 20a

Exceptions: Statement 5a and 6 are considered to be too stringent replaced by statements 5b and 7a, respectively.

The Manufacturing Chemists' Association reports that in contact with skin, solid chromic acid or a concentrated solution can destroy body tissues and cause severe burns, while dilute solutions result in local irritation. They note it is not absorbed through intact skin but may ulcerate skin wounds. They continue that contact with breaks in the skin may cause "chrome sores" appearing as slow-healing, hardrimmed ulcers which may leave the area vulnerable to secondary infection. Hunter notes that the chromates or bichromates of potassium and sodium and chromic acid "may cause either dermatitis or localized ulceration according to whether trauma is present or not." He notes that "dermatitis may occur on the hands, chest and arms . . ." In severe cases, "the face is intensely red and swollen and the affected parts itch a great deal." The ILO reports that primary irritation often occurs at points of contact with clothing at the wrists and neck, and notes that in some the lesions produce "only erythema or scattered papules and in others they resemble dyshidrotic pompholy, hummular eczema or follicular irritative-eczema." They comment on the identical nature of chromate dermatitis and constitutional eczema. Schwartz recalls that McCord et al. "applied dressings saturated with solutions of potassium and ammonium bichromate and with chromic acid solutions and concluded these substances readily produce skin irritation without previous skin injury." Hunter notes that chrome ulcers begin in an abrasion or cut of the skin and are usually formed at the root of the fingernails, on the knuckles of the hands or on the dorsum of the feet. He describes them as circular, clear-cut and punched out. He adds that if left untreated, they may infect the adjacent joint, necessitating amputation. The ILO reports the papules are painless, the edge is raised and the base is covered with an exudate or firmly adherent crusting. They add that healing is slow and an atrophic scar remains though "neoplastic changes never occur." Schwartz reports that "ulceration of the nasal septum is of frequent occurrence . . . (and) the chief offenders are alkaline chromates, bichromate of potassium and bichromate of sodium." According to Jacobs, "after continued, very extensive application of strong chromate solutions to the skin, haemorrhagic nephritis and uremia have been reported."

The data clearly indicate that all contact with strong solutions (or solids) of these substances must be prevented because of their corrosivity and the nature of the ulcers produced. Similarly, contact with even dilute solutions must

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be prevented when the skin is cut or abraded. Though dilute solutions in contact with intact skin can not be considered to be highly hazardous, the data are insufficient to allow any sort of differentiation. These substances are, therefore, generally assigned classifications of 1 and 5.

Ingestion - Classification: 1 and 5

Output statement numbers: 19, 20a

Exceptions: None

According to the Manufacturing Chemists' Association, chromic acid and chromates act "as their own emetics and purgatives, . . . and, if retained, stomach and kidney complications may ensue." Sax lists them as acute local, chronic local and chronic systemic ingestas of high toxic hazard. Gleason classifies chromic acid and chromates as "very toxic" (toxicity class 4 out of 6) corresponding to a human lethal dose of 50 - 500 mg/kg or between 1 tsp. and 1 ounce as fatal for the average 150 lb. man. He notes that chromate salts are corrosive because of their oxidizing potency and "if ingested, severe circulatory collapse and toxic nephritis may ensue." He adds that oral administration causes violent gastroenteritis, peripheral vascular collapse, vertigo, muscular cramps, coma and toxic nephritis with glycosuria. Chromic industrial exposure is said to lead to severe liver injury and a toxic encephalopathy has been recorded. Jacobs states that one manifestation of acute systemic chromate poisoning is an erythematous macular rash of the skin. He adds that prolonged exposure may cause fatigue, lassitude and rheumatic pain. Mancuso, in a study of chromate factory workers reports they "seem to have an excessive liability to inflammatory and ulcerative conditions of the gastro-intestinal tract caused by ingestion of chromates."

Classifications of 1 and 5 are concluded to be appropriate to prevent both local and systemic effects.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

- Allied Chemical Corp., "Chromium Chemicals," Technical Service Bulletin No. 52; "Treatment of Chromate Waste Liquors" (Allied)
- PPG Industries, "Chromium Chemicals" (PPG)
- Kirk - Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 5, p. 473 (K-O)
- Manufacturing Chemists' Association, Chemical Safety Data Sheets SD-44 and 50 - 46 (MCA)
- National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1975 (NFPA)
- "Lange's Handbook of Chemistry," 11th edition (Lange)

Sources of data items used:

- I. A. 1. Synonyms: K-O
- 2. Formula: K-O
- 3. Molecular weight: Allied, Lange
- B. 1. Boiling point: K-O, Allied, Lange
- 2. Specific gravity: K-O, Lange
- 3. Vapor density: Not applicable

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- 4. Melting point: PPG, MCA, Lange
- 5. Vapor pressure: ADL
- 6. Solubility in water: K-O, Lange
- 7. Evaporation rate: Not applicable
- 8. Appearance and odor: MCA
- IV. A. 1. NFPA-49
- 2. Special fire fighting procedures: NFPA-49
- B. 1. Conditions contributing to instability: None
- 2. Incompatibilities: NFPA-491M
- 3. Hazardous decomposition products: None
- 4. Special precautions: MCA
- III. A. Steps if released or spilled: PPG, MCA
- C. Waste disposal method: Allied, MCA
- V. Miscellaneous precautions: MCA, PPG, NFPA-49

USE/EXPOSURE AND CONTROL DOCUMENT

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3. K-O, NIOSH 11474, Mass #5, Walsh, Dankman
4. Mass #5, Morris, Walsh, K-O, Considine
5. K-O, Guide, Walsh, Dankman
6. K-O, Hartogensis, Morris, Walsh, Dankman, ILO, Baetjer
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RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Chromic acid and chromates

D. O. L. STANDARD: 1 mg/10M3 (0.1 mg/M3) shall not be exceeded

Eye Irritation Level: Grant states that in "contact with the solid material or with concentrated solution (of chromic acid) by splash in the eye causes severe corneal injury characterized by infiltration, vasculari-

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zation, and opacification of the cornea.

"More commonly, exposure to chromic acid occurs in less serious form as a result of spraying of fine droplets into the air from electroplating baths or by transfer to the eyes on the fingers. After chronic exposure to such conditions, the ocular changes seen are chronic conjunctival inflammation, analogous to the well-known irritation of the nasal mucosa which leads to perforation of the nasal septum. In addition, Grant states that "dichromates (bichromates) as ammonium, sodium, or potassium salts are water-soluble, crystalline substances which have a peculiar injurious effect on the cornea, causing great swelling of the corneal stroma."

The Documentation of TLV's states that "Vigliani and Zurlo reported . . . irritation of the mucous membranes of the larynx, pharynx and conjunctiva . . . in a group of workers allegedly exposed to chromates or chromic acid in concentrations ranging from 0.11 to 0.15 mg/M3."

For the purposes of this standard, only full facepiece respirators are permitted.

IDLH: 30 mg/M3

Basis for IDLH Value: There is very little quantitative information available concerning the acute toxicity produced by the inhalation of chromic acid and chromates. The AIHA Hygienic Guides state that both the short exposure tolerance to chromic acid and the atmospheric concentration immediately dangerous to life are unknown. The chosen IDLH is based upon the report in the ILO that "a man exposed for several days to concentrations of chromic acid mist of about 20 - 30 mg/M3" experienced "cough, headache, dyspnea and substernal pain . . . The signs persisted for 2 weeks. Another man working on the same process was similarly but less severely affected." There is no other useful information available upon which to base the IDLH.

Other Toxicological Information: Patty states that "chromates and dichromates act as protein precipitants and are irritant in action. Administered subcutaneously to rabbits and guinea pigs, chromates damage the kidney, with the production of albumin and casts. Fatal nephritis has occurred in man as a result of cauterizing a wound with chromic acid. Chromate ion is reported to be absorbed through the skin of rabbits in sufficient amounts to be systemically toxic. Inhalation of chromic acid dust by rabbits resulted in pulmonary hyperemia and inflammation, and guinea pigs exposed to the mist of Cr - plating baths for from 0.5 to 3 hours daily over a 45-day period developed lesions of the mucosa and submucosa of the respiratory tract as well as changes in the spleen and kidney." In addition, Deichmann and Gerarde note that the "chromates are recognized today as a group of chemicals capable of inducing pulmonary carcinoma in man."

The ILO states that "inhalation of dust or mist containing +6 chromium is irritating to mucous membranes. Sneezing, rhinorrhea, lesions of the nasal septum, irritation and redness of the throat and generalized bronchospasm are well-documented effects. In a few cases, sensitization occurs resulting in typical asthmatic attacks, which recur on subsequent exposure. Cough, headache, dyspnea and substernal pain have been described in a man exposed for several days to concentrations of chromic acid mist of about 20 - 30 mg/M3.

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Generalized rhonchi and moist rales were heard throughout the lungs. The signs persisted for 2 weeks. Another man working on the same process was similarly but less severely affected. The occurrence of bronchospasm in a man working with chromates should suggest chemical irritation of the lungs."

The Committee on Biologic Effects of Atmospheric Pollutants presents the following information on the effects of inhaling chromates:

Effects of Hexavalent Chromium in Animals

Animal	Material	Concentration (mg/M3)	Duration	Effect
Rabbit and cat	Chromates	1-50	14 hr/day for 1-8 months	Pathologic changes in lungs
Rabbit	Dichromates	11-23 as dichromates	2-3 hr/day for 5 days	None
Cat	Dichromates	11-23 as dichromates	2-3 hr/day for 5 days	Bronchitis, pneumonia
Mouse	Mixed dust containing chromates	1.5 as CrO3	4 hr/day, 5 days/wk for 1 year	None harmful
Mouse	Mixed dust containing chromates	16-27 as CrO3	1/2 hr/day intermittently	Fatal to some strains
Mouse	Mixed dust containing chromates	7 as CrO3	37 hours over 10 days	Fatal
Rat	Mixed dust containing chromates	7 as CrO3	37 hours over 10 days	Barely tolerated
Rabbit and guinea pig	Mixed dust containing chromates	5 as CrO3	4 hr/day, 5 days/wk for 1 year	None marked

The Documentation of TLV's states that "a review of the present status of the suitability of the TLV between TLV subcommittee members and industrial hygiene representatives of the chromate industry 10 years after improved controls had been in operation revealed that (1) the TLV for chromic acid mist was satisfactory in preventing nasal perforation; (2) contained a safety factor of three or four; and (3) that the limit was probably satisfactory for the prevention of lung cancer, as no new cases had appeared during the ten-year period; but (4) that the ten-year period was probably too short to be certain of its validity in this respect.

"The evidence available indicates that concentrations of CrO3 mists and soluble chromate mists must be kept close to 0.1 mg/M3 (as CrO3) to prevent irritation and injury to the nasal passages and other respiratory symptoms. To produce lung cancer it seems probable that higher concentrations possibly of sparingly soluble chromates,

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are necessary."

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USE/EXPOSURE AND CONTROL DOCUMENT
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	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of mist or dust and skin contact with solid or solution during use of chromic acid and chromates for metal finishing: Chrome plating, anodizing, conversion coatings (chromatizing provides added corrosion resistance)	A,B	Local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene
2.	Inhalation of dust or mist and skin contact with solid or solution during manufacture and distribution and during maintenance of equipment and storage containers. Chromic acid and sodium chromates, which are produced from chromite ore, are used for manufacture of most chromium chemicals	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene
3.	Inhalation of dust and skin contact with solid or solution during use of chromates (sodium dichromate) in leather finishing (shoe uppers, glove and garment leathers, bag leather)	A,B	Local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene
4.	Inhalation of dust and skin contact with solid or solution during use as corrosion inhibitors (in radiator coolants, internal combustion and gas turbine engines; refrigeration systems; some air conditioning units; water-cooled nuclear reactors)	A,B	Local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene
5.	Inhalation of dust and skin contact with solid	A,B	Local exhaust ventilation; personal protective equip-

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or solution during use in photoreproduction processes (ammonium chromates used as sensitizing agents for photoengraving; chromates used in photography, lithography and blueprinting)

ment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene

6. Inhalation of dust and skin contact with solid or liquid during manufacture and use of paints and pigments containing chromates. Alkali dichromates are used to produce important corrosion - inhibiting and coloring pigments: Chrome Oxide Green; Chrome Yellow and Orange; Molybdate Orange; Chrome Green; Zinc Yellow. Pigments are used in paints, artists' colors, jointing pastes, inks, rubber, and ceramics (exposure during color blending, packaging, and equipment maintenance). Zinc, lead, strontium, and calcium chromates are used in anticorrosive paints, and primers (exposure during spray painting).

A,B

Process enclosure; local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene

7. Inhalation of dust and skin contact with solid or liquid during use of chromates and dichromates in dyeing of fur, leather and fabrics (mordanting and dyeing of wool and nylon; oxidizing of dyes aftertreating on cotton); in textile and paper printing.

A,B

Local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene

- 8. Skin contact with solution during manufacture and use of glue from chrome tanned leather (used in shoes, furniture, packaging)

B

Local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary);

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good personal hygiene

- | | | | |
|-----|---|-----|---|
| 9. | Inhalation of dust and skin contact with solid or solution during use of chromates and dichromates as fungicides: Used in aqueous preservatives and fire retardants for wood; for protection of textiles and seed. | A,B | Local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene |
| 10. | Inhalation of dust and skin contact with solid during use of chromates and dichromates in battery manufacture (used for increased shelf-life; to provide corrosion resistance; for battery depolarization) | A,B | Local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene |
| 11. | Inhalation of dust and skin contact with solid during use of chromates (potassium dichromate) for the manufacture of safety matches and explosives | A,B | Local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene |
| 12. | Inhalation of dust and skin contact with solid or solution during use as chemical reagents (oxidizing agents; catalysts; manufacture of catalysts, indicators; bleaching of fats, oils and waxes; chemical synthesis; analytical chemistry) | A,B | Local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene |
| 13. | Inhalation of dust and skin contact with solid during manufacture, packaging and use of cement | A,B | Local exhaust ventilation; personal protective equipment (goggles, face shields, gloves, protective clothing, respiratory protective devices when necessary); good personal hygiene |

A -- Inhalation
B -- Skin and eye contact

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

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(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. (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for chromic acid and chromates.

(2) Chromic acid or chromates shall be stored so as not to come in contact with combustible, organic or other readily oxidizable materials.

(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 any possibility of skin contact with solids or liquids containing chromic acid or chromates. Face shields shall comply with § 1910.133 (a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that employees whose clothing may have become contaminated with solids or liquids containing chromic acid or chromates change into uncontaminated clothing before leaving the work premises.

(3) Employers shall ensure that clothing contaminated with chromic acid or chromates is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of the substance from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the chromic acid or chromates, the employer shall inform the person performing the operation of the hazardous properties of chromic acid and chromates.

(4) Where there is any possibility of exposure of an employee's body to solids or liquids containing chromic acid or chromates, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use, except that § 1910.94 (d)(9)(7) shall not apply.

(5) Employers shall ensure that non-impervious clothing which becomes contaminated with chromic acid or chromates be removed immediately and not reworn until the substance is removed from the clothing.

(6) 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 there is any possibility of solids or liquids containing chromic acid or chromates contacting the eyes.

(7) Where there is any possibility that an employee's eyes may be exposed to solids or liquids containing chromic acid or chromates, employers shall provide an eye-wash fountain within the immediate work area for emergency use.

(g) Spills and disposal. In the event that chromic acid or chromates 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 chromic acid or chromates immediately wash or shower with soap or mild detergent and water to remove any such substance from the skin.

(2) Employers shall ensure that all employees subject to skin contact with solids or liquids containing chromic acid or chromates wash with soap

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or mild detergent and water any areas of the body which may have contacted such a substance at the end of each work day.

(3) Employers shall ensure that employees do not eat or smoke in areas where solids or liquids containing chromic acid or chromates are handled, processed or stored.

(4) Employers shall ensure that employees who handle solids or liquids containing chromic acid or chromates wash their hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which chromic acid or chromates 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 chromic acid or chromates above the action level or employees who may have skin or eye contact with solids or liquids containing chromic acid or chromates, or employees who work where chromic acid or chromates presents a fire or explosion hazard, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for chromic acid and chromates (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to chromic acid or chromates.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to chromic acid or chromates which are listed in Appendix A of the section;

(iv) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to chromic acid and chromates.

(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 make available to each employee who is to be exposed to solids or liquids containing chromic acid or chromates or airborne concentrations of chromic acid and chromates at or above the action level a medical examination which shall include the following:

(i) A medical history and physical examination with emphasis on the lungs, blood, liver, kidneys and skin.

(ii) A complete blood count to include at least red and white cell count, a differential smear, hemoglobin and hematocrit.

(iii) 14" x 17" chest roentgenogram.

(iv) Forced vital capacity (FVC) and forced expiratory volume-one second (FEV (1 second)) tests.

(v) Sputum cytology.

(vi) Urinalysis to include specific gravity, albumin, glucose and a microscopic on centrifuged sediment.

(3) The employer shall obtain from the physician, as a record of the examination, the following information:

(i) A written opinion which conforms with paragraph (j)(7) of this section.

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(ii) A record of the results of the blood tests, pulmonary function testing, sputum cytology, and urinalysis.

(iii) 14" x 17" chest roentgenogram or a medically acceptable copy.

(4) The employer shall make available to each employee, exposed to chromic acid or chromates in excess of the action level at 12 months from the date of the employee's first exposure, and at every 12 months of exposure in excess of the action level thereafter, a medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the lungs, blood, liver, kidneys and skin.

(ii) A complete blood count to include at least red, and white cell count, a differential smear, hemoglobin and hematocrit.

(iii) 14" x 17" chest roentgenogram.

(iv) Forced vital capacity (FVC) and forced expiratory volume-one second (FEV (1 second)) tests;

(v) Sputum cytology.

(vi) Urinalysis to include specific gravity, albumin, glucose and a microscopic on centrifuged sediment.

(5) The employer shall obtain from the physician, as a record of the periodic examination, the following information:

(i) A written opinion which conforms with paragraph (j)(7) of this section.

(ii) A record of the results of the blood tests, pulmonary function testing, sputum cytology, and urinalysis.

(iii) 14" x 17" chest roentgenogram or a medically acceptable copy.

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

(i) A copy of this regulation with its Appendixes A, B, and C for chromic acid and chromates;

(ii) A description of the employee's duties as they relate to his exposure to chromic acid or chromates;

(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.

(7)(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 chromic acid or chromates or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to chromic acid or chromates, 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 diagnosis unrelated to exposure to chromic acid or chromates.

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

(8) No employee shall be exposed to solids or liquids containing chromic acid or chromates or airborne concentrations of chromic acid and chromates 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.

(9) The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to chromic acid or chromates.

(10) If the examining physician chooses to use alternative medical examinations to those specified in paragraphs (j)(2) and (4) of this section, the employer may accept such alternative medical surveillance examinations as meeting the requirements of this part provided that the employer:

(i) Obtains a statement from the examining physician setting forth the alternative medical examinations and the rationale for substitution and evidence that they will be equally effective.

(ii) Informs each exposed employee of the fact that alternative medical examinations to those required in paragraphs (j)(2) or (4) of this section are to be made available.

(11) 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 risks involved by refusing to be examined.

(12) 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 chromic acid and chromates.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to chromic acid or chromates 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.

(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

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the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) 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) Results of tests required by paragraph (j)(2) and (j)(4) of this section and results of any tests conducted pursuant to paragraphs (j)(4) of this section;

(B) Any employee medical complaints relative to exposure to chromic acid and chromates;

(C) A copy of information provided to the physician pursuant to paragraph (j)(6)(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 and for thirty years after termination 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 chromic acid and chromates which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to chromic acid or chromates requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

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(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 chromic acid and chromates 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 CHROMIC ACID AND CHROMATES

I. SUBSTANCE IDENTIFICATION

- A. Substance: Chromic acid and chromates
- B. Permissible Exposure: 0.1 milligram of chromic acid and chromates per cubic meters of air (0.1 mg/M3) shall not be exceeded.
- C. Appearance and Odor: chromic acid: Dark red, deliquescent solid with no odor; sodium dichromate: red-orange solid with no odor; potassium chromate: Yellow solid with no odor

II. HEALTH HAZARD DATA

- A. Comments: Repeated or prolonged exposure to chromic acid or chromates has produced cancer.
- B. Ways in which the chemical affects your body: Chromic acid or chromates can affect your body if you inhale them or if they come in contact with your eyes or skin. They may also affect your body if you swallow them.
- B. Effects of Overexposure:
 - 1. Short-term Exposure: Chromic acid mist and chromate dusts may cause severe irritation of the nose, throat, bronchial tubes and lungs. Chromic acid splashed in the eyes may cause severe injury. If swallowed chromates and sodium and potassium dichromates may cause stomach and kidney problems. These compounds, if swallowed, often cause vomiting. Skin exposure to chromic acid and chromates may cause ulceration of the skin.
 - 2. Long-term Exposure: Repeated or prolonged exposure to chromic acid or chromate dust or mist may cause an ulceration and perforation of the nasal septum.

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Respiratory irritation may occur with symptoms resembling asthma. Liver damage with yellow jaundice has been reported. Prolonged or repeated exposure of the skin may cause a skin rash. Allergic skin rash may also occur. An increased amount of lung cancer has been found in employees in the chromate producing industry.

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 chromic acid or chromates.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If solids or liquids containing chromic acid or chromates get into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with these chemicals.
- B. Skin Exposure: If solids or liquids containing chromic acid gets on your skin, immediately flush the contaminated skin with soap or mild detergent and water. If chromic acid soaks through your clothing, remove the clothing immediately and flush the skin with water. If irritation persists after washing, get medical attention.
- C. If chromates get on your skin, immediately wash the contaminated skin using soap or mild detergent and water. If solids or liquids containing chromic acid or chromates penetrate through your clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.
- D. Breathing: If you or any other person breathes in large amounts of chromic acid or chromates 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.
- E. Swallowing: When solids or liquids containing chromic acid or chromates 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.
- F. 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 chromic acid and chromates. 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-

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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 any possibility of skin contact with solids or liquids containing chromic acid or chromates. Replace or repair impervious clothing that has developed leaks.
- C. Eye Protection: You must wear splash-proof safety goggles where there is any possibility of liquids containing chromic acid or chromates contacting your eyes. You must wear dust-resistant safety goggles where there is any possibility of solids containing chromic acid and chromates contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Chromic acid and chromates must be stored in tightly closed containers in a cool, well ventilated area away from combustible, organic or other readily oxidizable materials.
- B. If your work clothing may have become contaminated with solids or liquids containing chromic acid or chromates, you must change into uncontaminated clothing before leaving the work premises.
- C. You must immediately remove any non-impervious clothing that becomes contaminated with chromic acid or chromates and this clothing must not be reworn until the substance is removed from the clothing.
- D. If your skin becomes contaminated with chromic acid or chromates you must immediately wash or shower with soap or mild detergent and water to remove the substance from your skin.
- E. If you are subject to skin contact with solids or liquids containing chromic acid or chromates, at the end of each work day you must wash with soap or mild detergent and water any areas of your body that may have contacted such a substance.
- F. You must not eat or smoke in areas where solids or liquids containing chromic acid or chromates are handled, processed or stored.
- G. If you handle solids or liquids containing chromic acid or chromates, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.
- H. Eye flushing facilities and quick drenching facilities, where provided, must be readily available and you should know where they are and how to operate them.