

## I. RECOMMENDATIONS FOR A CHROMIUM(VI) STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that worker exposure to chromium(VI), ie, hexavalent chromium or Cr(VI), in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and safety of workers for up to a 10-hour workday, 40-hour workweek over a working lifetime. Compliance with all sections of the standard should prevent all noncarcinogenic adverse effects of exposure to chromium(VI) in the workplace air and through skin exposure and should reduce materially the risk of lung cancer from occupational exposure to carcinogenic chromium(VI). The standard is measurable by techniques that are valid, reproducible, and available. Sufficient technology exists to permit compliance with the recommended standard. The standard will be subject to review and revision as necessary.

For the purpose of this standard, "chromium(VI)" is defined as the chromium in all materials in the +6 (hexavalent) state.

There are 2 recommended standards for chromium(VI). One addresses occupational exposure to a group of noncarcinogenic, but otherwise hazardous, materials, while the other pertains to occupations and workplaces where there is exposure to other chromium(VI) materials associated with an increased incidence of lung cancer.

On the basis of the chemical analysis of airborne chromium(VI) materials, there is no practical means of distinguishing between these 2 groups of chromium(VI) materials. Until the airborne chromium(VI) in a particular workplace is demonstrated by the employer to be of the type

considered to be noncarcinogenic, all airborne chromium(VI) shall be considered to comprise carcinogenic materials.

Based on current evidence, "noncarcinogenic chromium(VI)" is the chromium(VI) in monochromates and bichromates (dichromates) of hydrogen, lithium, sodium, potassium, rubidium, cesium, and ammonium, and chromium(VI) oxide (chromic acid anhydride). "Carcinogenic chromium(VI)" comprises any and all chromium(VI) materials not included in the noncarcinogenic group above. "Occupational exposure to carcinogenic chromium(VI)" is defined as exposure to airborne chromium(VI) at concentrations greater than one-half of the workplace environmental limit for carcinogenic chromium(VI). "Occupational exposure to noncarcinogenic chromium(VI)" is defined as exposure to airborne chromium(VI) at concentrations greater than one-half of the workplace environmental limit for noncarcinogenic chromium(VI). Exposure to chromium(VI) at concentrations less than one-half of the workplace environmental limit will not require adherence to the following sections, except for 3(a,b,c,d), 4a, 5, 6(b,c,e,f), and 7.

#### Section 1 - Environmental (Workplace Air)

##### (a) Concentration of Carcinogenic Chromium(VI)

Carcinogenic chromium(VI) shall be controlled in the workplace so that the airborne workplace concentration of chromium(VI), sampled and analyzed according to the procedures in Appendices I and II, is not greater than 1  $\mu\text{g Cr(VI)/cu m}$  of breathing zone air.

(b) Concentration of Noncarcinogenic Chromium(VI)

Noncarcinogenic chromium(VI) shall be controlled in the workplace so that the airborne workplace concentration is not greater than 25  $\mu\text{g Cr(VI)/cu m}$  of breathing zone air determined as a time-weighted average (TWA) exposure for up to a 10-hour workday, 40-hour workweek, and is not greater than 50  $\mu\text{g Cr(VI)/cu m}$  of breathing zone air as determined by any 15-minute sample.

Procedures for sampling and analysis of chromium(VI) in air shall be as provided in Appendices I and II, or by any method shown to be equivalent in precision, accuracy, and sensitivity to the methods specified.

Section 2 - Medical

Medical surveillance shall be made available as outlined below for all workers with occupational exposure to carcinogenic or noncarcinogenic chromium(VI), including maintenance personnel periodically exposed during routine maintenance or emergency repair operations.

(a) Preplacement and annual medical examinations shall include:

(1) A comprehensive or interim work history.

(2) A detailed medical history including information on conditions indicating the inadvisability of further exposure to chromium(VI), eg, potential skin or pulmonary sensitization, a skin or mucous membrane condition that may be exacerbated by chromium(VI), smoking habits, and history of liver or kidney disease.

(3) Examination of the skin for evidence of dermatitis or chrome ulcers, and of the membranes of the upper respiratory tract for

irritation, bleeding, ulcerations, or perforations.

(4) An evaluation of the worker's ability to use negative or positive pressure respirators.

(5) Urinalysis.

(b) For workers with occupational exposure to carcinogenic chromium(VI), preplacement and annual medical examinations shall include 14" X 17" chest X-rays. Other tests, including sputum cytology and liver function studies, shall be considered by the responsible physician.

(c) For workers with occupational exposure to noncarcinogenic chromium(VI) and not to carcinogenic chromium(VI), preplacement medical examinations shall include 14" x 17" chest X-rays. Thereafter, X-ray examinations shall be offered at 5-year intervals and annually after age 40. Other tests, such as liver function studies, may be considered by the responsible physician.

(d) Medical examinations shall be made available to all workers with signs or symptoms of skin or upper respiratory tract irritation likely to have been the result of exposure to chromium(VI).

(e) If clinical evidence of adverse effects due to chromium(VI) is developed from these medical examinations, the worker shall be kept under a physician's care until the worker has completely recovered or maximal improvement has occurred.

(f) Initial annual examinations for presently employed workers shall be offered within 6 months of the promulgation of a standard incorporating these recommendations.

(g) The medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, and of the employer

shall have access to all medical records. Physicians designated and authorized by any employee or former employee shall have access to that worker's medical records.

(h) Medical records shall be maintained for all employees with occupational exposure to carcinogenic or noncarcinogenic chromium(VI) and for maintenance personnel with periodic exposure. Preplacement X-rays and X-rays for the 5 years preceding termination of employment and all medical records with pertinent supporting documents shall be retained at least 30 years after the individual's employment is terminated.

### Section 3 - Labeling (Posting)

(a) Except for shipping and storage containers for lithium chromate, lithium bichromate, sodium chromate, sodium bichromate, potassium chromate, potassium bichromate, rubidium chromate, rubidium bichromate, cesium chromate, cesium bichromate, ammonium chromate, ammonium bichromate, and chromium(VI) oxide (chromic acid anhydride), as dry solids or concentrated solutions, all shipping and storage containers for chromium(VI) shall bear the following label in addition to, or in combination with, labels required by other statutes, regulations, or ordinances:

(Chemical name)  
(Synonyms)

DANGER! EXTREME HEALTH HAZARD  
MAY CAUSE IRRITATION, RASH, OR EXTERNAL ULCERS  
INHALATION MAY CAUSE CANCER

Keep container closed.  
Avoid contact with skin and eyes.  
Avoid breathing dust or solution spray.  
In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician. Flush skin with water.  
Wash clothing before reuse.

(b) All shipping and storage containers for lithium chromate, lithium bichromate, sodium chromate, sodium bichromate, potassium chromate, potassium bichromate, rubidium chromate, rubidium bichromate, cesium chromate, cesium bichromate, and ammonium chromate, the hydrates of these compounds, high purity aqueous solutions of these compounds, and dry mixtures containing only these materials shall bear the same label except that "Inhalation may cause cancer" shall be deleted and "Extreme Health Hazard" shall be replaced by "Moderate Health Hazard".

(c) Because of the flammable characteristics of ammonium bichromate (dichromate), shipping and storage containers for dry forms of this compound shall bear the following label in addition to, or in combination with, labels required by other statutes, regulations, or ordinances:

AMMONIUM BICHROMATE  
DANGER! HIGHLY FLAMMABLE  
MODERATE HEALTH HAZARD  
MAY CAUSE IRRITATION, RASH, OR EXTERNAL ULCERS.

Keep away from heat, sparks, and open flame.  
Keep container closed.  
Avoid contact with skin and eyes.  
Avoid breathing dust or solution spray.  
In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician. Flush skin with water.  
Wash clothing before reuse.

(d) All storage containers of chromic acid, or chromium(VI) oxide (chromic acid anhydride) shall bear the following label in addition to, or in combination with, labels required by other statutes, regulations, or ordinances.

CHROMIUM TRIOXIDE  
(CHROMIC ACID)  
DANGER! POWERFUL OXIDIZER  
CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE  
MAY CAUSE DELAYED BURNS OR EXTERNAL ULCERS

Keep container closed.  
Do not get in eyes, on skin, on clothing.  
Do not breathe dust or mist from solutions.  
In case of contact, immediately flush skin or eyes  
with plenty of water for at least 15 minutes.  
For eyes, get medical attention immediately.  
Wash clothing before reuse.  
Use fresh clothing daily. Take showers  
after work, using plenty of soap.

(e) In areas where there is occupational exposure to carcinogenic chromium(VI), the following warning sign shall be posted in readily visible locations, particularly at the entrances to the area.

WARNING  
CANCER-SUSPECT AGENT  
USED IN THIS AREA  
UNAUTHORIZED PERSONS KEEP OUT

The sign shall be printed both in English and in the predominant language of non-English-speaking workers, if any, unless they are otherwise trained and informed of the hazardous areas. All illiterate workers shall receive such training.

(f) In areas where airborne chromium(VI) comprises only lithium chromate, lithium bichromate, sodium chromate, sodium bichromate, potassium chromate, potassium bichromate, rubidium chromate, rubidium bichromate,

cesium chromate, cesium bichromate, ammonium chromate, or chromium(VI) oxide (chromic acid anhydride), their hydrates, or mixtures containing only these chromium(VI) materials, the warning sign shall read as follows:

WARNING  
CHROMATES, BICHROMATES OR CHROMIC ACID ANHYDRIDE  
USED IN THIS AREA  
UNAUTHORIZED PERSONS KEEP OUT

The sign shall be posted in readily visible locations, particularly at the entrances to the area. The sign shall be printed both in English and in the predominant language of non-English-speaking workers, if any, unless they are otherwise trained and informed of the hazardous areas. All illiterate workers shall receive such training.

(g) In areas where airborne chromium(VI) contains ammonium bichromate, or where ammonium bichromate is stored, manufactured, or used, the following shall be added to the warning sign in (e) or (f) above:

FLAMMABLE SUBSTANCE

#### Section 4 - Personal Protective Equipment and Protective Clothing

(a) Protective Clothing

(1) Coveralls or other full-body protective clothing shall be worn in areas where there is occupational exposure to chromium(VI). Protective clothing shall be changed at least daily at the end of the shift and more frequently if it should become grossly contaminated.

(2) Impervious gloves, aprons, and footwear shall be worn at operations where solutions of chromium(VI) may contact the skin. Protective gloves shall be worn at operations where dry compounds of



chromium(VI) are handled and may contact the skin.

(3) Eye protection shall be provided by the employer and used by the employees where eye contact with chromium(VI) is likely. Selection, use, and maintenance of eye protective equipment shall be in accordance with the provisions of the American National Standard Practice for Occupational and Educational Eye and Face Protection, ANSI Z87.1-1968. Unless eye protection is afforded by a respirator hood or facepiece, protective goggles or a face shield shall be worn at operations where there is danger of contact of the eye with dry or wet compounds of chromium(VI) because of spills, splashes, or excessive dust or mists in the air.

(4) The employer shall ensure that all personal protective devices are inspected regularly and maintained in clean and satisfactory working condition.

(5) Work clothing shall not be taken home by employees. The employer shall provide for maintenance and laundering of protective clothing.

(6) The employer shall ensure that precautions necessary to protect laundry personnel are taken when soiled protective clothing is laundered.

(b) Respiratory Protection from Carcinogenic Chromium(VI)

Engineering controls shall be used wherever feasible to maintain airborne carcinogenic and noncarcinogenic chromium(VI) concentrations below those recommended in Section 1 above. Compliance with the permissible exposure limits by the use of respirators is only allowed when airborne chromium(VI) concentrations are in excess of the workplace environmental limit because required engineering controls are being installed or tested,

when nonroutine maintenance or repair is being accomplished, or during emergencies. When a respirator is thus permitted, it shall be selected and used in accordance with the following requirements:

(1) For the purpose of determining the type of respirator to be used, the employer shall measure the airborne concentration of chromium(VI) in the workplace initially and thereafter whenever process, worksite, climate, or control changes occur which are likely to increase the airborne concentration of chromium(VI); this requirement does not apply when carcinogenic chromium(VI) is present.

(2) The employer shall ensure that no worker is overexposed to chromium(VI) because of improper respirator selection, fit, use, or maintenance.

(3) A respiratory protection program meeting the requirements of 29 CFR 1910.134 and 30 CFR 11 which incorporates the American National Standard Practices for Respiratory Protection Z88.2-1969 shall be established and enforced by the employer.

(4) The employer shall provide respirators in accordance with Table I-1, or Table I-2 when appropriate, and shall ensure that the employee uses the respirator provided.

(5) Respirators described in Tables I-1 and I-2 shall be those approved under the provisions of 29 CFR 1910.134 and 30 CFR 11.

(6) The employer shall ensure that respirators are adequately cleaned, and that employees are instructed on the use of respirators assigned to them and on how to test for leakage.

(7) Respirators specified for use in higher concentrations of airborne chromium(VI) may be used in workplaces with lower

concentrations of airborne chromium(VI).

(8) Where an emergency may develop which could result in employee injury from chromium(VI), the employer shall provide an escape device as listed in Table I-1, or in Table I-2 where appropriate.

TABLE I-1  
RESPIRATOR SELECTION GUIDE FOR PROTECTION AGAINST  
CARCINOGENIC CHROMIUM(VI)

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Self-contained breathing apparatus with positive pressure in full facepiece

Combination supplied air respirator, pressure-demand type, with auxiliary self-contained air supply.

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Section 5 - Informing Employees of Hazards from Chromium(VI)

At the beginning of employment or assignment for work in a chromium(VI) area, employees with occupational exposure to chromium(VI) shall be informed of the hazards, relevant signs and symptoms of overexposure, appropriate emergency procedures, and proper conditions and precautions for the safe use of chromium(VI).

Instruction shall include, as a minimum, all information in Appendix III which is applicable to the specific chromium(VI) product or material to which there is exposure. This information shall be posted in the work area and kept on file, readily accessible to the worker at all places of employment where chromium(VI) is involved in unit processes and operations.

TABLE I-2

RESPIRATOR SELECTION GUIDE FOR PROTECTION AGAINST  
NONCARCINOGENIC CHROMIUM(VI)

Multiples of TWA Limit	Respirator Type
Less than or equal to 10X	Half-mask respirator with replaceable high efficiency filter(s) or Type C supplied-air respirator, demand type (negative pressure), with half-mask facepiece
Less than or equal to 100X	Full facepiece respirator with replaceable high efficiency filter(s) or Type C supplied-air respirator, demand type (negative pressure), with full facepiece or Self-contained breathing apparatus in demand mode (negative pressure), with full facepiece
Less than or equal to 200X	Powered air-purifying (positive pressure) respirator with high efficiency filter(s)
Greater than 200X	Self-contained breathing apparatus with positive pressure in full facepiece or Combination supplied-air respirator, pressure-demand type, with auxiliary self-contained air supply
Emergency (no con- centration limit)	Self-contained breathing apparatus with positive pressure in full facepiece or Combination supplied-air respirator, pressure-demand type, with auxiliary self-contained air supply
Evacuation or Escape (no concen- tration limit)	Self-contained breathing apparatus in demand or pressure-demand mode (negative or positive pressure) or Gas mask, Type N, with high efficiency filter, and mouthpiece respirator with high efficiency filter(s)

Note: A high efficiency filter is defined as a filter having an efficiency of at least 99.97% against 0.3  $\mu\text{m}$  DOP (Diocetyl Phthalate)

A continuing educational program shall be instituted to ensure that all workers have current knowledge of job hazards, proper maintenance procedures, and cleanup methods, and that they know how to use respiratory protective equipment and protective clothing correctly.

Information as specified in Appendix III shall be recorded on US Department of Labor Form OSHA-20 "Material Safety Data Sheet" or a similar form approved by the Occupational Safety and Health Administration, US Department of Labor.

#### Section 6 - Work Practices

##### (a) Control of Airborne Contamination

Emission of airborne particulates (dust, mist, spray, etc) of chromium(VI) shall be controlled at the sources of dispersion by means of effective and properly maintained methods such as fully enclosed operations and local exhaust ventilation. Other methods may be used if they are shown to effectively control airborne concentrations of chromium(VI) within the limits of the recommended standard.

##### (b) Control of Contact with Skin and Eyes

(1) Employees working in areas of possible contact of skin or eyes with chromium(VI), dry or wet, shall wear full-body protective clothing, including neck and head coverings, and gloves, in accord with Section 4(a).

(2) Clean protective clothing shall be put on before each work shift.

(3) If, during the shift, the clothing becomes wetted with a solution, slurry, or paste of a chromium(VI) material, or grossly

contaminated with a dry form of such material, it shall be removed promptly and placed in a special container for garments for decontamination or disposal. The employee shall wash the contaminated skin area thoroughly with soap and a copious amount of water. A complete shower is preferred after anything but limited, minor contact. Then, clean protective clothing shall be put on before resuming work. When working directly with chromium(VI) oxide, with unsealed containers of chromium(VI) oxide, or with chromium(VI) oxide in other than fully enclosed operations, protective devices and clothing shall be removed and the arms, hands, and face thoroughly washed after working with chromium(VI) oxide, and at 30-minute intervals when working with chromium(VI) oxide for extended periods of time.

(4) Minor areas of skin (principally the hands) contaminated by contact with chromium(VI) shall be washed immediately and thoroughly with an abundance of water. Water shall be easily accessible in the work areas from low-pressure, free-running hose lines or showers.

(5) If chromium(VI) comes into contact with the eyes, the eyes should be flushed with a large volume of low-pressure flowing water for at least 15 minutes. Medical attention shall be obtained without delay but not at the expense of thoroughly flushing the eyes.

(c) Procedures for emergencies, including firefighting, shall be established to meet foreseeable events. Necessary emergency equipment, including appropriate respiratory protective devices, shall be kept in readily accessible locations. Only self-contained breathing apparatus with positive pressure in the facepiece shall be used in firefighting. Appropriate respirators shall be available for use during evacuation.

(d) Special supervision and care shall be exercised to ensure that the exposures of repair and maintenance personnel to chromium(VI) shall be within the limits prescribed by this standard.

(e) Prompt cleaning of spills of chromium(VI)

(1) No dry sweeping shall be performed. Wet methods or dry vacuuming shall be used as appropriate.

(2) Wet spills and flushing of wet or dry spills shall be channeled for appropriate treatment or collection for disposal. They shall not be channeled directly into the sanitary sewer system.

(f) General requirements

(1) Good practices of housekeeping shall be observed to prevent or minimize contamination of areas and equipment and to prevent build-up of such contamination.

(2) Good personal hygiene practices shall be encouraged.

(3) Equipment shall be kept in good repair and free of leaks.

(4) Containers of dry chromium(VI) shall be kept covered insofar as is practical.

## Section 7 - Sanitation

(a) Washing Facilities

Emergency showers and eye-flushing fountains with adequate pressure of cool water shall be provided and be quickly accessible in areas where there is potential of skin or eye contact with chromium(VI). This equipment shall be frequently inspected and maintained in good working condition.

Showers and washbasins shall be provided in the employees' locker areas. Employees exposed to chromium(VI) shall wash before eating or smoking during the work shift.

(b) Food Facilities

Food storage, preparation, and eating shall be prohibited in areas where chromium(VI) is handled, processed, or stored.

Eating facilities provided for employees shall be located in nonexposure areas. Washing facilities should be accessible nearby.

(c) Employees shall not smoke in areas where chromium(VI) is handled, processed, or stored.

(d) Clothing and Locker Room Facilities

Locker room facilities shall be provided in a nonexposure area for employees required to change clothing before and after work. The facilities shall provide for the separate storage of street clothing and clean work clothing from soiled work clothing. Showers and wash basins should be located in the locker area to encourage good personal hygiene.

Covered containers should be provided for work clothing discarded at the end of the shift or after a contamination incident. The clothing will be held in these containers until removed for decontamination or disposal.

Section 8 - Monitoring and Recordkeeping Requirements

Workers are not considered to have occupational exposure to chromium(VI) if, on the basis of a professional industrial hygiene survey, (a) the airborne concentration of carcinogenic chromium(VI) is sufficiently low that a sampling volume greater than 1.0 cu m is necessary in order to collect 0.5 µg of carcinogenic chromium(VI) and (b) the airborne



concentration of noncarcinogenic chromium(VI) is not greater than half the recommended limit of 25  $\mu\text{g Cr(VI)/cu m}$ . All samples of airborne chromium(VI) shall be analyzed by the chemical analytical method in Appendix II; if samples can be demonstrated to contain only noncarcinogenic chromium(VI), other methods of chemical analysis equivalent to the method in Appendix II may be used. Records of these surveys, including the basis for concluding that there is no occupational exposure to chromium(VI) shall be maintained until a new survey is conducted.

In workplaces where chromium(VI) is handled or processed, surveys shall be repeated annually and when any process change indicates a need for reevaluation. Requirements set forth below apply to areas in which there is occupational exposure to chromium(VI).

Employers shall maintain records of workplace environmental exposures to chromium(VI) based upon the following sampling, analytical, and recording schedules:

(a) In all monitoring, samples representative of the exposure in the breathing zone of employees shall be collected by personal samplers.

(b) An adequate number of samples shall be taken in order to permit construction of TWA exposures for every operation or process. Except as otherwise determined by a professional industrial hygienist, the minimum number of representative TWA determinations for an operation or process shall be based on the number of workers exposed as provided in Table I-3.

(c) The first determination of the workers' exposures to airborne chromium(VI) shall be completed within 6 months after the promulgation of a standard incorporating these recommendations.

(d) A reevaluation of the exposures of workers to airborne chromium(VI) shall be made within 30 days after installation of a new process or process changes.

(e) Samples of airborne chromium(VI) shall be collected and analyzed at least every 2 months for those work areas with occupational exposure to carcinogenic chromium(VI) and at least every 3 months if the airborne chromium(VI) is noncarcinogenic.

(f) A reevaluation of the worker's exposures to airborne chromium(VI) shall be repeated at 1-week intervals when the airborne concentration has been found to exceed the recommended workplace environmental limit. In such cases, suitable controls shall be instituted and monitoring shall continue at 1-week intervals until 3 consecutive surveys indicate the adequacy of controls.

(g) Records of all sampling and analysis of airborne chromium(VI) and of medical examinations shall be maintained for at least 30 years after the individual's employment is terminated. Records shall indicate the details of (1) type of personal protective devices, if any, in use at the time of sampling, and (2) methods of sampling and analysis used. Each employee shall be able to obtain information on his own exposure. In the event that the employer who has or has had employees with occupational exposure to carcinogenic chromium(VI) ceases business without a successor, he shall forward their records by registered mail to the Director, National Institute for Occupational Safety and Health.

TABLE I-3  
SAMPLING SCHEDULE

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Number of Employees Exposed	Minimum Number of Employees Whose Individual Exposures Shall Be Determined
1-20	50% of the total number of exposed employees
21-100	10 plus 25% of the excess over 20 exposed employees
over 100	30 plus 5% of the excess over 100 exposed employees

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(h) A regulated area shall be established and maintained where:

(1) Carcinogenic chromium(VI) is manufactured, reacted, repackaged, stored, handled, or used; and

(2) Airborne concentrations of carcinogenic chromium(VI) are in excess of the permissible exposure limit in Section 1.

(i) Access to the regulated areas designated by Section 8h shall be limited to authorized persons. A daily roster shall be made of authorized persons who enter; these rosters shall be maintained for 30 years.

## II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were prepared to meet the need for preventing occupational diseases arising from exposure to chromium(VI). The criteria document fulfills the responsibility of the Secretary of Health, Education, and Welfare, under Section 20(a) (3) of the Occupational Safety and Health Act of 1970 to "...develop criteria dealing with toxic materials and harmful physical agents and substances which will describe...exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."

The National Institute for Occupational Safety and Health (NIOSH), after a review of data and consultations with others, has formalized a system for the development of criteria upon which standards can be established to protect the health of workers from exposure to hazardous chemical and physical agents. It should be pointed out that any criteria for a recommended standard should enable management and labor to develop better engineering controls resulting in more healthful work environments and mere compliance with the recommended standard should not be used as a final goal.

These criteria for a standard for chromium(VI) are part of a continuing series of criteria developed by NIOSH. The proposed standard applies to the processing, manufacture, and use of chromium(VI), or its release as an intermediate, byproduct, or impurity, as applicable under the Occupational Safety and Health Act of 1970.

These criteria were developed to ensure that the standard would (1) protect against development of acute and chronic poisoning from

noncarcinogenic chromium(VI), (2) materially reduce the risk of lung cancer from occupational exposure to carcinogenic chromium(VI), (3) be measurable by techniques that are valid, reproducible, and available to industry and governmental agencies, and (4) be attainable with existing technology.

Skin disorders, distinct from other health effects arising out of the inhalation of chromium(VI), are associated with chromium(VI) and result from the contact of the materials with the skin. These disorders are best prevented by the appropriate work practices outlined in this document.

When chromium(VI) is present in combination or admixture with another material(s) for which an environmental standard(s) has been established, the most restrictive standard shall apply.

Throughout this document the terms "bichromate" and "dichromate" are completely synonymous and interchangeable, unless otherwise specified.

In a few instances, these recommendations for occupational exposure to chromium(VI) revise the 1973 recommendations for occupational exposure to chromic acid. One recommended change is the requirement that employers demonstrate that chromium(VI) is only that from the monochromates and bichromates of hydrogen, lithium, sodium, potassium, rubidium, cesium, and ammonium, or chromium(VI) oxide before the less restrictive workplace environmental limit will apply. Another is the change in the recommendation for chromic acid (chromium(VI) oxide and aqueous solutions thereof) regarding retention of medical records; it is now recommended that they be retained 30 years instead of 20 years. In addition, it is recommended that medical records be kept for all persons with occupational exposures to chromium(VI) and not just for those who have been employed for more than 1 year.

There are minor changes in the recommended workplace environmental limits from those recommended in the chromic acid criteria document. We are now recommending a 15-minute ceiling environmental limit of 50  $\mu\text{g Cr(VI)/cu m}$  instead of 52  $\mu\text{g Cr(VI)/cu m}$  and an 8- to 10-hour TWA limit of 25  $\mu\text{g Cr(VI)/cu m}$  instead of an 8-hour TWA limit of 26  $\mu\text{g Cr(VI)/cu m}$ . We are now recommending that records of sampling and analysis be retained 30 years instead of 20 years as recommended in the chromic acid criteria document. The method for analyzing chromium(VI) in the workplace air is different in these recommendations from that recommended in the chromic acid criteria document.

The standard was not designed for the population-at-large and any extrapolation beyond general occupational exposures is not necessarily warranted.

Throughout this document, when chemical formulas are used, they are written with traditional numerical subscripts on the text-line.