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## Standard Guide for Safety and Health Requirements Relating to Occupational Exposure to Water-Insoluble Chromates<sup>1</sup>

This standard is issued under the fixed designation E848; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### INTRODUCTION

This guide is intended to provide guidance in the safe handling of certain chromate compounds that are suspected to be carcinogenic in man **(1-8)**.<sup>2</sup> Precautions contained herein are believed to protect against possible carcinogenicity, and will also be sufficient to obviate any acute health hazards except where skin hypersensitivity is a factor. Other hazards are considered and discussed.

The time-weighted average (TWA) permissible exposure limit (PEL) specified in this guide are based on studies evaluated by the American Conference of Government Industrial Hygienists (ACGIH) **(9)**. Epidemiological studies of the chromate producing industry have indicated that observed adverse health effects were associated with environmental levels and hygiene procedures considerably less exacting than those recommended here (see [Appendix X1](#)).

Hygiene controls and medical surveillance measures have been chosen to protect workers, recognizing that the potential for exposure will vary widely from industry to industry and between one location and another, depending on the compounds handled, scale of operations, kind of process, and physical conditions.

The key to maintaining chromate levels below the PEL is through implementation of cost effective engineering controls augmented as necessary by personal protective equipment, or work practice controls, or both. The choice of methods should depend upon the factors involved in each specific situation.

Biological monitoring is also recommended for lead chromate (see [7.4](#)).

All applicable federal, state, county and local regulations must be complied with when this guide is used.

### 1. Scope

1.1 This guide covers control procedures for the safe production, storage, transportation, and handling of only the hexavalent chromium compounds found in [Table 1](#) and their various hydrates, and mixtures of coprecipitates of the same regardless of crystalline form.

1.2 This guide is not intended to cover (a) such “soluble” chromates as chromates of sodium, potassium, magnesium, or ammonium; (b) soluble bichromates; (c) chromic acid; (d) volatile chromyl compounds; (e) any trivalent chromium compound; or (f) elemental chromium. Omission of said

compounds or classes of compounds should not be construed to mean that they may be handled without due regard to their particular physical, chemical, and toxicological hazards **(9, 10, 11)**.

1.3 The chromate ion,  $\text{CrO}_4^{-2}$ , depending upon the acidity, complexes to form di-, tri-, and higher polychromates; hence, the chromates listed in [Table 1](#) may contain mixtures of polychromates, depending on the method of isolation and end use.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use. (For more specific precautionary information see Section 5.)*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the*

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee [D01](#) on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee [D01.21](#) on Chemical Analysis of Paints and Paint Materials.

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<sup>2</sup> The boldface numbers in parentheses refer to the references at the end of this guide.

**TABLE 1 Examples of Some Hexavalent Chromium Compounds**

Chemical Name	Formula	Color Index Name <sup>A</sup>
Barium chromate	BaCrO <sub>4</sub>	Pigment Yellow 31
Barium potassium chromate	BaK <sub>3</sub> (CrO <sub>4</sub> ) <sub>2</sub>	Pigment Yellow 31
Basic copper chromate	CuCrO <sub>4</sub> xCu(OH) <sub>2</sub>	Not listed
Basic cadmium chromate	Cd <sub>2</sub> (OH) <sub>2</sub> CrO <sub>4</sub>	Pigment Yellow 44
Basic lead chromate	PbCrO <sub>4</sub> PbO	Pigment Orange 21
Bismuth basic dichromate	Bi <sub>2</sub> O <sub>3</sub> CrO <sub>3</sub>	Pigment Red 103
Calcium chromate	CaCrO <sub>4</sub>	None assigned
“Chromic chromate” (calcium chromate sinter)	xCaO yCr <sub>2</sub> O <sub>3</sub> zCrO <sub>3</sub>	Pigment Yellow 33 Not listed
Ferric chromate	Fe <sub>2</sub> (CrO <sub>4</sub> ) <sub>3</sub>	Pigment Yellow 45
Basic ferric chromate	Fe(OH)CrO <sub>4</sub>	Pigment Yellow 45
Lead chromate	PbCrO <sub>4</sub>	Pigment Yellow 34
Lead molybdochromate	PbCrO <sub>4</sub> PbMoO <sub>4</sub>	Pigment Red 104
Potassium zinc chromate	K <sub>2</sub> O 4ano-4Cr4O <sub>3</sub>	Pigment Yellow 36
Strontium chromate	SrCrO <sub>4</sub>	Pigment Yellow 32
Zinc chromate	ZnCrO <sub>4</sub>	Pigment Yellow 36

<sup>A</sup> For Classification, not Toxicology.

*Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

### 2.1 ANSI Standards:<sup>3</sup>

Z87.1 Practice for Occupational and Educational Eye and Face Protection

Z88.2 Practices for Respiratory Protection

Z129.1 Precautionary Labeling for Hazardous Industrial Chemicals

### 2.2 OSHA Standards:<sup>4</sup>

29 CFR 1910.20 Access to Records

29 CFR 1910.1200 Hazard Communication

29 CFR 1910.134 Respiratory Protection

29 CFR 1910.1025 Lead

### 2.3 NIOSH Publications:<sup>4</sup>

“Certified Equipment,” HEW Publication No. 76-145

“Recommended Industrial Ventilation Guidelines,” January 1976, HEW Publication No. 76-162

“Criteria for a Recommended Standard Chromium (VI),” HEW Publication No. 76-129

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *exposure area, n*—buildings and exterior locations where insoluble chromates may be present as airborne particulates in excess of the concentrations specified in 5.1.2, or where there is a likelihood of skin contact with chromate containing dust.

3.1.2 *insoluble, n*—a relative term to distinguish the low-water solubility of the chromates listed in Table 1 from the much more water-soluble chromates of sodium, potassium, and

ammonia. The solubilities of lead chromates and calcium chromate are typical of the lower and upper solubilities of the class (see Section 6).

## 4. Significance and Use

4.1 This guide includes chromates that are not readily soluble in water and that have water solubilities (Chromate ION) within the range of the more soluble calcium chromate and the much less soluble lead chromate. The major occupations involving potential exposure to insoluble chromates are in roasting of chromite ore, the manufacture of chromate pigments, the manufacture of coatings containing chromate pigments, and spray painting with these coatings. There is insufficient evidence to conclude that trivalent chromium compounds are carcinogenic.

## 5. General Requirements

### 5.1 Environmental Levels:

5.1.1 The following guide is designed to protect the health and safety of workers for an 8 h to 10 h workday, 40 h workweek, over a working lifetime. The PEL can be met by techniques and controls that reduce employee exposure below the applicable safe limit. These controls must be reliable. Permissible exposure limits are based on the 1985 ACGIH recommended Threshold Limit Values (TLV) for chromates of lead and zinc and for chromite-ore processing (12).<sup>5</sup>

5.1.2 *PEL*—Occupational exposure to any of the compounds listed in Table 1 shall be controlled to a TWA of 0.05 mg/m<sup>3</sup> (as Chromium) for an 8 h workday.

5.1.3 At least one full-shift (80 % of the shift length) personal sample should be taken for each job classification and each work area involving insoluble chromates. These samples shall be representative of a monitored employee’s regular daily exposure to insoluble chromates, and may be used to represent the exposure of all employees in that job assignment. One sample may not be sufficient for an adequate characterization. For further guidance and appropriate control objectives see 5.6, 6.2, and 7.3.

### 5.2 Medical Surveillance:

5.2.1 *Examinations*—Individuals who are currently, or who are expected to be employed in exposure areas (see 3.1) shall be given preplacement and annual medical examinations that shall include, but not necessarily be limited to the following:

5.2.1.1 *Work History*, to elicit information on all past exposures to any hexavalent chromium compounds or other toxic substances, particularly those affecting lung function.

5.2.1.2 *Periodic Medical Examination*, consisting of at least the following: Completion of a health history questionnaire with attention given to smoking history, posterior-anterior chest X-ray, complete blood count or red cell count and hemoglobin, and pulmonary function studies (FVC, FEV 1.0 and FEV 1.0/FVC).

<sup>3</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

<sup>4</sup> Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

<sup>5</sup> Committee on Industrial Ventilation, *Documentation of TLVs, American Conference of Governmental Industrial Hygienist*, 1985.

5.2.2 Medical examinations shall be made available to workers with symptoms of skin or upper respiratory tract irritation at the time the symptoms are first observed or reported.

5.2.3 *Management*—Proper medical management shall be provided promptly for workers adversely affected by exposure to insoluble chromates. The cause of any excessive exposure shall be sought without delay, and corrective action initiated. A physician shall determine if sensitized individuals should be excluded from jobs with a risk of exposure.

#### 5.2.4 *First Aid:*

5.2.4.1 *Ingestion*—Induce vomiting promptly and obtain prompt medical attention. “Advice to physicians: Administer 500 mg to 1000 mg ascorbic acid IV as promptly as possible, followed by oral Vitamin C, 5 g/day to 10 g/day until risk of kidney failure has ceased,” (13).

5.2.4.2 *Chromium Contamination of Open Wounds*—Flush thoroughly for 15 min with water and seek medical attention.

5.2.4.3 *Eye Irritation*—Flush thoroughly with copious quantities of water for 15 min and seek medical attention.

#### 5.3 *Labeling and Posting:*

5.3.1 *Warning Signs*—In areas where insoluble chromate concentrations in the atmosphere are likely to exceed the standard, appropriate warning signs, barricades, or work practices should be used to restrict access to unauthorized persons. The sign must alert anyone entering the area as to what action should be taken.

5.3.2 *Container Labels*—All containers (bag, barrel, box, can, drum, reaction vessel, storage tanks, but not pipe or pipe lines) should be labeled, tagged, or marked with the following information:

5.3.2.1 *The Identity of the Material(s)*—Identity means any chemical or common name(s), code name or number, or brand name, that is indicated on the material safety data sheet for the chemical.

5.3.2.2 Batch process sheets, batch tickets, operating procedures, or other such written materials are acceptable alternatives to individual labels as long as the appropriate identity is readily accessible to employees.

5.3.2.3 Portable containers for immediate use need not be labeled.

5.3.3 *Safety Data Sheet (SDS)*—The SDS or equivalent is the primary source of the safety and health information. The chemical identification and SDS for all insoluble chromates used in the workplace must be made readily accessible to all employees. The SDS in conjunction with the identity on the label and employee training will convey the hazard(s) (both physical and health) determination for the chromate compounds. Information on the SDS must include:

5.3.3.1 The OSHA PEL and the ACGIH TLV.

5.3.3.2 A statement to that effect if the chromate has been identified as a suspect carcinogen by the National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC), OSHA, or the employer.

5.3.4 *Finished Product Labels*, are the responsibility of the manufacturer based on his knowledge of the end use of his unique products. However, the label should be in agreement

with the recommendations of ANSI Z129.1. Any applicable governmental regulation must be followed.

#### 5.4 *Personal Protective Equipment:*

5.4.1 *Respiratory Protection*—Each employee’s personal work environment shall be maintained at a safe exposure level through implementation of cost effective engineering controls, augmented as necessary by personal protective equipment or work practice controls, or both. The choice of method should depend on the factors involved in each specific situation. Two criteria should be used to guide the choice of the control measures. The measure chosen must reduce employee exposure below the applicable safe limit and the control method must be reliable (14, 15). With these two factors met, other factors such as logistics, product quality, economics, morale, housekeeping, and efficiency can then be incorporated into the decision logic for choosing appropriate control measures. Respirators are also required for emergencies and for the performance of nonroutine tests and duties that have the likelihood of exceeding the PEL. Brush or roller application of paints does not normally require respiratory protective equipment for protection from airborne chromates.

5.4.2 The Respiratory Protection Program must meet the general requirements outlined in OSHA 29 CFR 1910.134 and in ANSI Z88.2-1980, see Ref (16). This program shall include instructions on the proper selection and use, including fit testing, cleaning and maintenance of respirators and air supply devices. The fit test should be performed annually on all negative pressure respirators. Either a quantitative or qualitative test is satisfactory (14, 15). The type of respirator required for protection against known or expected concentration of airborne chromate to be encountered is outlined in Table 2.

5.4.3 *Foot Protection*—Industrial type leather shoes with synthetic soles will provide ample protection under normal operating and good housekeeping conditions. For wet operations during cleanup of spills or when conducting decontamination procedures, rubber or synthetic booties or pullover shoe protection shall be worn, and thoroughly rinsed and dried before reuse. Shoes that are torn or show evidence of inside contamination with chromate shall be disposed of properly.

5.4.4 *Clothing*—Any employee exposed to airborne levels of chromium above the PEL or when the possibility of skin or eye irritation exists, should be supplied with appropriate protective work clothing such as coveralls or similar full-body work clothes. See for example, ANSI Z87.1 for eye and face protection guidelines. Clean work clothing should be supplied at least weekly to employees in these cases. All protective clothing must be removed at the completion of each work shift in the change room provided for this purpose. Employees exposed to chromium above the PEL should shower at the end of the work shift. Employees must not wear or take any of the protective equipment off the work site. Care must be taken to prevent any cross contamination of street clothes.

5.4.5 *Hand Protection*—Suitable gloves to minimize skin contact shall be worn during operations where chromates are handled and may contact skin. Hands should be cleaned after removal of gloves. Gloves showing evidence of internal contamination shall be disposed of or thoroughly cleaned before reuse.