

Hexavalent Chromium

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This publication provides practical workplace safety and health information to assist you in making your place of work safer. It is not legal advice. SAIF has made every effort to bring significant Oregon Occupational Safety and Health Administration (Oregon OSHA) regulations to your attention. Nonetheless, compliance with Oregon OSHA remains your responsibility. You should read and understand all relevant Oregon OSHA regulations that apply to your job site(s). You may want to consult with your own attorney regarding aspects of Oregon OSHA that may affect you.

Note: The information in this publication is time sensitive. Do not rely upon this document if its publication date is more than three years old. Please check the "Safety and health" section of our web site at saif.com/safetyandhealth for a more recent, printable copy. You'll also find a variety of other valuable safety information designed to help your business prevent injuries and control costs.

Introduction

Hexavalent chromium, Cr(VI), has many uses in industrial processes. Some major industrial sources of hexavalent chromium are:

- Chromate pigments in dyes, paints, inks, and plastics
- Chromates added as anti-corrosive agents to paints, primers, and other surface coatings
- Chrome plating by depositing chromium metal onto an item's surface using a solution of chromic acid
- Particles released during smelting of ferro-chromium ore
- Fume from welding stainless steel or nonferrous chromium alloys
- Impurity present in Portland cement

SAIF has developed this guide to assist our policyholders with knowledge of the rules, the toxic effects, and how to minimize exposures to hexavalent chromium.

Workplace assessment

Before reading this guide, you need to conduct an assessment to determine whether there is hexavalent chromium in your workplace:

- Review your Hazard Communication Program and your Safety Data Sheets (SDSs) to help make this determination.
- Review the processes in your workplace to determine if hexavalent chromium could exist (e.g., welding on stainless steel, electroplating, chrome stripping).
- If you do have hexavalent chromium exposures, ask whether you need the substance in your workplace. It would be best to eliminate it and/or substitute it with something less toxic.

If you are successful in eliminating hexavalent chromium from your workplace, this will help minimize the compliance burden with 1910.1026 and you can serve as an example for other industries. However, if hexavalent chromium is essential to your operation, this guide will help you control exposures to your employees.

Step-by-step approach

- 1) Review the regulatory standards on hexavalent chromium. Exposure to hexavalent chromium is covered by three separate standards: general industry (1910.1026), construction (1926.1126), and shipyards (1915.1026). The standard for shipyards also applies to marine terminals and longshoring. The standards for construction and shipyards are like each other but differ in some respects from the standard for general industry. Refer to the "Resources" section to obtain web links to these standards.
- 2) As mentioned earlier, review your Hazard Communication Program, and determine whether you have hexavalent chromium in your workplace.
- 3) If you have hexavalent chromium in your workplace, clearly identify the staff member responsible for developing, implementing, and monitoring the hexavalent chromium

program. If there is an airborne exposure to hexavalent chromium, monitor the airborne levels by having initial and periodic air sampling conducted for hexavalent chromium.

- 4) Follow the Hexavalent Chromium Flow Chart to complete your program. (See Appendix A.)

General information and sources of exposure

Chromium is a metal. It exists in several different forms: divalent, trivalent, and hexavalent. Only hexavalent chromium is discussed in this document. The following table helps give an indication where hexavalent chromium compounds are found and the types. For more information on operations and the typical hexavalent chromium chemicals use, refer to Appendix B, which was extracted from the OSHA Directive CPL 02-02-074, Inspection Procedures for the Chromium (VI) Standards. However, this information was slightly modified to include differences in Oregon OSHA enforcement from the Federal OSHA standard.

Table 1: Types of hexavalent chromium and where it is found and used

Where found/used	Types
Pigments for paints, inks, and plastics	Lead chromate (chrome yellow, chrome green, molybdenum orange), zinc chromate, barium chromate, calcium chromate, potassium dichromate, sodium chromate
Anti-corrosion coatings (including chrome plating, spray coatings)	Chromic trioxide (chromic acid), zinc chromate, barium chromate, calcium chromate, sodium chromate, strontium chromate
Stainless steel	Hexavalent chromium is given off when stainless steel is cast, welded, or torch cut.
Textile dyes	Ammonium dichromate, potassium chromate, potassium dichromate, sodium chromate
Wood preservation	Chromium trioxide, Chromated Copper Arsenate (CCA), Acid Copper Chromate (ACC)
Leather tanning	Ammonium dichromate

Health hazards

Cancer: Hexavalent chromium is considered a potential lung carcinogen. Studies of workers in the chromate production, plating, and pigment industries consistently show increased rates of lung cancer. It also causes irritation of the lungs.

Eyes: Direct eye contact with chromic acid or chromate dusts can cause irritation and/or permanent eye damage.

Respiratory tract: Hexavalent chromium can irritate the nose, throat, and lungs. Repeated or prolonged exposure can damage the mucous membranes of the nasal passages and result in ulcers. In severe cases, exposures may cause perforation of the septum (the wall separating the nasal passages).

Skin: Prolonged skin contact can result in dermatitis and skin ulcers. Some workers can develop an allergic sensitization to chromium.

Note: Although the standard does not cover airborne exposures to hexavalent chromium in Portland Cement (air sampling has shown concentrations below the action level), specific PELs do exist for Portland Cement. Appropriate PPE use, washing facilities, and hazard communication requirements still apply.

Routes of entry

Hexavalent chromium may be inhaled into the lungs via airborne dust, fume, or mist. It can also be ingested via food, drinks, cosmetics, and cigarettes contaminated with hexavalent chromium. Family members of employees may be exposed to hexavalent chromium from contaminated clothing and articles brought home from the place of employment. Hexavalent salts generally are absorbed well topically through intact skin. Hexavalent chromium can also penetrate the skin and be transformed to trivalent chromium, which becomes a hapten and part of the allergic reaction causing eczematous dermatitis.

Factors affecting the magnitude of occupational risk

The process: High processing temperatures, extensive fume, dust or mist formation, and outdated working methods increase the risk; the more extreme the conditions, the greater the risk.

Engineering controls: The adequacy of the elimination technique used directly impacts the occupational hexavalent chromium exposure. Efficient ventilation, combined with work practices to reduce or eliminate the spreading of hexavalent chromium dust, greatly reduce the risk of exposure.

The two methods of ventilation used are dilution ventilation and local exhaust ventilation. Dilution ventilation (or general ventilation) is the dilution of contaminated air with uncontaminated air for the purpose of controlling potential airborne health hazards, fire and explosive conditions, odors, and nuisance type contaminants. Some of the limiting factors of dilution ventilation include:

- The quantity of contaminant generated must not be too great or the air flow rate necessary for dilution will be impractical;
- Workers must be far enough away from the contaminant source, or evolution of contaminant must be in sufficiently low concentrations, so that workers will not have an exposure more than the established permissible exposure level;
- The toxicity of the contaminant must be low (which is not the case with hexavalent chromium); and
- The evolution of contaminants must be reasonably uniform.

Local exhaust ventilation is the most desirable method for removal of hexavalent chromium fume and dust in the workplace. Local exhaust systems capture and remove process emissions at, or close to, their source of generation and prior to their escape into the workplace environment.

Workplace hygiene: Housekeeping, personal hygiene, and appropriate/effective personal protective equipment use have an impact on the magnitude of workplace exposure.

Prevention of occupational poisoning

Substitution by less toxic substances: The ideal method of prevention is the substitution for a toxic agent with one less toxic in nature. This can be a challenging decision. Some material substitutes have little information available as to the toxic effects, so research into the substitute material should be extensive. Also, it may not be economically or technologically feasible to replace the agent.

Ventilation: Effective local exhaust ventilation (LEV) is one of the best methods for the control of atmospheric contamination. The air must not be recirculated or discarded in a way that would cause environmental pollution. It is important to remember that open windows and doors or cooling fans can interfere with the effectiveness of the ventilation system. Regular cleaning and maintenance of the ventilation system is critical. Local and/or state environmental regulatory authorities may also need to be consulted regarding the emissions and any needed permits.

Special note on welding: A common concern that arises when using LEV to control welding fumes is that it may interfere with the shield gas. Capture velocities <200 feet per minute will prevent this. It is also important that the capture hood be less than 1 to 1½ duct diameters away (or as close as possible) from the weld to provide effective capture of the fume.

Housekeeping: The prevention of spreading of dust and fumes is critical to minimize exposure. Vacuuming by use of a High Efficiency Particulate Air Filter (HEPA) is the preferred method. Proper use of a HEPA vacuum prevents the dust from being dispersed back into the air. When the HEPA vacuums are cleaned and dumped out, it is important that the dust be controlled to minimize the reentry of hexavalent chromium into the workplace. Use of compressed air to clean floors and other surfaces is absolutely prohibited.

Eating, drinking, smoking, and applying lip balm and cosmetics must be prohibited in areas where hexavalent chromium is used. Hygiene facilities such as lunchrooms, changing rooms, and showers may be needed for employees exposed to hexavalent chromium. Contaminated coveralls and clothing must be properly bagged and labeled before being sent to a laundry facility or laundered by the employer.

Personal protective equipment (PPE): Use personal protective equipment when engineering control measures fail to reduce exposures to an acceptable level, until effective controls can be implemented, or to supplement controls to help maintain exposures as low as reasonably achievable.

The occupational hexavalent chromium standard

The Oregon Administrative Rule, Chapter 437, Division 2, General Occupational Safety and Health Rules (29 CFR 1910) Subdivision Z: Toxic & Hazardous Substances: HEXAVALENT CHROMIUM (1910.1026) applies to all occupational exposures to hexavalent chromium in general industry, construction, and maritime. The federal OSHA hexavalent chromium standard has an exception for pesticide use and Portland cement while the Oregon OSHA standard does not.

Initial determination/exposure assessment

Unless an employer can demonstrate through objective data that in their workplace any material containing chromium or any specific process, operation, or activity involving chromium cannot release dusts, fumes, or mists of hexavalent chromium in concentrations at or above $0.5 \mu\text{g}/\text{m}^3$ as an 8-hour time weighted average (TWA) under any expected conditions of use, the employer must make an exposure determination. A sufficient number of personal breathing zone air samples to accurately characterize full shift exposures on each shift, for each job classification, in each work area must be collected. If representative sampling is done instead of sampling all employees, the employer shall sample the employee(s) expected to have the highest hexavalent chromium exposure. This initial assessment is to determine if any employees are exposed above the action level. If the monitoring reveals employee exposures to be below the action level of $2.5 \mu\text{g}/\text{m}^3$ as an 8-hour TWA, the employer may discontinue monitoring for those employees who are represented by such monitoring, until changes in the workplace result in new or additional exposures.

Periodic monitoring

If the initial exposure assessment finds hexavalent chromium exposures to be at or above the action level, periodic personal exposure air monitoring must be done at least every six months. If the hexavalent chromium levels are at or above the PEL in the initial assessment, then monitoring must be done at least every three months.

Periodic monitoring may cease if two consecutive personal air samples, taken at least seven days apart, indicate that results are below the action level.

Highlights of the general industry hexavalent chromium standard - the Permissible Exposure Limit (PEL)

The Time Weighted Average Permissible Exposure Limit (TWA-PEL) is 5 micrograms of hexavalent chromium per cubic meter of air ($\mu\text{g}/\text{m}^3$) averaged over an 8-hour period.

The action level (AL)

The Action Level Exposure is $2.5 \mu\text{g}/\text{m}^3$ averaged over an eight-hour period.

Exposure monitoring

It is each employer's responsibility under the statute to determine if employee exposures to hexavalent chromium are at or above the action level. The standard bases these provisions only on exposure levels and apply whether the employees wear respiratory protection. When monitoring results show that the employee exposures exceed the PEL, within 15 days the employer must either post the result in a location that is accessible to all affected employees or must notify each affected employee individually in writing of the results.

Note: This notification must describe the corrective action(s) being taken by the employer to reduce the employee exposure to or below the PEL.

Methods of compliance (When employee exposure exceeds the PEL)

Engineering and work practice controls: If an employee is exposed to hexavalent chromium above the PEL for more than 30 days per year, the employer must implement engineering and work practice controls to reduce and maintain employee exposures to hexavalent chromium to or below the PEL, unless the employer can demonstrate that such controls are not feasible. If engineering and work practice controls do not reduce exposures below the PEL, then respiratory protection must be used.

If the employer can demonstrate that a process or task doesn't result in any employee hexavalent chromium exposure above the PEL for 30 or more days per year, the requirement to implement engineering and work practice controls to achieve the PEL does not apply to that process or task.

Aerospace industry: When painting aircraft or large aircraft parts in the aerospace industry, the employer must use engineering and work practice controls to reduce and maintain employee exposures to hexavalent chromium to or below 25 µg/m³ unless the employer can demonstrate that such controls are not feasible. The employer must supplement such engineering and work practice controls with the use of respiratory protection to achieve the PEL.

Prohibition of rotation: Employers may not rotate employees to different jobs to achieve compliance with the PEL, however the employer may rotate employees for other reasons (cross-training, reduce stress in physically demanding jobs, etc.)

Mechanical ventilation

The employer must measure to determine the effectiveness of any mechanical ventilation system used to control hexavalent chromium exposure. The parameters for measurement that the employer can use are the capture velocity, duct velocity, or static pressure. Take these measurements at least every three months. If there is a change in the production process, the employer must reevaluate the effectiveness of the mechanical ventilation system.

Recirculation of exhaust air in the workplace must be accompanied by high efficiency filters with reliable back up and set up so that the system will bypass the recirculation if the system fails.

The location of the exhaust stacks must be chosen to minimize or eliminate the chance of the hexavalent chromium from being re-entrained into the building's HVAC system air intake.

Respiratory protection

Respiratory protection must be provided to employees during time periods while feasible engineering and work practice controls are being implemented or if all feasible engineering and work practice controls are not successful in reducing exposures to or below the PEL. Respirators are also necessary when employees are conducting work tasks, such as maintenance and repair activities for which engineering, and work practice controls are not feasible.

Other situations in which the employer must provide respirators are for work operations where the employees are exposed above the PEL for fewer than 30 days per year and the employer has elected not to implement engineering and work practice controls to achieve the PEL. Uncontrolled releases of hexavalent chromium that result in significant and unexpected exposures also require respirators.

Respirators can cause some people distress, as they increase breathing resistance and decrease communications between workers. Wearing a respirator will also increase the physical exertion

required to perform a job and may become uncomfortable after a prolonged period. The discomfort and additional physical stress of wearing a respirator may also decrease the work efficiency of employees. When feasible, the use of engineering and work practice controls to control employee exposures to hexavalent chromium is preferable to the use of respirators.

Respirators must be fit-tested at initial assignment, following medical evaluation and at least annually thereafter.

Whenever respirators are required to be worn by employees for protection against hexavalent chromium exposure, the employer is required to institute a respiratory protection program in accordance with Oregon OSHA 29 CFR 1910.134 (Respiratory Protection Standard).

Protective work clothing and equipment

Where a hazard is present or is likely to be present from skin or eye contact with hexavalent chromium, the employer shall provide appropriate personal protective clothing and equipment at no cost to employees and shall ensure that employees use such clothing and equipment.

Depending upon the task or process which is generating the hexavalent chromium, the protective equipment and clothing may potentially include:

- 1) Full body suit or coveralls
- 2) Gloves, hats and shoes or disposable shoe coverlets
- 3) Face shields or vented goggles

Personal protective equipment and clothing will need to be selected in accordance with the OSHA standard for Eye and Face Protection, 1910.133 and included in the written workplace hazard assessment as required in 1910.132(d)(1) and (2).

Removal and storage

The employer must ensure that employees remove all protective clothing and equipment contaminated with hexavalent chromium at the end of their work shift or at the end of the tasks involving the hexavalent chromium exposure, whichever comes first.

The employer must also ensure that no employees remove hexavalent chromium contaminated protective equipment or clothing from the workplace, except for those whose job it is to launder, clean, maintain, or dispose of such clothing or equipment.

Contaminated protective clothing and equipment must be stored and transported in impermeable bags or containers when it is removed for laundering, cleaning, maintenance, or disposal.

Bags or containers of contaminated protective clothing or equipment that are removed from change rooms for laundering, cleaning, maintenance, or disposal must be labeled in accordance with the OSHA Hazard Communication Standard, 1910.1200.

Cleaning and replacement

For protective clothing and equipment to function, it needs to be clean and in proper working order. The OSHA Hexavalent Chromium Standard states that employers must clean, launder, repair, and

replace all required protective clothing as needed to maintain its effectiveness. The employer must prohibit employees from cleaning hexavalent chromium-contaminated protective clothing or equipment by blowing, shaking, or any other means that disperses hexavalent chromium into the air or onto an employee's body.

The person who launders or cleans hexavalent chromium-contaminated protective clothing or equipment must be informed by the employer of the potentially harmful effects of exposure to hexavalent chromium and that the clothing should be laundered or cleaned in a manner that minimizes skin or eye contact with the hexavalent chromium and prevents the release of airborne hexavalent chromium more than the PEL.

The laundry containers should have the following label:

CAUTION

CLOTHING CONTAMINATED WITH HEXAVALENT CHROMIUM.

**DO NOT REMOVE DUST BY BLOWING OR SHAKING. DISPOSE OF
HEXAVALENT CHROMIUM CONTAMINATED WASH WATER IN
ACCORDANCE WITH APPLICABLE LOCAL, STATE OR FEDERAL REGULATIONS.**

Housekeeping

Keep work surfaces free of accumulations of hexavalent chromium. Areas where hexavalent chromium may be present should be cleaned up regularly and all spills should be cleaned up promptly. For example, work surfaces should be cleaned by wet wiping, wet mopping, or vacuuming. However, be aware that vacuums can contribute to hexavalent chromium contamination, unless employees use a vacuum equipped with a HEPA air filter and employ work practices during emptying that preclude contamination. Only use shoveling, dry or wet sweeping, and brushing when vacuuming is not effective. Using compressed air for blowing hexavalent chromium dust from surfaces should not be allowed.

Disposal

Waste, scrap, or other debris that are contaminated with hexavalent chromium and are destined for disposal should be collected and disposed of in sealed, impermeable bags or other closed, impermeable containers that are labeled in accordance with the OSHA Hazard Communication Standard, 1910.1200.

Hygiene facilities and work practices

When protective equipment and clothing is required, the employer must provide change rooms and washing facilities that conform to OSHA's Sanitation regulation, 1910.141. The change rooms must have separate storage facilities for protective clothing and equipment and for street clothes and the facilities must prevent cross contamination. The washing facilities must be readily accessible and capable of removing hexavalent chromium from the skin. The employer is responsible for ensuring that employees use these facilities when necessary. This means that the employer may need to allow time at the beginning of the shift for employees to change from their street clothes into their work clothing. And at the end of the shift the employees may need to have time to wash or shower as necessary and to change back into their street clothing. The employee cannot take clothing or equipment worn during work home with them. The regulations require one shower for every 10

employees of each sex during the same shift. The employer must also furnish body soap, hot and cold water, and clean towels. According to OSHA, the time the employees spend to wash, shower, and change their clothing is considered to be part of their workday and they must be paid for this time. Therefore, it would be prudent to adjust the employees' schedules to allow time for these activities at the start and end of their workday.

Eating and drinking areas and surfaces at worksites where hexavalent chromium is present must be maintained as free as practicable of hexavalent chromium. Employees must be prohibited from entering eating or drinking areas with protective clothing or equipment that may be contaminated with hexavalent chromium.

Employees must be prohibited from eating, drinking, smoking, chewing tobacco or gum, or applying cosmetics in regulated areas or in areas where skin or eye contact with hexavalent chromium occurs. These items (food, drink, tobacco, and cosmetics) may not be carried or stored in these areas. Employees should keep these items in an approved break room or in a locker with their street clothing. Providing a lunchroom or break room facilitates good personal hygiene and provides opportunities for employees to eat in areas other than their work area. The lunchroom facility needs a temperature controlled, positive pressure, filtered air supply and needs to be readily accessible to employees. Employees are not to use the lunchroom with protective work clothing or equipment unless they have decontaminated their clothing and/or equipment.

Regulated areas

Any area where employees may have exposures to airborne concentrations of hexavalent chromium that exceed, or may be reasonably expected to exceed, the PEL must be demarcated from the rest of the workplace in a manner that adequately establishes the boundaries of the regulated area and alerts employees to these boundaries. Access to the regulated areas must be restricted to persons authorized by the employer and required by work duties to be in the area.

Medical surveillance

It is required for the employer to set up a medical surveillance program at no cost to the employees if they are exposed to hexavalent chromium over the action level ($2.5 \mu\text{g}/\text{m}^3$) for more than 30 days per year, if employees exhibit signs or symptoms of adverse effects of exposure to hexavalent chromium, or if they are exposed in an emergency. The contents of the medical examination must include:

- A medical and work history, with emphasis on: Past, present, and anticipated future exposure to hexavalent chromium; any history of respiratory system dysfunction; any history of asthma, dermatitis, skin ulceration, or nasal septum perforation; and smoking status and history
- A physical examination of the skin and respiratory tract
- Any additional tests deemed appropriate by the physician or licensed healthcare professional (PLHCP) conducting the exam

Medical exam frequency

The exams must be provided to a covered employee within 30 days of initial job assignment unless the employee has received a hexavalent chromium related medical examination in the last 12 months that meets the requirements of the standard.

Exams must also be offered:

- On an annual basis,
- Within 30 days of receiving a written medical opinion from a PLHCP that recommends additional exams,
- Whenever an employee show signs or symptoms of the adverse health effects as-associated with hexavalent chromium overexposure,
- Within 30 days after exposure during an emergency which results in an uncontrolled release of hexavalent chromium, or
- At the termination of employment, unless the last exam which meets the requirements of the OSHA standard was less than 6 months prior to the date of termination.

Information provided to and from the PLHCP

The employer must provide the following information to the PLHCP:

- A copy of the OSHA Hexavalent Chromium Standard;
- A description of the employee's former, current, and anticipated duties as they re-late to the employee's occupational exposures to hexavalent chromium;
- The employee's former, current, and anticipated levels of occupational exposure to hexavalent chromium;
- A description of any personal protective equipment used or to be used by the employee, including when and for how long the employee has used that equipment; and
- Information from records of employment-related medical examinations previously provided to the affected employee, currently within the control of the employer.

The PLHCP must provide a written medical opinion to the employer within 30 days which contains the following information:

- A written opinion as to whether the employee has any detected medical condition(s) that would place the employee at increased risk of material impairment to health from further exposure to hexavalent chromium;
- Any recommended limitations upon the employee's exposure to the hexavalent chromium or upon the use of personal protective equipment such as respirators;
- A statement that the PLHCP has explained to the employee the results of the medical examination, including any medical conditions related to hexavalent chromium that require further evaluation or treatment, and any special provisions for use of protective clothing or equipment.

The PLHCP must not reveal to the employer any specific findings or diagnoses unrelated to occupational exposures to hexavalent chromium. The employer must provide a copy of the PLHCP's written medical opinion to the examined employee within two weeks after receiving it.

Employee information and training

In addition to the requirements of the OSHA Hazard Communication Standard, 1910.1200, employers must provide the following information and training to employees if they have potential hexavalent chromium exposure at their workplace:

- 1) The contents of the OSHA Hexavalent Chromium Standard;
- 2) The purpose and a description of the medical surveillance program required by the standard;
- 3) The specific nature of the operations which could result in overexposure to hexa-valent chromium;
- 4) The purpose, proper selection, fitting, use and limitations of respirators and any other personal protective equipment used.
- 5) The proper use of ventilation or other engineering controls used to reduce employee exposures to hexavalent chromium.

Recordkeeping

The employer must maintain an accurate record of all air monitoring conducted to comply with the requirements of the hexavalent chromium standard. The record must include at least the following information:

- The date the measurement was taken;
- The operation involving exposure to hexavalent chromium that is being monitored; • Sampling and analytical methods used and evidence of their accuracy; • Number, duration, and the results of samples taken;
- Type of personal protective equipment, such as respirators worn; and
- Name, social security number, and job classification of all employees represented by the monitoring, indicating which employees were actually monitored. Note: Oregon OSHA has stated that because of concerns about identity theft they are not requiring the social security numbers of the employees being monitored to be collected or included in the monitoring data.

The employer must keep the exposure monitoring records for at least 30 years.

Employee medical records must be kept at least 30 years beyond duration of employment and the employer must provide employee access to the monitoring records in a reasonable time, place, and manner.

Historical monitoring and objective data

If the employer has relied on historical monitoring data to determine exposure to hexavalent chromium, they must establish and maintain an accurate record of the historical monitoring data relied upon.

Historical monitoring data and objective data or air monitoring data may be used to demonstrate that a process or task will not result in employee exposures above the PEL for 30 or more days per year. Other information, such as production orders showing that processes involving Cr(VI) exposures are conducted on fewer than 30 days per year, may also be used to demonstrate that

employees performing a process or task will not be exposed above the PEL for 30 or more days per year.

If exposure determinations show that whenever a process or task is performed under certain defined conditions the PEL is not exceeded, then any days on which that process, or task is performed under those conditions need not be counted for purposes of the 30-day exception. For example, if welders' exposures are determined to be at or below the PEL whenever they use specified low-chromium content materials, then days on which employees are welding only on those low-chromium content materials do not need to be counted as days above the PEL for purposes of the 30-day exception. The obligation to demonstrate that employees in a process or task will not be exposed above the PEL for 30 or more days per year is the same for general industry, construction, and shipyard employers.

Signs: Any area where employee exposures are reasonably expected to be more than the PEL must be demarcated from the rest of the work area in a manner that adequately establishes boundaries and alerts employees of the boundaries of the regulated area. There are no specific regulations for warning signs, but the following sign is recommended:

WARNING

**HEXAVALENT CHROMIUM WORK AREA NO SMOKING OR EATING
WEAR APPROPRIATE PROTECTIVE EQUIPMENT**

(The employer should specify the type of equipment here.)

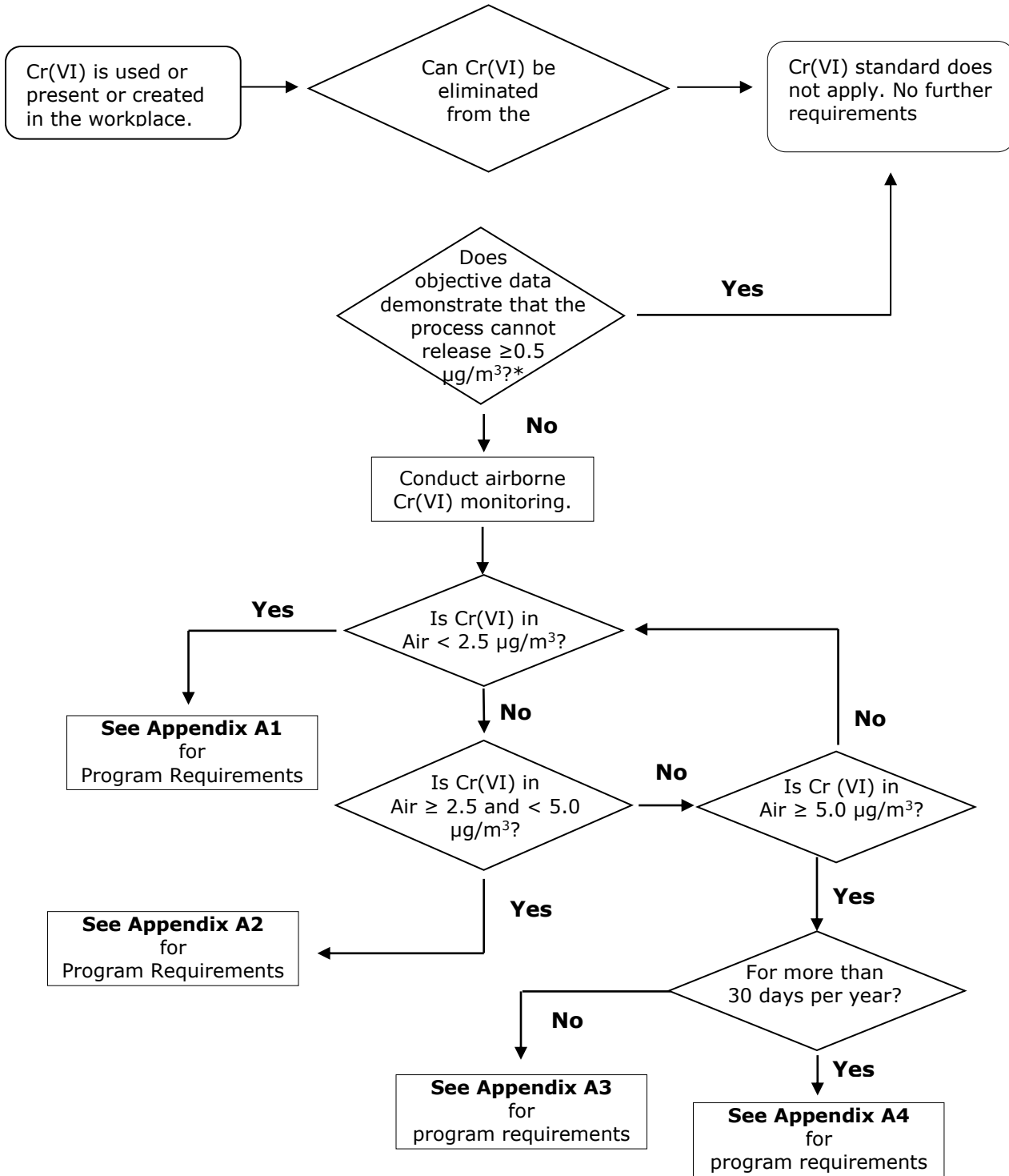
Resources

Oregon OSHA topic page: hexavalent chromium
<http://osha.oregon.gov/Pages/topics/hexavalent-chromium.aspx>

Federal OSHA safety and health topics: hexavalent chromium
<https://www.osha.gov/SLTC/hexavalentchromium/index.html>

CDC/NIOSH workplace safety and health topics: hexavalent chromium
<http://www.cdc.gov/niosh/topics/hexchrom/>

Appendix A: flowchart guide to Cr(VI) requirements



*Cr(VI) standard does not apply where the employer has objective data demonstrating that a material containing chromium or a specific process, operation, or activity involving chromium cannot release dusts, fumes, or mists of Cr(VI) in 8-hour TWA concentrations at or above 0.5 µg/m³ under any expected conditions of use. When this provision applies, the material, process, operation, or activity shown not to result in Cr(VI) exposures above the 0.5 µg/m³ threshold falls outside the scope of the Chromium (VI) standards. This exemption from the scope of the standard is based on total Cr(VI) exposures from all sources and must take into account all conditions that may add or contribute to the employees' overall exposure levels. The data must meet 3 key requirements, See details in OR-EGON OSHA Program Directive A-270.

Appendix A1: program requirements when air monitoring results show levels less than the action level of 2.5 µg/m³

1. Record employee(s) exposure level(s).
2. Record the:
 - Date of measurement for each sample;
 - The operation involving exposure to hexavalent chromium that is being monitored;
 - Sampling and analytical methods used and evidence of their accuracy;
 - Number, duration, and results of samples taken;
 - Type of personal protective equipment, such as respirators worn, and
 - Names and social security numbers of each employee monitored (note: OR OSHA does not enforce the requirement for recording the employee's social security number,)
3. Maintain the air sampling records in accordance with 29 CFR 1910.1020,
4. Notify the affected employees of monitoring results by either posting the results in an appropriate location that is accessible to all affected employees or notify each affected employee individually in writing of the results.
5. Repeat the monitoring whenever there has been any change in the production process, raw materials, equipment, personnel, work practices, or control methods that may result in new or additional exposures to hexavalent chromium or when the employer has any reason to believe that new or additional exposures have occurred.
6. Employees must be trained so that they can demonstrate knowledge of the contents of the hexavalent chromium standard, and the purpose and a description of the medical surveillance program required by this standard. A copy of the standard must also be made readily available without cost to the employees.

Appendix A2: program requirements when air monitoring results show levels at or above the action level and below the PEL (≥ 2.5 and $< 5.0 \mu\text{g}/\text{m}^3$)

1. Repeat the monitoring every six months.
2. Notify the affected employees of monitoring results by either posting the results in an appropriate location that is accessible to all affected employees or notify each affected employee individually in writing of the results.
3. Medical surveillance is necessary if air samples show hexavalent chromium at greater than $2.5 \mu\text{g}/\text{m}^3$ for more than 30 days per year (see 1910.1026 Medical Surveillance Requirements).
4. Employees must be trained so that they can demonstrate knowledge of the contents of the hexavalent chromium standard, and the purpose and a description of the medical surveillance program required by this standard. A copy of the standard must also be made readily available without cost to the employees.
5. Continue monitoring until at least two consecutive measurements, taken at least seven days apart, are below the action level. At this time, you can discontinue monitoring for that employee.
6. Repeat the monitoring whenever there has been a production, process, control, or personnel change which may result in new or additional exposure to hexavalent chromium, or whenever you feel there is a new or additional exposure to hexavalent chromium for your employees.

Appendix A3: program requirements when air monitoring results show levels at or above the PEL ($\geq 5.0 \mu\text{g}/\text{m}^3$) for less than 30 days per year

1. Repeat monitoring quarterly.
2. Notify employees of the results of each monitoring within 15 working days of receiving the results, either by posting them in an area that is accessible to all employees or by providing them to each affected employee individually in writing.
3. Provide respiratory protection to employees to reduce and maintain their exposures to hexavalent chromium to or below the PEL of $5.0 \mu\text{g}/\text{m}^3$. The use of respirators by employees must comply with the OSHA Respiratory Protection Standard, 1910.134.
4. Establish a regulated area where employee exposures to hexavalent chromium can reasonably be expected to exceed the PEL. This area must be demarcated from the rest of the workplace in a manner that adequately establishes boundaries and alerts employees of the boundaries of the regulated area.
5. Establish procedures for use of protective work clothing and equipment, including:
 - Provisions and use
 - Removal and Storage
 - Cleaning and replacement
 - Provide cleaning, laundering, or disposal of protective clothing and equipment.
 - Clean, launder, repair, or replace required protective clothing and equipment as needed to maintain their effectiveness.
 - Ensure that all protective clothing is removed at the completion of a work shift only in change rooms provided for that purpose.
 - Assure that contaminated protective clothing that is to be cleaned, laundered, or disposed of is placed in a closed container in the change room, which prevents dispersion of hexavalent chromium outside the container.
 - Inform in writing any person who cleans or launders protective clothing or equipment of the potentially harmful effects of exposure to hexavalent chromium.
 - Ensure that containers of contaminated protective clothing and equipment are labeled in accordance with the OSHA Hazard Communication Standard, 1910.1200.
 - Prohibit the removal of hexavalent chromium from protective clothing or equipment by blowing, shaking, or any other means that disperses hexavalent chromium into the air or onto an employee's body.
6. Establish housekeeping procedures that keep all surfaces as free as practicable of accumulations of hexavalent chromium.
7. Establish hygiene facilities and practices (see 1910.1026(i)), including:
 - Change rooms
 - Washing facilities
 - Eating and drinking areas
8. Train employees so that they can demonstrate knowledge of the contents of the hexavalent chromium standard, and the purpose and a description of the medical surveillance program required by this standard. A copy of the standard must also be made readily available without cost to the employees.

Appendix A4: program requirements when air monitoring results show levels at or above the PEL ($\geq 5.0 \mu\text{g}/\text{m}^3$) for more than 30 days per year

1. Repeat monitoring quarterly.
2. Notify employees of the results of each monitoring within 15 working days of receiving the results, either by posting them in an area that is accessible to all employees or by providing them to each affected employee individually in writing.
3. Implement engineering and work practice controls to reduce and maintain employee exposure to hexavalent chromium to or below the PEL, unless it can be demonstrated that they are not feasible.
4. Where painting of aircraft or large aircraft parts is performed in the aerospace industry, the employer must use engineering and work practice controls to reduce and maintain employee exposure to hexavalent chromium to or below $25 \mu\text{g}/\text{m}^3$, unless it can be demonstrated that such controls are not feasible.
5. Wherever feasible engineering and work practice controls are not sufficient to reduce employee exposures to or below the PEL, they must be used to reduce the exposures to the lowest levels achievable, and then must be supplemented with the use of respiratory protection. The use of respirators by employees must comply with the OSHA Respiratory Protection Standard, 1910.134.
6. Rotating employees to different jobs to achieve compliance with the PEL is not allowed by the OSHA Hexavalent Chromium Standard.
7. Establish procedures for use of protective work clothing and equipment, including:
 - Provisions and use
 - Removal and Storage
 - Cleaning and replacement
 - Provide cleaning, laundering, or disposal of protective clothing and equipment.
 - Clean, launder, repair, or replace required protective clothing and equipment as needed to maintain their effectiveness.
 - Ensure that all protective clothing is removed at the completion of a work shift only in change rooms provided for that purpose.
 - Assure that contaminated protective clothing that is to be cleaned, laundered, or disposed of is placed in a closed container in the change room, which prevents dispersion of hexavalent chromium outside the container.
 - Inform in writing any person who cleans or launders protective clothing or equipment of the potentially harmful effects of exposure to hexavalent chromium.
 - Ensure that containers of contaminated protective clothing and equipment are labeled in accordance with the OSHA Hazard Communication Standard, 1910.1200.
 - Prohibit the removal of hexavalent chromium from protective clothing or equipment by blowing, shaking, or any other means which disperses hexavalent chromium into the air or onto an employee's body.
8. Establish housekeeping procedures that keep all surfaces as free as practicable of accumulations of hexavalent chromium.
9. Establish hygiene facilities and practices (see 1910.1026(i)), including:
 - Change rooms
 - Washing facilities
 - Eating and drinking areas

10. Establish a medical surveillance program (see 1910.1026(k)), including:

- A medical examination which consists of:
 - A medical and work history, with emphasis on: Past, present, and anticipated future exposure to hexavalent chromium; any history of respiratory system dysfunction; any history of asthma, dermatitis, skin ulceration, or nasal septum perforation; and smoking status and history
 - A physical examination of the skin and respiratory tract
 - Any additional tests deemed appropriate by the physician or licensed healthcare professional (PLHCP) conducting the exam –The medical examination must be conducted:
 - On an annual basis,
 - Within 30 days of receiving a written medical opinion from a PLHCP that recommends additional exams,
 - Whenever an employee show signs or symptoms of the adverse health effects associated with hexavalent chromium overexposure,
 - Within 30 days after exposure during an emergency that results in an uncontrolled release of hexavalent chromium, or
 - At the termination of employment, unless the last exam that meets the requirements of the OSHA standard was less than 6 months prior to the date of termination.
- Employee medical records must be kept for at least 30 years beyond duration of employment and employees must be granted access to the records in accordance with the OSHA regulation 1910.1020, Access to Employee Exposure and Monitoring Records.

11. Train employees so that they can demonstrate knowledge of the contents of the hexavalent chromium standard, and the purpose and a description of the medical surveillance program required by this standard. A copy of the standard must also be made readily available without cost to the employees.

Appendix B: Cr(VI) compounds and typical industries/operations with exposures

Table 2: Common Cr(VI) compounds

Name and chemical formula of compound	
Acid copper chromate (ACC) - formulation of cupric oxide, CuO, and chromic acid, CrO ₃	Chromic sulfate, Cr(OH)SO ₄
	Lead chromate, PbCrO ₄
Ammonium dichromate, (NH ₄) ₂ Cr ₂ O ₇	Potassium chromate, K ₂ CrO ₄
tert-Butyl chromate, [(CH ₃) ₃ CO] ₂ CrO ₂	Potassium dichromate, K ₂ Cr ₂ O ₇
Calcium chromate, CaCrO ₄	Sodium chromate, Na ₂ CrO ₄
Chromated copper arsenate (CCA) formulation of arsenic pentoxide, As ₂ O ₅ , chromic acid, CrO ₃ , and cupric oxide, CuO	Strontium chromate, SrCrO ₄
Chromic acid (H ₂ CrO ₄), chromium trioxide (CrO ₃), or chromium oxide	Zinc chromate, ZnCrO ₄

Table 3: Typical industries/operations with Cr(VI) exposures

Industry	Type of Exposure
Manufacture of chromates	Various Cr(VI) compounds
Iron and steel foundries; steel mills; forging	Chromium metal, Cr(VI) fume
Welding ¹ of stainless steel or Cr(VI) coatings	Cr in steel oxidized to Cr(VI) fume when welded or torch-cut
Manufacture of pesticides (applications are excluded from Cr(VI) standards)	Acid copper chromate (ACC) - formulation of cupric oxide, CuO, and chromic acid, CrO ₃ ; Chromated copper arsenate (CCA) - formulation of arsenic pentoxide, As ₂ O ₅ , chromic acid, CrO ₃ , and cupric oxide, CuO
Manufacture of glass	Sodium dichromate dihydrate, Na ₂ Cr ₂ O ₇ [H ₂ O] ₂
Cleaning laboratory glassware	Potassium dichromate
Electroplating; chrome plating	Chromic acid

Construction with pressure-treated wood (manufacturing of pressure-treated wood is excluded in the Cr(VI) standards)	Acid copper chromate (ACC) - formulation of cupric oxide, CuO, and chromic acid, CrO ₃ ; Chromated copper arsenate (CCA) - formulation of arsenic pentoxide, As ₂ O ₅ , chromic acid, CrO ₃ , and cupric oxide, CuO
Operations with Portland cement	Excluded from Cr(VI) standard but must meet the Air contaminant PEL, PPE, general hygiene & training.
Manufacture of chromate pigments and dyes	Dichromates, lead chromate (chrome yellow); strontium chromate; zinc chromate
Painting (aerospace, auto body repair, traffic markings); paint removal from steel structures	Lead chromate, zinc chromate, strontium chromate
Fiberglass production	Cr(VI) contaminants formed in furnace

¹ Factors that can affect the concentration of Cr(VI) in the welding fume include the composition of the base metal and the welding consumable (electrodes or welding rods), as well as the chromium content of surface coatings on the base metal. Exposures tend to be higher for welding on stainless steel (12-30% chromium) compared with welding on carbon steel (generally 3% chromium or less). Also, the more confined the working space or the absence of effective exhaust, the higher the concentration of welding fume. A suggested reference on characteristics of welding processes is Chapter III of the NIOSH Criteria for a Recommended Standard on Welding, Brazing, and Thermal Cutting.