Washington State Department of
Labor & Industries

Hexavalent Chromium (chrome 6)

Training on the hazards of hexavalent chromium in the workplace

Developed by the Division of Occupational Safety & Health (DOSH) for employee training

August, 2009

What This Training Will Cover

- Characteristics of hexavalent chromium
- Health hazards of hexavalent chromium
- How you can be exposed to hexavalent chromium
- Control of your hexavalent chromium exposure
- Medical surveillance
- DOSH rules on hexavalent chromium

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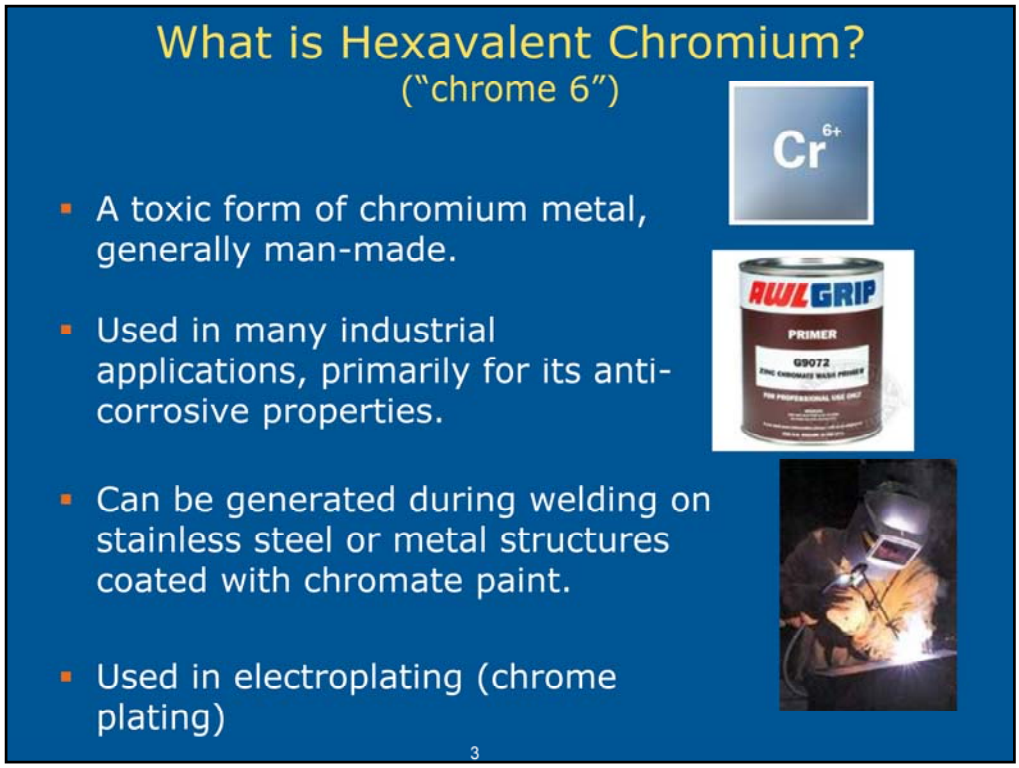
"You are being given this training because you may be exposed to hexavalent chromium at work. This training is done to meet L & I – DOSH safety and health regulations and to make sure you are protected from the hazards of this highly toxic form of chromium.
"You will also be given refresher training annually."



•"Chromium is a metal that exists in several forms or "valence states" - divalent, trivalent, and hexavalent. The hexavalent form of chromium, sometimes called "chromium or chrome 6", is a form that is known to be very toxic.
•Hexavalent chromium is not the same as metallic chromium you see on vehicles with chrome-plating.
•"It can exist as many different compounds that vary from highly water soluble (electroplating) to being practically insoluble in water. (most chromate paints)
•"Hexavalent chromium compounds have many varied uses in industry and are often used for their anti-corrosive properties in metal coatings, protective paints, dyes, and pigments.
•"Hexavalent chromium can also be formed when performing "hot work" such as welding on stainless steel, melting chromium metal, or heating refractory bricks in kilns, or performing hot work on steel structures with chromates in the coatings. In these situations, the chromium is not originally hexavalent but the high temperatures cause oxidation that converts the chromium to hexavalent chromium."

Products that contain hexavalent chromium

Product	Types of Hexavalent Chromium Chemicals
pigments in 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 (chrome plating, spray coatings)	•chromic trioxide (chromic acid) •zinc chromate •barium chromate •calcium chromate •sodium chromate •strontium chromate
stainless steel and other high chromium alloys	•hexavalent chromium (when cast, welded, or torch cut)
textile dyes	•ammonium dichromate •potassium chromate •potassium dichromate •sodium chromate
wood preservation	•chromium trioxide
leather tanning	•ammonium dichromate

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If a metal structure, airplane or vehicle has a green primer, it probably is zinc chromate. But you can't tell by color alone and often a paint chip would need to be sent to a lab to analyze for hexavalent chromium.

The use of hexavalent chromium in wood preservation and leather tanning had declined greatly in recent years. The operation of treating wood with hexavalent chromium is not covered by this standard, but construction activities using treated lumber is covered.

"Electroplating uses a water soluble form of hexavalent chromium. Depending on the type of electoplating, workers in electroplating operations can be exposed to chrome 6 mist and splashes or spills of liquid onto the skin.
Welding on stainless steel is one of the most common activity where workers would be exposed to chrome 6. Stainless steel contains 12% - 30 % chromium metal. High heat from welding on stainless steel creates hexavalent chromium in the welding fumes. Hexavalent chromium is found in chromate paints (lead and zinc chromates as examples.) Spray painting with chromate paints is one job where exposure to high levels of chrome 6 can occur.

A much less common job is the production of chromate pigment and chemicals containing chrome 6.

Other jobs with potential chrome 6 exposure

Road strip painting

- Chromium dye and catalyst production
- Glass manufacturing
- Plastic colorant production

bridge work

Construction
- Traffic painting
- Refractory brick restoration
- Paint removal from bridges
- Hazardous waste site work

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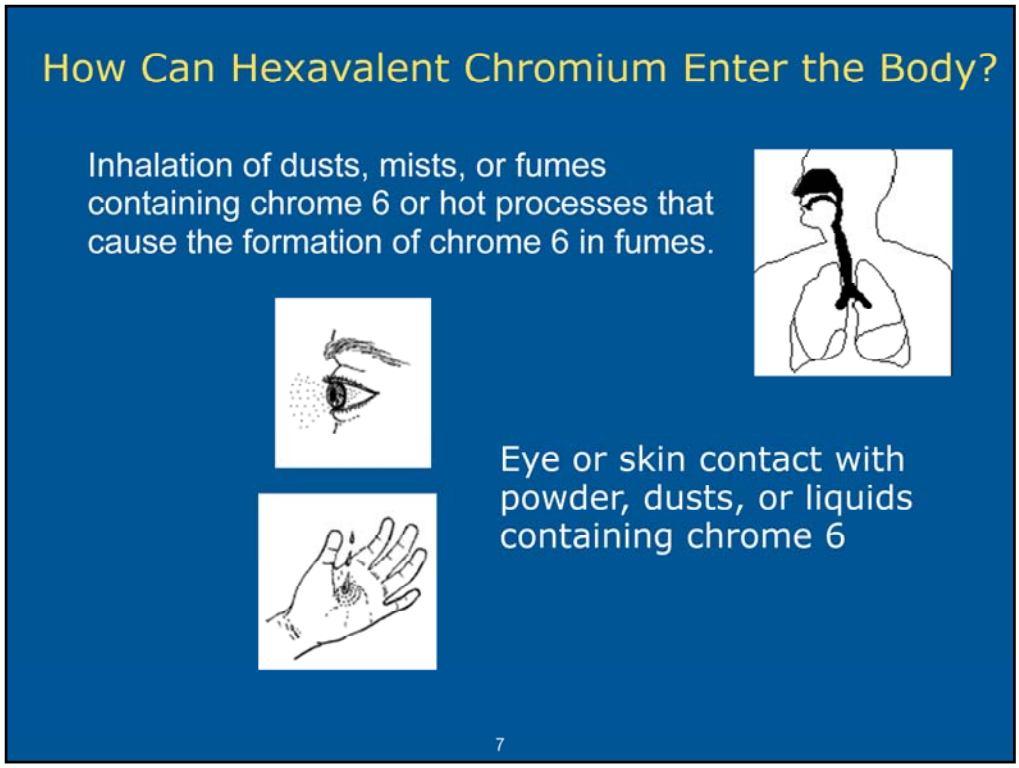
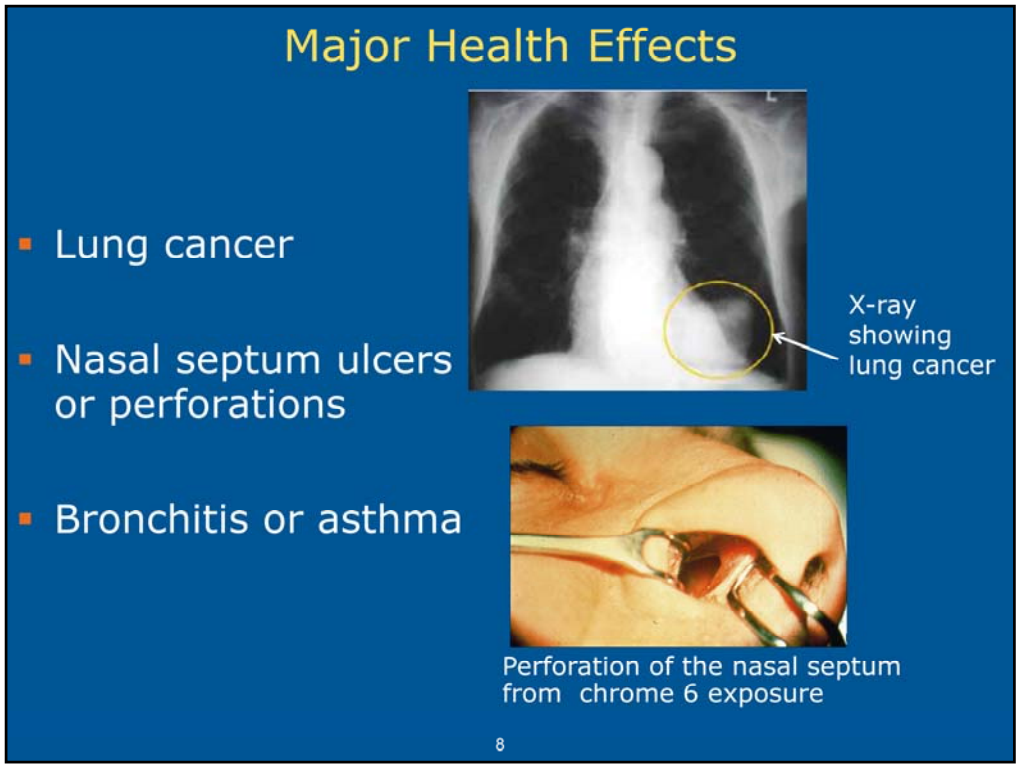
The green paint on this bridge is likely lead or zinc chromate



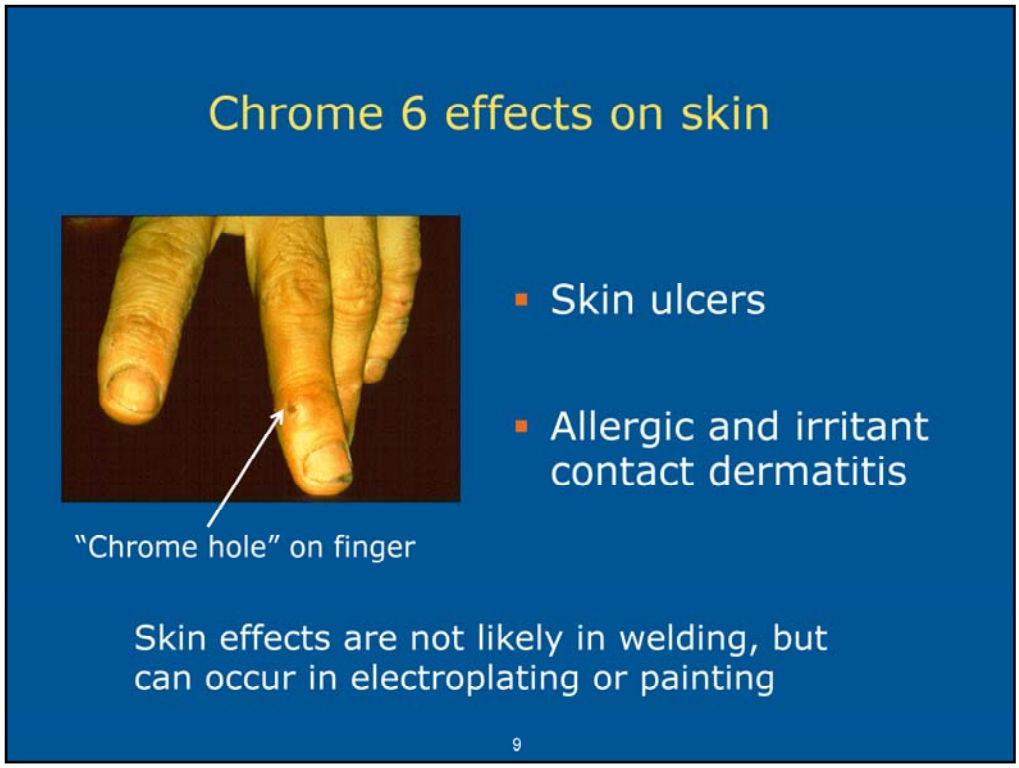
"The most common processes in the first bullet are spray painting (paint mist) or welding." The word "fumes" in this case means welding "smoke" rather than the common term sometimes used to describe auto exhaust or solvent vapors."

Eye or skin contact can occur in electroplating where chrome 6 is in the dip tank liquid. Mist or dust can come in contact with the skin and eyes while spray painting chromate paints (often primer) or grinding on objects coated with chromate paint, or cutting or sawing wood treated with hexavalent chromium. Use of chromium in iron and steel foundries or steel mills can also create dust that could get in the eyes or on the skin.



•"The primary health effect of concern is lung cancer caused by airborne exposures to hexavalent chromium. Chronic inhalation increases the risk of lung cancer. All Cr(VI) compounds are considered to be carcinogenic.

•"Symptoms from breathing Cr(VI) may include runny nose, sneezing, coughing, itching, and a burning sensation from irritation or damage to the nose, throat, and lung. In severe cases sores can develop in the nose and result in nosebleeds. Ulcers can develop and with continuous exposure, permanent perforations (holes) in the nasal septum (the wall separating the nasal passages) can occur, as seen in the photo of a worker employed in a chrome plating shop.
•"In some cases employees become "allergic" and sensitized to hexavalent chromium so that inhaling chromate compounds can cause work-related asthma, such as wheezing and shortness of breath."



•"Hexavalent chromium in contact with skin acts as both sensitizer and irritant. Once developed, chrome sensitivity becomes fairly persistent; in such cases, even contact with chromate-dyed textiles or wearing of chromate-tanned leather shoes can cause or exacerbate contact dermatitis.

•"Dermal exposures to hexavalent chromium can result in skin ulcers commonly referred to as "chrome holes" and may also lead to dermatitis. They have a corrosive action when they enter the skin through a minor nick or break in the skin, resulting in the formation of the ulcers. Typically, the lesions are found on fingers, hands or forearms. "Chrome holes" also occur on the bottom surfaces of the feet when chrome salts have been allowed to permeate boots or shoes. The lesions are usually painless and persist for many months before spontaneously healing with a permanent scar."

The following operations/work areas where you may be exposed to chrome 6 are:

[List the operations or work areas where chrome 6 is present.]

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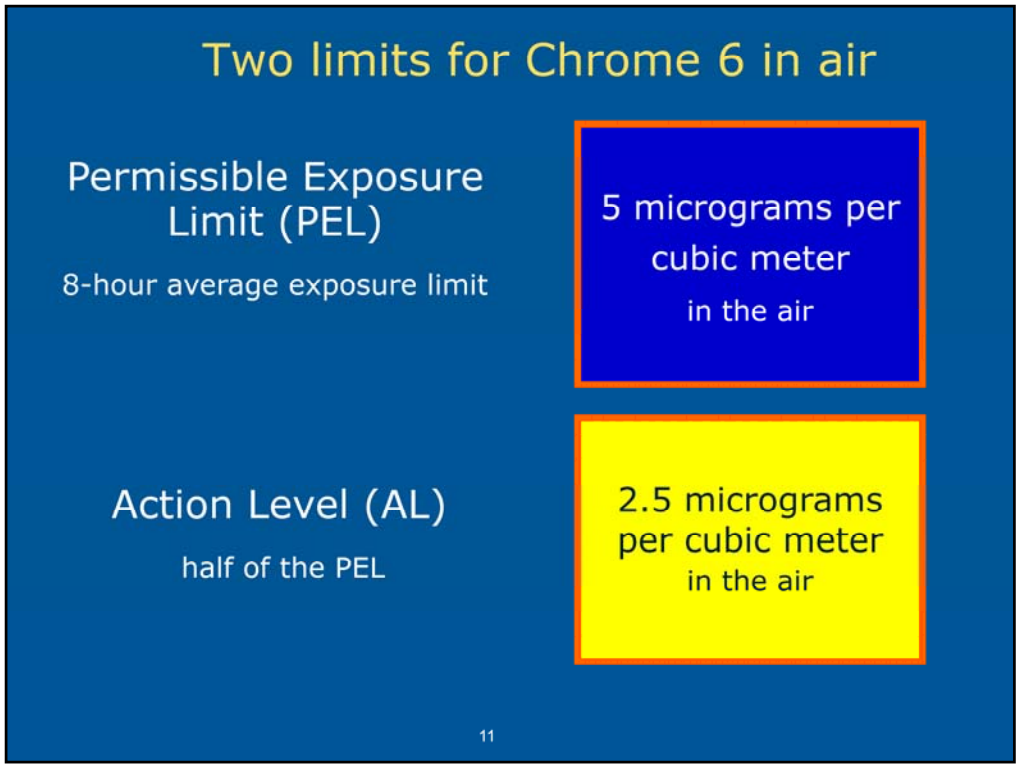

"The permissible exposure limit is the maximum average concentration of hexavalent chromium that you can be exposed to in air for a normal 8-hour working day and 40-hour week. The DOSH hexavalent chromium regulation states that we must make sure no employee is exposed to an airborne concentration of chrome 6 above the PEL.

The Action Level (AL) is ½ the PEL, or 2.5 micrograms of chrome 6 per cubic meter of air and if exceeded, triggers certain requirements for air monitoring and medical surveillance. More about those later.

These levels of chrome 6 are extremely low – think of a single grain of sand in 3 ft. square box, ground up to particles so fine they would be invisible and spread out evenly in the air in the box, as a rough comparison.

Air Monitoring for Chrome 6

To determine your exposure to chrome 6, we have elected to do air monitoring using the following schedule:

If initial Chrome 6 concentration is:	Then:
– Below the AL	No further monitoring
– At or above the AL	Monitor every 6 months
– Above the PEL	Monitor every 3 months

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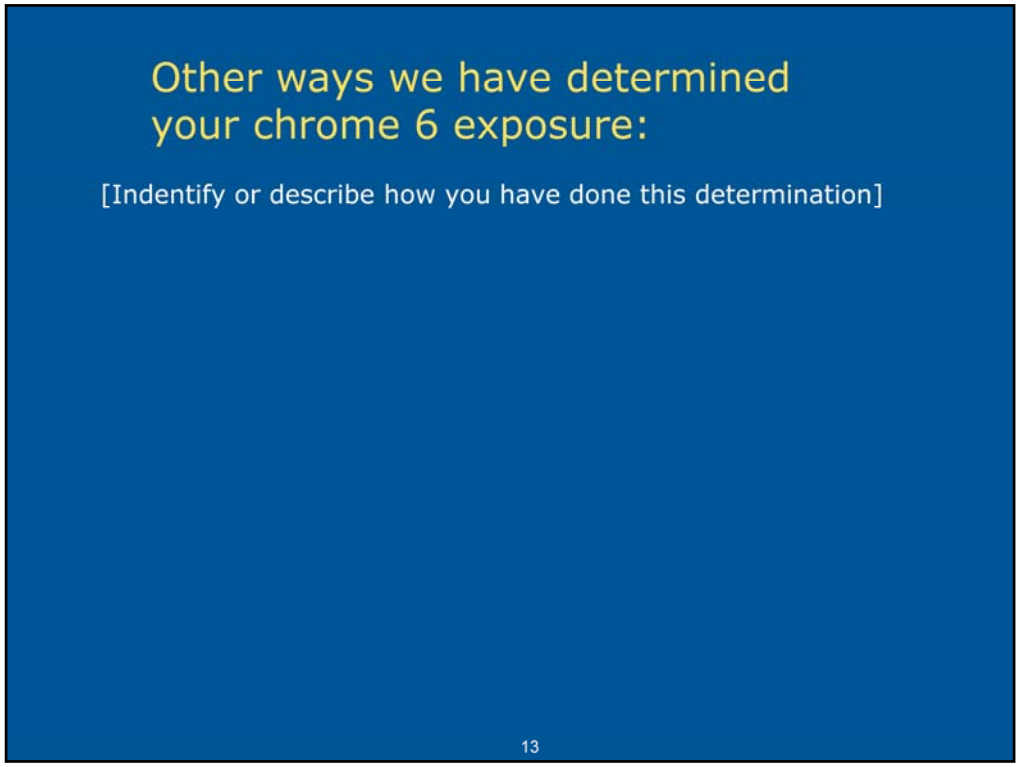
"The hexavalent chromium rule requires us to determine if you are in fact exposed to hexavalent chromium. One way we can do that is by air monitoring usually with a pump and filter attached to a worker like the photo. You have the right to observe this monitoring. The air monitoring must be done on a fixed schedule of conducting initial and periodic exposure air monitoring, where periodic monitoring is based on the results of the initial monitoring as shown in the colored chart.

"If periodic monitoring indicates that employee exposures are below the action level, and the result is confirmed by the result of another monitoring taken at least seven days later, monitoring may be discontinued for those employees whose exposures are represented by such monitoring.

"We will do additional monitoring will be performed when 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 chrome 6 or when there is any reason to believe that new or additional exposures have occurred."



[Optional slide]

Employer: the hexavalent chromium standard allows other methods of determining employee exposure to chrome 6 including historical air monitoring or “objective data sufficient to accurately characterize employee exposure to chromium VI”

Notification of air monitoring results

If air monitoring shows chrome 6 levels in the air exceed the PEL we must:

- Notify you within 5 days in construction or within 15 days in general industry

- Describe to you in writing what corrective actions we will take to reduce your exposure below the PEL.

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Note to Employer: Tell how you will provide exposure determination results to employees. This can be accomplished by posting the results in a location that is accessible to all affected employees or by notifying employees individually.

Employer: You can show air monitoring results on this slide or in a handout.

Regulated Areas

Areas where employee exposures do exceed or can be expected to exceed the PEL

- These area are clearly marked by: (describe method)
- Access is limited to:
  - authorized persons required by work duties to be there
  - designated representatives of employees for the purpose of observing monitoring procedures
  - employees entering must be wearing appropriate personal protective equipment such as a respirator.

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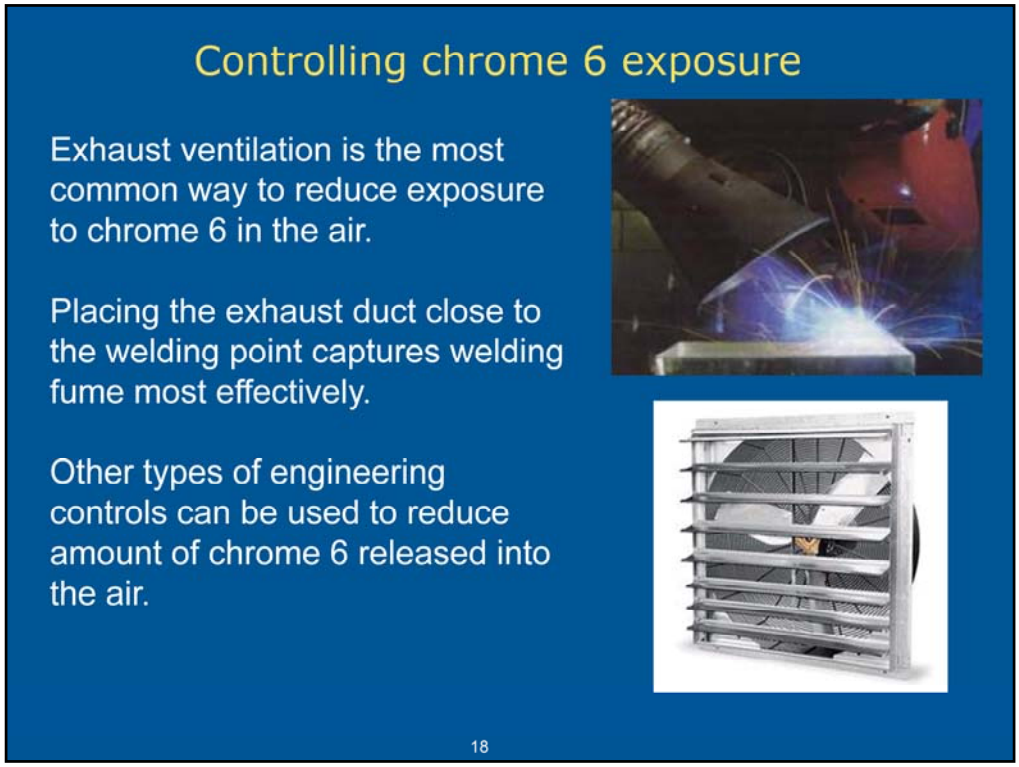
[Note: this applies to <u>General Industry</u> only]
" The boundaries of regulated areas are well marked so you can recognize them from the rest of the workplace.

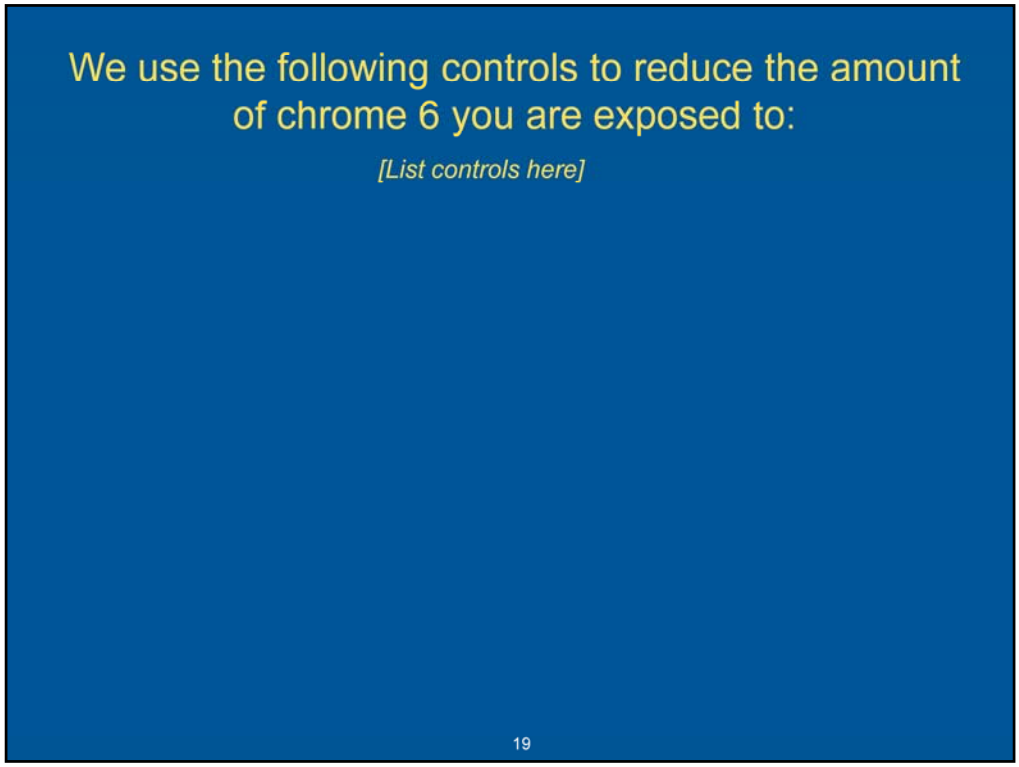
*[**Note to employer**: Regulated areas are to be demarcated from other areas but you have the flexibility to use any means you choose as long as the method effectively warns employees not to enter the area unless they are authorized, and are wearing the proper personal protective equipment.*

Note: not required for construction worksites.

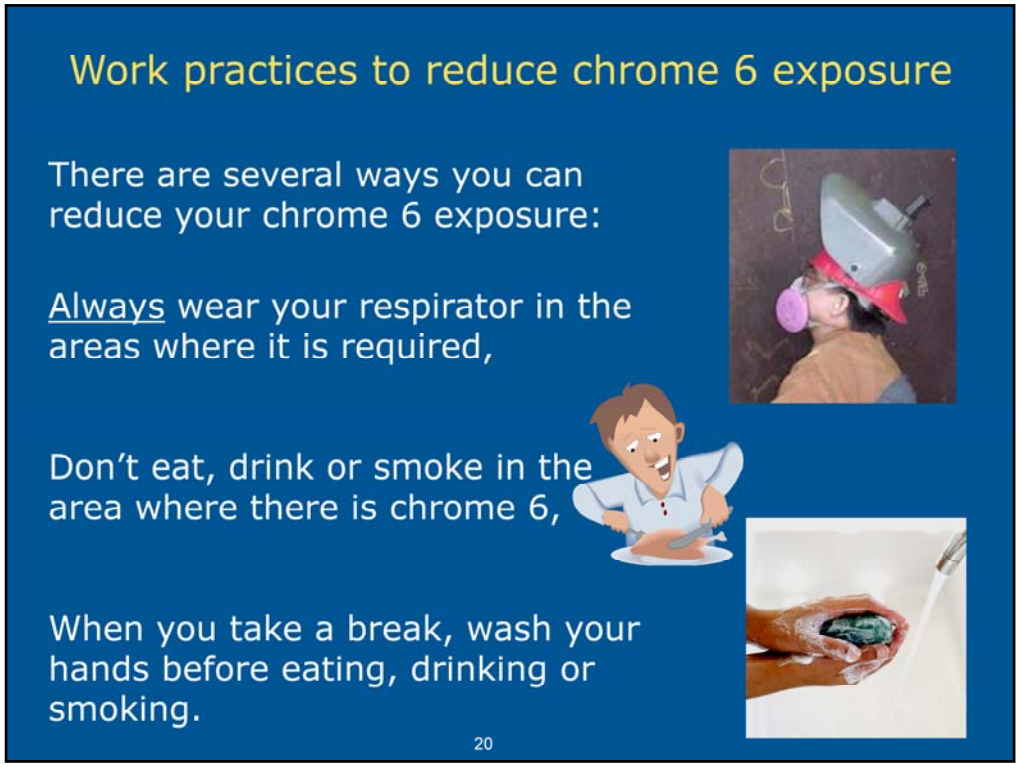


"Local exhaust ventilation can be used in stainless steel welding or welding, cutting or grinding on metal structures coated with chromate paint, or when spray painting with chromate-containing paints. In welding, TIG welding generates the least amount of welding fumes, followed by MIG welding and Stick welding. Stick welding can generate high levels of chrome 6 when welding on stainless steel. General room or building ventilation will usually not provide enough air movement to lower chrome 6 levels below the permissible exposure limit. Other engineering controls will depend on the type of operation and exposure to chrome 6.

Spray painting can be controlled with the use of well ventilated spray booths or rooms. Some hand-held grinders with built-in exhaust ventilation can be used when grinding on metal coated with chromate primer paint. "



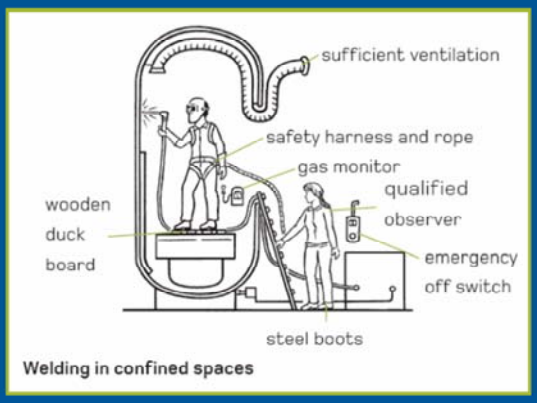
Employer: When feasible, you must consider first using engineering controls rather than personal protective equipment to prevent overexposure. You require employees to use respiratory protection, gloves, and protective clothing only when controls aren't feasible or if they can't completely remove the hazard.



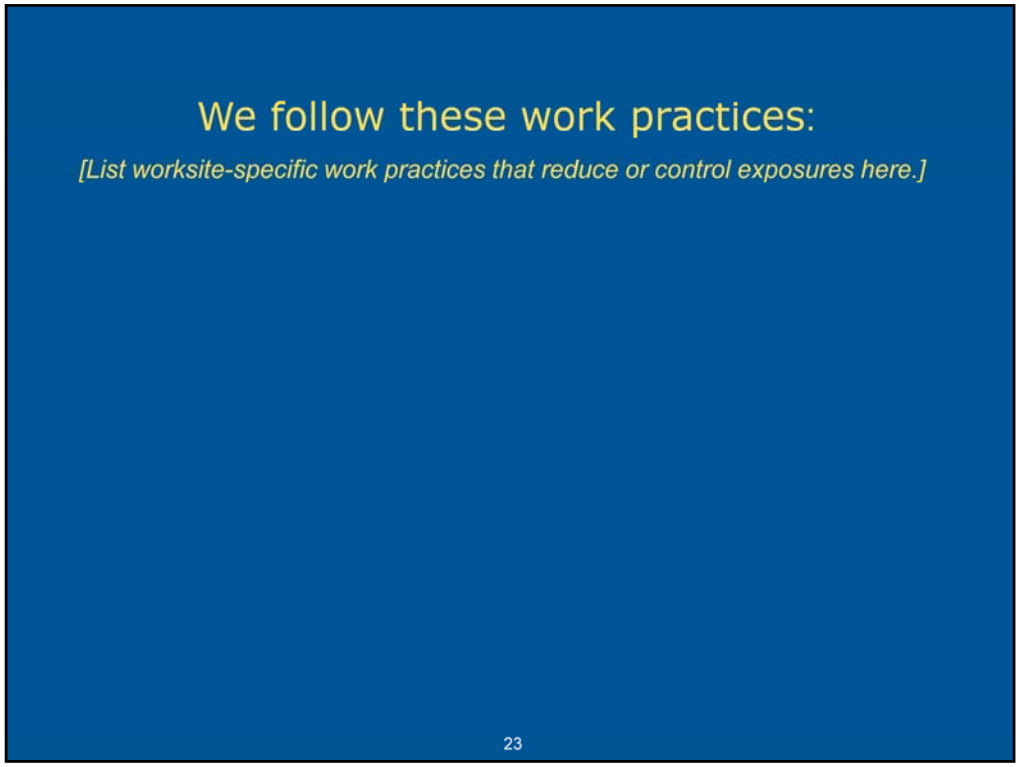
[You can talk here about where any eating areas or facilities are located, or where employees should eat, drink and smoke away from the area where they are or could be exposed to chrome 6. Also point out where washing facilities are located.]

"Since welding fumes typically go straight up, bending over a horizontal welding job like this puts the welder right in the welding plume. A local exhaust vent located close enough to the welding point to pull the fumes off to one side will greatly reduce the amount of welding fume containing chrome 6 in the welder's breathing zone."

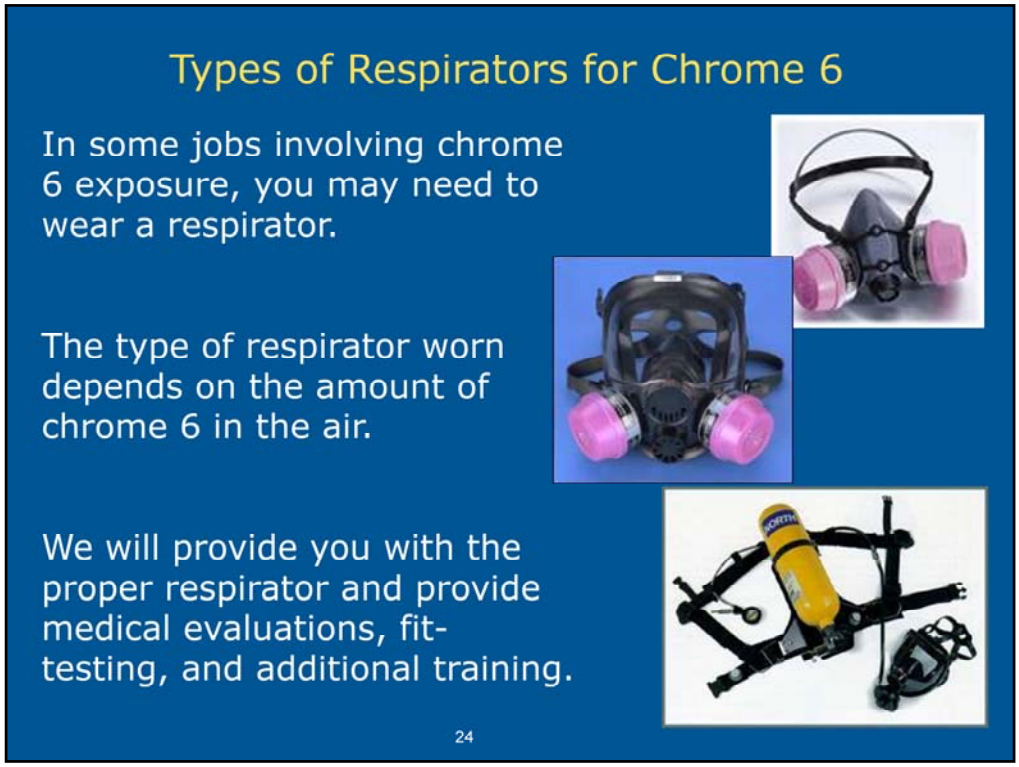
Welding in confined spaces



Welding on stainless steel in a confined space will most likely require both exhaust ventilation and the use of respirators.



[Employer: *list or describe the practices you require.]*



Respirators are required if the amount in the air is more than the Permissible Exposure Limit (PEL). We provide the respirators at no cost to you. Respirators with cartridges are always the "P100" type which provide the highest filtering capacity of the various types of cartridges. You can tell them by the pink color of the cartridges. If the amount of lead in the air is more than 10 times the permissible limit, then we must provide you with respirators that provide better protection. If the levels in the air are really high, we must provide you with supplied air respirators where you get clean uncontaminated air from a backpack tank (like the lower photo) or a compressor through an airline respirator.

Employer: Training on the use of these respirators can be done here or separately.

If chrome 6 levels in the air are above the PEL the DOSH rule requires respirator use in the following cases:

- During time needed to install or implement engineering and work practice controls.
- During maintenance or repair operations where engineering and work practice controls are not feasible
- Operations where all feasible controls have been used and exposures are still above the PEL .
- Operations where chrome 6 levels are above the PEL for less than 30 days per year. (your employer's option.)
- Emergencies (uncontrolled releases of chrome 6)

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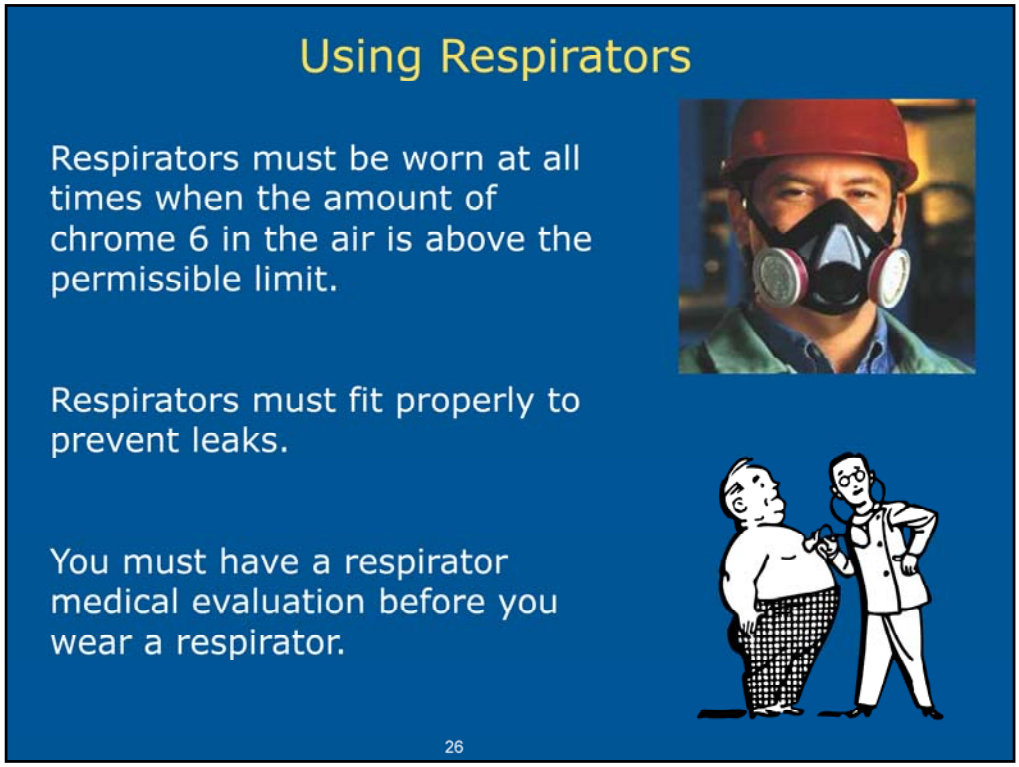
Employer: you have the option of not installing or implementing engineering controls or work practices to reduce hexavalent chromium levels below the PEL if the PEL is exceeded less than 30 days per year.



"Taking your respirator off just for minute can overexpose you to hexavalent chromium in the air. Respirators are only as good as they fit. If they leak, you will have a false sense of protection. A medical evaluation is required because respirators themselves cause some stress to the body, especially if a person has lung or heart problems." [If your employees wear respirators, they will need further training on their use, limitations and maintenance.]

"A beard prevents a tight fit, even a day's growth may cause leakage. You must be clean shaven to wear a tight-fitting respirator. We will cover the use of specific respirators you use in separate training."

When respirators are required, a respirator program will be followed that meets the requirements DOSH Respirator Regulations – WAC 296-842

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Type of Respirator You Will Use

List or describe what respirators must be used under what conditions, job tasks, or locations here]

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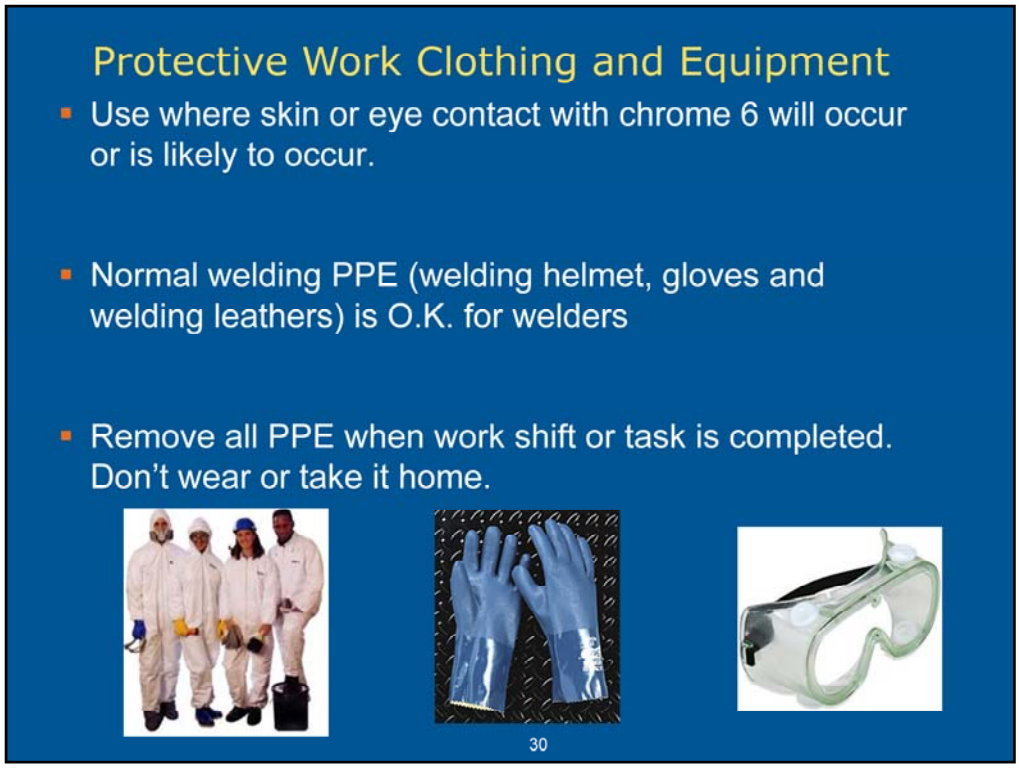

[**Note to Employer:** Because some hexavalent chromium exposures may also result in adverse effects on the skin and eyes, employers are required to provide and pay for protective work clothing and equipment when this situation exists. Electroplating is one example where rubber gloves, eye protection and rubber boots will likely be necessary. Grinding on chromate paint will likely generate enough dust that coveralls should be used. The normal PPE used by welders (leather gloves, welding helmet and welding leathers or coveralls) during welding on stainless steel will normally provide the needed protection for them.]

Protective Work Clothing Use

- Don't remove chrome 6 dust or residue from clothing by blowing, shaking, or any other means that disperses the dust into the air or onto the body.

Don't use compressed air to clean clothing

Don't shake out dusty coveralls or clothes

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Laundering and Cleaning PPE

We will launder, repair and replace all protective clothing and other protective equipment for you.

Put your contaminated PPE in a sealed bag for laundering or repair.

The person doing these tasks has been informed of the hazards of chrome 6.

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This would not normally apply to welders welding on stainless steel.

Hygiene Areas and Practices

If you have a job where chrome 6 can get on your skin or in your eyes, we will provide the following:

- Change rooms
  - separate storage facilities for PPE and street clothes
- Washing facilities

  Be sure to wash hands and face:
  - at the end of the work shift
  - before eating, drinking, smoking, chewing tobacco or gum, applying cosmetics, or using the toilet

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These procedures would not normally be required for welding operations. They would likely be required for electroplating, spray painting or removing chromate paints from metal surfaces.

Housekeeping

- Keep all surfaces as free as practicable of accumulations of dust containing chrome 6.
- Promptly clean up all spills and releases of chrome 6 containing materials
- Use a HEPA vacuum or wet methods for cleaning areas contaminated with dust or other materials containing chrome 6
- Dispose of chrome 6 contaminated waste in labeled & sealed bags or containers.

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[Note: applies to General Industry. only]

“Methods other than HEPA vacuums would include wet methods such as wet shoveling, wet sweeping, or wet brushing.
“Dry shoveling, dry sweeping, and dry brushing may be used only where HEPA-filtered vacuuming or other methods that minimize the likelihood of exposure to Cr(VI) have been tried and found not to be effective.
“

Who Must Be Provided Medical Exams?

- Any employee exposed at or above the action level for 30 or more days per year.
- Any employee experiencing signs or symptoms of chrome 6 exposure.
- Any employee exposed in an uncontrolled release of large amounts of chrome 6 in any form.

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"There are three categories of employees who must be offered medical surveillance:
• "Because routine exposures to chrome 6 may cause adverse effects such as nasal septum ulcerations, asthma, skin ulcerations or dermatitis, the standard requires medical surveillance to be offered to employees exposed above the action level for 30 or more days per year.
• "Some employees may experience signs and symptoms of chrome 6 exposure with less than 30 days exposure, so it is required that medical surveillance be offered to such individuals.
• "Medical surveillance after exposure during an emergency which results in an uncontrolled release of Cr(VI). Short-term effects such as skin ulcerations and dermatitis might result from high exposure during an emergency."

Medical Exams (cont.)

- Are done by or under the supervision of a physician or other licensed health care professional
- Provided at no cost to you at a reasonable place and time

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Medical Exams will do the following:

- Determine if you can be exposed to Chrome 6 without experiencing adverse health effects.
- Identify chrome 6 related adverse health effects so that appropriate measures can be taken.
- Determine your fitness to use respirators.

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“ If you have never worn a respirator before, the health care professional needs to determine if you have any health issues that would prevent you from wearing one. Breathing through a respirator can be difficult for anyone with a heart condition, asthma or other lung health issues.

Medical exams will include the following:

- Medical and work history
  - Cr(VI) exposure (past, present, future)
  - History of respiratory system dysfunction
  - History of asthma, dermatitis, skin ulceration or nasal system perforation
  - Smoking status and history
- Physical examination, with emphasis on the respiratory tract and skin
- Any additional tests deemed appropriate by the healthcare professional

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"We must offer you the medical exams, but you are not necessarily obliged to take them. However, it would be to your benefit to do so."

Employer: you can make medical exams a condition of employment. The hexavalent chromium standard simply requires you to make them available at no cost to the employee.

Medical Exams are offered:

- Within 30 days after initial assignment and annually thereafter
- Within 30 days after a doctor recommends additional examinations
- When employees shows signs or symptoms of Chrome 6 exposure
- Within 30 days after exposure during an emergency
- At the termination of employment

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"The requirement that the employer offer a medical examination at the termination of employment is intended to assure that no employee terminates employment while carrying an active, but undiagnosed, disease."

Healthcare professional's written medical opinion

- After your medical exam the health care professional will give a written medical opinion to us within thirty days
- Specific findings or diagnoses unrelated to occupational exposure to chrome 6 will be not revealed to us
- We will give you a copy of the written medical opinion within two weeks after we receive it

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The medical opinion contains information about:

- any medical conditions and any increased risk from further exposure to Cr(VI)
- recommended limitations regarding exposure or use of PPE such as respirators
- statement that healthcare professional explained to you the results of your medical examination and any special provisions for use of protective clothing or equipment

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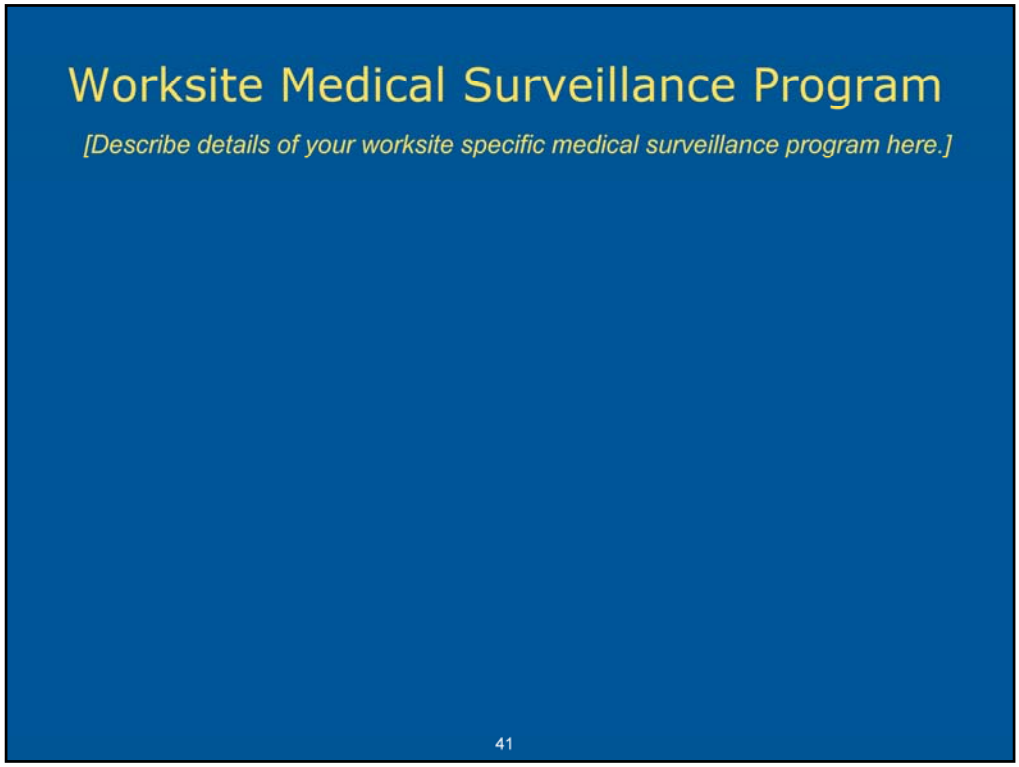
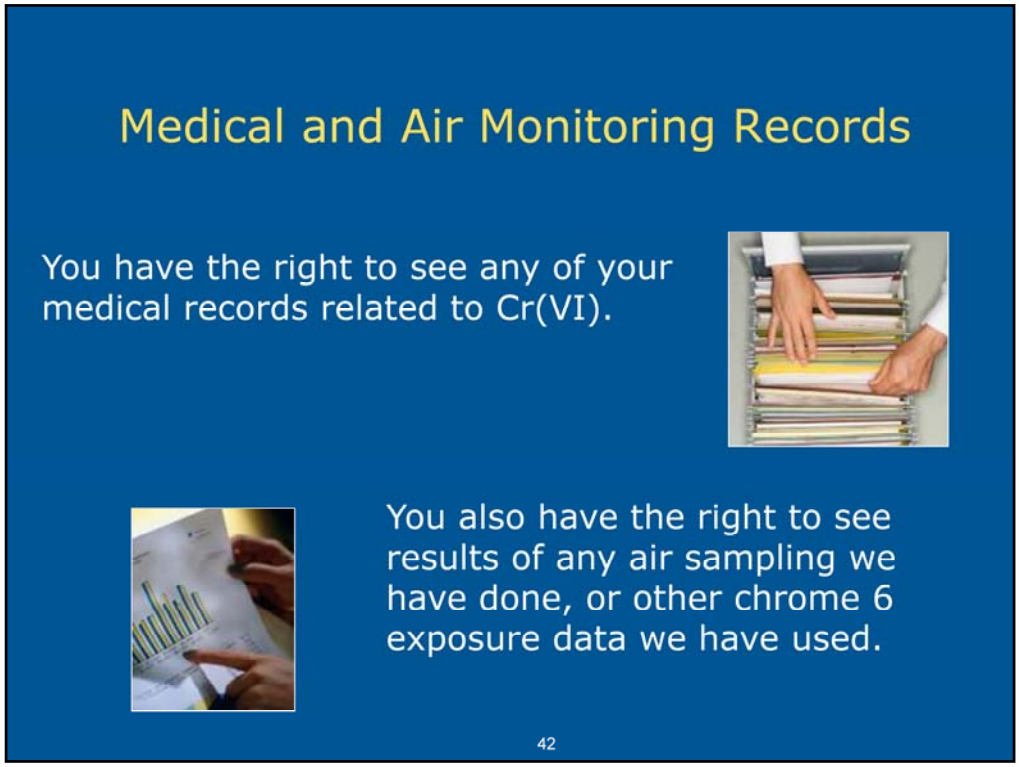


*[**Instructor**: describe medical surveillance program here.*
In addition to discussing your medical surveillance program include specific directions as to how obtain evaluations in the event of an emergency exposure.]



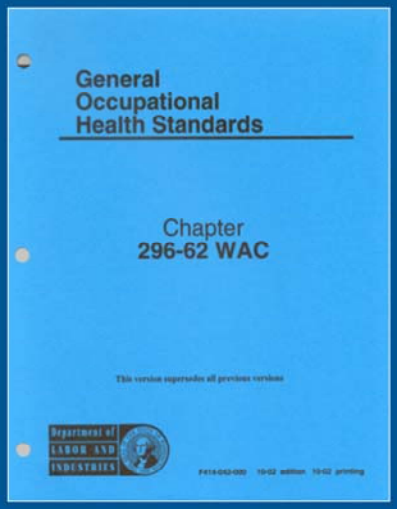
"Medical records are kept at *[name location]* and you can see them."

[Note to Employer: *If you have any records of air samples taken at the job site, inform your employees where these results can be viewed or post them, or give copies to affected employees.]*

Hexavalent Chromium Regulations

The WISHA regulation on Hexavalent Chromium - WAC 296-62-08003 contains much more information in detail.

A copy of this standard is available from the local L&I office.



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"The points we have covered here are required in this standard. We have given you copies of information about hexavalent chromium which covers the health effects of hexavalent chromium, what to do in an emergency, and other requirements of the standard plus additional information about the physical characteristics of this chemical. You can also get a copy of the standard at the following location:"
[Instructor**: **specify location**]

What Does the Standard Cover?

- Permissible Exposure Limit (PEL)
- Exposure Determination
- Regulated areas*
- Methods of Compliance
- Respiratory Protection
- Protective Work Clothing and Equipment
- Hygiene Areas and Practices
- Housekeeping*
- Medical Surveillance
- Communication of Hazards
- Recordkeeping

*General industry only

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"Listed here are the various provisions of the standard. The provisions for regulated areas and housekeeping apply only to general industry."