OSHA® FactSheet

# Controlling Hexavalent Chromium Exposures during Electroplating

**Electroplating is a metal finishing process in which an object is covered with a metal coating. Workers performing electroplating are exposed to hexavalent chromium [Cr(VI)] which can cause severe health effects including lung cancer. Electroplating uses an electrical current passed through a chemical electrolyte solution containing the plating metal. OSHA's Permissible Exposure Limit (PEL) for Cr(VI) is 5 µg/m3 as an 8-hour time-weighted average and OSHA regulates worker exposure to this hazardous substance under its Chromium(VI) standard, 29 CFR 1910.1026.**

## Types of chrome electroplating

- **Hard chrome (HC) plating:** a thick layer of chromium is electrodeposited on a base material (usually steel) to provide a surface with functional properties such as wear resistance, a low coefficient of friction, hardness and corrosion resistance. It is used in:
  - Piston rings
  - Hydraulic cylinder rods
  - Machine rollers
- **Decorative or bright (DC) plating:** a thin layer of chromium is electrodeposited onto a base metal or other electrodeposited metals (nickel) for cosmetic and tarnish resistance purposes. It is used in:
  - Chrome alloy wheels
  - Appliances
  - Plumbing fixtures

Anodizing, sometimes confused with electroplating, is used to increase the thickness of the natural oxide layer on the surface of a metal part. Aluminum alloys can be anodized using chromic acid.

Workers are exposed to Cr(VI) from mist generated during the electroplating or anodizing process. Severity of exposure to hexavalent chromium from the different processes can be ranked in the following order:

Highest
**Hard chrome**
**Decorative or bright**
Lowest
**Anodizing**

Hard chrome electroplating baths. (Photo courtesy of NIOSH).

## How electroplating operations cause Cr(VI) exposure in the workplace

There are several factors that contribute to hexavalent chromium exposure in the workplace, including:

- **Mist generation during plating:** hydrogen bubbles that form in the plating tanks burst when they reach the surface, causing small droplets of electrolyte solution, which contains Cr(VI), to go into the air. Conditions that increase the amount of mist generated include:
  - Higher electrical current in the bath
  - Longer plating times
  - Higher bath surface tension
  - Higher temperature of the plating bath
  - Increased agitation of the plating bath
- **Drag-out:** mists can be generated and spills can occur when workers insert the racks or barrels into, or remove them from, the plating baths.

- **Addition of Cr(VI):** adding chromic acid and chromium powders/solutions to plating baths may result in spills or generate dusts or mists.
- **Work practices:** using compressed air to dry parts, not cleaning up spills promptly, and leaving containers open can increase the amount of Cr(VI) in the workplace.

**Health Effects of Cr(VI)**

- Lung cancer and nasal and sinus cancer
- Eye, nose and throat irritation
- Nasal septum ulcerations and perforations, gastritis, and gastrointestinal ulcers
- Contact dermatitis, irritation, ulcers, and sensitization from skin contact

For more information on adverse health effects and protective measures see OSHA's Health Effects of Hexavalent Chromium Fact Sheet.

## How workers are exposed

- **Inhaling** mists/dust or fumes containing Cr(VI).
- Skin **contact** with Cr(VI) solutions.

## Role of personal air monitoring

- Air monitoring helps to determine the amount of Cr(VI) a worker may be exposed to.
- Monitoring results are compared to applicable exposure limits to evaluate compliance.
- Results of the air monitoring must be provided to the affected employees within 15 workdays.

## Controlling hexavalent chromium levels

- **Product substitution**. Use a less toxic substitute in place of Cr(VI). For example, trivalent chromium is less toxic than Cr(VI). There are a variety of alternatives available that provide similar characteristics to chrome electroplating.
- **Reduce mist generation**. Chemical surfactants or wetting agents can be added to the plating bath to lower surface tension and reduce mists. Foam blankets or plastic balls can also be used as physical barriers to reduce mists from going into the air. However, precautions should be taken if they are used. Foam blankets can cause explosive hazards and the plastic balls need to be handled carefully to prevent spills.
- **Use eductor nozzles for mixing chemical baths**. Eductor nozzles are used to reduce agitation in the tank during mixing and to ensure a uniform bath solution. Space constraints may be an issue when using eductors.
- **Remove mists from the air using ventilation**. Local exhaust ventilation (LEV) is the most effective method to reduce overall Cr(VI) concentrations during electroplating operations. The LEV needs to be properly designed and maintained to effectively remove Cr(VI) mists from the breathing zone. The LEV system should undergo regular inspections by qualified individuals to maintain proper air flow.

## How workers can reduce their Cr(VI) exposure during electroplating

- **Use good work practices:**
  - Remove parts slowly and carefully.
  - Rinse parts with low pressure.
  - Do not use compressed air for drying.
  - Clean up spills quickly and carefully.
  - Keep chemical tanks and containers covered when not in use.
  - Add chromic acid to the plating bath as a solution. Avoid dry chromic acid additions.
  - Clean surrounding work surfaces (tables, etc.) at the end of each shift.

For more information see the OSHA/National Association for Surface Finishing Alliance's resource on Electroplating Surface Finishing Safe Work Practices Manual [July 2009].

- **Personal protective equipment (PPE)**: Where skin or eye hazards are present due to likely contact with Cr(VI), employees must use appropriate protective clothing and equipment. In electroplating work, such PPE can include chemically-resistant aprons or suits, shoes/

boots, gloves, as well as face shields, safety glasses with side shields or goggles. PPE must be properly maintained and laundered.

- **Respirators:** If work practices and engineering controls are not sufficient to reduce Cr(VI) exposures to or below the PEL, workers must use respiratory protection. If respirators are used, a respiratory protection program is required under OSHA's Respiratory Protection standard (29 CFR 1910.134). For more information, see OSHA's Safety and Health Topics page on respiratory protection.

## More Information

For additional information on hexavalent chromium exposure, visit OSHA's website at www.osha.gov.