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Personal Safety Division

Hazard awareness bulletin.

Chromium and Hexavalent Chromium

Helping to reduce your exposure to Chromium and Hexavalent Chromium during metal production and fabrication.

What are Chromium and Hexavalent Chromium?

Elemental chromium metal (chrome) is steel-grey colour metal that can be readily polished and is highly resistant to corrosion. Elemental chromium metal and hexavalent chromium are rarely found in nature; trivalent chromium exists in various ores, making up approximately 13% of the earth's crust.

Chromium metal has been used through the ages as a decorative metal, for example in jewellery, ornamental works through to car body trim and metal plating. Due to its corrosion resistant properties, chromium is frequently used to electroplate other metals, particularly steel. Chromium is also used extensively in alloys – for example with steel to make stainless steel and other non-ferrous metal alloys.

In other industries, inorganic chromium (chromates) compounds often have vibrant colours and have been used extensively as pigments, dyes, preservatives and ceramics as well as being potentially hazardous components in Portland Cement.

How can Chromium and Hexavalent Chromium affect me?

Workplace exposures to chromium and hexavalent chromium can cause a range of detrimental health effects – some can result from short-term acute exposures, others from long-term, repetitive, chronic exposures.

Acute health effects from production or fabrication

- Irritation of the nose and upper respiratory tract
- Irritation, inflammation and ulceration of the skin (particularly from chromic acid exposure)
- Eye irritation and damage from liquid splashes

Chronic health effects from metal production or fabrication

- Damage to the membranes of the nose and upper respiratory tract, leading to ulcers and holes in the nasal septum
- Hypersensitivity Pneumonitis
- Allergic dermatitis
- Occupational asthma
- Hearing impairment
- Kidney damage
- Lung cancer
- Male fertility issues
- Foetal development issues
- Occupational asthma
- Pneumoconiosis

Medical Information

- Asthma is a debilitating and potentially fatal disease which causes difficulty with breathing, wheezing, coughing or a tight feeling in the chest. Occupational asthma is where the condition is specifically linked to workplace exposure to asthmagens (chemicals that cause an allegic asthmatic reaction).

  There are two types of occupational asthma: workplace exposure to asthmagens causing asthma in a worker, or workplace exposure aggravating existing asthma.

- Pneumoconiosis is the accumulation of dust in the lungs and the subsequent reaction to its presence. The term covers a wide range of different diseases and is derived from Greek, meaning "dusty lungs".

  Pneumoconioses are generally long-term and irreversible diseases characterised by inflammation (pneumonitis) and scarring (pulmonary fibrosis) of the lung tissue. However, in some cases, particularly silicosis, rapidly progressive forms can occur after only short periods of intense exposure.

When do workplace exposures occur?

Inhalation

Often the primary route of chromium and hexavalent chromium exposure is through inhaling dust and fumes from the production and working of elemental chromium and alloys. In metal fabrication the welding, grinding, cutting, drilling and polishing of alloys that contain chromium can result in significant exposure.

What is welding fume?

The majority of welding fume is filler wire material that is vapourised by the welding arc. The gaseous metal will react with oxygen in the air to form a metal oxide and will solidify to form tiny metal oxide particles of fume. Some welding fume will orginate from the metals being welded.

Many filler wires contain metals that are known to be toxic and that can have detrimental health effects if inhaled. The contents of the filler wire and the amount of welding fume generated will vary by welding process.

Hot work

Other high energy or 'hot work' processes, including cutting, grinding and even polishing metals can create particles of metal and metal oxides that can be readily inhaled.

Workers can also be exposed when working with metals which have a plating or surface coating that containing chromium and hexavalent chromium.

Other industrial applications may create dusts, mists or fumes of chromium and hexavalent chromium, for example the handling or application of powered or liquid chemicals which contain chromium and hexavalent chromium.

Dermal

The secondary route of exposure is through contact with the skin and eyes, particularly if hexavalent chromium is in a liquid form that can readily pass through or damage the skin.

Ingestion

Workers can be exposed by the accidental ingestion of chromium and hexavalent chromium, for example workers eating, drinking, smoking or biting their nails when their hands are contaminated.

Industries / Applications where workplace exposures may occur.

Examples of metal production and fabrication applications, as well as other industries and processes in which individuals may be exposed to chromium and hexavalent chromium compounds:

Metal production, metal fabrication and related

- Welding, cutting, grinding and casting of stainless steels and other alloys containing chromium
- Electroplating of chromium onto other metals (chromic acid)
- Smelting of copper, zinc and ferrochromium ores

Other aplications

- Pigments, dyes, inks, leather tanning
- Wood preservatives
- Pesticides
- Specialist paints, particularly aircraft, marine
- Automotive body repair industry – repair / spray application of paints containing chromium
- Chemical industries
- Plastics industries
- Portland cement (as an impurity)

Did you know?

Metal workers, and particularly welders, are prone to developing pneumonia infections. These can normally be treated by antibiotics, but there is a clear correlation between welders and increased risk of developing serious or fatal pneumonia infections.

Medical Information:

- Hexavalent chromium compounds are classified as carcinogenic to humans (Group 1) by the International Agency for Reseach on Cancer (IARC).

- Chronic Obstructive Pulmonary Disease (COPD) is a serious long-term lung disease, which results in irreversible narrowing of the airways over time, reducing the flow of air into the lungs, due to inflammation of the air passages and damage to the lung tissue.

  In extreme cases, the reduced air flow to the lungs is highly debilitating and can be fatal. Other symptoms include a persistent cough (>3 months of the year), wheezing and increased phlegm production.

  COPD includes the conditions bronchitis and emphysema.

What can I do to protect myself?

Use appropriate controls

Employers need to conduct a risk assessment, including a determination of exposure levels compared to exposure limits to understand what control measures may be needed.

If required, controls from the hierarchy of controls should be implemented and their effectiveness measured. For example local exhaust ventilation (LEV) can be a highly effective engineering control used in welding, grinding and many other applications.

Get the equipment that you need.

In addition to implementing other control measures, Personal Protective Equipment (PPE) such as Respiratory Protective Equipment (RPE) is commonly required to reduce exposures and risks to workers.

Respiratory Protective Equipment (RPE) – filtering respirators

From disposable particulate respirators, to reusable half- and full-face masks, through to heavy-duty battery-powered air purifying respirators combined with a range of robust face masks, headtops and helmets; 3M has a range of RPE that can help reduce your exposure to dusts, mists, metal fume, ozone as well as other gases and vapours, commonly encountered in metal production and fabrication.

Respiratory Protective Equipment (RPE) – supplied air respirators

3M also has a wide range of continuous and demand valve supplied air respirators, suitable for use in some of the most demanding working environments.

Welding shields with respiratory protection

3M also has a wide range of 3M™ Speedglas™ Welding shields that provide eye and face protection from harmful light, sparks and splatter. All of these welding shields can be used with 3M disposable or reusable half-masks. Alternatively, 3M has welding shields and helmets that are designed to work with 3M powered or supplied air systems, to give you multiple types of protection in one product.

Eye and Face Protective Equipment

Whether it be a 3M™ Spedglas™ welding visor with an auto-darkening filter or a lightweight full-face shield, 3M has a full range of PPE to help protect you from the many hazards encountered in welding and metal working.

Other PPE

3M also can provide a wide range of other safety solutions you need to work safely, comfortably and effectively, including:

- Head, eye and face protection
- Disposable and reusable ear plugs, ear muffs
- Communication solutions
- Disposable and reusable protective coveralls
- Appropriate gloves for hand and skin protection
- Fall protection
- Confined space solutions
- Fixed and personal gas detection
- Fixed flame detection solutions

Training

A key component of an effective PPE programme is a training concept for workers, those responsible for health and safety and employers in their roles and responsibilities.

For example, workers wearing PPE should be trained in and understand:

- the nature of all hazardous substances present and the potential effects upon their health
- how PPE works, what it does and its limitations
- proper fitting and use of the PPE
- inspection, maintainance and cleaning of the PPE as well as identifying defective PPE and knowing how to deal with it

Stay informed

When selecting the appropriate protective equipment, local or national regulations, laws and guidelines need to be complied with.

One of the tasks of the occupational safety and health department is to keep an eye on constantly changing legal regulations, occupational exposure limits, etc.

Technical help

At any time, you can get in touch with one of our PPE experts for personalised help on the selection and use of 3M products. Their job is to help you through the process of selecting adequate and suitable products based on your risk assessment, as well as helping you understand how to fit, use and look after your PPE – helping you to stay healthy and safe so you can focus on what matters: doing your job properly and staying healthy for your loved ones and family.

Oxidation States

Chromium rarely exists in its elemental metal form in nature as its relatively chemically reactive. When heated, for example during welding, chromium will react with oxygen in the air for form chromium oxides. But the the properties of chromium means that it can exist in different chemical forms, or oxidation states:

+3 oxidation state – trivalent chromium: Cr_2O_3 (chromium(III) oxide)

+6 oxidation state – hexavalent chromium: CrO_3 (chromium(VI) oxide)

Hexavalent chromium is most hazardous form of chromium and hexavalent chromium – it is known to cause skin and respiratory tract inflammation as well as being a known human carcinogen.

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