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Hazard Awareness Bulletin
December 2022

Nickel

Helping to reduce your exposure to Nickel during metal production and fabrication.

What is Nickel?

Nickel is a lustrous, hard, and ductile silvery-grey metal. Nickel is generally corrosion resistant, and so has historical use in plating other metals for both decorative and corrosion preventative purposes.

Today, most nickel is mainly used in the production of metal alloys (especially stainless steel), coins and jewelry. electro-plating and specialist applications including battery production. The combination of increased material cost and potential to cause allergic reactions for many people limit its use in some applications.

Nickel is ferromagnetic, and nickel metal is used in many consumer and industrial magnets.

Inorganic nickel compounds have a characteristic green color and are used in a wide range of applications.

How can Nickel affect me?

Workplace exposures to nickel have been associated with a range of potential health effects – some can result from short-term acute exposures, others from long-term, repetitive, chronic exposures.

Did you know?

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 the Greek, meaning “dusty lungs”.

Pneumoconiosis are generally long-term and irreversible diseases characterized 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.

Canadian Centre for Occupational Health & Safety. OSH Answers Fact Sheets - What are the Effects of Dust on the Lungs?. www.ccohs.ca/oshanswers/chemicals/lungs_dust.html

Potential acute health effects associated with metal production or fabrication

- Eye and skin irritation

Potential chronic health effects associated with metal production or fabrication

- Allergic dermatitis
- Occupational asthma
- Pneumonitis
- Pulmonary Fibrosis
- Lung and nasal

Did you know?

Asthma is a debilitating and potentially fatal disease which causes difficulty of 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 allergic asthmatic reaction).

Occupational asthma has two types: workplace exposure to asthmagens has caused asthma in a worker, or workplace exposure aggravates existing asthma.

Potential health effects from other industries or compounds

- Eye and skin irritation
- Allergic skin reaction
- Cancer

Did you know?

Nickel is classified as a Group 1 - Carcinogenic to humans by the International Agency for Research on Cancer (IARC). Insoluble nickel compounds are classified as an A1 - Confirmed human carcinogen by the American Conference of Governmental Industrial Hygienists (ACGIH).

When do workplace exposures occur?

Inhalation

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

What is welding fume?

The majority of welding fume is filler material that is vaporized 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, or fume. Some welding fume will originate from the metals being welded. Many filler materials will contain metals that are known to be toxic and that can have detrimental health effects if inhaled. The contents of the filler material 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 inhaled.

Other industrial applications may create dusts, mists, or fumes of nickel. For example, the handling or application of powered or liquid chemicals which contain nickel.

Dermal

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

Soluble Nickel salts are used extensively in the nickel-plating industries and can often result in dermal exposures.

Did you know?

Allergic contact dermatitis and respiratory irritation and sensitization can follow exposure to nickel and nickel compounds. Nickel oxides are also recognized as asthmagens and may have a role in causing occupational asthma in welders.

Nickel tetracarbonyl, Ni(CO)4, is an organic nickel compound that is volatile liquid / gas at room temperature and pressure and is extremely highly toxic. Occupational exposures may occur during the Mond process, a process that is rarely used as a nickel metal purification process.

Ingestion

Workers can be exposed by the accidental ingestion of nickel, 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 nickel compounds:

Metal production, metal fabrication and related applications

- Nickel mining, smelting and refining processes
- Production of alloys, melting and foundry operations as well as powder metallurgy
- Production of stainless steel (which has a significant nickel content)
- Welding and grinding of nickel and alloys and when using welding rods containing nickel, particularly stainless steel
- Polishing or other processes on stainless steel and nickel alloy articles
- Electroplating of metals

Did you know?

Metal workers, and particularly welders, are prone to developing pneumonia infections. Welders can be at risk for developing serious or fatal pneumonia infections.

Other applications

- Pigments for paint, pottery, glass, and plastics
- Chemical industry where nickel and nickel compounds are used as catalysts
- Manufacture, use, and recycling of nickel metal hydride batteries

Note: high temperature Nickel work (temp. >932°F (500°C)) typically give rise to higher airborne concentrations of Nickel fume, compared to other processes which are more likely to generate Nickel dusts.

What can I do to help protect my workers?

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 used to reduce exposures and risks to workers.

Respiratory Protective Equipment (RPE) – air-purifying respirators

3M has a range of RPE that can help reduce your exposure to dusts, mists, metal fume, as well as gases and vapors commonly encountered in metal production and fabrication. These include disposable particulate respirators, reusable half- and full-facepiece respirators, all the way to heavy-duty battery powered air-purifying respirators combined with a range of robust facepieces, headtops, and helmets.

Respiratory Protective Equipment (RPE) – supplied air respirators

3M also has a wide range of supplied air respirators, suitable for use in some of the most demanding work environments.

Welding shields with respiratory protections

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

Eye and Face Protective Equipment

Whether it be a 3M™ Speedglas™ 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 can also provide a wide range of other safety solutions including:

- Head, eye, and face protection
- Disposable and reusable ear plugs and ear muffs
- Protective Communication solutions
- Disposable protective coveralls
- Fall protection
- Confined space solutions

Find your respirator

Use our interactive disposable respirator selector to help you find a respirator that meets your protection needs.

Find your respirator

Use our respirator selection guide to help you find a respirator that meets your protection needs.

Find your respirator

Use our interactive powered & supplied air respirator selector to help you find a respirator that meets your protection needs.

View all 3M PPE Solutions

Training

A key component of an effective PPE program is training for both workers and those responsible for health and safety in the workplace.

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

- How PPE works, what it does, and its limitations
- Inspection, maintenance, and cleaning of the PPE as well as identifying defective PPE and knowing proper disposal
- Proper fitting and use of the PPE
- The nature of all hazardous substances present and the potential effects upon their health

Stay Informed

When selecting the appropriate protective equipment, local, state, provincial, or national regulations, laws, and guidelines need to be followed.

One of the tasks of the occupational safety and health specialist is to monitor constantly changing legal regulations, occupational exposure limits, etc.

Technical Help

At any time, you can get in touch with one of our PPE professionals for personalized help on the selection and use of 3M products. They can help you through the process of selecting suitable products based on your risk assessment, as well as helping you understand how to fit, use, and maintain your PPE – helping you to stay protected. In the U.S. contact Technical Service at 1-800-243-4630. In Canada contact Technical Service at 1-800-267-4414.

References and Resources

Webelements. Nickel: the basics. [Online] [Cited: 22 November 2018.] https://www.webelements.com/ncikel/.

Smedley, et al: Smedley, J, Dick, F and Sadhra, S. Oxford Handbook of Occupational Health (second edition). 2013.

Health and Safety Executive (HSE). INDG351 - Nickel and you. Working with nickel - are you at risk? [Online] [Cited: 8 October 2018.] http://www.hse.gov.uk/pubns/indg351.pdf.

ACGIH TLVs: American Conference of Governmental Industrial Hygienists (ACGIH(R)). Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices (TLVs(R) and BEIs(R)). 2018

Agency for Toxic Substances and Disease Registry (ATSDR). Toxic Substances Portal - Nickel. [Online] [Cited: 8 October 2018.] https://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=44.

NIOSH Pocket Guide: The National Institute for Occupational Safety and health (NIOSH). NIOSH Pocket Guide to Chemical Hazards. [Online] [Cited: 22 November 2018.] https://www.cdc.gov/niosh/npg/default.html.

International Agency for Research on Cancer (IARC). IARC Monograph - Nickel and Nickel Compounds. [Online] [Cited: 8 October 2018.] https://monographs.iarc.fr/wp-content/uploads/2018/06/mono100C-10.pdf.

Health Effects of Welding. Antonini, J M. 1, 2003, Critical Reviews in Toxicology, Vol. 33, pp. 61-103.

Nemery: Metal toxicity and respiratory tract. Nemery, B. 1990, Eu Respir J, Vol. 3, pp. 202-219.

Palmer: Palmer et al (2009). Mortality from infectious pneumonia in metal workers: a comparison with deaths from asthma in occupations exposed to respiratory sensitizers. THORAX Online first, published on August 23, 2009

HSE Burden of cancer: Health and Safety Executive (HSE). RR858 - The burden of occupational cancer in Great Britain - Lung Cancer. 2012. [Online] [Cited: 22 November 2018.] http://www.hse.gov.uk/research/rrpdf/rr858.pdf

Canadian Centre for Occupational Health & Safety. OSH Answers Fact Sheets – Asthma, Work-related. https://www.ccohs.ca/oshanswers/diseases/asthma.html

Health and Safety Executive (HSE). Health risks from welding. https://www.hse.gov.uk/welding/health-risks-welding.htm

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