

# SAFETY DATA SHEET

## 1. PRODUCT AND COMPANY IDENTIFICATION

**Product Name:** Techalloy® 420

**Product Size:** 1/16" (1.6 mm)

**Other means of identification**

**SDS number:** 200000001582

**Recommended use and restriction on use**

**Recommended use:** GMAW (Gas Metal Arc Welding)

**Restrictions on use:** Not known. Read this SDS before using this product.

**Manufacturer/Importer/Supplier/Distributor Information**

**Company Name:** The Lincoln Electric Company

**Address:** 22801 Saint Clair Avenue

Cleveland, Ohio 44117

USA

**Telephone:** +1 (216) 481-8100

**Contact Person:** Safety Data Sheet Questions: [www.lincolnelectric.com/sds](http://www.lincolnelectric.com/sds)

Arc Welding Safety Information: [www.lincolnelectric.com/safety](http://www.lincolnelectric.com/safety)

**Company Name:** The Lincoln Electric Company of Canada LP

**Address:** 179 Wicksteed Avenue

Toronto, Ontario M4G 2B9

CANADA

**Telephone:** +1 (416) 421-2600

**Contact Person:** Safety Data Sheet Questions: [www.lincolnelectric.com/sds](http://www.lincolnelectric.com/sds)

Arc Welding Safety Information: [www.lincolnelectric.com/safety](http://www.lincolnelectric.com/safety)

**Emergency telephone number:**

USA/Canada/Mexico +1 (888) 609-1762

Americas/Europe +1 (216) 383-8962

Asia Pacific +1 (216) 383-8966

Middle East/Africa +1 (216) 383-8969

**3E Company Access Code:** 333988

## 2. HAZARDS IDENTIFICATION

Classified according to the criteria of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), The United States Occupational Safety and Health Administration's Hazard Communication Standard (29 CFR 1910.1200), Canada's Hazardous Product Regulations and Mexico's Harmonized System for the Identification and Communication of Hazards and Risks from Hazardous Chemicals in the Workplace.

**Hazard Classification** Not classified as hazardous according to applicable GHS hazard classification criteria.

**Label Elements**

**Hazard Symbol:** No symbol

**Signal Word:** No signal word.

**Hazard Statement:** Not applicable

**Precautionary** Not applicable

**Statements:**
**Other hazards which do not result in GHS classification:**

Electrical Shock can kill. If welding must be performed in damp locations or with wet clothing, on metal structures or when in cramped positions such as sitting, kneeling or lying, or if there is a high risk of unavoidable or accidental contact with work piece, use the following equipment: Semiautomatic DC Welder, DC Manual (Stick) Welder, or AC Welder with Reduced Voltage Control.

Arc rays can injure eyes and burn skin. Welding arc and sparks can ignite combustibles and flammable materials. Overexposure to welding fumes and gases can be hazardous. Read and understand the manufacturer's instructions, Safety Data Sheets and the precautionary labels before using this product. Refer to Section 8.

**Substance(s) formed under the conditions of use:**

The welding fume produced from this welding electrode may contain the following constituent(s) and/or their complex metallic oxides as well as solid particles or other constituents from the consumables, base metal, or base metal coating not listed below.

| Chemical Identity                                 | CAS-No.    |
|---------------------------------------------------|------------|
| Carbon dioxide                                    | 124-38-9   |
| Carbon monoxide                                   | 630-08-0   |
| Nitrogen dioxide                                  | 10102-44-0 |
| Ozone                                             | 10028-15-6 |
| Manganese                                         | 7439-96-5  |
| Chromium (VI)                                     | 18540-29-9 |
| Nickel                                            | 7440-02-0  |
| Copper and/or copper alloys and compounds (as Cu) | 7440-50-8  |
| Chromium oxide                                    | 1308-38-9  |

**3. COMPOSITION / INFORMATION ON INGREDIENTS**
**Reportable Hazardous Ingredients  
Mixtures**

| Chemical Identity                                 | CAS number | Content in percent (%)* |
|---------------------------------------------------|------------|-------------------------|
| Iron                                              | 7439-89-6  | 50 - <100%              |
| Chromium and chromium alloys or compounds (as Cr) | 7440-47-3  | 10 - <20%               |
| Manganese                                         | 7439-96-5  | 0.1 - <1%               |
| Silicon                                           | 7440-21-3  | 0.1 - <1%               |
| Molybdenum                                        | 7439-98-7  | 0.1 - <1%               |
| Nickel                                            | 7440-02-0  | 0.1 - <1%               |
| Cobalt and compounds (as Co)                      | 7440-48-4  | 0.1 - <1%               |
| Copper and/or copper alloys and compounds (as Cu) | 7440-50-8  | 0.1 - <1%               |

\* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

**Composition Comments:**

The term "Hazardous Ingredients" should be interpreted as a term defined in Hazard Communication standards and does not necessarily imply the existence of a welding hazard. The product may contain additional non-hazardous ingredients or may form additional compounds under the condition of use. Refer to Sections 2 and 8 for more information.

#### 4. FIRST AID MEASURES

- Ingestion:** Unlikely due to form of product, except for granular materials. Avoid hand, clothing, food, and drink contact with metal fume or powder which can cause ingestion of particulate during hand to mouth activities such as drinking, eating, smoking, etc. If ingested, do not induce vomiting. Contact a poison control center. Unless the poison control center advises otherwise, wash out mouth thoroughly with water. If symptoms develop, seek medical attention at once.
- Inhalation:** Move to fresh air if breathing is difficult. If breathing has stopped, perform artificial respiration and obtain medical assistance at once.
- Skin Contact:** Remove contaminated clothing and wash the skin thoroughly with soap and water. For reddened or blistered skin, or thermal burns, obtain medical assistance at once.
- Eye contact:** Dust or fume from this product should be flushed from the eyes with copious amounts of clean, tepid water until transported to an emergency medical facility. Do not allow victim to rub or keep eyes tightly closed. Obtain medical assistance at once.
- Arc rays can injure eyes. If exposed to arc rays, move victim to dark room, remove contact lenses as necessary for treatment, cover eyes with a padded dressing and rest. Obtain medical assistance if symptoms persist.

#### Most important symptoms/effects, acute and delayed

- Symptoms:** Short-term (acute) overexposure to fumes and gases from welding and allied processes may result in discomfort such as metal fume fever, dizziness, nausea, or dryness or irritation of nose, throat, or eyes. May aggravate pre-existing respiratory problems (e.g. asthma, emphysema). Long-term (chronic) overexposure to fumes and gases from welding and allied processes can lead to siderosis (iron deposits in lung), central nervous system effects, bronchitis and other pulmonary effects. Refer to Section 11 for more information.

- Hazards:** Welding and allied process hazards are complex and may include physical and health hazards such as but not limited to electric shock, physical strains, radiation burns (eye flash), thermal burns due to hot metal or spatter and potential health effects of overexposure to welding fume or dust. Refer to Section 11 for more information.

#### Indication of immediate medical attention and special treatment needed

- Treatment:** Treat symptomatically.

#### 5. FIRE-FIGHTING MEASURES

- General Fire Hazards:** As shipped, this product is nonflammable. However, welding arc and sparks can ignite combustibles and flammable products. Read and understand American National Standard Z49.1, "Safety In Welding, Cutting and Allied Processes" and National Fire Protection Association NFPA 51B, "Standard for Fire Prevention During Welding, Cutting and Other Hot Work" before using this product.

#### Suitable (and unsuitable) extinguishing media

- Suitable extinguishing media:** As shipped, the product will not burn. In case of fire in the surroundings: use appropriate extinguishing agent.

**Unsuitable extinguishing media:**

Do not use water jet as an extinguisher, as this will spread the fire.

**Specific hazards arising from the chemical:**

Welding arc and sparks can ignite combustibles and flammable products.

**Special protective equipment and precautions for firefighters**
**Special fire fighting procedures:**

Use standard firefighting procedures and consider the hazards of other involved materials.

**Special protective equipment for fire-fighters:**

Selection of respiratory protection for fire fighting: follow the general fire precautions indicated in the workplace. Self-contained breathing apparatus and full protective clothing must be worn in case of fire.

**6. ACCIDENTAL RELEASE MEASURES**
**Personal precautions, protective equipment and emergency procedures:**

If airborne dust and/or fume is present, use adequate engineering controls and, if needed, personal protection to prevent overexposure. Refer to recommendations in Section 8.

**Methods and material for containment and cleaning up:**

Absorb with sand or other inert absorbent. Stop the flow of material, if this is without risk. Clean up spills immediately, observing precautions in the personal protective equipment in Section 8. Avoid generating dust. Prevent product from entering any drains, sewers or water sources. Refer to Section 13 for proper disposal.

**Environmental Precautions:**

Avoid release to the environment. Prevent further leakage or spillage if safe to do so. Do not contaminate water sources or sewer. Environmental manager must be informed of all major spillages.

**7. HANDLING AND STORAGE**
**Precautions for safe handling:**

Prevent formation of dust. Provide appropriate exhaust ventilation at places where dust is formed.

Read and understand the manufacturer's instruction and the precautionary label on the product. Refer to Lincoln Safety Publications at [www.lincolnelectric.com/safety](http://www.lincolnelectric.com/safety). See American National Standard Z49.1, "Safety In Welding, Cutting and Allied Processes" published by the American Welding Society, <http://pubs.aws.org> and OSHA Publication 2206 (29CFR1910), U.S. Government Printing Office, [www.gpo.gov](http://www.gpo.gov).

**Conditions for safe storage, including any incompatibilities:**

Store in closed original container in a dry place. Store in accordance with local/regional/national regulations. Store away from incompatible materials.

**8. EXPOSURE CONTROLS / PERSONAL PROTECTION**
**Control Parameters**
**Occupational Exposure Limits: US**

| Chemical Identity                                         | Type | Exposure Limit Values | Source                                                                      |
|-----------------------------------------------------------|------|-----------------------|-----------------------------------------------------------------------------|
| Chromium and chromium alloys or compounds (as Cr) - as Cr | TWA  | 0.5 mg/m3             | US. ACGIH Threshold Limit Values (12 2010)                                  |
|                                                           | PEL  | 1 mg/m3               | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |

|                                                                            |         |             |                                                                             |
|----------------------------------------------------------------------------|---------|-------------|-----------------------------------------------------------------------------|
|                                                                            | REL     | 0.5 mg/m3   | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
| Manganese - Fume. - as Mn                                                  | Ceiling | 5 mg/m3     | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
|                                                                            | REL     | 1 mg/m3     | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
|                                                                            | STEL    | 3 mg/m3     | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
| Manganese - Inhalable fraction. - as Mn                                    | TWA     | 0.1 mg/m3   | US. ACGIH Threshold Limit Values (03 2014)                                  |
| Manganese - Respirable fraction. - as Mn                                   | TWA     | 0.02 mg/m3  | US. ACGIH Threshold Limit Values (03 2014)                                  |
| Silicon - Total dust.                                                      | PEL     | 15 mg/m3    | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
| Silicon - Respirable fraction.                                             | PEL     | 5 mg/m3     | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
| Silicon - Respirable.                                                      | REL     | 5 mg/m3     | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
| Silicon - Total                                                            | REL     | 10 mg/m3    | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
| Molybdenum - Total dust. - as Mo                                           | PEL     | 15 mg/m3    | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
| Molybdenum - Inhalable fraction. - as Mo                                   | TWA     | 10 mg/m3    | US. ACGIH Threshold Limit Values (03 2014)                                  |
| Molybdenum - Respirable fraction. - as Mo                                  | TWA     | 3 mg/m3     | US. ACGIH Threshold Limit Values (03 2014)                                  |
| Nickel - Inhalable fraction.                                               | TWA     | 1.5 mg/m3   | US. ACGIH Threshold Limit Values (12 2010)                                  |
| Nickel - as Ni                                                             | PEL     | 1 mg/m3     | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
|                                                                            | REL     | 0.015 mg/m3 | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
| Cobalt and compounds (as Co) - as Co                                       | TWA     | 0.02 mg/m3  | US. ACGIH Threshold Limit Values (12 2010)                                  |
| Cobalt and compounds (as Co) - Dust and fume. - as Co                      | REL     | 0.05 mg/m3  | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
|                                                                            | PEL     | 0.1 mg/m3   | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | REL     | 0.1 mg/m3   | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
|                                                                            | PEL     | 0.1 mg/m3   | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | PEL     | 1 mg/m3     | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
|                                                                            | REL     | 1 mg/m3     | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
|                                                                            | TWA     | 1 mg/m3     | US. ACGIH Threshold Limit Values (03 2014)                                  |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | TWA     | 0.2 mg/m3   | US. ACGIH Threshold Limit Values (03 2014)                                  |

#### Occupational Exposure Limits: CANADA

| Chemical Identity                                         | Type | Exposure Limit Values | Source                                                                                             |
|-----------------------------------------------------------|------|-----------------------|----------------------------------------------------------------------------------------------------|
| Chromium and chromium alloys or compounds (as Cr) - as Cr | TWA  | 0.5 mg/m3             | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)            |
| Chromium and chromium alloys or compounds (as Cr)         | TWA  | 0.5 mg/m3             | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational |

|                                                           |            |            |                                                                                                                                                               |
|-----------------------------------------------------------|------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                           |            |            | Health and Safety Regulation 296/97, as amended) (07 2007)                                                                                                    |
| Chromium and chromium alloys or compounds (as Cr) - as Cr | TWA        | 0.5 mg/m3  | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2011)                                                                          |
|                                                           | TWA        | 0.5 mg/m3  | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (11 2010)                                                                        |
|                                                           | 8 HR ACL   | 0.5 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                                           | 15 MIN ACL | 1.5 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Chromium and chromium alloys or compounds (as Cr)         | TWA        | 0.5 mg/m3  | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Manganese - as Mn                                         | TWA        | 0.2 mg/m3  | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                                                           | TWA        | 0.2 mg/m3  | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|                                                           | 8 HR ACL   | 0.2 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                                           | 15 MIN ACL | 0.6 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Manganese - Fume. - as Mn                                 | TWA        | 1 mg/m3    | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Manganese - Dust. - as Mn                                 | TWA        | 5 mg/m3    | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Manganese - Fume. - as Mn                                 | STEL       | 3 mg/m3    | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Manganese - Respirable fraction. - as Mn                  | TWA        | 0.02 mg/m3 | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
| Manganese - Inhalable fraction. - as Mn                   | TWA        | 0.1 mg/m3  | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
| Manganese - as Mn                                         | TWA        | 0.2 mg/m3  | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (06 2015)                                                                        |
| Silicon - Total dust.                                     | TWA        | 10 mg/m3   | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (07 2010)                                                                        |
| Silicon                                                   | 8 HR ACL   | 10 mg/m3   | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                                           | 15 MIN ACL | 20 mg/m3   | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Silicon - Total dust.                                     | TWA        | 10 mg/m3   | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Molybdenum - Inhalable                                    | TWA        | 10 mg/m3   | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
| Molybdenum - Respirable.                                  | TWA        | 3 mg/m3    | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |

|                                           |            |            |                                                                                                                                                               |
|-------------------------------------------|------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Molybdenum - Inhalable fraction. - as Mo  | TWA        | 10 mg/m3   | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (11 2010)                                                                        |
|                                           | 8 HR ACL   | 10 mg/m3   | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Molybdenum - Respirable fraction. - as Mo | 8 HR ACL   | 3 mg/m3    | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Molybdenum - Inhalable fraction. - as Mo  | 15 MIN ACL | 20 mg/m3   | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Molybdenum - Respirable fraction. - as Mo | 15 MIN ACL | 6 mg/m3    | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Molybdenum - as Mo                        | TWA        | 10 mg/m3   | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Molybdenum - Respirable fraction. - as Mo | TWA        | 3 mg/m3    | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
| Molybdenum - Inhalable fraction. - as Mo  | TWA        | 10 mg/m3   | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
| Molybdenum - Respirable fraction. - as Mo | TWA        | 3 mg/m3    | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (06 2015)                                                                        |
| Nickel                                    | TWA        | 1.5 mg/m3  | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                                           | TWA        | 0.05 mg/m3 | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (05 2013) |
| Nickel - Inhalable fraction.              | TWA        | 1.5 mg/m3  | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2011)                                                                          |
| Nickel - Inhalable fraction. - as Ni      | 8 HR ACL   | 1.5 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                           | 15 MIN ACL | 3 mg/m3    | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Nickel                                    | TWA        | 1 mg/m3    | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Nickel - Inhalable fraction. - as Ni      | TWA        | 1 mg/m3    | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (06 2015)                                                                        |
| Cobalt and compounds (as Co) - as Co      | TWA        | 0.02 mg/m3 | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                                           | TWA        | 0.02 mg/m3 | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|                                           | TWA        | 0.02 mg/m3 | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2011)                                                                          |
|                                           | TWA        | 0.02 mg/m3 | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (11 2010)                                                                        |
|                                           | 8 HR ACL   | 0.02 mg/m3 | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                           | 15 MIN ACL | 0.06 mg/m3 | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                           | TWA        | 0.02 mg/m3 | Canada. Quebec OELs. (Ministry of Labor                                                                                                                       |



|                                                                            |            |           |                                                                                                                                                               |
|----------------------------------------------------------------------------|------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                            |            |           | - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                                                        |
| Copper and/or copper alloys and compounds (as Cu) - Fume.                  | TWA        | 0.2 mg/m3 | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | TWA        | 1 mg/m3   | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | TWA        | 0.2 mg/m3 | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | TWA        | 1 mg/m3   | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
| Copper and/or copper alloys and compounds (as Cu) - Fume.                  | TWA        | 0.2 mg/m3 | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (11 2010)                                                                        |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | 8 HR ACL   | 1 mg/m3   | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | 15 MIN ACL | 0.6 mg/m3 | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | 15 MIN ACL | 3 mg/m3   | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | 8 HR ACL   | 0.2 mg/m3 | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                                                            | TWA        | 0.2 mg/m3 | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | TWA        | 1 mg/m3   | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
|                                                                            | TWA        | 1 mg/m3   | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | TWA        | 0.2 mg/m3 | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
| Copper and/or copper alloys and compounds (as Cu) - Dust and fume. - as Cu | TWA        | 1 mg/m3   | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (06 2015)                                                                        |

### Occupational Exposure Limits: MEXICO

| Chemical Identity                                 | Type    | Exposure Limit Values | Source                                                                                                   |
|---------------------------------------------------|---------|-----------------------|----------------------------------------------------------------------------------------------------------|
| Chromium and chromium alloys or compounds (as Cr) | VLE-PPT | 0.5 mg/m3             | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
|                                                   | VLE-PPT | 0.05 mg/m3            | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
|                                                   | VLE-PPT | 0.01 mg/m3            | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Manganese - as Mn                                 | VLE-PPT | 0.2 mg/m3             | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Molybdenum - Respirable fraction. - as Mo         | VLE-PPT | 0.5 mg/m3             | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Nickel - Inhalable fraction. - as Ni              | VLE-PPT | 1.5 mg/m3             | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |



|                                                                            |         |            |                                                                                                          |
|----------------------------------------------------------------------------|---------|------------|----------------------------------------------------------------------------------------------------------|
| Cobalt and compounds (as Co) - as Co                                       | VLE-PPT | 0.02 mg/m3 | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | VLE-PPT | 0.2 mg/m3  | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | VLE-PPT | 1 mg/m3    | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |

**Biological Limit Values: US**

| Chemical Identity                                                                       | Exposure Limit Values | Source              |
|-----------------------------------------------------------------------------------------|-----------------------|---------------------|
| Cobalt and compounds (as Co) (Cobalt: Sampling time: End of shift at end of work week.) | 15 µg/l (Urine)       | ACGIH BEI (03 2015) |

**Biological Limit Values: MEXICO**

| Chemical Identity                                                                       | Exposure Limit Values | Source           |
|-----------------------------------------------------------------------------------------|-----------------------|------------------|
| Cobalt and compounds (as Co) (Cobalt: Sampling time: End of shift at end of work week.) | 15 µg/l (Urine)       | MX IBE (06 2012) |
|                                                                                         | 1 µg/l (Blood)        | MX IBE (06 2012) |

**Additional exposure limits under the conditions of use: US**

| Chemical Identity | Type      | Exposure Limit Values   | Source                                                                      |
|-------------------|-----------|-------------------------|-----------------------------------------------------------------------------|
| Carbon dioxide    | TWA       | 5,000 ppm               | US. ACGIH Threshold Limit Values (12 2010)                                  |
|                   | STEL      | 30,000 ppm              | US. ACGIH Threshold Limit Values (12 2010)                                  |
|                   | PEL       | 5,000 ppm 9,000 mg/m3   | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
|                   | STEL      | 30,000 ppm 54,000 mg/m3 | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
|                   | REL       | 5,000 ppm 9,000 mg/m3   | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
| Carbon monoxide   | TWA       | 25 ppm                  | US. ACGIH Threshold Limit Values (12 2010)                                  |
|                   | PEL       | 50 ppm 55 mg/m3         | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
|                   | REL       | 35 ppm 40 mg/m3         | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
|                   | Ceil_Time | 200 ppm 229 mg/m3       | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
| Nitrogen dioxide  | TWA       | 0.2 ppm                 | US. ACGIH Threshold Limit Values (02 2012)                                  |
|                   | Ceiling   | 5 ppm 9 mg/m3           | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
|                   | STEL      | 1 ppm 1.8 mg/m3         | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
| Ozone             | PEL       | 0.1 ppm 0.2 mg/m3       | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006) |
|                   | Ceil_Time | 0.1 ppm 0.2 mg/m3       | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                          |
|                   | TWA       | 0.05 ppm                | US. ACGIH Threshold Limit Values (03 2014)                                  |
|                   | TWA       | 0.20 ppm                | US. ACGIH Threshold Limit Values (03 2014)                                  |
|                   | TWA       | 0.10 ppm                | US. ACGIH Threshold Limit Values (03 2014)                                  |

|                                                                            |          |              |                                                                              |
|----------------------------------------------------------------------------|----------|--------------|------------------------------------------------------------------------------|
|                                                                            | TWA      | 0.08 ppm     | US. ACGIH Threshold Limit Values (03 2014)                                   |
| Manganese - Fume. - as Mn                                                  | Ceiling  | 5 mg/m3      | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)  |
|                                                                            | REL      | 1 mg/m3      | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                           |
|                                                                            | STEL     | 3 mg/m3      | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                           |
| Manganese - Inhalable fraction. - as Mn                                    | TWA      | 0.1 mg/m3    | US. ACGIH Threshold Limit Values (03 2014)                                   |
| Manganese - Respirable fraction. - as Mn                                   | TWA      | 0.02 mg/m3   | US. ACGIH Threshold Limit Values (03 2014)                                   |
| Chromium (VI) - as Cr                                                      | TWA      | 0.05 mg/m3   | US. ACGIH Threshold Limit Values (12 2010)                                   |
| Chromium (VI)                                                              | TWA      | 0.005 mg/m3  | US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050) (02 2006) |
|                                                                            | OSHA_ACT | 0.0025 mg/m3 | US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050) (02 2006) |
|                                                                            | Ceiling  | 0.1 mg/m3    | US. OSHA Table Z-2 (29 CFR 1910.1000) (02 2006)                              |
| Chromium (VI) - as Cr(VI)                                                  | REL      | 0.0002 mg/m3 | US. NIOSH: Pocket Guide to Chemical Hazards (2016)                           |
| Nickel - Inhalable fraction.                                               | TWA      | 1.5 mg/m3    | US. ACGIH Threshold Limit Values (12 2010)                                   |
| Nickel - as Ni                                                             | PEL      | 1 mg/m3      | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)  |
|                                                                            | REL      | 0.015 mg/m3  | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                           |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | REL      | 0.1 mg/m3    | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                           |
|                                                                            | PEL      | 0.1 mg/m3    | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)  |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | PEL      | 1 mg/m3      | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)  |
|                                                                            | REL      | 1 mg/m3      | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                           |
|                                                                            | TWA      | 1 mg/m3      | US. ACGIH Threshold Limit Values (03 2014)                                   |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | TWA      | 0.2 mg/m3    | US. ACGIH Threshold Limit Values (03 2014)                                   |
| Chromium oxide - as Cr                                                     | TWA      | 0.5 mg/m3    | US. ACGIH Threshold Limit Values (03 2012)                                   |
|                                                                            | PEL      | 0.5 mg/m3    | US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)  |
|                                                                            | REL      | 0.5 mg/m3    | US. NIOSH: Pocket Guide to Chemical Hazards (2005)                           |

**Additional exposure limits under the conditions of use: CANADA**

| Chemical Identity | Type | Exposure Limit Values      | Source                                                                                                                                                        |
|-------------------|------|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Carbon dioxide    | STEL | 30,000 ppm    54,000 mg/m3 | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                   | TWA  | 5,000 ppm    9,000 mg/m3   | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                   | TWA  | 5,000 ppm                  | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |

|                  |            |                              |                                                                                                                                                               |
|------------------|------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | STEL       | 15,000 ppm                   | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|                  | TWA        | 5,000 ppm                    | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2011)                                                                          |
|                  | STEL       | 30,000 ppm                   | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2011)                                                                          |
|                  | STEL       | 30,000 ppm                   | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (11 2010)                                                                        |
|                  | TWA        | 5,000 ppm                    | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (11 2010)                                                                        |
|                  | 8 HR ACL   | 5,000 ppm                    | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                  | 15 MIN ACL | 30,000 ppm                   | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                  | TWA        | 5,000 ppm      9,000 mg/m3   | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
|                  | STEL       | 30,000 ppm      54,000 mg/m3 | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Carbon monoxide  | TWA        | 25 ppm      29 mg/m3         | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                  | TWA        | 25 ppm                       | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|                  | STEL       | 100 ppm                      | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|                  | TWA        | 25 ppm                       | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2011)                                                                          |
|                  | TWA        | 25 ppm                       | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (07 2010)                                                                        |
|                  | 8 HR ACL   | 25 ppm                       | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                  | 15 MIN ACL | 190 ppm                      | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                  | TWA        | 35 ppm      40 mg/m3         | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
|                  | STEL       | 200 ppm      230 mg/m3       | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Nitrogen dioxide | STEL       | 5 ppm      9.4 mg/m3         | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                  | TWA        | 3 ppm      5.6 mg/m3         | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                  | CEILING    | 1 ppm                        | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |

|       |            |                   |                                                                                                                                                               |
|-------|------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       | TWA        | 0.2 ppm           | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2012)                                                                          |
|       | STEL       | 5 ppm             | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (11 2010)                                                                        |
|       | TWA        | 3 ppm             | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (11 2010)                                                                        |
|       | 8 HR ACL   | 3 ppm             | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|       | 15 MIN ACL | 5 ppm             | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|       | TWA        | 3 ppm 5.6 mg/m3   | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Ozone | STEL       | 0.3 ppm 0.6 mg/m3 | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|       | TWA        | 0.1 ppm 0.2 mg/m3 | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|       | TWA        | 0.05 ppm          | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|       | TWA        | 0.1 ppm           | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|       | TWA        | 0.08 ppm          | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|       | TWA        | 0.2 ppm           | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|       | TWA        | 0.1 ppm 0.2 mg/m3 | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (07 2010)                                                                        |
|       | STEL       | 0.3 ppm 0.6 mg/m3 | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (07 2010)                                                                        |
|       | 15 MIN ACL | 0.15 ppm          | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|       | 8 HR ACL   | 0.05 ppm          | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|       | CEILING    | 0.1 ppm 0.2 mg/m3 | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
|       | TWA        | 0.20 ppm          | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
|       | TWA        | 0.05 ppm          | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
|       | TWA        | 0.08 ppm          | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
|       | TWA        | 0.10 ppm          | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |

|                                          |            |             |                                                                                                                                                               |
|------------------------------------------|------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Manganese - as Mn                        | TWA        | 0.2 mg/m3   | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                                          | TWA        | 0.2 mg/m3   | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|                                          | 8 HR ACL   | 0.2 mg/m3   | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                          | 15 MIN ACL | 0.6 mg/m3   | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Manganese - Fume. - as Mn                | TWA        | 1 mg/m3     | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Manganese - Dust. - as Mn                | TWA        | 5 mg/m3     | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Manganese - Fume. - as Mn                | STEL       | 3 mg/m3     | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Manganese - Respirable fraction. - as Mn | TWA        | 0.02 mg/m3  | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
| Manganese - Inhalable fraction. - as Mn  | TWA        | 0.1 mg/m3   | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
| Manganese - as Mn                        | TWA        | 0.2 mg/m3   | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (06 2015)                                                                        |
| Chromium (VI) - as Cr                    | TWA        | 0.01 mg/m3  | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                                          | TWA        | 0.05 mg/m3  | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                                          | TWA        | 0.025 mg/m3 | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|                                          | CEILING    | 0.1 mg/m3   | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
|                                          | TWA        | 0.05 mg/m3  | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2011)                                                                          |
|                                          | TWA        | 0.05 mg/m3  | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (11 2010)                                                                        |
|                                          | 15 MIN ACL | 0.03 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                          | 15 MIN ACL | 0.15 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                          | 8 HR ACL   | 0.01 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                          | 8 HR ACL   | 0.05 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                          | TWA        | 0.05 mg/m3  | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
|                                          | TWA        | 0.01 mg/m3  | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the                                                                            |

|                                                                            |            |            |                                                                                                                                                               |
|----------------------------------------------------------------------------|------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                            |            |            | Work Environment) (12 2008)                                                                                                                                   |
| Nickel                                                                     | TWA        | 1.5 mg/m3  | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
|                                                                            | TWA        | 0.05 mg/m3 | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (05 2013) |
| Nickel - Inhalable fraction.                                               | TWA        | 1.5 mg/m3  | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2011)                                                                          |
| Nickel - Inhalable fraction. - as Ni                                       | 8 HR ACL   | 1.5 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                                                            | 15 MIN ACL | 3 mg/m3    | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Nickel                                                                     | TWA        | 1 mg/m3    | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Nickel - Inhalable fraction. - as Ni                                       | TWA        | 1 mg/m3    | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (06 2015)                                                                        |
| Copper and/or copper alloys and compounds (as Cu) - Fume.                  | TWA        | 0.2 mg/m3  | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | TWA        | 1 mg/m3    | Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                       |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | TWA        | 0.2 mg/m3  | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | TWA        | 1 mg/m3    | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (07 2007) |
| Copper and/or copper alloys and compounds (as Cu) - Fume.                  | TWA        | 0.2 mg/m3  | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (11 2010)                                                                        |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | 8 HR ACL   | 1 mg/m3    | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | 15 MIN ACL | 0.6 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | 15 MIN ACL | 3 mg/m3    | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | 8 HR ACL   | 0.2 mg/m3  | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|                                                                            | TWA        | 0.2 mg/m3  | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | TWA        | 1 mg/m3    | Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment) (12 2008)                                                |
|                                                                            | TWA        | 1 mg/m3    | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | TWA        | 0.2 mg/m3  | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2014)                                                                          |
| Copper and/or copper alloys and compounds (as Cu) - Dust and fume. - as Cu | TWA        | 1 mg/m3    | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (06 2015)                                                                        |
| Chromium oxide - as Cr                                                     | TWA        | 0.5 mg/m3  | Canada. Alberta OELs (Occupational                                                                                                                            |



|  |            |           |                                                                                                                                                               |
|--|------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |            |           | Health & Safety Code, Schedule 1, Table 2) (07 2009)                                                                                                          |
|  | TWA        | 0.5 mg/m3 | Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended) (09 2011) |
|  | TWA        | 0.5 mg/m3 | Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act) (03 2012)                                                                          |
|  | TWA        | 0.5 mg/m3 | Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents) (11 2010)                                                                        |
|  | 8 HR ACL   | 0.5 mg/m3 | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |
|  | 15 MIN ACL | 1.5 mg/m3 | Canada. Saskatchewan OELs (Occupational Health and Safety Regulations, 1996, Table 21) (05 2009)                                                              |

**Additional exposure limits under the conditions of use: MEXICO**

| Chemical Identity                                                          | Type    | Exposure Limit Values | Source                                                                                                   |
|----------------------------------------------------------------------------|---------|-----------------------|----------------------------------------------------------------------------------------------------------|
| Carbon dioxide                                                             | VLE-CT  | 30,000 ppm            | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
|                                                                            | VLE-PPT | 5,000 ppm             | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Carbon monoxide                                                            | VLE-PPT | 25 ppm                | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Nitrogen dioxide                                                           | VLE-PPT | 0.2 ppm               | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Ozone                                                                      | VLE-P   | 0.1 ppm               | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Manganese - as Mn                                                          | VLE-PPT | 0.2 mg/m3             | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Chromium (VI)                                                              | VLE-PPT | 0.05 mg/m3            | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Nickel - Inhalable fraction. - as Ni                                       | VLE-PPT | 1.5 mg/m3             | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Copper and/or copper alloys and compounds (as Cu) - Fume. - as Cu          | VLE-PPT | 0.2 mg/m3             | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Copper and/or copper alloys and compounds (as Cu) - Dust and mist. - as Cu | VLE-PPT | 1 mg/m3               | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |
| Chromium oxide                                                             | VLE-PPT | 0.5 mg/m3             | Mexico. OELs. (NOM-010-STPS-2014 Chemical Pollutants at the Workplace; Assessment and Control) (04 2014) |

**Appropriate Engineering Controls**

**Ventilation:** Use enough ventilation, local exhaust at the arc, or both to keep the fumes and gases from the worker's breathing zone and the general area. Train the welder to keep his head out of the fumes. **Keep exposure as low as possible.**

**Individual protection measures, such as personal protective equipment**
**General information:**

**Exposure Guidelines:** Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) are values published by the American Conference of Government Industrial Hygienists (ACGIH). ACGIH Statement of Positions Regarding the TLVs® and BEIs® states that the TLV-TWA should be used as a guide in the control of health hazards and should not be used

to indicate a fine line between safe and dangerous exposures. See Section 10 for information on potential fume constituents of health interest. Threshold Limit Values are figures published by the American Conference of Government Industrial Hygienists.

**Maximum Fume Exposure Guideline™ (MFEG)™** for this product (based on content of Manganese) is 0.2 mg/m<sup>3</sup>. This exposure guideline is calculated using the most conservative value of the ACGIH TLV or OSHA PEL for the stated substance. If your local applicable exposure limits are lower than the ACGIH TLV or OSHA PEL for any of the metallic substances listed in Section 2 or 3 of this SDS, you must take that into consideration before utilizing or applying this guideline.

**Eyeface protection:**

Wear helmet or use face shield with filter lens shade number 12 or darker for open arc processes – or follow the recommendations as specified in ANSI Z49.1, Section 4, based on your process and settings. No specific lens shade recommendation for submerged arc or electroslag processes. Shield others by providing appropriate screens and flash goggles.

**Skin Protection****Hand Protection:**

Wear protective gloves. Suitable gloves can be recommended by the glove supplier.

**Other:**

**Protective Clothing:** Wear hand, head, and body protection which help to prevent injury from radiation, sparks and electrical shock. See Z49.1. At a minimum this includes welder's gloves and a protective face shield, and may include arm protectors, aprons, hats, shoulder protection, as well as dark substantial clothing. Wear dry gloves free of holes or split seams. Train the welder not to permit electrically live parts or electrodes to contact skin . . . or clothing or gloves if they are wet. Insulate yourself from the work piece and ground using dry plywood, rubber mats or other dry insulation.

**Respiratory Protection:**

Keep your head out of fumes. Use enough ventilation and local exhaust to keep fumes and gases from your breathing zone and the general area. An approved respirator should be used unless exposure assessments are below applicable exposure limits.

**Hygiene measures:**

Do not eat, drink or smoke when using the product. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Determine the composition and quantity of fumes and gases to which workers are exposed by taking an air sample from inside the welder's helmet if worn or in the worker's breathing zone. Improve ventilation if exposures are not below limits. See ANSI/AWS F1.1, F1.2, F1.3 and F1.5, available from the American Welding Society, [www.aws.org](http://www.aws.org).

**9. PHYSICAL AND CHEMICAL PROPERTIES**

|                        |                            |
|------------------------|----------------------------|
| <b>Appearance:</b>     | Solid welding wire or rod. |
| <b>Physical state:</b> | Solid                      |
| <b>Form:</b>           | Solid                      |
| <b>Color:</b>          | No data available.         |
| <b>Odor:</b>           | No data available.         |
| <b>Odor threshold:</b> | No data available.         |
| <b>pH:</b>             | No data available.         |

|                                                              |                    |
|--------------------------------------------------------------|--------------------|
| <b>Melting point/freezing point:</b>                         | No data available. |
| <b>Initial boiling point and boiling range:</b>              | No data available. |
| <b>Flash Point:</b>                                          | No data available. |
| <b>Evaporation rate:</b>                                     | No data available. |
| <b>Flammability (solid, gas):</b>                            | No data available. |
| <b>Upper/lower limit on flammability or explosive limits</b> |                    |
| <b>Flammability limit - upper (%):</b>                       | No data available. |
| <b>Flammability limit - lower (%):</b>                       | No data available. |
| <b>Explosive limit - upper (%):</b>                          | No data available. |
| <b>Explosive limit - lower (%):</b>                          | No data available. |
| <b>Vapor pressure:</b>                                       | No data available. |
| <b>Vapor density:</b>                                        | No data available. |
| <b>Density:</b>                                              | No data available. |
| <b>Relative density:</b>                                     | No data available. |
| <b>Solubility(ies)</b>                                       |                    |
| <b>Solubility in water:</b>                                  | No data available. |
| <b>Solubility (other):</b>                                   | No data available. |
| <b>Partition coefficient (n-octanol/water):</b>              | No data available. |
| <b>Auto-ignition temperature:</b>                            | No data available. |
| <b>Decomposition temperature:</b>                            | No data available. |
| <b>Viscosity:</b>                                            | No data available. |

## 10. STABILITY AND REACTIVITY

|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Reactivity:</b>                         | The product is non-reactive under normal conditions of use, storage and transport.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Chemical Stability:</b>                 | Material is stable under normal conditions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Possibility of hazardous reactions:</b> | None under normal conditions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Conditions to avoid:</b>                | Avoid heat or contamination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Incompatible Materials:</b>             | Strong acids. Strong oxidizing substances. Strong bases.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hazardous Decomposition Products:</b>   | <p>Fumes and gases from welding and allied processes cannot be classified simply. The composition and quantity of both are dependent upon the metal being welded, the process, procedure and electrodes used. Other conditions which also influence the composition and quantity of the fumes and gases to which workers may be exposed include: coatings on the metal being welded (such as paint, plating, or galvanizing), the number of welders and the volume of the worker area, the quality and amount of ventilation, the position of the welder's head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities.)</p> <p>When the electrode is consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section 3. Decomposition products of normal operation include those originating from the volatilization, reaction, or oxidation of the</p> |

materials shown in Section 3, plus those from the base metal and coating, etc., as noted above. Reasonably expected fume constituents produced during arc welding include the oxides of iron, manganese and other metals present in the welding consumable or base metal. Hexavalent chromium compounds may be in the welding fume of consumables or base metals which contain chromium. Gaseous and particulate fluoride may be in the welding fume of consumables which contain fluoride. Gaseous reaction products may include carbon monoxide and carbon dioxide. Ozone and nitrogen oxides may be formed by the radiation from the arc.

## 11. TOXICOLOGICAL INFORMATION

### Information on likely routes of exposure

|                      |                                                                                                                                                                                   |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Inhalation:</b>   | Potential chronic health hazards related to the use of welding consumables are most applicable to the inhalation route of exposure. Refer to Inhalation statements in Section 11. |
| <b>Skin Contact:</b> | Arc rays can burn skin. Skin cancer has been reported.                                                                                                                            |
| <b>Eye contact:</b>  | Arc rays can injure eyes.                                                                                                                                                         |
| <b>Ingestion:</b>    | Health injuries from ingestion are not known or expected under normal use.                                                                                                        |

### Symptoms related to the physical, chemical and toxicological characteristics

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Inhalation:</b> | Short-term (acute) overexposure to fumes and gases from welding and allied processes may result in discomfort such as metal fume fever, dizziness, nausea, or dryness or irritation of nose, throat, or eyes. May aggravate pre-existing respiratory problems (e.g. asthma, emphysema). Long-term (chronic) overexposure to fumes and gases from welding and allied processes can lead to siderosis (iron deposits in lung), central nervous system effects, bronchitis and other pulmonary effects. |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Information on toxicological effects

#### Acute toxicity (list all possible routes of exposure)

##### Oral

|                                                   |                        |
|---------------------------------------------------|------------------------|
| <b>Product:</b>                                   | Not classified         |
| <b>Specified substance(s):</b>                    |                        |
| Iron                                              | LD 50 (Rat): 98.6 g/kg |
| Cobalt and compounds (as Co)                      | LD 50 (Rat): 550 mg/kg |
| Copper and/or copper alloys and compounds (as Cu) | LD 50 (Rat): 481 mg/kg |

##### Dermal

|                 |                |
|-----------------|----------------|
| <b>Product:</b> | Not classified |
|-----------------|----------------|

##### Inhalation

|                                |                               |
|--------------------------------|-------------------------------|
| <b>Product:</b>                | Not classified                |
| <b>Specified substance(s):</b> |                               |
| Cobalt and compounds (as Co)   | LC 50 (Rat, 4 h): ≤ 0.05 mg/l |

#### Repeated dose toxicity

|                 |                |
|-----------------|----------------|
| <b>Product:</b> | Not classified |
|-----------------|----------------|

#### Skin Corrosion/Irritation

**Product:** Not classified

**Serious Eye Damage/Eye Irritation**

**Product:** Not classified

**Respiratory or Skin Sensitization**

**Product:** Not classified

**Carcinogenicity**

**Product:** Arc rays: Skin cancer has been reported.

**IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:**

Nickel Overall evaluation: 2B. Possibly carcinogenic to humans.

Cobalt and Overall evaluation: 2B. Possibly carcinogenic to humans.  
compounds (as Co)

**US. National Toxicology Program (NTP) Report on Carcinogens:**

Nickel Reasonably Anticipated to be a Human Carcinogen.

**US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):**

No carcinogenic components identified

**Germ Cell Mutagenicity**

**In vitro**

**Product:** Not classified

**In vivo**

**Product:** Not classified

**Reproductive toxicity**

**Product:** Not classified

**Specific Target Organ Toxicity - Single Exposure**

**Product:** Not classified

**Specific Target Organ Toxicity - Repeated Exposure**

**Product:** Not classified

**Aspiration Hazard**

**Product:** Not classified

**Other effects:**

Organic polymers may be used in the manufacture of various welding consumables. Overexposure to their decomposition byproducts may result in a condition known as polymer fume fever. Polymer fume fever usually occurs within 4 to 8 hours of exposure with the presentation of flu like symptoms, including mild pulmonary irritation with or without an increase in body temperature. Signs of exposure can include an increase in white blood cell count. Resolution of symptoms typically occurs quickly, usually not lasting longer than 48 hours.

**Symptoms related to the physical, chemical and toxicological characteristics under the condition of use**

**Inhalation:**

**Specified substance(s):**

Manganese

Overexposure to manganese fumes may affect the brain and central nervous system, resulting in poor coordination, difficulty speaking, and arm or leg tremor. This condition can be irreversible.

|                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chromium (VI)                                     | Chromates may cause ulceration, perforation of the nasal septum, and severe irritation of the bronchial tubes and lungs. Liver damage and allergic reactions, including skin rash, have been reported. Asthma has been reported in some sensitized individuals. Skin contact may result in irritation, ulceration, sensitization, and contact dermatitis. Chromates contain the hexavalent form of chromium. Hexavalent chromium and its compounds are on the IARC (International Agency for Research on Cancer) and NTP (National Toxicology Program) lists as posing a cancer risk to humans. |
| Nickel                                            | Nickel and its compounds are on the IARC and NTP lists as posing respiratory cancer risk, and are skin sensitizers with symptoms ranging from slight itch to severe dermatitis.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Copper and/or copper alloys and compounds (as Cu) | Overexposure to copper fumes may cause fever, chills, congestion and headaches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

#### Additional toxicological Information under the conditions of use:

##### Acute toxicity

###### Oral

###### Specified substance(s):

|                                                   |                            |
|---------------------------------------------------|----------------------------|
| Chromium (VI)                                     | LD 50 (Rat): 27 - 59 mg/kg |
| Copper and/or copper alloys and compounds (as Cu) | LD 50 (Rat): 481 mg/kg     |

###### Inhalation

###### Specified substance(s):

|                  |                                 |
|------------------|---------------------------------|
| Carbon dioxide   | LC Lo (Human, 5 min): 90000 ppm |
| Carbon monoxide  | LC 50 (Rat, 4 h): 1,300 mg/l    |
| Nitrogen dioxide | LC 50 (Rat, 4 h): 88 ppm        |
| Ozone            | LC Lo (Human, 30 min): 50 ppm   |
| Chromium (VI)    | LC 50 (Rat, 4 h): 33 - 70 mg/m3 |

#### IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:

##### Specified substance(s):

|                |                                                                          |
|----------------|--------------------------------------------------------------------------|
| Chromium (VI)  | Overall evaluation: 1. Carcinogenic to humans.                           |
| Nickel         | Overall evaluation: 2B. Possibly carcinogenic to humans.                 |
| Chromium oxide | Overall evaluation: 3. Not classifiable as to carcinogenicity to humans. |

#### US. National Toxicology Program (NTP) Report on Carcinogens:

##### Specified substance(s):

|               |                                                  |
|---------------|--------------------------------------------------|
| Chromium (VI) | Known To Be Human Carcinogen.                    |
| Nickel        | Reasonably Anticipated to be a Human Carcinogen. |

#### US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):

##### Specified substance(s):

|               |        |
|---------------|--------|
| Chromium (VI) | Cancer |
|---------------|--------|

##### Other effects:

##### Specified substance(s):

|                  |                                    |
|------------------|------------------------------------|
| Carbon dioxide   | Asphyxia                           |
| Carbon monoxide  | Carboxyhemoglobinemia              |
| Nitrogen dioxide | Lower respiratory tract irritation |
| Nickel           | Dermatitis Pneumoconiosis          |

## 12. ECOLOGICAL INFORMATION



**Ecotoxicity****Acute hazards to the aquatic environment:****Fish****Product:** Not classified**Specified substance(s):**

Molybdenum LC 50 (Rainbow trout,donaldson trout (Oncorhynchus mykiss), 96 h): 800 mg/l

Nickel LC 50 (Fathead minnow (Pimephales promelas), 96 h): 2.916 mg/l

Cobalt and compounds (as Co) LC 50 (Rainbow trout,donaldson trout (Oncorhynchus mykiss), 28 d): &gt; 0.17 - &lt; 15.61 mg/l

Copper and/or copper alloys and compounds (as Cu) LC 50 (Fathead minnow (Pimephales promelas), 96 h): 1.6 mg/l

**Aquatic Invertebrates****Product:** Not classified**Specified substance(s):**

Manganese EC 50 (Water flea (Daphnia magna), 48 h): 40 mg/l

Nickel EC 50 (Water flea (Daphnia magna), 48 h): 1 mg/l

Copper and/or copper alloys and compounds (as Cu) EC 50 (Water flea (Daphnia magna), 48 h): 0.102 mg/l

**Chronic hazards to the aquatic environment:****Fish****Product:** Not classified**Aquatic Invertebrates****Product:** Not classified**Toxicity to Aquatic Plants****Product:** Not classified**Specified substance(s):**

Copper and/or copper alloys and compounds (as Cu) LC 50 (Green algae (Scenedesmus dimorphus), 3 d): 0.0623 mg/l

**Persistence and Degradability****Biodegradation****Product:** No data available.**Bioaccumulative potential****Bioconcentration Factor (BCF)****Product:** No data available.**Specified substance(s):**

Nickel Zebra mussel (Dreissena polymorpha), Bioconcentration Factor (BCF): 5,000 - 10,000 (Lotic) Bioconcentration factor calculated using dry weight tissue conc

Cobalt and compounds (as Co) Brown shrimp (Penaeus aztecus), Bioconcentration Factor (BCF): &gt; 2,250 - &lt; 2,500 (Static)

Copper and/or copper alloys and compounds (as Cu) Blue-green algae (Anacystis nidulans), Bioconcentration Factor (BCF): 36.01 (Static)

**Mobility in soil:** No data available.**13. DISPOSAL CONSIDERATIONS**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General information:</b>    | The generation of waste should be avoided or minimized whenever possible. When practical, recycle in an environmentally acceptable, regulatory compliant manner. Dispose of non-recyclable products in accordance with all applicable Federal, State, Provincial, and Local requirements.                                                                                                                                                                                                                                                                                                                                              |
| <b>Disposal instructions:</b>  | Disposal of this product may be regulated as a Hazardous Waste. The welding consumable and/or by-product from the welding process (including, but not limited to slag, dust, etc.) may contain levels of leachable heavy metals such as Barium or Chromium. Prior to disposal, a representative sample must be analyzed in accordance with US EPA's Toxicity Characteristic Leaching Procedure (TCLP) to determine if any constituents exist above regulated threshold levels. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner according to Federal, State and Local Regulations. |
| <b>Contaminated Packaging:</b> | Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

#### 14. TRANSPORT INFORMATION

**DOT**

|                            |                  |
|----------------------------|------------------|
| UN Number:                 |                  |
| UN Proper Shipping Name:   | NOT DG REGULATED |
| Transport Hazard Class(es) |                  |
| Class:                     | NR               |
| Label(s):                  | —                |
| Packing Group:             | —                |
| Marine Pollutant:          | No               |

**IMDG**

|                            |                  |
|----------------------------|------------------|
| UN Number:                 |                  |
| UN Proper Shipping Name:   | NOT DG REGULATED |
| Transport Hazard Class(es) |                  |
| Class:                     | NR               |
| Label(s):                  | —                |
| EmS No.:                   |                  |
| Packing Group:             | —                |
| Marine Pollutant:          | No               |

**IATA**

|                             |                  |
|-----------------------------|------------------|
| UN Number:                  |                  |
| Proper Shipping Name:       | NOT DG REGULATED |
| Transport Hazard Class(es): |                  |
| Class:                      | NR               |
| Label(s):                   | —                |
| Packing Group:              | —                |
| Marine Pollutant:           | No               |
| Cargo aircraft only:        | Allowed.         |

**TDG**

|                            |                  |
|----------------------------|------------------|
| UN Number:                 |                  |
| UN Proper Shipping Name:   | NOT DG REGULATED |
| Transport Hazard Class(es) |                  |
| Class:                     | NR               |
| Label(s):                  | —                |

Packing Group: –  
Marine Pollutant: No

## 15. REGULATORY INFORMATION

### US Federal Regulations

#### TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

None present or none present in regulated quantities.

#### US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

None present or none present in regulated quantities.

#### CERCLA Hazardous Substance List (40 CFR 302.4):

| <u>Chemical Identity</u>                          | <u>Reportable quantity</u>                                                              |
|---------------------------------------------------|-----------------------------------------------------------------------------------------|
| Chromium and chromium alloys or compounds (as Cr) | 5000lbs.                                                                                |
| Manganese                                         | Included in the regulation but with no data values. See regulation for further details. |
| Nickel                                            | 100lbs.                                                                                 |
| Cobalt and compounds (as Co)                      | Included in the regulation but with no data values. See regulation for further details. |
| Copper and/or copper alloys and compounds (as Cu) | 5000lbs.                                                                                |

#### Superfund Amendments and Reauthorization Act of 1986 (SARA)

##### Hazard categories

Not listed.

##### SARA 302 Extremely Hazardous Substance

None present or none present in regulated quantities.

##### SARA 304 Emergency Release Notification

| <u>Chemical Identity</u>                          | <u>Reportable quantity</u>                                                              |
|---------------------------------------------------|-----------------------------------------------------------------------------------------|
| Chromium and chromium alloys or compounds (as Cr) | 5000 lbs.                                                                               |
| Manganese                                         | Included in the regulation but with no data values. See regulation for further details. |
| Nickel                                            | 100 lbs.                                                                                |
| Cobalt and compounds (as Co)                      | Included in the regulation but with no data values. See regulation for further details. |
| Copper and/or copper alloys and compounds (as Cu) | 5000 lbs.                                                                               |

##### SARA 311/312 Hazardous Chemical

| <u>Chemical Identity</u> | <u>Threshold Planning Quantity</u> |
|--------------------------|------------------------------------|
|--------------------------|------------------------------------|

##### SARA 313 (TRI Reporting)

| <u>Chemical Identity</u>                          | <u>Reporting threshold for other users</u> | <u>Reporting threshold for manufacturing and processing</u> |
|---------------------------------------------------|--------------------------------------------|-------------------------------------------------------------|
| Chromium and chromium alloys or compounds (as Cr) | 10000 lbs                                  | 25000 lbs.                                                  |
| Nickel                                            | 10000 lbs                                  | 25000 lbs.                                                  |
| Cobalt and compounds (as Co)                      | 10000 lbs                                  | 25000 lbs.                                                  |

##### Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)

None present or none present in regulated quantities.

##### Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):

None present or none present in regulated quantities.

**US State Regulations****US. California Proposition 65**

This product contains chemical(s) known to the State of California to cause cancer and/or to cause birth defects or other reproductive harm.

|                              |               |
|------------------------------|---------------|
| Nickel                       | Carcinogenic. |
| Cobalt and compounds (as Co) | Carcinogenic. |

**WARNING:** This product contains or produces a chemical known to the State of California to cause cancer and birth defects (or other reproductive harm). (California Health & Safety Code Section 25249.5 et seq.)

**US. New Jersey Worker and Community Right-to-Know Act****Chemical Identity**

Chromium and chromium alloys or compounds (as Cr)  
Nickel  
Cobalt and compounds (as Co)

**US. Massachusetts RTK - Substance List****Chemical Identity**

Chromium and chromium alloys or compounds (as Cr)  
Nickel

**US. Pennsylvania RTK - Hazardous Substances****Chemical Identity**

Chromium and chromium alloys or compounds (as Cr)  
Nickel

**US. Rhode Island RTK**

No ingredient regulated by RI Right-to-Know Law present.

**Canada Federal Regulations****List of Toxic Substances (CEPA, Schedule 1)**

Not Regulated

**Export Control List (CEPA 1999, Schedule 3)**

Not Regulated

**National Pollutant Release Inventory (NPRI)****Canada. National Pollutant Release Inventory (NPRI) Substances, Part 5, VOCs with Additional Reporting Requirements**

|          |               |
|----------|---------------|
| NPRI PT5 | Not Regulated |
|----------|---------------|

**Canada. Canadian Environmental Protection Act (CEPA). National Pollutant Release Inventory (NPRI) (Parts 1-4)**

|      |               |
|------|---------------|
| NPRI | Not Regulated |
|------|---------------|

**Greenhouse Gases**

Not Regulated

**Controlled Drugs and Substances Act**

|           |               |
|-----------|---------------|
| CA CDSI   | Not Regulated |
| CA CDSII  | Not Regulated |
| CA CDSIII | Not Regulated |
| CA CDSIV  | Not Regulated |

|            |               |
|------------|---------------|
| CA CDSV    | Not Regulated |
| CA CDSVII  | Not Regulated |
| CA CDSVIII | Not Regulated |

#### Precursor Control Regulations

Not Regulated

**Mexico. Substances subject to reporting for the pollutant release and transfer registry (PRTR):** not applicable

#### Inventory Status:

|                                          |                                                                   |
|------------------------------------------|-------------------------------------------------------------------|
| Australia AICS:                          | On or in compliance with the inventory                            |
| Canada DSL Inventory List:               | On or in compliance with the inventory                            |
| EINECS, ELINCS or NLP:                   | On or in compliance with the inventory                            |
| Japan (ENCS) List:                       | One or more components are not listed or are exempt from listing. |
| China Inv. Existing Chemical Substances: | On or in compliance with the inventory                            |
| Korea Existing Chemicals Inv. (KECI):    | On or in compliance with the inventory                            |
| Canada NDSL Inventory:                   | One or more components are not listed or are exempt from listing. |
| Philippines PICCS:                       | On or in compliance with the inventory                            |
| US TSCA Inventory:                       | On or in compliance with the inventory                            |
| New Zealand Inventory of Chemicals:      | On or in compliance with the inventory                            |
| Japan ISHL Listing:                      | One or more components are not listed or are exempt from listing. |
| Japan Pharmacopoeia Listing:             | One or more components are not listed or are exempt from listing. |
| Mexico INSQ:                             | One or more components are not listed or are exempt from listing. |
| Ontario Inventory:                       | One or more components are not listed or are exempt from listing. |
| Taiwan Chemical Substance Inventory:     | One or more components are not listed or are exempt from listing. |

## 16. OTHER INFORMATION

#### Definitions:

**The Maximum Fume Exposure Guideline™ (MFEG)™** is a guideline limit for total welding fume exposure for a specific consumable product which may be used by employers to manage worker exposure to welding fume where that product is used. The MFEG™ is an estimate of the level of total welding fume exposure for a given product above which the exposure limit for one of the fume constituents may be exceeded. The exposure limits referenced are the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV®) and the U.S. OSHA Permissible Exposure Limit (PEL) whichever limit is lower. If local applicable limits for substances listed in Section 2 or 3 of this SDS are lower than the TLV or PEL this must be taken into consideration before utilizing or applying this guideline. The MFEG™ never exceeds 5 mg/m<sup>3</sup> which is the maximum recommended exposure limit for total welding fume. **The MFEG™ is intended to serve as a general guideline to assist in the management of workplace exposure to welding fume and does not replace the regular measurement and analysis of worker exposure to individual welding fume constituents in accordance with recommended industrial hygiene practice.**

**Revision Date:** 10/02/2017

**Further Information:** Additional information is available by request.

**Disclaimer:** The Lincoln Electric Company urges each end user and recipient of this SDS to study it carefully. See also [www.lincolnelectric.com/safety](http://www.lincolnelectric.com/safety). If necessary, consult an industrial hygienist or other expert to understand this information and safeguard the environment and protect workers from potential hazards associated with the handling or use of this product. This information is believed to be accurate as of the revision date shown above. However, no warranty, expressed or implied, is given. Because the conditions or methods of use are beyond Lincoln Electric's control, we assume no liability resulting from the use of this product. Regulatory requirements are subject to change and may differ between various locations. Compliance with all applicable

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Federal, State, Provincial, and local laws and regulations remain the responsibility of the user.

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