Section 1. Identification of the Substance and Company

1.1 Product Identification:
Product Name: Nickel; massive forms
Synonyms:
- FSC
- 1X1
- OSC
- S-Rounds
- Melt Rounds
- Cut Cathode (Strip)
- 4X4
- R-Rounds
- Discs
- Jumbos
- Pellets
- S-Pellets
- P-Pellets
- Chips
- Slab

Chemical Family: Metal.
EC No: 231-111-4
CAS No: 7440-02-0
REACH Registration number: see Section 15

1.2 Uses

Identified Uses:
- Stainless, special steels and special alloys manufacturing
- Integrated steel and iron
- EAF carbon steel manufacturing
- Powder metallurgy
- Metal surface treatment
- Production of nickel salts from nickel metal
- Manufacturing of batteries using positive nickel electrodes
- Ni catalyst production from NiO-containing catalyst precursor
- Use of pre-reduced nickel containing catalyst
- Production of magnets
- Production of nickel-containing products (electronics)
- Production of brazing alloys
- Use of brazing alloys
- Production of silver-nickel contact materials
- Use of silver-nickel contact materials
- Sputtering deposition
- Thin film deposition by evaporation technique
- Machining of nickel alloys and nickel-coated metal objects
- Use of Nickel metal for Thermal Spraying
- Use of Nickel metal and Nickel containing alloys for the production of steel and other alloys powder by atomisation
- Use of Ni-containing alloys for blasting

Uses Advised Against:
- Use of nickel in articles intended for direct and prolonged contact with the skin where the release of nickel exceed the limit set out in Directives 94/27/EC and 2004/6/EC and REACH regulation 1907/2009 (Annex XVII).
- Use of nickel in nickel-containing food contact materials for which migration into foodstuff would exceed more than 0.1 mg/kg of nickel in accordance with the Council of Europe Guidelines on metals and alloys used as food contact materials
- Use of nickel in immersion-type kettles which would release more than 0.05 mg/l of nickel into the water in accordance with the Council of Europe Guidelines on metals and alloys used as food contact materials
- Use of nickel in commercially available “do-it-yourself” home electroplating kits.

1.3 Company Identification

Manufactured by:

In Canada:
1. Vale Canada Limited
   Manitoba Operations
   Thompson, MB
   Canada R8N 1P3

2. Vale Canada Limited
   Ontario Operations
   Sudbury, ON
   Canada PoM 1No

Distributed by:

Vale Canada Limited
200 Bay St., Royal Bank Plaza
Suite 1600, South Tower, PO Box 70
Toronto, ON
Canada, M5J 2K2
Email: msds@vale.com

In North & South America:
Vale Americas Inc.
250 Pehle Avenue
Suite 302
Saddle Brook, NJ 07663
U.S.A.

In Europe, Middle East, Africa, India, & Pakistan:
Vale International SA
Route de Pallatex 29
1162 Saint-Prex
Switzerland

In Asia (Except India, & Pakistan):
Vale Base Metals Asia Pacific PTE. LTD.
One Temasek Avenue #39-01
Millenia Tower
Singapore, 039192

In the UK:
4. Vale Europe Limited
   Clydach Refinery
   Clydach Swansea
   UK, SA6 5QR
   Telephone number:+44 (0) 1792 8412501
   REACH@vale.com

For Fire, Spill, or chemical emergency call CHEMTREC: +1 703 527-3887
Section 2. Hazards Identification

2.1 Classification of the Substance:
- Skin Sensitization – Category 1
- Carcinogenicity – Category 2
- Specific Target Organ Toxicity, Repeated exposure – Category 1

Hazard Pictograms: GHS07 - Exclamation mark, GHS08 - Health Hazard
Signal Word: Danger

Hazard Statements:
- H317 - May cause an allergic skin reaction.
- H351 - Suspected of causing cancer by inhalation
- H372 - Causes damage to lungs through prolonged or repeated inhalation exposure


2.2: Label elements

Product identifier: Nickel
CAS #: 7440-02-0

Symbols: GHS07 - Exclamation mark, GHS08 - Health Hazard

Signal Word: Danger

Hazard Statements: H317, H351, H372

Precautionary Statements: P202, P261, P280, P302+352, P501
(NOTE: P-statements have been reduced, the full list can be found in Section 15).

For full text of Precautionary Statements see section 15.

Section 3. Composition

<table>
<thead>
<tr>
<th>Substance</th>
<th>Mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous Ingredients</td>
<td>Typical Composition</td>
</tr>
<tr>
<td>Nickel Metal (Ni)</td>
<td>&gt;99%</td>
</tr>
</tbody>
</table>
Section 4. First Aid Measures

Ingestion: No specific first aid required.

Inhalation: No specific first aid required.

Skin: Remove contaminated clothing, and wash affected areas thoroughly with water. If skin irritation or rash occurs: Get medical advice/attention. Show label if possible.

Eyes: Irrigate eyeball thoroughly with water for at least 10 minutes. If discomfort persists, seek medical attention.

Most important symptoms & affects, both acute/ delayed
Skin contact: Rash
Eye contact: Redness

Indication of immediate medical attention and special treatment needed
No special requirements

Section 5. Fire Fighting Measures

Suitable extinguishing media: Any, type to be selected according to materials stored in the immediate neighbourhood.

Special risks: Non-flammable. May oxidize to Nickel Oxide if exposed to high temperatures within a fire. Keep containers cool with water spray.

Special protective equipment for fire fighting: None needed. Wear protective equipment if required for other materials within the immediate vicinity.

Section 6. Accidental Release Measures

Person related precautionary measures: Avoid generation of dusty atmospheres. Do not inhale dusts. Contaminated work clothing should not be allowed out of the workplace. Use personal protective equipment as required. Wash hands, and face thoroughly after handling.

Environmental Protection measures: No specific measures needed.

Procedures for cleaning/absorption: Pick up and replace in original container. Nickel-containing material is normally collected to recover nickel values.

Section 7. Handling and Storage

7.1 Precautions for Safe Handling: Prevent the generation of inhalable dusts e.g. by the use of suitable ventilation. Do not inhale dust. Wear appropriate nationally approved respirators if handling is likely to cause the concentration limits of airborne nickel to exceed the locally prescribed exposure limits. Wear suitable protective clothing and gloves. Contaminated work clothing should not be allowed out of the workplace.
7.2 Conditions for Safe Storage: Keep in the container supplied, and keep container closed when not in use. Local regulations should be followed regarding the storage of this product.

Section 8. Exposure Controls / Personal Protection

8.1.1 Exposure Limits:

<table>
<thead>
<tr>
<th>Nickel Metal (Ni) – CAS 7440-02-0</th>
<th>Exposure Limit (mg/m³)</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACGIH TLV-TWA¹</td>
<td>1.5 *</td>
<td>2008</td>
</tr>
<tr>
<td>UK WEL²</td>
<td>0.5</td>
<td>2006</td>
</tr>
<tr>
<td>Japan</td>
<td>1</td>
<td>1968</td>
</tr>
<tr>
<td>Korea</td>
<td>1</td>
<td>2006</td>
</tr>
<tr>
<td>China</td>
<td>1</td>
<td>2007</td>
</tr>
</tbody>
</table>

* - as Ni in inhalable fraction

Environmental Limits:
PNEC's

<table>
<thead>
<tr>
<th>Compartment</th>
<th>Unit</th>
<th>PNEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater</td>
<td>μg Ni/L (bioavailable)</td>
<td>7.1</td>
</tr>
<tr>
<td>Marine</td>
<td>μg Ni/L</td>
<td>8.6</td>
</tr>
<tr>
<td>Terrestrial</td>
<td>mg Ni/kg</td>
<td>29.9</td>
</tr>
</tbody>
</table>

DNEL’s

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
<th>DNEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dermal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-term local</td>
<td>mgNi/cm²/day</td>
<td>0.035</td>
</tr>
<tr>
<td>Inhalation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute local</td>
<td>mgNi/m³</td>
<td>4.0</td>
</tr>
<tr>
<td>Long-term systemic</td>
<td>mgNi/m³</td>
<td>0.05</td>
</tr>
<tr>
<td>Long-term local</td>
<td>mgNi/m³</td>
<td>0.05</td>
</tr>
</tbody>
</table>

8.2.1 Occupational exposure controls:
As supplied, this product does not pose a health hazard by inhalation. Mechanical extraction ventilation may be required if user operations change it to other physical or chemical forms, whether as end products, intermediates or fugitive emissions, which are inhalable. Maintain airborne nickel levels as low as possible. Avoid repeated skin contact.

PPE
Respiratory protection: If required, use an approved respirator with particulate filters.

Eye protection: None

Hand & Skin Protection: Wear suitable protective clothing and gloves, which should be selected specifically for the working place, depending on concentration and quantity of the hazardous material (overalls and leather/rubber gloves). Wash skin thoroughly after handling and before eating, drinking or smoking. Change contaminated clothing frequently. Launder clothing and gloves as needed. Use of skin-protective barrier cream advised.

**Section 9. Physical and Chemical Properties**

Silver-grey odourless metal.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical state at 20°C and 101.3 kPa</td>
<td>solid</td>
</tr>
<tr>
<td>Melting / freezing point</td>
<td>1455°C</td>
</tr>
<tr>
<td>Boiling point</td>
<td>2730°C</td>
</tr>
<tr>
<td>Relative density</td>
<td>8.9 g/cm³ at 25°C</td>
</tr>
<tr>
<td>Vapour pressure</td>
<td>1 mm Hg at 1810°C.</td>
</tr>
<tr>
<td>Surface tension</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Water solubility</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Partition coefficient n-octanol/water (log value)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Flash point</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Flammability</td>
<td>Non-flammable</td>
</tr>
<tr>
<td>Explosive properties</td>
<td>Non-explosive</td>
</tr>
<tr>
<td>Self-ignition temperature</td>
<td>Autoflammability is not applicable to massive nickel metal.</td>
</tr>
<tr>
<td>Oxidising properties</td>
<td>Non-oxidising</td>
</tr>
<tr>
<td>Granulometry</td>
<td>Particle size distribution: &lt;100 um, &lt;99%</td>
</tr>
<tr>
<td>Stability in organic solvents and identity of relevant degradation products</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Dissociation constant</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Viscosity</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Packaged Density</td>
<td>Pellets: 5.4 – 6.0 g/cm³</td>
</tr>
<tr>
<td></td>
<td>Discs: 5.4 – 6.0 g/cm³</td>
</tr>
<tr>
<td></td>
<td>Chips: 4.5 – 6.0 g/cm³</td>
</tr>
</tbody>
</table>

**Section 10. Stability and Reactivity**

10.1 Reactivity Stable under normal conditions.

10.2 Chemical stability Stable under normal conditions.

10.3 Possibility of hazardous reactions Stable under normal conditions.
10.4 **Conditions to avoid**

This product can react vigorously with acids to liberate hydrogen, which can form explosive mixtures with air. Under special conditions nickel can react with carbon monoxide in reducing atmospheres to form nickel carbonyl, Ni(CO)$_4$, a toxic gas. Metal powders when heated in reducing atmospheres may become pyrophoric.

10.5 **Incompatible materials**

Acids, Strong oxidising agents.

10.6 **Hazardous Decomposition Product(s)**

Nickel carbonyl gas

### Section 11. Toxicological Information

#### Nickel

**Acute Toxicity:**

- **a) Oral:** Non toxic - LD$_{50}$ ORAL RAT >9000 mg/kg
- **b) Inhalation:** No information available
- **c) Dermal:** No information available.

**Corrosivity/Irritation:**

- **a) Respiratory Tract:** None
- **b) Skin:** See sensitization section.
- **c) Eyes:** Mechanical irritation may be expected.

**Sensitization:**

- **a) Respiratory tract:** Nickel metal induced asthma is very rare. 3 case reports are available; the data is not sufficient to conclude that nickel metal is classified as a respiratory sensitizer.
- **b) Skin:** Nickel metal is a well-known skin sensitizer. Direct and prolonged skin contact with metallic nickel may induce nickel allergy and elicit nickel allergic skin reactions in those people already sensitized to nickel, so-called nickel allergic contact dermatitis.
- **c) Pre-existing conditions:** Individuals known to be allergic to nickel should avoid contact with nickel whenever possible to reduce the likelihood of nickel allergic contact dermatitis reactions (skin rashes). Repeated contact may result in persistent chronic palmar/hand dermatitis in a smaller number of individuals, despite efforts to reduce or avoid nickel exposure.

**Chronic toxicity:**

- **a) Oral:** No information available
- **b) Inhalation:** Animal studies (rats) show that repeated-dose inhalation of micron-sized metallic nickel powder damages the lung. Chronic inflammation, lung fibrosis and accumulation of nickel particles were observed.
c) Dermal: Direct and prolonged skin contact with nickel metal may cause nickel sensitization resulting in nickel allergic contact dermatitis/skin rash.

Mutagenicity / Reproductive toxicity: No data.

Carcinogenicity:
  a) Ingestion: The U.S. National Institute for Occupational Safety and Health (NIOSH) concluded that there is no evidence that nickel metal is carcinogenic when ingested.

  b) Inhalation: To date, there is no evidence that nickel metal causes cancer in humans based on epidemiology data from workers in the nickel producing and nickel consuming industries. A recent animal (rat) inhalation study showed no increased respiratory cancer risk for nickel metal powder indicating that no carcinogen classification is warranted for nickel metal. The U.S. National Toxicology Program has listed metallic nickel as reasonably anticipated to be a human carcinogen.

The International Agency for Research on Cancer (IARC)(Vol 49) found there was inadequate evidence that metallic nickel is carcinogenic to humans but since there was sufficient evidence that it is carcinogenic to animals, IARC concluded that metallic nickel is possibly carcinogenic to humans (Group 2B). In 1997, the ACGIH categorized elemental nickel as: A5 “Not Suspected as a Human Carcinogen”. Epidemiological studies of workers exposed to nickel powder and to dust and fume generated in the production of nickel alloys and of stainless steel have not indicated the presence of a significant respiratory cancer hazard.

Section 12. Ecological Information

12.1 Toxicity Not classified as hazardous to the aquatic environment.

12.2 Persistence and degradability

The PBT and vPvB criteria of Annex XIII to the Regulation does not apply to inorganic substances, such as nickel metal. The methods for determining the biological degradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential Nickel does not tend to bioaccumulate or biomagnify in aquatic or terrestrial systems.

12.4 Mobility in soil The substance is essentially insoluble in water and therefore poorly mobile in soil.

12.5 Results of PBT and vPvB assessment Not classified as PBT or vPvB.

12.6 Other adverse effects None anticipated.

Section 13. Disposal Considerations
13.1 Waste treatment methods Recover or recycle if possible. Dispose of contents in accordance with local, state or national legislation.

13.2 Additional Information No information available.

Section 14. Transport Information

<table>
<thead>
<tr>
<th>Regulations/Agreements</th>
<th>Regulations/Agreements</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Civil Aviation Organization Technical Instructions for the Carriage of</td>
<td>Not regulated.</td>
</tr>
<tr>
<td>Dangerous Goods by Air</td>
<td></td>
</tr>
<tr>
<td>U.S. Dept. of Transportation Regulations</td>
<td>Not regulated.</td>
</tr>
<tr>
<td>Canadian Transportation of Dangerous Goods Act</td>
<td>Not regulated.</td>
</tr>
<tr>
<td>European Agreement Concerning the International Carriage of Dangerous Goods by Road</td>
<td>Not regulated.</td>
</tr>
</tbody>
</table>

MARPOL Annex V
Under the 7 Criteria contained within the MARPOL Annex V, This material is classified as:

<table>
<thead>
<tr>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmful to the Marine Environment (HME)</td>
</tr>
<tr>
<td>X Not Harmful to the Marine Environment (non-HME)</td>
</tr>
</tbody>
</table>

Section 15. Regulatory Information

Europe:
REACH Registration #’s:
01-2119438727-29-XXXX – Vale Europe Limited
01-2119438727-29-XXXX – Vale Canada Limited (Vale Europe Limited acting as Only Representative)

Exposure Scenarios: See Annex 1

Classification according to Part 3 of Annex VI of EU Regulation No. 1272/2008
Skin Sensitization – Category 1
Carcinogenicity – Category 2
Specific Target Organ Toxicity, Repeated exposure – Category 1

Symbols: GHS07 - Exclamation mark, GHS08 - Health Hazard
Signal Word: Danger

Hazard Statements:
- H317 - May cause an allergic skin reaction.
- H372 - Causes damage to lungs through prolonged or repeated inhalation exposure
- H351 - Suspected of causing cancer by inhalation

Precautionary Statements:
Prevention:
- P201 - Obtain special instructions before use
- P202 - Do not handle until all safety precautions have been read and understood
- P260 - Do not breathe dust or fume
- P261 - Avoid breathing dust or fume. Wear respiratory protective equipment if fine dusts are generated.
- P272 - Contaminated work clothing should not be allowed out of the workplace.
- P280 - Wear protective gloves and protective clothing
- P264 - Wash hands, and face thoroughly after handling.
- P270 - Do not eat, drink or smoke when using this product.

Response:
- P302+P352 - If on skin: Wash with plenty of soap and water.
- P308+P313 - If exposed or concerned: Get medical advice/attention
- P333+P313 - If skin irritation or rash occurs: Get medical advice/attention.
- P314 - Get medical advice/attention if you feel unwell.
- P311 - See Safety Data Sheet for specific treatment
- P362+P364 - Take off contaminated clothing and wash it before reuse

Storage:
- P405 - Store locked up

Disposal:
- P501 - Dispose of contents/container in accordance to local; regional; national and international regulations

Canada:
- WHMIS Classification: D2A
- All components are listed on the Canadian Domestic Substances List (DSL)

United States of America:
- Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200) This product contains NICKEL which is subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and of 40 CFR 372. Refer to the Hazardous Ingredients section of this MSDS for the appropriate CAS numbers and percent by weight.
- All components are listed on the US Toxic Substances Control Act (TSCA) inventory

Australia:
- Classified as Hazardous according to ASCC criteria
All components are listed on the Australian Inventory of Chemical Substances (AICS)

P.R. Korea: All components are listed in the Korean Toxic Substances Control Act inventory; KE-25818

Philippines: All components are listed in the Philippine Inventory of Chemicals and Chemical Substances (PICCS)

Japan: All components are listed in the Japanese Handbook of Existing and New Chemical Substances.

P.R. China: All components are listed in the Inventory of Existing Substances in China (IECSC).

Section 16. Other Information

Indications of change:
1.0 – original document
1.1 – Added Long Harbour Refinery

The following acronyms may be found in this document:

ACGIH American Conference of Governmental Industrial Hygienists
DNEL Derived No Effect Level
LTEL Long Term Exposure Limit
LR Lead Registrant
MMAD Mass Median Aerodynamic Diameter
NIOSH National Institute of Occupational Safety and Health
OEL Occupational Exposure Limits
OR Only Representative
OSHA Occupational Safety and Health Administration
PBT PBT: Persistent, Bioaccumulative and Toxic
PNEC Predicted No Effect Concentration
STEL Short Term Exposure Limit
STOT Specific Target Organ Toxicity
TLV-TWA Threshold Limit Value – Time Weighted Average
vPvB very Persistent and very Bioaccumulative
WEL Workplace Exposure Limit (UK HSE EH40)

Safety Data Sheet prepared by:
Vale Canada Limited
200 Bay St., Royal Bank Plaza
Suite 1600, South Tower, PO Box 70
Toronto, ON
Canada, M5J 2K2
Note:
Vale Canada believes that the information in this Safety Data Sheet is accurate. However, Vale Canada makes no express or implied warranty as to the accuracy of such information and expressly disclaims any liability resulting from reliance on such information.

1. Threshold Limit Values of the American Conference of Governmental Industrial Hygienists. 2008.
3. Describes possible health hazards of the product supplied. If user operations change it to other chemical forms, whether as end products, intermediates or fugitive emissions, the possible health hazards of such forms must be determined by the user.
ANNEX 1 – Exposure Scenarios

Exposure Scenarios can be obtained by clicking on the following link: Vale Nickel Exposure Scenarios. Exposure Scenarios are listed on the page according to GES # and by language.

If you are unable to retrieve the document or have difficulties, please contact one of the following email addresses for assistance: REACH@vale.com or msds@vale.com

GES 6 - Stainless, special steels and special alloys manufacturing
GES 7 - Integrated steel and iron
GES 8 - EAF carbon steel manufacturing
GES 9 - Powder metallurgy
GES 10 - Metal surface treatment
GES 11 - Production of nickel salts from nickel metal
GES 12 - Manufacturing of batteries using positive nickel electrodes
GES 14 - Use of pre-reduced nickel containing catalyst
GES 15 - Production of magnets
GES 16 - Production of nickel-containing products (electronics)
GES 17 - Production of brazing alloys
GES 18 - Use of brazing alloys
GES 19 - Production of silver-nickel contact materials
GES 20 - Use of silver-nickel contact materials
GES 21 - Sputtering deposition
GES 22 - Thin film deposition by evaporation technique
GES 33 - Machining of nickel alloys and nickel-coated metal objects
GES 34 - Use of Nickel metal for Thermal Spraying
GES 35 - Use of Nickel metal and Nickel containing alloys for the production of steel and other alloys powder by atomisation
GES 36 - Use of Ni-containing alloys for blasting
GES 37 – Formulation of surface treatment products
GES 38 – Manufacture of micronutrient powder in biogas production
GES 39 – Use of nickel metal-derived micronutrient powder in biogas production
GES 40 – Use of nickel metal in surface treatment for the production of abrasive tools