Nickel Powder 100 Series

Section 1. Identification of the Substance and Company

1.1 Product Identification:
Product Name: Nickel Powder – 100 Series
Synonyms: T-123; CGNP

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

1.2 Relevant Identified Uses of the Substance or mixture and Uses Advised Against
Identified Uses:
Formulation or re-packing; Use of nickel metal in the production of stainless, special steels and special alloys
Formulation or re-packing; Base metals and alloys; Use of nickel metal in the production of integrated steel and iron
Formulation or re-packing; Use of nickel metal in electric arc furnace carbon steel manufacturing
Formulation or re-packing; Use of nickel metal in the production of brazing alloys
Formulation or re-packing; Use of nickel metal for the production of silver-nickel contact materials
Formulation or re-packing; Use of nickel metal and nickel containing alloys for the production of steel and other alloy powders by atomisation
Use at industrial sites; Use of nickel metal containing powders in additive manufacturing (3D-printing)
Use at industrial sites; Use of nickel-containing stainless, special steels and special alloys
Use at industrial sites; Use of nickel-containing integrated steel and iron
Use at industrial sites; Use of nickel-containing carbon steel
Use at industrial sites; Use of nickel powder or nickel alloy powder in powder metallurgy
Use at industrial sites; Use of nickel-containing brazing alloys in industrial settings
Widespread use by professional workers; Use of nickel-containing consumables for welding/brazing by professionals
Use at industrial sites; Use of silver-nickel contact materials
Use at industrial sites; Use of nickel-containing steel and other alloy powders
Use at industrial sites; Use of nickel-containing alloys for sand blasting in industrial settings
Formulation or re-packing; Use of nickel metal in formulating and repackaging of surface treatment products
Use at industrial sites; Use of nickel metal in metal surface treatment (nickel electroplating and nickel electroforming technologies)
Use at industrial sites; Use of nickel metal in sputter deposition techniques
Use at industrial sites; Use of nickel metal in thin film deposition by evaporation technique
Use at industrial sites; Use of nickel metal for thermal spraying
Formulation or re-packing; Use of nickel metal powder in the formulation of micronutrient additives for biogas production
Use at industrial sites; Use of nickel metal-derived micronutrient powder in biogas production
Widespread use by professional workers; Use of nickel metal-derived micronutrient in compostable bags in biogas production
Use at industrial sites; Use of pre-reduced nickel-containing catalyst
Use at industrial sites; Intermediate use of nickel metal for the manufacture of other substances in catalyst or catalyst precursor manufacture
Use at industrial sites; Use of nickel metal in the production of abrasive tools
Use at industrial sites; Production of batteries using nickel electrodes
Use at industrial sites; Use of nickel metal in the production of nickel-containing electronics
Use at industrial sites; Intermediate use of nickel metal for the manufacture of nickel-containing inorganic pigments
Use at industrial sites; Use of nickel metal powder in the production of magnets
Use at industrial sites; Intermediate use of nickel metal for the manufacture of nickel salts
Use at industrial sites; Use of nickel containing anti-seize lubricant
Service life (worker at industrial site); Service life of nickel alloys and nickel-coated metal objects (machining and handling) in industrial settings
Service life (professional worker); Service life of nickel alloys and nickel-coated metal objects (machining and handling) in professional settings
Service life (worker at industrial site); Service life of nickel-containing electronic parts and batteries in industrial settings
Service life (professional worker); Service life of nickel-containing electronic parts and batteries in professional settings
Service life (worker at industrial site); Service life of abrasive tools containing nickel in industrial settings
Service life (professional worker); Service life of abrasive tools containing nickel in professional settings
Consumer use: Use of nickel-containing alloys for welding/brazing by consumers

Uses Advised Against:
Use of nickel-containing High Sulphur stainless steel for surgical implants (AISI grade 303 or ISO 7153-1 reference grade N)
Use of nickel and nickel compounds in tattoo inks or permanent makeup products.
Use of nickel containing food contact materials for which release into foodstuff would exceed more than 0.14mg/kg food of nickel

1.3 Details of the Supplier of the Safety Data Sheet
Manufactured by:
In Canada:
Vale Canada Limited
Ontario Operations
Sudbury, ON
Canada P0M 1N0

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

Distributed by:
Vale Canada Limited
200 Bay St., Royal Bank Plaza
Suite 1600, South Tower, PO Box 70
Toronto, ON, Canada, M5J 2K2, Email
Section 2. Hazards Identification

2.1 Classification of the Substance:
Classification according Regulation (EC) No. 1272/2008

Skin Sensitization – Category 1
Carcinogenicity – Category 2
Specific Target Organ Toxicity, Repeated exposure – Category 1
Aquatic Chronic – Category 3

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
H412 - Harmful to aquatic life with long lasting effects

Precautionary Statements:
P201, P202, P260, P261, P264, P270, P272, P273, P280, P302+P352,
P308+P313, P333+P313, P314, P321, P362+P364, P405, P501

2.2: Label elements
Product identifier: Nickel
CAS #: 7440-02-0
Symbols:

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
H412 - Harmful to aquatic life with long lasting effects

Precautionary Statements:

P202 - Do not handle until all safety precautions have been read and understood
P261 - Avoid breathing dust or fume. Wear respiratory protective equipment if fine dusts are generated.
P273 – Avoid release to the environment
P280 - Wear protective gloves and protective clothing
P302+352 - If on skin: Wash with plenty of soap and water.
P501 - Dispose of contents/container in accordance to local; regional; national and international regulations

2.3: Other hazards

The PBT and vPvB criteria of Annex XIII of the REACH regulation does not apply to inorganic substances, such as nickel metal.

2.4: Additional Information

For full text of Precautionary Statements see section 16.

Section 3. Composition

3.1 Substances

- Substance  - Mixture
### 3.2 Mixtures

Not applicable

### Section 4. First Aid Measures

#### 4.1 Description of first aid measures

**Inhalation**
No specific first aid required. Get medical advice/attention if you feel unwell.

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

**Eye Contact**
Irrigate eyeball thoroughly with water for at least 10 minutes. If discomfort persists, seek medical attention.

**Ingestion**
No specific first aid required. Get medical advice/attention if you feel unwell.

#### 4.2 Most important symptoms and effects, both acute and delayed

Skin contact: rash; Eye contact: redness

#### 4.3 Indication of any immediate attention and special treatment needed

If exposed or concerned: Get medical advice attention

### Section 5. Fire Fighting Measures

#### 5.1 Extinguishing media

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

**Unsuitable extinguishing media**
None

#### 5.2 Special hazards arising from the substance or mixture

Non-flammable. May oxidize to nickel oxide if exposed to high temperatures within a fire. Keep containers cool with water spray.
5.3 Advice for firefighters
Wear protective equipment if required for other materials within the immediate vicinity.

Section 6. Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures
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.

6.2 Environmental precautions
Avoid release to the environment

6.3 Methods and material for containment and cleaning up
Pick up and replace in original container. Use vacuum equipment for collecting spilt materials, where practicable

6.4 Reference to other sections
See also section 7 and 8.

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, including any incompatibilities
Keep in the container supplied, and keep container closed when not use. Local regulations should be followed regarding the storage of this product.

7.3 Specific end uses
See section 1.2.

Section 8. Exposure Controls / Personal Protection

8.1 Control parameters

8.1.1 Exposure Limits:
Nickel Metal (Ni) – CAS 7440-02-0

<table>
<thead>
<tr>
<th>Exposure Limit</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACGIH TLV-TWA ³</td>
<td>1.5 *</td>
</tr>
<tr>
<td>UK WEL ²</td>
<td>0.5</td>
</tr>
<tr>
<td>Japan</td>
<td>1</td>
</tr>
<tr>
<td>Korea</td>
<td>1</td>
</tr>
<tr>
<td>China</td>
<td>1</td>
</tr>
</tbody>
</table>

* - as Ni in inhalable fraction

8.1.2 Biological limit value
Not established

8.1.3 PNECs and DNELs

<table>
<thead>
<tr>
<th>Compartment</th>
<th>Unit</th>
<th>DNEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dermal</td>
<td>mgNi/cm²/day</td>
<td>0.035</td>
</tr>
<tr>
<td>Long-term local</td>
<td>mgNi/cm²/day</td>
<td>0.05</td>
</tr>
<tr>
<td>Long-term systemic</td>
<td>mgNi/m³</td>
<td>0.05</td>
</tr>
<tr>
<td>Acute local</td>
<td>mgNi/m³</td>
<td>11.9</td>
</tr>
<tr>
<td>Inhalation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compartments</th>
<th>Unit</th>
<th>PNEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater</td>
<td>µg Ni/L</td>
<td>7.1</td>
</tr>
<tr>
<td>Sediment</td>
<td>mg Ni/kg</td>
<td>109</td>
</tr>
<tr>
<td>Marine water</td>
<td>µg Ni/L</td>
<td>8.6</td>
</tr>
<tr>
<td>Sediment (marine)</td>
<td>mg Ni/kg</td>
<td>109</td>
</tr>
<tr>
<td>Agricultural soil</td>
<td>mg Ni/kg</td>
<td>29.9</td>
</tr>
</tbody>
</table>

8.2 Exposure Controls
8.2.1 Appropriate Engineering Controls
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.

8.2.2 Individual protection measures, such as personal protective equipment
Eye/face protection None specific, but recommended to wear eye protection.
Skin protection (Hand protection/other) 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.

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

Thermal hazards Not applicable.

8.2.3 Environmental exposure controls Avoid release to the environment.

Section 9. Physical and Chemical Properties

9.1 Information on basic physical and chemical properties
Silver-grey, odourless metal powder.

<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>Decomposition temperature</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Melting / freezing point</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>Vapour density</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Surface tension</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Water solubility</td>
<td>Not applicable</td>
</tr>
<tr>
<td>pH</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Evaporation rate</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>Very finely divided metal in the fully reduced state can smolder in the presence of oxygen or air.</td>
</tr>
<tr>
<td>Oxidising properties</td>
<td>Non-oxidising</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Granulometry</td>
<td>Particle size: 1-8 micron</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>Magnetic properties</td>
<td>Ferromagnetic</td>
</tr>
</tbody>
</table>

9.2 Other information
None

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 oxidizing agents

10.6 Hazardous decomposition products
Nickel carbonyl gas.

Section 11. Toxicological Information

11.1 Information on toxicological effects

Acute toxicity
Ingestion: Non-toxic- LD₅₀ Oral Rat > 9000 mg/kg

Inhalation: Not classified
Skin contact: Not classified

Eye contact: No information available

Skin corrosion/irritation: Not classified

Serious eye damage/irritation: Not classified

Respiratory or skin sensitization
Skin Sens. Category 1. 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. 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). Nickel metal induced asthma is very rare. The data is not sufficient to conclude that nickel metal is classified as a respiratory sensitizer.

Germ cell mutagenicity
Not classified

Carcinogenicity
Carcinogenicity – Category 2. 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.

Reproductive toxicity
Not classified

STOT – single exposure
Not classified

STOT repeated exposure
STOT repeated Category 1. Causes damage to lungs through prolonged or repeated exposure. 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.
11.2 Other information
None

Section 12. Ecological Information

12.1 Toxicity
Aquatic Chronic 3. May cause long lasting harmful effects to aquatic life.

12.2 Persistence and degradability
The PBT and vPvB criteria of Annex XIII to the Regulation do 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 applicable

12.6 Other adverse effects
None anticipated

Section 13. Disposal Considerations

13.1 Waste treatment methods
Product
Methods of Disposal
The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction.

Hazardous Waste
The classification of the product may meet the criteria for a hazardous waste.
Packaging

Methods of disposal  Generation of waste should be avoided or minimized wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

Special precautions  Container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

13.2 Additional information

None

Section 14. Transport Information

<table>
<thead>
<tr>
<th></th>
<th>ADR/RID</th>
<th>ADN</th>
<th>IMDG</th>
<th>IATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.1 UN Number</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>14.2 UN proper shipping name</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>14.3 Transport classes</td>
<td>Not classified as dangerous for transport</td>
<td>Not classified as dangerous for transport</td>
<td>Not classified as dangerous for transport</td>
<td>Not classified as dangerous for transport</td>
</tr>
<tr>
<td>14. Packing group</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>14.5 Environmental hazards</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

14.6 Special precautions for user

Transport within user's premises: always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

14.7 Transport in bulk according to Annex II of Marpol and the IBC Code

Not harmful to the marine environment (non HME).

Section 15. Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance

EU Regulation (EC) No. 1907/2006 (REACH)

Candidate List of SVHC for Not listed
Authorisation

Annex XIV List of substances subject to Authorisation
Not listed

Annex XVII List of substances subject to Restriction
Entry 27; Restriction on the use of nickel in jewelry and articles coming into direct/prolonged contact with skin.

Community Rolling Action Plan
Not listed

REACH Registration #’s:
01-2119438727-29-XXXX – Vale Europe Limited
01-2119438727-29-XXXX – Vale Canada Limited (H2 Compliance acting as Only Representative)

15.2 Chemical Safety Assessment
Available. See Annex 1 for Exposure Scenarios.

Section 16. Other Information
Indications of Change:
1.0 – Original document
2.0 – Updated with latest uses and exposure scenarios
2.1 - Updated Only Representative for Vale Canada
2.2 - Update of identified uses and Appendix 1-Exposure Scenarios, and update of H phrases
2.3 - Update of identified uses and Appendix 1-Exposure Scenarios

Full text of 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.
P273 - Avoid release to the environment
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.
P321 - 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

Legend
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
msds@vale.com

**Note:**

_Vale Canada Limited believes that the information in this Material Safety Data Sheet is accurate. However, Vale Canada Limited 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. 2016
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:


If you are unable to retrieve the document or have difficulties, please use the following email address for assistance: msds@vale.com

ES1 - Formulation or re-packing; Use of nickel metal in the production of stainless, special steels and special alloys
ES2 - Formulation or re-packing; Base metals and alloys; Use of nickel metal in the production of integrated steel and iron
ES3 - Formulation or re-packing; Use of nickel metal in electric arc furnace carbon steel manufacturing
ES4 - Formulation or re-packing; Use of nickel metal in the production of brazing alloys
ES5 - Formulation or re-packing; Use of nickel metal for the production of silver-nickel contact materials
ES6 - Formulation or re-packing; Use of nickel metal and nickel containing alloys for the production of steel and other alloy powders by atomisation
ES7 - Use at industrial sites; Use of nickel metal containing powders in additive manufacturing (3D-printing)
ES8 - Use at industrial sites; Use of nickel-containing stainless, special steels and special alloys
ES9 - Use at industrial sites; Use of nickel-containing integrated steel and iron
ES10 - Use at industrial sites; Use of nickel-containing carbon steel
ES11 - Use at industrial sites; Use of nickel powder or nickel alloy powder in powder metallurgy
ES12 - Use at industrial sites; Use of nickel-containing brazing alloys in industrial settings
ES13 - Widespread use by professional workers; Use of nickel-containing consumables for welding/brazing by professionals
ES14 - Use at industrial sites; Use of silver-nickel contact materials
ES15 - Use at industrial sites; Use of nickel-containing steel and other alloy powders
ES16 - Use at industrial sites; Use of nickel-containing alloys for sand blasting in industrial settings
ES17 - Formulation or re-packing; Use of nickel metal in formulating and repackaging of surface treatment products
ES18 - Use at industrial sites; Use of nickel metal in metal surface treatment (nickel electroplating and nickel electroforming technologies)
ES19 - Use at industrial sites; Use of nickel metal in sputter deposition techniques
ES20 - Use at industrial sites; Use of nickel metal in thin film deposition by evaporation technique
ES21 - Use at industrial sites; Use of nickel metal for thermal spraying
ES22 - Formulation or re-packing; Use of nickel metal powder in the formulation of micronutrient additives for biogas production
ES23 - Use at industrial sites; Use of nickel metal-derived micronutrient powder in biogas production
ES24 - Widespread use by professional workers; Use of nickel metal-derived micronutrient in compostable bags in biogas production
ES25 - Use at industrial sites; Use of pre-reduced nickel-containing catalyst
ES26 - Use at industrial sites; Intermediate use of nickel metal for the manufacture of other substances in catalyst or catalyst precursor manufacture
ES27 - Use at industrial sites; Use of nickel metal in the production of abrasive tools
ES28 - Use at industrial sites; Production of batteries using nickel electrodes
ES29 - Use at industrial sites; Use of nickel metal in the production of nickel-containing electronics
ES30 - Use at industrial sites; Intermediate use of nickel metal for the manufacture of nickel-containing inorganic pigments
ES31 - Use at industrial sites; Use of nickel metal powder in the production of magnets
ES32 - Use at industrial sites; Intermediate use of nickel metal for the manufacture of nickel salts
ES33 - Use at industrial sites; Use of nickel containing anti-seize lubricant
ES34 - Service life (worker at industrial site); Service life of nickel alloys and nickel-coated metal objects (machining and handling) in industrial settings
ES35 - Service life (professional worker); Service life of nickel alloys and nickel-coated metal objects (machining and handling) in professional settings
ES36 - Service life (worker at industrial site); Service life of nickel-containing electronic parts and batteries in industrial settings
ES37 - Service life (professional worker); Service life of nickel-containing electronic parts and batteries in professional settings
ES38 - Service life (worker at industrial site); Service life of abrasive tools containing nickel in industrial settings
ES39 - Service life (professional worker); Service life of abrasive tools containing nickel in professional settings
ES40 – Consumer use: Use of nickel-containing alloys for welding/brazing by consumers