Nickel Oxide

(In accordance to Regulation (EC) No. 1907/2006, Annex II, as amended by Regulation (EU) 2015/830)

Section 1. Identification of the Substance and Company

1.1 Product Identification:
Product Name: Nickel Oxide
Synonyms:

Nickel oxide sinter 75	NOS75	Nickel (II) Oxide
FMW	FEW	FEN
Green nickel oxide	Nickel oxide (NiO)	Nickel monoxide
Japanese Nickel Oxide	TNOS	Bunsenite
Ni Oxide Chunks		

EC No: 215-215-7 / 234-323-5
CAS No: 1313-99-1 / 11099-02-8
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 oxide for the formulation of nickel oxide-containing catalysts and catalyst precursors
Use at industrial sites; Use of nickel oxide containing catalysts
Use at industrial sites; Intermediate use of nickel oxide-containing catalyst precursors for the manufacture of other nickel substances in catalysts
Use at industrial sites; Intermediate use of nickel oxide for the manufacture of nickel-containing powders
Use at industrial sites; Intermediate use of nickel oxide for the manufacture of nickel-containing frits
Use at industrial sites; Intermediate use of nickel oxide for the manufacture of nickel-containing inorganic pigments
Use at industrial sites; Intermediate use of nickel oxide for the manufacture of nickel-containing glass
Use at industrial sites; Intermediate use of nickel oxide sinter in carbonyl refining (nickel carbonyl process)
Use at industrial sites; Intermediate use of nickel oxide sinter in the production of stainless, special steels and special alloy
Use at industrial sites; Use of nickel oxide for the production of nickel-containing electronics and thermally functioning ceramics
Use at industrial sites; Use of nickel oxide powder for the production of nickel zinc ferrite cores
Service life (worker at industrial site); Service life of nickel-containing electronics/ferrite cores in industrial settings
Service life (professional worker); Service life of nickel-containing electronics/ferrite cores in professional settings
Service life (consumers); Service life of nickel-containing electronics/ferrite cores used by consumers
Use at industrial sites; Use of nickel oxide for the production of nickel oxide containing automotive catalysts
Service life (worker at industrial site); Production of vehicle exhaust systems in industrial settings
Service life (professional worker); Service life of vehicle exhaust systems in professional settings
Service life (consumers); Catalysis application in vehicles used by consumers

Uses Advised Against:
Use of nickel and nickel compounds in tattoo inks or permanent makeup products.

1.3 Details of the Supplier of the Safety Data Sheet

Manufactured by:

Vale Canada Limited
Ontario Operations
Sudbury, ON
Canada P0M 1N0

Vale Japan Limited
Matsusaka Plant
345-52 Ryoshicho, Matsusaka City
Mie 515-0802, Japan

Distributed by:

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

REACH Only Representative for Vale Japan

H2 Compliance
Rubicon Building, CIT Campus
T12Y275, Bishopstown
Cork, Republic of Ireland
Chris Terrett, OR Manager
Telephone number: +353-21-486-8121
Email: Chris.Terrett@h2compliance.com

Imported by:

In North & South America
Vale Americas Inc.
140 E. Ridgewood Avenue
Suite 415, South Tower
Paramus, NJ 07652
U.S.A

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

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

1.4 Emergency Telephone Number

For Fire, Spill, or chemical emergency call CHEMTREC: +1 703 527-3887
for Europe call CHEMTREC: +(44) 870 8200

Section 2. Hazards Identification

2.1 Classification of the Substance:

Classification according Regulation (EC) No. 1272/2008

Acute toxicity inhalation – Category 4
Skin Sensitization – Category 1

Respiratory Sensitization – Category 1
Carcinogenicity – Category 1A
Reproductive Toxicity – Category 1B
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:	H332 – Harmful if inhaled H317 - May cause an allergic skin reaction H334 – May cause allergy or asthma symptoms or breathing difficulties if inhaled H350 - May cause cancer by inhalation H360 – May damage fertility or the unborn child 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, P271, P272, P273, P280, P284, P302+P352, P304+P340, P308+P313, P333+P313, P314, P321, P342+P311, P362+P364, P405, P501

2.2: Label elements
Product identifier: Nickel Oxide
CAS #: 1313-99-1 / 11099-02-8
Symbols:

GHS07 - Exclamation mark

GHS08 - Health Hazard

Signal Word:	Danger
Hazard Statements:	H332 – Harmful if inhaled H317 - May cause an allergic skin reaction H334 – May cause allergy or asthma symptoms or breathing difficulties if inhaled H350 - May cause 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. P302+P352 - If on skin: Wash with plenty of soap and water. P501 - Dispose of contents/container in accordance to local/regional/national/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 oxide.

2.4: Additional Information

For full text of Precautionary statements see section 16.

Section 3. Composition

3.1 Substances

☒ **Substance** ☐ **Mixture**

Typical Analysis:

Hazardous Ingredients	Typical Composition (%)	C.A.S. Number	EINECS/EC Label No.
Nickel Oxide (NiO)	90-96	1313-99-1	215-215-7
Copper Oxide (CuO)	0.2-9.0	1317-38-0	215-269-1
Cobaltous Oxide (CoO)	0.5- 1.5	1307-96-6	215-154-6
Nickel hydroxide	0 – 0.5	12054-48-7	235-008-05

3.2 Mixtures

Not applicable

Section 4. First Aid Measures

4.1 Description of first aid measures

Inhalation	No specific first aid required. Remove person to fresh air and keep comfortable for breathing.

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

4.2 Most important symptoms and effects, both acute and delayed

May cause allergy or asthma symptoms or breathing difficulties if inhaled. May cause an allergic skin reaction.

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. Extinguish surrounding fires using appropriate methods.

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 original container. Use vacuum equipment for collecting spilt materials, where practicable.

6.4 Reference to other sections

See also sections 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 in 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 Oxide (NiO) – CAS 1313-99-1		
	Exposure Limit (mg/m^3)	Year
ACGIH TLV-TWA [1]	0.2 * ‡ as Ni	2008
UK WEL [2]	0.5 as Ni	2011
Japan	1 as Ni	2012
Korea	0.1 as Ni	2006
China	1 as Ni	2007

* Inhalable fraction
‡ Insoluble inorganic fraction

8.1.2 Biological limit value

Not established

8.1.3 PNECs and DNELs

	Unit	DNEL
Dermal		
Long-term local	mgNi/cm²/day	0.035
Inhalation		
Acute local	mgNi/m³	11.9
Long-term systemic	mgNi/m³	0.05
Long-term local	mgNi/m³	0.05

Compartment	Unit	PNEC
Freshwater	µg Ni/L (bioavailable)	7.1
Sediment (freshwater)	mg Ni/kg	109
Marine water	µg Ni/L	8.6
Sediment (marine	mg Ni/kg	109
Agricultural soil	mg Ni/kg	29.9

8.2 Exposure Controls

8.2.1 Occupational exposure controls:

Do not inhale dust. 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.
Hand and 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. 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

Solid, granular dark grey material.

Physical state at 20°C and 101.3 kPa	Solid
Melting / freezing point	>1900°C
Boiling point	Not applicable
Decomposition temperature	Not applicable
Relative density	6.75g/cm^3 at 20°C
Vapour pressure	Not applicable
Vapour density	Not applicable
Surface tension	Not applicable
Water solubility	3.52x10^{-5} g/l at 20°C (green nickel oxide) 2.26x10^{-3} g/l at 20°C (black nickel oxide)
pH	Not applicable
Evaporation rate	Not applicable
Partition coefficient n-octanol/water (log value)	Not applicable
Flash point	Not applicable
Flammability	Non-flammable
Explosive properties	Not applicable
Self-ignition temperature	>400°C
Oxidising properties	Non-oxidising
Granulometry	<0.1% of particles with a diameter <100µm
Stability in organic solvents and identity of relevant degradation products	Not applicable
Dissociation constant	Not applicable
Viscosity	Not applicable
Packaged density	See relative density

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

None

10.5 Incompatible materials

None

10.6 Hazardous decomposition products

No information available.

Section 11. Toxicological Information[3]

11.1 Information on toxicological effects

The toxicology of the reported components is summarized below.

Nickel Oxide

Acute toxicity

Ingestion	LD_{50} ORAL RAT: >11,000 mg/kg (green); 9,990 (black) – Not classified.
Inhalation	LD_{50} INHAL RAT >5.08 mg/m^3 (green); >5.15 mg/m^3 (black) – Not classified.
Skin contact	Not classified.
Eye contact	Not classified

Skin corrosion/irritation

Not classified

Serious eye damage/irritation

Not classified, but mildly irritating

Respiratory or skin sensitisation

Nickel oxide is currently classified as a dermal sensitizer according to the 1st ATP to the CLP Regulation. Recent studies evaluating the bioaccessibility of a series of nickel compounds in synthetic sweat indicated very low nickel ion release from nickel oxide suggesting very low or no sensitization potency. Early Guinea pig maximization and Beuhler test results show low potential for nickel oxide to act as a dermal sensitizer. Nickel oxide is not classified as a respiratory sensitiser according to the 1st ATP to the CLP Regulation.

Germ cell mutagenicity

Nickel oxide is not classified for mutagenicity according to the 1st ATP to the CLP Regulation.

Carcinogenicity

Nickel oxide is classified for carcinogenicity via inhalation (Carc. 1A:350i) according to the 1st ATP to the CLP Regulation. The most robust and environmentally relevant carcinogenicity study for NiO was conducted as part

of a National Toxicology Program study (Dunnick et al 1995). The authors characterized the evidence for NiO carcinogenicity in the lungs as "equivocal".

Reproductive toxicity
Nickel oxide is not classified for reproductive toxicity.

STOT – single exposure
Not classified.

STOT – repeated exposure
Nickel oxide is classified for repeated dose toxicity (STOT-RE 1; H372) according to the 1st ATP to the CLP Regulation. Exposure related toxicities were noted following 13 weeks and two years of exposure to nickel oxide in both rats and mice in the US NTP chronic rat inhalation study. Adverse effects in rodents were primarily limited to the lung. The LOAEC from the chronic study in rats was 0.6 mg NiO/m^3 or 0.5 mg Ni/m^3

Aspiration hazard
None anticipated.

Cobaltous Oxide (CoO)

Acute toxicity

Ingestion	LD_{50} ORAL RAT: 202 mg/kg; According to the CLP regulation CoO has an harmonized legal classification of Category 4; H302.
Inhalation	CoO has is no harmonized CLP classification. However, based on recent test work the Cobalt Institute have self-classified as Acute Tox. 2; H330.
Skin contact	Not classified.
Eye contact	Not classified

Skin corrosion/irritation
Not classified

Serious eye damage/irritation
Not classified

Respiratory or skin sensitisation
According to the EC Regulation No. 1272/2008 and subsequent regulations, cobalt oxide is classified as Category 1; H317. Cobalt oxide has no harmonized classification for respiratory sensitisation. However, the Cobalt Institute have self-classified as Category IB; H334

Germ cell mutagenicity
Not classified.

Carcinogenicity
Cobalt oxide has no harmonized CLP Classification. However, recent test-work conducted by the Cobalt Institute as shown that it behaves similarly to Co metal powder and Co sulphate. According to the industry grouping methodology cobalt oxide is predicted to resemble Co metal powder and Co sulphate with respect to chronic inhalation toxicity. As a result, the decision has been made to self-classify as Carc. 1B; H350i.

Reproductive toxicity
Cobalt oxide is self-classified as a reproductive toxicant (H360Fd). Therefore, nickel oxide (with cobalt oxide impurity) is classified as Repro Tox. 1B (H360), triggered by ≥0.3% cobalt oxide impurity.

STOT – single exposure
Not classified.

STOT – repeated exposure
Not classified.

Aspiration hazard
None anticipated.

Copper oxide (CuO)

Acute toxicity

Ingestion	LD_{50} ORAL RAT: > 2500 mg/kg; Not classified.
Inhalation	Not classified.
Skin contact	Not classified.
Eye contact	Not classified

Skin corrosion/irritation
Not classified.

Serious eye damage/irritation
Not classified.

Respiratory or skin sensitisation
Not classified.

Germ cell mutagenicity
Not classified.

Carcinogenicity
Not classified.

Reproductive toxicity
Not classified.

STOT – single exposure
Not classified.

STOT – repeated exposure
Not classified.

Aspiration hazard
None anticipated.

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 oxide. 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.

12.5 Results of PBT and vPvB Assessment
Not classified.

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

	ADR/RID	ADN	IMDG	IATA
14.1 UN Number	None	None	None	None
14.2 UN proper shipping name	Not applicable	Not applicable	Not applicable	Not applicable
14.3 Transport classes	Not classified as dangerous for transport	Not classified as dangerous for transport	Not classified as dangerous for transport	Not classified as dangerous for transport
14. Packing group	Not applicable	Not applicable	Not applicable	Not applicable
14.5 Environmental hazards	Not applicable	Not applicable	Not applicable	Not applicable

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	Not listed
Community Rolling Action Plan	Not listed

REACH Registration #'s:
01-2119467172-41-XXXX – Vale Europe Limited
01-2119467172-41-XXXX – Vale Japan 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

1.1 – Update Only Representative for Vale Japan

1.2 - Update of identified uses and Appendix 1-Exposure Scenarios

1.3 – Update of Reproductive Toxicity classification (H360) because of cobalt oxide impurity. Update of uses and 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.
P264 - Wash hands, and face thoroughly after handling.
P270 - Do not eat, drink or smoke when using this product.
P271 – Use only outdoors or in a well-ventilated area
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
P284 – [In case of inadequate ventilation] wear respiratory protection

Response:
P302+P352 - If on skin: Wash with plenty of soap and water.
P304+P340 – IF INHALED: remove person to fresh air and keep comfortable for breathing
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
P342+P311 – If experiencing respiratory symptoms: Call a POISON CENTER/doctor
P362+P364 – Take off contaminated clothing and wash it before reuse

Storage:
P405 - store locked up

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

Legend

The following acronyms may be found in this document:

ACGIH	American Conference of Governmental Industrial Hygienists
DNEL	Derived No Effect Level
LD50	Lethal dose 50%
LOAEC	Lowest Observed Effect Concentration
LTEL	Long Term Exposure Limit
LR	Lead Registrant
MMAD	Mass Median Aerodynamic Diameter
NIOSH	National Institute of Occupational Safety and Health
NTP	National Toxicity Program (US)
OEL	Occupational Exposure Limit
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

SDS available online at http://www.vale.com/canada/en/business/mining/nickel/pages/default.aspx

Note:
Vale Canada Limited 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. 2016
2. Maximum Exposure Limit of the Health and Safety Executive in the U.K. in EH40/2005.
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:

http://www.vale.com/canada/EN/business/mining/product-safety-information/reach-scenarios-oxide/Pages/default.aspx

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

ES 1: Formulation or re-packing; Use of nickel oxide for the formulation of nickel oxide-containing catalysts and catalyst precursors
ES 2: Use at industrial sites; Use of nickel oxide containing catalysts
ES 3: Use at industrial sites; Intermediate use of nickel oxide-containing catalyst precursors for the manufacture of other nickel substances in catalysts
ES 4: Use at industrial sites; Intermediate use of nickel oxide for the manufacture of nickel-containing powders
ES 5: Use at industrial sites; Intermediate use of nickel oxide for the manufacture of nickel-containing frits
ES 6: Use at industrial sites; Intermediate use of nickel oxide for the manufacture of nickel-containing inorganic pigments
ES 7: Use at industrial sites; Intermediate use of nickel oxide for the manufacture of nickel-containing glass
ES 8: Use at industrial sites; Intermediate use of nickel oxide sinter in carbonyl refining (nickel carbonyl process)
ES 9: Use at industrial sites; Intermediate use of nickel oxide sinter in the production of stainless, special steels and special alloy
ES 10: Use at industrial sites; Use of nickel oxide for the production of nickel-containing electronics and thermally functioning ceramics
ES 11: Use at industrial sites; Use of nickel oxide powder for the production of nickel zinc ferrite cores
ES 12: Service life (worker at industrial site); Service life of nickel-containing electronics/ferrite cores in industrial settings
ES 13: Service life (professional worker); Service life of nickel-containing electronics/ferrite cores in professional settings
ES 14: Service life (consumers); Service life of nickel-containing electronics/ferrite cores used by consumers
ES 15: Use at industrial sites; Use of nickel oxide for the production of nickel oxide containing automotive catalysts
ES 16: Service life (worker at industrial site); Production of vehicle exhaust systems in industrial settings
ES 17: Service life (professional worker); Service life of vehicle exhaust systems in professional settings
ES 18: Service life (consumers); Catalysis application in vehicles used by consumers