1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers
Material Type: Nickel Oxide
Synonyms: Nickel monoxide, Nickelous Oxide
Product Names:
- **NOVAMET® Black Nickel Oxide**
  (High Purity ‘A’ Grade, High Purity ‘F’ Grade)
- **NOVAMET® Calcined Black Nickel Oxide**
  (Calcined ‘A’ Grade, Calcined ‘F’ Grade)
- **NOVAMET® Green Nickel Oxide**
  (Regular Grade, ‘A’ Grade, ‘F’ Grade, Coarse Grade)
- **Other Novamet® Nickel Oxides**
  (Brown Nickel Oxide)

CAS-No.: 1313-99-1

1.2 Relevant identified uses of the substance or mixture and uses advised against
Identified uses: Catalysts, Fuel cells, Frit Glass, nickel based powders from nickel oxide, nickel-containing electronics and thermally functioning ceramics, nickel-containing pigments, nickel-containing glass, Stainless, special steels and special alloys manufacturing

1.3 Details of the supplier of the safety data sheet
Company: Novamet Specialty Products Corp
1420 Toshiba Drive, Suite E
Lebanon, TN 37087
USA
Telephone: (615) 466-9999
Fax: (615) 466-9816

1.4 Emergency telephone number
Emergency Contact: Chemtrec
Telephone: (703) 527-3887
Contract No.: CCN644266

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture
- Skin Sensitization - Category 1;
- Respiratory Sensitization - Category 1;
- Carcinogenicity - Category 1 A;
- Specific Target Organ Toxicity, Repeated exposure - Category 1
- Aquatic Chronic - Category 4
2.2 GHS Label elements, including precautionary statements

**Product Identifier:** Nickel Oxide  
**CAS No.:** 1313-99-1

**Pictogram**  
GHS07  
GHS08

**Signal word**  
Danger

**Hazard statement(s)**
- **H317** May cause an allergic skin reaction.
- **H334** May cause allergy or asthma symptoms or breathing difficulties if inhaled.
- **H350** May cause cancer.
- **H372** Causes damage to organs through prolonged or repeated exposure.
- **H413** May cause long lasting harmful effects to aquatic life.

**Precautionary statement(s)**
- **P202** Do not handle until all safety precautions have been read and understood.
- **P261** Avoid breathing dust/fumes/gas/mist/vapors/spray.
- **P273** Avoid release to the environment.
- **P281** Use personal protective equipment as required.
- **P302 + P352** IF ON SKIN: Wash with plenty of soap and water.
- **P501** Dispose of contents/container to an approved waste disposal plant.

*(NOTE: number of P-statements has been reduced, as per CLP regulation, the full list can be found in Section 15).*

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS – none

May cause long lasting harmful effects to aquatic life

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

<table>
<thead>
<tr>
<th>Hazardous Ingredients</th>
<th>Typical Composition</th>
<th>C.A.S. Number</th>
<th>EINECS/EC Label No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel Oxide</td>
<td>&gt;98%</td>
<td>1313-99-1</td>
<td>215-215-7</td>
</tr>
<tr>
<td>Nickel Hydroxide</td>
<td>0.0 – 2.0%</td>
<td>12054-48-7</td>
<td>235-008-05</td>
</tr>
</tbody>
</table>
4. **FIRST AID MEASURES**

4.1 **Description of 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 soap and 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.

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

Skin contact: Rash

Eye contact: Redness

4.3 **Indication of any immediate medical attention and special treatment needed**

No special requirements

5. **FIREFIGHTING MEASURES**

5.1 **Suitable Extinguishing Media**

Any, type to be selected according to materials in the immediate neighborhood.

5.2 **Special Risks**

Non-Flammable. Extinguish surrounding fires with appropriate methods

5.3 **Special Protective equipment for fire fighting**

None needed. Wear protective equipment if required for other materials within immediate vicinity.

5.4 **NFPA Rating**

- Health hazard: 2
- Fire Hazard: 0
- Reactivity Hazard: 0

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**

Spillages and uncontrolled discharges must be prevented from entering waterways.

6.3 **Methods and materials for containment and cleaning up**

Pick up and replace in original container. Nickel-containing material is normally collected to recover nickel values.

6.4 **Reference to other sections**

For disposal see section 13.
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.

8. **EXPOSURE CONTROLS / PERSONAL PROTECTION**

8.1.1 **Exposure Limits**

<table>
<thead>
<tr>
<th>Nickel Oxide (NiO) – CAS 1313-99-1</th>
<th>Exposure Limit (mg/m³)</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACGIH TLV-TWA ¹</td>
<td>0.2 * as Ni</td>
<td>2012</td>
</tr>
<tr>
<td>UK WEL ²</td>
<td>0.5 as Ni</td>
<td>2011</td>
</tr>
<tr>
<td>Japan</td>
<td>1 as Ni</td>
<td>2012</td>
</tr>
<tr>
<td>Korea</td>
<td>0.1 as Ni</td>
<td>2006</td>
</tr>
<tr>
<td>China</td>
<td>1 as Ni</td>
<td>2007</td>
</tr>
</tbody>
</table>

* Inhalable fraction
+ Insoluble inorganic fraction

8.1.2 **Environmental Limits**

<table>
<thead>
<tr>
<th>PNEC’s</th>
<th>Compartment</th>
<th>Unit</th>
<th>PNEC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freshwater</td>
<td>μg Ni/L (bioavailable)</td>
<td>3.55</td>
</tr>
<tr>
<td></td>
<td>Marine</td>
<td>μg Ni/L</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td>Terrestrial</td>
<td>mg Ni/kg</td>
<td>29.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DNEL’s</th>
<th>Unit</th>
<th>DNEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dermal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acute systemic</td>
<td>mg Ni/kg/day</td>
</tr>
<tr>
<td></td>
<td>Acute local</td>
<td>mgNi/cm²/day</td>
</tr>
<tr>
<td></td>
<td>Long-term systemic</td>
<td>mg Ni/kg/day</td>
</tr>
<tr>
<td></td>
<td>Long-term local</td>
<td>mgNi/cm²/day</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acute systemic</td>
<td>mgNi/m³</td>
</tr>
<tr>
<td></td>
<td>Acute local</td>
<td>mgNi/m³</td>
</tr>
<tr>
<td></td>
<td>Long-term systemic</td>
<td>mgNi/m³</td>
</tr>
<tr>
<td></td>
<td>Long-term local</td>
<td>mgNi/m³</td>
</tr>
</tbody>
</table>

¹ Based on MMAD of 2.9 μm, increases with increasing MMAD (estimated as ≥6.4 mg Ni/m³ for exposures to particles with a MMAD of ≥30 μm.

²When handling powders of particle aerodynamic equivalent diameter (AED) below 10 μm, exposures (8h TWA) to these powders should be kept under 0.01 mg Ni/m³.
When exposure are solely to metallic and nickel oxides (without exposure to any other nickel compounds) and the mean particle size of the aerosol is greater than 10 \( \mu \text{m} \) AED (\( \leq 10\% \) of aerosol mass in respirable fraction), inhalable exposure levels up to 0.2 mg Ni/m\(^3\) could be reasonably assumed to be safe.

### 8.2 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.

**PPE**

- **Respiratory protection:** If required, use an approved respirator with particulate filters.
- **Eye protection:** If required.
- **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.

### 9. PHYSICAL AND CHEMICAL PROPERTIES

Solid granular dark gray material

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical state at 20(^\circ)C and 101.3 kPa</td>
<td>Solid</td>
</tr>
<tr>
<td>Melting / freezing point</td>
<td>( &gt;1900)^(\circ)C</td>
</tr>
<tr>
<td>Boiling point</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Relative Density</td>
<td>6.75 g/cm(^3) at 25(^\circ)C</td>
</tr>
<tr>
<td>Vapor Pressure</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Surface Tension</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Water Solubility</td>
<td>(3.52 \times 10^{-5}) g/l at 20(^\circ)C (green nickel oxide) (2.26 \times 10^{-3}) g/l at 20(^\circ)C (black nickel oxide)</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>( &gt;400)^(\circ)C</td>
</tr>
<tr>
<td>Oxidizing Properties</td>
<td>Non-oxidizing</td>
</tr>
<tr>
<td>Granulometry</td>
<td>Particle Size: ( &gt;1) 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>
</tbody>
</table>
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

11. TOXICOLOGICAL INFORMATION
As a mixture the toxicological properties of this product are unknown. The toxicology of the reported ingredients are summarized below.

Nickel Oxide

Acute toxicity
Oral: Nontoxic – LD$_{50}$ ORAL RAT> 11,000 mg/kg (green); 9,990 (black)
Inhalation: Nontoxic – LD$_{50}$ INHAL RAT >5.08 mg/m$^3$ (green); >5.15 mg/m$^3$ (black)
Dermal: No information available.

Corrosivity/Irritation
Respiratory Tract No classification.
Skin Not corrosive/irritating.
Eyes Mildly irritating.

Sensitization
Respiratory Tract No information available.

Skin Ni oxide is currently classified as a dermal sensitizer (R43) according to the 1st ATP to the CLP Regulation. Recent studies evaluating the bio accessibility of a series of Ni compounds in synthetic sweat indicated very low nickel ion release from Ni 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.

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**

**Oral:** No information available

**Inhalation:** Exposure related toxicities were noted following 13 weeks and two years of exposure to NiO in both rats and mice in the US NTP chronic rat inhalation study. Adverse effects in rodents were primarily limited to the lung (e.g., increased tissue weight, inflammation, macrophage hyperplasia). The LOAEC from the chronic study in rats was 0.6 mg NiO/m3 or 0.5 mg Ni/m3.

**Dermal:** No information available.

**Mutagenicity / Reproductive toxicity**

Not classified for reproductive/developmental toxicity. Not classified for mutagenicity.

**Carcinogenicity**

**Ingestion:** No information available. Not classified.

**Inhalation:** Cat. 1 A; Human epidemiological and animal data suggest that at least some forms of nickel oxide can be carcinogenic to the respiratory tract of humans after inhalation.

**Nickel Hydroxide**

No information currently available.

12. **ECOLOGICAL INFORMATION**

12.1 **Toxicity**

Aquatic Chronic 4. May cause long lasting harmful effects to aquatic life.

12.2 **Persistence and degradability**

No information available.

12.3 **Bio accumulative potential**

No information available.

12.4 **Mobility in soil**

The substance is essentially insoluble in water.

12.5 **Results of PBT and vPvB assessment**

Not classified as PBT or vPvB.

12.6 **Other adverse effects**

None anticipated.
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.

14. TRANSPORT INFORMATION

<table>
<thead>
<tr>
<th>International Maritime Dangerous Goods Code</th>
<th>Not Regulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Civil Aviation Organization Technical Instructions for the Carriage of Dangerous Goods by Air</td>
<td>Not Regulated</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>

15. REGULATORY INFORMATION

<table>
<thead>
<tr>
<th>International Inventories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component</td>
</tr>
<tr>
<td>Nickel Oxide</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Component</th>
<th>NLP</th>
<th>PICCS</th>
<th>ENCS</th>
<th>AICS</th>
<th>IECSC</th>
<th>KECL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel Oxide</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

X Listed
E Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P Indicates a commenced PMN substance
R Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S Indicates a substance that is identified in a proposed or final Significant New Use Rule
T Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.
U.S. Federal Regulations

TSCA 12(b) Not applicable
SARA 313 Not applicable

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS-No</th>
<th>Weight %</th>
<th>SARA 313 - Threshold Values %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel oxide</td>
<td>1313-99-1</td>
<td>&gt;95</td>
<td>0.1</td>
</tr>
</tbody>
</table>

SARA 311/312 Hazardous Categorization
Acute Health Hazard Yes
Chronic Health Hazard Yes
Fire Hazard No
Sudden Release of Pressure Hazard No
Reactive Hazard No

Clean Water Act Not applicable

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel Oxide</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
</tr>
</tbody>
</table>

Clean Air Act Not applicable

<table>
<thead>
<tr>
<th>Component</th>
<th>HAPS Data</th>
<th>Class 1 Ozone Depletors</th>
<th>Class 2 Ozone Depletors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel Oxide</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
Not applicable

California Proposition 65
This product contains the following Proposition 65 chemicals:

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS-No</th>
<th>California Prop. 65</th>
<th>Prop. 65 NSRL</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel Oxide</td>
<td>1313-99-1</td>
<td>Carcinogen</td>
<td>-</td>
<td>Carcinogen</td>
</tr>
</tbody>
</table>

State Right-to-Know

<table>
<thead>
<tr>
<th>Component</th>
<th>Massachusetts</th>
<th>New Jersey</th>
<th>Pennsylvania</th>
<th>Illinois</th>
<th>Rhode Island</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel Oxide</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

U.S. Department of Transportation
Reportable Quantity (RQ): N
DOT Marine Pollutant: N
DOT Severe Marine Pollutant: N
U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade  No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class  D2A Very toxic materials  D2B Toxic materials

Hazard statement(s)
H317  May cause an allergic skin reaction.
H334  May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H350  May cause cancer.
H372  Causes damage to organs through prolonged or repeated exposure.
H413  May cause long lasting harmful effects to aquatic life.

Precautionary statement(s)
P201  Obtain special instructions before use.
P202  Do not handle until all safety precautions have been read and understood.
P260  Do not breathe dust/fume/gas/mist/vapors/spray.
P261  Avoid breathing dust/fumes/gas/mist/vapors/spray.
P264  Wash hands and face thoroughly after handling.
P270  Do not eat, drink or smoke when using this product.
P272  Contaminated work clothing should not be allowed out of the workplace.
P273  Avoid release to the environment.
P280  Wear protective gloves/protective clothing/eye protection/face protection.
P281  Use personal protective equipment as required.
P284  Wear respiratory protection.
P302 + P352  IF ON SKIN: Wash with plenty of soap and water.
P304 + P340  IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P308 + P313  IF exposed or concerned: Get medical advice/attention.
P342 + P311  If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician.
P314  Get medical advice/attention if you feel unwell.
P363  Wash contaminated clothing before reuse.
P405  Store locked up.
P501  Dispose of contents/container to an approved waste disposal plant.
16. **OTHER INFORMATION**

Safety Data Sheet prepared by: Novamet Specialty Products Corp
1420 Toshiba Drive, Suite E
Lebanon, TN 37087
Telephone: (615) 466-9999
Fax: (615) 466-9816

Novamet Specialty Products Corp believes that the information in this Material Safety Data Sheet is accurate. However, Novamet Specialty Products Corp makes no express or implied warranty as to the accuracy of such information and expressly disclaims any liability resulting from reliance on such information.

Notes:
1. Threshold Limit Values of the American Conference of Governmental Industrial Hygienists. 2008.