Material Safety Data Sheet (MSDS):
Nickel CVD Coated Aramid Fiber

1. Chemical Composition

<table>
<thead>
<tr>
<th>C.A.S. Number</th>
<th>Nickel</th>
<th>7440-02-0</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.A.S. Number</td>
<td>Poly-paraphenylene terephthalamide (p-aramid)</td>
<td>26125-61-1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Typical Composition</th>
<th>OSHA/PEL mg/m³</th>
<th>ACGIH/TLV mg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel (Ni)</td>
<td>5-95%</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>p-aramid</td>
<td>5-95%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

2. Hazards Identification [See section 9 for additional information]

NFPA Hazard Rating – Health: 1  Fire: 1  Instability: 1  Other: None
[ 0 – Minimal  1 – Slight  2 – Moderate  3 – High  4 - Extreme ]

Primary Route(s) of Exposure: Eye contact, skin contact and inhalation.

Acute Exposure: The fiber product (polymer) is non-toxic. Prolonged and intimate contact with metallic nickel may cause irritation to the skin and nickel sensitivity which may result in allergic skin rashes. Inhalation of nickel may induce asthma. This effect is rare, it has been reported in welders where exposures to nickel are often mixed with other chemical substances. Persons with a known history of nickel sensitive asthma should avoid such contact. Dust may be irritating to the respiratory tract and cause symptoms of bronchitis. This product has a low order of acute toxicity and ingestion is not expected to cause any harm.

Carcinogenicity: IARC, NTP, ACGIH or OSHA does not classify aramid fiber as a carcinogen or suspect carcinogen. IARC rated p-Aramid fibrils as “non-classifiable as to its carcinogenicity for animals or humans” (Class III). IARC concluded that metallic nickel is possibly carcinogenic to humans. ACGIH categorizes elemental nickel as: A5 "Not Suspected as a Human Carcinogen."

Medical conditions aggravated: Inhalation of dust could aggravate existing respiratory condition. Prolonged and intimate skin contact can cause an allergic skin rash in previously sensitized individuals.

3. Precautions for Safe Handling and Use

THIS MATERIAL IS FIBROUS AND ELECTRICALLY CONDUCTING. USER GENERATED AIRBORNE FIBERS CAN SHORT CIRCUIT ELECTRICAL EQUIPMENT.

If user operations generate dust, mist or fume, use ventilation to keep exposure to airborne nickel below the exposure limit. Use extraction and ventilation equipment to reduce the occurrence of fiber fly, fiber dust and decomposition products of the finish. If ventilation alone cannot so control exposure, use NIOSH-approved respirators selected according to OSHA 29 CFR 1910.134. Maintain airborne nickel levels as low as possible. Do not inhale fibers. Ventilation is normally required when handling or using this product to keep airborne nickel and/or fibers below the nationally authorized limits.

Wear aprons, boots, and other suitable body protection appropriate to the existing work environment. Yarns that are processed at high speeds can cause abrasions and cuts. Make eyewash stations, washing facilities, safety showers available in areas of use and handling. All food and smoking materials should be kept in a separate area away from the storage/use location. Eating, drinking and smoking should be prohibited in areas where there is a potential for significant exposure to this material. Wash hands before eating, drinking, smoking or using...
washroom. Adhere to sanitation requirements of 29CFR1910.141.

Avoid repeated skin contact. Wear suitable gloves. Wash skin thoroughly after handling. Launder clothing and gloves as needed. Do not store near acids. Like other metals, nickel can react with acids to liberate hydrogen gas which can form explosive mixtures in air.

Finely-divided nickel metal may react explosively or incandescently with substances such as ammonium nitrate, perchlorates, phosphorous, etc. Under special conditions nickel can react with carbon monoxide in reducing atmospheres to form nickel carbonyl, Ni(CO)\textsubscript{4}, a toxic gas.

4. Spill, Leak, and Disposal Procedure

Safely stop source of spill. Restrict non-essential personnel from area. All personnel involved in spill cleanup should avoid skin and eye contact by wearing appropriate personal protective equipment. Do not breathe dust. If nickel dust accumulates where nickel is handled, collect it by wet sweeping or by vacuuming with the vacuum exhaust passing through a high efficiency particulate arresting (HEPA) filter if the exhaust is discharged into the workplace. Wear appropriate NIOSH-approved respirators if collection and disposal of dust is likely to cause the concentration of airborne contaminants to exceed the exposure limits.

Sweep or vacuum spilled solid material, being careful not to create dust. Return sweepings to stock or, if contaminated, place into a chemical waste container for disposal according to local, state or federal regulations. To minimize dust, vacuum cleaning is preferred. Nickel-containing waste is normally collected to recover nickel values. Should waste disposal be deemed necessary follow EPA and local regulations.

5. Emergency and First Aid Procedures

**Inhalation:** Remove victim to fresh air if person has been exposed to excessive quantities of fiber dust or fly. If breathing becomes difficult, oxygen may be given, preferably under physician’s advice. Get medical attention if coughing or other symptoms develop.

**Eye Contact:** Flush eyes with large quantities of running water for a minimum of 15 minutes. If easy to do, remove contact lenses, if worn. Hold the eyelids apart during the flushing to ensure rinsing of the entire surface of the eye and lids with water. Get medical attention if eye irritation occurs.

**Skin Contact:** Remove contaminated clothing, shoes and equipment. Flush skin with plenty of water for at least 15 minutes. Wash contaminated clothing and shoes before reuse. Get medical attention if irritation occurs.

**Ingestion:** Do not induce vomiting, unless instructed by a physician. If victim is conscious, rinse mouth and give water to drink. If vomiting occurs, keep head below the hips to reduce risk of aspiration. Give fluids again. Never give anything by mouth to an unconscious person. Get medical attention as warranted.

**Note to Physician:** Attending physician should treat exposed patients symptomatically.

If exposure to nickel carbonyl is suspected, seek medical attention immediately. For skin rashes, seek medical attention.

Cleanse wounds thoroughly to remove any particles.

American Association of Poison Control Centers: 1-800-222-1222

6. Fire Fighting Measures

**Conditions of Flammability:** not flammable or combustible

**Flash Point (Method):** not determined
Upper Flammable Limit (% by volume): not determined
Lower Flammable Limit (% by volume): not determined
Auto-Ignition Temperature: not determined

Extinguishing Media: This product is not flammable or combustible. If involved in a fire, use extinguishing agents suitable for surrounding materials, such as water fog or spray, dry chemical, foam, carbon dioxide or other Class B agents. Avoid solid water stream. Do not use water if fire was caused by an electrical short circuit.

Fire Fighting Procedures: As in any fire, prevent human exposure to fire, smoke, fumes or products of combustion. Evacuate all non-essential personnel from the fire area. Fire fighters should wear full-face, self-contained breathing apparatus approved by MSHA/NIOSH and impervious protective clothing.

Fire & Explosion Hazards: This product is not defined as flammable or combustible and should not be a fire hazard under normal use conditions. Organic dust can be explosive when ideal conditions of concentration, humidity, temperature and source are met.

Hazardous Combustion Products: Do not inhale explosion or combustion vapors. Thermal decomposition may release toxic and/or hazardous products such as carbon oxides, organic compounds of low molecular weight and hydrogen cyanide in low concentration. Decomposition products are roughly comparable to those of wool.

7. Safe Handling and Storage

Avoid prolonged and/or repeated skin and eye contact. Do not breathe dust.

Store this material in a cool, dry and well-ventilated area. Observe good housekeeping practices. Contain and prevent dust collection. If airborne contaminants are generated when the material is heated or handled, sufficient ventilation in volume and air flow should be provided. (See section 3).

8. Physical and Chemical Properties

Silvery odorless fiber material. Typically supplied on spools or as a woven cloth.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity</td>
<td>N/A</td>
</tr>
<tr>
<td>Melting point Ni</td>
<td>1453°C</td>
</tr>
<tr>
<td>Melting point p-aramid</td>
<td>does not melt</td>
</tr>
<tr>
<td>Boiling point Ni</td>
<td>2732°C</td>
</tr>
<tr>
<td>Boiling point C</td>
<td>N/A</td>
</tr>
<tr>
<td>Flash Point</td>
<td>N/A</td>
</tr>
<tr>
<td>Autoflammability</td>
<td>N/A</td>
</tr>
<tr>
<td>Explosive properties</td>
<td>N/A</td>
</tr>
<tr>
<td>Vapor pressure</td>
<td>N/A</td>
</tr>
<tr>
<td>Density Ni</td>
<td>8.9 g/cm³</td>
</tr>
<tr>
<td>Density p-aramid</td>
<td>1.44 g/cm³</td>
</tr>
<tr>
<td>Solubility</td>
<td>N/A</td>
</tr>
<tr>
<td>Partition coefficient</td>
<td>N/A</td>
</tr>
</tbody>
</table>

This product is stable at ambient temperatures and atmospheric pressures under recommended storage and handling conditions (see section 7). It is not self-reactive and is not sensitive to physical impact.

Temperatures over 932°F (500°C) will cause decomposition of the products and molecular disintegration. Strong bases and acids will cause chemical decomposition (hydrolysis) of the molecules if allowed to react for a relatively long duration.
Aromatic polyamides react with strong oxidizing agents. If allowed to act on the fibers for a relatively long time, UV light will cause a darkening of their inherent yellow color and will also adversely affect their strength. Nickel 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.

Hazardous polymerization is not expected to occur under normal temperatures and pressures.

Thermal decomposition may release toxic and/or hazardous products such as carbon oxides, organic compounds of low molecular weight and hydrogen cyanide in low concentration.

9. Toxicological Information

Wounds: Nickel metal powder has caused tumors at the site of injection in rodents. However, studies do not suggest a significant risk for humans from nickel-containing prostheses.

Inhalation: The National Toxicology Program has listed nickel as reasonably anticipated to be a carcinogen based on the production of injection site tumors. The International Agency for Research on Cancer (IARC) 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. 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.

Evidence for the association of nickel compound exposures and cancer risk comes mainly from workers in now obsolete nickel refining operations where very high concentrations of airborne nickel, mostly present as oxidic or sub-sulphidic species at up to 100 mg/m³ or more, were associated with excess nasal and lung cancers. The inhalation of nickel powder has not resulted in an increased incidence of malignant lung tumors in rodents. Repeated intratracheal instillation of nickel powder produced an increased incidence of malignant lung tumors in rats. Repeated intratracheal instillation of nickel powder did not produce an increased incidence of malignant lung tumors in hamsters when administered at the maximum tolerated dose. Single intratracheal instillations of nickel powder in hamsters at doses near the LD₅₀ produced an increased incidence of fibrosarcomas, mesotheliomas and rhabdomyosarcomas. Inhalation of nickel powder at concentrations 15 times the TLV irritated the respiratory tract in rodents.

Inhalation of nickel may induce asthma. This effect is rare, it has been reported in welders where exposures to nickel are often mixed with other chemical substances. Persons with a known history of nickel sensitive asthma should avoid such contact.

Ingestion: The U.S. National Institute for Occupational Safety and Health (NIOSH) concluded there is no evidence that nickel and its inorganic compounds are carcinogenic when ingested. The U.S. Food and Drug Administration has affirmed that nickel is generally recognized as safe (GRAS) as a direct human food ingredient.

Reproductive Toxicity: Animal experiments indicate that soluble nickel ingestion causes adverse effects on fetal development at a threshold oral exposure of 2.2 mg/ Ni/kg/day by pregnant rats. Data are insufficient to determine if this effect occurs in humans and no regulatory agency has classified soluble forms of nickel as reproductive risks for humans.
10. Regulatory Information

SARA Section 313 Supplier Notification
This product contains the following chemical(s) 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:

Nickel

Refer to the Hazardous Ingredients section of this MSDS for the appropriate CAS numbers and percent by weight.

California Proposition 65

“Nickel and certain nickel compounds” is on the Second Priority List for NSRL Development

11. Transport Information

International Maritime Dangerous Goods Code
Not regulated.

International Civil Aviation Organisation Technical Instructions for the Carriage of Dangerous Goods by Air
Not regulated.

U.S. Dept. of Transportation Regulations
Not regulated.

Canadian Transportation of Dangerous Goods Act
Not regulated.

European Agreement Concerning the International Carriage of Dangerous Goods by Road
Not regulated.

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