MATERIAL SAFETY DATA SHEET

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SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: ELECTROLESS NICKEL PLATING AMMONIA TYPE (ENPAT)
Chemical family: Nickel salt solutions
Reviewed: May 2008

SECTION II. INGREDIENTS AND HAZARDS

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>CAS#</th>
<th>%</th>
<th>Toxicity (mg/M^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMMONIUM CITRATE</td>
<td>3012-65-5</td>
<td>5-10</td>
<td>N/E</td>
</tr>
<tr>
<td>AMMONIUM CHLORIDE</td>
<td>12125-02-9</td>
<td>5-10</td>
<td>10mg fume/M^3</td>
</tr>
<tr>
<td>NICKEL CHLORIDE HEXAHYDRATE</td>
<td>7718-54-9</td>
<td>1-5</td>
<td>0.1mg/M^3 as Ni</td>
</tr>
<tr>
<td>SODIUM HYPOPHOSPHITE</td>
<td>10039-56-2</td>
<td>1-5</td>
<td>N/E</td>
</tr>
<tr>
<td>ETHYLENE DIAMINE TETRACETATE</td>
<td>64-02-8</td>
<td>&lt;1</td>
<td>N/E</td>
</tr>
<tr>
<td>AMMONIUM HYDROXIDE</td>
<td>1336-21-6</td>
<td>5-10</td>
<td>50 ppm</td>
</tr>
<tr>
<td>DISTILLED WATER (NON HAZARDOUS)</td>
<td>BALANCE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SECTION III. HEALTH HAZARD INFORMATION

HMIS Ratings
Health : 3  Reactivity : 0  Flammability : 0

Effects of overexposure: Highly irritating to the mucous membranes of the eyes, respiratory tract and the skin. Individuals hypersensitive to nickel may develop asthma, bronchitis, shortness of breath or wheezing. Causes irritation and sensitization or allergic reactions, which may be accentuated by heat and humidity.

FIRST AID:
Eye contact: Irritant to naked eye; in case of contact flush eyes well for 15 minutes. Obtain medical attention.
Skin contact: Irritant to exposed skin. Flush skin well with water for 15 minutes. Remove affected clothing, get medical attention.
Inhalation: If inhaled, remove to fresh air. If not breathing give artificial respiration. Seek medical attention.

SECTION IV. EFFECTS OF OVEREXPOSURE

Effects of overexposure: Highly irritating to the mucous membranes of the eyes, respiratory tract and the skin. Individuals hypersensitive to nickel may develop asthma, bronchitis, shortness of breath or wheezing. Causes irritation and sensitization or allergic reactions, which may be accentuated by heat and humidity.

SECTION V. FIRE AND EXPLOSION DATA

<table>
<thead>
<tr>
<th>Flash Point and Method</th>
<th>Auto-ignition Temp.</th>
<th>Flammability Limits In Air</th>
<th>LOWER</th>
<th>UPPER</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

REV 1 -1/4 -

Electroless Nickel Plating Ammonia Type
Extinguishing media: Water spray, or fog, CO₂ and dry chemical.

Special fire fighting procedures: Water may cause frothing. Wear chemical retardant gear and NIOSH approved self-contained breathing apparatus. Thermal decomposition produces toxic fumes.

SECTION VI. SPILL AND LEAK PROCEDURES

SPILLS, LEAKS: Cover the contaminated areas with absorbent material. Scoop up gross quantities. Place in DOT approved container.

SECTION VII. SPECIAL PRECAUTIONS AND COMMENTS

Storage & Handling Information: Store below 60° F. Store in cool dry place. Do not store near incompatible products or open flame. Store away from direct sunlight.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Respiratory protection: NIOSH approved organic vapor respirators where adequate ventilation is not present.
Ventilation: Where adequate ventilation is not available use NIOSH approved vapor respirator with dust, fume and mist filters. Local ventilation through fume hoods or laminar flow stations is preferred. Keep fumes away from strong bases.
Protective gloves: Skin contact should be minimized through use of rubber gloves.
Eye protection: Safety goggles, face shield
Other protective equipment: Steel-tipped shoes, eye wash station, chemical safety shower, chemical retardant clothing.

SECTION IX. PHYSICAL DATA

Boiling point at 1 atm, deg C N/A Specific gravity, 20/4°C N/A
Vapor pressure at 15°C, mm Hg N/A Evap. Rate(BuAc = 1) N/A
Vapor density (Air = 1) N/A Volatiles, % APPROXIMATELY 80%
Water solubility at 20°C 100% Molecular weight N/A
Appearance & Odor: blue liquid with slight ammoniacal odor, approximately of water density.

SECTION X. REACTIVITY DATA

Stability: Stable X Conditions to avoid: Heat releases NH₃ and HCl gases.
Unstable
Incompatible with: Strong oxidizing agents such as chlorates or nitrates. Strong alkalies or acids.
Hazardous decomposition products: NH₃ and hydrogen chloride gas
Hazardous polymerization: May occur Conditions to avoid: N/A
Will not occur X

SECTION XI. TOXICOLOGICAL INFORMATION

NOTE: The National Toxicology program has listed Ni and NiO as possible cancer hazards. Although these forms of nickel are not active ingredients of this mixture, they may be products of reactions, or formed when the mixture is heated. Please see the attached sheet for more information.

SECTION XII. ECOLOGICAL INFORMATION

REV 1 -2/4- Electroless Nickel Plating Ammonia Type
No data found for this product.

SECTION XIII. DISPOSAL

DISPOSAL: Dispose of in accordance with all federal, state and local regulations. Aqueous waste treatment if allowed. If not, contact professional disposal agency.

SECTION XIV. TRANSPORTATION INFORMATION

DOT Class: Non-restricted.
Nickel Chloride Solution.

SECTION XV. REGULATORY INFORMATION

HMIS Ratings
Health: 3
Reactivity: 0
Flammability: 0

SECTION XVI. OTHER INFORMATION

ELECTROLESS NICKEL PLATING - AMMONIA TYPE
ATTACHMENT

HEALTH HAZARDS:

POSSIBLE POSSIBLE CANCER HAZARD IF INHALED AND MAY CAUSE ALLERGIC REACTION.

Inhalation:
The National Toxicology Program has listed nickel and nickel oxide as possible cancer hazards. The International Agency for Research on Cancer concluded there was sufficient evidence that nickel refining was carcinogenic to humans and limited evidence that nickel and certain nickel compounds were carcinogenic to humans. IARC could not state with certainty, which forms of nickel, are human carcinogens but said “…metallic nickel seems less likely to be so than nickel subsulphide or nickel oxides.” The inhalation of nickel oxide, even at high concentrations, and of nickel powder has not resulted in an increased incidence of malignant tumors in rodents. Studies or workers exposed to nickel powder and to dust and fume generated in the production of nickel alloys and of stainless steel have not indicated a respiratory cancer hazard.

Inhalation of airborne nickel powder at concentrations fifteen times the PEL irritated the respiratory tract in rodents. Inhalation of nickel oxide impaired long-term lung clearance in rats and, at concentrations fifty times the PEL, produced pneumoconiosis in hamsters.

Skin Contact:
Repeated contact with metallic nickel can cause nickel sensitivity resulting in allergic skin rashes.

Wounds:
Nickel powder and nickel oxide have caused tumors at the site of injection in
of nickel-containing prosthesis do not suggest a significant risk for humans.

However, studies

Ingestion:
Nickel metal and nickel oxide have low oral toxicities; their oral rat LD$_{50}$ are $>9000$ mg/kg and $>5000$ mg/kg respectively. The U.S. Food and Drug Administration concluded that nickel and its inorganic compounds are not carcinogenic when ingested.

Pre-existing Conditions:
Sensitized individuals may experience an allergic skin rash.

ADDENDUM TO MATERIAL SAFETY DATA SHEET
REGULATORY STATUS

THIS ADDENDUM MUST NOT BE DETACHED FROM THE MSDS IDENTIFIES SARA 313 SUBSTANCE(S)
Any copying or redistribution of the MSDS must include a copy of this addendum (Chem.Key: PHACD)

HAZARD CATEGORIES FOR SARA Section 311/312 Reporting

<table>
<thead>
<tr>
<th>Acute</th>
<th>Chronic</th>
<th>Fire</th>
<th>Pressure</th>
<th>Reactive</th>
</tr>
</thead>
</table>

Product or Components Of Products

<table>
<thead>
<tr>
<th>SARA EHS Sect. 302</th>
<th>SARA Section 313 Chemicals</th>
<th>CERCLA Sec. 103</th>
<th>RCRA Section 261.33</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ (lbs.)</td>
<td>TPQ (lbs.)</td>
<td>Name List</td>
<td>Chemical Category</td>
</tr>
<tr>
<td>Nickel Chloride (Nickel Compound) (7718-54-9)</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Applicable Products:
Nickelex, Electroless Nickel Plating Ammonia Type, Electroless Nickel Plating Strike.

SARA Section 302 EHS RQ: Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.
SARA Section 302 EHS TPQ: Threshold Planning Quantity of Extremely Hazardous Substance. An asterisk (*) following a threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity + 10,000 LBS.
SARA Section 313 Chemicals: Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.
CERCLA Sec 103: Comprehensive Environmental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center (800-424-8802); Listed at 40 CFR 302.4
RCRA: Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

Effective Date 02-17-87 Supersedes 04-30-86

Nickel Chloride

-4/4- Electroless Nickel Plating Ammonia Type