1. Identification

Material name: ALUMINUM ETCH 16:1:1:2
Issue date: 07-October-2016
Revision date: 08-October-2018
Supersedes date: 07-October-2016
Other means of identification
Spec ID: 100000002073
Synonyms: Metal etchants, aluminum etchants.
Recommended use: Etchant used in semiconductor manufacturing.
Recommended restrictions: None known.
Supplier information
FUJIFILM Electronic Materials U.S.A., Inc.
80 Circuit Drive
North Kingstown RI 02852
Transportation Emergency:
FOR ALL TRANSPORTATION ACCIDENTS, CALL CHEMTREC: 1-800-424-9300
Medical Emergency (24HR):
FOR ANY HEALTH & MEDICAL EMERGENCY, 24 HOURS /7 DAYS CALL: 1-800-365-8951
Non-emergency Telephone:
FOR ALL SDS REQUESTS & QUESTIONS, CALL CUSTOMER SERVICE: 1-800-553-6546
SDS file: 10379_US_EN_V3.0
Replaces file: 10379_US_EN_V2.0

2. Hazard(s) identification

Physical hazards: Corrosive to metals Category 1
Health hazards: Skin corrosion/irritation Category 1B
Serious eye damage/eye irritation Category 1
OSHA defined hazards: Not classified.
Label elements

Signal word: Danger
Hazard statement: May be corrosive to metals. Causes severe skin burns and eye damage.
Precautionary statement
Prevention: Wear protective gloves/protective clothing/eye protection/face protection. Do not breathe mist/vapors/spray. Wash thoroughly after handling. Keep only in original container.
Response: If swallowed: Rinse mouth. Do NOT induce vomiting. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center/doctor. Absorb spillage to prevent material damage.
Storage: Store in corrosive resistant container with a resistant inner liner. Store locked up.
Disposal: Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazard(s) not otherwise classified (HNOC): None known.
Supplemental information: None.

3. Composition/information on ingredients

Mixture

100000002073 ALUMINUM ETCH 16:1:1:2
912092 SDS file: 10379_US_EN_V3.0

<table>
<thead>
<tr>
<th>Chemical name</th>
<th>Common name and synonyms</th>
<th>CAS number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphoric acid</td>
<td></td>
<td>7664-38-2</td>
<td>60 - 80</td>
</tr>
<tr>
<td>Acetic acid</td>
<td></td>
<td>64-19-7</td>
<td>0,01 - 10</td>
</tr>
<tr>
<td>Nitric acid</td>
<td></td>
<td>7697-37-2</td>
<td>0,01 - 5</td>
</tr>
</tbody>
</table>

**Composition comments**

All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

The product contains: Water.

4. First-aid measures

**Inhalation**

Immediately remove from further exposure. Get immediate medical assistance. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. Give supplemental oxygen, if available. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

**Skin contact**

Remove contaminated clothes and rinse skin thoroughly with water for at least 15 minutes. Get medical attention immediately. Chemical burns must be treated by a physician.

**Eye contact**

Flush thoroughly with water for at least 15 minutes. Get immediate medical assistance. If medical assistance is not immediately available, flush an additional 15 minutes. Make sure to remove any contact lenses from the eyes before rinsing.

**Ingestion**

Rinse mouth thoroughly with water and give large amounts of milk or water to people not unconscious. Do not induce vomiting. If vomiting occurs, the head should be kept low so that stomach vomit doesn't enter the lungs. Lay on the side. Obtain medical attention and take along this material safety data sheet.

**Most important symptoms/effects, acute and delayed**

Inhalation: May cause damage to mucous membranes in nose, throat, lungs and bronchial system. Be aware that symptoms of lung edema (shortness of breath) may develop up to 24 hours after exposure. Eye contact: Prolonged contact causes serious eye and tissue damage. Skin contact: May cause serious chemical burns to the skin. Ingestion: May cause burns in mucous membranes, throat, esophagus and stomach.

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

Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

**Suitable extinguishing media**

Use fire-extinguishing media appropriate for surrounding materials.

**Unsuitable extinguishing media**

None.

**Specific hazards arising from the chemical**

By heating and fire, toxic and corrosive vapors/gases may be formed.

**Special protective equipment and precautions for firefighters**

Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace. Self-contained breathing apparatus and full protective clothing must be worn in case of fire.

**Fire fighting equipment/instructions**

Use standard firefighting procedures and consider the hazards of other involved materials.

6. Accidental release measures

**Personal precautions, protective equipment and emergency procedures**

Avoid any exposure. Wear suitable protective clothing. See Section 8 of the SDS for Personal Protective Equipment.

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

Absorb spillage with suitable absorbent material. For waste disposal, see Section 13 of the SDS.

**Environmental precautions**

Avoid discharge into drains, water courses or onto the ground unless authorized by permit.

7. Handling and storage

**Precautions for safe handling**

Mechanical ventilation or local exhaust ventilation is required. Avoid any exposure. Wear approved safety goggles. Wear protective gloves and appropriate clothing to prevent skin contact. Work practice should minimize contact. Observe good industrial hygiene practices.

**Conditions for safe storage, including any incompatibilities**

Store in closed original container in a dry place. Store in corrosive resistant container with a resistant inner liner. Store away from incompatible materials.
8. Exposure controls/personal protection

Occupational exposure limits

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic acid (CAS 64-19-7)</td>
<td>PEL</td>
<td>25 mg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 ppm</td>
</tr>
<tr>
<td>Nitric acid (CAS 7697-37-2)</td>
<td>PEL</td>
<td>5 mg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 ppm</td>
</tr>
<tr>
<td>Phosphoric acid (CAS 7664-38-2)</td>
<td>PEL</td>
<td>1 mg/m³</td>
</tr>
</tbody>
</table>

US. ACGIH Threshold Limit Values

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic acid (CAS 64-19-7)</td>
<td>STEL</td>
<td>15 ppm</td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td>10 ppm</td>
</tr>
<tr>
<td>Nitric acid (CAS 7697-37-2)</td>
<td>STEL</td>
<td>4 ppm</td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td>2 ppm</td>
</tr>
<tr>
<td>Phosphoric acid (CAS 7664-38-2)</td>
<td>STEL</td>
<td>3 mg/m³</td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td>1 mg/m³</td>
</tr>
</tbody>
</table>

US. NIOSH: Pocket Guide to Chemical Hazards

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic acid (CAS 64-19-7)</td>
<td>STEL</td>
<td>37 mg/m³</td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td>15 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 mg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 ppm</td>
</tr>
<tr>
<td>Nitric acid (CAS 7697-37-2)</td>
<td>STEL</td>
<td>10 mg/m³</td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td>4 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 mg/m³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 ppm</td>
</tr>
<tr>
<td>Phosphoric acid (CAS 7664-38-2)</td>
<td>STEL</td>
<td>3 mg/m³</td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td>1 mg/m³</td>
</tr>
</tbody>
</table>

Biological limit values

No biological exposure limits noted for the ingredient(s).

Appropriate engineering controls

Provide adequate ventilation. Observe Occupational Exposure Limits and minimize the risk of inhalation of vapors. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

Eye/face protection

Wear approved safety goggles.

Skin protection

Hand protection

Wear protective gloves impervious to the chemicals in use.

Other

Also wear appropriate clothing to prevent any possibility of skin contact. Suitable items can be recommended by the protective equipment supplier or by a qualified industrial hygienist.

Respiratory protection

In the United States of America, if respirators are used, a program should be instituted to assure compliance with OSHA Standard 1910.134. Use a NIOSH/MSHA approved air purifying respirator as needed to control exposure. Consult with respirator manufacturer to determine respirator selection, use, and limitations. Use positive pressure, air-supplied respirator for uncontrolled releases or when air purifying respirator limitations may be exceeded. Follow respirator protection program requirements (OSHA 1910.134 and ANSI Z88.2) for all respirator use. If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.

Respiratory protection

Thermal hazards

Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations

Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.
9. Physical and chemical properties

Appearance
- Physical state: Liquid.
- Form: Liquid.
- Color: Colorless to Pale Yellow.
- Odor: Vinegar-like.
- Odor threshold: No data available.
- pH: < 2 (25 °C)
- Melting point/freezing point: No data available.
- Initial boiling point and boiling range: 244.4 - 249.8 °F (118 - 121 °C)
- Flash point: Not applicable.
- Evaporation rate: < 1 (Water = 1)
- Flammability (solid, gas): Not applicable.
- Upper/lower flammability or explosive limits:
  - Flammability limit - lower (%): Not applicable.
  - Flammability limit - upper (%): Not applicable.
- Vapor pressure: No data available.
- Vapor density: No data available.
- Relative density: 1.5 - 1.7
- Solubility(ies):
  - Solubility (water): Completely miscible with water.
- Partition coefficient (n-octanol/water): No data available.
- Auto-ignition temperature: None.
- Decomposition temperature: No data available.
- Viscosity: 15.3 mm²/s (24°C/75°F) (Kinematic)
- Other information:
  - Density: 1.50 - 1.70 g/cc
  - Molecular weight: Not applicable/mixture.
  - Percent volatile: 15 - 30 %

10. Stability and reactivity

Chemical stability: Stable under normal temperature conditions.
Possibility of hazardous reactions:
- May be corrosive to metals. Reacts with most metals to form flammable hydrogen gas.
Conditions to avoid:
- Contact with metals.
Incompatible materials:
Hazardous decomposition products:

11. Toxicological information

Information on likely routes of exposure:
- Inhalation: Causes respiratory tract burns. High concentrations: May cause lung damage.
- Skin contact: Causes severe skin burns.
- Eye contact: Causes serious eye damage.
- Ingestion: Causes digestive tract burns.
Symptoms related to the physical, chemical and toxicological characteristics:
- Inhalation: May cause damage to mucous membranes in nose, throat, lungs and bronchial system. Be aware that symptoms of lung edema (shortness of breath) may develop up to 24 hours after exposure. Eye contact: Prolonged contact causes serious eye and tissue damage. Skin contact: May cause serious chemical burns to the skin. Ingestion: May cause burns in mucous membranes, throat, esophagus and stomach.

Information on toxicological effects:

Acute toxicity:
### Components Test Results

**Acetic acid (CAS 64-19-7)**

**Acute**
- **Inhalation**
  - LC50 Rat 11.4 mg/l, 4 Hours
- **Oral**
  - LD50 Rat 3310 mg/kg

**Nitric acid (CAS 7697-37-2)**

**Acute**
- **Inhalation**
  - LC50 Rat > 2.65 mg/l, 4 hours

**Phosphoric acid (CAS 7664-38-2)**

**Acute**
- **Dermal**
  - LD50 Rabbit 2740 mg/kg
- **Oral**
  - LC50 Rat 2600 mg/kg (Approximate)

**Skin corrosion/irritation**
- Causes severe skin burns.

**Serious eye damage/eye irritation**
- Causes serious eye damage.

**Respiratory or skin sensitization**
- **Respiratory sensitization**
  - Due to lack of data the classification is not possible.
- **Skin sensitization**
  - Due to lack of data the classification is not possible.
- **Germ cell mutagenicity**
  - Based on available data, the classification criteria are not met.
- **Carcinogenicity**
  - Due to lack of data the classification is not possible.

**IARC Monographs. Overall Evaluation of Carcinogenicity**
- Not listed.

**NTP Report on Carcinogens**
- Not listed.

- Not regulated.

**Reproductive toxicity**
- Due to lack of data the classification is not possible.

**Specific target organ toxicity - single exposure**
- Due to lack of data the classification is not possible.

**Specific target organ toxicity - repeated exposure**
- Due to lack of data the classification is not possible.

**Aspiration hazard**
- Based on available data, the classification criteria are not met.

**Chronic effects**
- May cause lung damage. Inhalation of vapor or mist may cause lung edema. Erosion of exposed teeth. Exposure to this product is associated with an increased risk of bronchitis.

**Further information**
- Prolonged overexposure to fluorides may increase fluoride content of bones and teeth, and may result in fluorosis, with mottling of teeth (in children) and brittleness of bones.

### Ecological information

**Ecotoxicity**
- The product contains a substance which is harmful to aquatic organisms.

### Components Test Results

**Acetic acid (CAS 64-19-7)**

**Aquatic**
- **Acute**
  - **Algae**
    - EC50 Skeletonema costatum > 300.82 mg/l, 72 hours
  - **Crustacea**
    - EC50 Daphnia magna > 1000 mg/l, 48 hours
  - **Fish**
    - LC50 Cyprinodon variegatus > 300.82 mg/l, 96 hours
    - Oncorhynchus mykiss > 300.82 mg/l, 96 hours

**Nitric acid (CAS 7697-37-2)**

**Acute**
- **Fish**
  - LC50 Salmo gairdneri 4400 mg/l, 96 hours
Components Test Results

<table>
<thead>
<tr>
<th>Species</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daphnia magna</td>
<td>490 mg/l, 48 hours</td>
</tr>
<tr>
<td>&gt; 100 mg/l, 48 hours</td>
<td></td>
</tr>
</tbody>
</table>

Persistence and degradability
The product contains inorganic compounds which are not biodegradable.

Bioaccumulative potential
Not relevant for inorganic substances.

Octanol/water partition coefficient log Kow
Acetic acid (CAS 64-19-7) -0.17

Mobility in soil
This product is miscible in water and may not disperse in soil.

Other adverse effects
The product may affect the acidity (pH-factor) in water with risk of harmful effects to aquatic organisms.

13. Disposal considerations
Disposal instructions
Disposal recommendations are based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

Hazardous waste code
D002: Waste Corrosive material [pH <=2 or =>12.5, or corrosive to steel]

Waste from residues / unused products
Dispose of waste and residues in accordance with local authority requirements.

Contaminated packaging
Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT
UN number UN1760
UN proper shipping name Corrosive liquids, n.o.s. (Phosphoric acid, Acetic acid)

Transport hazard class(es)
Class 8
Subsidiary risk -
Label(s) 8
Packing group II

Environmental hazards
Marine pollutant No

Special precautions for user
Read safety instructions, SDS and emergency procedures before handling.

IATA
UN number UN1760
UN proper shipping name Corrosive liquid, n.o.s. (Phosphoric acid, Acetic acid)

Transport hazard class(es)
Class 8
Subsidiary risk -
Label(s) Corrosive

Packing group II

Environmental hazards
Marine pollutant No

ERG Code 8L

Special precautions for user
Read safety instructions, SDS and emergency procedures before handling.

IMDG
UN number UN1760
UN proper shipping name CORROSIVE LIQUID, N.O.S. (Phosphoric acid, Acetic acid)

Transport hazard class(es)
Class 8
Subsidiary risk -

Packing group II

Environmental hazards
Marine pollutant No

EmS F-A, S-B

Special precautions for user
Read safety instructions, SDS and emergency procedures before handling.
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

15. Regulatory information

US federal regulations
This product is hazardous according to OSHA 29 CFR 1910.1200.
TSCA Section 4(a) Final Test Rules & Testing Consent Orders: Not regulated.
TSCA Section 5(e) PMN-Substance Consent Orders: Not regulated.
SARA 311/312 Hazard categories: see Section 2 of the SDS.

Drug Enforcement Administration (DEA). List 1(i), Precursor Chemicals (21 CFR 1310.02(a) and 1310.04(f)(1))
Not listed.

TSCA Section 5(a)(2) Final Significant New Use Rules (SNURs)(40CFR 721, Subpt. E)
Not regulated.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)
Not regulated.

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List
Not regulated.

US EPCRA (SARA Title III) Section 302 - Extremely Hazardous Spill: Reportable quantity
Nitric acid (CAS 7697-37-2) 1000 LBS

US EPCRA (SARA Title III) Section 302 - Extremely Hazardous Substance: Threshold Planning Quantity
Nitric acid (CAS 7697-37-2) 1000 LBS

US EPCRA (SARA Title III) Section 313 - Toxic Chemical: De minimis concentration
Nitric acid (CAS 7697-37-2) 1.0 %

US EPCRA (SARA Title III) Section 313 - Toxic Chemical: Listed substance
Nitric acid (CAS 7697-37-2) Listed.

CERCLA (Superfund) reportable quantity (lbs) (40 CFR 302.4)
Phosphoric acid: 5000
Acetic acid: 5000
Nitric acid: 1000

Drug Enforcement Administration (DEA) (21 CFR 1308.11-15)
Not controlled

Inventory status

<table>
<thead>
<tr>
<th>Country(s) or region</th>
<th>Inventory name</th>
<th>On inventory (yes/no)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Australian Inventory of Chemical Substances (AICS)</td>
<td>Yes</td>
</tr>
<tr>
<td>Canada</td>
<td>Domestic Substances List (DSL)</td>
<td>Yes</td>
</tr>
<tr>
<td>Canada</td>
<td>Non-Domestic Substances List (NDSL)</td>
<td>No</td>
</tr>
<tr>
<td>New Zealand</td>
<td>New Zealand Inventory</td>
<td>Yes</td>
</tr>
<tr>
<td>Philippines</td>
<td>Philippine Inventory of Chemicals and Chemical Substances (PICCS)</td>
<td>Yes</td>
</tr>
<tr>
<td>United States &amp; Puerto Rico</td>
<td>Toxic Substances Control Act (TSCA) Inventory</td>
<td>Yes</td>
</tr>
</tbody>
</table>

All ingredients are TSCA compliant.

*A “Yes” indicates this product complies with the inventory requirements administered by the governing country(s)

State regulations

US. Massachusetts RTK - Substance List
Acetic acid (CAS 64-19-7) Listed.
Nitric acid (CAS 7697-37-2) Listed.
Phosphoric acid (CAS 7664-38-2) Listed.

US. New Jersey Worker and Community Right-to-Know Act
Acetic acid (CAS 64-19-7)
Nitric acid (CAS 7697-37-2)
Phosphoric acid (CAS 7664-38-2)

US. Pennsylvania Worker and Community Right-to-Know Law
Acetic acid (CAS 64-19-7)
Nitric acid (CAS 7697-37-2)
Phosphoric acid (CAS 7664-38-2)

US. Rhode Island RTK
Acetic acid (CAS 64-19-7) Listed.
Nitric acid (CAS 7697-37-2) Listed.
Phosphoric acid (CAS 7664-38-2) Listed.
California Proposition 65
California Safe Drinking Water and Toxic Enforcement Act of 2016 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins. For more information go to www.P65Warnings.ca.gov.

US. California. Candidate Chemicals List. Safer Consumer Products Regulations (Cal. Code Regs, tit. 22, 69502.3, subd. (a))
- Nitric acid (CAS 7697-37-2)
- Phosphoric acid (CAS 7664-38-2)

16. Other information, including date of preparation or last revision

Further information
HMIS® is a registered trade and service mark of the ACA.
G - Safety Glasses, Gloves, Vapor Respirator

HMIS® ratings
- Health: 3
- Flammability: 0
- Physical hazard: 0
- Personal protection: G

NFPA ratings
- Health: -
- Flammability: -
- Instability: -

List of abbreviations
- LD50: Lethal Dose, 50%.
- LC50: Lethal Concentration, 50%.
- EC50: Effective Concentration, 50%.

Disclaimer
THIS SAFETY DATA SHEET (SDS) HAS BEEN PREPARED IN COMPLIANCE WITH THE FEDERAL OSHA HAZARD COMMUNICATION STANDARD, 29 CFR 1910.1200. THE INFORMATION IN THIS SDS SHOULD BE PROVIDED TO ALL WHO WILL USE, HANDLE, STORE, TRANSPORT, OR OTHERWISE BE EXPOSED TO THIS PRODUCT. THIS INFORMATION HAS BEEN PREPARED FOR THE GUIDANCE OF PLANT ENGINEERING, OPERATIONS AND MANAGEMENT AND FOR PERSONS WORKING WITH OR HANDLING THIS PRODUCT. FUJIFILM ELECTRONIC MATERIALS BELIEVES THIS INFORMATION TO BE RELIABLE AND UP TO DATE AS OF THE DATE OF PUBLICATION BUT, MAKES NO WARRANTY THAT IT IS. ADDITIONALLY, IF THIS SDS IS MORE THAN THREE YEARS OLD, YOU SHOULD CONTACT FUJIFILM ELECTRONIC MATERIALS AT THE PHONE NUMBER 1-800-553-6546 (CUSTOMER SERVICE) TO MAKE CERTAIN THAT THIS DOCUMENT IS CURRENT.

This SDS contains revisions in the following section(s):
- 1, 2, 7, 10, 11, 12, 14, 15, 16.

SDS file
10379_US_EN_V3.0

Replaces file
10379_US_EN_V2.0