SAFETY DATA SHEET

1. Product and Company Identification

Material name: FFEM OS2
Issue date: 30-October-2013
Revision date: -
Supersedes date: -
CAS #: 108-94-1
Product use: Photoresist Stripper.
Synonym(s): None.
Spec ID: 100000003400
Supplier information:
FUJIFILM Electronic Materials U.S.A., Inc.
80 Circuit Road
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 MSDS REQUESTS & QUESTIONS, CALL CUSTOMER SERVICE:
1-800-553-6546

MSDS file: 16186_NA_EN_V2.0
Replaces file: 16186_NA_EN_V1.0

2. Hazards Identification

Physical state: Liquid.
Emergency overview: WARNING! Harmful if absorbed through skin. May be harmful if swallowed. Causes eye irritation. Prolonged or repeated contact may dry skin and cause irritation. Combustible liquid.
OSHA regulatory status: This product is hazardous according to OSHA 29 CFR 1910.1200.

Potential health effects:
Routes of exposure:
- Inhalation: Inhalation. Eyes. Skin. Ingestion.
- Eyes: Causes eye irritation.
- Skin: Harmful if absorbed through skin. May be absorbed through the skin. Prolonged or repeated contact may dry skin and cause irritation. Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis.
- Inhalation: Vapors may cause drowsiness and dizziness.
- Ingestion: May be harmful if swallowed. Swallowing or vomiting of the liquid may result in aspiration into the lungs. Droplets of the product aspirated into the lungs through ingestion or vomiting may cause a serious chemical pneumonia.

Chronic effects: Organic solvents may be absorbed into the body by inhalation and ingestion and cause permanent damage to the nervous system, including the brain. May cause damage to the liver and kidneys. Prolonged skin contact may cause dermatitis.
Signs and symptoms: Inhalation: Vapors may cause drowsiness and dizziness. Eye contact: May cause redness and pain. Skin contact: Defats the skin. Dermatitis. Ingestion: Be aware that symptoms of chemical pneumonia (shortness of breath) may occur several hours after exposure.

Potential environmental effects: The product is a volatile organic compound which has a photochemical ozone creation potential.

3. Composition / Information on Ingredients

<table>
<thead>
<tr>
<th>Components</th>
<th>CAS #</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexanone</td>
<td>108-94-1</td>
<td>95-100</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.
4. First Aid Measures

First aid procedures

Eye contact
Immediately flush with plenty of water for up to 15 minutes. Remove any contact lenses and open eyelids wide apart. Get medical attention promptly if symptoms occur after washing.

Skin contact
Remove contaminated clothes and rinse skin thoroughly with water for at least 15 minutes. Get medical attention immediately.

Inhalation
Move injured person into fresh air and keep person calm under observation. Get medical attention if any discomfort continues.

Ingestion
Rinse mouth thoroughly with water and give large amounts of milk or water, if person is conscious. 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. Get medical attention immediately.

Notes to physician
Treat symptomatically. Be aware that symptoms of chemical pneumonia (shortness of breath) may occur several hours after exposure.

General advice
Thermal burns: Flush with water immediately. While flushing, remove clothes which do not adhere to affected area. Call an ambulance. Continue flushing during transport to hospital.

5. Fire Fighting Measures

Flammable properties
The product is combustible, and heating may generate vapors which may form explosive vapor/air mixtures.

Extinguishing media
Suitable extinguishing media
Extinguish with alcohol-resistant foam, carbon dioxide, dry powder or water fog.

Unsuitable extinguishing media
None.

Protection of firefighters
Specific hazards arising from the chemical
During fire, gases hazardous to health may be formed. Solvent vapors may form explosive mixtures with air.

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. Containers close to fire should be removed or cooled with water.

Hazardous combustion products
Carbon monoxide and carbon dioxide.

6. Accidental Release Measures

Personal precautions
Extinguish all ignition sources. Avoid sparks, flames, heat and smoking. Ventilate the area. Avoid inhalation of vapors/spray and contact with skin and eyes. Wear suitable protective clothing. See Section 8 of the MSDS for Personal Protective Equipment.

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

Methods for cleaning up
Remove sources of ignition. Absorb spillage with non-combustible, absorbent material. For waste disposal, see Section 13 of the MSDS.

7. Handling and Storage

Handling
Local exhaust is recommended. Avoid inhalation of vapors and spray mist and contact with skin and eyes. Wear approved safety goggles. Wear protective gloves and appropriate clothing to prevent skin contact. The product is combustible, and heating may generate vapors which may form explosive vapor/air mixtures. Do not smoke and do not spray near an open flame or other sources of ignition. Vapors are heavier than air and may travel along the floor and in the bottom of containers. Vapors may be ignited by a spark, a hot surface or an ember. Ground container and transfer equipment to eliminate static electric sparks. Observe good industrial hygiene practices.

Storage
Follow rules for combustible liquids. Do not store near heat sources or expose to high temperatures. Keep away from heat, sparks and open flame. Store in closed original container in a dry place. Store away from incompatible materials.

8. Exposure Controls / Personal Protection

Occupational exposure limits
US. ACGIH Threshold Limit Values

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexanone (CAS 108-94-1)</td>
<td>STEL</td>
<td>50 ppm</td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td>20 ppm</td>
</tr>
</tbody>
</table>

100000003400 FFEM OS2

913918 MSDS File: 16186_NA_EN_V2.0
US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexanone (CAS 108-94-1)</td>
<td>PEL</td>
<td>200 mg/m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 ppm</td>
</tr>
</tbody>
</table>

Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2)

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexanone (CAS 108-94-1)</td>
<td>STEL</td>
<td>200 mg/m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 ppm</td>
</tr>
<tr>
<td>TWA</td>
<td></td>
<td>80 mg/m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 ppm</td>
</tr>
</tbody>
</table>

Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended)

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexanone (CAS 108-94-1)</td>
<td>STEL</td>
<td>50 ppm</td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td>20 ppm</td>
</tr>
</tbody>
</table>

Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents)

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexanone (CAS 108-94-1)</td>
<td>STEL</td>
<td>50 ppm</td>
</tr>
<tr>
<td></td>
<td>TWA</td>
<td>20 ppm</td>
</tr>
</tbody>
</table>

Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment)

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexanone (CAS 108-94-1)</td>
<td>TWA</td>
<td>100 mg/m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 ppm</td>
</tr>
</tbody>
</table>

Mexico. Occupational Exposure Limit Values

<table>
<thead>
<tr>
<th>Components</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexanone (CAS 108-94-1)</td>
<td>STEL</td>
<td>400 mg/m3</td>
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<tr>
<td></td>
<td></td>
<td>100 ppm</td>
</tr>
<tr>
<td>TWA</td>
<td></td>
<td>200 mg/m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 ppm</td>
</tr>
</tbody>
</table>

Engineering controls
Use explosion-proof equipment. Provide adequate ventilation. Observe Occupational Exposure Limits and minimize the risk of inhalation of vapors. Provide easy access to water supply or an emergency shower.

Personal protective equipment

**Eye / face protection**
Wear approved safety goggles.

**Skin protection**
Wear protective gloves impervious to the chemicals in use. 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**
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. In the United States of America, if respirators are used, a program should be instituted to assure compliance with OSHA 29 CFR 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.

**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 & Chemical Properties

**Molecular weight**
98.15 g/mol

**Physical state**
Liquid.

**Color**
Clear, colorless.
Odor: Peppermint.
Odor threshold: No data available.
pH: Not applicable.
Melting point/Freezing point: Not applicable.
Boiling point: 309.2 - 312.8 °F (154 - 156 °C)
Density: 0.947 g/cm³
Relative density (specific gravity): 0.947
Vapor pressure: 10 mm Hg (101.7°F)
Vapor density: 3.4 (Air = 1)
Evaporation rate: Not applicable.
Percent volatile: 100 %
Solubility (water): 50 g/l
Flash point: 111.2 °F (44.0 °C) Closed Cup
Auto-ignition temperature: 788 °F (420 °C)
Viscosity: No data available.
Flammability limits in air, upper, % by volume: 9.4
Flammability limits in air, lower, % by volume: 1.1
Decomposition temperature: No data available.

10. Chemical Stability & Reactivity Information
Chemical stability: Stable under normal temperature conditions.
Conditions to avoid: Heat, sparks, flames. Air.
Incompatible materials: Strong oxidizing agents. Nitric acid.
Hazardous decomposition products: At elevated temperatures: Carbon dioxide (CO₂). Carbon monoxide.
Possibility of hazardous reactions: Organic solvent creates peroxides in contact with air. Reacts with strong oxidants causing fire and explosion hazard.

11. Toxicological Information
Toxicological data
Components | Species | Test Results
--- | --- | ---
Cyclohexanone (CAS 108-94-1) | | 
  **Acute** | | 
  Dermal  
  LD50  
  Inhalation  
  LC50  
  Oral  
  LD50  | Rabbit | 948 mg/kg
                           | Rat | 8000 ppm, 4 Hours
                           | Rat | 1540 mg/kg
Sensitization: Not a skin sensitizer.
Acute effects: Harmful if absorbed through skin. May be harmful if swallowed. Swallowing or vomiting of the liquid may result in aspiration into the lungs.
Local effects: Causes eye irritation. Prolonged or repeated contact may dry skin and cause irritation. Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis.
Chronic effects: May cause damage to the liver and kidneys. Prolonged or repeated contact may dry skin and cause dermatitis. Organic solvents may be absorbed into the body by inhalation and cause permanent damage to the nervous system, including the brain.
Carcinogenicity: Not classified.

**ACGIH Carcinogens**
Cyclohexanone (CAS 108-94-1) A3 Confirmed animal carcinogen with unknown relevance to humans.

**IARC Monographs. Overall Evaluation of Carcinogenicity**
Cyclohexanone (CAS 108-94-1) 3 Not classifiable as to carcinogenicity to humans.
IARC: 1 = Carcinogenic to Humans; There is sufficient evidence of carcinogenicity in humans. 2A = Probably Carcinogenic to Humans; There is limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals. 2B = Possibly Carcinogenic to Humans; There is limited evidence of carcinogenicity in humans and less than sufficient evidence of carcinogenicity in experimental animals. 3 = Not classifiable as to carcinogenicity to humans; The evidence of carcinogenicity is inadequate in humans and inadequate or limited in experimental animals. 4 = Probably not carcinogenic to humans; There is inadequate evidence of carcinogenicity in humans but evidence suggesting lack of carcinogenicity in experimental animals. Not listed = Not evaluated by IARC.

ACGIH: A1 = Confirmed Human Carcinogen; The agent is carcinogenic to humans based on the weight of evidence from epidemiological studies. A2 = Suspected Human Carcinogen; Human data are accepted as adequate in quality but are conflicting or insufficient to classify the agent as a confirmed human carcinogen or the agent is carcinogenic in experimental animals at dose(s), by route(s), of histologic type(s), or by mechanism(s) considered relevant to worker exposure. A3 = Confirmed animal Carcinogen with unknown relevance to humans; The agent is carcinogenic in experimental animals at a relatively high dose, by route(s) of administration, at site(s), or histologic type(s), or by mechanism(s) that may not be relevant to worker exposure. Available evidence does not suggest that the agent is likely to cause cancer in humans except under uncommon or unlikely routes or levels of exposure. A4 = Not classifiable as a human carcinogen; Agents which cause concern that they could be carcinogenic for humans but which cannot be assessed conclusively because of a lack of data. A5 = Not suspected to be a human carcinogen; The agent is not suspected to be a human carcinogen on the basis of properly conducted epidemiological studies in humans. Not listed = Not evaluated by ACGIH.

Mutagenicity
Reproductive effects
Symptoms and target organs
Inhalation: Vapors may cause drowsiness and dizziness. Eye contact: May cause redness and pain. Skin contact: Defats the skin. Dermatitis. Ingestion: Be aware that symptoms of chemical pneumonia (shortness of breath) may occur several hours after exposure.

Further information
Vapors and spray mist may irritate throat and respiratory system and cause coughing. In high concentrations, vapors are narcotic and may cause headache, fatigue, dizziness and nausea.

12. Ecological Information

Ecotoxicological data

<table>
<thead>
<tr>
<th>Components</th>
<th>Species</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexanone (CAS 108-94-1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aquatic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crustacea</td>
<td>EC50</td>
<td>Daphnia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>800 mg/l, 24 Hours</td>
</tr>
<tr>
<td>Fish</td>
<td>LC50</td>
<td>Freshwater fish</td>
</tr>
<tr>
<td></td>
<td></td>
<td>536 mg/l, 48 Hours</td>
</tr>
</tbody>
</table>

Ecotoxicity
The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Environmental effects
The product is a volatile organic compound which has a photochemical ozone creation potential.

Persistence and degradability
The product is readily biodegradable.

Bioaccumulation / Accumulation
Not expected to bioaccumulate on the basis of the low octanol-water partition coefficient.

Partition coefficient
Cyclohexanone (CAS 108-94-1) 0.81

Mobility in environmental media
The product is partly soluble in water. May spread in the aquatic environment. This organic solvent will evaporate easily from all surfaces.

13. Disposal Considerations

Waste codes
F003: Waste Spent non-halogenated solvents

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.

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
Basic shipping requirements:
UN number: UN1915
Proper shipping name: Cyclohexanone
Hazard class: 3
Packing group: III
Environmental hazards: No
Marine pollutant: No
Special precautions: Read safety instructions, MSDS and emergency procedures before handling.
Additional information:
Special provisions: B1, IB3, T2, TP1
Packaging exceptions: 150
Packaging non bulk 203
Packaging bulk 242

IATA
UN number UN1915
UN proper shipping name Cyclohexanone
Transport hazard class(es) 3
Packing group III
Environmental hazards No
Labels required 3
ERG code 3L
Special precautions for user Read safety instructions, MSDS and emergency procedures before handling.

IMDG
UN number UN1915
UN proper shipping name Cyclohexanone
Transport hazard class(es) 3
Packing group III
Marine pollutant No
Labels required 3
EmS F-E, S-D
Special precautions for user Read safety instructions, MSDS and emergency procedures before handling.

TDG
UN number UN1915
Proper shipping name CYCLOHEXANONE
Hazard class 3
Packing group III
Marine pollutant No
Labels required 3

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.
Drug Enforcement Administration (DEA). List 1(i), Precursor Chemicals (21 CFR 1310.02(a) and 1310.04(f)(1))
Not listed.
Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number
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.
CERCLA (Superfund) reportable quantity (lbs) (40 CFR 302.4)
Cyclohexanone: 5000

Superfund Amendments and Reauthorization Act of 1986 (SARA)
Hazard categories
Immediate Hazard - Yes
Delayed Hazard - Yes
Fire Hazard - Yes
Pressure Hazard - No
Reactivity Hazard - No

Section 302 extremely hazardous substance (40 CFR 355, Appendix A)
No
SARA 311/312 Hazardous chemical
Yes

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

Canadian regulations
This product has been classified according to the hazard criteria of the Canadian Controlled Products Regulations, Section 33, and the MSDS contains all required information.

WHMIS status
Controlled
WHMIS classification
B3 - Combustible Liquids  
D1B - Immediate/Serious-TOXIC  
D2B - Other Toxic Effects-TOXIC

WHMIS labeling

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>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>

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

State regulations
This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance
Not listed.

US - New Jersey RTK - Substances: Listed substance
Cyclohexanone (CAS 108-94-1) Listed.

US. Massachussets RTK - Substance List
Cyclohexanone (CAS 108-94-1) Listed.

US. New Jersey Worker and Community Right-to-Know Act
Not regulated.

US. Pennsylvania RTK - Hazardous Substances
Cyclohexanone (CAS 108-94-1) Listed.

US. Rhode Island RTK
Cyclohexanone (CAS 108-94-1) Listed.

Mexico regulations
This product is dangerous according to Mexican regulations.

16. Other Information

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

HMIS® ratings
Health: 2*  
Flammability: 2  
Physical hazard: 0  
Personal protection: G

NFPA ratings
Health: 2  
Flammability: 2  
Instability: 0

Disclaimer
This material safety data sheet (MSDS) has been prepared in compliance with the federal OSHA hazard communication standard, 29 CFR 1910.1200 and the Canadian controlled product regulation (SOR/88-66). The information in this MSDS 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 MSDS 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 MSDS contains revisions in the following section(s):
1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16.

MSDS file
16186_NA_EN_V2.0
Replaces file
16186_NA_EN_V1.0