Safety Data Sheet

1. Identification

Product Name: SUMIREST® PFI-88 series
Name: SUMIREST® PFI-88A7/A8L/A/AL/B1L
Control No.: For semiconductor device manufacturing use only

Manufacture
Company Name: Sumitomo Chemical Co., Ltd.
Address: 2-27-1 Shinkawa, Chuo-ku, Tokyo 104-8260
Department: Electronic Materials Division
Phone Number: +81-3-5543-5812
FAX Number: +81-3-5543-5934
E-mail Address: semiconductordiv@ya.sumitomo-chem.co.jp

Supplier
Company Name: Sumitomo Chemical Advanced Technologies LLC
Address: 3832 E. Watkins Street Phoenix, AZ 85034
Phone Number: +1-602-659-2500

Emergency Contact: TEL + 1-800-424-9300 (CHEMTREC )

2. Hazard(s) identification

GHS Class
Physicochemical Hazards
Explosives: Not Applicable
Flammable gases: Not Applicable
Flammable aerosols: Not Applicable
Oxidizing gases: Not Applicable
Gases under pressure: Not Applicable
Flammable liquids: Category 3
Flammable solids: Not Applicable
Self-reactive substances: Classification not possible
Pyrophoric liquids: Not Classified
Pyrophoric solids: Not Applicable
Self-heating substances: Classification not possible
Substances which, in contact with water, emit flammable gases:
Oxidizing liquids: Not Applicable
Oxidizing solids: Not Applicable
Organic peroxides: Not Applicable
Corrosive to metals: Classification not possible

Health Hazards
Acute Toxicity (oral): Category 4
Acute Toxicity (dermal):
Classification not possible
Acute Toxicity (inhalation: gas):
Not Applicable
Acute Toxicity (inhalation: vapour):
Classification not possible
Acute Toxicity (inhalation: dust, mist):
Classification not possible
Skin corrosion, irritation:
Classification not possible
Serious eye damage, eye irritation:
Classification not possible
Respiratory sensitization:
Classification not possible
Skin sensitization:
Category 1
Germ cell Mutagenicity:
Classification not possible
Carcinogenicity:
Classification not possible
Reproductive Toxicity:
Classification not possible
Target Organ Systemic Toxicity (Single dose):

Target Organ Systemic Toxicity (Repeated dose):
Classification not possible
Aspiration Hazards:
Classification not possible
Acute hazardous to the aquatic environment
Classification not possible
Chronic hazardous to the aquatic environment
Category 3
Hazardous to the ozone layer
Classification not possible

Environmental Hazards

Hazards not otherwise classified
Simple asphyxiants
Classification not possible
Pyrophoric gas
Classification not possible
Combustible dust
Classification not possible

Content of ingredient(s) of unknown acute toxicity:
<25% of the mixture consists of ingredient(s) of unknown acute toxicity.

Symbol(s):

Signal Word(s):
Warning

hazard statement(s):
• H226: Flammable liquid and vapour.
• H302: Harmful if swallowed.
• H317: May cause an allergic skin reaction.
• H371: May cause damage to organs(systemic toxicity).
• H335: May cause respiratory irritation.
• H336: May cause drowsiness or dizziness.
• H412: May cause long lasting harmful effects to aquatic life.

Precautionary statement(s)
Preventive Measures:

• P210: Keep away from ignition sources such as heat, spark, naked flames, and high-temperature-No smoking.
• P233: Keep container tightly closed.
• P240: Ground/bond container and receiving equipment.
• P241: Use explosion-proof electrical/ventilating/lighting equipment.
• P242: Use only non-sparking tools.
• P243: Take precautionary measures against static discharge.
• P280: Wear protective gloves/eye protection/face protection.
• P264: Wash face and hands thoroughly after handling.
• P260: Do not breathe dust/fume/gas/mist/vapours/spray.
• P271: Use only outdoors or in a well-ventilated area.
• P272: Contaminated work clothing should not be allowed out of the workplace.
• P270: Do not eat, drink or smoke when using this product.
• P273: Avoid release to the environment.

Procedure:

• P302+P352: IF ON SKIN: Wash with plenty of soap and water.
• P303+P361+P353: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
• P370+P378: In case of fire: Use appropriate means for extinction.
• P304+P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
• P301+P312: IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.
• P309+P311: IF exposed or if you feel unwell: Call a POISON CENTER or doctor/physician.
• P312: Call a POISON CENTER or doctor/physician if you feel unwell.
• P330: Rinse mouth.
• P333+P313: If skin irritation or rash occurs: Get medical advice/attention.
• P363: Wash contaminated clothing before reuse.

Storage:

• P403+P235: Store in a well-ventilated place. Keep cool.
• P233: Keep container tightly closed.
• P405: Store locked up.

Disposal:

• P501: Dispose of contents/container in accordance with local/regional/national/international regulations.

3. Composition/information on ingredients

<table>
<thead>
<tr>
<th>Product Type [Single or Mixture]:</th>
<th>Mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Name or Generic Name:</td>
<td>Mixture of 2-heptanone, γ-butyrolactone, novolac resin, photosensitive component.</td>
</tr>
<tr>
<td>Chemical Characteristics:</td>
<td>Trade secret</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Ingredients, Content, etc.</th>
<th>CAS No.</th>
<th>Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-heptanone (methyl-n-pentyl ketone)</td>
<td>110-43-0</td>
<td>Ca. 71-76</td>
</tr>
<tr>
<td>γ-butyrolactone</td>
<td>96-48-0</td>
<td>Ca. 1</td>
</tr>
<tr>
<td>novolac resin</td>
<td>Not Disclosed</td>
<td>Ca.16-21</td>
</tr>
<tr>
<td>Photosensitive component</td>
<td>Not Disclosed</td>
<td>Ca.7-9</td>
</tr>
</tbody>
</table>

4. First-aid measures

If inhaled: Immediately remove the victim to fresh air, keep warm with cover or blanket, and at rest. Make the victim blow nose and gargle. Immediately consult doctor. If breathing is weak or has stopped, open the victim’s air way, loosen clothing, and administer oxygen or artificial respiration. If breathing but vomiting, turn the victim’s head to the side. If unconscious, do not give anything by mouth. Do not induce vomiting.

If on skin: Immediately take off contaminated clothing, shoes, etc. Rinse portions that contacted with this product with running water or lukewarm water. If any change in appearance or pain persists, immediately consult doctor. Because of the flammability of this product, take measures with caution to fire.

If in eyes: After washing with clean water for at least 15 minutes, immediately consult doctor. At rinsing eyes, holding wide open eyelids with fingers, thoroughly rinse eyeball and inner surface of eyelids with water. If contact lenses are used, unless adhered, remove them and rinse eyes. Do not rub eyes, nor do not let the victim close eyes tightly.

If swallowed: Rinse mouth thoroughly. May dilute in stomach with 1 or 2 glasses of water or milk. Cover body with blanket, keep warm, and at rest. Immediately seek medical attention. As necessary, give artificial respiration or oxygen. If breathing but vomiting, turn the victim’s head to the side. If unconscious, do not give anything by mouth and do not
induce vomiting.

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

No Information

**Indication of immediate medical attention and special treatment needed, if necessary:**

No Information

5. **Fire-fighting measures**

**Suitable extinguishing media.**

Powder, foam, AFFF (Aqueous Film-Forming Foam fire extinguisher), carbon dioxide

**Unsuitable extinguishing media.**

straight stream water

**Specific hazards arising from the chemical:**

Combustion gas contains harmful materials such as CO, NO\textsubscript{x} and SO\textsubscript{x} etc. Do not breathe fumes or gas during extinguishing work.

**Particular Extinguishing Method:**

Keep combustion source away from the fire origin, extinguish fire with appropriate fire extinguisher. Extinguish fire from the windward side of the fire as much as possible. Prohibit entry of people by other than authorized people to the surroundings of the site. Harmful gas (e.g., CO, NO\textsubscript{x} and SO\textsubscript{x} etc) may be generated by combustion or high temperature. Wear respiratory protective equipment. Take appropriate measures to prevent leak of materials that may affect the environment, such as discharging water. In case of large-scale fire, extinguish fire at once using a foam fire extinguisher, etc. In case of fire at the surrounding and the container cannot be cooled, evacuate the site because of concern of explosion. (For the cooling of the container without the leak) Keep a safe distance for pouring water, and use shielding. For initial fire extinguishing, use powder, carbon dioxide, etc.

**Special protective equipment and precautions for fire-fighters:**

Extinguish fire from the windward side of the fire, and avoid inhalation of toxic gas. Must wear appropriate protective equipment (gloves, eyeglasses, mask, etc.).

6. **Accidental release measures**

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

If occurred indoors, fully ventilate until completion of the measures. Upon work, wear appropriate protective equipment, and prevent adhesion of splash or the like on skin and not to inhale dust, mist, or gas. Evacuate people on the leeward side, and start the work from the windward side. Quickly remove any possible ignition source nearby. For case of ignition, prepare fire-extinguishing equipment. Prohibit entry of people other than authorized people to the site by roping off around the site of leak, or the like. The site of leak may be slippery, so
be careful not to fall.

**Methods and materials for containment and cleaning up:**
For small spills, absorb spills with dry sand, earth, crushed vermiculite, or the like, and then collect in an empty container that can be tightly closed.
For large spills, prevent discharge by constructing dikes of dirt, and treat after guiding to safe area. Collect spills in an empty container as much as possible. Absorb residual liquid with sand or inert absorbent material, and transfer to safe place.

**Environmental Cautions:**
Be careful not to let the leaked product enter river, etc., and not to significantly affect living organisms or water quality. Be careful not to discharge contaminated waste water to rivers or sewers without appropriate treatment in case of dilution with a large amount of water.

**Preventive Measures for Secondary Disaster:**
Use non-spark generating safe equipment.

## 7. Handling and Storage

**Handling**

**Technical Measures:**
Handle in well-ventilated area. In case of handling outside, work from the windward side as much as possible. Prohibit entry of people other than authorized people to the area. Install facility nearby the handling area to wash eyes and body in case of emergency. Handle with appropriate protective equipment to prevent contact with clothing, skin, or mucus, or in eyes.
Provide facility to wash hands, and eyes, etc. in rest area, and after handling, thoroughly wash hands, face, etc. and gargle. In addition, do not bring any contaminated protective equipment in rest area. Prohibit use of high-temperature material, spark, and fire nearby. Do not heat, give friction, or impact to the product. Use non-spark producing tool. Keep fire away.

**Cautions:**
Do not handle the product roughly, such as falling, dropping, dragging, or giving impact on the product. Handle in a place equipped with a full ventilation system. In a hot day, if products are heated, it may generate an explosive atmosphere by mixing with vapour and air.

**Cautions for Handling:**
This product is flammable liquid. Handle with care. Keep in a fireproof installation.

**Storage**

**Storage conditions:**
Avoid exposing to direct sunlight. Store in a dry, dark place. Store non-L grade at from 0 deg. C to 20 deg. C (from 32 deg. F to 68 deg. F) and L grade at from 0 deg. C to 10 deg. C (from 32 deg. F to 40 deg. F). Close the container tightly and store in a well-ventilated area. Keep fire away. Keep in a fireproof designed place.

(1) (Precautions regarding storage period and storage temperature)
In order to prevent explosion of a bottle (∗∗∗), store at the specified...
storage temperature and use up within the quality warranty period. Do not store for long period or at high temperature as follows while being closed tightly:

- Storage exceeding the quality warranty period.
- Storage at temperature higher than 25°C.
- Storage for over six months at 20°C -25°C.

(2) If this product is stored in inappropriate conditions indicated in (1), the bottle may be exploded. In this case, loosen the lid and lower the inner pressure to the atmospheric pressure. When handling, be very careful to the following points:

- Use appropriate protective equipment (impermeable and cut-resistant protective gloves, goggle-type protective eyeglasses, gas mask for organic gas, etc.)
- Work in a safe facility equipped with local exhaust equipment.
- Do not work turning the opening of the container to a person.

(3) Be careful for re-increase of the inner pressure if closed tightly again after opening.

(4) See specification for storage temperature and quality warranty period.

(※) Since the photosensitive component in the product will gradually decompose, and nitrogen gas will be generated, the pressure will increase in a tightly closed container, and the bottle could be exploded. Since the decomposition rate is proportional to the temperature, the storage expiration is longer for lower temperature and is shorter for higher temperature.

Conditions for safe storage:
Ventilate area so as not to let vapour stay. Keep combustible materials away. Keep away from fire and heat source.

Substances prohibited to mix or contact with:
Strong oxidizer

Container and wrapping Materials:
No Information

8. Exposure controls/personal protection

Permissible Concentration:

<table>
<thead>
<tr>
<th>Substance</th>
<th>OSHA PEL(2012)</th>
<th>ACGIH (Year 2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[2-Heptanone]</td>
<td>50 ppm (TWA)</td>
<td>50 ppm (TWA)</td>
</tr>
</tbody>
</table>

Appropriate engineering controls:
Provide local exhaust equipment. Devices should have explosion resistant structure, and electrostatic measures should be taken for equipment. Provided facility for washing eyes and body in case of emergency near handling area.

Protective Equipment

For respiratory: Wear NIOSH certified dust respirator.
For Hands: protective gloves (solvent resistant-type)
For eyes: protective eyeglasses (goggle type)
For skin and body: Protective clothing, hat, rubber apron, etc., boots, etc.
9. Physical and chemical properties

(a) Appearance;
   Physical state: Liquid
   Color: Reddish brown
(b) Odor;
   Aromatic odor
(c) Odor threshold;
   No data
(d) pH;
   No data
(e) Melting point/freezing point;
   [2-Heptanone] –35.5 °C
   [γ-Butyrolactone] –44 °C
(f) Initial boiling point and boiling range;
   [2-Heptanone] 151 °C
   [γ-Butyrolactone] 204 °C
(g) Flash point;
   [2-Heptanone] 39 °C
   [γ-Butyrolactone] 98 °C (C.C.)
(h) Evaporation rate;
   No data
(i) Flammability (solid, gas);
   No data
(j) Upper/lower flammability or explosive limits;
   [2-Heptanone] Explosion range: 1-5.5 vol.% (in Air)
(k) Vapour pressure;
   [2-Heptanone] 0.2 kPa (25 °C)
   [γ-Butyrolactone] 0.45 mmHg (25 °C)
(l) Vapour density;
   [2-Heptanone] 3.9 (Air=1)
(m) Relative density;
   Specific gravity: about 1
(n) Solubility(ies);
   Water; Hardly soluble
(o) Partition coefficient: n-octanol/water;
   [γ-Butyrolactone] log P=−0.64
(p) Auto-ignition temperature;
   [2-Heptanone] 393 °C
   [γ-Butyrolactone] 455 °C
(q) Decomposition temperature;
   No data
(r) Viscosity;
   No data

10. Stability and reactivity

(a) Reactivity;
   Risk of fire or explosion if contact with strong oxidizer.
(b) Chemical stability;
   Considered stable for normal storage and handling.
(c) Possibility of hazardous reactions;
   May generate CO, NOx, and SOx etc. by pyrolysis.
(d) Conditions to avoid;
   No information
(e) Incompatible materials;
   No information
(f) Hazardous decomposition products.
   May generate CO, NOx, and SOx etc. by pyrolysis.

11. Toxicological information

No information on this product, but information on the components (solvents), [2-Heptanone] [γ-Butyrolactone] and [novolac resin] is as follows:

Acute Toxicity
   Oral
   [2-Heptanone] Rat LD50=about 1600 mg/kg
   [γ-Butyrolactone] Rat LD50=1920mg/kg
Dermal

- [2-Heptanone] Rabbit LD50 = 12.6 mL/kg (converted value: 10,300 mg/kg)
- [γ-Butyrolactone] guinea pig LD50 = 5000 mg/kg
- [a part of novolac resin-2] Rat LD50 > 2000 mg/kg

Inhalation (vapour):

- [2-Heptanone] Rat LC50: 11.4~22.9 mg/L (Vapour, reduced value for 4h)
- [γ-Butyrolactone] Rat LC50 > 5100 mg/m³

Inhalation (dust, mist):

Skin Corrosion, Irritation:

- [γ-Butyrolactone] Rabbit: Non-irritating
- [a part of novolac resin-2] Rabbit: Non irritating.

Serious damage to eyes, eye irritation:

- [γ-Butyrolactone] Rabbit: Medium degree of irritation.
- [a part of novolac resin-2] Rabbit: Non irritating.

Skin Sensitization:

- [2-Heptanone] Guinea Pig (Draize method): Negative
- [γ-Butyrolactone] Guinea Pig: Positive (sensitization, Rate=10%) [a part of novolac resin-2]

Carcinogenesis

- [2-Heptanone] IARC, ACGIH, NTP: Not listed
- [γ-Butyrolactone] IARC: Group 3, ACGIH, NTP: Not listed

Germ Cell Mutagenicity:

- [2-Heptanone] (In vitro) Ames test: Negative
- [γ-Butyrolactone] (In vivo) mouse micronucleus test: Negative
- [a part of novolac resin-1,2] in-vitro test (Ames test): Negative

Reproduction Toxicity:

- [2-Heptanone] Teratogenicity study: oral administration, 6~15 days of gestation; NOEL=250mg/kg as maternal toxicity NOEL=1000mg/kg as offspring toxicity. Effects was observed at embryonic development but teratogenicity was not confirmed. Reproductive toxicity study; inhalation exposure 6~15 days of gestation; NOEL=80ppm as for maternal toxicity NOEL=1000ppm as for offspring toxicity. Reproductive toxicity was not confirmed.

Target organ, systemic toxicity (Single exposure):

- [2-Heptanone] guinea pig inhalation toxicity study in Irritation in respiratory tract (1500ppm) and anesthetic effects (2000ppm).
- [γ-Butyrolactone] Human: Effect: May cause anesthetic effects or unconsciousness.
- [a part of novolac resin-1] May cause damage to organs (digestive system) by ingestion.

Target Organ/Systemic Toxicity (Repeated Exposure)

- no data available

Inhalation Hazard to Respiratory System:

- [2-Heptanone] Since this is ketone having carbon atoms less than 13, it has inhalation hazard to respiratory system.

12. Ecological information

No information on this product, but there is the following information on the components (solvents),
[2-Heptanone] [γ-Butyrolactone] and [novolac resin]

<table>
<thead>
<tr>
<th><strong>Hazards to the Aquatic Environment (acute)</strong></th>
<th></th>
</tr>
</thead>
</table>
| **Fish** | [2-Heptanone] Fathead minnow: LC50(96h)=131 mg/L  
[γ-Butyrolactone] Carp: LC50(96h)= 220-460mg/L  
[a part of novolac resin-2] Rainbow trout LC50 (96h) =2.4 mg/L  |
| **Crustacea** | [γ-Butyrolactone] Water flea: EC50(96h)>500mg/L  
[a part of novolac resin-2] Water flea EC50 (48h)=1.4 mg/L  |
| **Algae** | [γ-Butyrolactone] Green algae: EC50 (72h)=360mg/L  
[a part of novolac resin-2] Algae : ErC50(72h)=1.8mg/L  |

<table>
<thead>
<tr>
<th><strong>Hazards to the Aquatic Environment (chronic)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[a part of novolac resin-2] Algae: NOEC(72hr)=0.082mg/L</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Persistence and degradability</strong></th>
<th></th>
</tr>
</thead>
</table>
| [γ-Butyrolactone] biodegradable, easily decomposable  
[a part of novolac resin-2] Bad decomposability  |

<table>
<thead>
<tr>
<th><strong>Bioaccumulative potential</strong></th>
<th></th>
</tr>
</thead>
</table>
| [γ-Butyrolactone] bioaccumulation: low accumulation (BOD=77%)  
[a part of novolac resin-2] partition ratio: LogPow=2.33~3.03(pH=7)  
LogPow=2.33~3.03(pH=2)  |

| **Mobility in soil;** | No data available  |

| **Other adverse effects** | [2-Heptanone] Not hardly-soluble (solubility in water=4076 m g/L)  |

13. Disposal considerations

**Residual Waste**
May generate harmful gas (CO, NO, and SO etc.). Incinerate in an incinerator, or request for disposal to a specialized waste disposal company permitted by the governor. Discharge water used for washing, etc. after cleaning by treating with coagulation and sedimentation, with activated sludge, etc.

**Contaminated container and package:**
If an empty container is disposed, dispose after completely removing the content. Request for disposal to a specialized waste disposal company permitted by the governor.

14. Transport information

(a) UN number; UN1866
(b) UN proper shipping name; Resin Solution
(c) Transport hazard class(es); Class 3
(d) Packing group III
(e) Marine pollutant; No
(f) Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code); No
(g) Specific Safety Measures and Conditions for Transportation:
Make sure no damage, corrosion, leaks, and so on on the container(s) before transportation. Load not to fall, drop, damage the product, and make sure to take measures to secure the loaded products. Equip in automobile or ship for transportation with protective equipment (gloves, eyeglasses, mask, etc), and fire extinguisher, tools necessary for emergency.

(h) Domestic Regulations:
Transport by container, packing, labeling, loading, and transportation method in accordance with provisions, such as the Fire Service Law, and the Ship Safety Law. Do not transport loading with a hazardous material of Groups 1 or 6 of the Fire Service Law.

15. Regulatory Information (not meant to be all-inclusive)

TSCA (Toxic Substance Control Act):
Parts of novolac resin are approved for TSCA PMN.
Photosensitive components are approved for TSCA Commercial purposes under the terms of the Low Volume Exemption (40CFR 723.50).
All the other components are listed on TSCA.
CERCLA (Comprehensive Environmental Response Compensation, and Liability Act): None
SARA TITLE III (Superfund Amendments and Reauthorization Act):
302 Extremely Hazardous Substance: None
311/312 Hazard Categories: Acute health and fire hazard
313 Reportable Ingredients: None
NFPA Ratings:
Health: 2
Flammability: 2
Reactivity: 0

16. Other Information

The above information is prepared based on currently available reference materials, information, and data, and will not make any warranties for the contents, physicochemical properties, hazards, etc. It is to be used for non-hazardous research and development in order to provide test data.

In addition, since the above cautions are intended for normal handlings, for special handling, please use the material with appropriate safety measures for the use and application under the supervision of a technically qualified individual.

Date of preparation or last revision: 2017/7/1