

## Product Safety Summary for ε-Caprolactam

### **SUBSTANCE NAME**

ε-caprolactam  
epsilon-Caprolactam  
Caprolactam  
omega.-Caprolactam  
2H-Azepin-2-one, hexahydro- (8Cl, 9Cl)  
Aminocaproic lactam  
2-Oxohexamethylenimine  
2-Ketohexamethylenimine  
2-Perhydroazepinone  
6-Hexanelactam  
Hexahydro-2H-azepin-2-one  
6-Caprolactam  
2-Azacycloheptanone  
Hexahydro-2-azepinone  
Hexanoic acid, 6-amino-, cyclic lactam  
1-Aza-2-cycloheptanone  
azepan-2-one

### **GENERAL STATEMENT**

ε-Caprolactam is used as an intermediate in the chemical industry to produce polyamides. Currently 73% of the polyamide is being used for fiber based applications (carpets and clothing), while the remainder 27% is used for the production of engineering plastics (gear wheels, drive systems, intermediates into Nylon-6).

### **CHEMICAL IDENTITY**

**EC Name:** ε-caprolactam

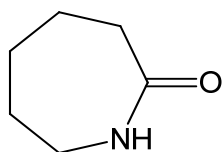
**EC-No. :** 203-313-2

**CAS-No. :** 105-60-2

**IUPAC name:** azepan-2-one

**Molecular formula:** C<sub>6</sub>H<sub>11</sub>NO

**Structural formula:**



## **USES AND APPLICATIONS**

ε-Caprolactam is used in industrial applications as a monomer for the manufacture of polyamide, polymers, thermoplastics, resins and thermo-hardened resins. ε-Caprolactam is also used in the laboratory as a reagent. Consumer uses include the use of ready-to-use products, such as coatings, paints and adhesives containing ε-caprolactam, and for which no dilution and mixing steps are necessary.

## **PHYSICAL CHEMICAL PROPERTIES**

ε-Caprolactam is a white organic solid with a characteristic odor.

**Melting point/range:** 69.3 °C

**Boiling point/boiling range:** 270.8 °C at 1013.25 hPa

**Auto-flammability:** non-flammable

**Explosive properties:** non-explosive

**Explosion limits:**

**Lower:** 1.4 vol % (air)

**Upper:** 8.0 vol % (air)

**Auto-ignition temperature:** 395 °C at 1013.25 hPa.

**Molecular weight:** 113.1576

**Water solubility:** 866.89 g/l solution at 22°C

**log Pow:** 0.12 at 25°C

**Vapor pressure:** 0.0013 hPa at 20°C

**Relative density:** 1.105 g/cm<sup>3</sup> at 20°C

## **HEALTH EFFECTS**

Based on the classification of the substance (REGULATION (EC) No 1272/2008) acute exposure to ε-Caprolactam may result in irritation and burning of the eyes, nose, throat, and skin in humans. ε-Caprolactam is considered harmful if swallowed, inhaled or absorbed through the skin.

EFFECT ASSESSMENT	RESULT
Acute Toxicity (oral/dermal/inhalation)	ε-Caprolactam is harmful if swallowed and inhaled.
Irritation/Corrosivity (skin/eye/respiratory tract)	ε-Caprolactam is a skin and eye irritant. Single exposure may cause respiratory irritation.
Sensitization (skin/respiratory tract)	ε-Caprolactam has not been found to be a skin sensitizer.
Carcinogenicity	ε-Caprolactam is not classified as a carcinogen.
Reproductive Toxicity	There is no evidence to indicate adverse reproductive or developmental potential to humans for ε-Caprolactam.

Repeated Dose Exposure	This substance has not been found to be harmful through prolonged or repeated exposure.
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### **ENVIRONMENTAL EFFECTS**

ε-Caprolactam is not classified as toxic to the environment or aquatic life. ε-Caprolactam is not considered to hydrolyze rapidly when released to water and is readily biodegradable.

EFFECT ASSESSMENT	RESULT
Aquatic Toxicity	Not harmful to aquatic life.

FATE AND BEHAVIOR	RESULT
Biodegradation	Readily biodegradable
Bioaccumulation potential	Due to the distribution coefficient n-octanol/water an accumulation in organisms is not expected.
PBT/vPvB conclusion	Regarding all available data on biotic and abiotic degradation, bioaccumulation and toxicity it can be stated that the substance does not fulfill the PBT criteria (not a PBT) and not the vPvB criteria (not a vPvB).

### **EXPOSURE**

#### **Human Health**

The most relevant route of exposure to ε-Caprolactam is by inhalation of workers involved in the manufacture and use of this compound, although dermal contact and eye contact routes have to be also taken into account. In an industrial setting, ingestion is not an anticipated route of exposure. The general population may, in the worst case, be exposed to traces of ε-Caprolactam found in some consumer products like coatings, paints, adhesives and other ready-to-use products for which no dilution and mixing steps are necessary, such as printing inks and toners.

#### **Environment**

ε-Caprolactam may be released to the environment in air and water from manufacturing and industrial use facilities. Identified uses of the substance have been assessed as safe for the environment. The substance is not known to be directly applied to sediment and an indirect release to sediment is unlikely since the substance is readily biodegradable.

### **RISK MANAGEMENT RECOMMENDATIONS**

Only properly trained and authorized, personnel should be allowed to handle the substance. ε-Caprolactam should be used in a closed system. ε-Caprolactam is a skin irritant and therefore personal protection is required when there is the likelihood of exposure. Therefore, the use of chemical resistant protective gloves should be

considered. ε-Caprolactam is an eye irritant; therefore personal protection is required when there is the likelihood of exposure. Exposure to the eyes can occur in two ways: direct from the air (splashes, aerosols, dust) or indirect via hand-eye contact. The likelihood of hand-eye contact is considered to be very low for all contributing scenarios due to the fact that only properly trained or authorized personnel should be allowed to handle the substance. Combined with stringent use of safety glasses with side-shields for all exposure sources at which a likelihood of exposure exists, an effective prevention of potential eye irritation can be achieved. ε-Caprolactam is harmful by inhalation and causes respiratory irritation; therefore suitable respiratory protective device shall be used when aerosol or mist is formed; respiratory filter device shall be used in case of brief exposure or low pollution; and self-contained respiratory protective device shall be used in case of intensive or longer exposure. For personal precautions in case of accidental release: Ensure adequate ventilation. Use breathing apparatus if exposed to vapors/dust/aerosol. For environmental precautions in case of accidental release: Do not empty into drains. Retain and dispose of contaminated wash water.

## **STATE AGENCY REVIEW**

This substance has been registered under REACH (EC) No. 1907/2006.

ε-Caprolactam is included in EU HPV list (High Production Volume Chemicals) and in US HPV list.

ε-Caprolactam is listed in the following Chemical Inventories: TSCA, ENCS, EINECS, ISHL, AICS, DSL, KECI, PICCS, IESCS, and NZIoC.

## **REGULATORY INFORMATION/CLASSIFICATION AND LABELING**

### **Classification of the substance according to REGULATION (EC) No 1272/2008:**

<b>Acute toxicity:</b>	Category 4; Oral; H302 Harmful if swallowed.
<b>Acute toxicity:</b>	Category 4; Inhalation; H332 Harmful if inhaled.
<b>Skin/Eye (Corrosion/irritation):</b>	Category 2; H315 Causes skin irritation. Category 2; H319 Causes serious eye irritation.
<b>Specific target organ toxicity - Single exposure:</b>	Category 3; H335 May cause respiratory irritation.

### **Labeling according to REGULATION (EC) No 1272/2008:**

#### **Pictogram:**



**Signal word:** Warning

<b>Hazard statements:</b>	H302: Harmful if swallowed.
	H332: Harmful if inhaled.
	H315: Causes skin irritation.

H319: Causes serious eye irritation.

H335: May cause respiratory irritation.

### **CONTACT INFORMATION WITHIN COMPANY**

For further information on this substance or product safety summaries in general, please contact:

**Company:** UBE Industries, Ltd.

**Department:** Caprolactam Business Unit

**Address:** Seavans North Bldg., 1-2-1 Shibaura, Minato-ku, Tokyo

**Town/Country:** Japan

**Postal code:** 105-8449

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**Additional information can be found at:**

<http://www.ube.co.jp>

### **GLOSSARY**

Acute toxicity	Harmful effect resulting from a single or short term exposure to a substance.
AICS	Australian Inventory of Chemical Substances.
Biodegradation	Decomposition or breakdown of a substance under natural conditions (actions of micro-organisms etc).
Bioaccumulation	Progressive accumulation in living organisms of a chemical substance present in the environment.
Canadian DSL	Domestic Substances List of Canada.
Carcinogenicity	Substance effects causing cancer.
CAS	Chemical Abstracts Service (division of the American Chemical Society).
Chronic toxicity	Harmful effect after repeated exposures or long term exposure to a substance.
EINECS	European Inventory of Existing Commercial Chemical Substances
ENCS	Existing Notified Chemical Substances (Japan).
Flash point	The lowest temperature at which vapor of the substance may form an ignitable mixture with air.
Genotoxicity	Substance effect that causes damage to genes, including mutagenicity and clastogenicity.
GHS	Globally Harmonized System of Classification and Labeling of Chemicals

HPV	High Production Volume Chemicals.
Hydrolyze	Undergo hydrolysis; decompose by reacting with water.
IECSC	Inventory of Existing Chemical Substances Produced or Imported in China.
Intermediate	Substance that is manufactured for and consumed in or used for chemical processing in order to be transformed into another substance.
KECI	Korean Existing Chemical Inventory.
Monomer	Means a substance which is capable of forming covalent bonds with a sequence of additional like or unlike molecules under the conditions of the relevant polymer-forming reaction used for the particular process.
Mutagenicity	Substance effect that cause mutation on genes.
NZIoC	New Zealand Inventory of Chemicals
PBT	Persistent, bioaccumulative, toxic chemical.
Persistence	Refers to the length of time a compound stays in the environment, once introduced.
PICCS	Philippine Inventory of Chemicals and Chemical Substances.
Risk Management Measures	Engineering controls, conditions and protective equipment needed to be implemented to ensure that the risks to human health and the environment are adequately controlled.
REACH (EC) No. 1907/2006	European Commission Regulation concerning the Registration, Evaluation, Authorization and Restriction of Chemicals.
REGULATION (EC) No 1272/2008	European Commission Regulation on Classification, Labeling and Packaging of Substances and Mixtures.
Reproductive toxicity	Including teratogenicity, embryotoxicity and harmful effects on fertility.
Sensitizing	Allergenic.
Sediment	Topsoil, sand and minerals washed from land into water forming in the end a layer at the bottom of rivers and sea.
TSCA	Toxic Substance Control Act (USA).
Vapor pressure	A measure of a substance's property to evaporate.
vPvB	Very persistent, very bio-accumulative.

## **DISCLAIMER**

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