# Caprolactam (dust and vapour) (incL. e‑caprolactAm)

| CAS number: | 105-60-2 |
| --- | --- |
| Synonyms: | 2H-Azepin-2-one, hexahydro, ɛ-caprolactam, hexahydro-2H-azepin-2-one, aminocaprolactam,  2-oxohexamethylenimine, cyclohexanone-isooxime, hexano-6-lactam |
| Chemical formula: | C6H11NO |

Workplace exposure standard (amended)

| TWA: | **5 mg/m3** |
| --- | --- |
| STEL: | — |
| Peak limitation: | — |
| Notations: | — |
| IDLH: | — |
| Sampling and analysis: | The recommended value is readily quantifiable through currently available sampling and analysis techniques. |

## Recommendation and basis for workplace exposure standard

A TWA of 5 mg/m3 is recommended to protect for irritation of the mucous membranes, respiratory tract and skin in exposed workers. The TWA is considered protective for both vapour and dusts exposures and both chronic and short-term exposures.

There are no acute effects reported within ten times of the TWA and the TWA is considered protective for any short-term effects. Therefore, it is recommended that the STEL be withdrawn.

## Discussion and conclusions

Caprolactam is primarily used as a monomer for synthetic fibres, plastics, coatings, plasticisers and paint vehicles and in polyurethanes. Due to its low volatility, significant vapour concentrations of caprolactam are only expected at elevated ambient temperatures (ACGIH, 2018).

Irritation is reported to be dose dependent in humans (ACGIH, 2018). Workers exposed to vapours for up to 18 years reported no irritation effects at less than 32 mg/m3 (7 ppm) (ACGIH, 2018); with the irritation threshold in humans reported at 56 mg/m3 (DFG, 2002). Caprolactam dust is reported to be irritating to the mucous membranes at 61 mg/m3 in workers. This human evidence is supported by slight irritation reported in guinea pigs at 51 mg/m3 in a sub-chronic inhalation study. A NOAEL for the liquid aerosol of 70 mg/m3 for upper respiratory irritation is reported in rats exposed via inhalation for 13 weeks.

On weight of evidence, considering all human and animal studies, a TWA of 5 mg/m3 is recommended. This TWA is considered protective for chronic and short-term irritation effects caused by both dust and vapour exposures in workers. The TWA applies to vapour and dust together because the forms are generally present simultaneously.

## Recommendation for notations

Not classified as a carcinogen according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

Not classified as a skin sensitiser or respiratory sensitiser according to the GHS.

There are insufficient data to recommend a skin notation.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 TWA: 1 mg/m3; STEL: 3 mg/m3 (dust) (caprolactam)  TWA: 10 mg/m3; STEL: 20 mg/m3 (e-caprolactam) | |
|  |
| ACGIH 2003 TLV-TWA: 5 mg/m3 (1.08 ppm) |
| TWA is recommended to protect for mucous membrane, respiratory tract and dermal irritation.  Summary of data:  Significant vapour concentrations would only be expected at elevated temperatures due to low volatility at ordinary temperatures.  Human data:   * A study of human exposures to vapours for 18 yr noted: * no difference in general health between exposed and unexposed workers even with infrequent, brief exposures ≅100 ppm (vapour) * dose-related symptoms of severe discomfort from burning nose, throat and eyes occurred with concentrations ≅100 ppm; effect severity reduced with decreasing concentrations * no reported eye irritation <25 ppm * transient nose and throat irritation >10 ppm * no irritation in active and semi-active workers ≤7 ppm (32 mg/m3) * all responses promptly ceased after vapour exposure stops; contrary to dust or mist exposures * The same study looked at those not continually exposed in the work environment, to establish irritant responses and discomfort thresholds and reported no irritation at levels <14 ppm and no response of any kind in 5 volunteers at <7 ppm * A study in workers reported complaints of bitter taste, nervousness, nosebleed, upper respiratory inflammation and dry, splitting nose and lips at a mean airborne dust concentration of 12 ppm (61 mg/m3); no further exposure details provided * Not demonstrated to be a skin irritant following application of a 5% solution.   Animal data:   * Guinea pigs exposed *via* inhalation to 51 mg/m3 (aerosol) for 5–8 h/d for 26–30 d; only slight evidence of nasal irritation * A whole-body inhalation study in rats exposed for 6 h/d, 5 d/wk for 13 wk (liquid aerosol) identified an upper respiratory irritation NOAEL of 70 mg/m3 and a systemic toxicity, neurotoxicity and lower respiratory tract effect NOAEL of 243 mg/m3 * Not carcinogenic in mice in dietary study; no tumours in guinea pigs injected subcutaneously or rats administered *via* drinking water * Negative results in the guinea pig Modified Buehler and Maximization test.   Not considered genotoxic.  TLV-TWA based on no irritation observed in workers at 7 ppm (32 mg/m3) (no additional information). |
| DFG 2002 MAK: 5 mg/m3 |
| The MAK has been determined based on irritant effects.  Summary of additional data:   * MAK apply to vapour and dust together which is consider appropriate because the forms are generally present simultaneously * Vapour: in humans 33 mg/m3 is not irritating, 56 mg/m3 is the LOEL for irritation and 66 mg/m3 has irritant effects on the skin * Dust: In humans LOEL 61 mg/m3 irritant effects on mucous membranes and 84 mg/m3 has irritant effects on the skin. |
| SCOEL 1995 TWA: 10 mg/m3; STEL; 40 mg/m3 |
| TWA is based on protection of irritant effects.  No additional information. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN NA NA |
| No report. |

### Secondary source reports relied upon

NIL.

### Carcinogenicity — non-threshold based genotoxic carcinogens

| Is the chemical mutagenic? | No |
| --- | --- |
| **The chemical is a non-threshold based genotoxic carcinogen.** |  |

## Notations

| Source | Notations |
| --- | --- |
| SWA | NA |
| HCIS | NA |
| NICNAS | NA |
| EU Annex | NA |
| ECHA | NA |
| ACGIH | Carcinogenicity – A5 |
| DFG | NA |
| SCOEL | NA |
| HCOTN | NA |
| IARC | Carcinogenicity – Group 3 |
| US NIOSH | NA |

NA = not applicable (a recommendation has not been made by this Agency); — = the Agency has assessed available data for this chemical but has not recommended any notations

### Skin notation assessment

| Calculation |
| --- |
| Insufficient data to assign a skin notation |

### IDLH

| Is there a suitable IDLH value available? | No |
| --- | --- |

## Additional information

| Molecular weight: | 113.16 |
| --- | --- |
| Conversion factors at 25°C and 101.3 kPa: | 1 ppm = Number mg/m3; 1 mg/m3 = Number ppm |
| This chemical is used as a pesticide: |  |
| This chemical is a biological product: |  |
| This chemical is a by-product of a process: |  |
| A biological exposure index has been recommended by these agencies: | ACGIH  DFG  SCOEL |

## Workplace exposure standard history

| Year | Standard |
| --- | --- |
| Click here to enter year |  |

## References

American Conference of Industrial Hygienists (ACGIH®) (2018) TLVs® and BEIs® with 7th Edition Documentation, CD-ROM, Single User Version. Copyright 2018. Reprinted with permission. See the [*TLVs® and BEIs® Guidelines section*](http://www.acgih.org/tlv-bei-guidelines/policies-procedures-presentations) on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2002) e-Caprolactam – MAK value documentation.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (1995) Recommendation from the Scientific Committee on Occupational Exposure Limits for e-Caprolactam. SEG/SUM/67.

International Agency for Research on Cancer (IARC) (1999) Volume 71 re-evaluation of some organic chemicals, hydrazine and hydrogen peroxide. IARC Monographs on the evaluation of the carcinogenic risk to humans.