# Benomyl

| CAS number: | 17804-35-2 |
| --- | --- |
| Synonyms: | Benlate, methyl-1-(butylcarbamoyl)-2-benzimidazole-carbamate |
| Chemical formula: | C14H18N4O3 |

 Workplace exposure standard (amended)

| TWA: | **1 mg/m3** |
| --- | --- |
| STEL: | **—**  |
| Peak limitation: | **—** |
|  Notations: | **DSEN** |
| 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 1 mg/m3 is recommended to protect for upper respiratory tract irritation in exposed workers. It is also considered protective for potential developmental and reproductive effects reported in animals.

## Discussion and conclusions

Benomyl is a systemic fungicide with adverse effects in animals following exposure including upper respiratory tract irritation and male reproductive system and foetal damage.

An inhalational study in rats have reported a NOAEL of 10 mg/m3 for degeneration of the olfactory epithelium (males only) and greater than 200 mg/m3 for reduced sperm development.

The recommended TWA is derived by dividing the NOAEL of 10 mg/m3 rats by an uncertainty factor of 10 for interspecies variation. When converted to a daily intake this TWA is also considered protective for possible developmental and reproductive effects in exposed workers.

## Recommendation for notations

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

Classified as a skin sensitiser and not a respiratory sensitiser according to the GHS.

A skin notation is not recommended based on the available evidence.

# Appendix

### Primary sources with reports

| Source Year set Standard  |
| --- |
| SWA 1991 TWA: 10 mg/m3 (0.84 ppm) |
|  |
| ACGIH 2014 TLV-TWA 1 mg/m3 |
| TLV-TWA recommended to protect for potential upper respiratory tract and reproductive toxic effects in exposed workers.Benomyl is a systemic fungicideSummary of data:Human data:* Reported eye irritation and contact dermatitis in workers
* Reports of dermal sensitisation
* Suggested increase in childhood leukaemia associated with prenatal parental exposure to certain pesticides including benomyl
* results not conclusive.

Animal data:* Reported low acute toxicity
* Acute dermal LD50: >10,000 mg/kg (rabbit)
* Inhalation study NOEL: 10 mg/m3 (male rat); 50 mg/m3 (female rat); olfactory epithelium degeneration and decreased gains in body weight; 6 h/d, 5 d/wk for 60 d
* Rat inhalation study reported reduced sperm development in some exposed animals with a NOEL of >200 mg/m3 (4 h)
* Rat feeding study reported decreased testicular weights and lowered fertility index at all doses (<1 ppm, 6.3 ppm and 203 ppm; daily for 70 d)
* Multiple rat oral studies reported decreased testicular weights, decreased sperm counts, and other reproductive organ changes
* Fetotoxicity and teratogenicity demonstrated in mice in a 10 d oral study; same study reported foetal growth retardation in rats at 505 mg/kg
* Reported as genotoxic in a variety of studies.
 |
| DFG 2015 NA |
| No recommended TWA.Summary of additional data:* Dermal sensitiser notation based on reported sensitising properties in case reports and positive results in studies with occupationally exposed persons
* Aneuploidy in the female germ cells of mice; no mutagenic effects in male germ cells.
 |
| SCOEL NA NA |
| No report |
| OARS/AIHA NA NA |
| No report  |
| HCOTN 2004 TWA: 1 mg/m3 |
| TWA considered sufficient to protect for respiratory irritation and reproductive effects in exposed workers.Summary of additional data:* NOAEL: 15 mg/kg/d for developmental and male reproduction toxicity in rats (oral; 0, 1, 5, 15, or 45 mg/kg/d for 62 d)
* TWA extrapolated from the NOAEL of 10 mg/m3 (same study as ACGIH, 2018) via application of an overall assessment factor of 8 to account for intra- and interspecies variation and critical effect
* Conversion of TWA to a daily intake (assuming 70 kg, 10 m3 inhalation, 8 h/d, and 100% retention) results in 0.15 mg/kg/d, 100 times lower than the NOAEL, justifying protection against reproductive effects.
 |

### Secondary source reports relied upon

NIL

### Carcinogenicity — non-threshold based genotoxic carcinogens

| Is the chemical mutagenic? | Insufficient data |
| --- | --- |
| Is the chemical carcinogenic with a mutagenic mechanism of action? | No |
| **The chemical is not a non-threshold based genotoxic carcinogen.** |  |

## Notations

| Source | Notations  |
| --- | --- |
| SWA | Sen |
| HCIS | Skin sensitisation – category 1 |
| NICNAS | NA |
| EU Annex | NA |
| ECHA | NA |
| ACGIH | Carcinogenicity – A3; DSEN |
| DFG | Sh (dermal sensitiser) |
| SCOEL | NA |
| HCOTN | — |
| IARC | — |
| 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  |
| --- |
|

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Adverse effects in human case study: | no |   |   |   |
| Dermal LD50 ≤1000 mg/kg: | no |   |   |   |
| Dermal repeat-dose NOAEL ≤200 mg/kg: |   |   |   |   |
| Dermal LD50/Inhalation LD50 <10: |   |   |   |   |
| *In vivo* dermal absorption rate >10%: |   |   |   |   |
| Estimated dermal exposure at WES >10%: |   |   |   |   |
|   |   |   | **a skin notation is not warranted** |

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### IDLH

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

## Additional information

| Molecular weight: | 290.4 |
| --- | --- |
| 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: |[x]
| 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) (2015) Benomyl – MAK value documentation.

Health Council of the Netherlands (HCOTN) (2004) Benomyl. Health-based calculated occupational cancer risk values. The Hague: Health Council of the Netherlands; publication no. 2000/15OSH/094.