PHENYL ISOCYANATE

CAS number: 103-71-9

Synonyms: Isocyanatobenzene, carbamil, phenyl carbamide

Chemical formula: C_7H_5NO

Structural formula: —

Workplace exposure standard (new)

TWA: **0.005 ppm (0.024 mg/m^3)**

STEL: **—**

Peak limitation: **—**

Notations: **—**

IDLH: **—**

Sampling and analysis: There is uncertainty regarding quantification of the recommended value with available sampling and/or analysis techniques.

Recommendation and basis for workplace exposure standard

A TWA of 0.005 ppm (0.024 mg/m^3) is recommended to protect for upper respiratory tract irritation and sensitisation in exposed workers.

Discussion and conclusions

Phenyl isocyanate (PI) is as an intermediate in organic chemical synthesis and in the production of pesticides. In addition, it is used in the paint and photographic industries, in the production of pharmaceutical products, optical brighteners and in textile additives and softeners.

Critical effects of exposure are upper respiratory tract irritation and possible sensitisation.

No quantitative data are available in humans other than reported increases in respiratory distress among workers exposed to a mixture of four isocyanates; no exposure concentration provided. No effects in rats exposed at 0.2 ppm *via* inhalation for two weeks, with hyperplasia in the nasal passage reported at 0.8 ppm. Significant airway injury and decrements in pulmonary function were observed at 1.5 and 2.1 ppm in this study (ACGIH, 2018). A NOAEC of 0.2 ppm and a LOAEC of 0.6 ppm based on hyperplasia in the nasal septum is reported in a 28-day inhalation study in rats (ECHA, 2012). ACGIH (2018) concluded that it is a potent sensitiser based on evidence in mice and guinea pigs.

The TWA of 0.005 ppm (0.024 mg/m^3) by ACGIH (2018) is recommended to protect for upper respiratory tract irritation and sensitisation in exposed workers. There is insufficient evidence to recommend a STEL.

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. However, a review of the classification is recommended based on the data reported.

A skin notation is not recommended based on evidence in animals.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	***NA***	***NA***
No report		

Source	Year set	Standard
ACGIH	***2015***	***TLV-TWA: 0.005 ppm (0.024 mg/m^3); TLV-STEL: 0.015 ppm (0.1 mg/m^3)***

TLV-TWA and TLV-STEL are recommended to protect for upper respiratory tract irritation and to minimise the potential for sensitisation.

Summary of data:

- Lung effects appear to be delayed
- No specific derivation of OELs provided; based on evidence in animals and consideration of sensitisation potential.

Human data:

- No quantitative data from human studies or human experience
- Potent inhibitor of AChE in human erythrocytes in culture; enzyme inhibition proposed as contributing factor in induction of respiratory distress observed in ~5% of workers exposed to isocyanate vapours; no further information.

Animal data:

- LC_{50}: 4.6 ppm (rats, 4 h); no deaths at 0.15 ppm; delayed deaths 4 d later; lung target organ
- LC_{50}: 12.6 ppm (rats 1 h) with most deaths 8–12 d post-exposure
- LD_{50}: 7,130 mg/kg (rabbits, dermal)
- Potent sensitiser:
  - mouse ear test: SD_{50} (dose producing sensitisation in 50% of mice) of 0.04 µmol/kg; compared to 30.4 µmol/kg for TDI and 2.1 µmol/kg for MDI
  - antibodies in guinea pigs sensitised to TDI via inhalation cross-reacted with PI-protein antigens; no further information
  - in mice, RD_{50} of 1.8, 1.2, 0.90, 0.82, and 0.75 ppm were reported for exposure times of 10, 30, 60, 120, and 180 min respectively
- 20 rats of each sex exposed 6 h/d, 5 d/wk for 2 wk at 0.2, 0.8, 1.5, or 2.1 ppm:
  - no effects at 0.2 ppm
  - goblet cell hyperplasia in nasal and paranasal regions and main bronchi at 0.8 ppm; no clinical signs
  - 1.5 and 2.1 ppm significant airway injury and decrements in pulmonary function consistent with clinical signs of respiratory tract irritation; delayed mortality in some rats associated with respiratory acidosis and hypoxemia
- 10 rats of each sex per group were exposed at 0.03, 0.1, or 0.7 ppm 6 h/d for 5 d; observed for 3 wk post-exposure:
  - no obvious effects at either 0.03 or 0.1 ppm
  - nasal discharge after 1st exposure to 0.7 ppm; no cumulative effects apparent; bronchoalveolar lavage fluid was unchanged.

Insufficient data to recommend a carcinogenicity notation. No explanation for skin notation.

DFG	***2002***	***Not assigned***

No further information.

SCOEL	***NA***	***NA***

No report.

Source	Year set	Standard
OARS/AIHA	***NA***	***NA***
No report.		
HCOTN	***NA***	***NA***
No report.		

Secondary source reports relied upon

Source		Year	Additional information
ECHA	✓	2012	• Rats exposed 5 d/wk, 6 h/d for 28 d; head/nose only; NOAEC of 0.2 ppm (0.83 mg/m³); LOAEC of 0.6 ppm (2.79 mg/m³) for hyperplasia in the nasal septum • 0/310 workers tested in a patch test showed allergic reaction; 3/310 workers an irritant reaction was evident.

Carcinogenicity — non-threshold based genotoxic carcinogens

Is the chemical mutagenic? No

The chemical is not a non-threshold based genotoxic carcinogen.

Notations

Source	Notations
SWA	NA
HCIS	NA
NICNAS	NA
EU Annex	NA
ECHA	NA
ACGIH	Skin, DSEN, RSEN
DFG	Sh (dermal sensitiser), Sa (respiratory sensitiser)
SCOEL	NA
HCOTN	NA
IARC	NA
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 LD_{50} ≤1000 mg/kg:	no
Dermal repeat-dose NOAEL ≤200 mg/kg:	
Dermal LD_{50}/Inhalation LD_{50} <10:	
In vivo dermal absorption rate >10%:	
Estimated dermal exposure at WES >10%:	
	a skin notation is not warranted

IDLH

Is there a suitable IDLH value available?	No

Additional information

Molecular weight:	119.1
Conversion factors at 25°C and 101.3 kPa:	1 ppm = Number mg/m^3; 1 mg/m^3 = 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* on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2002) Phenyl isocyanate – MAK value documentation.

European Chemicals Agency (ECHA) (2012) Phenyl isocyanate – REACH assessment.