

BENZIDINE

CAS number: 92-87-5

Synonyms: 4,4'-Bianiline, 4,4'-biphenyldiamine,
4,4'-diaminobiphenyl, 4,4'- diphenylenediamine

Chemical formula: C₁₂H₁₂N₂

Workplace exposure standard (new)

TWA: 0.002 µg/m³

STEL: —

Peak limitation: —

Notations: Carc. 1A

IDLH: —

Sampling and analysis: The recommended value is below the current limit of detection for available sampling and analysis techniques.

Recommendation and basis for workplace exposure standard

A TWA of 0.002 µg/m³ is recommended to protect for bladder cancers in exposed workers. Benzidine is characterised as an assumed non-threshold genotoxic carcinogen and the recommended TWA is associated with a minimal cancer risk.

Discussion and conclusions

Benzidine has been used historically in dyes and its use in Australia is strictly controlled. There is sufficient evidence in both humans and animals to classify benzidine as carcinogenic. Exposure to benzidine in an occupational setting is associated with increased incidence of bladder cancer. Positive results are reported in adequately conducted mutagenicity tests (ACGIH, 2018; US EPA, 1989).

A clear mechanism for tumour formation cannot be determined. However, genotoxicity cannot not be eliminated. Therefore, benzidine is assumed to be a non-threshold genotoxic carcinogen. The recommended TWA is derived using an inhalation slope factor based on human data from an occupational study involving benzidine exposure and increased cancer incidence (US EPA, 1987).

Recommendation for notations

Classified as a category 1A carcinogen according to the Globally Harmonized System of Classification and Labelling on Chemicals (GHS).

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

Insufficient evidence to recommend a skin notation.

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	1991	<i>Prohibition recommended</i>
Known to be carcinogenic to humans. There is sufficient evidence to establish a causal association between human exposure to this substance and the development of cancer.		
ACGIH	2001	NA
A TLV is not recommended. Summary of data: Human data: • Abundance of literature relating to industrial exposure and bladder cancer • Inhalation and skin absorption identified as important routes of exposure • Exposed workers with serum properdin levels lower than normal more likely to develop a bladder tumour (no further details). Animal data: • Sufficient evidence in mice, rats, hamsters and dogs to identify benzidine as carcinogenic. Genotoxicity data: • Mutagenic to <i>Salmonella typhimurium</i> • Negative in <i>Escherichia coli</i> assays • Mutagenic activity in <i>Drosophila melanogaster</i> • <i>In vitro</i> and <i>in vivo</i> studies demonstrating DNA damage.		
DFG	2018	NA
A MAK is not assigned due to carcinogenicity effects. No additional information.		
SCOEL	NA	NA
No report.		
OARS/AIHA	NA	NA
No report.		
HCOTN	NA	NA
No report.		

Secondary source reports relied upon

Source	Year	Additional information
NICNAS	✓ 2019	• 'Industrial use of this chemical is prohibited under state and territory workplace health and safety legislation'

Source	Year	Additional information
US EPA	✓ 1989	• Carcinogenicity in humans and animals • Positive results in mutagenicity tests • Inhalation unit risk factor based on a study reporting 11 cases of bladder cancer in 25 exposed workers (0.005–17.6 mg/m³; mean period of 11.46 yr).

Carcinogenicity — non-threshold based genotoxic carcinogens

Is the chemical mutagenic? Yes

Is the chemical carcinogenic with a mutagenic mechanism of action? Yes

The chemical is a non-threshold based genotoxic carcinogen.

Is a cancer slope factor or inhalation unit risk value available? Yes

Inhalation unit risk value (1/(μg/m³)) 0.067

Calculated TWA value (μg/m³) 0.002

Notations

Source	Notations
SWA	NA
HCIS	Carcinogenicity – category 1A
NICNAS	NA
EU Annex	Carcinogenicity – Category 1A
ECHA	—
ACGIH	Carcinogenicity – A1; Skin
DFG	Carcinogenicity – 1; H (skin)
SCOEL	NA
HCOTN	NA
IARC	Carcinogenicity – Group 1
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, the chemical is a genotoxic carcinogen

Additional information

Molecular weight:	184.3
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) (2018) List of MAK and BAT Values.

International Agency for Research on Cancer (IARC) (2012) 100F Dyes Metabolized to Benzidine. IARC Monographs on the evaluation of the carcinogenic risk to humans.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2019) [1,1'-Biphenyl]-4,4'-diamine: Human health tier I assessment – IMAP report.

Tenth Adaptation to Technical Progress Commission Regulation (EU) No 2017/776 amending, for the purpose of its adaptation to technical and scientific progress, Regulation (EC) No 1272/2008 of the European Parliament and of the Council on classification, labelling and packaging of substances and mixtures (the CLP Regulation).

US Environmental Protection Agency (US EPA) (1989) Benzidine. Integrated Risk Information System (IRIS) Chemical Assessment Summary