

P-PHENYLENEDIAMINE

CAS number: 106-50-3

Synonyms: *p*-Aminoaniline, 1,4-benzenediamine, *p*-diaminobenzene, orsin

Chemical formula: C₆H₈N₂

Structural formula: —

Workplace exposure standard (retained)

TWA: 0.1 mg/m³

STEL: —

Peak limitation: —

Notations: DSEN

IDLH: 25 mg/m³

Sampling and analysis: The recommended value is quantifiable through available sampling and analysis techniques.

Recommendation and basis for workplace exposure standard

A TWA of 0.1 mg/m³ is recommended to protect for irritation, dermatitis and possible skin and respiratory sensitisation in exposed workers.

Given the indication that a TWA of 0.1 mg/m³ may exacerbate workers with asthma, it is recommended that a review of additional sources be conducted at the next scheduled review.

Discussion and conclusions

p-Phenylenediamine is used in permanent hair dye preparations. It is also used as a photographic developing agent, in photochemicals and as an intermediate in the manufacture of dyes, antioxidants and rubber accelerators.

Critical effects of exposure are eye and skin irritation, dermatitis and blood dyscrasia. It has the potential for respiratory and skin sensitisation.

Limited toxicological data are available. *p*-Phenylenediamine is reported as being highly sensitising and induces reactions on the skin and in the respiratory tract. Evidence indicates *p*-phenylenediamine induces asthma and persistent irritation of the mucosa of the upper airways in workers in the fur processing industry (DFG, 2000). Acute renal (kidney) failure, methaemoglobinaemia, haemolysis, dyspnoea, swelling of the lips, tongue and neck and rhabdomyolysis in muscles was reported in cases of poisoning after accidental ingestion of hair dyes containing *p*-phenylenediamine. There is no evidence of any carcinogenic effect based on epidemiological studies and negative results in animal studies (ACGIH, 2018).

Given the limited available data, the TWA of 0.1 mg/m³ is recommended to be retained to limit irritant effects, dermatitis and possible skin and respiratory sensitisation as per ACGIH (2018) in exposed workers. This TWA is reported as being sufficiently low to minimise workers becoming sensitised but

may not prevent exacerbation of asthma in those already sensitised. It is recommended that a priority investigation of additional data sources is undertaken to assess the sensitising potential at the next scheduled review.

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 respiratory sensitiser according to the GHS. A review of this classification is recommended based on evidence of asthma in workers.

There are insufficient data to recommend a skin notation.

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APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	1991	TWA: 0.1 mg/m³
ACGIH	2001	TLV-TWA: 0.1 mg/m³
<p>TLV-TWA recommended to minimise the potential for respiratory and skin sensitisation and to protect for eye and skin irritation, dermatitis and blood dyscrasia.</p> <p>Summary of data:</p> <ul style="list-style-type: none"> No specific derivation of the TWA is provided; no dose-response evidence presented Sufficiently low to minimise the number of persons who may become sensitised, may not prevent exacerbation of asthma in those already sensitised. <p>Human data:</p> <ul style="list-style-type: none"> Case reports of poisoning after accidental ingestion of hair dyes containing <i>p</i>-phenylenediamine; acute renal failure (tubular necrosis); methaemoglobinaemia; haemolysis, dyspnoea, swelling of the lips, tongue, and neck and rhabdomyolysis in muscles Known to cause local dermatitis and urticaria Cases of lacrimation, ophthalmia and permanent blindness after eye contact; no further details No evidence of any carcinogenic effect from hair dyes in occupations and users examined based on epidemiological studies The number of positive reactions varied from 1.1–84.6% in diagnostic patch tests performed on patients suffering from dermatologic disease Known dermal and a possible respiratory sensitiser for humans. <p>Animal data:</p> <ul style="list-style-type: none"> LD₅₀: 80–98 mg/kg (rats, oral) Acute poisoning of animals characterised by lethargy, piloerection, increased salivation, lacrimation, ataxia, tremor, changes in respiratory rate, increase in pulse and decrease in temperature Tested for primary skin irritation in rabbits, guinea pigs, mice, miniature pigs, piglets, dogs and baboons; results varied from non-irritant to slight or moderate irritant Reported as a potent sensitiser in guinea pigs based on evidence from induction routines and challenge patches No significant changes in bw or food intake, and no treatment-related ulceration or dermatitis were observed in a chronic study with percutaneous application with mice and rabbits Negative results from various carcinogenic studies in animals. <p>Insufficient data to recommend a skin or sensitiser notation or a TLV-STEL.</p>		



Source	Year set	Standard
DFG	2000	MAK: 0.1 mg/m³ (inhalable dust fraction)
MAK is established based on observations of sensitisation, not adequately supported by published data. Summary of additional data: <ul style="list-style-type: none"> Highly sensitising and induces reactions on the skin and in the respiratory tract 34 men exposed to undisclosed concentrations of vapour and dust working in the fur processing industry for durations of 1–20 yr; rhinitis, tickle in the nose, itching in the throat, dyspnoea, bronchial asthma, Heinz bodies in the blood; no other details Studies of the reproductive toxicology in rats revealed no substance related effects. 		
SCOEL	NA	NA
No report.		
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 not a non-threshold based genotoxic carcinogen.

Notations

Source	Notations
SWA	NA
HCIS	Skin sensitisation – category 1
NICNAS	NA
EU Annex	Skin sensitisation – category 1
ECHA	NA
ACGIH	Carcinogenicity – A4
DFG	Carcinogenicity – 3, H (skin), Sh (dermal sensitiser)
SCOEL	NA
HCOTN	NA
IARC	Carcinogenicity – Group 3



Source	Notations
US NIOSH	SK:SEN
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 recommend a skin notation.

IDLH

Is there a suitable IDLH value available? Yes

Additional information

Molecular weight:	108.15
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:	<input type="checkbox"/>
This chemical is a biological product:	<input type="checkbox"/>
This chemical is a by-product of a process:	<input type="checkbox"/>
A biological exposure index has been recommended by these agencies:	<input type="checkbox"/> ACGIH <input type="checkbox"/> DFG <input type="checkbox"/> 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) p-Phenylenediamine – MAK value documentation.

International Agency for Research on Cancer (IARC) Some Aromatic Amines and Related Nitro Compounds—Hair Dyes, Colouring Agents and Miscellaneous Industrial Chemicals. IARC Monographs – 16.

Tenth Adaptation to Technical Progress Commission Regulation (EU) No 2017/776 amending, for the purposes 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 National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – p-Phenylene diamine.

US National Institute for Occupational Safety and Health (NIOSH) (2011) Skin Notation Profiles: p-Phenylene Diamine).

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