



HYDROQUINONE

CAS number: 123-31-9

Synonyms: 1,4- Benzenediol, p-dihydroxybenzene, p-hydroxyphenol

Chemical formula: C₆H₆O₂

Structural formula: —

Workplace exposure standard (interim)

TWA: 2 mg/m³

STEL:

Peak limitation:

Notations: Carc. 2, Sk., DSEN

IDLH: 50 mg/m³

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

An interim TWA of 2 mg/m³ is recommended to protect for irritation of the eye and eye damage in exposed workers.

A priority evaluation is recommended to better understand the human carcinogenic potential at the next scheduled review.

Discussion and conclusions

Hydroquinone is used in various commercial situations including as a stabiliser in paints, varnishes, motor fuels and oils; and as a chemical intermediate in dyes. The critical effects are irritation and damage to the eye and skin sensitisation. There is also evidence of carcinogenic effects in animals but this is not conclusive for humans.

Long-term exposure to Hydroquinone dust at concentrations as low as 1 mg/m³ caused eye injury in workers. No serious injury was identified in workers exposed for less than five years. The main evidence for carcinogenicity is from a two-year oral study in rats and mice that reported excess risks of mononuclear-cell leukaemia in female rats, hepatocellular adenomas in male and female mice, and renal tubular adenomas in male rats (ACGIH, 2018). A cohort of workers with definite and lengthy exposure to hydroquinone had low cancer rates compared with two comparison populations (IARC, 1999). It is confirmed animal carcinogen with unknown relevance to humans (ACGIH, 2018). The weight of evidence from both *in vitro* and *in vivo* studies does not indicate that the chemical is genotoxic (NICNAS, 2014).

Given the limited available data, the current TWA of 2 mg/m³ is recommended to be retained in the interim to limit irritant effects. A priority review is recommended at the next scheduled review to identify additional repeat dose-toxicity and carcinogenicity studies.

Recommendation for notations

Classified as a category 2 carcinogen according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

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

A skin notation is recommended based on *in vivo* and *in vitro* evidence demonstrating dermal absorption.

DRAFT

APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	1991	TWA: 2 mg/m³
ACGIH	2014	TLV-TWA: 1 mg/m³
TLV-TWA is recommended to minimise irritation and damage to the eye in exposed workers. Summary of data: Derivation of TLV-TWA not provided; justification based on eye irritation and characteristic eye lesions in workers exposed at 1 to 10 mg/m³. Human data: • Eye irritation and eye lesions in workers exposed to hydroquinone dust; quinone vapour more acutely irritating but hydroquinone dust stays in eye longer • Study in workers exposed to quinone vapour and dust; developed eye injury over years; no serious injury in cases exposed <5 yr: ○ quinone vapour concentration 0.01–3 ppm (≈0.045–13.5 mg/m³) ○ hydroquinone dust concentration 0.2–12 ppm (≈1–54 mg/m³) • Corneal changes consisting of changes in the curvature of the lens reported to exist long after exposure had ceased; caused by quinone vapor or hydroquinone dust. Animal data: • Skin sensitisation has been observed in studies of guinea pigs • 2 yr study in rats and mice; gavage application; excess risks of mononuclear-cell leukaemia in female rats; hepatocellular adenomas in male and female mice, and renal tubular adenomas in male rats • Evidence of clastogenicity. Insufficient evidence to recommend a TLV-STEL. Evidence does not warrant a skin notation.		



Source	Year set	Standard
DFG	2013	Not assigned
MAK not assigned as it is considered a genotoxic carcinogen. Summary of additional data:		
- Metabolite of benzene; accumulates in bone marrow and contributes to the toxic effects on the bone marrow and blood count - Considered genotoxic in mammalian cells: <i>in vitro</i> and <i>in vivo</i> it induces micronuclei, chromosomal aberrations, DNA single strand breaks, oxidative damage to DNA <i>in vitro</i> also covalent DNA adducts, gene mutations and SCE - Same carcinogenic study results as ACGIH (2018) - Skin notation assigned based on: - demonstrated absorption through human skin <i>in vitro</i> (no further details) - rate of dermal absorption for human stratum corneum $0.52 \pm 0.13 \mu\text{g}/\text{cm}^2/\text{h}$ - max of 29% dermally applied dose absorbed over 24-h in rats		
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	✓ 2014	- LD₅₀: >2,000 mg/kg (dermal, rats); low acute dermal toxicity - Negative in Ames test with <i>Salmonella</i> - Gene mutation in human lymphocytes and Chinese hamster lung cells - DNA damage in HeLa cells - Sister chromatid exchange in V79 Chinese hamster cells and human lymphocytes - Weight of evidence from both <i>in vitro</i> and <i>in vivo</i> studies, does not indicate that the chemical is genotoxic.
IARC	✓ 1999	- Mutagenic in many in-vitro systems using a variety of end-points - After intraperitoneal administration, it caused genotoxicity or chromosomal aberrations in bone marrow - A cohort of workers with definite and lengthy exposure to hydroquinone had low cancer rates compared with two comparison populations - A cohort of lithographers, some of whom had worked with hydroquinone, had an excess of malignant melanoma based



Source	Year	Additional information
		on five cases; only two of the cases reported exposure to hydroquinone
		Inadequate evidence in humans for carcinogenicity.
US EPA	✓ 1990	No further information.

Carcinogenicity — non-threshold based genotoxic carcinogens

Is the chemical mutagenic?

Yes

Is the chemical carcinogenic with a mutagenic mechanism of action?

Insufficient data

Insufficient data are available to determine if the chemical is a non-threshold based genotoxic carcinogen.

Notations

Source	Notations
SWA	Carc. 2
HCIS	Carcinogenicity – category 2, Skin sensitisation – category 1
NICNAS	Skin sensitisation, Carc. Cat 3
EU Annex	Skin sensitisation – category 1, Carcinogenicity – category 2
ECHA	Skin Sens. 1, Carc. 2
ACGIH	DSEN, Carcinogenicity – A3
DFG	Carcinogenicity – 2, H (skin)
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

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%: yes

Estimated dermal exposure at WES
> 10%: yes

consider assigning a skin
notation

IDLH

Is there a suitable IDLH value available? Yes

Additional information

Molecular weight: 110.11

Conversion factors at 25°C and 101.3
kPa: 1 ppm = 4.5 mg/m³; 1 mg/m³ = 0.222 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) (2013) Hydroquinone – MAK value documentation.
- European Chemicals Agency (ECHA) (2019) Hydroquinone – REACH assessment.
- International Agency for Research on Cancer (IARC) (1999) Hydroquinone. IARC Monographs on the evaluation of the carcinogenic risk to humans.
- National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2014) 1,4-Benzenediol: Human health tier II assessment – IMAP report.
- 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 Environmental Protection Authority (US EPA) (1990) Integrated Risk Information System (IRIS) Chemical Assessment Summary – Hydroquinone.
- US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – Hydroquinone.