

BROMINE

CAS number: 7726-95-6

Synonyms: Dibromine

Chemical formula: Br₂

Workplace exposure standard (interim)

TWA: 0.1 ppm (0.66 mg/m³)

STEL: —

Peak limitation: 0.2 ppm (1.3 mg/m³)

Notations: —

IDLH: 3 ppm (19.6 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 ppm (0.66 mg/m³) is recommended to minimise potential for irritation to the eyes, respiratory tract and mucous membranes in exposed workers.

A peak limitation of 0.2 ppm (1.3 mg/m³) is recommended to protect for severe irritation in acutely exposed workers.

Investigation of additional data sources is recommended at the next scheduled review, particularly for chronic exposure data.

Discussion and conclusions

Bromine is used in chemical manufacture, organic syntheses, water purification, fumigant production and analytical reagents.

Contact with moisture produces corrosive hydrolysis products including hydrobromic acid (HBr). This contact results in the critical effect of irritation of the eyes, respiratory tract and mucous membranes (DFG, 2013). Acute human exposure data suggests the severity of these symptoms increases steeply with concentration. However, chronic exposures have not been studied in animals nor humans (ACGIH, 2018; DFG, 2013).

The TWA is based on an occupational threshold cited in ACGIH (2018) and is supported by a LOAEL of 0.2 ppm for eye irritation reported in an acute inhalational exposure study in humans (DFG, 2013; HCOTN, 2005).

Higher concentrations are reported to cause severe symptoms (DFG, 2013). Additionally, there are reports of wide range of subjective irritant effects (ACGIH, 2018) and there is a lack of currently available chronic exposure data (DFG, 2013; HCOTN, 2005). A peak limitation is recommended due to the severity of these effects.

Due to the wide range of reported irritation effects and lack of chronic exposure data, a priority review of the TWA is recommended 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).

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

There are insufficient data to recommend a skin notation.

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APPENDIX

Primary sources with reports

Source	Year set	Standard
SWA	Year	TWA: 0.1 ppm (0.66 mg/m³); STEL: 0.2 ppm (1.3 mg/m³)
ACGIH	2001	TLV-TWA: 0.1 ppm (0.66 mg/m³); TLV-STEL: 0.2 ppm (1.3 mg/m³)
<p>TLV-TWA intended to protect for irritation of the respiratory tract and injury of lung tissue. TLV-STEL intended to provide additional protection for effects for chronic exposures at the concentration of the TLV-TWA.</p> <p>Insufficient data to assign notations for skin, sensitisation or carcinogenicity.</p> <p>Extremely irritating to eyes and mucous membranes and can produce lesions of the upper respiratory tract.</p> <p>TLV-TWA based on recommendation from cited report that a concentration of 0.1 ppm should not be exceeded for prolonged exposure (derivation not discussed).</p> <p>TLV-STEL based on symptoms presented in patients acutely exposed after accidental release of 0.2–0.5 ppm.</p> <p>Summary of data:</p> <p>Human data:</p> <ul style="list-style-type: none"> • Wide range of reported odour thresholds: 0.01–3.8 ppm • Low concentrations (not specified) cause excessive mucous secretion, inflammation of the eyelids, lachrymation, coughing, nose-bleeds, vertigo and headaches <ul style="list-style-type: none"> ◦ symptoms may be followed by gastric disturbances and asthmatic bronchitis ◦ photophobia, blepharospasm and chemical burns to the lungs reported (no further information provided) • Cited reports recommend 0.08–0.15 ppm not be exceeded for prolonged exposures <ul style="list-style-type: none"> ◦ 0.5–0.6 ppm intolerable without a respirator ◦ 1.7–3.5 ppm causes severe choking and lachrymation ◦ 4 ppm not to be exceeded for 0.5–1 h ◦ 10 ppm considered extremely dangerous (durations generally not specified) • Fatal exposure (unknown concentration) caused chemical burns to 20% of body and extensive damage to respiratory tract, kidneys and liver <ul style="list-style-type: none"> ◦ comparable to autopsy of rat exposed to 10 ppm • Irritation of mucous membranes and respiratory tract in 91 patients exposed by accidental release at 0.2–0.5 ppm <ul style="list-style-type: none"> ◦ symptoms lasted 3 d to 1 mo in 20–30% of cases • Excessive irritation in workers exposed to 1 ppm during liquid handling (duration not specified) • Calculated LD₅₀ respectively for regular, vulnerable and average populations: <ul style="list-style-type: none"> ◦ 10 min exposure: 650 ppm, 260 ppm, 546 ppm, respectively ◦ 30 min exposure: 375 ppm, 150 ppm, 315 ppm, respectively • Approximately 1.5 times less toxic than chlorine. <p>Animal data:</p> <ul style="list-style-type: none"> • Oral lethal dose range: 2,600–5,500 mg/kg (mice, rats, guinea pigs, no further information) 		



Source	Year set	Standard
<ul style="list-style-type: none"> Severe irritation and corneal clouding at 180 ppm (3 species, no further information) LC₅₀: 750 ppm (mice, 9 min), 174 ppm (mice, 30 min), 240 ppm (mice, 60 and 100 min) Lethal concentration 10% (LC₁₀): 140 ppm (cats and guinea pigs, 7 h) CNS disturbances at 300 ppm (rabbits and guinea pigs, 3 h) <ul style="list-style-type: none"> autopsy reported lung oedema, pseudomembranous deposits on trachea and bronchi and gastric mucosa haemorrhages Respiratory, nervous and endocrine disturbances at 2 ppm in inhalation study (rats, mice and rabbits, 4 mo, dose frequency not specified) <ul style="list-style-type: none"> NOAEL: 0.02 ppm Altered behaviour and adverse haematological effects at 0.01 mg/kg in repeat feeding study (rats, 6 mo, dose frequency not specified). 		
DFG	2013	MAK: not established
<p>Summary of additional data:</p> <p>Previous MAK (0.1 ppm) withdrawn due to inadequacy of available repeat-exposure data.</p> <p>Acknowledge that LOAEL of 0.2 ppm in case study of accidental exposure supports withdrawn MAK of 0.1 ppm.</p> <p>No sensitisation, skin absorption, genotoxicity or carcinogenicity data available.</p> <p>Formation of HBr on contact with moisture likely to be primary cause of irritation from exposure.</p> <p>Bromide metabolite is preferentially reabsorbed over chloride and can lead to a chlorine imbalance.</p> <p>Human data:</p> <ul style="list-style-type: none"> Half-life of bromide metabolite ≈12 d in blood Serum bromide levels may be used to determine bromine exposure, but available data is inconclusive Subjective eye irritation at 0.02–0.05 ppm in single dose inhalation study (n=40, 15–35 min) Acute pain in nose and throat and eye irritation at 0.2–0.5 ppm single dose inhalation study (n=29, 45–55 min) Persons with varying levels of respiratory protection accidentally exposed to >3 ppm (estimated) presented eye irritation, shortness of breath and chemical burns on the skin <ul style="list-style-type: none"> diverse irritations reported 6–8 wk post-exposure, but no clinical signs of abnormality weak evidence for spermatogenic suppression following exposure dismissed due to small sample size Skin contact with liquid or gaseous bromine causes ulcers and acne (no further information provided). <p>Animal data:</p> <ul style="list-style-type: none"> LC₅₀: 407 ppm (rats, duration not specified) 18–23% bw reduction at 5–10 ppm in acute repeat dose inhalation study (mice, 3/8 h). 		
SCOEL	NA	NA
No report.		
OARS/AIHA	NA	NA
No report.		

Source	Year set	Standard
HCOTN	2005	8-hour TWA: 0.1 ppm (0.66 mg/m³)
<p>Summary of additional data: Current 8 h TWA is an administrative level and considered too high; recommends a health-based 15 min TWA of 0.2 ppm based on LOAEL of 0.2 ppm for irritation of the eyes, nose and throat in volunteers exposed to gradually increasing bromine concentrations (n=3, up to 50 min). Human data:</p> <ul style="list-style-type: none"> Reliability of accidental release case of 0.2–0.5 ppm questioned due to inappropriate sampling method Arterial hypertension, chronic bronchitis and contact and allergic dermatitis reported in chronically exposed production workers (concentrations not specified, no further details provided). <p>Animal data:</p> <ul style="list-style-type: none"> Mortality in lethal concentration inhalation studies, also cited by other agencies, tended to occur in two distinct phases following exposure; either at 4 or 8 d post-exposure <ul style="list-style-type: none"> early deaths caused by bronchospasm, later deaths by peribronchitis. 		

Secondary source reports relied upon

Source	Year	Additional information
HSE	✓ 2002	<ul style="list-style-type: none"> 8 h TWA: 0.1 ppm; STEL: 0.2 ppm.
US NIOSH	✓ 1994	<ul style="list-style-type: none"> IDLH based on acute inhalation toxicity data in humans Levels >10 ppm intolerable in humans and causes respiratory damage (no further information provided) 40–60 ppm dangerous for brief exposures (no further information provided).

Carcinogenicity — non-threshold based genotoxic carcinogens

Is the chemical mutagenic? Insufficient data

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	—
HCIS	—
NICNAS	NA
EU Annex	—
ECHA	NA
ACGIH	—



Source	Notations
DFG	—
SCOEL	NA
HCOTN	—
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

Insufficient data to assign a skin notation.

IDLH

Is there a suitable IDLH value available? Yes

Additional information

Molecular weight:	159.81
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 checked="" type="checkbox"/>
This chemical is a biological product:	<input type="checkbox"/>
This chemical is a by-product of a process:	<input checked="" 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) (2013) Bromine – MAK value documentation.

Health Council of the Netherlands (HCOTN) (2005) Bromine. Health-based calculated occupational cancer risk values. The Hague: Health Council of the Netherlands; publication no. 2000/15OSH/143.

UK Health and Safety Executive (HSE) (2002) EH40/2005 Workplace exposure limits.

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – Bromine.

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