# Aniline and Homologues

| CAS number: | 62-53-3 |
| --- | --- |
| Synonyms: | Benzenamine, phenylamine, aminobenzene |
| Chemical formula: | C6H5NH2 |
| Structural formula: |  |

Workplace exposure standard (amended)

| TWA: | **0.5 ppm (1.94 mg/m3)** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **—** |
| Notations: | **Carc. 2, Sk., DSEN** |
| IDLH: | **100 ppm** |
| Sampling and analysis: | There is uncertainty regarding quantification of the recommended value with currently available sampling and/or analysis techniques. |

## Recommendation and basis for workplace exposure standard

A TWA of 0.5 ppm (1.94 mg/m3) is recommended to protect for the risk of elevated blood methaemoglobin and associated effects in exposed workers.

## Discussion and conclusions

Aniline is used in the manufacturing of polyurethane foams, pigments, dyes and pharmaceuticals. The critical toxic effect of aniline exposure is formation of methaemoglobin (MHb) which results in methaemoglobinaemia and cyanosis.

In vapour and liquid form, it is readily absorbed by the skin and associated with systemic toxicity. Exposure to seven to 53 ppm for several hours is reported to cause slight symptoms (ACGIH, 2018; DFG, 2007; SCOEL; 2013). Significant dermal absorption of aniline from the gas (vapour) phase is reported (ACGIH 2018; SCOEL 2013). Acute poisonings in humans have resulted in death.

A NOAEL of 5 ppm for increased MHb levels is reported in rats exposed for six months. A daily dose of 35 mg, reported in humans, caused a concentration blood MHb of 3.7% which is considered tolerable and without adverse effects.

The recommended TWA is based on the 35 mg dose in human studies and corresponds to an airborne concentration of 0.5 ppm (1.94 mg/m3). The TWA is expected to protect for the increase of MHb concentrations caused by exposure fluctuations around the TWA. Therefore, a STEL is not recommended.

## Recommendation for notations

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

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

A skin notation is recommended based on the available data on absorption and systemic toxicity.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 TWA: 2 ppm (7.6 mg/m3) | |
|  |
| ACGIH 2001 TLV-TWA: 2 ppm (7.6 mg/m3) |
| TLV-TWA based on the increase in MHb in blood observed in animals and for risk of skin absorption in humans on contact with liquid aniline.  Summary of data:  Human data:   * Acute poisoning causing death associated with formation of MHb and cyanosis * Liver cirrhosis and atrophy identified in one fatal poisoning * Exposure (7–53 ppm, 2–3 h) reported to be associated with slight symptoms (no further information) * Exposure (100–160 ppm, 1 h) reported to be associated with serious disturbances (no further information) * Skin absorption and systemic toxicity *via* vapour exposure and contact with liquid aniline * Maximum allowable daily dose at 35 mg (≈1 ppm; 8 h, mild exertion).   Animal data:   * 5 ppm (rats, daily for six months) associated with no effects other than slight increase in MHb in blood * Compound induced haemangiosarcomas, fibrosarcomas and sarcomas of spleen as well as a combination of fibrosarcomas and sarcomas of other organs in rats fed 0.6% or 0.3% aniline for 103 weeks * No carcinogenicity in mice * Aniline was negative in the *Salmonella* and *Drosophila* assays. |
| DFG 2007 MAK: 2 ppm (7.7 mg/m3) |
| The MAK protects healthy workers from methaemoglobinaemia, if exposure *via* skin contact with liquid aniline is prevented.  Summary of additional data:   * LOAEL: a 45 mg oral dose in healthy persons results in no symptoms induced by MHb * MAK value is considered protective for methaemoglobinaemia considering aniline half-life of 3.5 h in humans and slower onset of effects after inhalation than ingestion * LD50: 254 mg/kg (cat, dermal); 670 mg/kg (rat) * Available data indicates low genotoxic potential * Assumed the genotoxicity is of secondary importance if concentrations in the workplace are below the MAK. |
| SCOEL 2010 TWA: 0.5 ppm (1.94 mg/m3); STEL: 1 ppm (3.87 mg/m3) |
| The TWA and STEL are recommended to protect for elevated blood MHb in exposed workers.  Summary of additional data:   * MHb level of ≈5% considered tolerable by way of analogy with 4% COHb levels being tolerable * Oral intake of 35 mg resulted in maximal increase of 3.7% MHb (humans) * Calculated a total (dermal and inhalation) intake of 140 mg over 8 h at 2 ppm * TWA is derived from allowable daily dose of 35 mg/d considering a 90% respiratory uptake and a ventilation volume of 10 m3/8 h. |
| OARS/AIHA NA NA |
| No report |
| HCOTN NA NA |
| No report |

### Secondary source reports relied upon

| Source |  | Year | Additional information |
| --- | --- | --- | --- |
| NICNAS |  | 2013 | * Humans are more sensitive than rats in the formation of MHb * Reported to be readily absorbed through all exposure routes * Human toxicity from dermal exposure reported * Pulmonary retention of ~90% reported for humans * Clinical adverse effects not observed in four human volunteers exposed at 2 ppm/8 h * MHb levels in humans: * <20% generally caused no symptoms * 20–50% result in dyspnoea, tachycardia, headache, and dizziness * >60–70% produce coma and death * Considers further assessment necessary to determine whether current exposure controls are appropriate to offer adequate protection to workers. * Classified as possible hazardous mutagenic substance. |
| US EPA |  | 1990 | * LOAEL: 17 ppm (rat; 5 d/wk, 6 h/d for 2 w); MHb increase and splenic involvement. |

### Carcinogenicity — non-threshold based genotoxic carcinogens

| Is the chemical mutagenic? | Insufficient data |
| --- | --- |
| Is the chemical carcinogenic with a mutagenic mechanism of action? | No |
| **The chemical is not a non-threshold based genotoxic carcinogen.** | |

## Notations

| Source | Notations |
| --- | --- |
| SWA | Carc. 2; Skin; Sen |
| HCIS | Carcinogenicity – category 2; Skin sensitisation – category 1 |
| NICNAS | — |
| EU Annex | Carcinogenicity – category 2; Skin sensitisation – category 1 |
| ECHA | — |
| ACGIH | Carcinogenicity – A3; Skin |
| DFG | Carcinogenicity – 4; Sh (dermal sensitiser); H (skin) |
| SCOEL | Carcinogenicity – C; Skin |
| HCOTN | — |
| IARC | Carcinogenicity – Group 3 |
| US NIOSH | SK:SYS; 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 |
| --- |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | Adverse effects in human case study: | yes | 4.00 |  |  | | Dermal LD50 ≤1000 mg/kg: | yes | 3.00 |  |  | | Dermal repeat-dose NOAEL ≤200 mg/kg: |  |  |  |  | | Dermal LD50/Inhalation LD50 <10: |  |  |  |  | | *In vivo* dermal absorption rate >10%: |  |  |  |  | | Estimated dermal exposure at WES >10%: |  |  |  |  | |  |  | 3 | **a skin notation is warranted** | | |

### IDLH

| Is there a suitable IDLH value available? | Yes |
| --- | --- |

## Additional information

| Molecular weight: | 93.13 |
| --- | --- |
| Conversion factors at 25°C and 101.3 kPa: | 1 ppm = Number mg/m3; 1 mg/m3 = 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*](http://www.acgih.org/tlv-bei-guidelines/policies-procedures-presentations) on the ACGIH website.

Deutsche Forschungsgemeinschaft (DFG) (2007) Aniline – MAK value documentation.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (2010) Recommendation from the Scientific Committee on Occupational Exposure Limits for aniline. SCOEL/SUM/153.

International Agency for Research on Cancer (IARC) (1987) Aniliine. IARC Monographs on the evaluation of the carcinogenic risk to humans.

National Industrial Chemicals Notification and Assessment Scheme (NICNAS) (2013) Aniline: Human health tier II assessment – IMAP report.

US Environmental Protection Agency (US EPA) (1990) Integrated Risk Information System (IRIS), Chemical Assessment Summary: Aniline; CASRN 62-53-3.

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

US National Institute for Occupational Safety and Health (NIOSH) (2015) NIOSH Skin Notation Profiles: Aniline