# Chromium (metal), (II), (iii) (as Cr)

| CAS number: | 7440-47-3 |
| --- | --- |
| Synonyms: | Chrome |
| Chemical formula: | Cr |
| Structural formula: | — |

Workplace exposure standard (interim)

| TWA: | **0.04 mg/m3** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **—** |
| Notations: | **—** |
| IDLH: | **250 mg/m3 (as metal & Cr[II])**  **25 mg/m3 (as Cr[III])** |
| Sampling and analysis: | The recommended value is readily quantifiable through currently available sampling and analysis techniques. |

## Recommendation and basis for workplace exposure standard

A TWA of 0.04 mg/m3 (as chromium) is recommended to minimise irritation and lung effects from chromium (Cr) metal, Cr(II) and Cr(III) compounds in exposed workers.

The available toxicological data are inconsistent and investigation of additional data sources is recommended at the next scheduled review.

## Discussion and conclusions

Chromium (Cr) is only found in nature in a combined state, predominantly Cr(III), and not as a free metal. A wide range of metallic and inorganic chromium compounds can be found in the workplace. This report includes the available data on Cr(0), Cr(II) and Cr(III) and does not include an evaluation of Cr(VI), which is evaluated separately.

Limited toxicological information exists about the inhalational effects of Cr(0), but it is likely to cause respiratory tract irritation. No chromium related effects are reported in the lungs of rabbits exposed at up to 3.1 mg/m3 of Cr(0) for four weeks (ACGIH, 2018).

Lung effects are reported as the critical effect in humans and animals after inhalation of Cr(III). A case study of 203 workers exposed to a mean concentration of 2.4 mg/m3 (total dust) with an unspecified concentration of Cr(III) reported frequent shortness of breath, breathlessness and phlegm production (DFG, 2009). A follow-up of this study reported workers exposed to Cr(III) at median concentration of 0.03 mg/m3 with cough, production of phlegm and shortness of breath and breathlessness on exertion (ACGIH, 2018). On follow-up, some symptoms persisted even when median concentration had decreased to 0.004 mg/m3.

In rats and rabbits, short-term exposure to 0.5 mg/m3 Cr(III) salts did not cause changes of pathophysiological significance (ACGIH, 2018). A LOAEL of 4.4 mg/m3 Cr(III) for the incidence of histopathological lung findings was reported in a 13 week study in rats (DFG, 2009).

Based on the reported LOAEL in rats of 4.4 mg/m3 and applying an uncertainty factor of 10 to account for no identified NOAEL and a factor of 10 for interspecies uncertainty, a value of 0.044 mg/m3 is derived. This value is rounded to a TWA of 0.04 mg/m3. This concentration is considered to protect for irritation and lung effects in exposed workers and is supported by the data presented in humans. Given the limited toxicological data for Cr(0) and that exposures in the workplace will likely occur in the presence of Cr(II) and Cr(III), a combined TWA is recommended.

## 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 reports of sensitisation potential of Cr(III) (ACGIH, 2018; DFG,2009). A review of the classification of Cr(II) is recommended as the available toxicological data are inconsistent.

There are insufficient data to recommend a skin notation.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA 1991 TWA: 0.5 mg/m3 |
|  |
| ACGIH 2018 TLV-TWA: 0.5 mg/m3, inhalable particle matter (as Cr(0))  TLV-TWA: 0.003 mg/m3, inhalable particle matter (as Cr(III)) |
| **Metallic Chromium, Cr(0) (7440-47-3)**  TLV-TWA adopted in 1931 is applied to protect for irritant effects in the respiratory tract in exposed workers.  Summary of data:  May cause upper and lower respiratory tract irritation if inhaled.  When exposure to Cr(0) occurs in presence off Cr(III) or Cr(VI) species. The TLV for those compounds should be used.  Human data:   * Normal urinary levels of enzymes and proteins were reported after a mean exposure of 0.61 mg/m3 Cr(0) for 7 yr.   Animal data:   * No effects reported in lungs of rabbits exposed at ≤3.1 mg/m3 for 6 h/d, 5 d/wk for 4 wk * alveolar macrophage structure and function *in vitro* were not affected * particles were readily phagocytosed by alveolar macrophages *in vivo* * Tumours reported in animals administered Cr(0) *via* injection and other routes considered not relevant to workers * Unlikely to cause cancer *via* inhalation.   Insufficient data to assign a skin, sensitiser or carcinogenicity notation or a TLV-STEL.  **Trivalent Chromium Compounds, Cr(III) (various CAS)**  TLV-TWA recommended to protect for effects in the respiratory tract in exposed workers.  Summary of data:  Movement of Cr(III) compounds across cell membranes in each direction is very slow and accumulation leads to toxic effects.  Human data:   * Study in workers exposed to Cr(III) at median concentration 0.03 mg/m3 reported cough, phlegm >3 mo, shortness of breath and breathlessness on exertion * a follow up study 11 years later showed median concentration had decreased to 0.004 mg/m3 and most respiratory symptoms were substantially reduced * increased rates of phlegm and shortness of breath with wheezing remained in some workers; unclear if symptoms were ongoing effects from prior exposure * findings suggest a LOAEL of 0.03 mg/m3 * unclear if a true NOAEL of 0.004 mg/m3 for respiratory effects is demonstrated * A study of lung cancer deaths in 2,357 workers exposed to both Cr(III) and Cr(VI) concluded that Cr(III) levels were not significantly associated with the lung cancer * Absorption across the skin is poor, resulting in low systemic distribution and low urinary excretion; no skin notation warranted * Sensitisation to Cr(VI) compounds increases an individual’s risk of subsequent allergic reaction from exposures to Cr(III) * induction of sensitisation by water-soluble Cr(III) compounds independently of Cr(VI) exposures cannot be ruled out.   Animal data:   * No significant effects reported in rats and rabbits, short-term exposure at 0.5 mg/m3 Cr(III) salts (no further information) * Inflammatory lung changes in rats at 3.0 mg/m3 (nose only; Cr(III) oxide or basic Cr(III) sulphate) for 13 wk * No association identified between exposure to Cr(III) compounds by inhalation and cancer in animals * ingestion study reported increased incidence of preputial gland adenomas in male rats, but no excess tumours in female rats or in male and female mice * mutagenicity demonstrated only at highest concentration in female mice * Sensitisation demonstrated in animals *via* intradermal injection.   TWA based on suggested NOAEL 0.004 mg/m3 observed in workers.  Insufficient data to derive TLV-STEL. |
| DFG 2009 Not assigned |
| **Chromium(III) and its Inorganic Compounds (various CAS)**  No MAK established.  Summary of additional data:   * Lung effects the critical outcome after inhalation by humans and animals * No inhalational NOAEL identified * Case control study of 203 workers at mean concentration of 2.4 mg/m3 (total dust; Cr[III] concentration not specific) revealed shortness of breath, the production of phlegm and breathlessness occurred more frequently in the exposed persons than in the 81 control persons; follow-up study reported by ACGIH (2018) by which TLV-TWA was derived * In epidemiological studies, there is no evidence of increased incidence of lung cancer after long-term exposure to inorganic Cr(III) compound * Historic carcinogenicity studies in rats and mice not robust to determine carcinogenic effects * LOAEL of 4.4 mg/m3 Cr(III) for incidence of histopathological lung findings in rats * Not mutagenic in *in vitro* and *in vivo* studies * Case report of sensitisation in workers exposed to leather tanned with Cr(III). |
| SCOEL 2002 2.0 mg/m3 (total dust)(Cr) |
| TWA recommended to minimise potential effects of chromium metal and Cr(II) and Cr(III) insoluble compounds on the respiratory tract of exposed workers.  Summary of additional data:   * No adverse effects on the lungs reported in humans and animals in repeated exposure at ≈0.5–2.3 mg/mg3 Cr(III) * Limited toxicological data available for Cr(0) and Cr(II) compounds; Cr(II) likely similar to Cr(III) * Cr(0) less biologically active; found in nature only in the combined state (Cr(III) and Cr(VI)) and not as a Cr(0) |
| OARS/AIHA NA NA |
| No report. |
| HCOTN 1998 TLV: 0.5 mg/m3 (Cr(0) and Cr(III)) |
| No additional data. |

### Secondary source reports relied upon

| Source |  | Year | Additional information |
| --- | --- | --- | --- |
| NICNAS |  |  | Human health tier I assessment for 7440-74-3: Not considered to pose an unreasonable risk to the health of workers |

### 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 | NA |
| NICNAS | NA |
| EU Annex | NA |
| ECHA | NA |
| ACGIH | Water soluble Cr(III) compounds: Carcinogenicity – A4, DSEN, RSEN |
| DFG | Sh (dermal sensitiser) |
| SCOEL | NA |
| HCOTN | — |
| 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 |
| --- |
| Insufficient data to assign a skin notation. |

### IDLH

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

## Additional information

| Molecular weight: | 51.996 (elemental) |
| --- | --- |
| 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) (2009) Chromium (III) and its inorganic compounds – MAK value documentation.

EU Scientific Committee on Occupational Exposure Limits (SCOEL) (2002) Recommendation from the Scientific Committee on Occupational Exposure Limits for Chromium Metal, Inorganic Chromium (II) Compounds, and Inorganic Chromium (III) Compounds. SCOEL/SUM/50.

Health Council of the Netherlands (HCOTN) (2011) Metallic chromium. Evaluation of the carcinogenicity and genotoxicity. The Hague: Health Council of the Netherlands; publication no. 2011/34.

International Agency for Research on Cancer (IARC) (1990) Chromium, Nickel and Welding. IARC Monographs on the evaluation of the carcinogenic risk to humans.

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

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

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – Chromium (II) compounds [as Cr(II)].

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – Chromium (III) compounds [as Cr(III)].