# Hard metals (containing cobalt and tungsten carbide)

| CAS number: | 7440-48-4, Cobalt (Co)  12070-12-1, tungsten carbide (WC) |
| --- | --- |
| Synonyms: | — |
| Chemical formula: | Co2C  WC |
| Structural formula: | — |

Workplace exposure standard (interim)

| TWA: | **0.005 mg/m3** |
| --- | --- |
| STEL: | — |
| Peak limitation: | — |
| Notations: | **RSEN** |
| IDLH: | **20 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 0.005 mg/m3 is recommended for joint exposure to hard metals containing cobalt and tungsten carbide to protect for hard metals disease in exposed workers. The TWA does not apply for either chemical exposure in the absence of the other.

Given the limited data available from the primary sources, it is recommended that a review of additional sources be conducted at the next scheduled review.

## Discussion and conclusions

Hard metals are used in saw tips, cutting tools, wear-resistant materials and a wide variety of emerging applications. Hard metals are blends compressed and sintered from powder components and consisting mainly of tungsten carbide (WC) and other metals, in most cases cobalt (Co). They present a different health risk than either tungsten carbide or cobalt alone due to interaction at the molecular level to promote formation of reactive oxygen species.

Critical effects of exposure include lung cancer, hard metals disease and asthma. Significantly elevated lung cancer odds ratios in hard metals workers is identified with simultaneous exposures to cobalt and tungsten carbide. Evidence demonstrating DNA strand breaks *in vitro*, implicates reactive oxygen species in the observed response. A morbidity study of 1,039 hard metals production workers identified a LOAEC of 5.6 µg/m3 (0.0056 mg/m3) for thoracic cobalt for giant cell interstitial pneumonitis (considered characteristic of hard metals disease). ACGIH (2018) state a residual risk of 0.3% is assumed if setting an exposure guideline based on this study; how this conclusion was reached was not reported. Accordingly, a TLV-TWA of 0.005 mg/m3 measured as thoracic cobalt is recommended by ACGIH (2018) to minimise the risk of interstitial lung disease caused by joint exposure to cobalt and tungsten carbide.

An interim TWA of 0.005 mg/m3, as per ACGIH (2018) is recommended as an interim exposure guideline to protect for hard metal disease. Due to the potential for cancer outcomes, a priority evaluation of additional data sources 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). The evidence suggests carcinogenicity in humans. A review of the classification is recommended.

Classified as a respiratory sensitiser and not a skin sensitiser according to the GHS. The evidence suggests respiratory sensitisation potential. A review of the classification is recommended.

There are insufficient data to recommend a skin notation.

# Appendix

### Primary sources with reports

| Source Year set Standard |
| --- |
| SWA NA NA | |
|  |
| ACGIH 2016 TLV-TWA: 0.005 mg/m3 |
| TLV-TWA recommended for joint exposure to Co and WC to protect against hard metals disease. Does not apply for either chemical exposure in the absence of the other (no further explanation on derivation of TLV-TWA).  Summary of data:   * Hard metals consist of WC bound in a Co-containing matrix * Present a different health risk than either WC or Co alone interacting at the molecular level to promote formation of ROS.   Human data:   * Associated with Giant cell interstitial pneumonia (GIP); considered characteristic of hard metals disease * Morbidity study of 1,039 hard metals production workers: * average working duration was 7 y (±6 y) * interstitial lung disease in 3 workers with average total Co exposure <8 µg/m3 * LOAEL is 8 µg/m3 for GIP * Based on a total to thoracic ratio of 0.7; 8 µg/m3 ≡5.6 µg/m3 thoracic Co: * a residual risk of 0.3% is assumed if setting an exposure guideline based on this study * Combined trachea, bronchus and lung cancer mortality significantly elevated in a 709 hard metals worker cohort with high occupational exposures to Co >50 µg/m3: * no trend with duration of employment identified * Significantly elevated lung cancer OR in hard metals workers with simultaneous exposures to Co and WC: * OR slightly higher for those exposed to pre-sintered as compared to sintered hard metals dusts * Exposure associated with asthma in hard metals workers: * attributed to the Co co-exposure * RSEN warranted.   Animal data:   * Intramuscular implantation of W alloy pellets consisting of W, Ni and Co in male rats; all animals (n=92) developed local, extremely aggressive rapidly metastasising tumours (high-grade pleomorphic rhabdomyosarcomas) * Inflammation induced in rats by intratracheal instillations of WC-Co mixture: * similar in magnitude to crystalline silica * greater than that induced by either component alone.   DNA single strand breaks in human peripheral blood lymphocytes induced by WC-Co and Co metal in single-cell gel and alkaline elution assays; effects were inhibited, by formate, implicating ROS in the observed responses.  An *in vitro* study of powder mixtures of W with other components of hard metal alloys reported to synergistically transform human cells to neoplastic phenotype.  Mixture of W, Ni and Co synergistically induced tumour promoters of human hepatoma cell genes. |
| DFG 2007 Not assigned |
| No MAK due to carcinogenicity and genotoxicity.  Summary of additional data:   * Based on hard metal dusts containing WC and Co in inhalable form * DNA strand breaks and micronuclei in type II pneumocytes of rats after intratracheal instillation of hard metal dust. |
| 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 |
| --- | --- | --- | --- |
| IARC |  | 2006 | * Co metal with WC is probably carcinogenic to humans. |

### 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 | NA |
| HCIS | NA |
| NICNAS | NA |
| EU Annex | NA |
| ECHA | NA |
| ACGIH | Carcinogenicity A2, RSEN |
| DFG | Carcinogenicity – 1, Sh (dermal sensitiser), Sa (respiratory sensitiser) |
| SCOEL | NA |
| HCOTN | — |
| IARC | Carcinogenicity – Group 2B |
| 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: | 129.88 |
| --- | --- |
| 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) Hard metal containing tungsten carbide and cobalt (inhalable fraction) – MAK value documentation.

Health Council of the Netherlands (HCOTN) (2013) Tungsten and tungsten compounds. Health-based calculated occupational cancer risk values. The Hague: Health Council of the Netherlands; publication no. 2013/16.

International Agency for Research on Cancer (IARC) (2006) Cobalt metal without tungsten carbide. IARC Monographs on the evaluation of the carcinogenic risk to humans.

US National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – Cobalt metal dust and fume (as Co).