# Nickel carbonyl (as ni)

| CAS number: | 13463-39-3 |
| --- | --- |
| Synonyms: | Nickel tetracarbonyl, tetracarbonylnickel,  (T-4)-nickel tetracarbonyl |
| Chemical formula: | Ni(CO)4 |
| Structural formula: | — |

Workplace exposure standard (amended)

| TWA: | **—** |
| --- | --- |
| STEL: | **—** |
| Peak limitation: | **0.05 ppm (0.12 mg/m3)** |
| Notations: | **Carc. 2** |
| IDLH: | **2 ppm** |
| **Sampling and analysis:** The recommended value is quantifiable through available sampling and analysis techniques. | |

## Recommendation and basis for workplace exposure standard

A peak limitation of 0.05 ppm (0.12 mg/m3) is recommended to protect for severe lung irritation and damage in exposed workers.

## Discussion and conclusions

Nickel carbonyl is used for nickel vapour plating in the metallurgical and electronics industries and is also used as a catalyst in the synthesis of methyl-and ethyl acrylate monomers.

The critical effect of exposure is lung irritation. Effects associated with exposure include acute tightness of the chest, headache, nausea and dizziness that may be followed by delayed symptoms of shortness of breath, cyanosis, pulmonary oedema and death.

Limited data are available. ACGIH report a high level of acute inhalation toxicity associated with severe lung inflammation based on short-term studies in mice, rats and cats. An estimated exposure at 30 ppm for 340 minutes may be lethal to humans. A cross-sectional spirometry study of 112 nickel carbonyl workers showed that chronic low-grade exposure can impair lung function with severity related to exposure duration. Rats exposed at 4 to 9 ppm for thirty minutes three times a week for one year showed extensive pulmonary damage. Limited evidence in rats indicates potential carcinogenic effects following inhalation exposure and intravenous injection. Insufficient evidence is available regarding carcinogenicity in humans (ACGIH, 2018).

Given the evidence regarding acute toxicity and the severity of the effects, a peak limitation of 0.05 ppm (0.12 mg/m3) as cited by ACGIH (2018) is recommended to protect for lung irritation effects.

## Recommendation for notations

Classified as a category 2 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.

# Appendix

### Primary sources with reports

| **Source Year set Standard** |
| --- |
| SWA 1991 TWA: 0.05 ppm (0.12 mg/m3) | |
|  |
| ACGIH 2014 TLV-Ceiling: 0.05 ppm (0.12 mg/m3) |
| TLV-Ceiling recommended to protect for acute lung irritation.  Summary of data:  No derivation provided.  Previous TLV-TWA of 0.05 ppm; TWA-Ceiling justified by highly irritant effects from short-term exposures: symptoms of chest tightness, headache, nausea and dizziness that may be followed by delayed symptoms of shortness of breath, cyanosis, pulmonary oedema and death.  Human Data:   * Estimated exposure at 30 ppm for 340 min may be lethal; primary symptoms noted above * Case study: 1 worker acutely exposed from contaminated clothes; unknown concentration; light-headedness, headache, shortness of breath, chest pain and weakness: * signs of pulmonary involvement; initial urine Ni was 172 µg/dL (severely toxic, >50 µg/dL) * recovered after treatment 18 d * normal pulmonary function tests after 3 mo follow up * Case study: 7 male workers with non-direct contact exposure; concentration not reported; 3 d history of high fever, chills, substernal pleuritic chest pain and exertional dyspnoea: * all received respiratory support * 3 died, 4 survived * Cross-sectional spirometry study of 112 nickel carbonyl workers (64 males and 48 females) and 75 controls; exposure durations of 2.5–18.8 yr; exposure concentration: 0.007–0.52 mg/m3; chronic low-grade exposure can impair lung function characterised by an obstructive pattern with small airway dysfunction * severity related to duration * A nonsignificant excess of lung cancer SMR 139, 95% CI (92–201) in cohort study of 812 workers employed in nickel refinery 1953–1992.   Animal Data:   * 30 min LC50: 10 ppm (mice), 35 ppm (rats), 270 ppm (cats) * Mice exposed at 2.17 ppm for 30 min (no frequency); pulmonary damage likely but not irreversible; no further information * Rats exposed at ~4–9 ppm for 30 min 3/wk for 1 yr showed extensive pulmonary damage, including squamous metaplasia of the bronchial epithelium: * 1 yr post-exposure observation period, 4/9 rats still living showed an increased number of pulmonary tumours * Increased incidence of malignant tumours of various tissues resulted from 6, 9 mg/kg iv injections into rats; no further information * Pregnant rats exposed at 11, 23 or 43 ppm for 15 min on GD 7 or 8; congenital eye defects at 23 and 43 ppm.   Insufficient data are available for TLV-STEL or Skin, DSEN or RSEN notations. |
| DFG NA NA |
| No report. |
| SCOEL NA NA |
| No report. |
| OARS/AIHA NA NA |
| No report. |
| HCOTN 2003 Not assigned |
| Available report is an evaluation of the effects on reproduction; no data are available on the fertility effects; ophthalmic malformations and lower birth weight in offspring after treatment of the dam; no further information. |

### Secondary source reports relied upon

| **Source** |  | **Year** | **Additional information** |
| --- | --- | --- | --- |
| AIOH |  | 2016 | * Position paper on nickel and its compounds * No data available for nickel carbonyl. |
| US EPA |  | 1987 | * In a detailed analysis of epidemiological data from a study of workers, no excess risk of cancer was found in the workers in the areas where nickel carbonyl exposure was present; no further information * After exposure of rats to radioactive nickel carbonyl, nickel was bound to the liver and kidney DNA * Classified as a probable human carcinogen based on the observation of pulmonary carcinomas (inhalation) and malignant tumours (IV injection) at various sites in rats; cited by ACGIH, 2018. |

### 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 | Carcinogenicity – category 2 |
| NICNAS | NA |
| EU Annex | Carcinogenicity – category 2 |
| ECHA | Carcinogenicity – category 1B |
| ACGIH | Carcinogenicity – A3 |
| DFG | NA |
| 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: | 170.74 |
| --- | --- |
| 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.

European Chemicals Agency Regulation (ECHA) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Health Council of the Netherlands (HCOTN) (2003) Nickel and its compounds. Evaluation of the effects on reproduction, recommendation for classification. The Hague: Health Council of the Netherlands; publication no. 2003/05OSH.

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 National Institute for Occupational Safety and Health (NIOSH) (1994) Immediately dangerous to life or health concentrations – Nickel carbonyl (as Ni).