

# Nickel and sparingly soluble nickel compounds (nickel as nickel metal, nickel sulfide, sulfidic ores, nickel oxide, nickel carbonate) – Addendum for re-evaluation of EKA

## Assessment Values in Biological Material – Translation of the German version from 2019

### Keywords

nickel metal, nickel oxide, nickel carbonate, nickel sulfide, sulfidic ores, EKA, exposure equivalents for carcinogenic substances

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## Abstract

The German Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area has re-evaluated the correlation (EKA) between inhalation exposure to nickel and sparingly soluble nickel compounds (nickel as nickel metal [7440-02-0], nickel sulfide [16812-54-7], sulfidic ores, nickel oxide [1313-99-1], nickel carbonate [3333-67-3]) and urinary nickel excretion. The update and evaluation of the available literature led to the conclusion that the EKA correlation could be confirmed for exposures in the range between 100 and 500 µg Ni/m<sup>3</sup>. An extrapolation of the regression equation to the low dose range turned out to be impossible for both formal and practical reasons.

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**EKA (1990, 2018)** The following correlation between external and internal exposure is obtained:

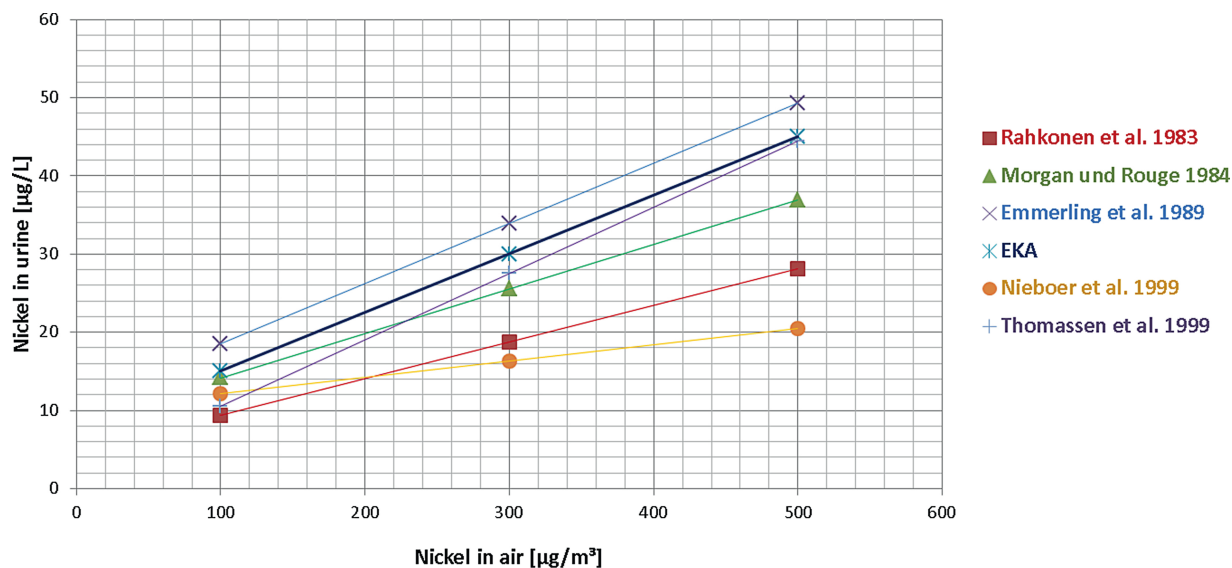
<b>Air Nickel</b> [mg/m <sup>3</sup> ]	<b>Urine Nickel</b> [µg/l]
0.10	15
0.30	30
0.50	45

Sampling time: for long-term exposures: at the end of the shift after several shifts

In 1990, an EKA correlation was evaluated for nickel metal and sparingly soluble nickel compounds, relating to exposures to 100, 300 and 500 µg Ni/m<sup>3</sup> air described in the addendum of 1990 (translated 1995, Angerer 1995). The biological reference value (BAR) of 3 µg Ni/l urine was evaluated in 2009 described in the addendum of 2010 (translated 2016, Schaller 2016). The objective of this addendum was to investigate the possibility of extrapolating this EKA correlation into this low exposure range.

## Re-evaluation

The EKA correlation valid so far was based on four studies from which regression equations for the relationship between the nickel concentration in the breathing zone and the nickel excretion in the urine could be obtained (Emmerling et al. 1989; Morgan and Rouge 1984; Rahkonen et al. 1983). More recent studies have been published in the meantime giving regression equations for various scenarios of exposure to sparingly soluble nickel compounds (Nieboer et al. 1999; Thomassen et al. 1999). A study by Kiilunen et al. (1997) was not included, because no correlation could be derived and the nickel concentrations differed by a factor of 10 from those in the other studies. The picture obtained from the now summarized studies is sufficiently consistent and plausible for the indicated exposure range between 100 and 500 µg Ni/m<sup>3</sup> air (Figure 1). The studies, however, are not suitable for extrapolation into the lower exposure range. The equations from the underlying studies relate to exposures between about 100 and 300 µg Ni/m<sup>3</sup> air, in some cases also exceeding that range. An extrapolation of this correlation beyond this exposure range is thus not automatically permissible. Moreover, this extrapolation does not lead to the desired result, as the urinary nickel concentrations derived therefrom will be determined mainly by the constants of the linear equations.



**Fig. 1** Studies on the correlation of sparingly soluble nickel compounds in the air with nickel excretion in urine

Due to the biopersistence of sparingly soluble or insoluble nickel compounds, an acute low exposure to these substances does not lead to a significant, interindividually comparable increase in urinary nickel excretion. Rather, this is determined mainly by the nickel deposit in the lungs as a function of a more or less long-term occupational exposure. Monitoring of workers who were exposed to comparably low concentrations of metallic nickel or sparingly soluble nickel compounds did not yield significant correlations between inhalation exposure and urinary excretion as a rule (for example Bernacki et al. 1978; Scansetti et al. 1998).

**The EKA correlation for nickel metal and sparingly soluble nickel compounds remains valid for exposures in the range between 100 and 500  $\mu\text{g Ni}/\text{m}^3$  air. However it cannot be extrapolated into the exposure range of < 100  $\mu\text{g Ni}/\text{m}^3$  air.**

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