Biological Monitoring
Guidance Values

Guidance sheet for:
Carbon monoxide (CO) in breath

BMGV: 30ppm carbon monoxide in end-tidal breath

Hazardous Substance
Carbon monoxide (CO)
CAS number: 630-08-0

Workplace Exposure Limits:
8-hour TWA: 30ppm, 35mg/m$^3$
15-minute STEL: 200ppm, 232mg/m$^3$
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### Biological Monitoring Guidance Value (BMGV)

**Guidance value:** 30ppm end-tidal breath carbon monoxide

### Other Guidance Values

The ACGIH BEI is 20ppm CO in breath at end of shift, or 3.5% carboxyhaemoglobin in blood collected at the end of the shift. The DFG BAT is 5% carboxyhaemoglobin in blood collected at the end of the shift.

### Sample Collection

Breath CO is measured on-site using a portable CO breath analyser, which gives a direct readout of CO in ppm, or the equivalent percentage of carboxyhaemoglobin. Breath samples should be collected at the end of shift.

### Description of Suggested Method

The good relationship between breath CO and carboxyhaemoglobin levels in blood means that measurement of CO in end-tidal breath is a reliable, non-invasive approach to biological monitoring. This is measured using a portable, direct-reading CO monitor. These are based on electro-chemical sensors and can display CO concentration in the breath, or its blood carboxyhaemoglobin equivalent.

### Analytical Evaluation

**Detection limit:**

2-3ppm

**Calibration range:**

Typically 0-500ppm

**Drift:**

Less than 2% a month

**Analytical Interferences:**

None likely to be encountered in breath. Negligible effect from organic solvents. Environmental CO exposure can influence the measurement; it is recommended to carry out breath analysis in an environment removed from external CO sources.

http://www.hsl.gov.uk/online-ordering/analytical-services-and-assays/biological-monitoring
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Other Information

Elimination half-time:
Elimination half-time in breath after CO exposure is 3-5 hours

Confounding factors:
CO exposure from confined vehicle exhaust emissions and tobacco smoke. Some dihalomethanes (e.g. dichloromethane and bromochloromethane) are metabolised to CO. Passive smoking will not significantly influence breath CO levels.

Unexposed levels¹:
- in non-smokers: <6ppm
- in light smokers: <20ppm
- in heavy smokers: >20ppm

Quality Assurance

Quality assurance for breath sampling is not practical. However, regular calibration of these instruments is recommended using standard gas mixtures containing CO concentrations at appropriate levels (50ppm). Technical data with specific instruments will suggest calibration intervals, but these are usually between 3-6 months. If the CO monitor needs zeroing between individual readings, it is important that this is performed in a low CO contaminated atmosphere. Outdoor atmospheres without excessive vehicle emissions are generally suitable for this purpose, with CO levels of 2ppm or less. Before zeroing indoors, sources of CO from the work process, heating appliances or tobacco smoke need to be considered.

Interpretation

Exposure to the WEL of 30ppm CO in a non-smoker leads to an end-of-shift breath CO level of 30ppm, equivalent to 5% carboxyhaemoglobin. Unexposed levels are much higher in smokers than non-smokers, and can be above 20ppm in heavy smokers. Therefore, smoking during the workshift will substantially reduce the value of the end-of-shift breath measurement as a measure of occupational CO exposure. Since the elimination half-time is 3-5 hours, if the worker has not smoked during the shift, its confounding influence is reduced. Although smoking during the shift can complicate the interpretation of the BMGV for CO for that individual, assessment of biological monitoring on a group basis may still be useful in determining the effectiveness of control.

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Links

EH40 List of Approved Workplace Exposure Limits
http://www.hse.gov.uk/pubns/books/eh40.htm

Biological Monitoring at HSL
http://www.hsl.gov.uk/online-ordering/analytical-services-and-assays/biological-monitoring

References


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