

Compliance with occupational limit values by applying workplace measurements

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Abstract

Workplace measurements are mainly performed for two reasons. At first, they are used to show the compliance with occupational exposure limits (OEL). On the other hand, they are a good tool to support establishing good practice.

Workplace measurements include strategic and technical sampling, analytical determination of the substance of interest and calculation of workers' exposure for comparison with OEL. When performing workplace measurements a number of normative and regulative requirements have to be fulfilled.

According to EN 482 "Workplace atmospheres – General requirements for the performance of procedures for the measurement of chemical agents" measurement procedures for the determination of hazardous substances have to fulfil specified requirements regarding limit of determination (in relation to the OEL), reproducibility, measuring range, transport and storage conditions, and other. The most important parameter for the characterization of an analytical method is expanded uncertainty. This value is considering the error contribution of all steps of the measurement procedure. Depending on the aim of the measurement the expanded uncertainty may amount at maximum 30 or 50 percent.

The European standard EN 689 "Workplace atmospheres – Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy" describes the strategy of performing workplace measurements. This includes where, when and how often workplace measurements have to be carried out. Sources of exposure have to be identified. Additionally, protective measures have to be described enabling a check of their efficiency. This standard is the basis for the German code of practice (TRGS) 402, which has to be applied when exposure measurements are performed.

Measurement procedures which are in accordance to the standards mentioned above may be used as stationary or personal sampling, with direct reading instruments and for the determination of shift values or short term exposure. Keeping in mind the available information, the decision which kind of measurement is necessary is expert judgement.

According to the Chemical Agents directive 98/24/EC a database of suitable analytical methods for hazardous substances in the workplace atmosphere was established. At the moment, this database contains 229 method sheets for 123 chemical agents. The sources of these validated methods are the European member states and the USA. The use of this database is free of charge and available on the website of the project partners, e. g. the BG-Institute for Occu-

pational Safety and health (BGIA). Regularly, BAuA is publishing a collection of recommended analytical procedures for workplace measurements, which gives an overview of more the 1500 methods for more than 700 substances.

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Workplace measurements

- show compliance with occupational exposure limits (OEL, TLV, MAK, ...)
- establish good practice
- identify sources of exposure
- check effectiveness of technical measures
- describe workers' exposure
- provide a solid basis for exposure models



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European standards (CEN TC 137 – Workplace atmosphere)

EN 482 General requirements for the performance of
procedures for the measurement of chemical
agents

EN 689 Guidance for the assessment of exposure by
inhalation to chemical agents for comparison
with limit values and measurement strategy

(Germany: code of praxis TRGS 402)



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Workplace measurements include

- strategic and technical sampling
- analytical determination
- calculation of workers' exposure



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Sampling strategy

- aim of the measurement (**why**)
- place of measurement (**where**)
- time (**when**) and duration (**how long**) of measurement
- kind of measurement (**how**): personal or stationary

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Technical sampling

sampling devices for dust, vapours and gases

- sampling pump
- sampling head
- collection medium

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Measurement of hazardous substances

requirements according to EN 482

- measuring range
- limit of determination
- expanded uncertainty
- reproducibility
- storage stability



Analytical methods

Chemical Agents directive 98/24 EC

Database:

- 123 chemical agents
- 229 analytical methods (validated)


[http://www.hvbq.de/d/bia/gestis/
analytical_methods/index.html](http://www.hvbq.de/d/bia/gestis/analytical_methods/index.html)




Database


List No.	Substance	CAS-No.	EINECS-No.
88	Acetaldehyde	75-07-0	200-836-8

No.	Source and method name	Language	Year of publication	Principle of the method	Flow rate/ Recommended air volume	LOQ/ Validated working range	Indicative rating	Remarks
1	DFG (D) Aldehyde DFG (E) Aldehydes	German English	1996 2002	Impregnated silica gel cartridges (2,4-DNPH). Desorption with 5 ml acetonitrile. Analysis by HPLC/UV.	100 ml/min 6 l	LOD: 0,004 mg/m ³ 6 l	B	Partially validated No storage data available
2	BLA 6024 Acetaldehyd	German	1998	2 impregnated GF-filter (2,4-DNPH). Desorption with 15 ml acetonitrile. Analysis by HPLC/UV.	0,33 l/min 40 l	LOQ: 0,04 mg/m ³ 20 l	B	Brief method description Sampling included in the method validation
3	MetroPol Fiche 901 Aldehydes	French	2004	Impregnated silica gel tube (2,4-DNPH). Desorption with acetonitrile. Analysis by HPLC/UV.	0,2-1 l/min 60 l		B	Partially validated Brief method description Sampling included in the method validation





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Schriftenreihe der Bundesanstalt für Arbeitsschutz und Arbeitsmedizin

Gefährliche Arbeitsstoffe

GA 13

will be revised 2007

J. Auffarth
R. Hebisch
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Empfohlene Analyseverfahren für Arbeitsplatzmessungen Dokumentation


Recommended analytical methods for workplace measurements


about 750 substances

> 1700 methods

> 600 direct reading instruments

also available on CD





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Problems (1)

- **performance requirements are independent on the kind of limit value**
- **what to do for substances without limit value**
- **not all methods are validated according to EN 482**
- **analytical methods are not available for all substances, but for more we know**



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Problems (2)

- **complex systems of many substances**
- **very often no workplace measurements performed (Germany: measurements in 1-2 % of all enterprises)**
- **conclusion by analogy**
- **use of existing data**



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Substances without limit value

What to do ?

- describe the state of the art
- comparison with similar chemical substances
- comparison of different workplaces
- minimizing exposure by applying good practice

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Complex systems – many substances

- identify main source of exposure
- use of pattern recognition
- use of indicator components
(critical components)



car repair shops: carbon monoxide

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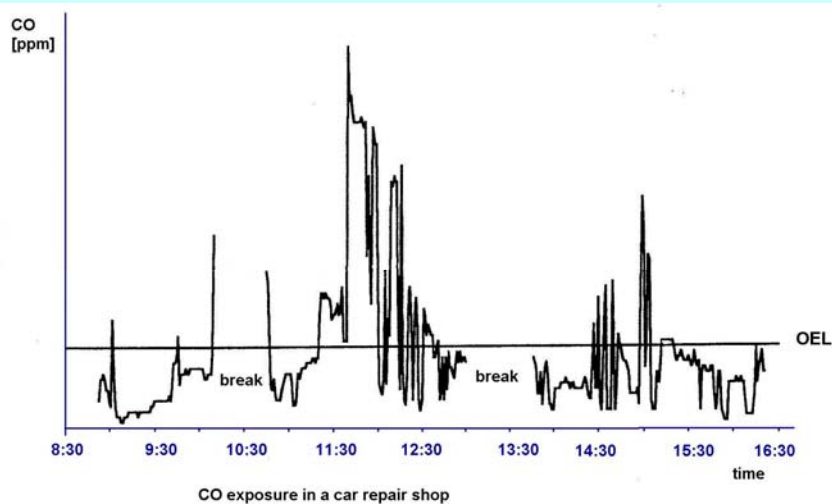
 2007 DE
baua:

Car repair shops

- **typical for maintenance**
- **variety of activities**
- **many substances**
 - **organic vapours** (e. g. gasoline, glues, ...)
 - **dust** (e. g. welding, grinding, ...)
 - **exhaust components**
(CO, CO₂, NO_x, diesel particulate matter, ...)

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Indicator components

- **representative for the total exposure**
(well known contribution to total exposure)
- **easy to measure**
- **technical measures to reduce exposure**
reduce exposure to other substances, too



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Establishing good practice

example: recycling of plastic scrap

- **workplace measurements**
 - inhalable and respirable dust fraction
 - gases (hydrogen chloride)
 - lead, cadmium, diesel particulate matter ...
- **aims: compliance with OEL ?**
good practice ?
- **results: checklist for use in enterprises**



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Checkliste
(Schwerpunkt Gefahrstoffe)
zur Unterstützung bei der
beurteilung bei der werkstofflichen
Kunststoffverwertung


Checklist for recycling of plastic scrap



OEL's are adhered to
Good practice
Exposure values for substances without OEL
No measurements necessary for monitoring








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Quality assured workplace measurements are not dispensable

- to derive good praxis**
- to validate exposure models**

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