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Workplace exposure — Measurement of chemical agents complying with the requirements given in EN 482 and either one of EN 838, EN 1076, EN 13205, EN 13890 and EN 13936 — Choice of procedures

bsi.

National foreword

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Workplace exposure - Measurement of chemical agents complying with the requirements given in EN 482 and either one of EN 838, EN 1076, EN 13205, EN 13890 and EN 13936 - Choice of procedures

Exposition sur les lieux de travail - Mesurage des agents chimiques conformément aux exigences spécifiées dans l'EN 482 et dans l'une des normes EN 838, EN 1076, EN 13205, EN 13890 et EN 13936 - Choix des modes opératoires

Exposition am Arbeitsplatz - Messung von chemischen Arbeitsstoffen, welche die Anforderungen nach EN 482 sowie nach einer von EN 838, EN 1076, EN 13205, EN 13890 und EN 13936 erfüllen - Auswahl von Verfahren

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European foreword

This document (CEN/TR 17055:2017) has been prepared by Technical Committee CEN/TC 137 "Assessment of workplace exposure to chemical and biological agents", the secretariat of which is held by DIN.

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Introduction

Article 3 (10) of the Chemical Agents Directive 98/24/EC [1] called for suitable analytical methods for hazardous substances in workplace atmospheres. However, CEN/TC 137 has adopted a significantly different strategy of standardization which has not involved preparation of separate European Standards for measuring procedures. Instead, CEN/TC 137 has developed several European Standards that present general requirements for measuring procedures and which are used to test whether measuring procedures meet these requirements. A measuring procedure that fulfils these requirements is suitable for the measurement of hazardous substances in workplace atmospheres in the sense of Directive 98/24/EC. To fulfil the demand of Directive 98/24/EC it is necessary to find out whether measuring procedures are available that meet the requirements of the European Standards elaborated by CEN/TC 137.

Several EU Members have committees or organisations which issue measuring procedures. Furthermore, for example, the US National Institute for Occupational Safety and Health (NIOSH) and other institutions of Non-EU-Members publish suitable measuring procedures. The main aim of this CEN Technical Report is to check whether these measuring procedures fulfil the requirements of EN 482.

EN 482 is one of the basic standards elaborated by CEN/TC 137. Whereas, its first edition was already published in 1994, the second edition was published in 2006 subsequent to a major revision that took the principles on laid down in ISO/IEC Guide 98-3 (GUM). As consequence of the issue of the revised EN 482 in 2006 its “daughter standards” EN 838, EN 1076, EN 13890 and EN 13936 needed to be revised fundamentally, too. In 2012, a third edition of EN 482 was published taking into account the changes introduced to its daughter standards during their revisions. In 2015, EN 482 has been amended by introducing a new sub-clause dealing with chemical agents with low limit values and republished as fourth edition of EN 482 consolidated with its Amendment 1.

The “major revision” of EN 482 was one main task of the European project “Analytical methods for chemical agents” funded by the Commission under the Mandate BC/CEN/EN/TR 000/2002-16. The second part of this project was the selection and examination of existing measuring procedures.

The European project report comprises measuring procedures for 126 high profile hazardous substances. The measuring procedures were listed in “methods sheets” and selected (analytical) methods were rated with regard to the requirements of the first edition of EN 482 published in 1994. To make these lists and method sheets easily accessible, a database was established and made publicly available on the IFA homepage designated as “GESTIS - Analytical methods” [2].

From today's point of view, the lists and method sheets are no longer up to date. For some chemical agents the occupational exposure limit values have changed in recent years. Additionally, in the meantime several new measuring procedures have been published which base on the requirements of subsequent editions of EN 482.

For those reasons, it was decided to update the database “Analytical methods for chemical agents” accordingly.

1 Scope

This CEN Technical Report describes how the measuring procedures for chemical agents complying with the requirements given in EN 482 and either one of EN 838, EN 1076, EN 13890, EN 13936 and/or the EN 13205 series, as far as applicable, have been chosen.

This document refers on the selection of chemical agents and related substance groups and the establishment of corresponding method lists. It describes the evaluation of available measuring procedures in order to select for a particular chemical agent the most appropriate one.

This document is also intended to:

— provide a means to compare for a given chemical agent a new measuring procedure with those listed in the database GESTIS Analytical methods [2];

— to evaluate and rate a given measuring procedure (from an accepted source) for a given chemical agent not yet selected in the database GESTIS Analytical methods [2].

2 Measuring procedures

2.1 General

Measuring procedures (“analytical methods”) for chemical agents in workplace atmospheres are available from many sources. In Europe, for example in France, Germany, Spain and UK “official” measuring procedures for workplace atmospheres are published. Furthermore, a number of International Standards have been promulgated the use in this field, but the most important sources of measuring procedures from countries outside Europe are those published by OSHA and NIOSH.

2.2 Selection of chemical agents

Further surveys show that there are about 2000 different chemical agents, mixtures and preparations with existing limit values in Europe [3]. Beyond, many so called “derived no-effect levels” (DNEL's) have been published by the European Chemical Agency (ECHA) since 2010 [4]. It is far beyond the application range of the database to select measuring procedures for all chemical agents with a limit value. In any case for many chemical agents no measuring procedure exists. Furthermore, due to the very specific problems of fibre measurements and measurements of nanoparticles, no procedures for these chemical agents are listed.

The selection of chemical agents is based mainly on the number of measurements carried out in France and Germany. Both countries have similar databases for measurements in workplace atmospheres, and in both countries several hundred thousand measurements have been performed since the early 1970s [5], [6]. These databases give a very good overview about chemical agents of high priority. The chemical agents for the method lists are mainly selected from that group of chemical agents which remained more or less unchanged since 2006, and a few other criteria:

— high number of measurements;

— high profile substances (e.g. diesel fume);

— EU limit value and a reasonable number of measurements;

— limit values in most countries of the EU.

The following substances or groups of chemical agents were selected:

a) aerosols

   — inhalable and respirable dust;

   — crystalline silica;

   — diesel fume;

   — metal working fluids/oil mist.

b) metals

   — Ag, As, Ba-soluble, Be, Cd, Co, Cr, Cr (VI), Cu, Hg, Mn, Ni, Ni-soluble, Pb, Sb, Sn.

c) Organic substances

   — Acetonitrile, Acrylates, Alcohols, Aldehydes, Aliphatic amines, Aliphatic ester alcohols, Aliphatic ethers, Alkanolamines, N-Alkyl-2-pyrrolidons, Amides, Chlorinated aromatic hydrocarbons, Cresols, Cyclic ethers, hydrocarbons (aliphatic, aromatic, cyclic), Esters, Glycol esters, Halogenated hydrocarbons (aliphatic), Isocyanates, Ketones (aliphatic and cyclic), Organic acids, Oxiranes, Phenol

d) Gases

   — CO, CO_2, NH_3, N_2O, NO, NO_2, PH_3, SO_2, halogens

e) Inorganic acids and alkaline substances

   — Hydrogen cyanide and Cyanides, Hydrogen fluoride and fluorides, Hydroxides, Particulate inorganic acids and anhydrides, Volatile inorganic acids

A list of the chemical agents selected for the database GESTIS – Analytical methods [2] is given in Annex A.

3 Method lists

3.1 General

After selection of chemical agents and related substance groups the basic requirements given in 3.2 are specified.

3.2 Origin of the measuring procedure

The following criteria are taken into account for the compilation of the measuring procedures:

a) The measuring procedure is examined by an independent group and has already been published in another set of (measuring) procedures for measurements in workplace atmospheres.

b) The measuring procedure has been designed for personal exposure measurement and requires the use of a personal sampler.

c) Measuring procedures either using static (area) sampling only or developed for ambient air are excluded from further considerations.

The accepted sources are listed in Table 1.

Table 1 — Accepted sources of methods for workplace air measurements

Abbreviation	Language	Source	Web address
EN	English (French/ German)	European Organization for Standardization (CEN), CEN-CENELEC Management Centre Avenue Marnix 17, B-1000 Brussels, Belgium European Standards Also available from National Standards Bodies, e.g. AFNOR, AENOR, BSI, DIN, SIS etc.	http://www.cen.eu/ with costs
ISO	English (French)	International Organization for Standardization (ISO), ISO Central Secretariat Chemin de Blandonnet 8, Case Postale 401 CH-1214 Vernier, Geneva, Switzerland: International Standards Also available from National Standards Bodies, e.g. AFNOR, AENOR, BSI, DIN, SIS etc.	http://www.iso.org with costs
DGUV I	German	Deutsche Gesetzliche Unfallversicherung (DGUV): Von den Berufsgenossenschaften anerkannte Analysenverfahren zur Feststellung der Konzentration krebserzeugender Arbeitsstoffe in der Luft in Arbeitsbereichen 83 methods since 1983 (some methods are published in DFG (E))	http://publikationen.dguv.de/dguv/udt_dguv_main.aspx?QPX=TUlEPSZDSUQ9MTAwNzI6U0cjR2VmYWhyc3RvZmZl for free
IFA	German	Institut für Arbeitsschutz der Deutschen Gesetzlichen Unfallversicherung IFA-Arbeitsmappe, Messung von Gefahrstoffen, Sankt Augustin. Erich Schmidt Verlag, Berlin, Loose leaf edition, > 50 supplements since 1988	http://bgia-arbeitsmappedigital.de/login.html with costs
DFG (D)	German	Deutsche Forschungsgemeinschaft (DFG): Analytische Methoden zur Prüfung gesundheitsschädlicher Arbeitsstoffe – Luftanalysen, Ed. H. Greim, Wiley-VCH, Weinheim, Germany Loose leaf edition, 18 supplements since 1976	http://onlinelibrary.wiley.com/book/10.1002/3527600418/topics for free

Abbreviation	Language	Source	Web address
DFG (E)	English	Deutsche Forschungsgemeinschaft (DFG): Analyses of Hazardous Substances in Air, Wiley-VCH. Weinheim, New York	http://onlinelibrary.wiley.com/book/10.1002/3527600418/topics for free
MDHS	English	Health and Safety Laboratory (HSL), Harpur Hill, Buxton, Derbyshire SK17 9JN, UK: Methods for the Determination of Hazardous Substances (MDHS) 100 methods since 1979	http://www.hse.gov.uk/pubns/mdhs/ for free
Metropol	French (English)	Institut National de Recherche et de Sécurité (INRS) MétroPol – Métrologie des polluants (Recueil des méthodes de prélèvement et d'analyse de l'air pour l'évaluation de l'exposition professionnelle aux agents chimiques) – INRS, Paris CD edition with cost (new edition every 1 or 2 years) and Website (free downloadable .PDF files) updated as needed. 124 methods (1998 to 2016) New database: > 300 methods available from 2016	http://www.inrs.fr/publications/bdd/metropol.html for free
MTA	Spanish	Instituto Nacional de Seguridad e Higiene en el Trabajo (INSHT), c/ Torrelaguna 73, 28027 Madrid Métodos de Toma de muestra y Análisis (MTA) 80 methods since1987	http://www.insht.es/portal/site/Insht/menuitem.a82abc159115c8090128ca10060961ca/?vgnextoid=f6a8908b51593110VgnVCM100000dc0ca8c0RCRD for free
NIOSH	English	National Institute for Occupational Safety and Health (NIOSH), 4676 Columbia Parkway, Cincinnati, OH 45226–1998, USA:	http://www.cdc.gov/niosh/docs/2003-154/ for free
OSHA	English	Occupational Safety and Health Administration (OSHA), Salt Lake Technical Center, 8660 South Sandy Parkway, Sandy, UT 84070, USA: OSHA Sampling and Analytical Methods	http://www.osha.gov/dts/sltc/methods/ for free
IRSST	English French	Institut de recherche Robert-Sauvé en santé et en sécurité de travail (IRSST) 505 Maisonneuve Blvd West, Montréal, Québec H3A 3C2, CANADA	http://www.irsst.qc.ca/laboratoires/outils-references/methodes-laboratoire for free
NOTE For lack of space only the abbreviations of the method publisher are given in the first table column and in the method lists.			

3.3 Structure of the method lists

The aim of the lists of measuring procedures ("method lists") is to give the reader for the chemical agent of interest a first overview and basic information about existing measuring procedures and a first impression of their potential usefulness.

Each method list comprises the following fields of information:

Page header:

— **List Number**

List numbers are ordered from the table where the substances are sorted by WORD by rising CAS-numbers.

— **Substance name, CAS- number, EINECS-Number**

These characters are for identification of the substance.

— **Occupational Exposure Limit Values (8 h, 15 min, ceiling)**

Occupational Exposure Limit values (OELs) can easily be found in the database "GESTIS - International limit values for chemical agents"[3]. Only OELs from European countries are considered.

NOTE 1 OELs can vary over a wide range.

— **Aerosol fraction** (if applicable)

Table Header:

— **Number**

Sequential number of the measuring procedure in the individual method table.

— **Source and method name**

Short form of the source of the measuring procedure (see Table 1) and name of the measuring procedure, web address for the method download

— **Language**

Language of the measuring procedure

NOTE 2 Some measuring procedures are published in the native language and in English for international users.

— **Year of publication**

Year when the measuring procedure was issued.

NOTE 3 E.g. the DFG methods (Germany) are normally published as a group of methods, and for this reason the year of publication and the year of completing the method can be different.

— **Principle of the method**

Brief description of the principle of the measuring procedure. Contains information on the sampling substrate, sample preparation and analytical technique.

— **Flow rate/ recommended air volume**

The column gives information about the sampling conditions (flow rate, recommended air volume) described in the measuring procedure.

— **LOQ/ Validated working range /Expanded uncertainty/Variability**

These data are given in the method description, when available. According to the recommended sampling conditions and the analytical conditions the basic validation data LOQ (Limit of quantification) and/or the validated working range are given. LOQ and the expanded uncertainty (*U*) are the preferred values. Where alternative data are given in that entry, e.g. limit of detection (LOD), overall precision or accuracy, this is mentioned accordingly.

— **Rating**

Rating of the measuring procedure based on the available information (see Clause 4)

— **Remarks**

Brief additional information about e.g. similar measuring procedures, special interferences, reasons for rating

4 Evaluation of measuring procedures

4.1 General

Evaluation and rating is based on the requirements given in EN 482 and either one of EN 838, EN 1076, EN 13890, EN 13936 and/or the EN 13205 series, as far as applicable.

4.2 Rating

For the measuring procedures three method categories are defined:

— **Category A**

The measuring procedure meets the general requirements specified in EN 482 and the specific requirements given in EN 838, EN 1076, EN 13890, EN 13936 and/or the EN 13205 series, as far as applicable.

— **Category B**

The validation data are incomplete but the measuring procedure has the potential to meet the general requirements of EN 482 and the specific requirements given in EN 838, EN 1076, EN 13890, EN 13936 and/or the EN 13205 series, as far as applicable.

NOTE 1 – Usually, only methods assigned “A” or “B” will appear in the method lists.

— **Category C**

The measuring procedure has not the potential to meet the general requirements of EN 482.

NOTE 2 – A measuring procedure assigned category "C" is normally disregarded. However, if no measuring procedure assigned to category "A" or category "B" is available a category "C" method is included.

Table 2 gives the criteria used for the rating of the methods/measuring procedures.

Table 2— Criteria for method rating of measuring procedures

Criteria	**Requirement**	**Rationale for rating**
Origin of the method	Measuring procedure published in an „accepted source" See Table 1.	Required
Structure of the method description	ISO 78-2 EN 482:2012+A1:2015, Annex B	Preferable. If possible, the main clauses should be presented.
Sampling conditions	Description of sampling conditions Sampler, flow rate, recommended air volume or sampling time	Required For aerosol sampling the sampler shall fulfil the requirements for the type of aerosol according to the EN 13205 series (inhalable or respirable fraction). Normative references: EN 689, EN 838, EN 1076, EN 13936, EN ISO 13137
Transportation and storage	Description of sample transport or sample stability	Required for critical samples. For critical samples detailed transportation and storage condition need to be defined. For non-critical samples a short statement should be given.
Sample preparation	Description of sample handling	Required
Analytical technique	Description of the analytical conditions	Required
Specified measuring range / Validated working range	0,1 LV to 2 LV according to EN 482:2012+A1:2015	Required
Specified measuring range / Validated working range	Specified measuring range / validated working range larger than required according to EN 482:2012+A1:2015	Preferable
Expanded uncertainty	0,1 LV to 0,5 LV ≤ 50 % 0,5 LV to 2,0 LV ≤ 30 % according to EN 482:2012+A1:2015	Required In most cases uncertainty only for sample clean-up and analytical steps will be available.
Limit of quantification or lowest concentration of the validated working range verified for the method	LOQ per sample (e.g. µg per filter) and LOQ calculated for the recommended air volume, where appropriate	Required

Criteria	**Requirement**	**Rationale for rating**
Method bias	Information necessary	Required The bias is very often only available for analytical steps.
Sampler bias	For aerosol sampling, estimated data for samplers are used for uncertainty calculation (e.g. see EN 13890:2009, B.3.4)	Preferable
Sampling efficiency	Information about sampling efficiency is needed. According to EN 482:2012+A1:2015, B.3.1 the sampling efficiency of vapours and gases is assumed to be 100 % for pumped samplers. For diffusive samplers sampling efficiency can be calculated according to EN 838:2010, B.3. For aerosol sampling, generated data for samplers are used for uncertainty calculation (see EN 13890:2009, B.3.4)	Preferable
Repeatability	Minimum six repeat measurements under defined conditions at three different concentrations.	Required
Recovery	How was the recovery determined?	Information needed, e.g. use of a test gas atmosphere
Selectivity	Information needed Experiments to interferences described or lucid explanations given about the selectivity (e.g. the method is highly selective because the measuring wavelength is selective).	Required
Analytical precision	Precision data for the analytical steps stated in the method (mostly RSD)	Preferable
Method precision	Method precision data stated in the method, e.g. when a test gas atmosphere for method validation was used.	Required, when no expanded uncertainty is given.
Environmental conditions	Information on relative humidity, temperature, pressure effects needs to be given, when appropriate	Required

Criteria	Requirement	Rationale for rating
Sampler capacity	Information on sampler capacity or breakthrough volume is needed	Required For samplers with limited capacity (e.g. sampling tubes, impregnated filters)
Similar methods	Very often similar methods (similar sampling, sample preparation and analytical technique) are available from the different sources for analytical methods	Preferable. Consideration of existing similar methods can be helpful if they contain sufficient validation data.
Unambiguity	Information needed	Preferable

4.3 Downgrade of a rating

Even measuring procedures from accepted sources of methods do not always fulfil all requirements specified in EN 482. For example, the older IFA methods (published before 2006) are mainly very short and do not fulfil the requirement for “Structure of the method description” and Metropol methods very often include insufficient validation data. The indicative rating for such methods cannot be better than “B”. In such instance, a special phrase appears in the method list “remarks” (see Table 3).

Table 3 — Downgrade of a rating

Criteria	Phrase	Action
Short method description only or some main clauses from ISO 78-2 or EN 482:2012+A1:2015, Annex B are missing	Brief method description	Downgrade to "B"
No or insufficient method performance data	No (or insufficient) performance data published in the method	Downgrade to "B" (example: Metropol methods)
Sampler does not sample the inhalable aerosol fraction	Inhalable sampler not used or, where applicable, Inhalable sampler not used, but wall deposits analysed	Downgrade to "B" (example: cassette filter holder used)
For critical substances: No information about transport and sample stability on storage available	—	Downgrade to "B"
No information about the importance of blank values in case of critical substances with ubiquitous sources available (e.g. Chlorides, Sodium, Calcium)	—	Downgrade to "B"
No information about the influence of relative humidity on gas and vapour samples available.	—	Downgrade to "B"
Method not practicable	Method not practicable	Downgrade to "B" (example: laboratory methods for gases like CO)
Older methods using techniques which are no longer up-to-date	Old method, no longer state of the art	Downgrade to "B" (example: photometric method for ammonia)

4.4 Expanded uncertainty

The expanded uncertainty is calculated according to EN 482. For calculation of the expanded uncertainty it is necessary to consider all random and non-random uncertainty components. Most of the uncertainty components are unknown (e.g. instrumental drift) or included in the analytical uncertainty (e.g. sample dilution).

EN 482, EN 838, EN 1076, EN 13890, EN 13936 as well as the EN 13205 series give consensus values for some uncertainty components for calculations of the expanded uncertainty or refer on them.

Annex A
(informative)

Selection of chemical agents related to 2.2

List No.	Substance	CAS-No.[a]	EINECS-No.[b]
1	Dinitrogen monoxide	10024–97–2	233–032–0
2	Hydrogen bromide	10035–10–6	233–113–0
3	Ethylbenzene	100–41–4	202–849–4
4	Styrene	100–42–5	202–851–5
5	Nitrogen oxide	10102–43–9	233–271–0
6	Nitrogen dioxide	10102–44–0	233–272–6
7	Methylene bisphenyl isocyanate (MDI)	101–68–8	202–966–0
47	p-Xylene	106–42–3	203–396–5
8	1,4-Dichlorobenzene	106–46–7	203–400–5
9	1-Chloro-2,3-epoxypropane	106–89–8	203–439–8
10	Acrolein	107–02–8	203–453–4
11	Ethane-1,2-diol	107–21–1	203–473–3
12	1-Methoxypropan-2-ol	107–98–2	203–539–1
13	4-Methylpentan-2-one (MIBK)	108–10–1	203–550–1
14	Isopropyl acetate	108–21–4	203–561–1
47	m-Xylene	108–38–3	203–576–3
15	1-Methoxy-2-propyl acetate	108–65–6	203–603–9
16	Methylcyclohexane	108–87–2	203–624–3
17	Toluene	108–88–3	203–625–9
18	Chlorobenzene	108–90–7	203–628–5
19	Cyclohexanone	108–94–1	203–631–1
20	Phenol	108–95–2	203–632–7
21	n-Pentane	109–66–0	203–692–4
22	2-Methoxyethanol	109–86–4	203–713–7
23	Diethylamine	109–89–7	203–716–3
24	Tetrahydrofuran	109–99–9	203–726–8
25	Isobutyl acetate	110–19–0	203–745–1
26	n-Hexane	110–54–3	203–777–6
27	2-Ethoxyethanol	110–80–5	203–804–1

List No.	Substance	CAS-No.[a]	EINECS-No.[b]
28	Cyclohexane	110–82–7	203–806–2
29	2-Ethoxyethyl acetate	111–15–9	203–839–2
30	Glutaraldehyde	111–30–8	203–856–5
31	n-Octane	111–65–9	203–892–1
32	2-Butoxyethanol	111–76–2	203–905–0
33	2-Butoxyethyl acetate	112–07–2	203–933–3
34	2-(2-Butoxyethoxy)ethanol	112–34–5	203–961–6
35	Triethylamine	121–44–8	204–469–4
36	4-Hydroxy-4-methylpentan-2-one	123–42–2	204–626–7
37	n-Butyl acetate	123–86–4	204–658–1
38	Carbon dioxide	124–38–9	204–696–9
39	Dimethylamine	124–40–3	204–697–4
40	Tetrachloroethylene	127–18–4	204–825–9
41	N,N-Dimethylacetamide	127–19–5	204–826–4
42	Calcium hydroxide	1305–62–0	215–137–3
43	Lithium hydroxide	1310–65–2	215–183–4
44	Potassium hydroxide	1310–65–2	215–183–4
45	Sodium hydroxide	1310–73–2	215–185–5
46	Cresol, all isomers	1319–77–3	215–293–2
47	Xylene, o-,m-,-p- or mixed isomers	1330–20–7	215–535–7
48	n-Butyl acrylate	141–32–2	205–480–7
49	2-Aminoethanol	141–43–5	205–483–3
50	Ethyl acetate	141–78–6	205–500–4
51	n-Heptane	142–82–5	205–563–8
52	Quartz	14808–60–7	238–878–4
53	Caesium hydroxide	21351–79–1	244–344–1
54	Trimethylbenzenes, all isomers or mixtures	25551–13–7	247–099–9
55	Naphtalene diisocyanate (NDI)	3173–72–6	221–641–4
56	Isophorone diisocyanate (IPDI)	4098–71–9	223–861–6
57	Formaldehyde	50–00–0	200–001–8
58	2,4-Toluene diisocyanate (TDI)	584–84–9	209–544–5
59	N,N-Dimethylethylamine	598–56–1	209–940–8
60	Diethyl ether	60–29–7	200–467–2
61	Carbon monoxide	630–08–0	211–128–3
62	Formic acid	64–16–8	200–579–1

List No.	Substance	CAS-No.[a]	EINECS-No.[b]
63	Ethanol	64–17–5	200–578–6
64	Acetic acid	64–19–7	200–580–7
65	Methanol	67–56–1	200–659–6
66	Propan-2-ol	67–63–0	200–661–7
67	Acetone	67–64–1	200–662–2
68	Chloroform	67–66–3	200–663–8
69	Propan-1-ol	71–23–8	200–746–9
70	Butan-1-ol	71–36–3	200–751–6
71	Benzene	71–43–2	200–753–7
72	1,1,1-Trichloroethane	71–55–6	200–756–3
73	Lead and inorganic compounds (as Pb)	7439–92–1	231–100–4
74	Manganese and inorganic compounds (as Mn)	7439–96–5	231–104–1
75	Mercury	7439–97–6	231–106–7
76	Nickel	7440–02–0	231–111–4
77	Tin compounds, inorganic, except SnH4 (as Sn)	7440–31–5	231–141–8
78	Antimony and compounds (as Sb) (except stibine)	7440–36–0	231–146–5
79	Arsenic and compounds, except arsine (as As)	7440–38–2	231–148–6
80	Beryllium and beryllium compounds (as Be)	7440–41–7	231–150–7
81	Cadmium and inorganic compounds (as Cd)	7440–43–9	231–152–8
82	Chromium and chromium II and III compounds (as Cr)	7440–47–3	231–157–5
83	Cobalt and cobalt compounds (as Co)	7440–48–4	231–158–0
84	Copper dusts and mists (as Cu)	7440–50–8	231–159–6
85	Sulphur dioxide	7446–09–5	231–195–2
86	Hydrogen cyanide	74–90–8	200–821–6
87	Acetonitrile	75–05–8	200–835–2
88	Acetaldehyde	75–07–0	200–836–8
89	Dichloromethane	75–09–2	200–838–9
90	Ethylene oxide	75–21–8	200–849–9
91	Iodine	7553–56–2	231–442–4
92	2-Methylpropan-2-ol	75–65–0	200–889–7
93	Hydrogen chloride	7647–01–0	231–595–7
94	Phosphoric acid	7664–38–2	231–633–2
95	Hydrogen fluoride/Fluorides	7664–39–3	231–634–8
96	Ammonia	7664–41–7	231–635–3

List No.	Substance	CAS-No.[a]	EINECS-No.[b]
97	Sulphuric acid	7664–93–9	231–639–5
98	Nitric acid	7697–37–2	231–714–2
99	Bromine	7726–95–6	231–778–1
100	Fluorine	7782–41–4	231–954–8
101	Chlorine	7782–50–5	231–959–5
102	Phosphine	7803–51–2	232–260–8
103	2-Methylpropan-1-ol	78–83–1	201–148–0
104	Butan-2-ol	78–92–2	201–158–5
105	Butan-2-one (MEK)	78–93–3	201–159–0
106	Trichloroethylene	79–01–6	201–167–4
107	Propionic acid	79–09–4	201–176–3
108	Methyl acetate	79–20–9	201–185–2
109	Methyl methacrylate	80–62–6	201–297–1
110	Hexamethylene diisocyanate (HDI)	822–06–0	212–485–8
111	1-Methyl-2-pyrrolidone	872–50–4	212–828–1
47	o-Xylene	95–47–6	202–422–2
112	1,2-Dichlorobenzene	95–50–1	202–425–9
54	1,2,4-Trimethylbenzene	95–63–6	202–436–9
113	Cumene	98–82–8	202–704–5
114	2-Phenylpropene	98–83–9	202–705–0
115	Barium compounds soluble (as Ba)	various	various
116	Chromium, hexavalent	various	various
117	Crystalline silica (Quartz, Tridymite, Cristobalite)	various	various
118	Cyanides	various	various
119	Nickel compounds, water-soluble (as Ni)	various	various
120	Polycyclic Aromatic Hydrocarbons	various	various
121	Silver compounds (as Ag)	various	various
122	Diesel particulate matter	-	-
123	Metal working fluids	-	-
124	Inhalable aerosol fraction and gravimetric analysis	-	-
125	Respirable aerosol fraction and gravimetric analysis	-	-
126	Thoracic aerosol fraction and gravimetric analysis	-	-

[a] CAS: Chemical Abstracts Service

[b] EINECS: European Inventory of Existing Commercial Chemical Substances

Annex B
(informative)

Examples of method lists

See Tables B.1 to B.2.

Table B.1 — Method list for 2-Butoxyethanol

List No. 32	**Substance** 2-Butoxyethanol	**CAS-No.** 111–76–2	**EINECS-No.** 203–905–0		**Limit Values*** 49 mg/m³ to 98 mg/m³ (8 h) 20 mg/m³ to 246 mg/m³ (15 min)			
No.	**Source and method name**	**Language**	**Year of publication**	**Principle of the method**	**Flow rate/ Recommended air volume**	**LOQ/ Validated working range/ Expanded uncertainty/ Variability**	**Rating**	**Remarks**
1	IFA 7569 Glykolester, Glykolether, Methacrylsäuremethylester http://www.ifa-arbeitsmappedigital.de/.download/pdf/007569.pdf	German	2013	Sorbent tube containing activated charcoal (Dräger® Type B[a]) Desorption with 10 ml of a ternary mixture of $CH_2Cl_2/CS_2/$ CH_3OH (60/35/5) Analysis by GC/FID with two columns of different polarity in parallel	For 2 h sampling: 20 l/h 40 l For 8 h sampling: 5 l/h 40 l	WR: 1 mg/m³ to 198 mg/m³ LOQ: 1 mg/m³ Variation coefficient: 1 % to 2,6 % U: 11,1 % to 12,2 %	A	

List No. 32	Substance 2-Butoxyethanol	CAS-No. 111–76–2	EINECS-No. 203–905–0		Limit Values* 49 mg/m³ to 98 mg/m³ (8 h) 20 mg/m³ to 246 mg/m³ (15 min)			
No.	**Source and method name**	**Language**	**Year of publication**	**Principle of the method**	**Flow rate/ Recommended air volume**	**LOQ/ Validated working range/ Expanded uncertainty/ Variability**	**Rating**	**Remarks**
2	NIOSH 1403 http://www.cdc.gov/niosh/docs/2003-154/pdfs/1403.pdf	English	2003	Sorbent tube containing activated charcoal (100/50 mg). Desorption in 1 ml CH_2Cl_2/CH_3OH (95:5) in ultrasonic bath for 30 min Analysis by GC/FID.	0,01 l/min to 0,2 l/min 2 l to 10 l	WR: 3 µg to 361 µg 0,3 mg/m³ to 180,5 mg/m³ LOQ: 0,1 mg/m³ Precision: 0,048 µg (NIOSH protocol)	A	
3	Métropol Fiche 022 Éthers de glycol http://www.inrs.fr/publications/bdd/metropol/fiche.html?refINRS=METROPOL_118	French	2009	Sorbent tube containing activated charcoal (900/300 mg or 100/50 mg). Desorption with CH_2Cl_2 or CH_2Cl_2/CS_2 (50/50). Analysis by GC/FID.	0,2 l/min to 1 l/min 60 l 0,05 l/min to 0,1 l/min 15 l	WR: 12 mg/m³ to 180 mg/m³	B	Insufficient performance data published in the method Sampling included in the method validation
4	OSHA https://www.osha.gov/dts/sltc/methods/organic/org083/org083.html	English	1990	Sorbent tube containing activated charcoal (100/50 mg). Desorption in 1 ml CH_2Cl_2/ CH_3OH (95:5) in ultrasonic bath for 30 min Analysis by GC/FID.	0,1 l/min 48 l	LOD: 150 µg/m³ LOQ: 150 µg/m³ WR: 12 mg/m³ to 48 mg/m³ (OSHA protocol)	B	-

[a] Dräger® Type B is an example of a suitable product available commercially. This information is given for the convenience of users of this CEN Technical Report and does not constitute an endorsement by CEN of this product.

LOQ Limit of quantification, WR working range, GC/FID gas chromatography/flame ionization detector

Table B.2 — Method list for sulphuric acid

List No. 97	**Substance** Sulphuric acid	**CAS-No.** 7664–93–9	**EINECS-No.** 231–639–5		**Limit Values*** 0,05 mg/m³ (8 h) thoracic aerosol 0,1 mg/m³ to 1 mg/m³ (8 h) inhalable aerosol 0,1 mg/m³ to 3 mg/m³ (15 min) inhalable aerosol			
No.	**Source and method name**	**Language**	**Year of publication**	**Principle of the method**	**Flow rate/ Recommended air volume**	**LOQ/ Validated working range/ Expanded uncertainty/ Variability**	**Rating**	**Remarks**
1	NIOSH 7908 Non-volatile acids (Sulfuric Acid and Phosphoric Acid) http://www.cdc.gov/niosh/docs/2003-154/pdfs/7908.pdf	English	2014	QF filter to collect the aerosol. Immediately after sampling add 4 ml of eluent (2,7 mM Na_2CO_3 / 0,3 mM $NaHCO_3$) to the filter. IC analysis with conductivity detection.	1,0 l/min to 5,0 l/min 15 l to 2000 l	LOQ: 0,002 mg/m³ (1 m³) WR: 0,005 mg/m³ to 2 mg/m³ U: < 23	A	Similar methods described in OSHA ID-113 and DFG (2,3) and IFA 6173
2	IFA 6173 Anorganische Säuren, particular: Phosphorsäure, Schwefelsäure http://www.ifa-arbeitsmappedigital.de/.download/pdf/006173.pdf (with costs)	German	2010	QF filter to collect the aerosol. Immediately after sampling add 4 ml of eluent (2,7 mM Na_2CO_3 / 0,3 mM $NaHCO_3$) to the filter. IC analysis with conductivity detection.	3,5 l/min 420 l	LOQ: 0,005 mg/m³ WR: 0,005 mg/m³to 1,0 mg/m³ U: 20,5 % to 22,5 %	A	Fully validated according to EN 482 and EN 13890 Similar methods described in OSHA ID-113 and DFG (2,3) and NIOSH 7908

List No. 97	Substance Sulphuric acid	CAS-No. 7664–93–9	EINECS-No. 231–639–5		Limit Values* 0,05 mg/m³ (8 h) thoracic aerosol 0,1 mg/m³ to 1 mg/m³ (8 h) inhalable aerosol 0,1 mg/m³ to 3 mg/m³ (15 min) inhalable aerosol			
No.	**Source and method name**	**Language**	**Year of publication**	**Principle of the method**	**Flow rate/ Recommended air volume**	**LOQ/ Validated working range/ Expanded uncertainty/ Variability**	**Rating**	**Remarks**
3	DFG (1) Partikulär auftretende anorganische Säuren http://onlinelibrary.wiley.com/doi/10.1002/3527600418.am766493d0011/pdf	German	1998	PTFE filter to collect the aerosol. Add 10 ml of eluent (2,7 mM Na_2CO_3 / 0,3 mM $NaHCO_3$) to the PTFE filter. IC analysis with conductivity detection.	1 l/min 120 l	LOQ: 0,04 mg/m³ WR: 0,1 mg/m³ to 2 mg/m³ Analytical precision: 1,8 % to 5 %	B	Similar methods described in OSHA ID-113 LOQ not sufficient for lower limit values
4	DFG (2) Inorganic acids mist http://onlinelibrary.wiley.com/doi/10.1002/3527600418.am766438e0006/pdf	English	2002	Quartz-fibre-filter to collect the aerosol. Immediately after sampling add 4 ml of eluent (2,7 mM Na_2CO_3 / 0,3 mM $NaHCO_3$) to the filter. IC analysis with conductivity detection.	3,5 l/min 420 l	LOQ: 0,01 mg/m³ WR: 0,01 mg/m³ to 2 mg/m³ Analytical precision: 0,5 % to 2,6 %	B	Similar methods described in OSHA ID-113, IFA 6173, DFG (3) and NIOSH 7908

List No. 97	Substance Sulphuric acid	CAS-No. 7664–93–9	EINECS-No. 231–639–5		Limit Values* 0,05 mg/m³ (8 h) thoracic aerosol 0,1 mg/m³ to 1 mg/m³ (8 h) inhalable aerosol 0,1 mg/m³ to 3 mg/m³ (15 min) inhalable aerosol			
No.	**Source and method name**	**Language**	**Year of publication**	**Principle of the method**	**Flow rate/ Recommended air volume**	**LOQ/ Validated working range/ Expanded uncertainty/ Variability**	**Rating**	**Remarks**
5	DFG (3) (BGI 505) Method for the determination of sulfuric acid http://onlinelibrary.wiley.com/doi/10.1002/3527600418.am766493e0009a/pdf	English	2005 (Issue 2001)	Quartz-fibre-filter to collect the aerosol. Immediately after sampling add 4 ml of eluent (3,1 mM Na_2CO_3 / 0,35 mM $NaHCO_3$) to the filter. IC analysis with conductivity detection.	3,5 l/min 420 l	LOQ: 0,01 mg/m³ WR: 0,01 mg/m³ to 0,2 mg/m³ Analytical precision: 0,5 % to 2,6 %	B	Similar methods described in OSHA ID-113, IFA 6173, DFG (2) and NIOSH 7908
6	DFG (4) (BGI 505) Method for the determination of sulfuric acid or oleum http://onlinelibrary.wiley.com/doi/10.1002/3527600418.am766493e0009b/pdf	English	2005 (Issue 2001)	Glass midget impinger (B 70) containing 10 ml of 3,5 mM Na_2CO_3 and 0,5 mM $NaHCO_3$. After sampling the content of the absorber is transferred into a 10-ml-flask (2,7 mM Na_2CO_3 / 0,3 mM $NaHCO_3$) and aliquoted to 10 ml. IC analysis with conductivity detection.	1,166 l/min 560 l	LOQ: 0,002 mg/m³ WR: 0,002 mg/m³ to 0,2 mg/m³ Analytical precision: 3,2 % to 4,3 %	B	Method was targeted to measure Oleum LOQ not sufficient for new lower limit values

List No. 97	Substance Sulphuric acid	CAS-No. 7664–93–9	EINECS-No. 231–639–5		Limit Values* 0,05 mg/m³ (8 h) thoracic aerosol 0,1 mg/m³ to 1 mg/m³ (8 h) inhalable aerosol 0,1 mg/m³ to 3 mg/m³ (15 min) inhalable aerosol			
No.	**Source and method name**	**Language**	**Year of publication**	**Principle of the method**	**Flow rate/ Recommended air volume**	**LOQ/ Validated working range/ Expanded uncertainty/ Variability**	**Rating**	**Remarks**
7	IFA 8560 Method No. 3 Schwefelsäure, rauchend http://www.ifa-arbeitsmappedigital.de/.download/pdf/008580.pdf (with costs)	German	2001	Quartz-fibre-filter to collect the aerosol and impregnated (KOH) carbon bead tube for sampling of SO_3. Immediately after sampling add 4 ml of eluent (2,7 mM Na_2CO_3 / 0,3 mM $NaHCO_3$) to the filter. To the tube add 10 ml NaOH (0,015 M). IC analysis with conductivity detection.	1 l/min 120 l	LOQ: 0,04 mg/m³ WR: 0,1 mg/m³ to 2 mg/m³ Analytical precision: 0,5 % to 2,6 %	B	Method was targeted to measure Oleum LOQ not sufficient for new lower limit values
8	IFA 8560 Method No. 4 Schwefelsäure http://www.ifa-arbeitsmappedigital.de/.download/pdf/008580.pdf (with costs)	German	2001	Glass midget impinger containing 10 ml of 3,5 mM Na_2CO_3 and 0,5 mM $NaHCO_3$. After sampling transfer the solution into a 10 ml flask and make to the mark. IC with conductivity detection.	1,166 l/min 140 l	LOQ: 0,002 mg/m³ WR: 0,002 mg/m³ to 0,2 mg/m³ Analytical precision: 0,7 % to 5,1 %	B	Method was targeted to measure Oleum LOQ not sufficient for new lower limit values

List No.	Substance	CAS-No.	EINECS-No.		Limit Values*			
97	Sulphuric acid	7664–93–9	231–639–5		0,05 mg/m³ (8 h) thoracic aerosol 0,1 mg/m³ to 1 mg/m³ (8 h) inhalable aerosol 0,1 mg/m³ to 3 mg/m³ (15 min) inhalable aerosol			
No.	**Source and method name**	**Language**	**Year of publication**	**Principle of the method**	**Flow rate/ Recommended air volume**	**LOQ/ Validated working range/ Expanded uncertainty/ Variability**	**Rating**	**Remarks**
9	MTA/MA-060/A05 DETERMINACIÓN DE ÁCIDOS INORGÁNICOS http://www.insht.es/InshtWeb/Contenidos/Documentacion/FichasTecnicas/MetodosAnalisis/Ficheros/MA/MA_060_A05.pdf	Spanish	2005	PVC filter (5 µm) to collect the aerosol. Add 4 ml of ultrapure water to the filter. IC analysis with conductivity detection.	2 l/min 200 l	LOQ: 0,04 mg/m³ WR: 0,075 mg/m³ to 2,0 mg/m³ Analytical precision: 1,2 % to 2,5 %	B	LOQ not sufficient for new lower limit values

List No. 97	Substance Sulphuric acid	CAS-No. 7664–93–9	EINECS-No. 231–639–5		Limit Values* 0,05 mg/m³ (8 h) thoracic aerosol 0,1 mg/m³ to 1 mg/m³ (8 h) inhalable aerosol 0,1 mg/m³ to 3 mg/m³ (15 min) inhalable aerosol			
No.	**Source and method name**	**Language**	**Year of publication**	**Principle of the method**	**Flow rate/ Recommended air volume**	**LOQ/ Validated working range/ Expanded uncertainty/ Variability**	**Rating**	**Remarks**
10	MétroPol methods M-53 (IC with suppression), M-137 (IC without suppression) and M-144 (CE) Anions minéraux http://www.inrs.fr/publications/bdd/metropol/fiche.html?refINRS=METROPOL_53 http://www.inrs.fr/publications/bdd/metropol/fiche.html?refINRS=METROPOL_137 http://www.inrs.fr/publications/bdd/metropol/fiche.html?refINRS=METROPOL_144	French	2010	Combination of filters into 37 mm close-faced cassette: PTFE (<1 µm) filter to sample the particulate phase and two impregnated (5 % Na_2CO_3) or one impregnated (5 % Na_2CO_3) quartz-fibre-filter to sample the vapour phase. The filters are analysed separately. Add 5 ml to 20 ml of deionised water to each sample. For particle analysis, add 5 ml to 10 ml of deionised water into the upper part of the cassette with the PTFE filter to take into account wall deposits. Ultrasonication for 5 min to 10 min IC analysis with conductivity detection with or without suppression, or CE analysis with UV detection.	2 l/min 30 l to 960 l	For V_{eluent} = 20 ml, V_{air} = 240 l LOQ: 0,026 mg/m³ (IC with suppression) LOQ: 0,083 mg/m³ (IC without suppression) LOQ: 0,22 mg/m³ (CE) Working range: LOQ – 0,8 mg/m³ Repeatability and reproducibility < 10 %	A	Method partially validated (performance data available) Thoracic sampler not used. Inhalable sampler not used but wall deposits taken into account.

List No. 97	**Substance** Sulphuric acid	**CAS-No.** 7664–93–9	**EINECS-No.** 231–639–5		**Limit Values*** 0,05 mg/m³ (8 h) thoracic aerosol 0,1 mg/m³ to 1 mg/m³ (8 h) inhalable aerosol 0,1 mg/m³ to 3 mg/m³ (15 min) inhalable aerosol			
No.	**Source and method name**	**Language**	**Year of publication**	**Principle of the method**	**Flow rate/ Recommended air volume**	**LOQ/ Validated working range/ Expanded uncertainty/ Variability**	**Rating**	**Remarks**
11	OSHA ID-113 https://www.osha.gov/dts/sltc/methods/inorganic/id113/id113.html	English	1980	MCE filter to collect the aerosol. Add 10 ml of eluent (3 mM Na_2CO_3 / 2,4 mM $NaHCO_3$) to the filter. ICA with conductivity detection.	2 l/min 480 l	WR: 0,01 mg/m³ to 10 mg/m³ Accuracy: 9,0 % (OSHA protocol)	B	Brief method description Partially validated Similar methods described in DFG (1) and IFA 6173 Inhalable sampler not used
LOQ Limit of quantification, WR Working range, MCE Mixed cellulose esters; ICA Immediate constituent analysis								

Bibliography

[1] Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work (fourteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)

[2] Database: GESTIS – Analytical methods, http://www.dguv.de/ifa/GESTIS/GESTIS-Analysenverfahren-für-chemische-Stoffe/index-2.jsp

[3] Database: GESTIS – International limit values for chemical agents, http://www.dguv.de/ifa/GESTIS/GESTIS-Internationale-Grenzwerte-für-chemische-Substanzen-limit-values-for-chemical-agents/index-2.jsp

[4] European Chemicals Agency (ECHA), Guidance on Information Requirements and Chemical Safety Assessment, Chapter R.15: Consumer exposure assessment, Version 3.0, July 2016, https://echa.europa.eu/documents/10162/13632/information_requirements_r15_en.pdf

[5] VINCENT. R., JEANDEL, B.: COLCHIC - Occupational exposure to chemical agents database: current contents and development perspectives. *Appl. Occup. Environ. Hyg.* 2001, **16** (2) pp. 115–121

[6] STAMM. R.: MEGA-Database: One Million Data Since 1972. *Appl. Occup. Environ. Hyg.* 2000, **16** (2) pp. 159–163

[7] EN 482:2012+A1:2015, *Workplace exposure — General requirements for the performance of procedures for the measurement of chemical agents*

[8] EN 689, *Workplace atmospheres — Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy*

[9] EN 838:2010, *Workplace exposure — Procedures for measuring gases and vapours using diffusive samplers — Requirements and test methods*

[10] EN 1076, *Workplace exposure — Procedures for measuring gases and vapours using pumped samplers — Requirements and test methods*

[11] EN 13205 (all parts), *Workplace exposure — Assessment of sampler performance for measurement of airborne particle concentrations*

[12] EN 13890:2009, *Workplace exposure — Procedures for measuring metals and metalloids in airborne particles — Requirements and test methods*

[13] EN 13936, *Workplace exposure — Procedures for measuring a chemical agent present as a mixture of airborne particles and vapour — Requirements and test methods*

[14] EN ISO 13137, *Workplace atmospheres — Pumps for personal sampling of chemical and biological agents - Requirements and test methods (ISO 13137)*

[15] ISO 78-2, *Chemistry — Layouts for standards — Part 2: Methods of chemical analysis*

[16] ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

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