UL 80079-20-1

STANDARD FOR SAFETY

Explosive Atmospheres – Part 20-1: Material Characteristics for Gas and Vapour Classification – Test Methods and Data

UL Standard for Safety for Explosive Atmospheres – Part 20-1: Material Characteristics for Gas and Vapour Classification – Test Methods and Data, UL 80079-20-1

First Edition, Dated June 2, 2020

Summary of Topics

This First Edition of ANSI/UL 80079-20-1, the Standard for Explosive Atmospheres – Part 20-1: Material Characteristics for Gas and Vapour Classification – Test Methods and Data, is an adoption of ISO/IEC 80079-20-1 (first edition, issued by ISO/IEC December 2017) and Corrigendum 1 (issued 2018).

UL 80079-20-1 is an IEC-based UL standard with US Differences.

The new requirements are substantially in accordance with Proposal(s) on this subject dated December 6, 2019 and February 21, 2020.

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UL 80079-20-1

Standard for Explosive Atmospheres – Part 20-1: Material Characteristics for Gas and Vapour Classification – Test Methods and Data

First Edition

June 2, 2020

This ANSI/UL Standard for Safety consists of the First Edition.

The most recent designation of ANSI/UL 80079-20-1 as an American National Standard (ANSI) occurred on June 2, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

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Preface (UL)

This UL Standard is based on ISO/IEC Publication 80079-20-1: First edition, Explosive Atmospheres – Part 20-1: Material Characteristics for Gas and Vapour Classification – Test Methods and Data. ISO/IEC publication 80079-20-1 is copyrighted by the IEC.

This edition has been issued to satisfy UL Standards policy.

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> Note – Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

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There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

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FOREWORD

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EXPLOSIVE ATMOSPHERES – Part 20-1: Material characteristics for gas and vapour classification – Test methods and data

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International Standard ISO/IEC 80079-20-1 has been prepared by subcommittee 31M: Non-electrical equipment and protective systems for explosive atmospheres, of IEC technical committee 31: Equipment for explosive atmospheres.

This first edition of ISO/IEC 80079-20-1 cancels and replaces IEC 60079-20-1:2010. It constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition:

The classifications for the temperature class or equipment group were changed in the informative Annex B for the following materials: CAS-No. 64-17-5; 78-93-3; 107-31-3:

- For dry Ethanol (CAS-No. 64-17-5), equipment group remains IIB, but for Ethanol in air with ≥4% water vapour, as in common atmospheres, a second line has been added to indicate IIA;

- For 2-Butanone (CAS-No. 78-93-3), re-measurement indicated change from IIB to IIA was needed; and
- For Formic Acid Methyl Ester (CAS-No. 107-31-3), re-measurement indicated change from T2 to T1 was justified.

No significant changes were made with respect to the normative text of IEC 60079-20-1:2010.

It is published as a double logo standard.

The text of this standard is based on the following documents:

FDIS	Report on voting
31M/122/FDIS	31M/126/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60079 series, under the general title: *Explosive atmospheres*, as well as the International Standard 80079 series, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore. iec. ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

EXPLOSIVE ATMOSPHERES – Part 20-1: Material characteristics for gas and vapour classification – Test methods and data

1 Scope

1DV DR *Modification of Clause 1 to replace with the following:*

This standard ~~part of ISO/IEC 80079~~ provides guidance on classification of gases and vapours for the purpose of area classification in accordance with NFPA 70, National Electrical Code (NEC) as hazardous (Classified) locations. It describes a test method intended for the measurement of the maximum experimental safe gaps (MESG) for gas-air mixtures or vapour-air mixtures under normal conditions of temperature and pressure (20 °C, 101,3 kPa) so as to permit the selection of an appropriate group of equipment. This document also describes a test method intended for use in the determination of the auto-ignition temperature (AIT) of a vapour-air mixture or gas-air mixture at atmospheric pressure, so as to permit the selection of an appropriate temperature class of equipment.

Values of chemical properties of materials are provided to assist in the selection of equipment to be used in hazardous areas. Further data may be added as the results of validated tests become available.

The materials and the characteristics included in a table (see Annex B) have been selected with particular reference to the use of equipment in hazardous areas. The data in this document have been taken from a number of references which are given in the bibliography.

These methods for determining the MESG or the AIT may also be used for gas-air-inert mixtures or vapour-air-inert mixtures. However, data on air-inert mixtures are not tabulated.

Where references are made to IEC standards, the referenced requirements found in these standards shall apply as modified by any applicable US National Differences for the standard (see Clause 2).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

2DV DR *Modification of Clause 2 references to replace with the following:*

IEC 60050-426, *International Electrotechnical Vocabulary − Part 426: Electrical apparatus for explosive atmospheres* (available at http://www.electropedia.org/)

IEC 60079-11, *Explosive atmospheres − Part 11: Equipment protection by intrinsic safety "i"*

~~**IEC 60079-14, *Explosive atmospheres − Part 14: Electrical installations design, selection and erection***~~

NFPA 70 National Electrical Code (NEC)

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-426 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
auto-ignition
reaction which is evidenced by a clearly perceptible flame and/or explosion, and for which the ignition delay time does not exceed 5 min

Note 1 to entry: See 7.2.2 for a test method.

3.2
ignition delay time
time between the completed injection of the flammable material and the ignition

3.3
auto-ignition temperature
AIT
lowest temperature (of a surface) at which under specified test conditions an ignition of a flammable gas or vapour in mixture with air or air-inert gas occurs

Note 1 to entry: See Clause 7 for a test method.

3.4
maximum experimental safe gap
MESG
maximum gap of a joint of 25 mm in width which prevents any transmission of an explosion during tests made under the conditions specified in this document

Note 1 to entry: See Clause 6 for a test method.

3.5
minimum igniting current
MIC
minimum current in a specified test circuit that causes the ignition of the explosive test mixture in the spark test apparatus according to IEC 60079-11

Note 1 to entry: See 5.1.6 for the test circuit.

3.6
flammable limits
lower flammable limit (LFL) and upper flammable limit (UFL) of gas in a gas-air mixture, between which a flammable mixture is formed

Note 1 to entry: The term “explosive limits” is used especially in European standardization and regulations interchangeably to describe these limits.

Note 2 to entry: The concentration can be expressed as either a volume fraction or a mass per unit volume.

3.6.1

lower flammable limit

LFL

concentration of flammable gas or vapour in air, below which an explosive gas atmosphere does not form

Note 1 to entry: For the purposes of Ex Equipment, this was previously referred to as the lower explosive limit (LEL).

Note 2 to entry: The concentration can be expressed as either a volume fraction or a mass per unit volume.

3.6.2

upper flammable limit

UFL

concentration of flammable gas or vapour in air, above which an explosive gas atmosphere does not form

Note 1 to entry: For the purposes of Ex Equipment, this was previously referred to as the upper explosive limit (UEL).

Note 2 to entry: The concentration can be expressed as either a volume fraction or a mass per unit volume.

3.7

equipment grouping

classification system of equipment related to the explosive atmosphere for which they are intended to be used

Note 1 to entry: IEC 60079-0 identifies three equipment groups:

Group I − equipment for mines susceptible to fire damp;

Group II, which is sub-divided into groups IIA, IIB and IIC − equipment for all places with an explosive gas atmosphere other than mines susceptible to fire damp;

Group III, which is sub-divided into groups IIIA, IIIB and IIIC − equipment for all places with an explosive dust atmosphere other than mines susceptible to fire damp.

3.8

flash point

FP

lowest liquid temperature at which, under specified test conditions, a liquid gives off vapours in quantity such as to be capable of forming an ignitable vapour-air mixture

3.9

gas

gaseous phase of a substance that cannot reach equilibrium with its liquid or solid state in the temperature and pressure range of interest

Note 1 to entry: This is a simplification of the scientific definition, and merely requires that the substance is above its boiling point or sublimation point at the ambient temperature and pressure.

3.10

vapour

gaseous phase of a substance that can reach equilibrium with its liquid or solid state in the temperature and pressure range of interest

Note 1 to entry: This is a simplification of the scientific definition, and merely requires that the substance is below its boiling point or sublimation point at the ambient temperature and pressure.

4 Classification of gases and vapours

4.1 General

Equipment Group I addresses mines susceptible to firedamp.

NOTE Firedamp consists mainly of methane, but always contains small quantities of other gases, such as nitrogen, carbon dioxide, and hydrogen, and sometimes ethane and carbon monoxide. The terms firedamp and methane are used frequently in mining practice as synonyms.

Equipment Group II addresses flammable gases and vapours other than in mines susceptible to firedamp. Equipment Group II gases and vapours are classified according to their MESG and/or MIC ratio into equipment groups IIA, IIB and IIC.

All flammable materials are classified according to their AIT into temperature classes.

4.2 Classification according to the maximum experimental safe gap (MESG)

Gases and vapours may be classified according to their MESG into Equipment Groups IIA, IIB or IIC, based on the determination method described in this document. In order to ensure standardized results the MESG apparatus is dimensioned to avoid the possible effects of obstruction on the safe gaps.

NOTE 1 The standard method for determining MESG is described in 6.2, but where determinations have been undertaken only in an 8 l spherical vessel with ignition close to the flange gap these can be accepted provisionally.

NOTE 2 The design of the test apparatus for safe gap determination, other than that used for selecting the appropriate equipment group of enclosure for a particular gas, may need to be different to the one described in this document. For example, the volume of the enclosure, flange width, gas concentrations and the distance between the flanges and any external wall or obstruction may have to be varied. As the design depends on the particular investigation which is to be undertaken, it is impracticable to recommend specific design requirements, but for most applications the general principles and precautions indicated in this document will still apply.

NOTE 3 In IEC 60079-14 minimum distances of obstruction from the flameproof flange joints related to the equipment group of the hazardous area are given.

For the purpose of classification the MESG limits are:

Equipment Group IIA:	MESG ≥ 0,90 mm.
Equipment Group IIB:	0,50 mm < MESG < 0,90 mm.
Equipment Group IIC:	MESG ≤ 0,50 mm.

Determination of both the MESG and MIC ratio is required when 0,50 < MESG < 0,55. Then the equipment group is determined by MIC ratio,

NOTE 4 For gases and highly volatile liquids, the MESG is determined at 20 °C.

NOTE 5 If it was necessary to do the MESG determination at temperatures higher than ambient temperature a temperature 5 K above that needed to give the necessary vapour pressure or 50 K above the flash point is used and this value of MESG is given in the table and the classification of the equipment group is based on this result.

4.3 Classification according to the minimum igniting current ratio (MIC ratio)

Gases and vapours may be classified according to the ratio of their minimum igniting currents (MIC) to the ignition current of laboratory methane into Equipment Groups IIA, IIB or IIC. The purity of laboratory methane shall be not less than 99,9 % by volume.

NOTE The standard method of determining MIC ratios is with the apparatus described in IEC 60079-11, but where determinations have been undertaken in other apparatus these can be accepted provisionally.

For the purpose of classification the MIC ratios are:

Equipment Group IIA: MIC > 0,80.

Equipment Group IIB: $0,45 \leq MIC \leq 0,80$.

Equipment Group IIC: MIC < 0,45.

Determination of both the MESG and MIC ratio is required when 0,70 < MIC < 0,90 or 0,40 < MIC < 0,50. Then the equipment group is determined by MESG.

4.4 Classification according to the similarity of chemical structure

When a gas or vapour is a member of a homologous series of compounds, the classification of the gas or vapour can provisionally be inferred from the data of the neighbouring members of the series.

The classification according to the similarity of chemical structure is not allowed if the classification of one of the neighbouring members is based on MESG and the other on MIC ratio.

4.5 Classification of mixtures of gases

Mixtures of gases should generally be allocated to an equipment group only after a special determination of MESG or MIC ratio. One method to estimate the equipment group is to determine the MESG of the mixture by applying a form of Le Châtelier's principle:

$$MESG_{\text{mix}} = \frac{1}{\sum_i \left(\frac{X_i}{MESG_i} \right)}$$

Where X_i is the percentage by volume of material *i* and $MESG_i$ is the MESG of material *i*.

This method should not be applied in case of exceptions to the Le Châtelier's principle and to mixtures and/or streams that have:

a) acetylene or its equivalent hazard (e.g. self-decomposition properties);

b) oxygen or other strong oxidizer as one of the components;

c) large concentrations (over 5 % by volume) of carbon monoxide. Because unrealistically high MESG values may result, caution should be exercised with two component mixtures where one of the components is an inert, such as nitrogen.

For mixtures containing an inert such as nitrogen in concentrations less than 5 % by volume, use an MESG of infinity. For mixtures containing an inert such as nitrogen in concentrations 5 % by volume and greater, use an MESG of 2.

NOTE An alternate method that includes stoichiometric ratios is presented in the essay “Maximum experimental safe gap of binary and ternary mixtures,” by Brandes and Redeker.

5 Data for flammable gases and vapours, relating to the use of equipment

5.1 Determination of the properties

5.1.1 General

The compounds listed in this document are in accordance with Clause 4, or have physical properties similar to those of other compounds in that list.

5.1.2 Equipment group

The equipment groups are the result of MESG or MIC ratio determination except where there is no value listed for MESG or MIC ratio. For these, the equipment group is based on chemical similarity (see Clause 4).

NOTE If it was necessary to do the MESG determination at temperatures higher than ambient temperature, a temperature 5 K above that needed to give the necessary vapour pressure or 50 K above the Flash Point is used. This value of MESG is given in Table B.1 and the classification of the equipment group is based on this result.

5.1.3 Flammable limits

Determinations have been made by a number of different methods, but the preferred method is with a low energy ignition at the bottom of a vertical tube. The values (in percentage by volume and mass per volume) are listed in Table B.1.

If the flash point is high, the compound does not form a flammable vapour air/mixture at normal condition of temperature (20 °C). Where flammability data are presented for such compounds the determinations have been made at a temperature sufficiently elevated to allow the vapour to form a flammable mixture with air.

5.1.4 Flash point (FP)

The value given in Table B.1 is the “closed cup” measurement. When this data was not available, the “open cup” value is quoted and indicated by (oc). The symbol < (less than), indicates that the flash point is below the value (in degree Celsius) stated, this probably being the limit of the apparatus used.

5.1.5 Temperature class

5.1.5DV DR *Modification of Clause 5.1.5 to replace with the following:*

The temperature class of a gas or vapour is given according to NFPA 70 ~~IEC 60079-14~~, as shown in Table 1:

Table 1
Classification of temperature class and range of auto-ignition temperatures

Temperature class	Range of auto-ignition temperature (AIT) °C
T1	> 450
T2	300 < AIT ≤ 450
T3	200 < AIT ≤ 300
T4	135 < AIT ≤ 200
T5	100 < AIT ≤ 135
T6	85 < AIT ≤ 100

5.1.6 Minimum igniting current (MIC)

The apparatus for the determination of minimum igniting current is defined in IEC 60079-11. The test apparatus shall be operated in a 24 V d.c. circuit containing a (95 ± 5) mH air-cored coil. The current in this circuit is varied to a minimum value until ignition of the most easily ignited concentration of the specific gas or vapour in air is obtained.

5.1.7 Auto-ignition temperature (AIT)

The value of auto-ignition temperature depends on the method of testing. The preferred method and data obtained is given in Clause 7 and in Annex A.

If the compound is not included in these data, the data obtained in similar apparatus, such as the apparatus described by ASTM E659, is listed.

NOTE Results from using the apparatus described in ASTM D2155 (now replaced by ASTM E659) were reported by C.J. Hilado and S.W. Clark. The apparatus is similar to the one used by Zabetakis. If there is no determination by either the IEC apparatus, nor similar apparatus, the lowest value obtained in other apparatus is listed. A more comprehensive list of data for auto-ignition temperature, with the reference to sources, is given by Hilado and Clark.

5.2 Properties of particular gases and vapours

5.2.1 Coke oven gas

Coke oven gas is a mixture of hydrogen, carbon monoxide and methane. If the sum of the concentrations (Vol. %) of hydrogen and carbon monoxide is less than 75 % by volume of the total, flameproof equipment of Equipment Group IIB is recommended; otherwise, equipment of Equipment Group IIC is recommended.

5.2.2 Ethyl nitrite

The auto-ignition temperature of ethyl nitrite is 95 ° C, above which the gas suffers explosive decomposition.

NOTE Ethyl nitrite is not be confused with its isomer, nitroethane.

5.2.3 MESG of carbon monoxide

The MESG for carbon monoxide relates to a mixture with air saturated with moisture at normal ambient temperature. This determination indicates the use of Equipment Group IIB equipment in the presence of carbon monoxide. A larger MESG may be observed with less moisture. The lowest MESG (0,65 mm) is observed for a mixture of CO/H_2O near 7:1 mole ratio. Small quantities of hydrocarbon in the carbon monoxide-air mixture have a similar effect in reducing the MESG so that Equipment Group IIB equipment is required.

5.2.4 Methane, Equipment Group IIA

Industrial methane, such as natural gas, is classified as Equipment Group IIA, provided it does not contain more than 25 % by volume of hydrogen. A mixture of methane with other compounds from Equipment Group IIA, in any proportion, is classified as Equipment Group IIA.

6 Method of test for the maximum experimental safe gap (MESG)

6.1 Outline of method

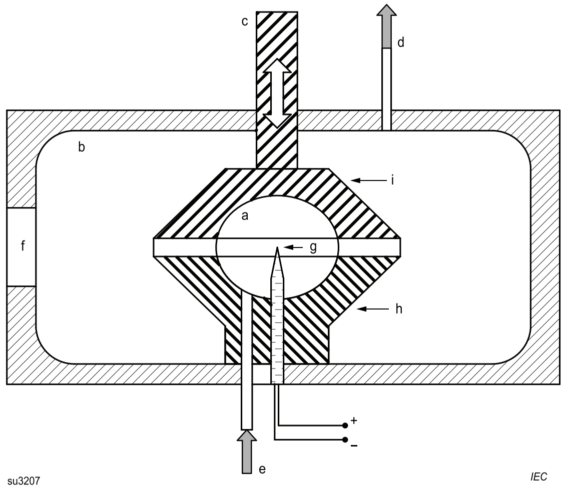
The interior and exterior chambers of the test apparatus are filled with a known mixture of the gas or vapour in air, under normal conditions of temperature and pressure (20 °C, 101,3 kPa) and with the circumferential gap between the two chambers accurately adjusted to the desired value. The internal mixture is ignited and the flame propagation, if any, is observed through the windows in the external chamber. The maximum experimental safe gap for the gas or vapour is determined by adjusting the gap in small steps to find the maximum value of gap which prevents ignition of the external mixture, for any concentration of the gas or vapour in air.

NOTE An exception is made for substances with vapour pressures which are too low to permit mixtures of the required concentrations to be prepared at normal ambient temperatures. For these substances, a temperature 5 K above that needed to give the necessary vapour pressure or 50 K above the flash point is used.

6.2 Test apparatus

6.2.1 General

The apparatus is described in the following subclauses and is shown schematically in Figure 1. It is also possible to use an automatic set-up when it is proven that the same results are obtained as with a manual apparatus.



Key

[a] interior spherical chamber

[b] exterior cylindrical enclosure

[c] adjustable part

[d] outlet of mixture

[e] inlet of mixture

[f] observation windows

[g] spark electrode

[h] lower gap plate, fixed

[i] upper gap plate, adjustable

Figure 1

Test apparatus

6.2.2 Material and mechanical strength

The whole apparatus is constructed to withstand a maximum pressure of 1 500 kPa without significant expansion of the gap, so that no such expansion of the gap will occur during an explosion.

The main parts of the test apparatus, and in particular the walls and flanges of the inner chamber and the electrodes of the spark-gap, are normally of stainless steel. Other materials may have to be used with some gases or vapours, however, in order to avoid corrosion or other chemical affects. Light alloys should not be used for the spark-gap electrodes.

6.2.3 Exterior chamber

The exterior cylindrical enclosure "b" has a diameter of 200 mm and a height of 75 mm.

6.2.4 Interior chamber

The interior chamber "a" is a sphere with a volume measuring 20 cm^3. The interior chamber is placed in the centre of the exterior chamber.

6.2.5 Gap adjustment

The two parts "i" and "h" of the internal chamber are so arranged that an adjustable 25 mm gap can be set up between the plane parallel faces of the opposing rims. The exact width of the gap can be adjusted by means of the micrometer (part "c").

6.2.6 Injection of mixture

The internal chamber is filled with the gas-air or vapour-air mixture through an inlet ("e"). The exterior chamber is filled with the mixture via the gap. The inlet and outlet should be protected by flame arresters.

6.2.7 Position of ignition source

The electrode "g" shall be mounted in such a way that the spark occurs in the centre of the internal chamber.

6.3 Procedure

6.3.1 Preparation of gas mixtures

As the consistency of the mixture concentration, for a particular test series, has a pronounced effect on the dispersion of the test results, it has to be carefully controlled. The flow of the mixture through the chamber is therefore maintained until the inlet and outlet concentrations are the same, or a method of equivalent reliability shall be used.

For the classification according to this document, the moisture content of the air used for the preparation of the mixture should not exceed 10 % relative humidity. Higher values of humidity could result for some substances in lower MESG values.

6.3.2 Temperature and pressure

The tests are made at an ambient temperature of (20 ± 5) °C, except where otherwise permitted. The pressure within the test apparatus is adjusted to (101,3 ± 1) kPa.

NOTE An exception is made for substances with vapour pressures which are too low to permit mixtures of the required concentrations to be prepared at normal ambient temperatures. For these substances, a temperature 5 K above that needed to give the necessary vapour pressure or 50 K above the flash point is used.

6.3.3 Gap adjustment

The gap is first reduced to a very small value and examined to ensure that the flanges are parallel. The zero setting of the gap is checked but the value of torque applied should be low (e.g. a force of about 10^{-2} N applied at the circumference of the micrometer head).

6.3.4 Ignition

The internal mixture is ignited by an electrical spark generated by a high voltage transformer, with a root mean square of approximately 15 kV and a short circuit current of 30 mA. The spark discharge time shall be adjusted to 0,2 s.

6.3.5 Observation of the ignition process

Ignition of the internal mixture is confirmed by observation through the gap when the test is made. If no internal ignition occurs, the test is invalid. Ignition of the mixture in the external chamber is taken to occur when the whole volume of the chamber is seen to be filled by the flame of the explosion.

6.4 Determination of maximum experimental safe gap (MESG)

6.4.1 General

Mostly, the MESG is found at slightly rich mixtures, so it is recommended to start with the stoichiometric mixture.

6.4.2 Preliminary tests

With a defined mixture of the combustible vapour or gas with air, two ignition tests are carried out on a number of gaps, at 0,02 mm intervals, covering the range from a safe gap to an unsafe gap. From the results, the highest gap, g_0, at which there is 0 % probability of ignition of the outer volume, and the lowest gap, g_{100}, giving 100 % probability of ignition of the outer volume, are determined.

The test series is repeated with a range of mixture concentrations, and the variation of the gap g_0 and g_{100} are obtained. The most incendive mixture is that for which these values are a minimum.

6.4.3 Confirmatory tests

The results are confirmed by repeating the tests, with 10 ignition tests for each step of gap adjustment, at different concentrations above and below the mixture found in the preliminary series. The minimum values of g_0 and g_{100} are then determined.

6.4.4 Reproducibility of maximum experimental safe gaps (MESG)

The highest acceptable difference between the values of $(g_0)_{\text{min}}$ obtained from different test series is 0,04 mm.

If all values are within this range, the tabulated value of MESG will be equal to $(g_0)_{\text{min}}$ where $(g_{100})_{\text{min}} - (g_0)_{\text{min}}$ is the smallest. For most substances, this difference will lie within one step of gap adjustment, i.e. within 0,02 mm.

If the difference between the values of $(g_0)_{\text{min}}$ taken from different test series exceeds 0,04 mm, the laboratories concerned should repeat their tests after confirming that the test apparatus is able to reproduce the tabulated value for hydrogen.

6.4.5 Tabulated values

The values of the MESG, the difference $(g_{100})_{\text{min}} - (g_0)_{\text{min}}$ and the most incendive mixture determined in 6.4.1 are tabulated in Annex B.

The value of the MESG is used to determine the equipment group. The value $(g_{100})_{\text{min}} - (g_0)_{\text{min}}$ indicates the accuracy of the tabulated value of the MESG.

6.5 Verification of the MESG determination method

This verification procedure shall be used for new apparatus as well as for checking the performance of existing apparatus. Existing apparatus shall be checked at least every 12 months or whenever parts of the apparatus have been changed or renewed. For new apparatus, carry out experiments according to the instructions given in 6.3 with all the substances listed in Table 2. When renewing the test vessel it is in general sufficient to carry out the check test with methane and hydrogen.

Verification will be confirmed if the values obtained do not deviate more than ± 0,02 mm from the values given in Table 2. The values are valid for an ambient temperature of (20 ± 2) °C and an ambient pressure of (100 ± 2) kPa.

If the results obtained by the test apparatus meet the required verification performance, record this fact in a permanent report.

Table 2
Values for verification of the apparatus

Flammable substance	Concentration range Vol. %	MESG mm	Purity of substances mol %
Methane	8,0 to 10,0	1,16	99,995
Propane	3,5 to 4,5	0,92	99,95
Hydrogen	29,0 to 31,0	0,30	99,999

If the results obtained by the test apparatus do not meet the required verification performance, check the apparatus, especially the plane parallelism of the faces of the inner volume. The parallel offset of the faces has to be less than 0,01 mm for distances between 0,3 mm and 1,5 mm. If appropriate verify again.

7 Method of test for auto-ignition temperature (AIT)

7.1 Outline of method

A known volume of the product to be tested is injected into a heated open flask containing air. The contents of the flask are observed until ignition occurs. The test is repeated with different flask temperatures and different sample volumes. The lowest flask temperature at which ignition occurs is recorded as the auto-ignition temperature.

7.2 Apparatus

7.2.1 General

Historically, two apparatus types have been used: the IEC apparatus described in A.2 and the DIN apparatus described in A.3. The difference is that the IEC apparatus has an additional heater at the neck of the flask. Normally there is no impact on the test results. The principle of the test apparatus is described in the following subclauses. It is also possible to use an automatic set-up.

The test apparatus consists of:

- a test vessel;
- support for the test vessel;
- calibrated measuring thermocouple;
- an electrical hot-air oven;
- metering devices for metering the flammable substance;
- a mirror for observing the ignition;

- timer;

- equipment for cleaning the test vessel.

7.2.2 Test vessel and support

The test vessel shall be a 200 ml narrow-necked Erlenmeyer flask made of borosilicate glass according to ISO 1773. It shall be ensured that the inner surface of the bottom is flat. A clean flask shall be used for tests.

The support for the Erlenmeyer flask shall ensure that the heat dissipation via the support is as low as possible. If the support is mounted at the neck it shall be ensured that it does not use more than (5 ± 2) mm of the height of the neck of the Erlenmeyer flask (for example see Annex A).

If there is special need to know exactly the influence of volume on the auto-ignition temperature additional experiments in larger (respectively smaller) volumes of the same shape and material may be carried out.

NOTE Data from literature show a decrease of the auto-ignition temperature with increasing volume where at the same time the ignition delay time increases. See Annex D.

Where the auto-ignition temperature of the test sample exceeds the softening point of a borosilicate glass flask, or where the sample would cause deterioration of such a flask, i.e. by chemical attack, a quartz or metal flask may be used, provided this is declared in the test report.

7.2.3 Thermocouples

The vessel shall be equipped with at least one calibrated measuring thermocouple of 1,5 mm maximum diameter, having an accuracy of 1,5 K or better. The thermocouple (s) shall be mounted with intimate contact to the external surface of the flask at a distance of (25 ± 2) mm to the bottom of the flask (see Annex A).

7.2.4 Oven

The oven shall be of sufficient dimensions to heat up the test vessel in a uniform manner. It shall be designed in such a way that

1) when the oven is covered with a well-fitting lid and after having reached the respective temperature equilibrium

   - the temperature measured at the position of the measuring thermocouple and the temperature measured at the position of the centre of the bottom of the Erlenmeyer flask differ not more than 3 K over the whole temperature range and

   - the temperature measured at the position of the measuring thermocouple and the temperature measured at the position half of the height of the Erlenmeyer flask along the vertical axis differ not more than 15 K over the whole temperature range;

2) when the oven is equipped with the Erlenmeyer flask filled with air

   - the temperature measured with the measuring thermocouple varies not more than 2 K over a period of 6 min over the whole temperature range.

Care shall be taken that there is no direct contact between the test vessel and the inner walls of the oven. The distance between the inner walls and the Erlenmeyer flask shall be at least 4 mm. The test vessel shall be mounted in such a way that

- it is totally immersed in the oven, whereas the oven should not overlap the Erlenmeyer flask more than 30 mm;

- it is uniformly heated;

- the mixture of air and flammable substance which is generated inside the Erlenmeyer flask by introducing the sample is not affected by the convection inside the oven;

- there is no possibility that the (explosive) mixture of air and flammable substance which is generated inside the Erlenmeyer flask by introducing the sample enters into the oven; and

- it is possible to meter the flammable substances and to observe the ignition.

Examples of ovens suitable for this purpose are described in Annex A.

7.2.5 Metering devices

For liquid samples, the metering device (e.g. pump, pipette, syringe) shall be designed in such a way that it is possible to meter droplets having a volume of (25 ± 10) µl. This requirement can be fulfilled by, for example:

a) a 0,25 ml or 1 ml hypodermic syringe equipped with a stainless steel needle of 0,15 mm maximum bore diameter, and calibrated in units not greater than 0,01 ml;

b) a calibrated 1 ml pipette allowing 1 ml of distilled water at room temperature to be discharged in 35 to 40 droplets.

For gaseous samples, the metering device (e.g. flow meter, pump, syringe) shall be designed in such a way that it is possible to meter the gas with an accuracy of 10 % at a rate of (25 ± 5) ml/s. A filling tube that can be introduced into the test vessel shall be connected (movably) to the metering device.

Precaution against flash-back is taken for gaseous samples. One method which has been used is illustrated diagrammatically in Figure A.9.

7.2.6 Mirror

It is recommended that a mirror should be suitably positioned approximately 250 mm above the flask to permit convenient observation of the interior of the flask.

7.2.7 Timer

A timer subdivided at least in one-second intervals shall be used to determine the ignition delay time.

7.2.8 Equipment for purging the test vessel with air

The equipment (e.g. pump, air gun) shall allow the quick and complete purging of the test vessel by flushing it with clean, oil-free air.

7.2.9 Automated apparatus

If automated apparatus are used they shall fulfill all the requirements stated in 7.2.2 to 7.2.8. If the monitoring of the ignition is automated as well, it shall be ensured that all kinds of flames (even the very pale ones and the very small ones) are monitored, e.g. by thermocouple and photodiode. Additional visual observation of ignition shall be possible.

7.3 Sampling, preparation and preservation of test samples

7.3.1 Sampling

For sampling of liquid or gaseous products use the respective national/international standards.

NOTE Respective standards are, for example, ISO 3170, ISO 3171, ISO 15528.

Samples shall only be taken or stored in appropriate containers that prevent degradation or contamination of the samples. For liquid mixtures the free vapour space above the sample shall not exceed 20 % of the container volume.

The sample shall be stored at appropriate temperatures to avoid any change in the composition.

If the sample consists of a gas mixture that is removed from a container containing a liquid phase, take into account that the composition of the gas and the liquid phase can be different. Hence, it is recommended to take the test substance from the liquid phase.

7.3.2 Preparation and preservation

The components necessary for the test shall fulfill the following requirements:

a) Air: The air shall be free of oil.

b) Synthetic air (mixture of oxygen and nitrogen only): The concentration of the oxygen shall be within a range of 20,5 % to 21,0 % by volume. If synthetic air is used, it shall be stated in the test report.

c) Inert gas: The purity of the inert gas, or the mixture of inert gases, shall be 99,8 % by volume or greater. If a mixture of inert gases is used, the composition of the mixture shall be stated in the test report.

d) Sample: The sample may be:

1) a single substance or

2) a mixture of substances or

3) a process sample (of known or unknown composition).

When a single substance or a mixture of substances is used, the purity of each substance shall be 99,8 % by volume or greater. In the case of a mixture of substances or a process sample of known composition the precision of the composition shall be stated in the test report. In the case of a process sample of unknown composition, the source of the sample or the sample shall be defined as well as possible (e.g. process conditions, other physical properties or safety characteristic data).

7.4 Procedure

7.4.1 General

The auto-ignition temperature is determined by varying the temperature of the test vessel and the amount of the sample.

It shall be ensured before each test that:

- the test vessel is clean, dry, without any residue and any visible alteration of the inner surface;

- the test vessel is flushed completely by air before each injection of the sample;

- before injecting the sample, the temperature of the test vessel is the intended one because cleaning and purging may lower the temperature.

If the auto-ignition temperature is to be determined in mixture with air/inert gas, purge the test vessel with the air/inert gas mixture after cleaning (with air) so that the atmosphere inside the Erlenmeyer flask is completely changed, or clean the test vessel with the air/inert gas mixture before each injection.

7.4.2 Sample injection

7.4.2.1 Liquid samples

When testing samples with boiling points at or near room temperature, care shall be taken to maintain the temperature of the sample injection system at a value which will ensure that no change of state occurs before the sample is injected into the test flask.

The required volume of the sample to be tested shall be injected as droplets (see 7.2.5) into the centre of the flask at a rate of 1 to 2 droplets per second. The metering device shall then be quickly withdrawn. Care shall be taken to avoid wetting the walls of the flask during injection.

7.4.2.2 Gaseous samples

The metering device and the connected filling tube are purged sufficiently (at least 10 times the volume) and then filled with the gas. The filling tube is introduced into the centre of the flask so that the outlet of the tube has a distance of (10 ± 2) mm to the bottom. The required volume shall then be injected into the test flask in portions of (10 ± 1) ml at a rate of about 25 ml per second, keeping the rate of injection as constant as possible. The filling tube shall then be quickly withdrawn from the flask.

7.4.3 Determination of the auto-ignition temperature (AIT)

7.4.3.1 Ignition criterion

Any flame detected within 5 min via the mirror or the photo-diode shall be taken as ignition.

Within 5 min a rapid temperature rise of at least 200 K with a rate of 10 K/s shall be met when using thermocouple(s) to detect an ignition.

NOTE With this criterion, normally hot flames are observed. Even if they are very pale ones (e.g. hydrogen, methane), these are hot flames. Some substances or mixtures of substances are able to form cool flames. For such cool flame phenomena see Annex C.

7.4.3.2 Testing procedure

The testing procedure to determine the auto-ignition temperature given in 7.4.3.3 to 7.4.3.8 shall be used.

7.4.3.3 Starting temperature

Starting from 80 °C the test vessel is heated up with a temperature rate of (5 ± 1) K/min. Whilst heating up inject every 20 K, (50 ± 5) ml in case of a gas or five droplets in case of a liquid till an ignition occurs. The test vessel shall be flushed completely by air before each injection. The temperature of the vessel at which this ignition occurs is the starting temperature.

The starting temperature shall be higher than the auto-ignition temperature.

7.4.3.4 Variation of temperature

Heat the test vessel to the starting temperature. Inject (50 ± 5) ml in the case of a gas or five droplets in the case of a liquid. If an ignition occurs within 5 min, lower the temperature of the test vessel in intervals of (5 ± 1) K till no ignition occurs within 5 min after introducing the same amount of sample. The test vessel shall be flushed completely by air before each injection.

7.4.3.5 Variation of amount

At that temperature of 7.4.3.4 where just no ignition occurred vary the introduced amount of the sample (from the (50 ± 5) ml in the case of a gas or five droplets in the case of a liquid) stepwise in increments of (10 ± 1) ml in the case of gases or (25 ± 10) µl in the case of liquids in both directions till an ignition occurs or until it is ensured that no ignition will occur at this temperature with any amount of sample. The test vessel shall be flushed completely by air before each injection.

7.4.3.6 Second variation of temperature

Choose the temperature found in 7.4.3.4 and the amount found in 7.4.3.5 where an ignition occurred. Lower the temperature of the test vessel in intervals of (2 ± 1) K till no ignition occurs within 5 min after introducing every time the same amount of substance as found in 7.4.3.5.

7.4.3.7 Second variation of amount

At the temperature of 7.4.3.6 vary the introduced amount of the sample (starting with the amount of 7.4.3.5 respectively. 7.4.3.6 for repeated tests) stepwise in increments of (10 ± 1) ml in the case of gases or (25 ± 10) µl in the case of liquids in both directions till an ignition occurs or until it is ensured that no ignition will occur at this temperature with any amount of sample. The test vessel shall be flushed completely by air before each injection.

7.4.3.8 Repetition of tests

Repeat 7.4.3.6 and 7.4.3.7 until a temperature is found where no ignition occurs whatever the amount of substance will be.

NOTE For flammable liquids, having the (initial) boiling point clearly above the ignition temperature as determined, an additional injection of air, after having metered the flammable liquid, may lower the ignition temperature remarkably (F. Gutte: Erdöl, Erdgas, Kohle: 111 1995, 203-207). For taking this into account, introduce (30 ± 10) ml of air with high velocity to mix up the vapour layer of the flammable liquid that is formed in such cases at the bottom of the test vessel.

Record the lowest temperature of the test vessel at which an ignition occurred (whatever the introduced amount of sample was) and the corresponding ignition delay time.

The last repetition round shall be repeated twice.

7.5 Auto-ignition temperature (AIT)

The lowest temperature at which auto-ignition occurs in the tests described in 7.4.3.8 reduced by 3 % and rounded to the next 1 °C shall be recorded as the auto-ignition temperature, provided that the results satisfy the validity requirements of 7.6. The corresponding auto-ignition delay time and the barometric pressure shall be recorded.

7.6 Validity of results

7.6.1 Repeatability

Results of repeated tests on pure substances obtained by the same operator and fixture shall be considered suspect if they differ by more than ±1 % of the mean value.

7.6.2 Reproducibility

Results of tests on pure substances obtained in different laboratories shall be considered suspect if they differ by more than ±3 % of the mean value.

NOTE For substances able to change the surface of flask during testing the values for repeatability and reproducibility may be greater than those given above.

7.7 Data

A record shall be kept of the sample identification (name, purity, source and/or characterization in the case of mixtures or process samples), oxidizer identification (atmospheric or synthetic air; composition, purity and amount of added inert), test conditions (ambient temperature and ambient pressure), automated test set-up used or not, type of oven used, results (auto-ignition temperature and auto-ignition delay time; amount of sample at which the AIT is found).

7.8 Verification of the auto-ignition temperature determination method

This verification procedure shall be used for new apparatus as well as for checking the performance of existing apparatus. Existing apparatus has to be checked at least every 12 months or whenever parts of the apparatus have been changed or renewed. For new apparatus, carry out experiments according to the instructions given in 7.3 with all the substances listed in Table 3, starting the tests at the given starting temperature. When renewing the test vessel it is in general sufficient to carry out the check test with only one of the substances chosen according to the temperature range expected. The purity of the substances ethylene and acetone shall be 99,8 mol % or greater, and that of *n*-Heptane shall be 99,3 mol % or greater.

The values given in Table 3 are the respective mean values of the lowest temperatures reached by interlaboratory tests.

Verification will be confirmed if the values obtained for the lowest temperature for ignition do not deviate more than ±3 % from the values given in Table 3. The values are valid for an ambient temperature of (20 ± 2) °C and an ambient pressure of (100 ± 2) kPa.

Table 3
Values for verification of the apparatus

Flammable substance	Starting temperature °C	Measured lowest temperature for ignition °C
Acetone	560	528
Ethylene	455	436
n-Heptane	240	221

If the results obtained by the test apparatus meet the required verification performance, record this fact in a permanent report.

If the results obtained by the test apparatus do not meet the required verification performance, check the test vessel and the hot-air oven. If appropriate, change the test vessel and verify again.

Annex A
(normative)

Ovens of test apparatus for the tests of auto-ignition temperature

A.1 General

Ovens constructed in accordance with A.2 and A.3 are suitable for the tests described in Clause 7.

A.2 "IEC oven"

The "IEC oven" is shown schematically in Figure A.1 to Figure A.5.

NOTE Historically this consists of a refractory cylinder, 127 mm in internal diameter and 127 mm long, circumferentially wound with a 1 200 W electric heater uniformly spaced along its length; a suitable refractory insulating material and retaining shell; a cover ring and flask guide ring made from a board of refractory material; a 300 W neck heater and a 300 W base heater.

Three thermocouples are used, positioned 25 mm and 50 mm below the bottom of the neck heater, and under the base of the flask near its centre.

A.3 "DIN oven"

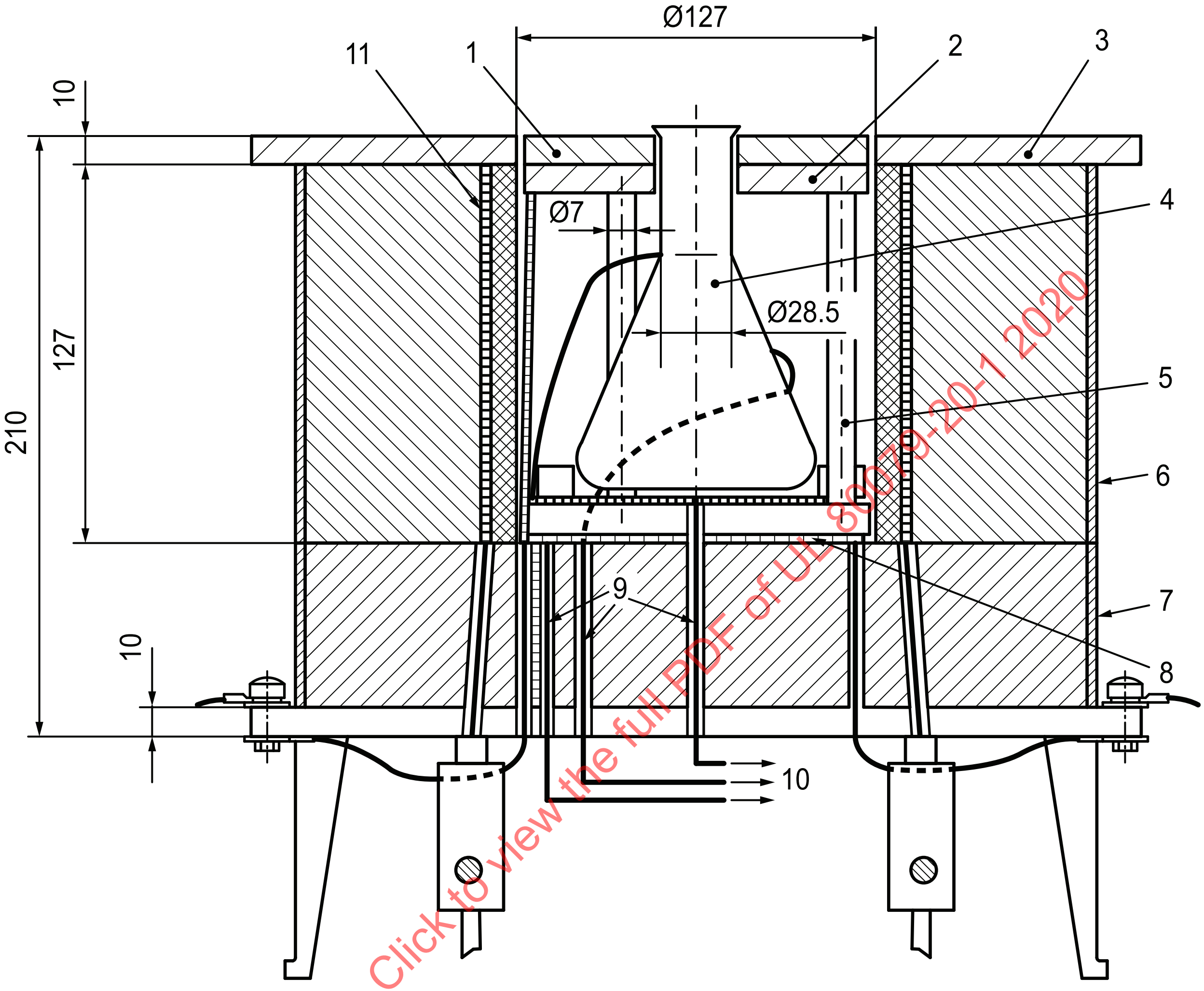
The "DIN oven" is shown schematically in Figure A.6 to Figure A.8. It consists of a resistance-heated oven of approximately 1 300 W, maximum heating current 6 A.

NOTE The heating wire, diameter 1,2 mm, length 35,8 m, of (Cr/Al 30/5) alloy is circumferentially wound round the full length of a ceramic cylinder, with a turn spacing of 1,2 mm. The heater is fixed in position with high temperature mastic and enclosed by a thermally insulating layer of aluminium oxide powder 20 mm thick. A stainless steel cylinder is inserted in the ceramic body with the smallest possible clearance. The lid, covering the whole oven, is also of stainless steel and holds the flask within the oven. For this purpose, the lid consists of a top disk, a split insulating gasket and a split lower disk. The neck of the flask is fitted into the lid with heat insulating packing and is held by the segments of the split gasket and the lower disk, which are squeezed against it and fixed to the top disk by means of two ring nuts.

The heater may be operated on a. c. or d. c. with appropriate means of voltage control. The maximum heating current of about 6 A should be used to attain the temperature required for the preliminary tests. If an automatic temperature control system is used, the heating and cooling periods should be of equal length and if possible only a part of the heater current should be so controlled.

Measurement thermocouples are positioned on the outer-surface of the wall of the flask, 25 mm ± 2 mm from its base, and at the centre of the under-surface of the base.

Dimensions in millimetres



su3208

IEC

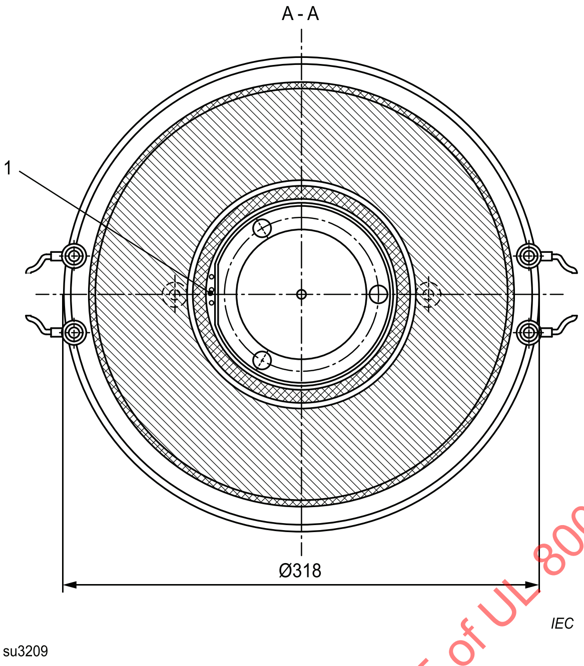
Key

1 cover ring
2 neck heater
3 board of refractory material
4 200 ml Erlenmeyer flask
5 ceramic support
6 retaining cylinder
7 electric crucible furnace
8 base heater
9 thermocouples
10 to potentiometers
11 main heater

Figure A.1

Test apparatus: assembly

Dimensions in millimetres



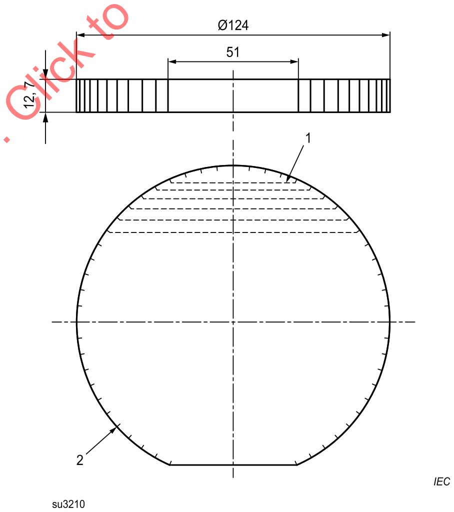
Key

1 wiring and thermocouple entry space

Figure A.2

Section A-A (flask omitted)

Dimensions in millimetres



Key

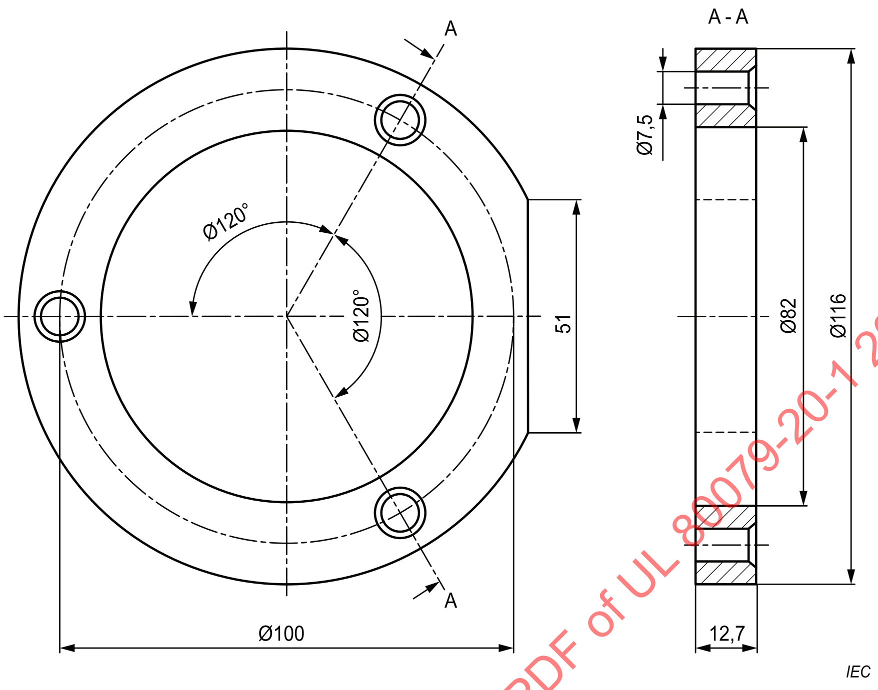
1 Dotted line indicates method of wiring.

2 Grooves cut approx. 1,5 mm wide and 1,5 mm deep on outside diameter of disk.
Nickel-chrome wire, length approx. 2,5 m and diameter 0,4 mm.

Figure A.3

Base heater (board made of refractory material)

Dimensions in millimetres

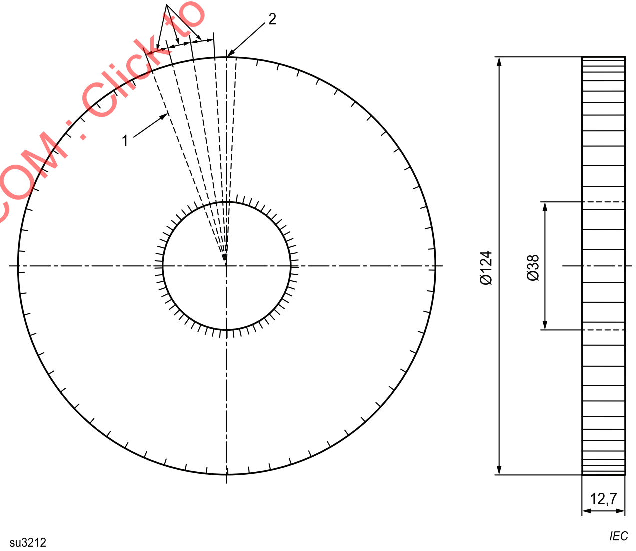


su3211

Figure A.4

Flask guide ring (board made of refractory material)

Dimensions in millimetres



su3212

Key

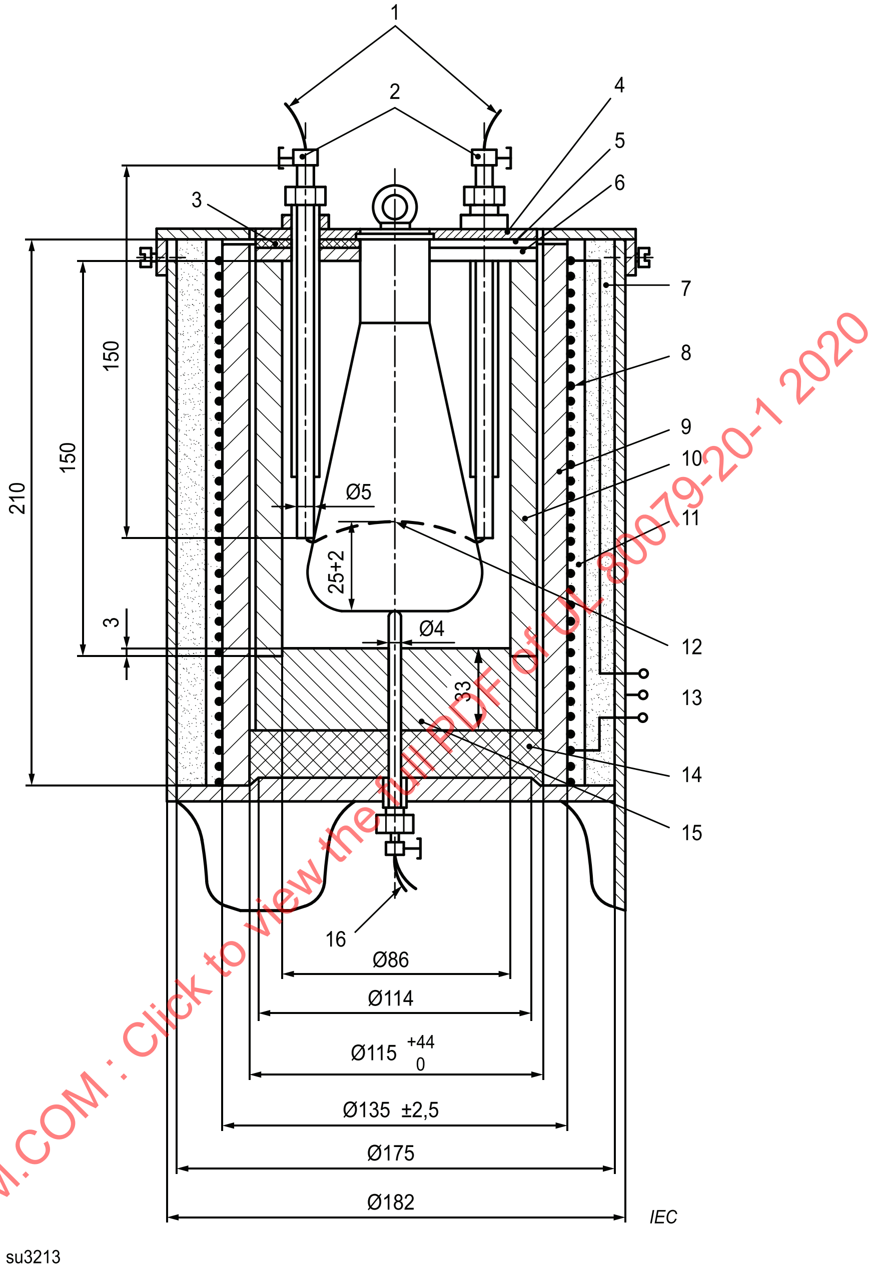
1 Dotted line indicates method of wiring.

2 Grooves cut approx. 1,5 mm wide and 1,5 mm deep on outside and inside diameter of ring.
Nickel-chrome wire, length approx. 4,5 m and diameter 0,4 mm.

Figure A.5

Neck heater (board made of refractory material)

Dimensions in millimetres



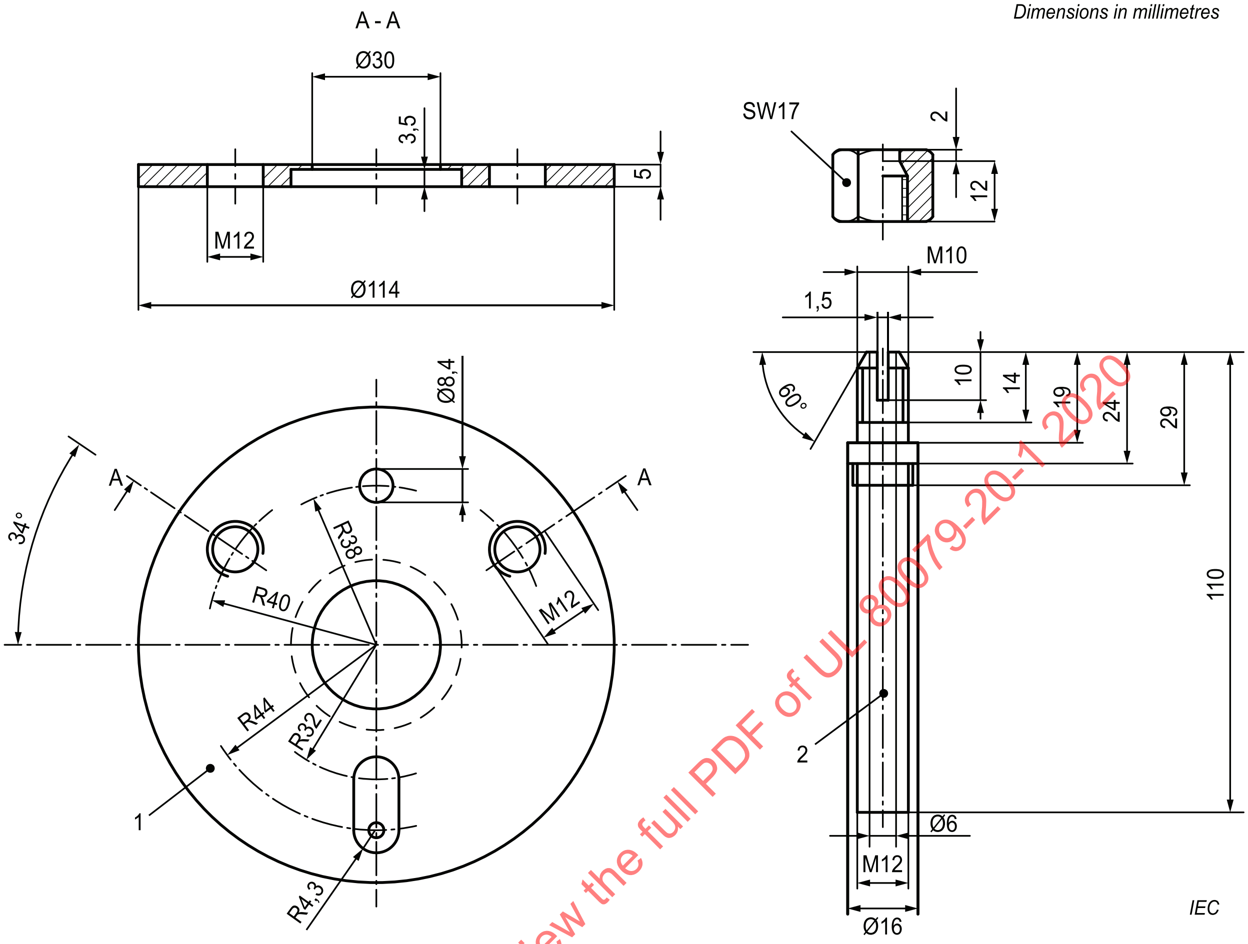
Key

1 thermocouples	9 ceramic tube
2 collets	10 steel cylinder
3 heat insulation	11 high temperature mastic
4 upper part of lid	12 test points
5 insulating ring	13 heater coupling 220 V
6 lower part of lid	14 insulating disk
7 thermal insulation	15 metal bottom
8 heater	16 thermocouples

Figure A.6

Oven

Dimensions in millimetres



su3214

Key

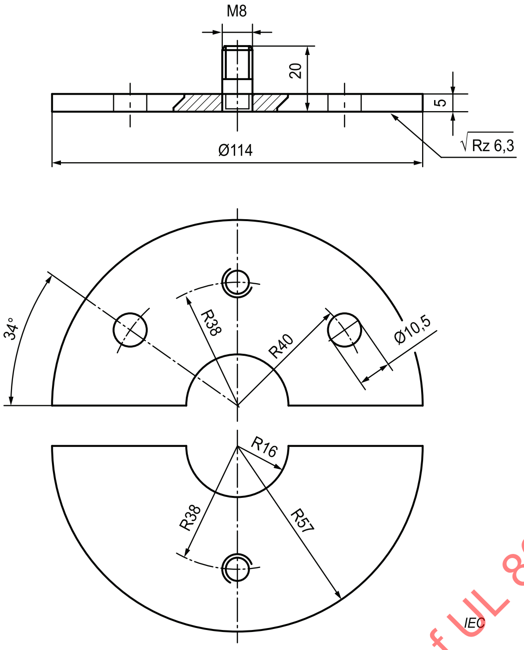
1 upper part of lid

2 fittings for thermocouples

Figure A.7

Lid of steel cylinder

Dimensions in millimetres



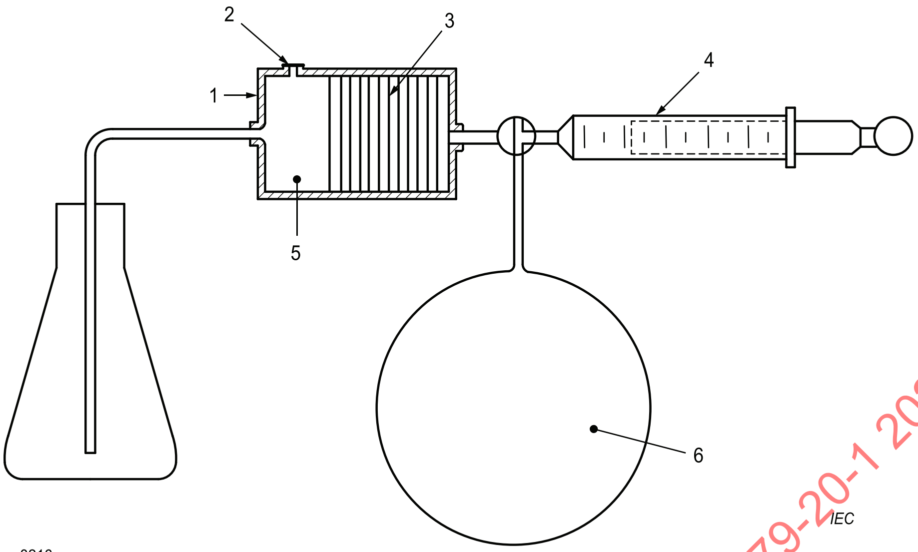
su3215

Key

1 lower two-piece part of lid

Figure A.8

Lid of steel cylinder



su3216

Key

1 flame trap	4 gas-tight syringe
2 1 mm thick plastic foil	5 antechamber
3 sintered glass disks about 10 mm × 3 mm	6 inflatable rubber reservoir

Figure A.9

Injection of gaseous sample

Annex B
(informative)

Tabulated values

The classification in this document provides guidance on the equipment group of equipment to be used in a particular gas/air or vapour/air mixture to avoid the danger of an explosion from an ignition source. It should be noted that some materials listed, for example ethyl nitrate, are relatively unstable and may be prone to spontaneous decomposition. The list of gases and vapours in Table B.1 should not be considered to be comprehensive.

Users of the data in this document should be aware that all its data are the result of experimental determinations, and as such are influenced by variation in experimental apparatus and procedures, and in the accuracy of instrumentation. In particular, some of the data have been determined at temperatures above ambient temperature, so that the vapour is within the flammable range. Variation in the temperature for the determination would be expected to influence the result of the determination; for example: lower flammability limits and maximum experimental safe gap decrease with increasing temperature and/or pressure; upper flammability limits increase with increasing temperature and/or pressure. Data are subject to revision and, where more recent information is required, the use of a maintained database is recommended.

NOTE For information on the availability of maintained databases refer to Bibliography.

The following values are tabulated:

a) CAS-number

CAS: chemical abstract system

b) English name

(= synonyms)

Formula

c) Relative density (air = 1)

d) Melting point

e) Boiling point

f) Flash point

g) Flammability limits

h) Ignition temperature

i) Most incendive mixture

j) MESG

k) $g_{100} - g_0$

l) MIC ratio

m) Temperature class

n) Equipment group

o) Method of classification

The significance of the letter against each gas is as follows:

a = classified according to MESG determination.

b = classified according to MIC ratio.

c = both MESG and MIC ratio have been determined.

d = classified according to similarity of chemical structure (provisional classification).

The meaning of the symbol "./." is that in some cases for some properties a value based on physical and chemical reasons is not possible.

The flammable limits are stated as volumetric (volume fraction of gas or vapour in entire test mixture (gas-air mixture) or mass (mass of gas or vapour in entire volume of test mixture) concentration and for converting LFL (or UFL) the following equation may be used:

$$LFL_{\mathrm{m}} = \frac{M \cdot P_{\mathrm{a}}}{R \cdot T_{\mathrm{a}}} \cdot \frac{LFL_{\mathrm{v}}}{100 - LFL_{\mathrm{v}}}$$

where

LFL_{m} is the mass LFL of test mixture [kg/m^3]

LFL_{v} is the volumetric LFL of test mixture [Vol. %]

M is the molar/molecular mass of test mixture [kg/kmol]

p_a is the normal atmospheric pressure (101,3 kPa)

T_a is the normal atmospheric temperature (293 K)

R is the universal gas constant (8 314 J kmol^{-1} K^{-1}).

Table B.1
Material data

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
50-00-0	Formaldehyde (= Methanal) (= Methyl aldehyde) (= Methylene oxide) HCHO	1,03	−92	−6	60	7,0	73,0	88	920	424		0,57			T2	IIB	a
51-80-9	N,N,N',N'-Tetramethyl methanediamine $(CH_3)_2NCH_2N(CH_3)_2$	3,5	−140	84	<−13	1,61		67		180		1,06			T4	IIA	a
57-14-7	1,1-Dimethylhydrazine $(CH_3)_2NNH_2$	2,07	−58	63	−18	2,4	20,0	60	490	240		0,85			T3	IIB	a
60-29-7	1,1'-Oxybisethane (= Diethyl ether) (= Diethyl oxide) (= Ethyl ether) (= Ethyl oxide) (= Ether) $(CH_3CH_2)_2O$	2,55	−116	35	−45	1,7	39,2	50	1210	175	3,47	0,87	0,01	0,88	T4	IIB	a
62-53-3	Benzenamine (= Aminobenzene) (= Aniline) (= Phenylamine) $C_6H_5NH_2$	3,22	−6	184	75	1,2	11,0	47	425	615					T1	IIA	d
64-17-5	Ethanol (= Alcohol) (= Ethyl alcohol) CH_3CH_2OH	1,59	−114	78	12	3,1	19,0 at 60 °C 27,7 at 100 °C	59	532 at 100 °C	400	6,5	0,89	0,02	0,88	T2	IIB	c

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
64-17-5	Ethanol (= Alcohol) (= Ethyl alcohol) CH_3CH_2OH											> 0,9 for ≥ 4 Vol. % water				IIA	
64-18-6	Formic Acid (= Hydrogen carboxylic acid) (= Methanoic acid) HCOOH	1,60	8	101	42	18,0	57,0	344	1090	525		1,86			T1	IIA	a
64-19-7	Acetic acid (= Ethanoic acid) (= Glacial acetic acid) CH_3COOH	2,07	17	118	39	4,0	19,9	100	497	510		1,76		2,67	T1	IIA	b
64-67-5	Sulfuric acid diethyl ester (= Diethyl sulphate) $(CH_3CH_2)_2SO_4$	5,31	−25	208	104					360		1,11			T2	IIA	a
67-56-1	Methanol (= Carbinol) (= Methyl alcohol) CH_3OH	1,11	−98	65	9	6,0	36,0 at 60 °C 50,0 at 100 °C	80	469 at 60 °C 665 at 100 °C	440	11,0	0,92	0,03	0,82	T2	IIA	c
67-63-0	2-Propanol (= Dimethyl carbinol) (= Isopropanol) (= Isopropyl alcohol) (= Propan-2-ol) $(CH_3)_2CHOH$	2,07	−88	83	12	2,0	12,7	50	320	399		1,00			T2	IIA	a
67-64-1	2-Propanone	2,00	−95	56	<−20	2,5	14,3 at 100 °C	60	345 at 100 °C	528	5,9	1,01		1,00	T1	IIA	c

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit $[g/m^3]$	Upper flam. limit $[g/m^3]$	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Acetone) (= Dimethyl ketone) $(CH_3)_2CO$																
68-12-2	N,N-Dimethyl formamide (= Dimethylformamide) $HCON(CH_3)_2$	2,51	−61	153	58	1,8	16,0	55	486	440		1,08			T2	IIA	d
71-23-8	1-Propanol (= Propan-1-ol) (= n-Propyl alcohol) $CH_3CH_2CH_2OH$	2,07	−126	97	15	2,1	17,5	52	353	385		0,89			T2	IIB	a
71-36-3	1-Butanol (= n-Butyl alcohol) (= n-Butanol) (= Butyl alcohol) (= 1-Hydroxybutane) (= n-Propyl carbinol) (= Butan-1-ol) $CH_3(CH_2)_2CH_2OH$	2,55	−89	118	35	1,4	12,0	43	369	343	115 mg/l	0,91			T2	IIA	a
71-41-0	1-Pentanol (= n-Amyl alcohol) (= n-Butyl carbinol) (= Pentan-1-ol) (= n-Pentyl alcohol) (= n-Pentanol) $CH_3(CH_2)_3CH_2OH$	3,03	−78	138	42	1,06	10,5	39	384	320	100 mg/l	0,99			T2	IIA	a
71-43-2	Benzene	2,70	6	80	−11	1,2	8,6	39	280	498		0,99		1,00	T1	IIA	c

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	Benzene (= Phenyl hydride) C_6H_6																
74-82-8	Methane (see 5.2.4) CH_4		−182	−162	gas	4,4	17,0	29	113	600		1,12		1,00	T1	IIA	a
	Methane (firedamp, see 5.2.4) CH_4	0,55			gas	4,4	17,0	29	113	595	8,2	1,14	0,11		T1	I	a
74-84-0	Ethane CH_3CH_3	1,04	−183	−86	gas	2,4	15,5	30	194	515	5,9	0,91	0,02	0,82	T1	IIA	c
74-85-1	Ethene (= Ethylene) $CH_2{=}CH_2$	0,97	−169	−104	gas	2,3	36,0	26	423	440	6,5	0,65	0,02	0,53	T2	IIB	a
74-86-2	Ethine (= Acetylene) (= Ethyne) $CH{\equiv}CH$	0,90			gas	2,3	100	24	1092	305	8,5	0,37	0,01	0,28	T2	IIC	c
74-87-3	Methyl chloride (= Chloromethane) (= Monochloromethane) CH_3Cl	1,78		−24	gas	7,6	19,0	160	410	625		1,00			T1	IIA	a
74-89-5	Methylamine (= Aminomethane) (= Carbinamine) CH_3NH_2	1,00	−92	−6	gas	4,2	20,7	55	270	430		1,10			T2	IIA	a
74-90-8	Hydrocyanic acid (= Hydrogen cyanide) (= Formic anammonide) (= Hydrocyanic acid)	0,90	−13	26	<−20	5,4	46,0	60	520	538	18,4	0,80	0,02		T1	IIB	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m³]	Upper flam. limit [g/m³]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Methanenitrile) (= Prussic acid) HCN																
74-93-1	Methanethiol (= Mercaptomethane) (= Methyl mercaptan) (= Methyl sulfhydrate) CH_3SH	1,60	−126	6	gas	4,1	21,0	80	420	340		1,15			T2	IIA	a
74-96-4	Bromoethane (= Ethyl bromide) (= Monobromoethane) CH_3CH_2Br	3,75	−119	38		6,7	11,3	306	517	511					T1	IIA	d
74-98-6	Propane (= Dimethyl methane) (= Propyl hydride) $CH_3CH_2CH_3$	1,56	−188	−42	gas	1,7	10,9	31	200	445	4,2	0,92	0,03	0,82	T2	IIA	c
74-99-7	Propyne (= Allylene) (= Methylacetylen) $CH_3C{\equiv}CH$	1,38	−103	−23	gas	1,7	16,8	28	280	340					T2	IIB	d
75-00-3	Chloroethane (= Ethyl chloride) (= Hydrochloric ether) (= Monochloroethane) (= Muriatic ether) CH_3CH_2Cl	2,22	−139	12	gas	3,6	15,4	95	413	510					T1	IIA	d
75-01-4	Chloroethene	2,15	−160	−14	gas	3,6	33,0	94	610	415	7,3	0,99	0,04		T2	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Vinyl Chloride) (= Chloroethylene) CH_2=CHCl																
75-04-7	Ethylamine (= Aminoethane) (= Monoethylamine) $C_2H_5NH_2$	1,50	−92	7	gas	3,5	14,0	66	262	385		1,20			T2	IIA	a
75-05-8	Acetonitrile (= Cyanomethane) (= Ethyl nitrile) (= Methyl cyanide) CH_3CN	1,42	−45	82	2	3,0	16,0	51	275	523	7,2	1,50	0,05		T1	IIA	a
75-07-0	Ethanal (= Acetic aldehyde) (= Acetaldehyde) (= Ethyl aldehyde) CH_3CHO	1,52	−123	20	−38	4,0	60,0	74	1108	155		0,92		0,98	T4	IIA	a
75-08-1	Ethanethiol (= Ethyl Mercaptan) (= Ethyl sulfhydrate) (= Mercaptoethane) CH_3CH_2SH	2,11	−148	35	−48	2,8	18,0	73	468	295		0,90		0,9	T3	IIA	a
75-15-0	Carbon Disulfide CS_2	2,64	−112	46	−30	0,6	60,0	19	1900	90	8,5	0,34	0,02	0,39	T6	IIC	c
75-19-4	Cyclopropane (= Trimethylene) $CH_2CH_2CH_2$	1,45	−128	−33	gas	2,4	10,4	42	183	500		0,91		0,84	T1	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
75-21-8	Oxirane (= Ethylene oxide) (= Epoxyethan) CH_2CH_2O	1,52	−123	20	gas	2,6	100	47	1848	429	~8	0,59	0,02	0,47	T2	IIB	a
75-28-5	2-Methylpropane (= iso-Butane) $(CH_3)_2CHCH_3$	2,00	−159	−12	gas	1,3	9,8	31	236	460		0,95			T1	IIA	a
75-29-6	2-Chloropropane $(CH_3)_2CHCl$	2,70	−117	35	<−20	2,8	10,7	92	350	590		1,32			T1	IIA	a
75-31-0	2-Propaneamine (= iso-Propylamine) (= 2-Aminopropane) (= 1-methylethylamine) $(CH_3)_2CHNH_2$	2,03	−101	32	<−24	2,3	8,6	55	208	340		1,05			T2	IIA	a
75-34-3	1,1-Dichloroethane (= Asymmetrical dichloroethane) (= Ethylidene chloride) (= 1,1-Ethylidene dichloride) CH_3CHCl_2	3,42	−98	57	−10	5,6	16,0	230	660	439		1,82			T2	IIA	a
75-35-4	1,1-Dichloroethene (= Vinylidene Chloride) $CH_2{=}CCl_2$	3,40	−122	32	−18	6,5	16,0	260	645	530	10,5	3,91	0,08		T1	IIA	a
75-36-5	Acetyl chloride CH_3COCl	2,70	−112	51	−4	5,0	19,0	157	620	390					T2	IIA	d
75-38-7	1,1-Difluoroethene (= Vinylidene fluoride)	2,21	−144	−86	gas	3,9	25,1	102	665	380		1,10			T2	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Vinylidene difluoride) $CH_2{=}CF_2$																
75-50-3	Trimethylamine $(CH_3)_3N$	2,04	−117	3	gas	2,0	12,0	50	297	190		1,05			T4	IIA	a
75-52-5	Nitromethane (= Nitrocarbol) CH_3NO_2	2,11	−29	101	35	7,3	63,0	187	1613	414		1,17		0,92	T2	IIA	a
75-56-9	2-Methyloxirane (= 1,2-Epoxypropane) (= Propylene oxide) CH_3CHCH_2O	2,00	−112	34	−37	1,9	37,0	49	901	430	4,55	0,70	0,03		T2	IIB	c
75-83-2	2,2-Dimethylbutane (= Neohexane) $(CH_3)_3CCH_2CH_3$	2,97	−100	50	−48	1,0	7,0	36	260	405					T2	IIA	d
75-85-4	2-Methylbutan-2-ol $CH_3CH_2C(OH)(CH_3)_2$	3,03	−8	102	18	1,4	10,2	50	374	392		1,10			T2	IIA	a
75-86-5	2-Hydroxy-2-methyl-propionitrile (= Cyanohydrin-2-propanone) (= 2-Cyano-2-propanol) (= alpha-Hydroxyisobutyronitrile) (= Acetone cyanohydrin) (= 2-Methyllactonitrile) $CH_3C(OH)CNCH_3$	2,90	−20	82	74	2,2	12,0	78	424	543					T1		
75-89-8	2,2,2-Trifluoroethanol (= 2,2,2-Trifluoroethyl alcohol) CF_3CH_2OH	3,45	−44	77	30	8,4	8,4	28,8	350	1195	463		3,00		T1	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m³]	Upper flam. limit [g/m³]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
76-37-9	2,2,3,3-Tetrafluoropropan-1-ol $HCF_2CF_2CH_2OH$	4,55	−15	109	43						437		1,90		T2	IIA	a
77-73-6	3a,4,7,7a-Tetrahydro-4,7-methano-1H-indene (= Dicyclopentadiene) (= Cyclopentadiene dimer) $C_{10}H_{12}$	4,55	33	172	36	0,8		43		455		0,91			T1	IIA	a
77-78-1	Sulfuric acid dimethyl ester (= Dimethyl sulfate) $(CH_3O)_2SO_2$	4,34	−32	188	83					449		1,00			T2	IIA	a
78-10-4	Tetraethoxy Silane (= Silicic acid tetraethyl ester) (= Tetraethyl silicate) (= Silicon tetraethoxide) $(C_2H_5)_4Si\ O_4$	7,18	−83	169	38	0,45	7,2	39	623	174					T4		
78-78-4	2-Methylbutane (= Ethyl dimethyl methane) (= Isopentane) $(CH_3)_2CHCH_2CH_3$	2,50	−160	28	−56	1,3	8,3	39	249	420		0,98			T2	IIA	a
78-80-8	2-Methyl-1-buten-3-yne $HC{\equiv}CC(CH_3)CH_2$	2,28	−113	32	−54	1,4		38		272		0,78			T3	IIB	a
78-81-9	2-Methylpropan-1-amine (= iso-Butylamine) $(CH_3)_2CHCH_2NH_2$	2,52	−85	66	−20	1,47	14,0 at 100 °C	44	425 at 100 °C	374		1,15			T2	IIA	a
78-83-1	2-Methyl-1-propanol (= iso-Butanol) (= iso-Propylcarbinol)	2,55	−108	+108	28	1,4	11,0	43	340	408	105 mg/l	0,96			T2	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= iso-Butyl alcohol) $(CH_3)_2CHCH_2OH$																
78-84-2	2-Methyl-1-propanal (= iso-Butanal) (= iso-Butyraldehyde) $(CH_3)_2CHCHO$	2,48	−65	64	−22	1,6	11,0	47	320	165		0,92			T4	IIA	a
78-86-4	2-Chlorobutane (= sec-Butyl chloride) $CH_3CHClCH_2CH_3$	3,19	−140	68	−21	2,0	8,80	77	339	415		1,16			T2	IIA	a
78-87-5	1,2-Dichloropropane (= Propylene dichloride) $CH_3CHClCH_2Cl$	3,90	−80	96	15	3,4	14,5	160	682	557					T1	IIA	d
78-92-2	2-Butanol (= sec-Butyl alcohol) (= Butylene hydrate) (= 2-Hydroxybutane) (= Methyl ethyl carbinol) $CH_3CHOHCH_2CH_3$	2,55	−89	99	24	1,7	9,8	52	302	406					T2	IIA	d
78-93-3	2-Butanone (= Ethyl methyl ketone) (= Methyl acetone) (= Methyl ethyl ketone) $CH_3CH_2COCH_3$	2,48	−86	80	−10	1,5	13,4	45	402	404	4,8	0,9	0,02	0,92	T2	IIA	a
79-09-4	Propionic acid (= Carboxyethane) (= Ethanecarboxylic acid)	2,55	−21	141	53	2,1	12,1	65	372	485		1,10			T1	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit $[g/m^3]$	Upper flam. limit $[g/m^3]$	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Methyl acetic acid) CH_3CH_2COOH																
79-10-7	2-Propenoic acid (= Acroleic acid) (= Ethylenecarboxylic acid) (= Glacial acrylic acid) (= Acrylic acid) CH_2=CHCOOH	2,48	13	141	55	2,4	8,0	72		406		0,86			T2	IIB	a
79-20-9	Acetic acid methyl ester (= Methyl acetate) (= Ethanoic acid methyl ester) (= Methyl ethanoate) CH_3COOCH_3	2,56	–99	57	–10	3,1	16,0	95	475	505	208 mg/l	0,97		1,08	T1	IIA	c
79-22-1	Carbonochloridic acid methyl ester (= Methyl chloroformate) (= Methoxycarbonyl chloride) CH_3OOCCl	3,30	–61	72	10	7,5	26,0	293	1020	475		1,20			T1	IIA	a
79-24-3	Nitroethane $CH_3CH_2NO_2$	2,58	–90	114	27	3,4		107		412		0,87			T2	IIB	d
79-29-8	2,3-Dimethylbutane (= Diisopropyl) $(CH_3)_2CH(CH_3)CH_2CH_3$	2,97	–129	58	<–20	1,0		36		396					T2	IIA	d
79-31-2	2-Methylpropanoic acid (= iso-Butyric acid) (= Dimethylacetic acid) $(CH_3)_2CHCOOH$	3,03	–46	155	58	2,0	10,0	73	366	443		1,02			T2	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m³]	Upper flam. limit [g/m³]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
79-38-9	Chlorotrifluoroethene (= Chlorotrifluoroethylene) $CF_2=CFCl$	4,01	–157	–28	gas	4,6	64,3	220	3117	607		1,50			T1	IIA	a
80-62-6	2-Methyl-2-propenoic acid methyl ester (= Methyl methacrylate) (= Methacrylate monomer) (= Methyl ester of methacrylic acid) (= Methyl-2-methyl-2-propenoate) $CH_3=CCH_3COOCH_3$	3,45	–48	101	10	1,7	12,5	71	520	430		0,95			T2	IIA	a
91-20-3	Naphthalene (= Tar camphor) (= White tar) $C_{10}H_8$	4,42	80	218	77	0,6 at 150 °C	5,9	29 at 150 °C	317	540					T1	IIA	d
95-47-6	1,2-Dimethyl benzene (= o-Xylene) (= o-Xyol) $C_6H_4(CH_3)_2$	3,66	–25	144	30	1,0	7,6	43	335	470		1,09			T1	IIA	a
95-92-1	Ethanedioic acid diethyl ester (= Diethyl Oxalate) (= Oxalic acid diethyl ester) $(COOCH_2CH_3)_2$	5,04	–41	185	76							0,90				IIA	a
96-22-0	Pentan-3-one (= Diethyl ketone) (= Metacetone) (= Propione)	3,00	–42	102	7	1,6		58		445		0,90			T2	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	$(CH_3CH_2)_2CO$																
96-33-3	Propenoic acid methyl ester (= Acrylic acid methyl ester) (= Methoxycarbonyl ethylene) (= Methyl propenoate) (= Methyl Acrylate) $CH_2{=}CHCOOCH_3$	3,00	–75	80	–3	1,95	16,3	71	581	455	5,6	0,85	0,02	0,98	T1	IIB	a
96-37-7	Methylcyclopentane $CH_3CH(CH_2)_3CH_2$	2,90	–142	72	<–10	1,0	8,4	35	296	258					T3	IIA	d
97-62-1	2-Methylpropanoic acid ethyl ester (= Ethyl isobutyrate) (= Ethyl 2-methylpropanoate) $(CH_3)_2CHCOOC_2H_5$	4,00	–88	110	10	1,6		75		438		0,96			T2	IIA	a
97-63-2	2-Methyl-prop-2-enoic acid ethyl ester (= Methacrylic acid ethyl ester) (= Ethyl methacrylate) $CH_2{=}CCH_3COOCH_2CH_3$	3,90	–75	117	19	1,5		70				1,01				IIA	a
97-85-8	2-Methylpropanoic acid 2-methylpropyl ester (= iso-Butyl isobutyrate) $(CH_3)_2CHCOOCH_2CH(CH_3)_2$	4,93	–81	147	34	0,8		47		424		1,00			T2	IIA	a
97-88-1	2-Methyl-2-propenoic acid butyl ester (= Butyl methacrylate) (= Butyl-2-methylprop-2-enoate) $CH_2{=}C(CH_3)COO(CH_2)_3CH_3$	4,90		163	53	1,0	6,8	58	395	289		0,95			T3	IIA	a
97-95-0	2-Ethyl-1-butanol	3,52	–52	149	57	1,2	8,3	51	352	315					T2		

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Isohexyl alcohol) $CH_3CH(CH_2CH_3)CH_2CH_2OH$																
97-99-4	Tetrahydro-2-furan methanol) (= Tetrahydrofurfuryl alcohol) (= Tetrahydrofuran-2-yl-methanol) (= Tetrahydro-2-furan carbinol) (= 2-Hydroxymethyl oxolane) $OCH_2CH_2CH_2CHCH_2OH$	3,52		178	70	1,5	9,7	64	416	280		0,85			T3	IIB	d
98-00-0	2-Furylmethanol (= Furfuryl Alcohol) (= 2-Hydroxymethylfuran) $OC(CH_2OH)CHCHCH$	3,38	–31	171	61	1,8	16,3	70	670	370		0,8			T2	IIB	a
98-01-1	2-Furancarbox aldehyde (= Fural) (= Furfural) (= 2-Furaldehyde) OCH=CHCH=CHCHO	3,30	–33	162	60	2,1	19,3	85	768	316		0,88			T2	IIB	a
98-82-8	(1-Methylethyl) benzene (= Cumene) (= Isopropyl benzene) (= 2-Phenyl propane) $C_6H_5CH\ (CH_3)_2$	4,13	–96	152	31	0,8	6,5	40	328	424		1,05			T2	IIA	d
98-83-9	α-Methyl styrene (= Isopropenyl benzene) (= 1-Methyl-1-phenylethylene) (= 2-Phenyl propylene)	4,08	–23	166	40	0,8	11,0	39	540	445		0,88			T2	IIB	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	$C_6H_5C(CH_3)=CH_2$																
98-95-3	Nitrobenzene (= Nitrobenzol) (= Oil of mirbane) $C_6H_5NO_2$	4,25	6	211	88	1,4	40,0	72	2067	481		0,94			T1	IIA	a
99-87-6	1-Methyl-4-(1-methylethyl) benzene (= p-Cymene) (= *p*-isopropyltoluene) $CH_3C_6H_4CH\ (CH_3)_2$	4,62	–68	177	47	0,7	5,6	39	362	436					T2	IIA	d
100-37-8	2-Diethylaminoethanol (= Diethylaminoethanol) (= 2-Diethylaminoethyl alcohol) (= N,N-Diethylethanol amine) (= Diethyl-(2-hydroxyethyl)amine) (= 2-Hydroxytriethylamine) $(C_2H_5)_2NCH_2CH_2OH$	4,0	–70	162	60					320					T2	IIA	d
100-40-3	4-Ethenylcyclohexene (= Vinyl cyclohexene) $(CH_2=CH)CH(CH_2)_4CH_2$	3,72	–109	128	15	0,8		35		257		0,96			T3	IIA	a
100-41-4	Ethylbenzene (= α-Methyltoluene) (= Phenylethane) $C_6H_5CH_2CH_3$	3,66	–95	136	15	0,8	7,8	35	344	431					T2	IIA	d
100-42-5	Ethenylbenzene (= Styrene) (= Vinylbenzene)	3,60	–31	145	30	1,0	8,0	42	350	490				1,21	T1	IIA	b

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Phenylethylene) (= Styrol) $C_6H_5CH{=}CH_2$																
100-43-6	4-Vinylpyridine (= 4-Ethenylpyridine) (= γ-Vinylpyridine) $NCHCHC(CH_2{=}CH)CHCH$	3,62		171	43	1,1		47		501		0,95			T1	IIA	a
100-44-7	(Chloromethyl)benzene (= Benzyl chloride) (= α-Chlorotoluene) (= Tolyl chloride) $C_6H_5CH_2Cl$	4,36	–39	179	60	1,1		55		585					T1	IIA	d
100-52-7	Benzaldehyde C_6H_5CHO	3,66	–26	179	64	1,4		62		192					T4	IIA	d
100-69-6	2-Vinylpyridine (= 2-Ethenylpyridine) (= α-Vinylpyridine) $NC(CH_2{=}CH)CHCHCHCH$	3,62	–50	159	35	1,2		51		482		0,96			T1	IIA	a
103-09-3	Acetic acid-2-ethylhexyl ester (= 2-Ethylhexyl acetate) $CH_3COOCH_2CH(C_2H_5)C_4H_9$	5,94	–93	199	44	0,8	8,1	57	580	335		0,88			T2	IIB	a
103-11-7	Prop-2-enoic acid 2-ethylhexyl ester (= 2-Ethylhexyl 2-propenoate) (= 2-Ethylhexyl acrylate) $CH_2{=}CHCOO(CH_2)_4CH_3$	6,36	–90	214	82	0,7	8,2	54	628	252					T3		
104-76-7	2-Ethyl-1-hexanol	4,5	–76	182	73	0,9	9,7	49	525	288					T3		

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Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	$CH_3(CH_2)_3CH(CH_2CH_3)\ CH_2OH$																
105-45-3	3-Oxo-butanoic acid methyl ester (= Acetoacetic acid methyl ester) (= 1-Methoxybutane-1,3-dione) (= Methyl acetoacetate) $CH_3COOCH_2COCH_3$	4,00	–80	170	62	1,3	14,2	62	685	280		0,85			T3	IIB	a
105-46-4	Acetic acid 1-methylpropyl ester (= sec-Butyl acetate) (= sec-Butyl ester of acetic acid) (= 1-Methylpropyl acetate) $CH_3COOCH(CH_3)CH_2CH_3$	4,00	–99	112	–18	1,3	7,5	63	362	422					T2		
105-48-6	Chloroacetic acid-1-methylethyl ester (= iso-Propyl chloroacetate) (= Propan-2-yl 2-chloroacetate) $ClCH_2COOCH(CH_3)_2$	4,71		151	42	1,6		89		426		1,24			T2	IIA	a
105-54-4	Butanoic acid ethyl ester (= Ethyl butanoate) (= Ethyl butyrate) (= Butyric acid ethyl ester) $CH_3CH_2CH_2COO\ CH_2CH_3$	4,00	–93	121	21	1,4		66		435		0,92			T2	IIA	a
105-58-8	Carbonic acid diethyl ester (= Diethyl carbonate) $(CH_3CH_2O)_2CO$	4,07	–43	126	24	1,4	11,7	69	570	450		0,83			T2	IIB	a
106-35-4	3-Heptanone (= Ethyl butyl ketone) $CH_3CH_2CO[CH_2]_3CH_3$	3,94	–38	298	37	1,1	7,3	52	346	410					T2		

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
106-42-3	1,4-Dimethyl benzene (= p-Xylene) (= p-Xyol) $C_6H_4(CH_3)_2$	3,66	13	138	25	0,9	7,6	42	335	535		1,09			T1	IIA	a
106-46-7	1,4-Dichlorobenzene (= Dichlorocide) $C_6H_4Cl_2$	5,07	53	174	66	2,2	9,2	134	564	648					T1	IIA	d
106-58-1	1,4-Dimethylpiperazine $NH(CH_3)CH_2CH_2NH(CH_3)$ CH_2CH_2	3,93	–1	131	21,5	1,0		47		199		1,00			T4	IIA	a
106-89-8	(Chloromethyl) oxirane (= Epichlorohydrin) (= 1-Chloro-2,3-epoxypropane) (= 2-Chloropropylene oxide) OCH_2 $CHCH_2Cl$	3,19	–48	116	28	2,3	34,4	86	1325	385		0,74			T2	IIB	a
106-92-3	[(2-Propenyloxy) methyl] oxirane (= Allyl 2,3-epoxypropylether) (= 1-(Allyloxy)-2,3-epoxypropan) (= Glycidyl allyl ether) (= Allyl glycidyl ether) $CH_2{=}CH\text{-}CH_2\text{-}O\text{-}CHCH_2CH_2O$	3,94	–100	154	45					249		0,70			T3	IIB	a
106-96-7	3-Bromo-1-propine (= Bromo propyne) $CH_3CH_{\equiv}CBr$	4,10	–61	89	10	3,0		150		324					T2		
106-97-8	n-Butane (= Butyl hydride) (= Diethyl)	2,05	–138	–1	gas	1,4	9,3	33	225	372	3,2	0,98	0,02	0,94	T2	IIA	c

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m³]	Upper flam. limit [g/m³]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Methylethylmethane) $CH_3(CH_2)_2CH_3$																
106-98-9	1-Butene (= n-Butylene) (= Ethylethylene) $CH_2{=}CHCH_2CH_3$	1,93	–185	–6	gas	1,6	10,0	38	235	345		0,94			T2	IIA	a
106-99-0	1,3-Butadiene (= Biethylene) (= Bivinyl) (= Divinyl) (= Erythrene) (= Vinylethylene) $CH_2{=}CHCH{=}CH_2$	1,87	–109	–5	gas	1,4	16,3	31	365	420	3,9	0,79	0,02	0,76	T2	IIB	c
107-00-6	1-Butine (= Ethylacetylene) $CH_3CH_2C{\equiv}CH$	1,86	–125	8	gas							0,71				IIB	a
107-02-8	2-Propenal (inhibited) (= Acraldehyde) (= Acrylaldehyde) (= Acrylic aldehyde) (= Allyl aldehyde) (= Propenal) (= Acrolein) $CH_2{=}CHCHO$	1,93	–88	52	–18	2,8	31,8	65	741	217		0,72			T3	IIB	a
107-05-1	3-Chloro-1-propene (= Allyl chloride)	2,64	–136	45	–32	2,9	11,2	92	357	390		1,17		1,33	T2	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m³]	Upper flam. limit [g/m³]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= 1-Chloro-2-propene) (= 3-Chloropropylene) CH_2=$CHCH_2Cl$																
107-06-2	1,2-Dichloroethane (= Ethylene chloride) (= Ethylene dichloride) CH_2ClCH_2Cl	3,42	–36	84	13	6,2	16,0	255	654	438	9,5	1,80	0,05		T2	IIA	a
107-07-3	Ethylene chlorohydrin (= 2-Chloroethanol) (= 2-Chloroethyl alcohol) CH_2ClCH_2OH	2,78	–68	128	55	4,9	16,0	164	535	425					T2	IIA	d
107-10-8	1-Propaneamine (= 1-Aminopropane) (= 1-Propylamine) $CH_3(CH_2)_2NH_2$	2,04	–83	49	–37	2,0	10,4	49	258	318		1,13			T2	IIA	d
107-13-1	2-Propenenitrile (= Acrylonitrile) (= Cyanoethylene) (= Propenenitrile) (= Acrylonitrile) (= Vinyl cyanide, VCN) CH_2=$CHCN$	1,83	–82	77	–5	2,8	28,0	64	620	480	7,1	0,87	0,02	0,78	T1	IIB	c
107-15-3	1,2-Ethanediamine (= Ethylenediamine) (= Dimethylenediamine) $NH_2CH_2CH_2NH_2$	2,07	8	116	33	2,5	16,5	64	396	385		1,18			T2	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m³]	Upper flam. limit [g/m³]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
107-18-6	2-Propen-1-ol (= Allylic alcohol) (= Propenol) (= Allyl alcohol) (= Vinyl carbinol) $CH_2{=}CHCH_2OH$	2,00	–129	97	21	2,5	18,0	61	438	378		0,84			T2	IIB	a
107-19-7	2-Propine-1-ol (= Prop-2-yn-1-ol) (= Propargyl alcohol) $HC{\equiv}CCH_2OH$	1,89	–48	115	33	2,4		55		346		0,58			T2	IIB	a
107-20-0	Chloroacetaldehyde (= 2-Chloroethanal) $ClCH_2CHO$	2,69			88 (aqueous solution 40 %)	5,7	18,4	186	600								
107-30-2	Chloromethoxymethane (= Chloromethyl methyl ether) (= Chlorodimethyl ether) (= Chloromethoxy methane) (= Dimethylchloroether) (= Methylchloromethyl ether) CH_3OCH_2Cl	2,78	–104	59	–8							1,00				IIA	a
107-31-3	Formic acid methyl ester (= Methyl formate) (= Methyl methanoate) $HCOOCH_3$	2,07	–100	32	–20	5,0	23,0	125	580	525		0,94			T1	IIA	a
108-01-0	2-(Dimethylamino)ethanol $(CH_3)_2NC_2H_4OH$	3,03	–40	131	39					220					T3	IIA	d

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Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m³]	Upper flam. limit [g/m³]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
108-03-2	1-Nitropropane $CH_3CH_2CH_2NO_2$	3,10	–108	132	35	2,2		82		420		0,84			T2	IIB	a
108-05-4	Acetic acid ethenyl ester (= Vinyl acetate) (= 1-Acetoxyethylene) $CH_3COOCH{=}CH_2$	3,00	–100	72	–7	2,6	13,4	93	478	385	4,75	0,94	0,02		T2	IIA	a
108-10-1	4-Methylpentan-2-one (= Hexone) (= Isopropylacetone) (= Methyl isobutyl ketone) $(CH_3)_2CHCH_2COCH_3$	3,45	–80	116	16	1,2	8,0	50	336	475		1,01			T1	IIA	a
108-11-2	4-Methylpentan-2-ol (= Isobutylmethylcarbinol) (= Methyl amyl alcohol) (= Methyl isobutyl carbinol) $(CH_3)_2CHCH_2CHOHCH_3$	3,50	–60	133	37	1,14	5,5	47	235	334		1,01			T2	IIA	a
108-18-9	n-(1-Methylethyl)-2-propanamine (= Diisopropylamine) $((CH_3)_2CH)_2NH$	3,48	–61	82	–20	1,2	8,5	49	358	285		1,02			T3	IIA	a
108-20-3	2,2´-Oxybispropane (= Diisopropyl ether) (= 2-Isopropoxy propane) $((CH_3)_2CH)_2O$	3,52	–86	69	–28	1,0	21,0	45	900	405	2,6	0,94	0,06		T2	IIA	a
108-21-4	Acetic acid-1-methylethyl ester (= iso-propyl acetate) (= iso-propyl ester of acetic acid)	3,51	–17	90	1	1,7	8,1	75	340	425		1,05			T2	IIA	a

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Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m³]	Upper flam. limit [g/m³]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= 1-Methylethyl ester of acetic acid) (= 2-Propyl acetate) $CH_3COOCH(CH_3)_2$																
108-24-7	Acetic anhydride (= Acetic acid anhydride) (= Acetic oxide) (= Acetyl oxide) (= Ethanoic anhydride) $(CH_3CO)_2O$	3,52	–73	140	49	2,0	10,3	85	437	316		1,23			T2	IIA	a
108-38-3	1,3-Dimethylbenzene (= m-Xylene) (= m-Xylol) $C_6H_4(CH_3)_2$	3,66	–48	139	25	1,0	7,0	44	309	465		1,09			T1	IIA	d
108-62-3	2,4,6,8-Tetramethyl-1,3,5,7-tetraoxocane (= Metaldehyde) $(C_2H_4O)_4$	6,10	246	./.	36											IIA	d
108-67-8	1,3,5-Trimethylbenzene (= Mesitylene) $CHC(CH_3)CHC(CH_3)CHC\ (CH_3)$	4,15	–45	165	44	0,8	7,3	40	365	499		0,98			T1	IIA	a
108-82-7	2,6-Dimethylheptan-4-ol (= Diisobutylcarbinol) $((CH_3)_2CHCH_2)_2CHOH$	4,97	–65	176	75	0,7	6,10	42	370	290		0,93			T3	IIA	a
108-87-2	Methylcyclohexane (= Hexahydrodoluene) $CH_3CH(CH_2)_4CH_2$	3,38	–127	101	–4	1,0	6,70	41	275	250					T3	IIA	d

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
108-88-3	Methyl benzene (= Toluene) (= Methyl benzol) (= Phenyl methane) $C_6H_5CH_3$	3,20	–95	111	4	1,0	7,8	39	299	530		1,06			T1	IIA	d
108-89-4	4-Methylpyridine (= γ-Picoline) $NCHCHC(CH_3)CHCH_2$	3,21	3	145	43	1,1	7,8	42	296	534		1,12			T1	IIA	a
108-90-7	Chlorobenzene (= Phenyl chloride) (= Monochlorobenzene) C_6H_5Cl	3,88	–45	132	28	1,3	11,0	61	514	593					T1	IIA	d
108-91-8	Cyclohexylamine (= Aminocyclohexane) (= Aminohexahydro-benzene) (= Hexahydroaniline) (= Hexahydro-benzenamine) $CH_2(CH_2)_4CHNH_2$	3,42	–18	134	27	1,1	9,4	45	387	275					T3	IIA	d
108-93-0	Cyclohexanol (= Cyclohexyl alcohol) (= Hexahydrophenol) (= Hexalin) $CH_2(CH_2)_4CHOH$	3,45	24	161	61	1,2	11,1	50	460	300					T3	IIA	d
108-94-1	Cyclohexanone (= Anone) (= Cyclohexyl ketone)	3,38	–26	156	43	1,3	9,4	53	386	419	3,0	0,95	0,03		T2	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m³]	Upper flam. limit [g/m³]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Pimelic ketone) $CH_2(CH_2)_4CO$																
108-95-2	Phenol (= Carbolic acid) (= Hydroxybenzene) (= Monohydroxybenzene) (= Monophenol) (= Oxybenzene) C_6H_5OH	3,24	41	182	75	1,3	9,5	50	370	595					T1	IIA	d
108-99-6	3-Methylpyridine (= β-Picoline) $NCHC(CH_3)CHCHCH$	3,21	–18	144	43	1,4	8,1	53	308	537		1,14			T1	IIA	a
109-06-8	2-Methylpyridine (= α-Picoline) $NC(CH_3)CHCHCHCH$	3,21	–70	128	27	1,2		45		533		1,08			T1	IIA	a
109-55-7	N,N-Dimethylpropane-1,3-diamine (= 3-Dimethylamino-propylamine) (= 1-Amino-3-dimethylaminopropane) $(CH_3)_2N(CH_2)_3NH_2$	3,52	–70	134	26	1,2		50		219		0,95			T3	IIA	a
109-60-4	Acetic acid n-propyl ester (= n-Propyl acetate) (= 1-Acetoxypropane) (= n-propyl ester acetic acid) $CH_3COOCH_2CH_2CH_3$	3,50	–92	102	10	1,7	8,0	70	343	430	135 mg/l	1,04			T2	IIA	a
109-65-9	1-Bromobutane	4,72	–112	102	13	2,5	6,6	142	376	265					T3	IIA	d

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m³]	Upper flam. limit [g/m³]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= n-Butyl bromide) $CH_3(CH_2)_2CH_2Br$																
109-66-0	n-Pentane $CH_3(CH_2)_3CH_3$	2,48	–130	36	–40	1,1	8,7	33	260	243	2,55	0,93	0,02	0,97	T3	IIA	c
109-69-3	1-Chlorobutane (= n-Butyl chloride) (= n-Propylcarbinyl chloride) $CH_3(CH_2)_2CH_2Cl$	3,20	–123	78	–12	1,8	10,0	69	386	245		1,06			T3	IIA	a
109-73-9	1-Aminobutane (= n-Butylamine) $CH_3(CH_2)_3NH_2$	2,52	–50	78	–12	1,7	9,8	49	286	312		0,92		1,13	T2	IIA	c
109-79-5	1-Butanethiol (= Butanethiol) (= n-Butyl mercaptan) (= n-Butanethiol) (= 1-Mercaptobutane) $CH_3(CH_2)_3SH$	3,10	–116	98	2	1,4	11,3	52	423	272					T3		
109-86-4	2-Methoxyethanol (= Ethylene glycol monomethyl ether) $CH_3OCH_2CH_2OH$	2,63	–86	104	39	1,8	20,6	57	651	285		0,85			T3	IIB	a
109-87-5	Dimethoxymethane (= Methylal) (= Dimethyl acetal methanal) (= Dimethyl acetal formaldehyde) (= Dimethyl formal) (= 2,4-Dioxapentane)	2,60	–105	43	–21	2,2	19,9	71	630	235		0,86			T3	IIB	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit $[g/m^3]$	Upper flam. limit $[g/m^3]$	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	$CH_2(OCH_3)_2$																
109-89-7	n-Ethylethanamine (= Diethamine) (= Diethylamine) $(C_2H_5)_2NH$	2,53	–50	56	–23	1,7	10,1	50	306	312		1,15			T2	IIA	a
109-94-4	Formic acid ethyl ester (= Ethyl methanoate) (= Ethyl formate) $HCOOCH_2CH_3$	2,55	–80	54	–20	2,7	16,5	87	497	440		0,91			T2	IIA	a
109-95-5 or (8013-58-9) comment: both are valid	Nitrous acid ethyl ester (= Ethyl nitrite; see 5.2.2) CH_3CH_2ONO	2,60		17	–35	3,0	50,0	94	1555	95	270 mg/l	0,96			T6	IIA	a
109-99-9	Tetrahydrofuran (= 1,4-Epoxybutane) (= Oxolane) (= Oxacyclopentane) (= Tetramethylene oxide) $CH_2(CH_2)_2CH_2O$	2,49	–108	64	–14	1,5	12,4	46	370	230		0,87			T3	IIB	a
110-00-9	Furan (= Divinylene oxide) (= Furfuran) (= Tetrole) (= Oxole) (= Oxacyclopentadiene) CH=CHCH=CHO	2,30	–86	32	<–20	2,3	14,3	66	408	390		0,68			T2	IIB	a
110-01-0	Tetrahydrothiophene	3,04	–96	121	13	1,1	12,3	42	450	200		0,99			T4	IIA	a

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Tetramethylene sulphide) (= Thiolane) (= Thiophane) (= Thiocyclopentane) $CH_2(CH_2)_2CH_2S$																
110-02-1	Thiophene (= Divinylene sulphide) (= Thiacyclopentadiene) (= Thiofuran) CH=CHCH=CHS	2,90	–36	84	–9	1,50	12,5	50	435	395		0,91			T2	IIA	a
110-05-4	bis(1,1-Dimethylethyl) peroxide (= tert-Dibutyl peroxide) $(CH_3)_3COOC(CH_3)_3$	5,0	–40	110	4	0,74	100	45	6073	170		0,84			T4	IIB	a
110-43-0	Heptan-2-one (= 1-Methylhexanal) (= 2-Oxoheptane) (= Amyl methyl ketone) (= Butylacetone) $CH_3CO(CH_2)_4CH_3$	3,94	–35	151	39	1,1	7,9	52	378	305					T2	IIA	d
110-54-3 (n-Hexane)	Hexane (mixed isomers) (= Hexyl hydride) $CH_3(CH_2)_4CH_3$	2,97			–22	1,0	8,9	35	319	225	2,5	0,93	0,02	0,88	T3	IIA	c
110-62-3	1-Pentanal (= Amyl aldehyde) (= Butyl formal) (= Valeraldehyde)	2,97	–92	103	6	1,4	9,5	50		206					T3		

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	$CH_3(CH_2)_3CHO$																
110-71-4	1,2-Dimethoxyethane (= Monoglyme) (= Ethylene glycol dimethyl ether) (= Dimethylglycol) (= 2,5-Dioxahexane) $CH_3O(CH_2)_2OCH_3$	3,10	–58	84	–6	1,6	10,4	60	390	197		0,72			T4	IIB	a
110-80-5	2-Ethoxyethanol (= Ethane-1,2-diol ethyl ether) (= Ethyl cellosolve) (= 3-Oxapentan-1-ol) (= Ethylene glycol ethyl ether) (= Ethylene glycol monoethyl ether) $CH_3CH_2OCH_2CH_2OH$	3,10	–100	135	40	1,7	15,7	64	588	235		0,78			T3	IIB	a
110-82-7	Cyclohexane (= Hexahydrobenzene) (= Hexamethylene) (= Hexanaphthene) $CH_2(CH_2)_4CH_2$	2,83	7	81	–17	1,0	8,0	35	280	244	90 mg/l	0,94			T3	IIA	a
110-83-8	Cyclohexene (= Benzene tetrahydride) (= Tetrahydrobenzene) $CH_2(CH_2)_3CH{=}CH$	2,90	–104	83	–17	1,1	8,3	37	283	244		0,94		0,97	T3	IIA	d
110-86-1	Pyridine (= Azine)	2,73	–42	116	18	1,7	12,4	56	407	482					T1	IIA	d

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Azabenzene) C_5H_5N																
110-88-3	1,3,5-Trioxane (= Trioxymethylene) $OCH_2OCH_2OCH_2$	3,11	62	115	45	3,2	29,0	121	1096	410		0,75			T2	IIB	b
110-91-8	Morpholine (= Diethylene imidoxide) (= Diethylene oximide) (= Tetrahydro-1,4-oxazine) $OCH_2CH_2NHCH_2CH_2$	3,00	–5	129	33	1,4	15,2	51	550	275		0,92			T3	IIA	a
110-96-3	2-Methyl-n-(2-methylpropyl)-1-propanamine (= Diisobutylamine) $((CH_3)_2CHCH_2)_2NH$	4,45	–70	139	26	0,8	3,60	42	190	256		1,12			T3	IIA	d
111-15-9	Acetic acid 2-ethoxy-ethyl ester (= 2-Ethoxyethyl acetate) (= Ethylene glycol monoethyl etheracetate) (= Glycol monoethyl ether acetate) $CH_3COOCH_2CH_2OCH_2CH_3$	4,56	–62	156	51	1,2	12,7	66	697	380		0,97		0,53	T2	IIA	a
111-27-3	1-Hexanol (= Amylcarbinol) (= Hexyl alcohol) (= 1-Hydroxyhexane) (= Pentylcarbinol) $CH_3(CH_2)_4CH_2OH$	3,50	–45	157	60	1,1	11,8	47	502	280	3,0	0,85	0,06		T3	IIB	a
111-43-3	1,1´-Oxybispropane	3,53	–122	90	<–5	1,18		50		175					T4	IIB	a

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Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= Dipropylether) (= 1-propoxy-propane) $CH_3(CH_2)_2O$																
111-49-9	Hexahydro-1H-acepine (= Azepane) $CH_2(CH_2)_5NH$	3,41	–37	135 to 137	23					279		1,00			T3	IIA	a
111-65-9	n-Octane $CH_3(CH_2)_6CH_3$	3,93	–57	126	13	0,8	6,5	38	308	206	1,94	0,94	0,02		T3	IIA	a
111-69-3	Hexanedinitrile (= 1,4-Dicyanobutane) (= Adiponitrile) (= Tetramethylene cyanide) $NC(CH_2)_4CN$	1,00	2	295	93	1,70	5,0	76	225	550					T1		
111-70-6	Heptan-1-ol (= hexylcarbinol) (= heptyl alcohol) (= enanthic alcohol) (= 1-hydroxyheptane) $CH_3(CH_2)_5CH_2OH$	4,03	–34	175	60	0,9		43		275		0,94			T3	IIA	a
111-76-2	2-Butoxyethanol (= Ethylene glycol monobutyl ether) (= Butyl cellosolve) (= Butylglykol) $CH_3(CH_2)_3O(CH_2)_2OH$	4,1	–75	171	61	1,1	12,7	54	623	238					T3		
111-84-2	Nonane (= Nonyl hydride)	4,43	–51	151	30	0,7	5,6	37	301	205					T3	IIA	d

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Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	$CH_3(CH_2)_7CH_2$																
111-87-5	1-Octanol (= Caprylic alcohol) (= Heptyl carbinol) (= 1-Hydroxyoctane) (= n-Octyl alcohol) $CH_3(CH_2)_6CH_2OH$	4,50	–60	195	81	0,9	7,0	49	379	270		1,05			T3	IIA	d
111-90-0	2-(2-Ethoxyethoxy) ethanol (= Diethylene glycol monoethyl ether) (= 3,6-Dioxaoctan-1-ol) $CH_3CH_2OCH_2CH_2OCH_2\ CH_2OH$	4,62	–80 to –76	202	94	1,3		73		190		0,94			T4	IIA	a
112-07-2	2-Butoxyethanol acetate (= Ethylene glycol monobutyl etheracetate) $C_4H_9O(CH_2)_2OCOCH_3$	5,52	64	192	71	0,9	8,9	60	592	340					T2		
112-30-1	1-Decanol (= Decyl alcohol) $CH_3(CH_2)_9OH$	5,30	7	230	82	0,7	5,5	46	361	288					T3		
112-34-5	2-(2-Butoxyethoxy) ethanol (= Butyldiglykol) (= Diglycol monobutyl ether) $CH_3(CH_2)_3OCH_2CH_2OCH_2\ CH_2OH$	5,59	–68	231	>100	0,85		58		225		1,11			T3	IIA	a
112-41-4	1-Dodecene $CH_3(CH_2)_9CH{=}CH_2$	5,80	–32	213	77	0,6		42		225					T3		
112-58-3	1,1´-Oxybishexane (= Dihexyl Ether)	6,43	–43	227	75					187					T4	IIA	d

Table B.1 Continued on Next Page

Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	$(CH_3(CH_2)_5)_2O$																
115-07-1	Propene (= Methylethylene) (= Propylene) CH_2=$CHCH_3$	1,50	–185	–48	gas	2,0	11,1	35	194	455	4,8	0,91	0,02		T1	IIA	a
115-10-6	Oxybismethane (= Methyl ether) (= Dimethylether) (= Wood ether) (= Methoxymethane) $(CH_3)_2O$	1,59	–142	–25	gas	2,7	32,0	51	610	240	7,0	0,84	0,06		T3	IIB	a
115-11-7	2-Methylprop-1-ene (= 1,1-Dimethylethylene) (= Isobutylene) (= Isobutene) (= 2-Methylpropene) $(CH_3)_2C$=CH_2	1,93	–140	–7	gas	1,6	10,0	37	235	483		1,00			T1	IIA	a
116-14-3	Tetrafluoroethylene CF_2=CF_2	3,40	–143	–76	gas	10,0	59,0	420	2245	255		0,60			T3	IIB	a
121-44-8	N,N-Diethylethanamine (= Triethylamine) $(CH_3CH_2)_3N$	3,50	–115	89	–8	1,2	8,0	51	339	215					T3	IIA	d
121-69-7	N,N-Dimethylbenzeneamine (= N,N-Dimethylaniline) $C_6H_3(CH_3)_2NH_2$	4,17	2	194	62	1,2	7,0	60	350	370					T2		
123-05-7	2-Ethylhexanal	4,4	–50	163	42	0,9	7,2			185					T4		

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Table B.1 Continued

CAS No.	Name formula	Relative density (air = 1)	Melting point [°C]	Boiling point [°C]	Flash point [°C]	Lower flam. limit [Vol. %]	Upper flam. limit [Vol. %]	Lower flam. limit [g/m^3]	Upper flam. limit [g/m^3]	Auto ign. temp. [°C]	Most inc. mixture [Vol. %]	MESG [mm]	$g_{100} - g_0$ [mm]	MIC ratio	Temp. class	Equip. group	Method of class.
	(= 2-Ethylhexaldehyde) $CH_3CH(CH_2CH_3)(CH_2)_3CHO$																
123-38-6	1-Propanal (= Propionic aldehyde) CH_3CH_2CHO	2,00	–81	49	<–26	2,0		47		175		0,86			T4	IIB	a
123-42-2	4-Hydroxy-4-methylpenta-2-one (= Diacetone alcohol) (= 2-Methyl-2-pentanol-4-one) $CH_3COCH_2C(CH_3)_2OH$	4,00	–47	166	58	1,8	6,9	88	336	680					T1	IIA	d
123-51-3	3-Methylbutan-1-ol (= Isoamyl alcohol) $(CH_3)_2CH\ (CH_2)_2OH$	3,03	–117	131	42	1,3	10,5	47	385	339		1,06			T2	IIA	a
123-54-6	Pentane-2,4-dione (= Acetylacetone) $CH_3COCH_2COCH_3$	3,50	–23	140	34	1,7		71		340	3,3	0,95	0,15		T2	IIA	a
123-63-7	2,4,6-Trimethyl-1,3,5-trioxane (= p-Acetaldehyde) (= Paracetaldehyde) (= Paraldehyde) $OCH(CH_3)OCH(CH_3)OCH\ (CH_3)$	4,56	12	124	27	1,3		72		235		1,01			T3	IIA	a
123-72-8	1-Butanal (= Butyraldehyde) (= Butyl aldehyde) $CH_3CH_2CH_2CHO$	2,48	–97	75	–12	1,7	12,5	51	378	205		0,92			T3	IIA	a
123-86-4	Acetic acid n-butyl ester (= n-Butyl acetate)	4,01	–77	127	22	1,2	8,5	58	408	390	130 mg/l	1,04		1,08	T2	IIA	c

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