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Australian/New Zealand Standard™

Explosive atmospheres

Part 20.1: Material characteristics for gas and vapour classification—Test methods and data

STANDARDS Australia

STANDARDS NEW ZEALAND PAEREWA AOTEAROA

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Australian/New Zealand Standard™

Explosive atmospheres

Part 20.1: Material characteristics for gas and vapour classification—Test methods and data

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee MS-011, Classification of Hazardous Areas.

This Standard forms the first edition of AS/NZS 60079.20.1 and it is intended to replace AS/NZS 60079.1.1:2002, *Electrical apparatus for explosive gas atmospheres—Flameproof enclosures 'd'—Method of test for ascertainment of maximum experimental safe gap,* AS/NZS 60079.4:2000 *Electrical apparatus for explosive gas atmospheres—Method of test for ignition temperature,* AS/NZS 60079.12:2000, *Electrical apparatus for explosive gas atmospheres—Classification of mixtures of gases or vapours with air according to their maximum experimental safe gaps and minimum igniting currents,* AS/NZS 60079.20:2000, *Electrical apparatus for explosive gas atmospheres—Data for flammable gases and vapours, relating to the use of electrical apparatus,* and its Amendment 1.

The objective of this Standard is to provide guidance on classification of gases and vapours. It describes a test method intended for the measurement of the maximum experimental safe gaps (MESG) for gas or vapour-air mixtures under normal conditions of temperature and pressure so as to permit the selection of an appropriate group of equipment. It describes also a test method intended for use in the determination of the auto-ignition temperature of a chemically pure vapour or gas in air at atmospheric pressure.

The tabulated values of chemical and engineering properties of substances are provided to assist engineers in their selection of equipment to be used in hazardous areas.

This Standard is identical with, and has been reproduced from IEC 60079-20-1, Ed.1.0 (2010), *Explosive atmospheres*—Part 20-1: *Material characteristics for gas and vapour classification—Test methods and data.*

As this Standard is reproduced from an International Standard, the following applies:

(a) Its number appears on the cover and title page while the International Standard number appears only on the cover.

(b) In the source text 'this part of IEC 60079' should read 'this Australian/New Zealand Standard'.

(c) A full point substitutes for a comma when referring to a decimal marker.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

Reference to International Standard		*Australian/New Zealand Standard*	
IEC		AS/NZS	
60079	Explosive atmospheres	60079	Explosive atmospheres
60079-11	Part 11: Equipment protection by intrinsic safety "i"	60079.11	Part 11: Equipment protection by intrinsic safety 'i'
60079-14	Part 14: Electrical installations design, selection and erection	60079.14	Part 14: Electrical installations design, selection and erection

The terms 'normative' and 'informative' have been used in this Standard to define the application of the annex to which they apply. A 'normative' annex is an integral part of a Standard, whereas an 'informative' annex is only for information and guidance.

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AUSTRALIAN/NEW ZEALAND STANDARD

Explosive atmospheres

Part 20.1:
Material characteristics for gas and vapour classification—Test methods and data

1 Scope

This part of IEC 60079 provides guidance on classification of gases and vapours. It describes a test method intended for the measurement of the maximum experimental safe gaps (MESG) for gas- or vapour-air mixtures under normal conditions of temperature[1] and pressure so as to permit the selection of an appropriate group of equipment. The method does not take into account the possible effects of obstacles on the safe gaps[2]. This standard describes also a test method intended for use in the determination of the auto-ignition temperature of a chemically pure vapour or gas in air at atmospheric pressure.

The tabulated values of chemical and engineering properties of substances are provided to assist engineers in their selection of equipment to be used in hazardous areas. It is hoped to publish further data from time to time, as the results of tests made in several countries become available.

The scope of these data has been selected with particular reference to the use of equipment in hazardous areas, and notice has been taken of standard measurement methods.

NOTE 1 The data in this standard have been taken from a number of references which are given in the bibliography.

NOTE 2 Some variations in the data may appear when references are compared, but usually the discrepancy is sufficiently small to be of no importance in the selection of equipment.

2 Normative references

The following referenced documents are indispensable for the application 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.

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*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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1 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.

2 The design of the test apparatus for safe gap determination, other than that used for selecting the appropriate group of enclosure for a particular gas, may need to be different to the one described in this standard. 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 the clauses of this standard will still apply.

NOTE For the definitions of any other terms, particularly those of a more general nature, reference should be made to IEC 60050(426) or other appropriate parts of the IEV (International Electrotechnical Vocabulary).

3.1
ignition by hot surface (auto-ignition)
a reaction in the test flask described in 7.2.2 which is evidenced by a clearly perceptible flame and/or explosion, and for which the ignition delay time does not exceed 5 min

3.2
ignition delay time
the period of time between the introduction of the ignition source and the actual ignition

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

3.4
maximum experimental safe gap
MESG
maximum gap between the two parts of the interior chamber which, under the test conditions specified below, prevents ignition of the external gas mixture through a 25 mm long flame path when the internal mixture is ignited, for all concentrations of the tested gas or vapour in air

3.5
minimum igniting current
MIC
minimum current in resistive or inductive circuits that causes the ignition of the explosive test mixture in the spark-test apparatus according to IEC 60079-11

4 Classification of gases and vapours

4.1 General

Gases and vapours can be classified according to the group or sub-group of equipment required for use in the particular gas or vapour atmosphere.

The general principles used to establish the lists of gases and vapours in the table of Annex B are given below.

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

Gases and vapours may be classified according to their maximum experimental safe gaps (MESG) into the groups I, IIA, IIB and IIC.

NOTE The standard method for determining MESG should be the vessel 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.

The groups for equipment for explosive gas atmospheres are:

Group I: equipment for mines susceptible to firedamp.

Group II: equipment for places with an explosive gas atmosphere other than mines susceptible to firedamp.

Group II equipment is subdivided and, for the purpose of classification of gases and vapours, the MESG limits are:

Group IIA: MESG ≥ 0,9 mm.

Group IIB: 0,5 mm < MESG < 0,9 mm.

Group IIC: MESG ≤ 0,5 mm.

NOTE 1 For gases and highly volatile liquids the MESG is determined at 20 °C.

NOTE 2 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 currents (MIC)

Gases and vapours may be classified according to the ratio of their minimum igniting currents (MIC) with the ignition current of laboratory methane. The standard method of determining MIC ratios shall be with the apparatus described in IEC 60079-11, but where determinations have been undertaken in other apparatus these can be accepted provisionally.

Group II equipment is subdivided and, for the purpose of classification of gases and vapours, the MIC ratios are:

Group IIA: MIC > 0,8.

Group IIB: 0,45 ≤ MIC ≤ 0,8.

Group IIC: MIC < 0,45.

4.4 Classification according to MESG and MIC

For most gases and vapours, it is sufficient to make only one determination of either MESG or MIC ratio to classify the gas or vapour.

One determination is adequate when:

Group IIA: MESG > 0,9 mm, or MIC > 0,9.

Group IIB: 0,55 mm ≤ MESG ≤ 0,9 mm, or 0,5 ≤ MIC ≤ 0,8.

Group IIC: MESG < 0,55 mm, or MIC < 0,5.

Determination of both the MESG and MIC ratio is required when:

for IIA: 0,8 ≤ MIC ≤ 0,9 need to confirm by MESG,

for IIB: 0,45 ≤ MIC ≤ 0,5 need to confirm by MESG,

for IIC: 0,5 ≤ MESG ≤ 0,55 need to confirm by MIC.

4.5 Classification according to a similarity of chemical structure

When a gas or vapour is a member of an homologous series of compounds, the classification of the gas or vapour can provisionally be inferred from the data of the other members of the series with lower molecular weights. However, it is best to run the test if it is possible.

4.6 Classification of mixtures of gases

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

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

This method should not be applied to mixtures and/or streams that have:

a) acetylene or its equivalent hazard;

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

c) large concentrations (over 5 %) 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 % and greater by volume, use an MESG of 2.

An alternate method that includes stoichiometric ratios is presented in the paper 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 standard 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 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 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 and this value of MESG is given in the table of Annex B 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 the table of Annex B.

If the flash point is high, the compound does not form a flammable vapour air/mixture at normal ambient temperature. 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 the table of Annex B is the “closed cup” measurement. When this data was not available the “open cup” value is quoted. 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

The temperature class of a gas or vapour is given according IEC 60079-14 in the following table:

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 until ignition of the most easily ignited concentration of the specific gas or vapour in air is obtained.

5.1.7 Auto-ignition temperature

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 B.

If the compound is not included in these data, the data obtained in similar apparatus, such as the apparatus described by ASTM International standard (ASTM E659), is listed [3].

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 % of the total, flameproof equipment of Group IIB is recommended, otherwise equipment of 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 should 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 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: molar ratio. Small

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[3] 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.

quantities of hydrocarbon in the carbon monoxide/air mixture have a similar effect in reducing the MESG so that Group IIB equipment is required.

5.2.4 Methane, Group IIA

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

6 Method of test for the maximum experimental safe gap

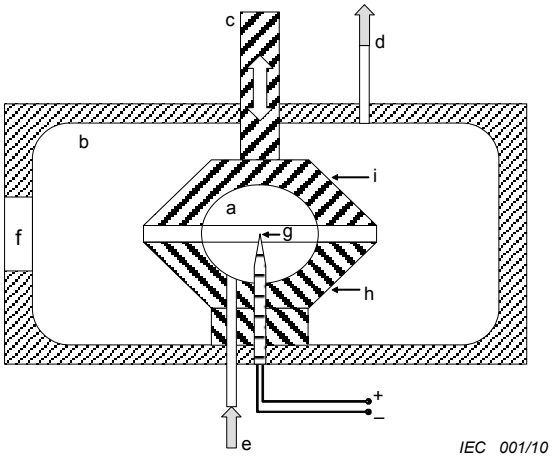
6.1 Outline of method

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[4] and pressure (20 °C, 100 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.

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

4 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.

6.2.2 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.

6.2.3 Interior chamber

The interior chamber "a" is a sphere with a volume measuring 20 cm^3.

6.2.4 Exterior chamber

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

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 Source of ignition

The electrodes "g" shall be mounted in such a way that the spark path is perpendicular to the plane of the joint and should be symmetrically placed on both sides of the plane.

6.2.8 Materials of test apparatus

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.

6.3 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 must be used.

The moisture content of the air used for the preparation of the mixture should not exceed 0,2 % by volume (10 % relative humidity).

6.3.2 Temperature and pressure

The tests are made at an ambient temperature of (20 ± 5) °C, except where otherwise permitted[5]. The pressure within the test apparatus is adjusted to (1 ± 0,01) kPa.

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5 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 with a voltage of approximately 15 kV.

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 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, and the lowest gap, g_{100}, giving 100 % probability of ignition, 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 dangerous mixture is that for which these values are a minimum.

6.4.2 Confirmatory tests

The results are confirmed by repeating the tests, with 10 explosion tests for each step of gap adjustment, at a number of concentrations in the neighbourhood of the most dangerous mixture found in the preliminary series. The minimum values of g_0 and g_{100} are then determined.

6.4.3 Reproducibility of maximum experimental safe gaps

The highest acceptable difference between the values of $(g_0)_{min}$ 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 $(g_0)_{min}$ where $(g_{100})_{min} - (g_0)_{min}$ 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 $(g_0)_{min}$ 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.

6.4.4 Tabulated values

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

The value of the MESG is used to determine the group. The value $(g_{100})_{min} - (g_0)_{min}$ 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 a new apparatus as well as for checking the performance of existing apparatus. Existing apparatuses shall be checked at least every 12 months or whenever parts of the apparatus have been changed or renewed. For a 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 (1,013 ± 0,02) 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
Methane	8,0 – 10,0	1,16	5.5
Propane	3,5 – 4,5	0,90	2.5
Hydrogen	29,0 – 31,0	0,30	5.0

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

7.1 Outline of method

A known volume of the product to be tested is injected into a heated open 200 ml Erlenmeyer flask containing air. The contents of the flask are observed in a darkened room until ignition occurs. The test is repeated with different flask temperatures and different sample volumes. The lowest flask temperature at which ignition occurs is taken to be the auto-ignition temperature of the product in air at atmospheric pressure.

7.2 Apparatus

7.2.1 General

Historically there haven been used two apparatus, the IEC apparatus described in A.1 and the DIN apparatus described in A.2. 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.

7.2.2 Test flask

The test flask shall be a 200 ml Erlenmeyer flask of borosilicate glass. A chemically clean flask shall be used for tests on each product and for the final series of tests.

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 Furnace

The test flask shall be heated in an adequately uniform manner by a hot-air furnace. Examples of furnaces suitable for this purpose are described in Annex A to this standard.

The test flask shall be deemed to be adequately uniformly heated and the position or positions selected for temperature measurement shall be deemed to be satisfactory if the measured auto-ignition temperatures of n-heptane, ethylene and acetone agree with the specified values within the tolerances given in 7.5, when the test procedure of this standard is followed. The samples used for these checks shall have a purity of not less than 99,9 %.

7.2.4 Thermocouples

One or more calibrated thermocouples of 0,8 mm maximum diameter shall be used to determine the flask temperature. The thermocouple(s) shall be positioned at selected points on the flask (see 7.2.3) and in intimate contact with its external surface.

7.2.5 Sampling syringes or pipettes

Liquid samples shall be introduced into the flask by means of either :

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.

Gaseous samples shall be introduced by means of a 200 ml gas-tight calibrated glass syringe fitted with a three-way stopcock and connecting tubes.

NOTE Precaution against flash-back should be taken. One method which has been used is illustrated diagrammatically in Figure 10.

7.2.6 Timer

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

7.2.7 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.

7.3 Procedure

The temperature of the furnace shall first be adjusted to give the flask the desired uniform temperature.

7.3.1 Sample injection

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.

7.3.1.1 Liquid samples

The required volume of the sample to be tested shall be injected into the test flask with the hypodermic syringe or pipette as appropriate. The sample shall be injected as droplets into the centre of the flask, as quickly as possible, so that the operation is completed in 2 s. The syringe or pipette shall then be quickly withdrawn. Care shall be taken to avoid wetting the walls of the flask during injection.

7.3.1.2 Gaseous samples

Gaseous samples shall be injected by first filling the gas-tight syringe and its associated tubes, making certain by repeated flushing that the system is completely filled with the gas to be tested. The required volume shall then be injected into the test flask 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.

7.3.1.3 Initial sample volume

Suitable sample volumes for the initial tests are 0,07 ml for liquid samples and 20 ml for gaseous samples.

7.3.2 Observations

The timer shall be started as soon as the sample has been completely injected into the test flask and stopped immediately when a flame is observed. The temperature and auto-ignition delay time shall be recorded. If no flame is observed, the timer shall be stopped after 5 min and the test discontinued.

7.3.3 Subsequent tests

The tests shall be repeated at different temperatures and with different sample volumes until the minimum value of the auto-ignition temperature is obtained. Between each test the flask shall be flushed completely with clean dry air. After flushing, a sufficient time interval shall be allowed to ensure that the flask temperature is stabilized at the desired test temperature before the next sample is injected. The final tests shall be made in temperature steps of 2 K until the lowest temperature at which auto-ignition occurs has been obtained.

7.3.4 Confirmatory tests

The final tests shall be repeated five times.

7.4 Auto-ignition temperature

The lowest temperature at which auto-ignition occurs in the tests described in 7.3 shall be recorded as the auto-ignition temperature, provided that the results satisfy the validity requirements of 7.5. The corresponding auto ignition delay time and the barometric pressure shall be recorded.

7.5 Validity of results

7.5.1 Repeatability

Results of repeated tests obtained by the same operator and fixture shall be considered suspect if they differ by more than 2 %.

7.5.2 Reproducibility

The averages of results obtained in different laboratories shall be considered suspect if they differ by more than 5 %.

NOTE The tolerances stated above for repeatability and reproducibility are tentative values pending the accumulation of more information.

7.6 Data

A record shall be kept of the name, source and physical properties of the product, test number, date of test, ambient temperature, pressure, quantity of sample used, auto-ignition temperature and auto-ignition delay time.

7.7 Verification of the auto-ignition temperature determination method

This verification procedure shall be used for a new apparatus as well as for checking the performance of existing apparatus. Existing apparatus have to be checked at least every 12 months or whenever parts of the apparatus have been changed or renewed. For a new apparatus carry out experiments according to the instructions given in 7.3 of this standard 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 expressed by mol fraction shall be 99,8 % or better, that one of *n*-heptane shall be 99,3 % or better.

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

Verification will be confirmed if the values obtained for the lowest temperature for ignition do not deviate more than ±1,5 % from the values given in Table 3. The values are valid for an ambient temperature of (20 ± 2) °C and an ambient pressure of (1,013 ± 0,02) kPa.

Table 3 – Values for verification of the apparatus

Flammable substance	Starting temperature °C	Measured lowest temperature for ignition °C
Acetone	534	539
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)

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

Furnaces constructed in accordance with Clauses A.1 and A.2 below are suitable for the tests described in Clause 7.

A.1 The furnace is shown schematically in Figure A.1 to Figure A.5.

It 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.

The temperature measured by each of the thermocouples can be adjusted to within ±1 °C of the desired test temperature by the use of independently variable controls for each of the three heaters.

A.2 The furnace is shown schematically in Figure A.6 to Figure A.8. It consists of a resistance-heated furnace of approximately 1300 W, maximum heating current 6 A.

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 furnace, is also of stainless steel and holds the flask within the furnace. 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.

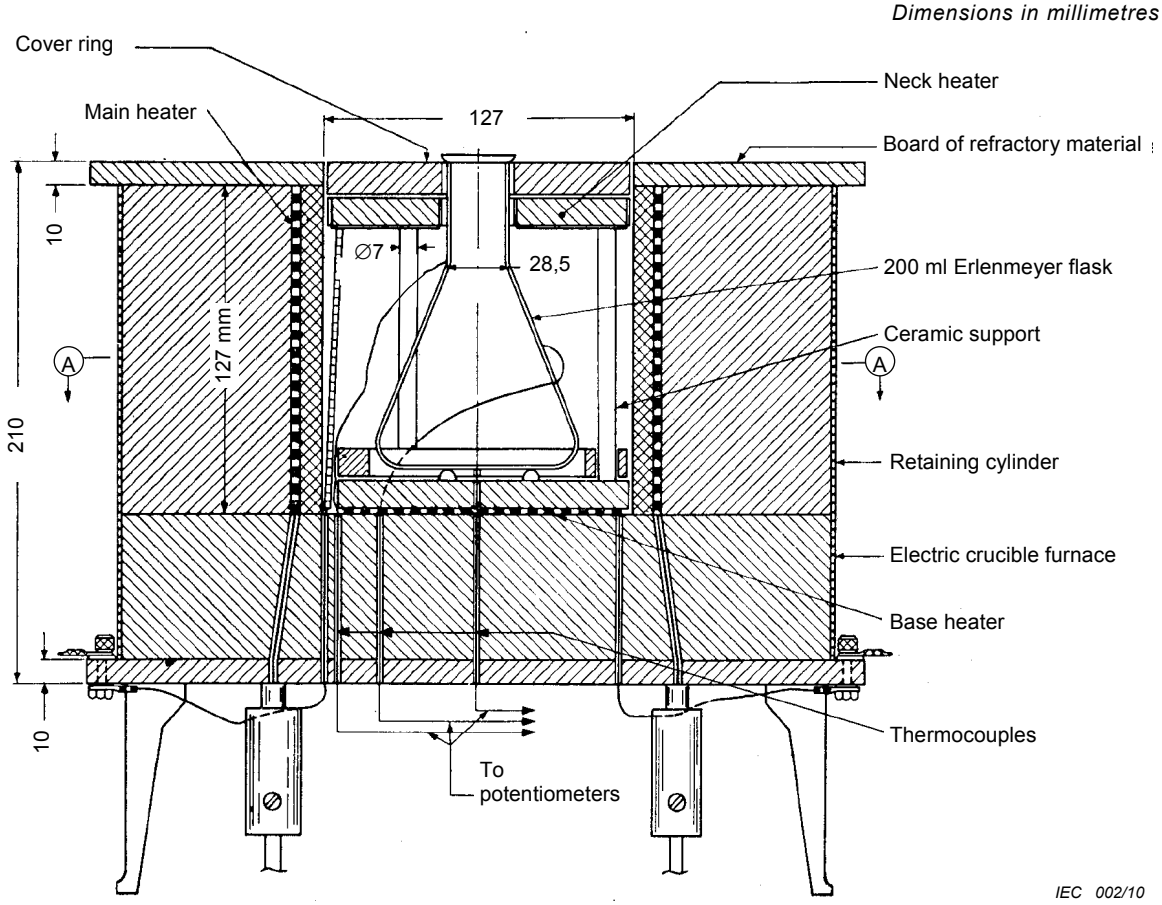

Figure A.1 – Test apparatus: assembly

Dimensions in millimetres

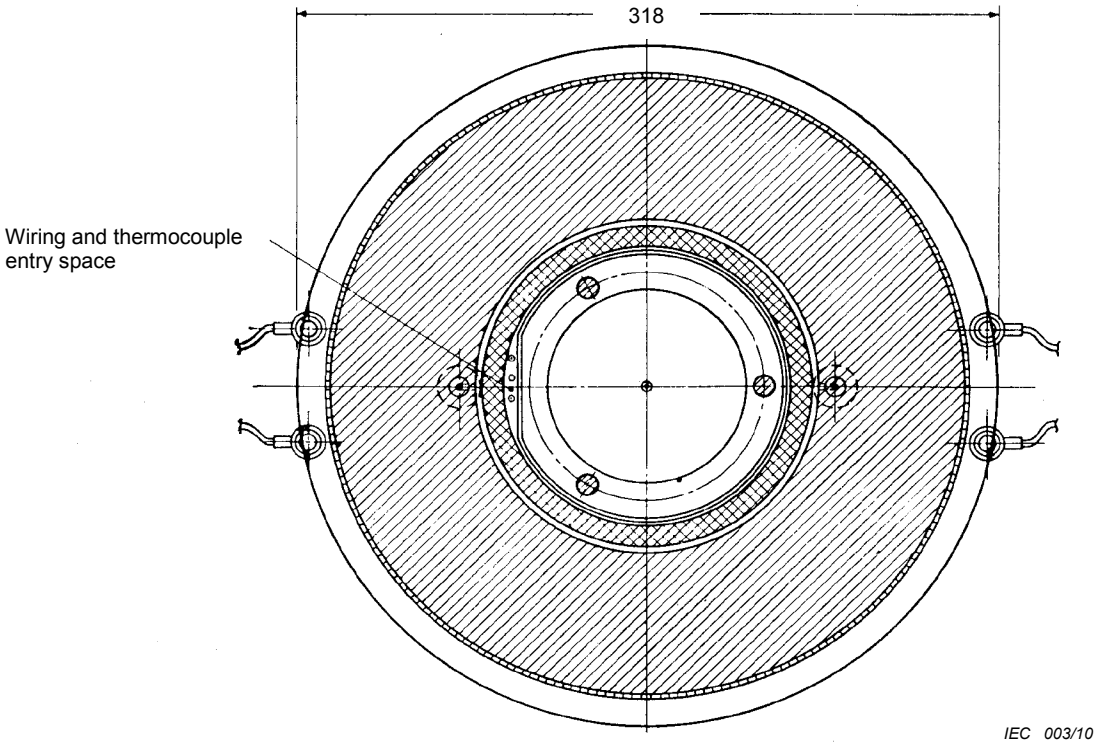

Figure A.2 – Section A-A (flask omitted)

Dimensions in millimetres

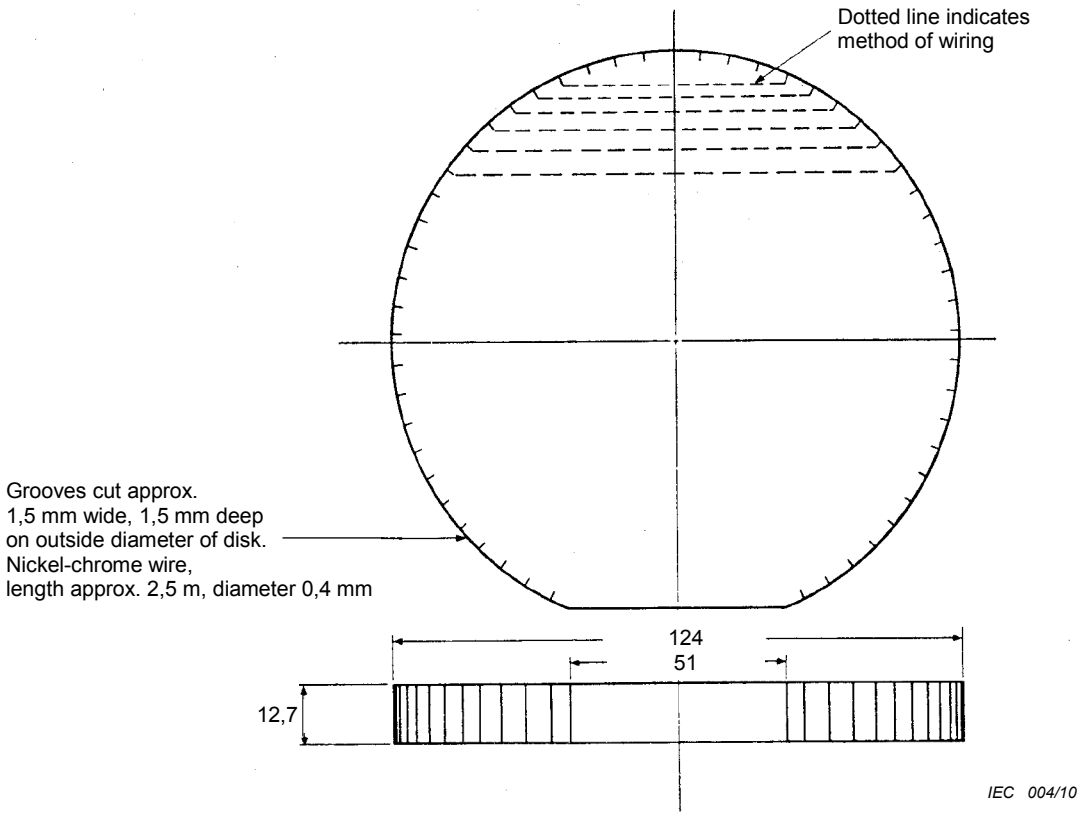

Figure A.3 – Base heater (board made of refractory material)

Dimensions in millimetres

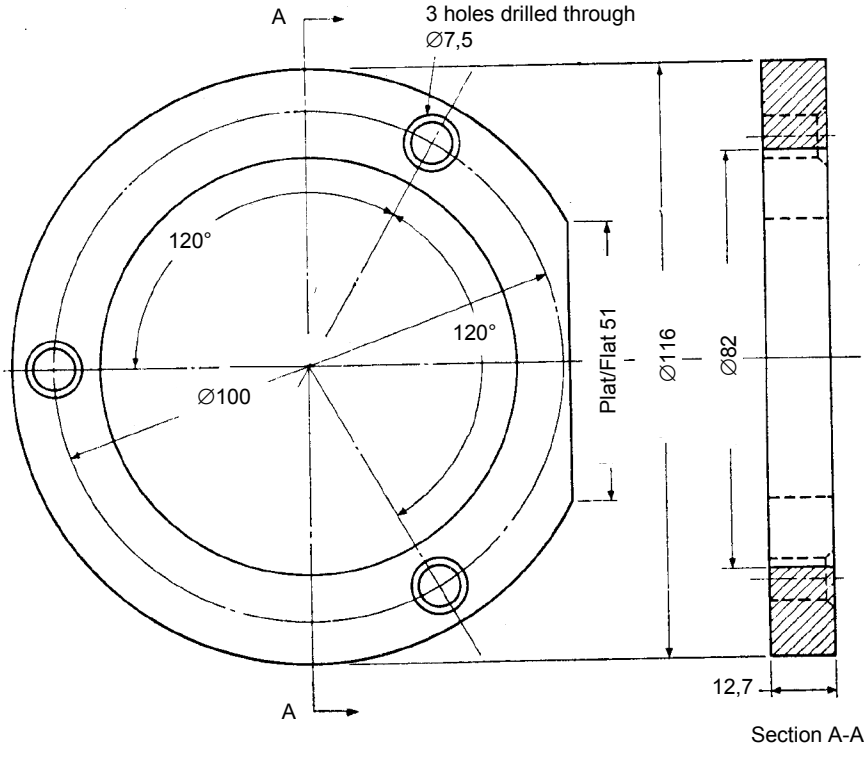

Figure A.4 – Flask guide ring (board made of refractory material)

Dimensions in millimetres

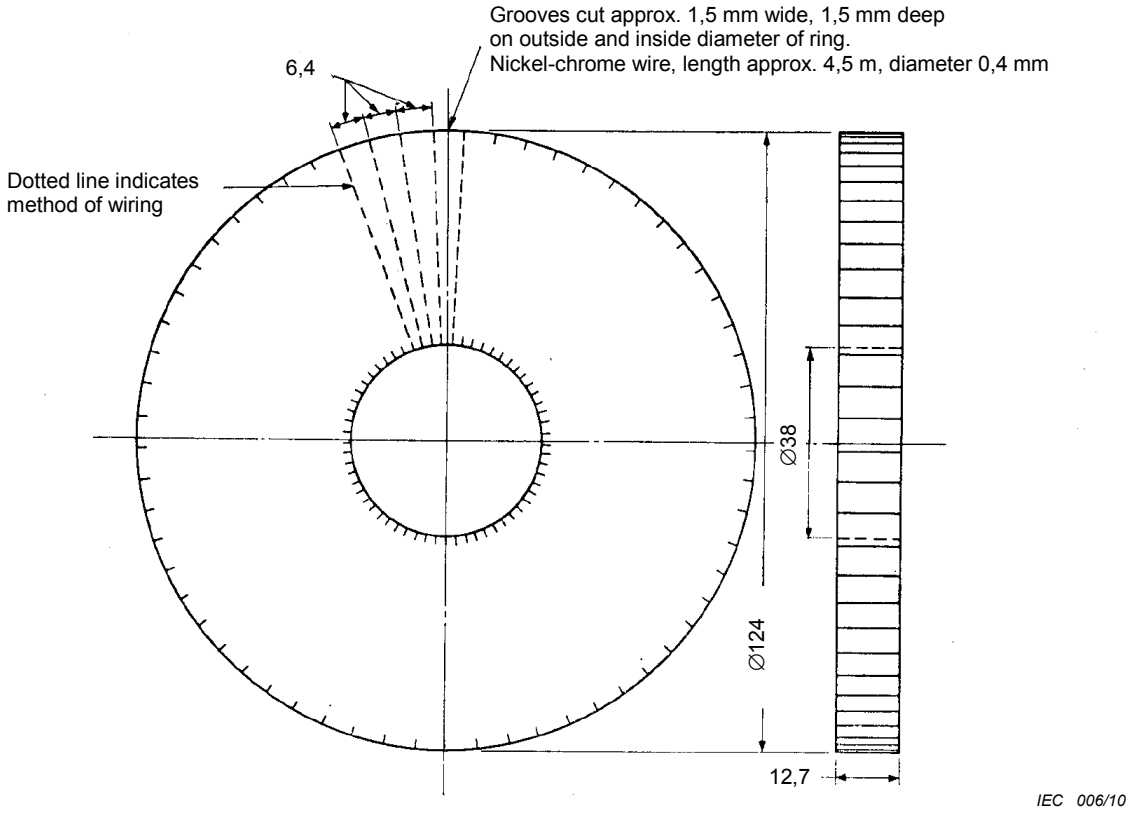

Figure A.5 – Neck heater (board made of refractory material)

Dimensions in millimetres

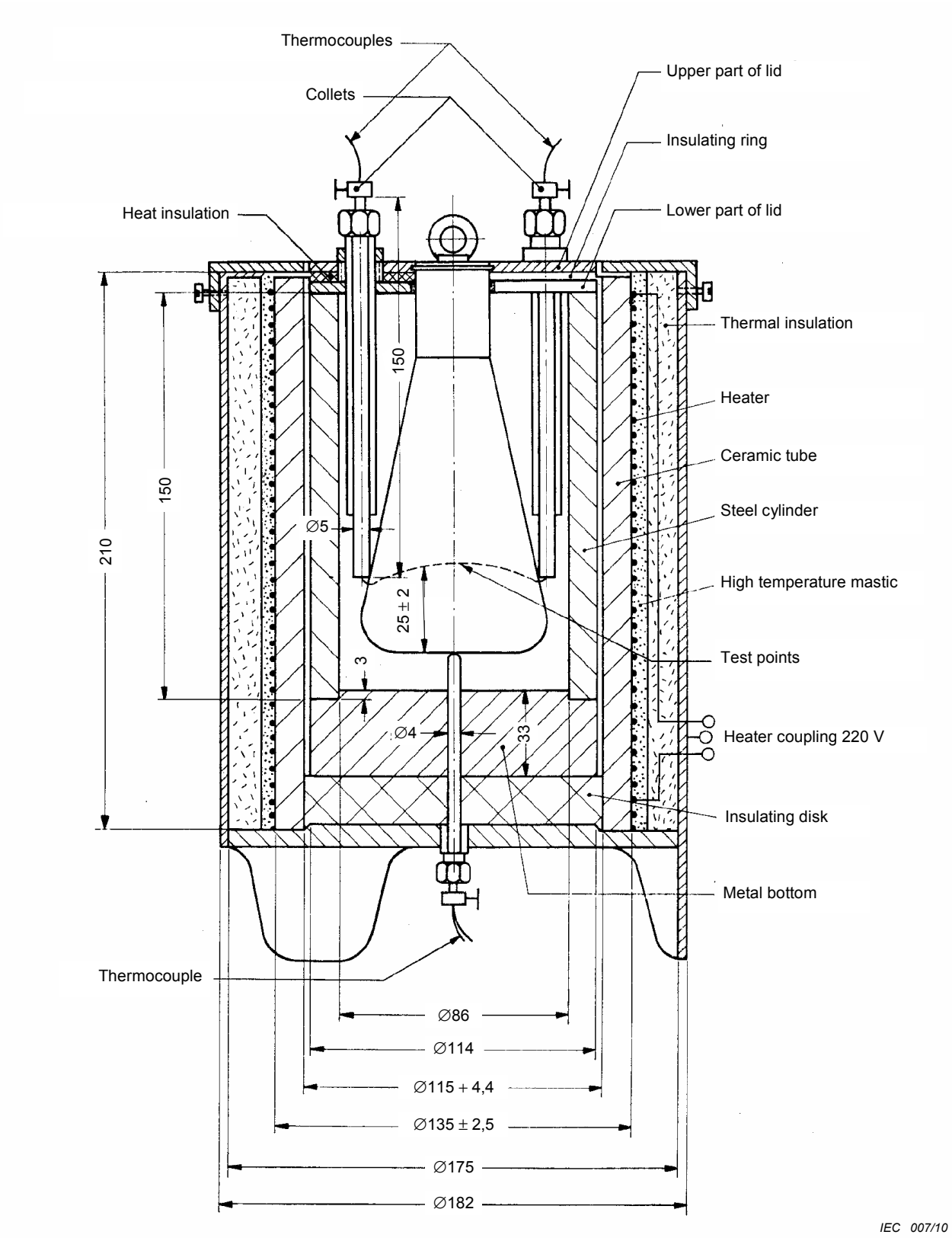

Figure A.6 – Furnace

Dimensions in millimetres

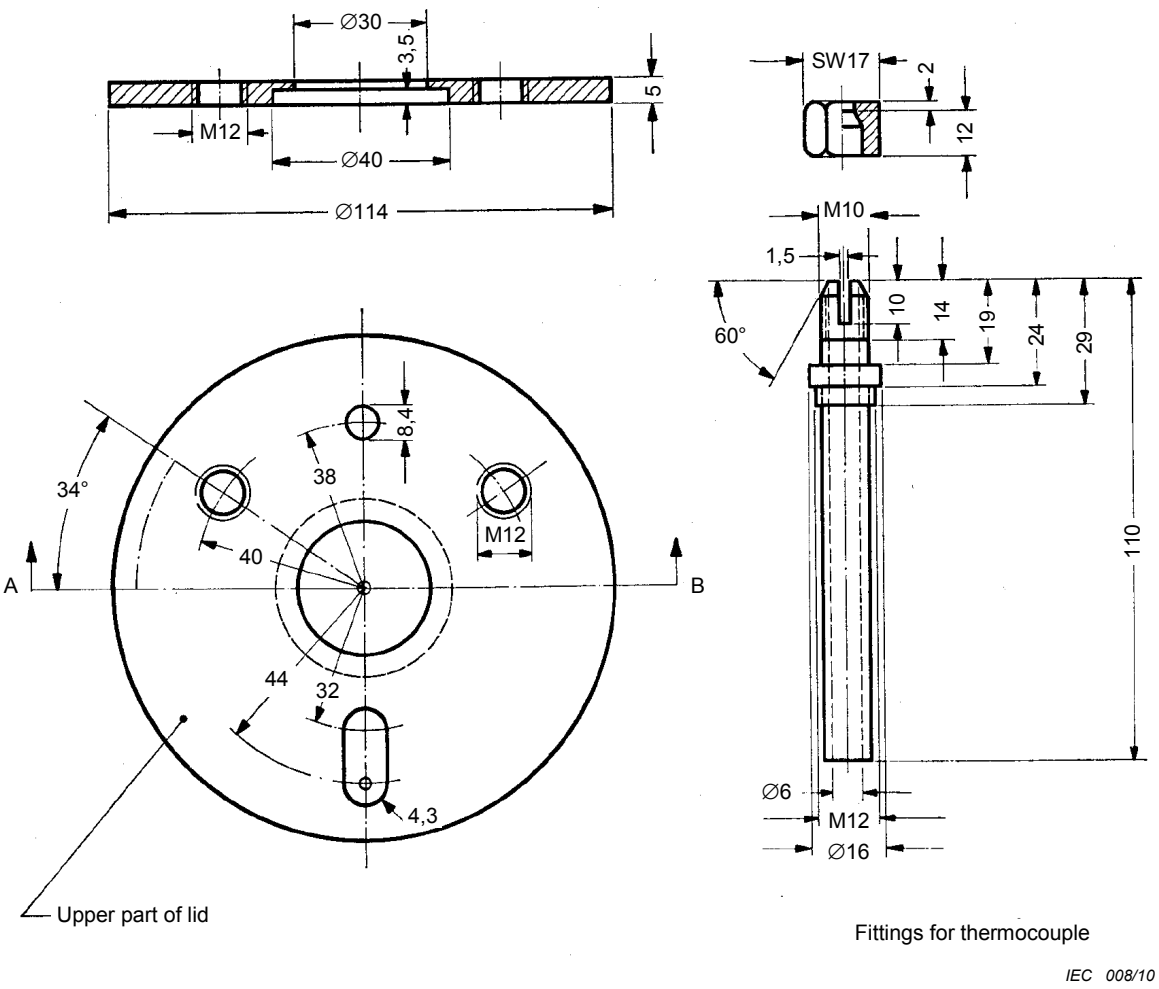

Figure A.7 – Lid of steel cylinder

Dimensions in millimetres

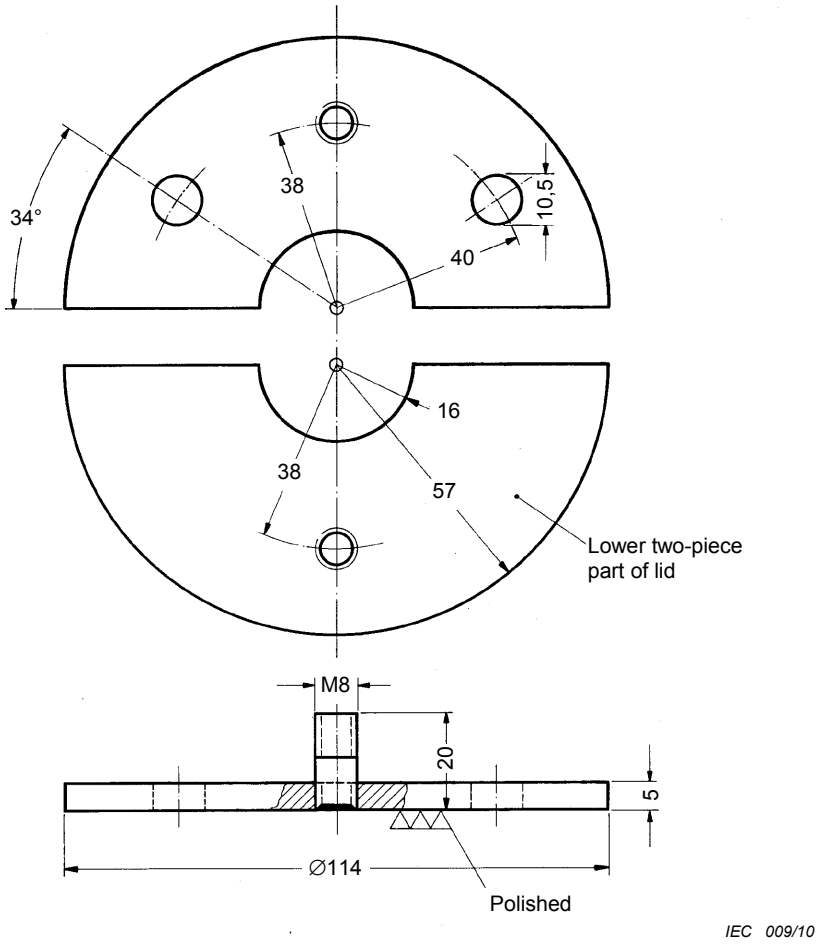

Figure A.8 – Lid of steel cylinder

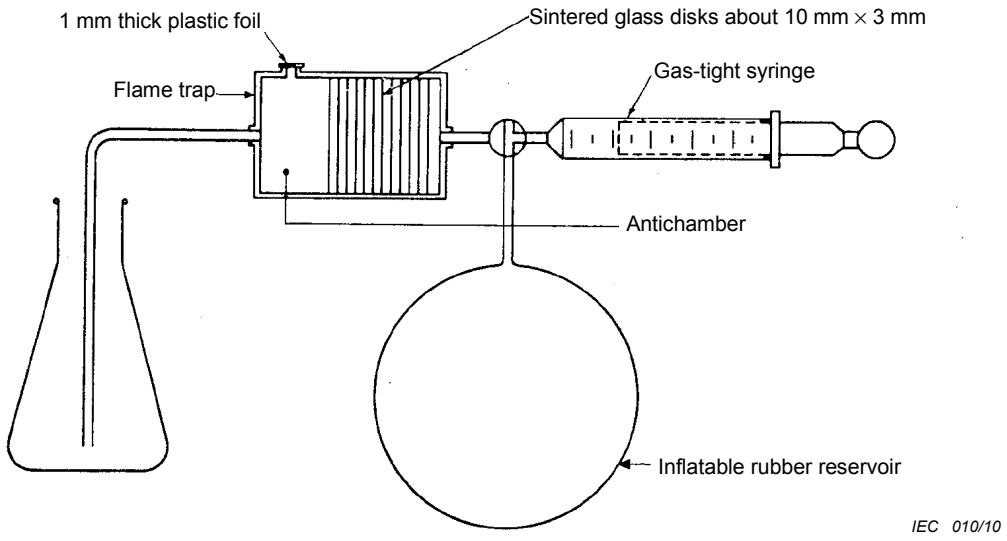

Figure A.9 – Injection of gaseous sample

Annex B
(informative)

Tabulated values

The classification in this standard provides guidance on the 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 the tables should not be considered to be comprehensive.

Users of the data in this standard 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[6] is recommended.

The following values are tabulated:

a) CAS-number
   CAS: chemical abstract system
b) English name and
   (= synonyms)

   Formula
c) Relative density (air = 1)
d) Melting point
e) Boiling point
f) Flash point
g) Flammability limits
h) Ignition temperature
i) Most incentive 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).

[6] For information on the availability of maintained databases refer to Bibliography.

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.
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

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.
64-18-6	Formic Acid (= Hydrogen carboxylic acid) (= Methanoic acid) HCOOH	1,60	8	101	42	18,0	57,0	190	1049	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	428	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	73	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 (= Acetone) (= Dimethyl ketone) $(CH_3)_2CO$	2,00	-95	56	<–20	2,5	14,3 at 100 °C	60	345 at 100 °C	539	5,9	1,01		1,00	T1	IIA	c

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.
68-12-2	N,N-Dimethyl formamide (= Dimethylformamide) $HCON(CH_3)_2$	2,51	-61	153	58	1,8	16,0	55	500	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) $CH_3(CH_2)_2CH_2OH$	2,55	-89	118	35	1,4	12,0	52	372	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	36	385	320	100 mg/l	0,99			T2	IIA	a
71-43-2	Benzene (= Phenyl hydride) C_6H_6	2,70	6	80	–11	1,2	8,6	39	280	498		0,99		1,00	T1	IIA	c

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.
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≡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

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.
74-90-8	Hydrocyanic acid (= Hydrogen cyanide) (= Formic anammonide) (= Hydrocyanic acid) (= Methanenitrile) (= Prussic acid) HCN	0,90	-13	26	<–20	5,4	46,0	60	520	538	18,4	0,80	0,02		T1	IIB	a
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	450	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

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.
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 (= Vinyl Chloride) (= Chloroethylene) $CH_2=CHCl$	2,15	-160	-14	gas	3,6	33,0	94	610	415	7,3	0,99	0,04		T2	IIA	a
75-04-7	Ethylamine (= Aminoethane) (= Monoethylamine) $C_2H_5NH_2$	1,50	-92	7	gas	3,5	14,0	49	260	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

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.
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) $\underbrace{CH_2CH_2}CH_2$	1,45	-128	-33	gas	2,4	10,4	42	183	500		0,91		0,84	T1	IIA	a
75-21-8	Oxirane (= Ethylene oxide) (= Epoxyethan) $\underbrace{CH_2CH_2}O$	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

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.
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) (= Vinylidene difluoride) $CH_2=CF_2$	2,21	-144	-86	gas	3,9	25,1	102	665	380		1,10			T2	IIA	a
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 (= Neohexan) $(CH_3)_3CCH_2CH_3$	2,97	-100	50	-48	1,0	7,0	36	260	405					T2	IIA	d

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.
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			543					T1		
75-89-8	2,2,2-Trifluoroethanol (= 2,2,2-Trifluoroethyl alcohol) CF_3CH_2OH	3,45	-44	77	30	8,4	28,8	350	1195	463		3,00			T1	IIA	a
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) $(C_2H_5)_4Si$	7,18	-83	169	38	0,45	7,2			174					T4		

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78-78-4	2-Methylbutane (= Ethyl dimethyl methane) (= Isopentane) $(CH_3)_2CHCH_2CH_3$	2,50	-160	28	–56	1,3	8,3	38	242	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	330	374		1,15			T2	IIA	a
78-83-1	2-Methyl-1-propanol (= iso-Butanol) (= iso-Propylcarbinol) (= iso-Butyl alcohol) $(CH_3)_2CHCH_2OH$	2,55	-108	+108	28	1,4	11,0	43	340	408	105 mg/l	0,96			T2	IIA	a
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

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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			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	0,84	0,02	0,92	T2	IIB	a
79-09-4	Propionic acid (= Carboxyethane) (= Ethanecarboxylic acid) (= Methyl acetic acid) CH_3CH_2COOH	2,55	-21	141	53	2,1	12,1	64	370	485		1,10			T1	IIA	a
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

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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-Methylpropanoc acid (= iso-Butyric acid) (= Dimethylacetic acid) $(CH_3)_2CHCOOH$	3,03	-46	155	58	2,0	10,0			443		1,02			T2	IIA	a
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

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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) $(CH_3CH_2)_2CO$	3,00	-42	102	7	1,6		58		445		0,90			T2	IIA	a
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

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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 (= Isohexyl alcohol) $CH_3CH(CH_2CH_3)CH_2CH_2OH$	3,52	-52	149	57	1,2	8,3			315					T2		
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

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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) $C_6H_5C(CH_3)=CH_2$	4,08	-23	166	40	0,8	11,0	44	330	445		0,88			T2	IIB	a
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	366	436					T2	IIA	d

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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) $(\underline{CH_2}=CH)CH(CH_2)_4\underline{CH_2}$	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	44	340	431					T2	IIA	d
100-42-5	Ethenylbenzene (= Styrene) (= Vinylbenzene) (= Phenylethylene) (= Styrol) $C_6H_5CH=CH_2$	3,60	-31	145	30	1,0	8,0	42	350	490				1,21	T1	IIA	b
100-43-6	4-Vinylpyridine (= 4-Ethenylpyridine) (= γ-Vinylpyridine) $N\underline{CHCHC}(CH_2=CH)\underline{CHCH}$	3,62		171	43	1,1		47		501		0,95			T1	IIA	a

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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	53	439	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			252					T3		
104-76-7	2-Ethyl-1-hexanol $CH_3(CH_2)_3CH(CH_2CH_3)CH_2OH$	4,5	-76	182	73	0,9	9,7			288					T3		
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

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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			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			410					T2		
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

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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-CH_2-O-$CHCH_2CH_2O$	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				324					T2		
106-97-8	n-Butane (= Butyl hydride) (= Diethyl) (= Methylethylmethane) $CH_3(CH_2)_2CH_2$	2,05	-138	-1	gas	1,4	9,3	33	225	372	3,2	0,98	0,02	0,94	T2	IIA	c
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

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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	728	217		0,72			T3	IIB	a
107-05-1	3-Chloro-1-propene (= Allyl chloride) (= 1-Chloro-2-propene) (= 3-Chloropropylene) CH_2=CHCH_2Cl	2,64	-136	45	-32	2,9	11,2	92	357	390		1,17		1,33	T2	IIA	a
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

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107-07-3	Ethylene chlorohydrin (= 2-Chloroethanol) (= 2-Chloroethyl alcohol) CH_2ClCH_2OH	2,78	-68	128	55	4,9	16,0	160	540	425					T2	IIA	d
107-10-8	1-Propaneamine (= 1-Aminopropane) $CH_3(CH_2)_2NH_2$	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
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

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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 (aquous solution 40 %)	5,7	18,4										
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			T2	IIA	a
108-01-0	2-(Dimethylamino)ethanol $(CH_3)_2NC_2H_4OH$	3,03	-40	131	39					220					T3	IIA	d
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

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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) (= 1-Methylethyl ester of acetic acid) (= 2-Propyl acetate) $CH_3COOCH(CH_3)_2$	3,51	-17	90	1	1,7	8,1	75	340	425		1,05			T2	IIA	a

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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	428	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		310	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
108-88-3	Methyl benzene (= Toluene) (= Methyl benzol) (= Phenyl methane) $C_6H_5CH_3$	3,20	-95	111	4	1,0	7,8	39	300	530		1,06			T1	IIA	d

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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	60	520	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	47		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) (= Pimelic ketone) $CH_2(CH_2)_4CO$	3,38	-26	156	43	1,3	9,4	53	386	419	3,0	0,95	0,03		T2	IIA	a

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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-dimethyl-aminopropane) $(CH_3)_2N(CH_2)_3NH_2$	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 (= n-Butyl bromide) $CH_3(CH_2)_2\ CH_2Br$	4,72	-112	102	13	2,5	6,6	6,6	143	265					T3	IIA	d
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

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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			272					T3		
109-86-4	2-Methoxyethanol (= Ethylene glycol monomethyl ether) $CH_3OCH_2CH_2OH$	2,63	-86	104	39	1,8	20,6	76	650	285		0,85			T3	IIB	a
109-87-5	Dimethoxymethane (= Methylal) (= Dimethyl acetal methanal) (= Dimethyl acetal formaldehyde) (= Dimethyl formal) (= 2,4-Dioxapentane) $CH_2(OCH_3)_2$	2,60	-105	43	–21	2,2	19,9	71	630	235		0,86			T3	IIB	a
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

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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 (= Tetramethylene sulphide) (= Thiolane) (= Thiophane) (= Thiocyclopentane) $CH_2(CH_2)_2CH_2S$	3,04	-96	121	13	1,1	12,3	42	450	200		0,99			T4	IIA	a

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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		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) $CH_3(CH_2)_3CHO$	2,97	-92	103	6	1,4	9,5	50		206					T3		

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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	68	593	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	290	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		244		0,94		0,97	T3	IIA	d
110-86-1	Pyridine (= Azine) (= Azabenzene) C_5H_5N	2,73	-42	116	18	1,7	12,4	56	398	482					T1	IIA	d

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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	65	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	68	642	380		0,97		0,53	T2	IIA	a
111-27-3	1-Hexanol (= Amylcarbinol) (= Hexyl alcohol) (= 1-Hydroxyhexane) (= Pentylcarbinol) $CH_3(CH_2)_4CH_3$	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 (= Dipropylether) (= 1-propoxy-propane) $CH_3(CH_2)_2O$	3,53	-122	90	<–5	1,18		50		175					T4	IIB	a

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111-49-9	Hexahydro-1H-acepine (= Azepane) $\underbrace{CH_2}(CH_2)_5\underbrace{NH}$	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	311	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			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) $CH_3(CH_2)_3OCH_2OH$	4,1	-75	171	61	1,1	12,7			238					T3		
111-84-2	Nonane (= Nonyl hydride) $CH_3(CH_2)_7CH_2$	4,43	-51	151	30	0,7	5,6	37	301	205					T3	IIA	d

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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	385	270		1,05			T3	IIA	d
111-90-0	2- (2-Ethoxyethoxy) ethanol (= Diethylene glycol monoethyl ether) (= 3,6-Dioxaoctan-1-ol) $CH_3CH_2OCH_2CH_2OCH_2CH_2OH$	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			340					T2		
112-30-1	1-Decanol (= Decyl alcohol) $CH_3(CH_2)_9OH$	5,30	7	230	82	0,7	5,5			288					T3		
112-34-5	2-(2-Butoxyethoxy) ethanol (= Butyldiglykol) (= Diglycol monobutyl ether) $CH_3(CH_2)_3OCH_2CH_2OCH_2CH_2OH$	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) $(CH_3(CH_2)_5)_2O$	6,43	-43	227	75					187					T4	IIA	d

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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 (= 2-Ethylhexaldehyde) $CH_3CH(CH_2CH_3)(CH_2)_3CHO$	4,4	-50	163	42	0,9	7,2			185					T4		

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.
123-38-6	1-Propanal (= Propionic aldehyde) CH_3CH_2CHO	2,00	-81	49	<–26	2,0		47		188		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) (= n-Butyl ester of acetic acid) (= Butyl ethanoate) $CH_3COOCH_2(CH_2)_2CH_3$	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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123-91-1	1,4-Dioxane (= Diethylene dioxide) (= Diethylene ether) $OCH_2CH_2OCH_2CH_2$	3,03	10	101	11	1,4	22,5	51	813	375	4,75	0,70	0,02	0,19	T2	IIB	a
124-13-0	Octanal (= Octaldehyde) $CH_3(CH_2)_6CHO$	4,42	12 to 15	171	52					200					T4	IIA	a
124-18-5 (n-Decane)	Decane (mixed isomers) $C_{10}H_{22}$	4,90			46	0,7	5,6	41	332	235	120 mg/l	1,05			T3	IIA	a
124-40-3	n-Methylmethanamine (= Dimethylamine) $(CH_3)_2NH$	1,55	-92	7	gas	2,8	14,4	53	272	400		1,15			T2	IIA	a
126-99-8	2-Chloro-1,3-butadiene (= Chloroprene) $CH_2=CClCH=CH_2$	3,0		60	-29	1,9	20,0			320					T2		
138-86-3	1-Methyl-4-(1-methylethenyl) cyclohexene $CH_3CCHCH_2CH(C(CH_3)=CH_2)CH_2CH_2$	4,66	-89	175	43	0,7	6,1	39	348	237		1,18			T3	IIA	a
140-88-5	2-Propenoic acid ethyl ester (= Acrylic acid ethyl ester) (= Ethyl acrylate) (= Ethyl propenoate) $CH_2=CHCOOCH_2CH_3$	3,45	-75	100	9	1,4	14,0	59	588	350	4,3	0,86	0,04		T2	IIB	a

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141-32-2	2-Propenoic acid butyl ester (inhibited) (= n-Butyl acrylate) (= Butyl ester of acrylic acid) (= Butyl-2-propenoate) CH_2=CHCOOC_4H_9	4,41	-65	148	38	1,2	9,9	63	425	268		0,88			T3	IIB	a
141-43-5	2-Aminoethanol (= Ethanolamine) (= beta-Aminoethyl alcohol) (= Ethylolamine) (= 2-Hydroxyethylamine) (= Monoethanolamine) $NH_2CH_2CH_2OH$	2,10	10	172	85					410					T2	IIA	d
141-78-6	Acetic acid ethyl ester (= Ethyl acetate) (= Ethyl ethanoate) $CH_3COOCH_2CH_3$	3,04	-83	77	–4	2,0	12,8	73	470	470	4,7	0,99	0,04		T1	IIA	a
141-79-7	4-Methylpent-3-en-2-one (= Mesityl oxide) $(CH_3)_2CCHCOCH_3$	3,78	-59	130	24	1,6	7,2	64	289	306		0,93			T2	IIA	a
141-97-9	3-Oxobutanoic acid ethyl ester (= Acetoacetic acid ethyl ester) (= 1-Ethoxybutane-1,3-dione) (= Ethyl acetoacetate) $CH_3COCH_2COOCH_2CH_3$	4,50	-44	180	65	1,0	9,5	54	519	350		0,96			T2	IIA	a
142-29-0	Cyclopentene CH=CHCH$_2$CH$_2$CH	2,30	-135	46	<–22	1,48		41		309		0,96			T2	IIA	a

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142-82-5 (n-Heptane)	Heptane (mixed isomers) C_7H_{16}	3,46	-91	98	-7	0,85	6,7	35	281	204	2,3	0,91	0,02	0,88	T3	IIA	c
142-84-7	n-Propyl-1-propanamine (= Dipropylamine) $(CH_3CH_2CH_2)_2NH$	3,48	-40	105	4	1,2	9,1	50	376	260		0,95			T3	IIA	a
142-96-1	1,1´-Oxybisbutane (= Dibutyl ether) (= 1-Butoxybutane) $(CH_3(CH_2)_3)_2O$	4,48	-95	141	25	0,9	8,5	48	460	175	2,6	0,86	0,02		T4	IIB	c
151-56-4	Ethylenimine (= Aminoethylene) (= Aziridine) CH_3CH_2N	1,5	-71	55	-11	3,3	54,8			320				0,48	T2	ÎIB	b
287-23-0	Cyclobutane (= Tertamethylene) $CH_2(CH_2)_2CH_2$	1,93	-91	13	gas	1,8		42								IIA	d
287-92-3	Cyclopentane (= Pentamethylene) $CH_2(CH_2)_3CH_2$	2,40	-94	49	–37	1,4		41		320		1,01			T2	IIA	d
291-64-5	Cycloheptane $CH_2(CH_2)_3CH_2$	3,39	-8	119	6	1,1	6,7	44	275							IIA	d
300-62-9	(+-)-α-Methylbenzeneethanamine (= Amphetamine) (=1-Phenylpropan-2-amine) $C_6H_5CH_2CH(NH_2)CH_3$	4,67		200	<100											IIA	d

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350-57-2	1,1,2,2-Tetrafluoroethoxybenzene $C_6H_5OCF_2CF_2H$	6,70		152 to 162	47	1,6		126		483		1,22			T1	IIA	a
359-11-5	Trifluoroethylene CF_2=CFH	2,83		-51	./.	15,3	27,0	502	904	319		1,40			T2	IIA	a
420-46-2	1,1,1-Trifluoroethane (= Methylfluoroform) CF_3CH_3	2,90	-111	-47	./.	6,8	17,6	234	605	714		>2,00			T1	IIA	a
461-53-0	Butanoyl fluoride (= Butyryl fluoride) $CH_3(CH_2)_2COF$	3,10		66	<–14	2,6		95		440		1,14			T2	IIA	a
463-58-1	Carbonyl sulfide COS	2,07	-139	-50	gas	6,5	28,5	160	700	209		1,35			T3	IIA	a
493-02-7	trans-Decahydronaphthalene $CH_2(CH_2)_3CHCH(CH_2)_3CH_2$	4,76	-30	187	54	0,7	4,9	40	284	288					T3	IIA	d
504-60-9	Penta-1,3-diene (= Piperylene) CH_2=CH-CH=CH-CH_3	2,34		41	<–31	1,2	9,4	35	261	361		0,97			T2	IIA	a
507-20-0	2-Chloro-2-methylpropane $(CH_3)_3CCl$	3,19	-27	51	<–18					541		1,40			T1	IIA	a
513-35-9	2-Methylbut-2-ene (= Amylene) (= Trimethylethylene) $(CH_3)_2C$=$CHCH_3$	2,40	-134	38	–53	1,3	6,6	37	189	290		0,96			T3	IIA	a
513-36-0	1-Chloro-2-methylpropane $(CH_3)_2CHCH_2Cl$	3,19	-131	69	<–14	2,0	8,8	75	340	416		1,25			T2	IIA	a

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526-73-8	1,2,3-Trimethylbenzene (= Hemimellitene) CHCHCH(CH_3) C(CH_3)C(CH_3)	4,15	-26	176	51	0,8	7,0			470					T1	IIA	d
534-22-5	2-Methylfuran OC(CH_3) CHCHCH	2,83	-89	64	<–16	1,4	9,70	47	325	318		0,95			T2	IIA	a
536-74-3	Phenylacetylene (= Ethynylbenzene) (= Phenyl ethyne) $C_6H_5C{\equiv}CH$	3,52	-45	142	41					420		0,86			T2	IIB	a
540-54-5	1-Chloropropane $CH_3CH_2CH_2Cl$	2,70	-123	47	–32	2,4	11,1	78	365	520					T1	IIA	a
540-59-0	1,2-Dichloroethene (= Acetylene dichloride) (= trans-Acetylene dichloride) (= sym-Dichloroethylene) ClCH=CHCl	3,55	-57	48 to 60	–10	9,7	12,8	391	516	440		3,91			T2	IIA	a
540-67-0	Ethyl methyl ether (= Methoxythane) $CH_3OCH_2CH_3$	2,10	-139	7	gas	2,0	10,1	50	255	190					T4	IIB	d
540-84-1	2,2,4-Trimethylpentane (= iso-Butyltrimethyl methane) (= iso-Octane) $(CH_3)_2CHCH_2C(CH_3)_3$	3,90	-107	99	–12	0,7	6,0	34	284	413	2	1,04	0,04		T2	IIA	a
540-88-5	Acetic acid 1,1-dimethylethyl ester (= tert-Butyl acetate) (= tert-Butyl ester of acetic acid) $CH_3COOC(CH_3)_3$	4,00		97	1	1,3	7,3			435					T2		

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542-92-7	1,3-Cyclopentadiene $CH_2CH=CHCH=CH$	2,30	-97	40	–50					465		0,99			T1	IIA	a
544-01-4	1,1´-Oxybis(3-methylbutane) (= Diisopentylether) (= Di(3-methyl-1-butyl) ether) (= 3-Methyl-1-(3-methyl-butoxy)-butane) $(CH_3)_2CH(CH_2)_2O(CH_2)_2CH\ (CH_3)_2$	5,45	-96	173	44	1,27		104		185		0,92			T4	IIA	a
554-14-3	2-Methylthiophene $SC(CH_3)\ CHCHCH$	3,40	-63	113	–1	1,3	6,5	52	261	433		1,15			T2	IIA	a
557-99-3	Acetyl fluoride CH_3COF	2,14	-84	21	<–17	5,6	19,9	142	505	434		1,54			T2	IIA	a
563-47-3	3-Chloro-2-methyl-1-propene $CH_2=C(CH_3)CH_2Cl$	3,12	-80	72	–16	2,1		77		476		1,16			T1	IIA	a
583-48-2	3,4-Dimethylhexane $CH_3CH_2CH(CH_3)CH(CH_3)CH_2CH_3$	3,87		118	2	0,8	6,5	38	310	305					T2	IIA	d
590-01-2	Propionic acid butyl ester (= Propanoic acid, butyl ester) (= Butyl propanoate) (= Butyl propionate) $C_2H_5COOC_4H_9$	4,48	-90	146	38	1,0	7,7	53	409	405		0,93			T2	IIA	a
590-18-1	2-Butene (cis) $CH_3CH=CHCH_3$	1,93	-139	4	gas	1,6	10,0	40	228	325		0,89			T2	IIB	a
590-86-3	3-Methylbutanal (= iso-Pentanal) (= iso-Valeraldehyde) (= 3-Methylbutyraldehyde) $(CH_3)_2CHCH_2CHO$	2,97	-51	92	-5	1,3	13	60		207		0,98			T3	IIA	a

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591-78-6	2-Hexanone (= Hexan-2-one) (= Methyl butyl ketone) $CH_3CO(CH_2)_3CH_3$	3,46	-56	128	23	1,2	9,4	50	392	420		0,98			T2	IIA	a
591-87-7	Acetic acid-2-propenyl ester (= Acetoxypropene) (= Acetic acid, allyl ester) (= Allyl acetate) $CH_2=CHCH_2OOCCH_3$	3,45	103		13	1,7	10,1	69	420	348		0,96			T2	IIA	a
592-77-8	Hept-2-ene $CH_3(CH_2)_3CH=CHCH_3$	3,40	-109	98	<0					263		0,97			T3	IIA	a
598-61-8	Methylcyclobutane $CH_3\underline{CH(CH_2)_2}CH_2$	2,41		36												IIA	d
623-36-9	2-Methylpent-2-enal $CH_3CH_2CHC(CH_3)COH$	3,78	-94	136	30	1,46		58		206		0,84			T3	IIB	a
624-83-9	Methylisocyanate (= Methyl ester of isocyanic acid) CH_3NCO	1,96		38	–35	5,3	26,0	123	605	517		1,21			T1	IIA	a
625-55-8	Formic acid-1-methylethyl ester (= iso-Propyl formate) (= Formic acid isopropyl ester) (= 1-Methylethyl formate) $HCOOCH(CH_3)_2$	3,03		68	<–6					469		1,10			T1	IIA	a

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626-38-0	Acetic acid 1-methylbutyl ester (= sec-Amyl acetate) (= 1-Methylbutyl acetate) (= 2-Pentanol acetate) (= 2-Pentyl ester of acetic acid) $CH_3COOCH(CH_3)(CH_2)_2CH_3$	4,50		134	23	11,0	7,5									IIA	d
628-63-7	Acetic acid penthyl ester (= n-Amyl acetate) (= Amyl acetic ester) (= 1-Pentanol acetate) (= Pentyl Acetate) (= Pentyl ester of acetic acid) (= Primary amyl acetate) $CH_3COO(CH_2)_4CH_3$	4,48	-71	149	25	1,0	7,5	55	387	360	110 mg/l	1,02			T2	IIA	a
629-14-1	1,2-Diethoxyethane (= 3,6-Dioxaoctane) $CH_3CH_2O(CH_2)_2OCH_2CH_3$	4,07	-74	122	16					170		0,81			T4	IIB	a
630-08-0	Carbon monoxide (water saturated air at 18° C; see 5.2.3) CO	0,97			gas	10,9	74,0	126	870	607	40,8	0,84	0,03		T1	IIB	a
645-62-5	2-Ethyl-2-hexenal (= Ethylpropylacrolein) $CH_3CH(CH_2CH_3)=CH(CH_2)_2CH_3$	4,34		175	40					184		0,86			T4	IIB	a
646-06-0	1,3-Dioxolane (= glycolformal) (= formaldehyde ethylene acetal) (= ethylene glycol formal) $OCH_2CH_2OCH_2$	2,55	-26	74	–5	2,3	30,5	70	935	245					T3	IIB	d

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674-82-8	4-Methylene-2-oxetanone (= Acetyl ketene) (= But-3-en-3-olide) (= Diketene) $CH_2{=}CCH_2C(O)O$	2,90	-7	127	33					262		0,84			T3	IIB	a
677-21-4	3,3,3-Trifluoroprop-1-ene $CF_3CH{=}CH_2$	3,31		-29	./.	4,7		184		490		1,75			T1	IIA	a
693-65-2	1,1´-Oxybispentane (= Dipentylether) $(CH_3(CH_2)_4)_2O$	5,45	-69	180	57					171					T4		
760-23-6	3,4-Dichlorobut-1-ene $CH_2{=}CHCHClCH_2Cl$	4,31	-51	123	31	1,3	7,2	66	368	469		1,38			T1	IIA	a
764-48-7	2-Vinyloxyethanol (= 2-Ethenoxyethanol) $CH_2{=}CH\text{-}OCH_2CH_2OH$	3,04		143	52					250		0,86			T3	IIB	a
765-43-5	1-Cyclopropyl ethanone (= acetylcyclopropane) (= Cyclopropyl methyl ketone) $CH_2CH_2CHCOCH_3$	2,90	-68	114	15	1,7		58		452		0,97			T1	IIA	a
814-68-6	Acryloyl chloride (= Propenoyl chloride) (= Acrylic acid chloride) $CH_2CHCOCl$	3,12		74	–8	2,68	18,0	220	662	463		1,06			T1	IIA	a
872-05-9	1-Decene $CH_2(CH_2)_8CH_3$	4,84	-66	172	47	0,55	5,7			235					T3		

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.
920-46-7	Methacryloyl chloride (= Methacrylic acid chloride) (= 2-Methyl-2-propenoyl chloride) CH_2CCH_3COCl	3,60	-60	99 to 102	17	2,5		106		510		0,94			T1	IIA	a
926-57-8	1,3-Dichloro-2-butene $CH_3CCl{=}CHCH_2Cl$	4,31		126	27					469		1,31			T1	IIA	a
994-05-8	2-Methoxy-2-methyl-butane (= 1,1-Dimethylpropyl methyl ether) (= Methyl tert-pentyl ether) $(CH_3)_2C(OCH_3)CH_2CH_3$	3,50	-80	86	<–14	1,18		50		345		1,01			T2	IIA	a
1120-56-5	Methylenecyclobutane $C(=CH_2)(CH_2)_2CH_2$	2,35	-135	42	<0	1,25	8,6	35	239	352		0,76			T2	IIB	a
1122-03-8	4,4,5-Trimethyl-1,3-dioxane $OCH_2OCH(CH_3)C(CH_3)_2CH_2$	4,48			35					284		0,90			T3	IIA	a
1300-73-8	Xylidenes (Mixture of isomers) (= Xylidine) $C_6H_3(CH_3)_2NH_2$	4,17 4,2			90 to 98	1,0	7,0	50	355	500 to 545					T1		
1319-77-3 (o-Cresol)	Cresol (mixed isomers) $CH_3C_6H_4OH$	3,73			81	1,1		50		557					T1	IIA	d
1333-74-0	Hydrogen H_2	0,07	-259	-253	gas	4,0	77,0	3,4	63	560	27	0,29	0,01	0,25	T1	IIC	c
1498-64-2	O-Ethyl phosphoro dichloridothioate $C_2H_5OPSCl_2$	7,27			75					234		1,20			T3	IIA	a
1634-04-4	2-Methoxy-2-methylpropane (= tert-Butyl methylether) (= Methyl tert-butylether) $CH_3OC(CH_3)_3$	3,03	-109	55	–27	1,5	8,4	54	310	385		1,00			T2	IIA	a

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.
1640-89-7	Ethylcyclopentane $CH_3CH_2\underline{CH(CH_2)_3}CH_2$	3,40	-138	103	<5	1,05	6,8	42	280	262					T3	IIA	d
1678-91-7	Ethylcyclohexane $CH_3CH_2\underline{CH(CH_2)_4}CH_2$	3,87	-113	132	<24	0,9	6,6	42	310	238					T3	IIA	d
1712-64-7	Nitric acid-1-methylethyl ester (= iso-Propyl nitrate) (= Nitric acid isopropyl ester) (= Propane-2-nitrate) $(CH_3)_2CHONO_2$	3,62		101	11	2,0	100	75	3738	175					T4	IIB	d
1719-53-5	Dichlorodiethylsilane (= Diethyl-dichloro-silane) $(C_2H_5)_2SiCl_2$	5,42	-96	130	24	3,4		233				0,45				IIC	a
1738-25-6	3-(Dimethylamino) propiononitrile $(CH_3)_2NHCH_2CH_2CN$	3,38	-43	170	50	1,57		62		317		1,14			T2	IIA	a
2032-35-1	2-Bromo-1,1-diethoxyethane $(CH_3CH_2O)_2CHCH_2Br$	7,34		170 to 172	57					175		1,00			T4	IIA	a
2426-08-6	(Butoxymethyl)oxirane (= n-Butyl glycidil ether) (= Butyl 2,3- Epoxypropylether) (= 1,2-Epoxy-3-butoxypropane) $(CH_2)_3OCH_2$ $CH_3CH_2(CH_2)_3O\ \underline{CH_2\ CHCH_2O}$	4,48		165	44					215		0,78			T3	IIB	a
2673-15-6	2,2,3,3,4,4,5,5-Octafluoro-1,1-dimethylpentan-1-ol $H(CF_2CF_2)_2C(CH_3)_2OH$	8,97			61					465		1,50			T1	IIA	a

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.
2993-85-3	2,2,3,3,4,4,5,5,6,6,7,7-Dodecafluoroheptyl methacrylate $CH_2=C(CH_3)COOCH_2(CF_2)_6H$	9,93		197	./.	1,6		185		390		1,46			T2	IIA	a
3583-47-9	1,4-Dichloro-2,3 Epoxybutane (= 2,3-bis(chloromethyl) oxirane) $CH_2ClCH_2CHCHOCH_2Cl$	2,0				1,9	8,5					1,07		0,98		IIA	a
4170-30-3	2-Butenal (= Crotonaldehyde) (= beta-Methyl acrolein) (= Propylene aldehyde) $CH_3CH=CHCHO$	2,41	-75	102	8	2,1	16,0	62	470	230		0,81			T3	IIB	a
4806-61-5	Ethylcyclobutane $CH_3CH_2CH(CH_2)_2CH_2$	2,90	-147	71	<–16	1,2	7,7	42	272	212					T3	IIA	d
5870-82-6	1,1,3-Triethoxybutane $(CH_3CH_2O)_2CHCH_2CH(CH_3CH_2O)CH_3$	6,56			33	0,78	5,8	60	451	165		0,95			T4	IIA	a
5891-21-4	5-Chloro-2-pentanone $CH_3CO(CH_2)_3Cl$	4,16		172	61	2,0		98		440		1,10			T2	IIA	a
7383-71-3	2,2,3,3-Tetrafluoropropyl acrylate (= Acrylic acid 2,2,3,3-tetrafluoro-propyl ester) (= 2,2,3,3-Tetrafluoro propyl prop-2-enoate) $CH_2=CHCOOCH_2CF_2CF_2H$	6,41		135	45	2,4		182		357		1,18			T2	IIA	a
7397-62-8	Hydroxyacetic butylester (= Butyl glycolate) (= Butyl-2-hydroxyacetate) $HOCH_2COO(CH_2)_3CH_3$	4,45	-26	187	61						4,2	0,88	0,02			IIB	a

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.
7664-41-7	Ammonia (= Anhydrous ammonia) NH_3	0,59	-78	-33	gas	15,0	33,6	107	240	630	24,5	3,18		6,85	T1	IIA	a
7783-06-4	Hydrogen Sulfide (= Hydrosulfuric acid) (= Sewer gas) (= Sulfuretted hydrogen) H_2S	1,19	-88	-60	gas	4,0	45,5	57	650	260		0,83			T3	IIB	a
8006-61-9	Gasoline (= Motor fuel) (= Natural gasoline) (= Petrol)	3,0			-46	1,4	7,6			280					T3		
8006-64-2	Turpentine oil	./.	-50 to -60	154 to 170	35	0,8				253					T3	IIA	d
8008-20-6	Kerosene (= Diesel Oil No. 1) (= Fuel Oil No. 1)				38 to 72	0,7	5,0			210					T3	IIA	d
17639-76-8	Methyl-2-methoxypropionate $CH_3CH(CH_3O)COOCH_3$	4,06		42 (at 200 mbar)	48	1,2		58		211		1,07			T3	IIA	a
20260-76-8	2-Methyl-5-vinylpyridine $NC(CH_3)CHCHC(CH_2{=}CH)CH$	4,10			61					520		1,30			T1	IIA	a
25377-83-7	Octene (mixed isomers) C_8H_{16}	3,66			–18	0,9	5,9	42	270	230		0,95			T3	IIA	a
25639-42-3	Methylcyclohexanol (mixed isomers) (= Hexahydromethyl phenol) (= Hexahydrocresol) $C_7H_{13}OH$	3,93	-50	155 to 180	68					295					T3	IIA	d

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.
26519-91-5	Methylcyclopentadiene-1,3 $(CH_3)C=CHCH=CHCH_2$	2,76		73	<–18	1,3	7,6	43	249	432		0,92			T2	IIA	a
29553-26-2	2,2,3,3-Tetrafluoro-1,1-dimethylpropan-1-ol $HCF_2CF_2C(CH_3)_2OH$	5,51			35					447		1,42			T2	IIA	a
30525-89-4	Paraformaldehyde (= Polyoxymethylene) (= Polymerised formaldehyde) (= Formaldehyde polymer) $poly(CH_2O)$	./.			70	7,0	73,0			380		0,57			T2	IIB	a
34590-94-8	(2-Methoxymethylethoxy)propanol (= Dipropylene glycol monomethyl ether) $H_3COC_3H_6OC_3H_6OH$	5,11	-80	209	74	1,1	10,9	69		270					T3		
35158-25-9	2-iso-Propyl-5-methylhex-2-enal (= 2-Hexenal, 5-methyl-2-(1-methylethyl)) $(CH_3)_2CH-C(CHO)CHCH_2CH(CH_3)_2$	5,31		181						188		>1,0			T4	IIA	a
45102-52-1	2,2,3,3-Tetrafluoropropyl methacrylat (= 2,2,3,3-Tetrafluoro propyl 2-methylprop-2-enoate) $CH_2=C(CH_2)COOCH_2CF_2CF_2H$	6,90		70 (at 68 mbar)		1,9		155		389		1,18			T2	IIA	a
68476-34-6	Diesel Oil No. 2 (= Diesel fuel No. 2) (=Fuel Oil No. 2)				52 to 96	0,6	6,5			254 to 285					T3		
No CAS	1-Chloro-2,2,2-trifluoroethyl methyl ether $CF_3CHClOCH_3$	5,12			4	8,0		484		430		2,80			T2	IIA	a
No CAS	Coke oven gas (see 5.2.1)				gas											IIB or IIC	d

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.
No CAS	Fuel oil-6				66 to 132												
No CAS	4-Methylenetetra-hydropyran $OCH_2CH_2C(=CH_2)\ CH_2CH_2$	3,78			2	1,5		60		255		0,89			T3	IIB	a
No CAS	2-Methylhexa-3,5-dien-2-ol $CH_2=CHC=CHC(OH)(CH_3)2$	3,79			24					347		1,14			T2	IIA	a
No CAS	Water gas Mixture of $CO + H_2$	./.													T1	IIC	d

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