

Electrical apparatus for explosive gas atmospheres —

**Part 20: Data for flammable gases and
vapours, relating to the use of electrical
apparatus**

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National foreword

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Summary of pages

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**Partie 20:
Données pour gaz et vapeurs inflammables,
en relation avec l'utilisation des matériels
électriques**

**Electrical apparatus for explosive
gas atmospheres –**

**Part 20:
Data for flammable gases and vapours,
relating to the use of electrical apparatus**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRICAL APPARATUS FOR EXPLOSIVE
GAS ATMOSPHERES –****Part 20: Data for flammable gases and vapours,
relating to the use of electrical apparatus**

FOREWORD

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IEC 79-20, which is a technical report of type 3, has been prepared by technical committee 31: Electrical apparatus for explosive atmospheres.

The text of this technical report is based is based on the following documents:

Committee draft	Report on voting
31/195/CDV	31/211/RVC

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

This report is a Technical Report of type 3 and is of a purely informative nature. It is not to be regarded as an International Standard.

ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES –

Part 20: Data for flammable gases and vapours, relating to the use of electrical apparatus

1 Scope

This technical report gives guidance on the selection of appropriate electrical apparatus, protected by flame-proof enclosure or designed to be intrinsically safe, according to the gas or vapour in which it is intended to be used.

2 General

Tables of chemical and engineering properties of substances are provided to assist electrical engineers in their selection of electrical apparatus to be used in hazardous areas.

The scope of these data has been selected with particular reference to the use of electrical equipment in hazardous areas, and notice has been taken of standard measurement methods given in IEC 79-1A, IEC 79-3, IEC 79-4 and IEC 79-4A.

NOTES

- 1 The data in this report have been taken from a number of references which are given in the bibliography (see annex A).
- 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 electrical apparatus.

Users of the data in this report 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 database¹⁾ is recommended.

3 Determination of the properties

3.1 General

The compounds listed in this technical report are in accordance with IEC 79-12, or have been the subject of a determination of maximum experimental safe gap (MESG), or have physical properties similar to those of other compounds in that list.

¹⁾ For information on the availability of maintained databases refer to annex A.

3.1.1 *Determination of MESG*

The preferred method for the determination of MESG is the 20 ml vessel (see IEC 79-1A), with 25 mm broad flanges and internal spark ignition 10 mm from the inside edge of the flanges. Usually this method gives the same result as an 8.1 sphere, with the one exception of carbon disulphide (see 4.4).

3.2 *Flame proof apparatus group*

The groups are the result of MESG determination except where there is no value listed for MESG. For these, the group is based on chemical similarity (see IEC 79-12).

3.3 *Flammability 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) listed for the lower limit are the lowest reported, and for the upper limit are the highest reported.

If the flash point is high, the compound does not form a flammable vapour cloud in air 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.

3.4 *Flash point (FP)*

The value given 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 degrees Celsius) stated, this probably being the limit of the apparatus used. The lowest reported value is listed.

3.5 *Temperature class*

The temperature class of a compound is allocated according to IEC 79-0. See also 3.7.

3.6 *Minimum igniting current (MIC)*

The apparatus for the determination of minimum igniting current is defined in IEC 79-3. A contact disc with two grooves rotates to make and break contact with a tungsten wire. The low voltage circuit broken in this way has an inductance of 95 mH.

3.7 *Ignition temperature (IT)*

The value of IT depends on the apparatus ²⁾ used in its determination and the manner in which it is used. The preferred data are those reported in IEC 79-4. If the compound is not included in these data, the data obtained in similar apparatus, such as the apparatus described by the American Society for Testing Materials (ASTM) standard (ASTM E659), is listed ³⁾.

²⁾ A description of apparatus agreed as a standard, and some values recorded with that apparatus, are described in IEC 79-4.

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 [1]*. The apparatus is similar to the one used by Zabetakis [2]*. 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 autoignition temperature, with the reference to sources, is given by Hilado and Clark.

* See the Bibliography given in annex A.

4 Properties of particular gases and vapours

4.1 Coke oven gas [73]

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 apparatus of Group IIB is recommended, otherwise apparatus of Group IIC is recommended.

NOTE – For all concentrations, Group IIC intrinsically safe apparatus is recommended.

4.2 Ethyl nitrite [159]

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.

4.3 MESG of acetylene [7]

In clean apparatus an MESG of 0,37 mm is observed, but in apparatus in which carbon has been deposited, for example by an explosion of a rich acetylene/air mixture, ignition can be transmitted through a narrower gap. Acetylene requires Group IIC apparatus.

4.4 MESG of carbon disulphide [51]

The MESG for carbon disulphide appears to be size-dependent. Determination of MESG in a 20 ml vessel (see IEC 79-1A) gives a MESG of 0,34 mm, whereas an 8 000 ml vessel gives a MESG of 0,20 mm. Carbon disulphide requires Group IIC apparatus.

4.5 MESG of carbon monoxide [52]

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 apparatus 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/H₂O near 7: molar ratio. Small quantities of hydrocarbon in the carbon monoxide/air mixture have a similar effect in reducing the MESG so that Group IIB apparatus is required.

4.6 Methane, Group IIA [184]

Industrial methane, such as natural gas, is classified as Group IIA, provided it does not contain more than 15 % (V/V) of hydrogen. A mixture of methane with other compounds from Group IIA, in any proportion is classified as Group IIA.

5 Reference documents

IEC 79-0: 1983, *Electrical apparatus for explosive gas atmospheres – Part 0: General requirements*

IEC 79-1A: 1975, *Electrical apparatus for explosive gas atmospheres – Part 1: Construction and verification test of flameproof enclosures of electrical apparatus – First supplement: Annex D: Method of test for ascertainment of maximum experimental safe gap*

IEC 79-3: 1990, *Electrical apparatus for explosive gas atmospheres – Part 3: Spark-test apparatus for intrinsically-safe circuits*

IEC 79-4: 1975, *Electrical apparatus for explosive gas atmospheres – Part 4: Method of test for ignition temperature*

IEC 79-4A: 1970, *Electrical apparatus for explosive gas atmospheres – First supplement*

IEC 79-8: 1969, *Electrical apparatus for explosive gas atmospheres – Part 8: Classification of maximum surface temperatures*

IEC 79-12: 1978, *Electrical apparatus for explosive gas atmospheres – Part 12: Classification of mixtures of gases or vapours with air according to their maximum experimental safe gaps and minimum igniting currents*

ASTM E679-78, *Test method for autoignition temperature of liquid chemicals*

Tableau 1 – Données d'inflammabilité
Table 1 – Flammability data

Les mots de l'en-tête suivants sont utilisés dans le tableau 1:

Réf	–	Numéro de référence pour chaque gaz ou vapeur.
Rho, ρ	–	Densité par rapport à l'air (normalement à température et pression normalisées sauf spécification contraire)
PE	–	Point-éclair.
Temp d'infl	–	Température d'inflammation.
IEMS	–	Interstice expérimental maximal de sécurité.
Classe de T	–	Classe de température, conformément à la CEI 79-0.
Groupe	–	Voir 3.2.

The following headings are used in table 1:

Ref	–	Reference number for each gas or vapour.
Rho, ρ	–	Density relative to air (normally at standard temperature and pressure, unless otherwise stated).
FP	–	Flash point.
Ign temp	–	Ignition temperature.
MESG	–	Maximum experimental safe gap.
T class	–	Temperature class according to IEC 79-0.
Group	–	See 3.2.

Tableau 1 - Données d'inflammabilité
Table 1 - Flammability data

Ref.	Gaz ou vapeur Gas or vapour	Formule Formula	Rho ρ	PE FP	Limites d'inflammabilité Flammability limits				Temp d'infl Ign temp	IEMS MESG	Classe de T T class	Groupe Group
					Inf Lower	Sup Upper	Inf Lower	Sup Upper				
				° C	vol pour cent vol per cent		mg/1		° C	mm		
1	Aldéhyde acétique Acetaldehyde	CH ₃ CHO	1,52	−38	4,00	60,0	74	1108	204	0,92	T3	IIA
2	Acide acétique Acetic acid	CH ₃ COOH	2,07	40	4,00	17,0	100	428	464	1,76	T1	IIA
3	Anhydride acétique Acetic anhydride	(CH ₃ CO) ₂ O	3,52	49	2,00	10,0	85	428	334	1,23	T2	IIA
4	Acétone Acetone	(CH ₃) ₂ CO	2,00	<−20	2,50	13,0	60	316	535	1,01	T1	IIA
5	Acétonitrile Acetonitrile	CH ₃ CN	1,42	2	3,00	16,0	51	275	523	1,50	T1	IIA
6	Chlorure d'acétyl Acetyl chloride	CH ₃ COCl	2,70	−4	5,00	19,0	157	620	390		T2	(IIA)
7	Acétylène (voir 4.3) Acetylene (see 4.3)	CH≡CH	0,90		2,30	100,0	24	1092	305	0,37	T2	IIC
8	Acétylé flouride Acetyl flouride	CH ₃ COF	2,14	<−17	5,60	19,9	142	505	434	1,54	T2	IIA
9	Acrylaldehyde	CH ₂ =CHCHO	1,93	−18	2,85	31,8	65	728	217	0,72	T3	IIB
10	Acide acrylique Acrylic acid	CH ₂ =CHCOOH	2,48	56	2,90		85		406	0,86	T2	IIB
11	Acrylonitrile Acrylonitrile	CH ₂ =CHCN	1,83	−5	2,80	28,0	64	620	480	0,87	T1	IIB
12	Acryloyl chloride	CH ₂ CHCOCl	3,12	−8	2,68	18,0	220	662	463	1,06	T1	IIA