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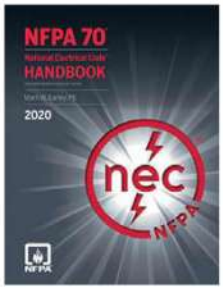
A.2 Hazardous Areas Classification

Locations where fire or explosion hazards may exist due to flammable gases, flammable or combustible liquid-produced vapors, combustible dusts, or ignitible fibers and flyings shall be classified so as to facilitate the proper selection and installation of electrical equipment to be used safely in that environment. The area classification should be carried out by those who have knowledge of the properties of flammable and combustible materials, the process and equipment, in consultation, as appropriate, with safety, electrical, mechanical and other engineering personnel. The classification shall be referred to standard which is regulated within each country or area of used e.g. the National Electrical Code (NEC) for USA, the Canadian Electrical Code (CEC) for Canada, the European Standard (EN) for Europe and CENELEC members, or the International Electrotechnical Commission (IEC) for countries which prefer using the international standard for reference.

National Electrical Code (NEC)

The National Fire Protection Association (NFPA) has acted as sponsor to develop the National Electrical Code ® since 1987 as a result of the united efforts of various insurance, electrical, architectural, and allied interests. This code is made available for a wide variety of both public and private uses in the interest of life and property protection in USA and other countries.

The first mention for hazardous locations requirement was published in NEC (NFPA 70) 1920 edition. NEC articles 500 through 504 have specifically defined the requirements for electrical equipment and wiring for all voltages in areas where fire or explosion hazards may occur. The principle for classification of locations according to NEC article 500.5 is determined as “Class and Division”, equated suitably depending upon the properties of the flammable gases, flammable or combustible-liquid produced vapors, combustible dusts, or ignitible fibers/ flyings that are or may be present, and the likelihood that the flammable or combustible concentration or quantity is present. Furthermore, since 1996 and 2005 editions, the area classification also has the “Zone System” detailed in article 505 and 506. More Information, see *http://www.nfpa.org.*



NFPA 70 (NEC) 2020 ed.

International Standard

The International Electrotechnical Commission (IEC) is an organization for standardization comprising the national electrotechnical committees worldwide. The IEC’s objective is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. IEC Publications have the status of recommendations which are used for orientation purposes for national and regional standards and are accepted by IEC National Committees in that sense. IEC Publications which deal with equipment for explosive atmospheres, classification of hazardous areas and installation requirements have been prepared and developed by the Technical Committee TC31 and its subcommittees.

The classification of hazardous areas according to IEC International Standard were previously detailed in IEC 60079-10 and IEC 61241-10. Nowadays the standard publications for areas classification are revised to IEC 60079-10-1 for explosive gas atmospheres and IEC 60079-10-2 for combustible dust atmospheres. The catalogue of IEC Publications and their up-to-date can be searched in website *http://webstore.iec.ch.*

IEC 60079-10-1 (2015)
IEC 60079-10-2 (2015)

European Standard

The European Committee for Electrotechnical Standardization (CENELEC) was established in 1973 as a result of the merger of two previous European organizations, CENELCOM and CENEL. The aim was to harmonize national electrotechnical standards to help develop a Single European Market or European Economic Area (EEA) by removing the trade barriers and cutting compliance costs for electrical and electronic goods and services. This single standard is called **EN** - **E**uropäische **N**orm (European Standard).

The EN standards related to equipment and protective system for use in the explosive atmospheres were published in 1972 which numbering in EN 50014 series. Later these standards, developed by the Technical Committee CENELEC TC31, were updated and re-numbered to EN 60079 series which related to the IEC International Standard. The hazardous areas classification for European Standard, detailed in EN 60079-10-1 and EN 60079-10-2 , are equated to zones classification introduced by the IEC. More information and relevant EN standards, see *http://www.cenelec.eu.*

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A.2 Hazardous Areas Classification

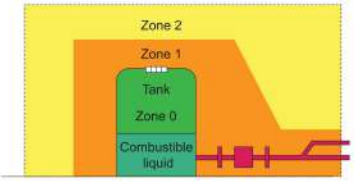
Hazardous Areas Classification

The classification of hazardous areas according to IEC and EN standards is based upon the frequency and duration of the occurrence of the explosive atmospheres. The basic terms and definition are defined as follows:

Zone 0: An area in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapor or mist is present continuously or for long periods or frequently.

Zone 1: An area in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapor or mist is likely to occur in normal operation.

Zone 2: An area in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapor or mist is not likely to occur in normal operation but, if it does occur, is likely to do so only infrequently and will exist for a short period only.

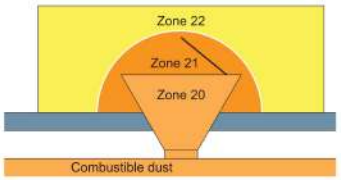


Example of zones classification for flammable liquid and vapor

Zone 20: An area in which an explosive atmosphere, in the form of a cloud of combustible dust in air, is present continuously or for long periods or frequently.

Zone 21: An area in which an explosive atmosphere, in the form of a cloud of combustible dust in air, is likely to occur occasionally in normal operation.

Zone 22: An area in which an explosive atmospheres, in the form of a cloud of combustible dust in air, is not likely to occur in normal operation but, if it does occur, will persist for a short period only.



Example of zones for combustible dust

Explosion Groups/ Equipment Grouping:

According to IEC 60079-0, electrical equipment for explosive atmospheres is divided into 3 groups;
Group I : Electrical equipment which is intended for use in mines susceptible to firedamp
Group II : Electrical equipment which is intended for use in explosive gas atmospheres other than mines.
Group III : Electrical equipment which is intended for use in explosive dust atmospheres other than mines.

Equipment Protection Level (EPLs)

EPLs were introduced to IEC 60079 in year 2006. The EPL code consists of 2 alphabetic abbreviations, one to inform the user the level of protection given to equipment based on zone classification and another is the type of hazardous atmosphere that the equipment are applicable in.

Gas		Dust	
Zones	EPL	Zones	EPL
0	Ga	20	Da
1	Gb	21	Db
2	Gc	22	Dc

Typical Material and Criteria for Grouping:

Group I shall be referred to all underground coal mining e.g. methane gas.
Group II (for explosive gas atmospheres)
Electrical equipment for Group II is subdivided into IIA, IIB, and IIC according to the nature of the explosion characteristics and ignitibility of flammable gas in which the equipment may be installed. This subdivision is based on the Maximum Experimental Safe Gap (MESG) or the Minimum Ignition Current (MIC) ratio (see IEC 80079-20-1). The MESG is the maximum gap width between two parts of the test chamber with an adjustable gap of 25mm long flame path which the internal ignition of an explosive mixture is not propagated to the exterior under the test conditions. The MIC is a ratio of minimum ignition current to ignite the test gas or vapor with relative to that of laboratory methane.

Criteria for subdivision of explosion group II and the typical materials

Explosion Groups	MESG	MIC ratio	Typical Gas
IIA	above 0.9 mm	above 0.8	Propane, Petrol and majority of industrial gas
IIB	between 0.5 mm to 0.9 mm	between 0.45 to 0.8	Ethylene, Coal gas (lighting gas)
IIC	below 0.5 mm	below 0.45	Hydrogen, Acetylene, Carbon disulphide

Equipment marked IIB is suitable for application requiring Group IIA equipment. Similarly, equipment marked IIC is suitable for application requiring Group IIA or Group IIB equipment.

Group III (for explosive dust atmospheres)
Electrical equipment for Group III is subdivided into IIIA, IIIB, and IIIC according to the nature of the explosive dust atmosphere for which it is intended.
Group IIIA: combustible flyings **Group IIIB:** non-conductive dust **Group IIIC:** conductive dust

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A.2 Hazardous Areas Classification

Equipment marked IIIB is suitable for application requiring Group IIIA equipment. Similarly, equipment marked IIIC is suitable for application requiring Group IIIA or Group IIIB equipment.

Equipment Surface Temperature:

The maximum surface temperature of equipment shall be determined or measured when it is subjected to maximum ambient temperature and, where relevant, the maximum rated external source of heating. Normally the maximum ambient temperature during test is 40 °C and higher if such equipment is intended to be used for higher ambient temperature. It is usually to measure the maximum surface temperature of equipment in still ambient air, under the most adverse ratings with an input voltage between 90% and 110% of the rated voltage, and with equipment mounted in its normal service conditions. The fault conditions shall also be concerned during test such as luminaire operating during a lamp "end-of-life".

Limit of Maximum Surface Temperature:

Electrical equipment for Group I, Group II, and Group III shall be specified the maximum surface temperature in its marking and relevant documentation. The maximum surface temperature determined shall not exceed the following limitation:

Group I electrical equipment

- 150 °C on any surface where coal dust can form a layer, or
- 450 °C where coal dust is not likely to form a layer (i.e. inside of a dust-protected enclosure)

Group II electrical equipment

- the temperature class assigned, or
- the maximum surface temperature assigned, or
- the ignition temperature of the specific gas for which it is intended.

Group III electrical equipment

- the maximum surface temperature assigned, or
- the layer or cloud ignition temperature of the specific combustible dust for which it is intended

Classification of maximum surface temperature for Group II electrical equipment

Maximum Surface Temperature (°C)	Temperature Class
450	**T1**
300	**T2**
200	**T3**
135	**T4**
100	**T5**
85	**T6**

Example for the classification of gases and vapors into explosion groups and temperature classes

Temp / Group	T1 (450°C <…)	T2 (300°C<…≤450°C)	T3 (200°C<…≤300°C)	T4 (135°C<…≤200°C)	T5 (100°C<…≤135°C)	T6 (85°C<…≤100°C)
I	Methane					
IIA	Acetone Ethane Ethyl acetate Ammonia Benzene (pure) Acetic acid Carbon monoxide Methane Methanol Propane Toluene	Ethanol i-amyl acetate n-butane n-butyl alcohol	gasoline Diesel fuel Aviation fuel Heating oils n-hexane	Acetaldehyde Ethyl ether		
IIB	Coal gas (lighting gas)	Ethylene				
IIC	Hydrogen	Acetylene				Carbon disulfide

Remark: Explosion groups are classified according to MESG.