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Explosive atmospheres –
Part 43: Equipment in adverse service conditions

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FOREWORD

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- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 60079-43, which is a technical specification, has been prepared by IEC Technical committee 31: Equipment for explosive atmospheres.

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

Enquiry draft	Report on voting
31/1311/DTS	31/1328A/RVDTS

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

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

A list of all parts in the IEC 60079 series, published under the general title *Explosive atmospheres*, can be found on the IEC website.

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

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

IEC 60079-0 specifies the requirements for electrical equipment intended for use in explosive atmospheres at standard atmospheric conditions:

- temperature –20 °C to +60 °C;
- pressure 80 kPa (0,8 bar) to 110 kPa (1,1 bar); and
- air with normal oxygen content, typically 21 % v/v.

In some cases, other parts of the IEC 60079 series also specify conditions outside the above range, for example in IEC 60079-1.

IEC 60079-0 states the normal ambient temperature range as –20 °C to +40 °C and states that electrical equipment designed for use in other than this normal ambient temperature range is considered to be special and includes additional marking to communicate this to the user.

IEC 60079-14 includes requirements for users to select and install equipment so that it is suitable for the environmental conditions, but does not provide any specific guidance for installations outside of the standard atmospheric conditions or for other adverse environmental conditions.

Extreme climate conditions in Polar environments are challenging to explosion protection technology and solutions. Conditions such as snow build-up, icing from spray and freezing of precipitation can negatively affect the operation and safety of equipment. Extreme low temperatures and weather conditions make it difficult to process hydrocarbons in open outdoor process areas and it can also be challenging for equipment operation. Measures to deal with these challenges are often called 'winterization'.

This document is a guide for equipment subject to adverse service conditions, for example equipment considered as 'special' in IEC 60079-0. It is applicable to the design, manufacture, installation, inspection and use of such equipment. Annex A gives recommendations on materials and Annex C gives information on electric motors in low temperatures. It is possible that some details in this technical specification will be relocated to relevant parts of the IEC 60079 series at the next edition of each of those relevant parts as guidance material.

This technical specification does not at this time address other environmental conditions such as high temperatures, which will be explored further at a later date.

EXPLOSIVE ATMOSPHERES –

Part 43: Equipment in adverse service conditions

1 Scope

This part of IEC 60079, which is a Technical Specification, provides guidance for equipment for use in explosive atmospheres in environments which may include ambient temperatures below –20 °C, and additional adverse conditions, including maritime applications.

The purpose of this document is to provide recommendations to be considered for the design, manufacture and use of equipment. It is intended that this document be used for equipment operating within the environmental range specified on the certificate for the equipment.

NOTE For detailed classification of climate conditions refer to IEC 60721 series and IEC 60068-1.

This document is intended to be used in conjunction with the IEC 60079 series and the ISO/IEC 80079 series.

2 Normative references

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

IEC 60034-5, *Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification*

IEC 60068 (all parts), *Environmental testing*

IEC 60079-0, *Explosive atmospheres - Part 0: Equipment - General requirements*

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*

IEC 60079-17, *Explosive atmospheres - Part 17: Electrical installations inspection and maintenance*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60721-1, *Classification of environmental conditions - Part 1: Environmental parameters and their severities*

IEC 60721-2-1, *Classification of environmental conditions - Part 2-1: Environmental conditions appearing in nature - Temperature and humidity*

IEC TR 60721-4 (all parts), *Classification of environmental conditions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60079-0 apply.

NOTE Additional definitions applicable to explosive atmospheres can be found in IEC 60050-426, *International Electrotechnical Vocabulary – Part 426: Equipment for explosive atmospheres*.

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

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

4 Environmental conditions affecting the equipment used in explosive atmospheres

4.1 General

For the purposes of this document, the environmental conditions and specific operating parameters are considered to the extent that they can cause failure of the equipment or its parts related to explosion protection properties.

Useful information on climate classifications can be found in the IEC 60721 series. These documents provide for five classifications of Tropical, Arid, Temperate, Cold and Polar. If a manufacturer wishes to reference equipment as conforming to one of those classifications, it is recommended the temperatures shown in the specific part of IEC 60721 be used, for example in establishing the temperatures to be applied for the thermal endurance to heat and cold tests in IEC 60079-0.

The main environmental factors which may affect the equipment addressed by this document individually or in combination, include:

– low temperature;
– humidity;
– corrosive media;
– powder snow;
– precipitation;
– spray from waves;
– high winds;
– solar radiation; and
– mechanical effects.

The effect of these factors can be significant, particularly if they arise jointly. Information on these effects is provided below.

4.2 Low temperature effects

For low temperatures, the following may be relevant and should be considered:

– electrochemical capacitors may freeze and fail;
– battery units may discharge;
– wax and protective compounds may become solid and crack;
– rubber materials may lose elasticity and fail;
– greases may freeze affecting parts such as hinges and shafts;

– relays may malfunction;
– amplifying properties of transistors may decrease;
– loss of ductility or embrittlement of materials or welded joints may occur;
– differential expansion or contraction of materials may have an impact on correct fitting of components;
– oil viscosity increases, and flow may be restricted or cease, which may cause loss of protection, or failure of mechanical systems;
– oil as dielectric insulation in aged electrical equipment may contain higher water content which may reduce its dielectric strength or even cause dielectric failure.

4.3 Other environmental effects

High humidity can occur due to changes in temperature, for example, in maritime conditions. In these cases, the following may be relevant and should be considered:

– dielectric permeability of insulation materials may increase;
– surface resistance of insulation materials may decrease;
– permittivity of air gaps may decrease;
– auxiliary physical-chemical processes in dielectrics and metals may occur, for example corrosion or biological changes.

These conditions may cause undesirable changes in the capacitance of capacitors, decrease in insulation resistance, swelling and peeling of dielectrics, metal corrosion, or formation of mould inside the equipment.

Salt or other contaminants may exacerbate many of the problems that humidity creates, such as reduced insulating properties and increased corrosion.

5 Recommendations for design of equipment

5.1 General

IEC 60079-0 requires equipment to be constructed in accordance with the applicable safety requirements of relevant industrial standards. Such standards can include the IEC 60068 series of standards on environmental testing which include some tests relevant to adverse service conditions. The IEC TR 60721-4 series includes references to relevant tests in the IEC 60068 series.

Where equipment can be subject to adverse service conditions while in operation, the manufacturer should supply additional information necessary for the selection, installation, operation and maintenance of the equipment under those conditions. The upper and lower values of temperature and humidity should be specified. The recommended values for the climate classifications are given in IEC 60721-1 and IEC 60721-2-1. Where relevant, the rate of temperature change for which the equipment is intended should also be specified in the instructions for the equipment.

NOTE For the same type of equipment, different ranges of temperature are often specified depending on the specific application.

When storage and transportation conditions before installation exceed the temperature range covered by the certificate, the potential impact of these temperatures on the Type of Protection of the equipment should be addressed in the instructions supplied by the manufacturer. Where such information is not provided in the instructions, it is recommended that the storage temperatures are not outside the range covered by the certificate.

Types of Protection should remain effective while such equipment is exposed to adverse service conditions. This will need to be considered during selection and installation, and also

considered during inspection and maintenance. Guidance on these aspects is included in Clauses 7 and 8.

The selection of equipment, design of installations and maintenance should consider the environmental factors and performance as required by IEC 60079-14 and IEC 60079-17. This technical specification can also be used to provide additional guidance for these aspects.

5.2 Atmospheres containing salt and chlorides

When equipment is intended for use in areas where it can be exposed to salt mist, requirements for corrosion resistance due to salt mist should be applied.

NOTE Useful information on classification of chemically active substances and the effect of these substances on equipment can be found in the IEC 60721-3 series, IEC 60654-4 and ISO 9223.

5.3 Snow conditions

Under powder snow conditions equipment with an ingress protection rating of IP6X, according to IEC 60529 or IEC 60034-5, is recommended to prevent powder snow entering an enclosure in a similar way to dust ingress.

Heat dissipating equipment, particularly those with rotating parts, should be protected against the effect of fallen snow that can melt when the equipment is switched on and re-freeze when it is switched off. Such equipment should be installed so it is protected against snow or heated to prevent freezing.

5.4 Solar Radiation

The requirements for the resistance to solar radiation may only need to be applied to parts which are exposed to solar radiation in working conditions rather than to the whole equipment. Annex B contains additional information and recommendations regarding solar radiation.

NOTE For equipment with other than white or silver-white surfaces that are subject to solar radiation, the surface temperatures could rise at least 5K. See Annex B for details.

5.5 Mechanical integrity

At low temperatures, increased requirements for mechanical integrity should be considered. For equipment, this is addressed during the preparation of a certificate as required by IEC 60079-0. For installations, this may mean additional requirements, for example mounting requirements.

NOTE Some grades of steel and cast iron become more brittle at temperatures below -20 °C.

For equipment intended for use in the open air or in rooms (spaces), where the air temperature and humidity variations do not significantly differ from those in the open air, at a temperature below -20 °C, the following should be considered:

- In threaded joints, where dissimilar materials with different temperature expansion coefficients mate, consideration should be given to avoid damage to materials and to ensure the required tightness when the dimensions of parts change due to the wide range of temperatures that may be encountered;
- Parts subject to wear, for example as a result of friction, should not wear at a faster rate at low temperatures compared with wear in temperate climates;
- For parts that may have low impact resilience at low temperature, additional measures may be necessary to ensure their integrity.