TECHNICAL REPORT

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English version

Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation – Guide

Evaluation des risques d'inflammation des atmosphères inflammables par des rayonnements de radiofréquence – Guide

Leitfaden zur Verhinderung der unbeabsichtigten Zündung explosionsfähiger Atmosphären durch hochfrequente Strahlung

This Technical Report was approved by CENELEC on 2004-08-28.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This Technical Report was prepared by the Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres - General requirements.

The text of the draft was submitted to the formal vote and was approved by CENELEC as CLC/TR 50427 on 2004-08-28.

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Introduction

Electromagnetic waves produced by radio-frequency (RF) transmitters (e.g. radio, television and radar) will induce electric currents and voltages in any conducting structure on which they impinge. The magnitude of the induced current and voltages depends upon the shape and size of the structure relative to the wavelength of the transmitted signal and on the strength of the electromagnetic field. When parts of the structure normally in contact are caused to break or separate momentarily (e.g. during maintenance or as a result of vibration) a spark may occur if the induced voltage and current is sufficiently large. If this happens in a location where a potentially flammable atmosphere may be present a hazardous situation can occur. However, the possibility of ignition will depend on many factors including whether the spark can deliver sufficient energy to ignite a particular flammable atmosphere.

This European Technical Report provides a systematic approach to assist transmitter operators, plant managers and all others concerned with a logical method for the assessment and elimination of RF induced ignition hazards.

The assessment procedures recommended in this European Technical Report are based on measurements of the powers and energy that can be extracted from typical structures, including cranes, and measurements of the minimum powers and energy that are required to ignite various flammable atmosphere gas groups.

The assessment procedures for probability of ignition recommended in this European Technical Report are based on the assumption that worst case conditions apply at all times. The critical features are the coincidence of the structure in resonance and the presence of the gas/air mixture in the optimum proportions for RF spark ignition. Deviation from these optimum conditions will result in significantly higher powers being required for ignition.

NOTE 1 Several studies have been performed which indicate that the power could be twice as great for an assumed risk as detailed in reference [1], if due allowance is taken for probabilistic effects. In order to achieve a probability of ignition comparable with other risks, it would be necessary for effective extractable power calculated to be twice the values determined according to this European Technical Report. The probabilistic elements could be taken into consideration following further research work and practical experience.

NOTE 2 If allowances for probabilities are to be applied then expert advice should be sought.

1 Scope

This European Technical Report provides guidance on assessing the potential ignition hazard from the inadvertent extraction of energy from electromagnetic fields, propagated from communication, radar or other transmitting antennas to plant where a potentially flammable atmosphere may be present. The frequency range covered by this European Technical Report is 9 kHz to 60 GHz. This European Technical Report does not apply to similar hazards arising from electromagnetic fields generated by other means, such as electric storms, electricity generating installations or other radiating electrical equipment, nor does it apply to any hazard arising within telecommunication or other electronic equipment.

NOTE 1 The methods of assessment from 9 GHz to 60 GHz are based on extrapolation of data for frequencies below 9 GHz.

NOTE 2 The ignition of dust is not covered in this European Technical Report. This European Technical Report also provides advice on how to mitigate the hazard in cases where the assessment indicates that a hazard may exist. This European Technical Report does not cover the hazards associated with the use of electro-explosive devices (EED) (see CLC/TR 50426), or the biological hazards of exposure to RF fields.

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.

Publication	Year	Title
EN 60079-0		*Electrical apparatus for explosive gas atmospheres — Part 0: General requirements* (IEC 60079-0)
EN 50020		*Electrical apparatus for potentially explosive atmospheres — Intrinsic safety "i"*
EN 60079-10		*Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas (*IEC 60079-10)

3 Terms and definitions

For the purposes of this European Technical Report the following terms and definitions apply.

3.1
circuit factor, Q_k
performance parameter for a structure acting as a receiving antenna (see [2])

NOTE Assuming the structure to be tuned to the transmission frequency f_t, Q_k is the ratio of f_t to Δf, where Δf is the difference between those frequencies, one above and one below f_t, at which the structure resonates when it is re-tuned so that the open circuit voltage at f_t has fallen by 3 dB. Q_k is closely related to the Q factor of a tuned circuit.

3.2
extractable power, P_{max}
power dissipated in a resistive load connected across a discontinuity in a structure acting as a receiving antenna

NOTE The extractable power reaches its maximum when the structure is tuned to the frequency of the transmitter (under these conditions the impedance of the structure presents a resistive value only, with no reactive components), and the load resistance is a value equal to that of the structure.

3.3
modulus match power, P_{mm}
maximum value of extractable power that can be achieved with a resistive load at a frequency to which the structure is not tuned (see [2])