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Explosive Atmospheres – Part 28: Protection of equipment and transmission systems using optical radiation

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INTRODUCTION

Optical equipment in the form of lamps, lasers, LEDs, optical fibers, etc. is increasingly used for communications, surveying, sensing and measurement. In material processing, optical radiation of high irradiance is used. Often the installation is inside or close to potentially explosive atmospheres, and radiation from such equipment may pass through these atmospheres. Depending on the characteristics of the radiation it might then be able to ignite a surrounding explosive atmosphere. The presence or absence of an additional absorber significantly influences the ignition.

There are four possible ignition mechanisms.

a) Optical radiation is absorbed by surfaces or particles, causing them to heat up, and, under certain circumstances, this may allow them to attain a temperature which will ignite a surrounding explosive atmosphere.

b) Thermal ignition of a gas volume, where the optical wavelength matches an absorption band of the gas.

c) Photochemical ignition due to photo dissociation of oxygen molecules by radiation in the ultraviolet wavelength range.

d) Direct laser induced breakdown of the gas at the focus of a strong beam, producing plasma and a shock wave both eventually acting as the ignition source. These processes can be supported by a solid material close to the breakdown point.

The most likely case of ignition occurring in practice with lowest radiation power of ignition capability is case a). Under some conditions for pulsed radiation, case d) also will become relevant.

Optical equipment is used in most cases in conjunction with electrical equipment, for which clear and detailed requirements and standards for use in potentially explosive atmospheres exist. One purpose of this standard is to inform industry about potential ignition hazards associated with the use of optical systems in hazardous locations as defined in IEC 60079-10 and the adequate protection methods.

This standard details the integrated system used to control the ignition hazard from equipment using optical radiation in hazardous locations.

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EXPLOSIVE ATMOSPHERES –

Part 28: Protection of equipment and transmission systems using optical radiation

1 Scope

This standard ~~part of IEC 60079-~~ explains the potential ignition hazard from equipment using optical radiation intended for use in explosive gas and combustible dust atmospheres. It covers EPLs Ma, Mb, Ga, Gb, Gc, Da, Db and Dc. It also covers equipment, which itself is located outside but its emitted optical radiation enters such atmospheres. It describes precautions and requirements to be taken when using optical radiation transmitting equipment in explosive gas and combustible dust atmospheres. It also outlines a test method, which can be used to verify a beam is not ignition capable under selected test conditions, if the optical limit values cannot be guaranteed by assessment or beam strength measurement.

This standard contains requirements for optical radiation in the wavelength range from 380 nm to 10 µm. It covers the following ignition mechanisms:

- optical radiation is absorbed by surfaces or particles, causing them to heat up and, under certain circumstances, this may allow them to attain a temperature which will ignite a surrounding explosive atmosphere;
- direct laser induced breakdown of the gas at the focus of a strong beam, producing plasma and a shock wave both eventually acting as the ignition source. These processes can be supported by a solid material close to the breakdown point.

NOTE 1 See items a) and d) of the introduction.

This standard applies to optical fibre equipment and optical equipment, including LED and laser equipment, other than as detailed below:

- Non-array indicator LEDs used for example to show equipment status or backlight function.
- Luminaires involving light sources as follows:
  - LED light sources for Gc and Dc applications.
  - light sources, other than LED, that are continuous and divergent for all EPL applications.
- Optical radiation sources for Gc and Dc applications which comply with Class I limits in accordance with US Code of Federal Regulations, 21 CFR Part 1040.
- Optical radiation sources for Mb, Gb or Gc, and Db or Dc applications which comply with Class 1 limits in accordance with IEC 60825-1.

NOTE 2 Class I limit evaluations in accordance with US Code of Federal Regulations, 21 CFR Part 1040 are based on normal operating conditions. Class 1 limit evaluations in accordance with IEC 60825-1 are based on normal operating and single fault conditions.

This standard does not cover ignition by ultraviolet radiation and by absorption of the radiation in the explosive mixture itself. Explosive absorbers or absorbers that contain their own oxidizer as well as catalytic absorbers are also outside the scope of this standard.

This standard specifies requirements for equipment intended for use under atmospheric conditions.

This standard supplements and modifies the general requirements of ANSI/ISA-~~IEC~~ 60079-0. Where a requirement of this standard conflicts with a requirement of ANSI/ISA-~~IEC~~ 60079-0, the requirement of this standard will take precedence.