

Foreword

At this time there is minimal awareness of the potential risk associated with optical ignitions even though fiber optic systems have been used for at least 20 years in hazardous (classified) locations. Hazardous (classified) locations are described in the *National Electrical Code*[®] (*NEC*[®]). (*National Electrical Code* and *NEC* are registered trademarks of the National Fire Protection Association, Quincy, MA.) One purpose of this technical report is to inform industry of potential ignition hazards associated with the use of fiber optic systems in explosive gas atmospheres. The technical report is also intended to suggest engineering and installation practices to reduce the ignition hazard from fiber optic systems in Class I locations. This technical report is provided for general guidelines pending the final results of ongoing testing and the development of official standards.

Safety standards to reduce human exposure hazards from laser equipment and fiber optic communication systems are found in IEC 60825, Parts 1 and 2.

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Abstract

For optical wavelengths in the visible, near infrared, and certain regions of the mid infrared, ignition of an explosive gas atmosphere occurs with the lowest beam strength when a target intercepting the beam is heated to a high temperature. Minimum ignition criteria for explosive gas atmospheres are described in terms of the beam's spatial and temporal characteristics. Three protection concepts are described for preventing ignitions by fiber optic terminal devices and cables in Class I hazardous (classified) locations. Hazardous (classified) locations are described in the *National Electrical Code*. Inherent safety is an energy limitation approach to safety that also takes into consideration over-power fault conditions. Protected optical fiber is the second protection concept, where the level of safety is defined by the mechanical protection provided by robust cabling, raceway, cable tray, or conduit. Optical radiation interlock with optical fiber breakage is the third protection concept, where the transmit fiber optic terminal device shuts off or reduces the beam strength to a safe level upon detection of a loss in signal, such as occurs when there is a break in the optical fiber. Applications of the protection concepts as a function of Class I Divisions or Zones are suggested. Safe installation practices are recommended.

Key Words

Fiber optics, optical fiber, fiber optic cable, fiber optic terminal device, hazardous (classified) locations, Class I locations, *National Electrical Code*, explosive gas atmosphere, laser, nonbeam hazards.

1 Scope

This technical report provides guidance on the safe use of fiber optic systems and their constituent parts producing or guiding visible, near infrared, or mid infrared (maximum wavelength of 10 μm) radiation in Class I hazardous (classified) locations. Hazardous (classified) locations are described in the *National Electrical Code (NEC)*. Limiting levels prescribed in this document apply only to the minimum levels of optical power, optical power density, and optical energy needed to ignite explosive gas atmospheres. In apparatus where optical energy is transduced to electrical energy, the limiting values for the electrical energy must be determined from relevant standards for electrical apparatus (e.g. ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod)).

2 Purpose

At this time there is minimal awareness of the potential risk associated with optical ignitions even though fiber optics have been used for at least 20 years in hazardous (classified) locations. One purpose of this technical report is to inform industry of potential ignition hazards associated with the use of fiber optic systems in explosive gas atmospheres. The technical report is also intended to suggest engineering and installation practices to reduce the ignition hazard from fiber optic systems in Class I locations.

3 Definitions and figures

In the context of this technical report, the following definitions apply.

3.1

absorption:

the conversion of electromagnetic wave energy into another form of energy, for instance heat.

3.2

beam diameter (or beamwidth):

the distance between two diametrically opposed points where the irradiance is a specified fraction of the beam's peak irradiance. [IEV 731-01-05]

NOTE — Most commonly applied to beams that are circular or nearly circular in cross section.

3.3

beam strength:

a general term referring to an optical beam's power, irradiance, energy, or energy density.

3.4

combustible dust layer:

accumulation of combustible dust sufficient to pose a smoldering hazard.

3.5

core:

the central region of an optical fiber through which most of the optical power is transmitted. [IEV 731-02-04] (See Figure 1.)