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IEEE Guide for the Application of Electric Motors in Class I, Division 2 and Class I, Zone 2 Hazardous (Classified) Locations

IEEE Industry Applications Society

Sponsored by the
Petroleum and Chemical Industry Committee

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Abstract: Three-phase and single-phase AC synchronous and induction electric motors in ratings 0.18 kW (1/4 hp) and larger are covered in this guide. Primary emphasis is on the use of open or nonexplosionproof or nonflameproof enclosed motors in Class I, Division 2 and Class I, Zone 2 locations as covered in NFPA 70-2011. Surface temperature test methods and sine wave and non-sine wave applications are covered. Precautions against excessive surface temperatures and sparking are included. To mitigate hot surface temperatures and sparking, this document provides guidance for selecting, operating, and maintaining motors in Class I, Division 2 and Class I, Zone 2 locations. This guide does not cover AC wound rotor motors and DC electric motors. Motors installed in locations other than Class I, Division 2 and Class I, Zone 2 as covered in NFPA 70-2011 are not covered in this guide. This document is not a specification and is not intended to be used as a specification for purchasing motors. The voltage breaks in this document are 1000 V and less, and over 1000 V.
Keywords: adjustable speed drive; autoignition temperature; Class I, Division 2; Class I, Zone 2; classified locations; enclosure sparking; hazardous locations; IEEE 1349; induction motor; label test; motor; motor enclosure; motor temperature; multisection motor; paint test; rotor; rotor sparking; rotor temperature; synchronous motor; T Code; temperature code

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Introduction

This introduction is not part of IEEE Std 1349-2011, IEEE Guide for the Application of Electric Motors in Class I, Division 2 and Class I, Zone 2 Hazardous (Classified) Locations.

This guide was developed to assist individuals, organizations, and suppliers with the application of motors in Class I, Division 2 and Class I, Zone 2 locations, where flammable gases and vapors may occasionally be present.

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Contents

IEEE Guide for the Application of Electric Motors in Class I, Division 2 and Class I, Zone 2 Hazardous (Classified) Locations

1. Overview

This guide is divided into several clauses. Clause 1 provides the scope of this guide. Clause 2 lists references to other standards that are inclusive when applying this guide. Clause 3 provides definitions, abbreviations, and acronyms that are either not found in other standards, or have been modified for use with this guide. Clause 4 describes the phenomenon of a motor as a possible ignition source. Clause 5 provides guidance for Common applications of motors in Class I, Division 2 and Class I, Zone 2 locations. Consideration should be given to the maximum recommended Class I, Division 2 or Zone 2 exposed motor surface temperatures described in 5.2 for Common applications. Clause 6 provides guidance for Uncommon applications of motors in Class I, Division 2 and Class I, Zone 2 locations. Clause 7 discusses the operating and maintenance considerations that mitigate hot surface temperatures and sparking, specifically focusing on motors located in Class I, Division 2 or Zone 2 locations. Clause 8 describes preferred test methods for determining internal motor surface temperatures for the purpose of applying motors in Class I, Division 2 and Class I, Zone 2 locations.

Ten annexes are included: A) bibliography, B) regulations and standards for motors used in areas where flammable gases or vapors may be present, C) AITs (autoignition temperature) and group designations for Class I materials, D) motor enclosure types and protection techniques, E) motor information tables to check a motor data sheet, F) multisection motor inspection procedure, G) motor sparking considerations, H) surface temperature study results and considerations, I) motor surface temperature test methods and limitations, and J) event history.

1.1 Scope

Three-phase and single-phase AC synchronous and induction electric motors in ratings 0.18 kW (1/4 hp) and larger are covered in this guide. Primary emphasis is on the use of open or nonexplosionproof or nonflameproof enclosed motors in Class I, Division 2 and Class I, Zone 2 locations as covered in *National Electrical Code*® (*NEC*®) (NFPA 70-2011).[1] Surface temperature test methods and sine wave and non-sine wave applications are covered. Precautions against excessive surface temperatures and sparking are included. To mitigate hot surface temperatures and sparking, this document provides guidance for selecting, operating, and maintaining motors in Class I, Division 2 and Class I, Zone 2 locations. This guide does not cover AC wound rotor motors and DC electric motors. Motors installed in locations other than Class I, Division 2 and Class I, Zone 2 as covered in NFPA 70-2011 are not covered in this guide. This document is not a specification and is not intended to be used as a specification for purchasing motors.

The voltage breaks in this document are 1000 V and less, and over 1000 V.

1.2 Purpose

Existing codes and standards contain cautionary notes for open or nonexplosionproof or nonflameproof enclosed motors in Class I, Division 2 and Class I, Zone 2 locations as covered in the *NEC*. This guide documents industry experience and established practices and provides guidance for applying motors in these locations.

1.3 Background

As early as 1905, the *National Electrical Code*® (*NEC*®)[2] recognized that a suitable enclosure would be required when an electric motor was installed in the vicinity of combustible materials (*National Electric Code*, 1905) [B54].[3] In the early 1920s, the *NEC* began to designate and recognize flammable and combustible materials by the current Class system without Division subcategories. With this system, an electric motor located within a Class I location was required to have an explosionproof enclosure.

In 1931, Classes were introduced to the *NEC*; in 1935, Groups A, B, C, and D were added; and in 1947, Divisions 1 and 2 were added. By allowing a Division 2 location to be individually evaluated on the basis of the amount of material that may escape during abnormal operating conditions, adequacy of ventilation, total area involved, and the history of the type of installation, the *NEC* allowed open-type, nonexplosionproof electric motors to be installed in Division 2 locations. During this same period, electric motor manufacturers also developed the totally enclosed, fan cooled (TEFC) motor. By 1947, the *NEC* permitted open-type and TEFC motors "without brushes, switching mechanisms or integral resistance devices" for installation in Division 2 locations. From that time until the mid-1980s, hundreds of thousands of open-type and TEFC motors, ranging in size from fractional horsepower to over 10000 hp, had been installed in Class I, Division 2 locations.

This guide addresses two Informational Notes for Division applications: Fine Print Note (FPN) No. 1 was added to the *NEC* in 1984 to Section 501 and currently is in Section 501.125(B) Informational Note No. 1 as follows: "It is important to consider the temperature of internal and external surfaces that may be exposed to the flammable atmosphere."[4] FPN No. 2 was added to the *NEC* in 1993 to Section 501 and

[1] Information on references can be found in Clause 2.
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