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IEEE Std 303™-2004
(Revision of
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303™

IEEE Recommended Practice for Auxiliary Devices for Rotating Electrical Machines in Class I, Division 2 and Zone 2 Locations

IEEE Industry Applications Society

Sponsored by the
Petroleum and Chemical Industry Committee

IEEE

3 Park Avenue, New York, NY 10016-5997, USA

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Petroleum and Chemical Industry Committee

of the

Industry Applications Society

Approved 24 June 2004

IEEE-SA Standards Board

Abstract: This recommended practice applies to the application and installation procedures of auxiliary devices in or on electric rotating machines that are employed in hazardous locations classified as Class I, Division 2 or Class I Zone 2 under commonly used worldwide regulations. These regulations are: the National Electrical Code (United States); the Canadian Electrical Code, Part 1 (Canada); and combined practices of the International Electrotechnical Commission (IEC), the European Committee for Electrotechnical Standardization (CENELEC), and Standards Australia / Standards New Zealand (AS/NZS). Included is a list of source documents, definitions and nomenclature. Devices include terminal housings, heaters, surge protection, power factor correction capacitors, shaft grounding, and enclosures. Special marking requirements are also discussed.

Keywords: auxiliary devices, Class I Division 2, Class I Zone 2, arcing/sparking component, rotating electrical machine

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Introduction

This introduction is not part of IEEE Std 303-2004, IEEE Recommended Practice for Auxiliary Devices for Rotating Electrical Machines in Class I, Division 2 and Zone 2 Locations.

This standard was originally published in 1969, revised in 1984 and reaffirmed in 1991. In keeping with the goals of maintaining progressive standards, in 2000 the standards group of the IEEE Petroleum and Chemical Industry Committee assigned a task force to revise and update this standard. References to other documentation were corrected. The wording in this standard was modified to reflect worldwide standards and to promote uniform application of such devices in petroleum and chemical industry facilities.

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IEEE Recommended Practice for Auxiliary Devices for Rotating Electrical Machines in Class I, Division 2 and Zone 2 Locations

1. Overview

1.1 Scope

This recommended practice is limited to auxiliary devices associated with rotating electrical machines operating in Division 2 or Zone 2 areas, classified as Class I under the practice of NFPA 70-2005, National Electrical Code® (NEC®),[1,2] CSA C22.1-02,[3] or Zone 2 areas classified under the practice of IEC 60079-10-2002[4] and CENELEC EN 60079-10-1996.[5] This recommended practice is not an attempt to rewrite or otherwise supersede applicable sections or clauses of these noted documents or any other codes or ordinances. Rather, it is intended to serve as a supplement to existing codes that in this area may not be sufficiently specific to serve as a guide to good engineering practice.

1.2 Purpose

The following information is intended to bring together a brief description of basic electrical practices with regard to the application and installation of auxiliary devices to rotating electrical machines operating in Class I, Division 2 or Zone 2 locations using NFPA 70-2005, National Electrical Code, CSA C22.1-02, or Zone 2 locations using IEC 60079-14-2002 and CENELEC EN 60079-14-1997. It should be understood that this information is only a recommended practice to promote consistent application of such devices and must be used with sound engineering judgment.

2. References

This recommended practice shall be used in conjunction with the following publications. When the following standards are superseded by an approved revision, the revision shall apply.

API RP 500-1997, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2.[6]

[1]NFPA publications are available from Publications Sales, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101, USA (http://www.nfpa.org/).

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[4]IEC publications are available from the IEC Central Office, 3, rue de Varembé, P.O. Box 131, Switzerland (http://www.iec.ch/).

[5]CENELEC publications are available from the Cenelec CS Info & Publications Department, Rue de Stassartstraat 35, 1050 Brussels (http://www.cenelec.org/).

[6]API publications are available from the Publications Section, American Petroleum Institute, 1200 L Street NW, Washington, DC 20005, USA (http://www.api.org/).

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API RP 505-1997, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2.

AS/NZS 60079.0:2000, Electrical apparatus for explosive gas atmospheres—General requirements.[7]

AS/NZS 60079.1:2002, Electrical apparatus for explosive gas atmospheres—Flameproof enclosure “d”.

AS/NZS 60079.1.1:2002, Electrical apparatus for explosive gas atmospheres—Flameproof enclosures “d”—Method of test for ascertainment of maximum experimental safe gap.

AS/NZS 60079.2:2002, Electrical apparatus for explosive gas atmospheres—Pressurized enclosures “p”.

AS/NZS 60079.5:2000, Electrical apparatus for explosive gas atmospheres—Powder filling.

AS/NZS 60079.6:2000, Electrical apparatus for explosive gas atmospheres—Oil-immersion “o”.

AS/NZS 60079.7:2002, Electrical apparatus for explosive gas atmospheres—Increased safety “e”.

AS/NZS 60079.11:2000, Electrical apparatus for explosive gas atmospheres—Intrinsic safety “i”.

AS/NZS 60079.12:2000, Electrical apparatus for explosive gas atmospheres—Classification of mixtures of gases or vapours with air according to their maximum experimental safe gap and minimum igniting currents.

CSA C22.1-02, Canadian Electrical Code (CEC), Part I.

CSA C22.2 No. 0.4-M1982 (R1999), Bonding and Grounding of Electrical Equipment.

CSA C22.2 No. 30-M1986 (R1999), Explosion-Proof Enclosures for Use in Class I Hazardous Locations.

CSA C22.2 No. 213-M1987 (R1999), Non-Incendive Electrical Equipment for Use in Class I Division 2 Hazardous Locations.

CAN/CSA-C22.2 No. 157-92 (R2002), Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations.

CAN/CSA-E79-7-95, Electrical Apparatus for Explosive Gas Atmospheres—Part 7: Increased Safety “e”.

CAN/CSA-E79-18-95 (R2004), Electrical Apparatus for Explosive Gas Atmospheres—Part 18: Encapsulation “m”.

CAN/CSA-E60079-0:02, Electrical Apparatus for Explosive Gas Atmospheres—Part 0: General Requirements.

CAN/CSA-E60079-1:02, Electrical Apparatus for Explosive Gas Atmospheres—Part 1: Flameproof Enclosures “d”.

CAN/CSA-E60079-2:02, Electrical Apparatus for Explosive Gas Atmospheres—Part 2: Pressurized Enclosures “p”.

CAN/CSA-E60079-5:02, Electrical Apparatus for Explosive Gas Atmospheres—Part 5: Powder Filling “q”.

[7]AS/NZS publications are available from Standards Australia, GPO Box 5420, Sydney NSW 2001, Australia (http://www.standards.com.au).

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CAN/CSA-E60079-6:02, Electrical Apparatus for Explosive Gas Atmospheres—Part 6: Oil-Immersion “o”.

CAN/CSA-E60079-11:02, Electrical Apparatus for Explosive Gas Atmospheres—Part 11: Intrinsic Safety “i”.

CAN/CSA-E60079-15:02, Electrical Apparatus for Explosive Gas Atmospheres—Part 15: Electrical Apparatus with Type of Protection “n”.

CSA Technical Information Letter (TIL) E-22- November 1989, Equipment: Motors and Generators for Use in Class I, Division 2 and Class II, Division 2 Hazardous Locations. Item: Interim Certification Requirements.

CENELEC EN 50014:1997, Electrical apparatus for potentially explosive atmospheres—General requirements.

CENELEC EN 50015:1998, Electrical apparatus for potentially explosive atmospheres—Oil immersion “o”.

CENELEC EN 50016:1996, Electrical apparatus for potentially explosive atmospheres—Pressurized apparatus “p”.

CENELEC EN 50017:1998, Electrical apparatus for potentially explosive atmospheres—Powder filling “q”.

CENELEC EN 50018:2000, Electrical apparatus for potentially explosive atmospheres—Flameproof enclosure “d”.

CENELEC EN 50019:2000, Electrical apparatus for potentially explosive atmospheres—Increased safety “e”.

CENELEC EN 50020:2002, Electrical apparatus for potentially explosive atmospheres—Intrinsic safety “i”.

CENELEC EN 50021:1999, Electrical apparatus for potentially explosive atmospheres—Type of protection “n”.

CENELEC EN 50028:1987 Electrical apparatus for potentially explosive atmospheres—Encapsulation “m”.

CENELEC EN 60034-1:1995, Rotating Electrical Machines Part 1. Rating and performance.

CENELEC EN 60079-10:1996, Electrical apparatus for explosive gas atmospheres—Part 10: Classification of hazardous areas.

CENELEC EN 60079-14:1997 Electrical Apparatus for explosive gas atmospheres. Electrical installations for hazardous area (other than mines).

IEC 60079-0:2000, Electrical apparatus for explosive gas atmospheres—Part 0—General requirements.

IEC 60079-1:2001, Electrical apparatus for explosive gas atmospheres—Part 1—Construction and verification test of flameproof enclosures of electrical apparatus.

IEC 60079-1-1:2002 Electrical apparatus for explosive gas atmospheres—Part 1-1: Flameproof enclosures “d”—Method of test for ascertainment of maximum experimental safe gap.

IEC 60079-2:2001, Electrical apparatus for explosive gas atmospheres—Part 2: Electrical apparatus—type of protection “p”.

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IEC 60079-3:1990, Electrical apparatus for explosive gas atmospheres—Part 3: Spark-test apparatus for intrinsically-safe circuits.

IEC 60079-5:1997, Electrical apparatus for explosive gas atmospheres—Part 5: Powder filling “q”.

IEC 60079-6:1995, Electrical apparatus for explosive gas atmospheres—Part 6: Oil immersion “o”.

IEC 60079-7:2001, Electrical apparatus for explosive gas atmospheres—Part 7: Increased safety “e”.

IEC 60079-10:2002, Electrical apparatus for explosive gas atmospheres—Part 10: Classification of hazardous areas.

IEC 60079-11:1999, Electrical apparatus for explosive gas atmospheres—Part 11: Intrinsic safety “i”.

IEC 60079-12:1978 Electrical apparatus for explosive gas atmospheres—Part 12: Classification of mixtures of gases of vapours with air according to their maximum experimental safe gaps and minimum igniting currents.

IEC 60079-14:2002, Electrical apparatus for explosive gas atmospheres—Part 14: Electrical installations for hazardous areas (other than mines).

IEC 60079-15:2001, Electrical apparatus for explosive gas atmospheres—Part 15: Electrical apparatus with type of protection “n”.

IEC 60079-18:1992, Electrical apparatus for explosive gas atmospheres—Part 18: Encapsulation “m”.

IEC 60755:1983, General requirements for residual current operated protective devices.

NFPA 70-2005, National Electrical Code® (NEC®).

NFPA 496-2003, Standard for Purged and Pressurized Enclosures for Electrical Equipment.

NFPA 497-2004, Recommended Practice for Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.

UL 698-1995, Standard for Industrial Control Equipment for Use in Hazardous (Classified) Locations.[8]

UL 913-2002, Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.

UL 1203-2000, Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.

UL 1604-1994, Standard for Electrical Equipment for Use in Class I and II, Division 2, and Class III Hazardous (Classified) Locations.

UL 60079-0-2002, Electrical Apparatus for Explosive Gas Atmospheres—Part 0: General Requirements.

UL 60079-1-2002, Electrical Apparatus for Explosive Gas Atmospheres—Part 1: Flameproof Enclosures “d”.

[8]UL standards are available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (http://global.ihs.com/).

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UL 60079-5-2002, Electrical Apparatus for Explosive Gas Atmospheres—Part 5: Powder Filling “q”.

UL 60079-6-2002, Electrical Apparatus for Explosive Gas Atmospheres—Part 6: Oil-Immersion “o”.

UL 60079-7-2002, Electrical Apparatus for Explosive Gas Atmospheres—Part 7: Increased Safety “e”.

UL 60079-11-2002, Electrical Apparatus for Explosive Gas Atmospheres—Part 11: Intrinsic Safety “i”.

UL 60079-15-2002, Electrical Apparatus for Explosive Gas Atmospheres—Part 15: Electrical Apparatus with Type of Protection “n”.

UL 60079-18-2002, Electrical Apparatus for Explosive Gas Atmospheres—Part 18: Encapsulation “m”.

3. Definitions and acronyms

3.1 Definitions

For the purposes of this standard, the following terms and definitions apply. *The Authoritative Dictionary of IEEE Standards Terms*, Seventh Edition[9] should be referenced for terms not defined in this clause.

3.1.1 auxiliary devices: Components installed either integrally within the rotating electrical machine, located adjacent to or mounted on the machine, or attached to its terminals for the purpose of monitoring the operating conditions or protection.

3.1.2 Class I, Division 2: A location 1) in which volatile flammable liquids or flammable gases and vapors are handled, processed, or used, but in which the liquids, vapors or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; or 2) in which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operation of the ventilating equipment; or 3) that is adjacent to a Class I, Division 1 location, and to which ignitable concentration of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.

NOTE—Refer to the latest edition of NFPA 70-2005, Chapter 5, Articles 500 and 505. For a guide in establishing the limits of these locations, refer to API RP 500-1997; API RP 505-1997; and NFPA 497-2004.[10]

3.1.3 Class I, Zone 2:
Locations in which:

a) Explosive gas atmospheres are not likely to occur in normal operation and, if they do occur, they will exist for a short time only; or

b) Flammable volatile liquids, flammable gases, or vapors are handled, processed, or used, but in which liquids, gases, or vapors are normally confined within closed containers or closed systems from which they can escape only as a result of accidental rupture or breakdown of the containers or systems or the abnormal operation of the equipment by which the liquids or gases are handled, processed or used; or

c) Explosive gas atmospheres are normally prevented by adequate ventilation but may occur as a result of failure or abnormal operation of the ventilation system; or

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d) The location is adjacent to a Class I, Zone 1 location from which explosive gas atmospheres could be communicated, unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

NOTE—Refer to the latest edition of CSA C22.1 02 Section 18. For a guide in establishing the limits of these locations, refer to API RP 500-1997; API RP 505-1997; and NFPA 497-2004.

3.1.4 classified area: Also referred to as *hazardous (classified) area*. (*See:* **hazardous area**).

3.1.5 explosion-proof enclosure: An enclosure designed and constructed to withstand an explosion of a specified flammable gas or vapor that may occur within it, and to prevent the ignition of flammable gas or vapor in the atmosphere surrounding the enclosure by sparks, flashes, or explosions of the specified gas or vapor that may occur within the enclosure.

3.1.6 flameproof enclosure: Flameproof enclosure "d": An enclosure in which the parts which can ignite an explosive atmosphere are placed and which can withstand the pressure developed during an internal explosion of an explosive mixture, and which prevents the transmission of the explosion to the explosive atmosphere surrounding the enclosure.

NOTE—Refer to AS/NZS 60079.1-2002; CENELEC EN 50018-2000; CAN/CSA-E60079-1:02; IEC 60079-1:2001; and UL 60079-1 -2002.

3.1.7 flammability classification: Flammable gases or vapors of flammable liquids are segregated into groups by the degree of severity relevant to the flame transmission characteristics and explosion pressure of gases or vapors within that group. For the respective area classification methodologies, those groups are:

Groups A, B, C, and D—Four groups defined as:

A Atmospheres containing acetylene

B Atmospheres containing hydrogen fuel and process gas containing >30% hydrogen or gasses of equivalent hazard (butadiene, ethylene oxide, propylene oxide, acrolein, etc.)

C Atmospheres such as ethyl ether, ethylene or gasses of equivalent hazard

D Atmospheres such as acetone, ammonia, benzene, butane, cyclopropane, ethanol, gasoline, hexane, methanol, natural gas, naptha, propane, or gasses of equivalent hazard.

NOTE—Refer to NFPA 497-2004.

Groups IIC, IIB, and IIA—Three groups defined as:

IIC Atmospheres containing acetylene, hydrogen or gasses of equivalent hazard

IIB Atmospheres containing acetaldehyde, ethylene, or gasses of equivalent hazard

IIA Atmospheres containing acetone, ammonia, ethyl alcohol, gasoline, methane, propane, or gasses of equivalent hazard.

NOTE—Refer to NFPA 70-2005, Section 505.6.

Groups I, IIA, IIB, and IIC—Four groups defined as:

I Mining applications (methane)

IIA Maximum Experimental Safe Gap (MESG) greater than 0.9 mm or Minimum Igniting Current (MIC) ratio greater than 0.8

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IIB MESG greater than 0.5 mm and less than or equal to 0.9 mm or MIC ratio greater than 0.45 and less than or equal to 0.8

IIC MESG less than or equal to 0.5 mm or MIC ratio less than or equal to 0.45.

NOTES

1—Refer to AS/NZS 60079.0:2000 Annex A; CENELEC EN 50014-1997 Annex A; or IEC 60079-0:2000 Annex A.

2—For most gasses and vapors it is sufficient to make only one determination of either MESG or MIC for classification.

3.1.8 hazardous area: An area in which a gas or vapor is present, or may be expected to be present in quantities sufficient to produce explosive or ignitable mixtures, and which require appropriate precautions for the design, manufacturing, installation and operation of electrical apparatus.

3.1.9 hermetically sealed: A device which is so constructed that the external atmosphere cannot gain access to the interior and in which the seal is made by soldering, brazing, welding or the fusion of glass to metal. Under NFPA 70-2005, hermetically sealed devices are permitted for current-interrupting contacts.

NOTE—See also the sealed device requirements of CENELEC EN 50021-1999; CSA C22.2 No. 213-M1987 (R1999); CAN/CSA-E60079-15:02; IEC 60079-15:2001; UL 1604-1994; and UL 60079-15-2002.

3.1.10 intrinsically safe circuit: A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under prescribed test conditions. Test conditions generally consider opening, shorting, grounding, or field wiring, along with failures in the circuit.

NOTE—Refer to AS/NZS 60079.11:2000; CENELEC EN 50020-2002; CAN/CSA C22.2 No. 157-1992; CAN/CSA-E60079-11:02; IEC 60079-11:1999; UL 913-2002; and UL 60079-11-2002.

3.1.11 nonincendive: A protective technique where, under normal operating conditions, any arcing or thermal effects are not capable of igniting the flammable gas, vapor, or dust-in-air mixture.

NOTE—Refer to CENELEC EN 50021-1999; CSA C22.2 No. 213-M1987 (R1999); CAN/CSA-E60079-15:02; IEC 60079-15:2001; UL 1604-1994; and UL 60079-15-2002.

3.1.12 non-hazardous: An area in which explosive gasses or vapors are not expected to be present in quantities sufficient to require special precautions.

NOTE—Also referred to as an *unclassified location*.

3.1.13 rotating electrical machine: An electric apparatus depending on electro-magnetic induction for its operation and having one or more component members capable of rotary and/or linear movement.

NOTE—For the purpose of this document, rotating electrical machines include dc, ac synchronous and asynchronous types of motors; dc, ac synchronous and asynchronous types of generators; and ac synchronous condensers.

3.1.14 temperature code: A marking or identification number to show the maximum surface temperature as shown in the following chart:

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IEC/CENELEC	NEC/CEC	Maximum Surface Temperature (°C)
T1	T1	450
T2	T2	300
–	T2A	280
–	T2B	260
–	T2C	230
–	T2D	215
T3	T3	200
–	T3A	180
–	T3B	165
–	T3C	160
T4	T4	135
–	T4A	120
T5	T5	100
T6	T6	85

Source: NFPA 70-2005, Table 500.8(B); CSA C22.1-02 Section 18-052(4); and CENELEC EN 50014 through 50021 and 50028 series.

NOTE—The NEC and CEC Temperature Codes are identical, and have subsections which provide further refinement compared to IEC 60079-14:2002 and CENELEC EN 50014-1997.

3.1.15 Zone 2: An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it does occur, is likely to do so only infrequently and will exist for a short period only (less than 10 hours per year).

NOTE—Refer to IEC 60079-10:2002; CENELEC EN 60079-10-1996.

3.2 Acronyms

CENELEC European Committee for Electrotechnical Standardization

MESG Maximum Experimental Safe Gap. A method to determine explosive characteristics employing a sealed vessel and an ignition gap.

NOTE—See Annex A of AS/NZS 60079.0:2000; Annex A of CENELEC 50014-1997; or Annex A of IEC 60079-0:2000; and AS/NZS 60079.1.1:2002; or IEC 60079-1-1:2002.

MIC Minimum Igniting Current. A ratio of the minimum igniting currents for the gas in question with that of laboratory methane.

NOTE—See Annex A of AS/NZS 60079.0:2000; Annex A of CENELEC EN 50014-1997; Annex A of IEC 60079-0:2000; and IEC 60079-3:1990.

RCD Residual Current Device

RTD Resistance Temperature Detector

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4. Auxiliary device categories

For installation requirements, auxiliary devices generally fall in one of two categories:

1) Devices containing an arcing/sparking component and/or a make-and-break contact
2) Devices that do not contain an arcing/sparking component or a make-and-break contact.

4.1 Protection devices containing an arcing/sparking component and/or a make-and-break contact

Devices containing an arcing/sparking component and/or a make-and-break contact are installed either inside or outside of the machine housing. Examples of devices included in this category are:

a) Commutators or slip-rings
b) Bearing temperature switches or relays
c) Certain types of winding temperature sensors
d) Vibration switches
e) Air filter differential pressure switches
f) Zero speed switches
g) Brush or switch type encoders, resolvers or tachometers
h) Leak detector switches or relays
i) Other types of relays or switches
j) Fuses
k) Pre-start purging panels
l) Shaft grounding brushes.

These devices must be installed following acceptable protection techniques (i.e. those suitable for the application, Class, Group [where applicable], Division or Zone). The enclosure should be designed for the stated environmental conditions.

4.1.1 Protection techniques

4.1.1.1 Class I, Division 2 techniques

For Class I, Division 2 locations, acceptable protection techniques include:

a) Explosion-proof enclosures (approved for Class I, Division 1 or Division 2). CSA C22.2 No. 30-M1986 (R1999); and UL 1203-2000.
b) Contacts immersed in oil, UL 698-1995.
c) Intrinsically safe circuits, CAN/CSA C22.2 No. 157-92 (R2002), NFPA 70-2005, Articles 500 and 504, and UL 913-2002.
d) Non-incendive circuits, NFPA 70-2005; Article 501.3(B)(1)(c); CSA C22.2 No. 213-M1987 (R1999); and UL 1604-1994.
e) Purged/pressurized enclosures, NFPA 496-2003.
f) Contacts mounted in an hermetically sealed chamber. CSA C22.2 No. 213-M1987 (R1999); and UL 1604-1994.
g) Any Class I, Zone 0, 1 or 2 technique.

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4.1.1.2 Class I, Zone 2 techniques

For Class I, Zone 2 locations, acceptable protection techniques include:

a) Flameproof enclosures “d”. AS/NZS 60079.1:2000; CENELEC EN50018-2000; CAN/CSA-E60079-1:02; IEC 60079-1:2001; and UL 60079-1-2002.

b) Purged and Pressurized “p”. AS/NZS 60079.2:2002; CENELEC EN 50016-1996; CAN/CSA-E60079-2:02; IEC 60079-2:2001; and NFPA 496-2003.

c) Intrinsically safe “i”. AS/NZS 60079.11:2000; CENELEC EN 50020-2002; CAN/CSA-E60079-11:02; IEC 60079-11:1999; and UL 60079-11 -2002.

d) Type “n” protection. CENELEC EN 50021-1999; CAN/CSA-E60079-15:02; IEC 60079-15:2001; and UL 60079-15-2002.

e) Oil immersion “o”. AS/NZS 60079.6:2000; CENELEC EN 50015-1998; CAN/CSA-E60079-6:02; IEC 60079-6:1995; and UL 60079-6-2002.

f) Increased Safety “e”. AS/NZS 60079.7:2002; CENELEC EN 50019-2000; CAN/CSA-E79-7-95; IEC 60079-7:2001; and UL 60079-7-2002.

g) Encapsulation “m”. CENELEC EN 50028-1987; CAN/CSA-E79-18-95; IEC 60079-18:1992; and UL 60079-18-2002.

h) Powder filling “q”. AS/NZS 60079.5:2000; CENELEC EN 50017-1998; CAN/CSA-E60079-5:02; IEC 60079-5:1997; and UL 60079-5-2002.

i) Any Class I, Division 1 or 2 technique.

j) Any Class I, Zone 0 or 1 technique.

4.2 Protection devices without an arcing/sparking component or a make-and-break contact

Devices without an arcing/sparking component or a make-and-break contactinstalled either inside or outside of the machine housing may be of the general-purpose type unless other environmental considerations dictate the use of a specific enclosure especially designed for operation in that environment. Examples of devices included in this category are:

a) Resistance temperature detectors (RTDs)

b) Space heaters

c) Bearing oil heaters

d) Brake solenoids

e) Solid state type speed transducers (pulse generators, encoders, resolvers and tachometers)

f) Non-contacting shaft vibration probes and their oscillator/demodulators (drivers)

g) Current or potential transformers

h) Partial Discharge couplers

i) Surge capacitors

j) Gapless type arresters

k) Other devices that do not arc during normal operation.

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5. Wiring methods and materials

5.1 NFPA requirements

5.1.1 Internal

The general and specific rules of NFPA 70-2005 with regard to wiring methods are not intended to apply to internal wiring of rotating electrical machines. Refer to NFPA 70-2005, Article 300.1(B). It is suggested that the user notify the manufacturer of any specific environmental considerations that dictate the use of a specific wiring material specifically designed for operation in that environment.

5.1.2 External

For Class I, Division 2 locations, device wiring located outside the machine should meet the requirements of NFPA 70-2005, Article 501, pertaining to wiring methods and installations. For Class I, Zone 2 locations, device wiring located outside the machine should meet the requirements of NFPA 70-2005, Article 505.15. Intrinsically safe wiring should meet the requirements of NFPA 70-2005, Article 504.

5.2 Canadian requirements

Class I, Division 2 installations are covered in CSA C22.1-02 Annex J18-150 to J18-178. Class I, Zone 2 location installations are covered in CSA C22.1-02, paragraphs 18-150 to 18-187.

6. Device and component installation recommendations

6.1 Terminal housings

6.1.1 General

Terminal housings for auxiliaries containing no arcing devices are in the category of junction boxes, and as such, are not required to be explosion-proof or flameproof. See NFPA 70-2005, Article 501.4. The construction of the terminal housing is basically determined by environmental conditions other than the hazardous (classified) location.

6.1.2 Access

Auxiliary devices from the list in 4.2 are permitted to be mounted in a terminal housing, provided the housing is designed to permit ready access to all parts for inspection and maintenance. The terminal housing should be designed with ample space for mounting of and wiring to the auxiliary device and terminals.

6.1.3 Bonding jumpers

If a locknut-bushing attachment is used instead of a threaded fitting, a bonding jumper must be provided across the junction to provide a continuous path of adequate capacity for ground-fault currents that may pass through the junction. Refer to the following documents as appropriate: NFPA 70-2005, Article 250.100; or CSA C22.2 No. 0.4-M1982 (R1999), Bonding and Grounding of Electrical Equipment.

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6.1.4 Conductors of different systems or devices

6.1.4.1 Machine rated voltage = 600 V

If the rated machine voltage does not exceed 600 V, any conductors used in connection with the machine (i.e., control, relay or ammeter wiring) may occupy the same terminal housing as the machine circuit conductors, provided all conductors have an insulation rating equal to at least the maximum circuit voltage applied to any conductor within the terminal housing. Refer to NFPA 70-2005, Article 300.3(C)(1).

6.1.4.2 Machine rated voltage > 600 V

If the rated machine voltage exceeds 600 V, only excitation, control, relay, ammeter and surge arrester and surge capacitor conductors are permitted in the same equipment wiring enclosure as the machine circuit conductors. Where current transformers (CT) and voltage transformers (VT) are located within the machine main terminal housing, their secondary connections may be terminated within that housing provided there is adequate spacing from the main power conductors and a physical barrier. This physical barrier should provide the equivalent of a separate terminal housing except for the common external cover. Machines may have windings and auxiliary devices terminated within the machine enclosure, provided such terminations are conveniently accessible and are protected against mechanical damage and accidental contact by personnel. Where internal terminations are provided, a nameplate shall be mounted on the cover plate, or near the access point. Some installations may require that accessory devices located within the main terminal housing (i.e.: CTs, VTs, PD couplers) have their leads routed to a junction box outside the main terminal housing whereby the signal wires are accessible without opening the higher voltage cabinet.

6.1.5 Surge protective equipment

Surge protective equipment may occupy the same terminal housing as the machine circuit conductors provided such equipment will, under normal operating conditions, not be exposed to temperatures beyond its ratings. See 6.4 for further information.

6.2 Space heaters

6.2.1 General requirements

6.2.1.1 Identification and surface temperature

Unless the space heater is identified for use in Class I, Division 2 or Zone 2 areas, the maximum surface temperature of the space heater shall not exceed 80% of the auto ignition temperature in degrees Celsius of the gas or vapor involved when continuously energized at rated voltage at the maximum rated ambient air temperature. It is important to consider the T Code as it relates to the various gases or vapors encountered in a Class I Division 2 or Zone 2 location. For example: if a machine identified for use in a Class I, Division 2, T Code T1 location was moved to a Class I, Division 2, T Code T2 location (or higher), the machine would not be suitable in its present configuration. Modification or re-configuration of the machine, in accordance with local codes and regulations, could achieve suitability.

For the purpose of this clause, the term heating does not apply to induction, skin-effect, dielectric heating, trickle current, heat tracing, or other system involving passing current through a liquid, pipework or enclosure.

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6.2.1.2 Protection and installation

Space heaters should be unaffected by the accumulation of moisture. Terminals shall be adequately protected and suitable for the location. Space heaters should be mounted on non-combustible material and operate without thermal damage to the machine or themselves.

6.2.1.3 Nameplate

A stainless steel nameplate should be mounted and visible from the outside of the machine. The nameplate shall be stamped or etched with the following information:

— Wattage
— Rated voltage, phase and current
— Maximum surface temperature at 40 °C ambient when operated at nameplated voltage.

6.2.1.4 Cautionary note

A cautionary note that replacement heaters must not have a surface temperature greater than this nameplate value should be included in the machine maintenance manual.

6.2.1.5 Operation

Space heaters should not be energized during machine operation.

6.2.2 Additional Canadian requirements

6.2.2.1 Nameplate

Machines including a space heater shall carry a nameplate which includes the Temperature Code and appropriate area classification designation.

6.2.2.2 Canadian Certification

Approval for machines requires:

a) Space heater surfaces shall be instrumented for continuous temperature readout, and recorded.
b) The machine (or one unit of duplicate units) must undergo a heat run test of sufficient duration to bring all components to their maximum loaded temperature
c) As soon as the machine is de-energized, the space heaters shall be activated, and continue operation until after the surface temperature(s) have peaked and started to decline.
d) The peak temperature shall be corrected to a 40 °C (104 °F) ambient, and this value shall be less than the Temperature Code listed on the nameplate.
e) Nameplate(s) shall also include the word HEATER, and the rating of the heater in watts.

6.2.2.3 Surface temperature indication

The manufacturer shall indicate the maximum operating temperature of the space heater. Maximum surface temperatures must not exceed the limits noted in 3.1.14 for a given Temperature Code.

6.2.2.4 Atmospheric contact

Heating elements (resistor components) shall be electrically insulated to prevent direct contact with potentially explosive atmospheres.

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6.2.2.5 Limitations

When energized, the heating device shall not exceed the limiting temperatures by means of a:

a) stabilized design when operated under specific conditions

b) self-limiting property

c) manually reset electrical protective system, independent of any control system used to regulate surface temperatures.

6.2.3 Additional IEC/CENELEC requirements

6.2.3.1 General

To limit the maximum surface temperature of resistance-heating devices, the heating devices and protective devices, where required, shall be installed in accordance with the requirements of the manufacturer and the documentation. Reference CENELEC EN 60079-14:1997, Section 11.4.

6.2.3.2 Thermal protective device

The temperature protective device, if required, shall de-energize the resistance-heating device either directly or indirectly. It shall be of a type that has to be manually reset.

6.2.3.3 Additional protection

In addition to the over current protection, and in order to limit the heating effect due to abnormal earth-fault and earth-leakage currents, the following protection shall be installed:

a) For a TT or TN type system, a Residual Current Device (RCD) with a rated residual operating current not exceeding 300 mA shall be used. Preference should be given to RCDs with a rated residual operating current of 30 mA. The device shall have a maximum break time not exceeding 5 seconds at the rated residual operating current and not exceeding 0.15 seconds at five times the rated residual operating current. Additional information on RCD's is given in IEC 60755.

b) For an IT system, an insulation monitoring device shall be used to disconnect the supply whenever the insulation resistance is not greater than 50 ohms per volt of rated voltage.

NOTES

1—TN: A power system having a separate neutral (N) and a protective conductor (PE) as defined in IEC 60079-14 clause 6.2.1.

2—TT: A power system having separate earths for power system and exposed conductive parts as defined in IEC 60079-14 clause 6.2.2.

3—IT: A power system having a neutral isolated from earth or earthed through an impedance as defined in IEC 60079-14 clause 6.2.3.

4—The above additional protection is not required if the resistance-heating device (for example an anti-condensation heater in an electric motor) is intended to be protected by the manner in which it is installed in an electrical apparatus.

6.3 Bearing oil heaters

Bearing oil heaters should be designed to maintain the oil at a suitable temperature without causing the formation of hazardous vapors or flame or carbonization of the oil. Oil heater surface temperature may be considered in the event that the oil level falls below the heating element. Thermostatic elements including a make-or-break contact shall be contained within an enclosure appropriate for that location's classification codes and regulations.

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6.4 Surge Protection

6.4.1 General description

Surge protection equipment consists of surge arresters and/or surge capacitors. These devices do not replace, nor are they intended that they be substituted for, similar equipment required for the electrical system by applicable codes and engineering design.

6.4.2 Surge arrester design

Surge arresters should be the gapless (typically metal-oxide) type with sealed construction to confine normal electric discharges within the device.

6.4.3 Surge capacitor design

Surge capacitors should be of sealed type specifically designed for surge-protective duty.

6.4.4 Location and installation

Location and installation of these devices should follow recommended practices of the manufacturer with respect to allowable mounting positions, wiring and grounding details.

6.5 Power Factor Correction Capacitors

6.5.1 General requirements

When power-factor correction capacitor(s) are located at the machine, the installation shall meet applicable codes and requirements.

6.5.2 NFPA installation requirements

A power-factor correction capacitor installation that meets the installation requirements as outlined in NFPA 70-2005, Article 460, will be acceptable for installation in Class I, Division 2 locations, except that any overcurrent device, disconnecting means, and associated wiring that may be provided with the capacitors should conform to the requirements of NFPA 70-2005, Article 501.

6.5.3 CSA installation requirements

CSA C22.1-02 permits the installation of capacitors Class I, Zone 2 provided the capacitors do not contain any arcing or spark- producing components. Any arc producing devices need to conform to applicable provisions of Section 18 of CSA C22.1-02.

6.6 Shaft grounding

When grounding brushes are used, they shall be contained in an explosion-proof or purged housing or use other approved means to provide suitable guarding of the sparking brushes in accordance with applicable codes and requirements.

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7. Enclosures

7.1 Multi-sectioned requirements

For multi-sectioned equipment, circulating currents may develop across component discontinuities, causing arcing or elevated temperatures. Such conditions may require enhanced bonding means between joints or sections, such as straps or additional fasteners. Refer to the following documents as appropriate: NFPA 70-2005, Article 501.8 (B) FPN No. 2; or CSA C22.2 No. 0.4-M1982 (R1999); Bonding and Grounding of Electrical Equipment.

7.2 Purging or pressurizing components

Where auxiliary devices are provided for purging or pressurizing of enclosures, components shall comply with applicable area classification requirements. For pre-start and running condition requirements, see AS/NZS 60079.2-2002; CENELEC EN 50016-1996; and CENELEC EN 50021-1999; IEC 60079-2:2001; or NFPA 496-2003, as applicable.

8. Marking

8.1 CSA requirements

Components of the machine required to comply with CSA C22.1-02 that are not suitably protected for the location shall be included in the marking if the surface temperature exceeds 100 °C (212 °F).

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