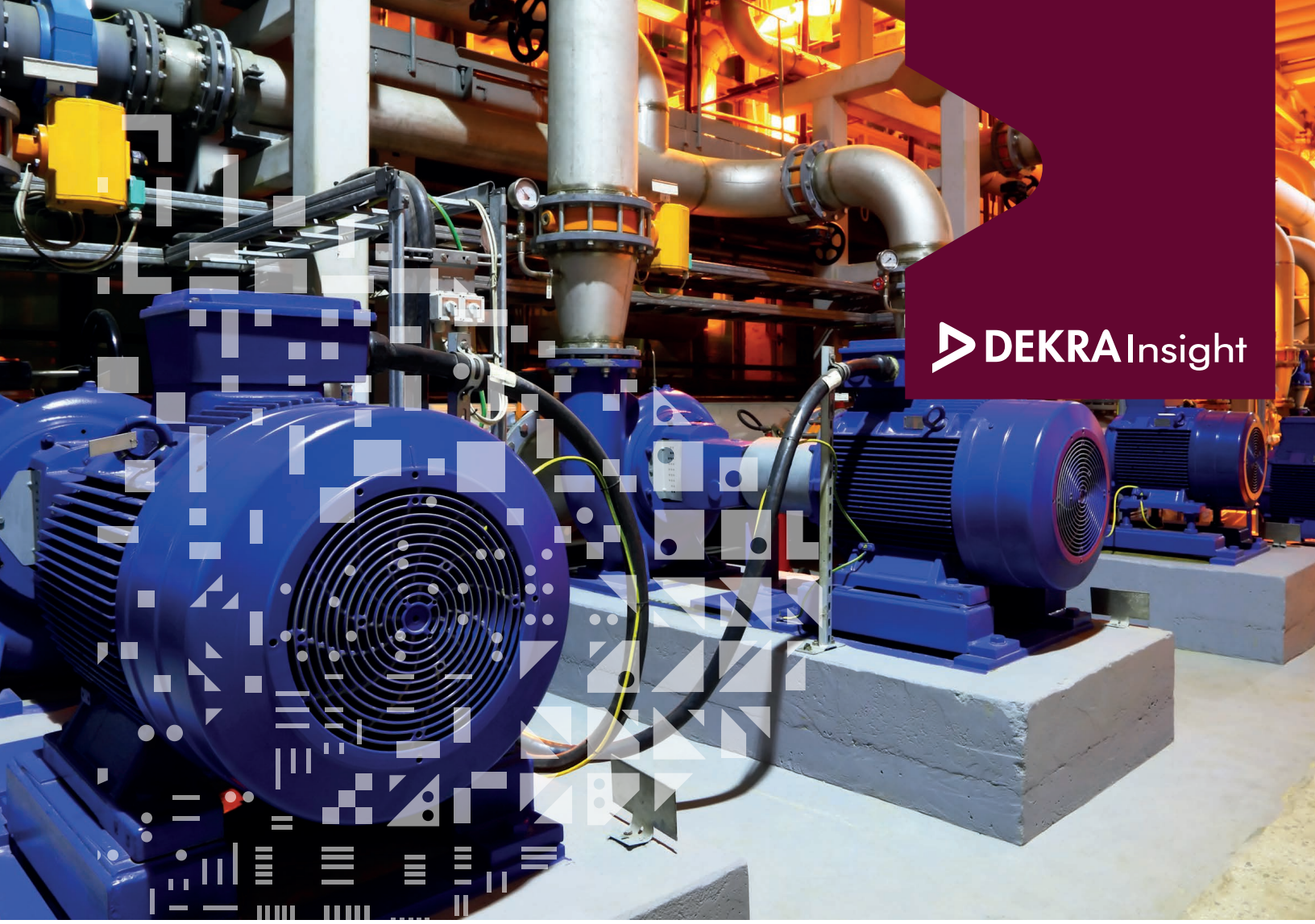

FOCUS ARTICLE

HAZARDOUS AREA ELECTRICAL CLASSIFICATION SHOULD I CLASSIFY AND WHAT GUIDELINES SHOULD I USE?

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Introduction

In the industrial plant where flammable liquids, gases and vapors, combustible dusts or fibers and flyings are handled, processed, or otherwise generated, there can be a risk of fire or explosion. In order to have a fire or explosion, certain conditions must be met. There must be fuel present, the fuel must be mixed with an oxidizer, typically the oxygen in air, in the appropriate ratio, and an ignition source of sufficient intensity must be present. Electrical equipment, including motors, lighting, switchgear, contacts, control and pilot devices during normal use, as well as loose electrical connections, faulty cables and other components can generate energetic sparks and arcs. Also, energy-consuming/converting electrical devices such as motors, transformers, solenoid coils, and light fixtures produce hot surfaces under both normal and abnormal operating conditions. These surfaces, may ignite flammable/combustible materials that come in contact with them. Where flammable/combustible materials and/or atmospheres are present it is a requirement that electrical equipment be designed, installed, and maintained to prevent the occurrence of fires and explosions.

REGULATORY REQUIREMENTS

OSHA 29 CFR, Part 307 (Hazardous (classified) locations) establishes mandated requirements for electric equipment and wiring in locations which are classified depending on the properties of the flammable vapors, liquids or gases, or combustible dusts or fibers that may be present therein and the likelihood that a flammable or combustible concentration or quantity is present. In addition, the National Fire Protection Association (NFPA) codes and standards for gases, flammable liquids, combustible dusts and fibers/flyings also require that electrical equipment and installations comply with the requirements of NFPA 70 (National Electrical Code) and that the electrical hazardous area classification and its extent be determined according to NFPA 499 (for dusts), and NFPA 497 (for vapors/gases). These standards require that local areas of a plant where a flammable atmospheres could be present be classified and all electrical equipment and installations in those local areas be compliant with Articles 500 through 503 of the National Electrical Code.

CLASSIFICATION SCHEMES

In North America the Class and Division format is used for the purposes of classification of electrical equipment. The type of classification depends on the nature of the fuel. Class I, addresses flammable liquids, gases or vapors, Class II, Combustible dusts, and Class III, fibers/flyings. In the European community (IEC/ATEX), and some other countries, the Zone scheme is used. The zone classification schemes may also be used to classify hazardous areas in the US. The fuels may be further broken down according to Groups. Tables 1 and 2 provide relevant information with regard to the differences between the two schemes.

GUIDING DOCUMENTS

In the US, typically NFPA 497 and NFPA 499 documents are used to provide guidance for classification of locations where flammable atmospheres may be present. These documents provide useful information and example diagrams that can be used to classify areas based on the nature of the fuel and the type of process equipment in those areas. The selection, installation, and performance requirements for electrical equipment used in classified areas are outlined in Chapters 500 through 503 of the National Electrical Code. In the European or ATEX scheme, EN 60079-10-1 and EN 60079-10-2 are the relevant classification documents.

PERFORMING A HAZARDOUS AREA ELECTRICAL CLASSIFICATION

NFPA 30, the Flammable and Combustible Liquids Code, requires that electrical equipment and wiring will not constitute a source of ignition of ignitable vapors that might be present under both normal and abnormal operation, for example a liquid spill. This standard requires delineation and classification of areas where these conditions may exist. The newly created NFPA 652 standard for combustible dusts also requires documentation of the location and extent of Class II and Class III areas. Furthermore, this documentation must be preserved for access at the facility. The documentation should be reviewed every three years or when substantive changes are made to the area. A typical hazardous area classification exercise consists of the following steps:

- Assembling a team with a fundamental understanding of the operational areas, electrical equipment, process, and maintenance requirements.
- Compiling the appropriate flammability data for the materials of interest. This could include for powders and dusts, explosibility (Dust deflagration constant (Kst)) and ignitibility (Minimum Ignition Energy of a dust cloud (MIE), Minimum Ignition Temperature of both a dust cloud and layer (MITc and MITl), Minimum Explosible Concentration

Table 1: Hazardous areas and relationship between divisions and zones

NFPA 70/NEC North America		**IEC/ATEX** Europe and some other countries	
Class-Division		Zones	
Class I Gas or vapor **Class II** Dust **Class III** Fiber or flying No group designation	**Division 1** Explosive atmosphere is present or likely to be present in normal operation	**Zone 0 - Gas** **Zone 20 - Dust**	A area in which an explosive atosphere is continually present or present for long periods or frequently
	Division 2 Explosive atmosphere is not present in normal operation, could be present in abnormal operation	**Zone 1 - Gas** **Zone 21 - Dust**	An area in which an explosive atmosphere is likely to occur in normal operation
		Zone 2 - Gas **Zone 22 - Dust**	An area in which an explosive atmosphere is not likely to occur in normal operations and, if it does occur, will exist for only a short time

Note: The United States has adopted guidance for zones for gasses and vapors per NFPA 497. Similar guidance for zones for dust are not yet developed for North America.

Table 2: Gas and dust groups

NFPA 70/NEC	IEC/ATEX	Examples of hazardous material in surrounding atmosphere
Group A	**IIC**	Acetylene
Group B	**IIB + H_2**	Hydrogen, fuel and combustible process gases containing more than 30% hydrogen by volume or gases of equivalent hazard such as butadiene, ethylene oxide, propylene oxide and acrolein
Group C	**IIB**	Ethyl ether and ethylen or gases of equivalent hazard
Group D	**IIA***	Gasoline, acetone, ammonia, benzene, butane, cyclopropane, ethanol, hexane, methanol, methane*, natural gas, naphta, propane or gases of equivalent hasard
-	**I**	Methane
Group E	**-**	Metal conductive dusts including aluminium, magnesium and their commercial alloys or other combustible dusts whose particle size, abrasiveness and conductivity present similar hazards in connection with electrical equipement
Group F	**-**	Carbonaceous dusts, coal black, charcoal, coal or coke dusts that have more than 8% total entrapped volatiles or dusts that have been sensitized by other material so they present an explosion hazard
Group G	**-**	Flour, sugar, starch grain, wood and plastic dusts and chemicals

* Under IEC/ATEX classification, methane is designated as Group I

(MEC)) tests, and conductivity properties. Where gases or liquids are concerned important tests include limits of flammability, flashpoints (liquids), gas or vapor density, auto ignition temperature (AIT), Minimum Igniting Current (MIC) and Maximum Experimental Safe Gap (MESG).

- Compiling building and equipment layout drawings.
- Identifying potential sources of liquid, vapor, gas, and dust releases, considering normal and abnormal conditions.
- Estimating the duration of the leakage or releases.
- Evaluating the effectiveness of ventilation, in the case of gases and vapors.
- Determining if there is an ignitable mixture likely to occur during any release/leakage due to repair, maintenance and assessing the probability of fuel transmission by trenches, pipes, conduits or ducts.
- Using the proper guidelines, assigning a Class and Division (or Zone) rating, including the extent of the area covered.
- Documenting the classified areas, and the extent of classification and specifying the Class, Division (or Zone) and group ratings of electrical equipment to be used in these areas

Conducting a Hazardous Area Electrical Classification can be challenging. A thorough understanding of the processes and equipment associated with the processes is essential. Engineering controls such as room and building design, room ventilation, Local Exhaust Ventilation (LEV), dust control systems and flammable atmosphere sensors as well as Administrative controls, i.e., Housekeeping, Maintenance practices including Preventive Maintenance (PM) Programs can all be important with regard to the need to classify and the extent of the classification. In many cases, expert advice may be required.

SUMMARY

Where flammable liquids, gases, combustible dusts, fibers and flyings may be present in an industrial plant, electrical equipment must be designed not to provide an ignition source. These requirements are part of the OSHA safety regulations as well as the NFPA commodity specific standards. There are two principal schemes that are used to classify electrical equipment for use in hazardous areas. In North America, the Class and Division scheme is used and in European and some other countries the Zone Convention applies. Electrical classification exercises typically involve compiling of the data with respect to the particular fuel, determining points of release, extent of the release, and applying appropriate Class and Division coverage areas. Guidelines are available to enable classification with both the Division and Zone schemes. A Hazardous Area Electrical Classification report should be prepared for every facility, where flammable atmospheres may be created during normal and also abnormal operating conditions. This documentation should be revised every three years or where substantive changes are made. Preparation of the report can be challenging and the services of an expert may be required.

REFERENCES

29 CFR, Part 1910.307 - Hazardous (classified) locations

NFPA 30 - Flammable and Combustible Liquids Code

NFPA 70 - National Electrical Code

NFPA 496 - Standard for Purged and Pressurized Enclosures for Electrical Equipment

NFPA 497 - Recommended Practice for the Classification of Flammable Liquids, gases, or vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

NFPA 499 - Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

Explosive Atmospheres, Part 10-1 - Classification of areas - Explosive gas atmospheres, EN60079-10-1

Explosive atmospheres, Part 10-2 - Classification of areas - Combustible dust atmospheres, EN 60079-10-2

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ABOUT DEKRA INSIGHT

DEKRA Insight is the global leader in safety at work. We specialize in helping clients evolve both their organizational culture and their operational environment, empowering them to reduce injuries, save lives, protect assets - and in the process, achieve higher performance. Our integrated solutions have been honed over decades and are proven to reduce risk and enhance organizational cultures:

- Safety strategy - Building your roadmap for long-term safety improvement
- Culture & leadership - Building high-performance teams
- Behavioral reliability - Assuring unwavering execution of safety systems and processes
- Governance & capabilities - Providing the framework for safety execution and results
- Safety Resource Optimization - Putting your resources to work for safety
- Management Systems - Developing and aligning the systems that drive safety excellence
- Data Analytics & Metrics - Information and insight that drive results
- Process Safety Lab Testing - Precise data, analysis and tools for process safety decision and action
- Process Safety Engineering - Engineering and advice for process safety excellence everywhere

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