PRODUCT APPLICATION

A technical bulletin for engineers, contractors and students in the air movement and control industry

A Guide to Explosion-Resistant Disconnect Switches for Ventilation Products

Explosion-resistant disconnect switches are a required and necessary safety feature for every fan operating in a hazardous environment. Mounted directly on the fan, within sight and reach, disconnect switches provide the best, most reliable protection against accidental start-up during service or inspection. This feature is not included in remote-mounted fan controls. This article addresses the mounting and wiring of two types of explosion-resistant disconnect switches. (For general-purpose disconnect switches, refer to the Application Guide article *A Guide to Selecting Disconnect Switches for Human Safety, Overload, and Short Circuit Protection of HVAC Equipment (FA/106-24).*

Hazardous NEMA Enclosures

Most hazardous environments require an explosion-resistant enclosure. Explosion-resistant enclosures are designed to contain an explosion, not prevent one. They are generally constructed of cast iron or aluminum and provide limited access making them unsuitable as control system enclosures.

The following are typical NEMA electrical enclosure descriptions designed for use in hazardous environments.

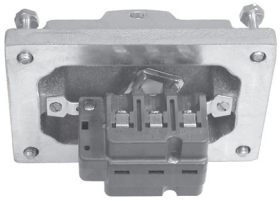
NEMA 7: Explosion resistant. Not weatherproof. As defined in the National Electric Code, Class I, Group A, B, C, or D, are intended for use in indoor locations. The enclosure shall be capable of withstanding the pressures resulting from an internal explosion of specified gases and contain such an explosive gas-air mixture so that the atmosphere surrounding the enclosure will not be ignited. Enclosure heat-generating devices shall not cause external surfaces to reach temperatures capable of igniting explosive gas-air mixtures in the surrounding atmosphere. The NEMA 7 enclosure design meets explosion, hydrostatic, and temperature design tests.

NEMA 9: Class II, Group E, F, or G hazardous locations. Not weatherproof. This switch is intended for indoor use and has an enclosure that is capable of preventing the entrance of dust. Enclosed heat-generating devices shall not cause external surfaces to discolor or reach temperatures capable of igniting dust on the enclosures. Enclosed heat-generating devices will also not cause external surfaces to ignite dust air mixtures in the surrounding atmosphere. The NEMA 9 enclosure design meets dust penetration and temperature design tests, and aging of gaskets.

Class, Division, and Group Specifications

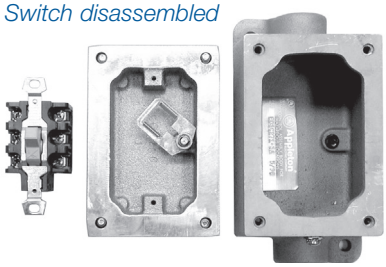
The following explains the meaning of class, division, and group specifications. The class, division, and group specifications on these hazardous enclosures are designated by the National Electrical Code (NEC). For complete details, refer to the NEC article 500.

Closed NEMA 9 Disconnect Switch



Top portion of a NEMA 9 Disconnect Switch with a toggle switch mounted

Open NEMA 9 Disconnect Switch disassembled



Classes:

The Class number specifies acceptable working conditions of the disconnect switch in a specific mounting location.

Class I: Considered acceptable to operate in locations where flammable gases or vapors are (or may be) present under normal conditions and may ignite, explode, or cause failure of electrical equipment. Examples include petroleum refineries, gasoline storage areas, and dry cleaning plants.

Class II: Allows operation in dust, but not in a flammable vapor or gas. Large quantities of fine airborne dust particles may ignite, explode, or cause electrical equipment failure by becoming electrically conductive or cause overheating.

Class III: Ignitable fibers or particles in the air such as in cottonseed mills or wood processing facilities.

Divisions:

Divisions are categorized by “normal” and “abnormal.”

Division I: Normal situation; the hazard would be expected to be present in everyday repair and maintenance.

Division II: Abnormal situation; the material is expected to be confined within closed containers or closed systems and will be present only during accidental rupture, breakage, or unusual faulty operation.

Groups:

Gases, Dusts, and Fibers listed in the respective Groups are examples. A specific application may have other compounds that must be considered. Groups are separated into two classes:

Class I: Gases and vapors are broken into groups A, B, C, and D depending on the ignition temperatures of the substance, its explosion pressure, and other flammable characteristics.

Class II: Dust locations are broken into groups E, F, and G according to the ignition temperatures and conductivity of the hazardous substance.

Letter Designations:

The letter designations rank similar types of gas within each group.

Group A: Acetylene

Group B: Hydrogen including butadiene, ethylene oxide, manufactured gases containing more than 30% hydrogen by volume, propylene oxide

Group C: Ethylene including acetaldehyde, cyclopropane, diethyl ether, ethylene, unsymmetrical dimethyl hydrazine

Group D: Propane including acetone, acrylonitrile, ammonia, benzene, butane, 1-butanol (butyl alcohol), 2-butanol (secondary butyl alcohol), n-butyl acetate, isobutyl acetate, ethane, ethanol (ethyl alcohol), ethyl acetate, ethylene dichloride, gasoline, heptanes, hexanes, isoprene, methane (natural gas), methanol (methyl alcohol), 3-methyl-1-butanol (isoamyl alcohol), methyl ethyl ketone, methyl isobutyl ketone, 2-methyl-1-propanol (isobutyl alcohol), 2-methyl-2-propanol (tertiary butyl alcohol), petroleum naphtha, octanes, pentanes, 1-pentanol (amyl alcohol), 1-propanol (propyl alcohol), 2-propanol (isopropyl alcohol), propylene, styrene, toluene, vinyl acetate, vinyl chloride, xylenes

Group E: Metal dusts including aluminum, magnesium, and their commercial alloys with similar hazardous characteristics

Group F: Carbon including carbon black, coal, charcoal, and coke dust with more than 8% volatile material

Group G: Nonconductive dust including wood/sawdust, flour, starch, grain, or dust of combustible plastic or chemicals

Class and Division Groups

The following defines Class and Division groupings.

Class I, Division 1: Rating states that it is acceptable to operate in locations where flammable gases or vapors are (or may be) present under normal conditions and may ignite, explode or cause failure of electrical equipment. These Class I, Division 1 locations are termed “normally hazardous.”

Class I, Division 2: Termed “not normally hazardous.” Unlike the Division 1 disconnect, Class I Division 2 disconnects are normally contained within closed containers, closed systems, or adjacent to Class I, Division 1 areas. Similar to the Class I disconnects, the Class II disconnects are also termed “normally hazardous” and “not normally hazardous” respectively.

Class II, Division 1: Applicable in locations where combustible dust is (or could be) present in the air under normal operating conditions sufficient to produce explosive or ignitable mixtures or interfere with the normal operation of electrical equipment.

Class II, Division 2: Applicable in locations where combustible dust is not normally present in the air in quantities sufficient to produce explosive or ignitable mixtures, and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus.

The Class, Division, and Group should be specified by the building owner or insurance underwriter.

NEMA 7 & 9 disconnect switch mounted and wired with hard piping.

Wiring Terminology for Explosion-Resistant Disconnects

Many manufacturers provide explosion-resistant disconnects to be ordered two ways—loose or mounted and wired.

- Loose—the disconnect is shipped with the fan but is not mounted; the wiring will not be connected.
- Mounted and wired—the disconnect box will be mounted on the unit and the wiring will be run from the motor to the disconnect box. The wires at the disconnect box will NOT be connected to the load side of the switch so the switch can easily be moved to install supply-side wiring.

Wiring Methods

Depending on the Class and Division types being specified, there are two types of wiring methods available with mounted and wired explosion-resistant disconnects.

- If the disconnect is classified as Class I Division 1, hard piping will be used. Hard piping is similar to galvanized water pipe and is used on 90% of the explosion-resistant fans.
- Mineral Insulated (MI) cable or metallic liquid tight conduit can be used when a fan is specified as Class I, Division I or Class I, Division 2. MI cable or metallic liquid-tight conduit can also be used in conjunction with some belt-driven fans, allowing for motor adjustments to be made.

Disconnect Characteristics for Mounting

In addition to determining a mounting style, it is necessary to distinguish the disconnect by various characteristics:

Speed: Explosion-resistant disconnects are rated for single-speed motors. Two-speed explosion-resistant motors and disconnects for the most part are a thing of the past, except in rare applications. The application of variable speed drives (VFDs) has replaced multispeed motors.

Phase: Disconnects are categorized like motors, either single-phase or three-phase, and are factory-selected to match the fan.

Voltage: Explosion-resistant disconnects could be single-phase or three-phase with high or low voltage. The high voltage ratings for single phase are 208, 230, and 277, and the low voltage rating is 115. The three-phase high voltages are 460 and 600, and the low voltages are 200, 208, and 230. Please consult our factory for the availability of voltages not listed.

Horsepower: There is a maximum and minimum horsepower designation for each disconnect. The horsepower must fall between these values. The proper disconnect should be selected by the manufacturer depending on the fan motor size.

Explosion-Resistant Disconnect Offerings

Reputable fan manufacturers offer the following three options of disconnect switches:

Option 1: Explosion-resistant switch and enclosure unmounted, unwired. (Usually shipped in the motor compartment for field mounting and wiring by others.)

Option 2: Explosion-resistant switch and enclosure mounted and wired with Class I, Division 2 wiring.

Option 3: Explosion-resistant switch and enclosure mounted and wired with Class I, Division 1 wiring.

The explosion-resistant switch and enclosure mounted and wired with Class I, Division 1 wiring meets most hazardous location applications.

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