GREENHECK

Fan Application

FA/106-00

PRODUCT APPLICATION GUIDE

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

A guide to disconnect switches for ventilation products

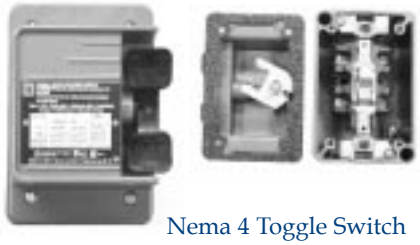
Fan-mounted disconnect switches are a recommended and necessary safety feature for every fan. Mounted directly on the fan, within sight and reach, disconnect switches provide the best protection against accidental startup during service or inspection.

Disconnect switches come in a multitude of shapes and sizes, and they are classified under many different NEMA ratings. Understanding the similarities and differences in disconnect switches will offer dollar savings to you and your customers.

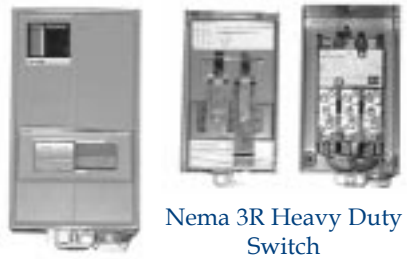
Although there are different types of disconnect switches, toggle and heavy duty disconnects switches are most commonly used. Toggle switches are flipped on and off like a light switch, and heavy duty switches have a push button or a flip arm knife blade design. They may be visible or enclosed in some type of housing.

Disconnect switches are available in many enclosures and duties, and are classified under several different National Electrical Manufacturers Association (NEMA) ratings based upon the special applications and production conditions they are installed in.

Nema 1 Disconnect



Nema 4 Toggle Switch



Nema 3R Heavy Duty Switch

Nema 12 Heavy Duty Switch

NEMA ratings range from NEMA 1 through NEMA 12 and are based on the switch enclosures' ability to protect against moisture, dust, corrosion or explosion.

Non-Hazardous NEMA Enclosures

The following NEMA electrical enclosures are recommended for non-hazardous locations:

NEMA 1: Enclosure constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection against falling dust. The NEMA 1 enclosure meets the rod entry and the indoor corrosion protection design tests. The rod entry test is intended to simulate incidental contact with enclosure equipment.

NEMA 3R: Enclosure constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment: to provide a degree of protection against falling dirt, rain, sleet, snow, and windblown dust. The enclosed equipment will be undamaged by the external formation of ice on the enclosure. The NEMA 3R enclosure meets the rod entry, rain, external icing, outdoor corrosion protection and gasket design tests.

GREENHECK
The Solution Company.

P.O. Box 410 • Schofield, WI 54476 • 715.359.6171 • Fax 715.355.2399

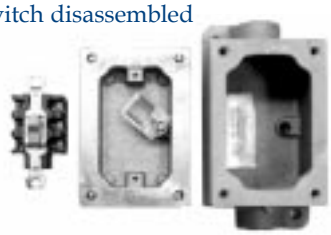
NEMA 4: Enclosure constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosure equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, and hose-directed water; and that will be undamaged by the external formation of ice on the enclosure. The NEMA 4 enclosure meets the external icing, hosedown, outdoor corrosion protection, and the gasket design tests.

NEMA 4X: - The NEMA 4X enclosure has the same protection as the NEMA 4 but it also includes protection against corrosion. The NEMA 4X enclosure meets the external icing, hosedown, outdoor corrosion protection, 4X corrosion protection, and the gasket design tests. 4X corrosion protection is the indoor corrosion protection test (24-hour salt spray test). The 24-hour test assures the switch to withstand 200 hours.

NEMA 12: Is a heavy duty enclosure constructed (without knockouts) for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dust; against circulation dust, lint, fibers, and flyings; and against dripping and light splashing of liquids. The NEMA 12 enclosure meets the circulating dust, indoor corrosion protection, and the gasket design tests.

Left:. Closed NEMA 9 Disconnect Switch Below: Top portion of a NEMA 9 Disconnect Switch with a toggle switch mounted.

Below: Open NEMA 9 Disconnect switch disassembled



Hazardous NEMA Enclosures

The following NEMA electrical enclosures are designed for use in hazardous environments. Most hazardous environments require an explosion resistant enclosure.

Explosion resistant enclosures are designed to contain an explosion, not prevent one. They are constructed of cast iron or aluminum, and provide limited access rendering them unsuitable as control system enclosures.

NEMA 7: Explosion resistant. Not weatherproof. Intended for indoor use in locations classified as Class I, Groups A, B, C or D, as defined in the National Electrical Code (NEC). It is capable of withstanding the pressures resulting from an internal explosion of specified gases and contain such that an explosive gas-air mixture existing in the atmosphere surrounding 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 meets explosion, hydrostatic, and temperature design tests.

NEMA 9: Class II, Group E, F, or G hazardous locations. Not weatherproof. 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 reach temperatures capable of igniting or discoloring dust on the enclosure or igniting dust air mixtures in the surrounding atmosphere. The NEMA 9 meets dust penetration and temperature design tests, and aging of gaskets.

The class, division, and group specifications on these hazardous enclosures are designated by the NEC. The Class number specifies acceptable working conditions of the disconnect switch in a specific mounting location. Below are specific explanations of 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. This Class I, Division 1, locations are termed "normally hazardous".

Class I, Division 2, disconnects are termed "not normally hazardous" because, unlike the Division 1 disconnect, it is normally contained within closed containers or a closed system, or are adjacent to Class I, Division 1 areas.

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

Greenheck's CUBE-180 up-blast roof fan shown with a NEMA 3R disconnect, exterior mounted and factory wired to the motor with non-metallic liquid tight conduit.

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

For a more specific explanation of explosion resistant disconnect switches please refer to the National Electric Code of Greenheck's Product Application article FA/107-00.

Mounting locations for fan mounted disconnects

The mounting locations of the disconnect switches depend on the fan type and the disconnect enclosure.

Mounting locations, wiring terminology, etc. vary by manufacturer. For purposes of explaining, we will describe Greenheck's approach.

For a Nema-1, 7, and 9 switches, the disconnect box will be interior mounted on the fan listed in the following locations:

- Centrifugal roof fans – on the support pan. (see photo on page 4)
- Hooded propeller roof fans – on fan base next to the access door.
- Sidewall propeller fan with wall housing – on inside of wall housing.
- Sidewall propeller fans without housing – on fan panel (also when a wall collar is used).

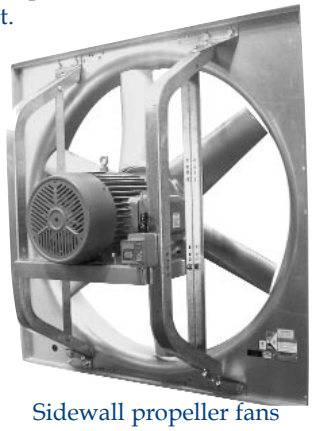
Centrifugal fans commonly use NEMA 12 disconnects switches that are often shipped loose. Fan shown is Greenheck's Centrifugal Model 36-BISW-21.

For Nema-3R, 4, 4X, and 12 switches, the disconnect box will be mounted on the exterior in the following locations:

- Centrifugal roof fans – on the windband. *(photo)*
- Hooded propeller roof fans – on fan base.
- Sidewall propeller fan – on wall housing. Requires special considerations: wall housing will not pass through the wall opening.
- Sidewall propeller fans – on wall collar. Requires special consideration: wall collar will not pass through wall opening.
- Sidewall propeller fans - on wall fan panel if no housing or collar is present. *(photo)*

Wiring terminology

When ordering disconnects, it is helpful to understand the different wiring terminology, i.e. loose, mounted and wired, or mounted, wired, and connected. If requested as loose the disconnect will be shipped with the fan. The box will not be mounted and the wiring will not be connected.



Sidewall propeller fans commonly use a dust-tight NEMA 4 disconnect.

Mounted and wired means that the disconnect box will be mounted on the unit and the wiring will be connected and 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. The switch is shipped in a bag attached to the fan. This allows external wiring to be run to and connected in the disconnect box without having to remove the switch. This is the standard Greenheck method of wiring uses on its fans.

Mounted, wired and connected applies only when an extended wiring pigtail is specified. This means the disconnect box will be mounted on the unit, the wiring will be run from the motor to the disconnect box, and the wire will be connected to the load side of the switch. The extended wiring pigtail is also connected to the supply side of the switch. At Greenheck, the fan is then factory tested with power connected to the extended wiring pigtail.

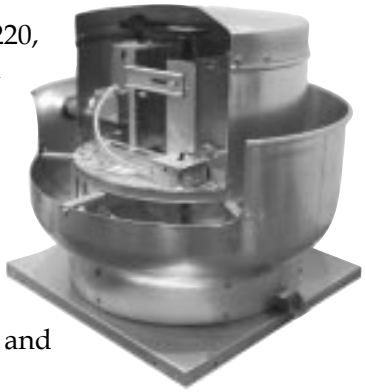
Characteristics of disconnects

In addition to determining a mounting style, switch type, and NEMA enclosure, it's necessary to distinguish the disconnect by various characteristics:

Speed: Disconnect switches are selected to match the number of speeds the fan motor is capable of operating at.

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

Voltage: Disconnects could be single or two speed with high or low voltages. The high voltage ratings for single phase applications are 208, 220, 230, 240, and 277, and the low voltage ratings are; 110, 115, 120, and 127. The three phase high voltages are 380, 400, 460, and 575, and low voltages are 190, 200, 208, 220,230, and 240.



Left:
Example shown is Greenheck's CUBE-180 up-blast roof fan with a mounted and wired NEMA 1 disconnect switch.

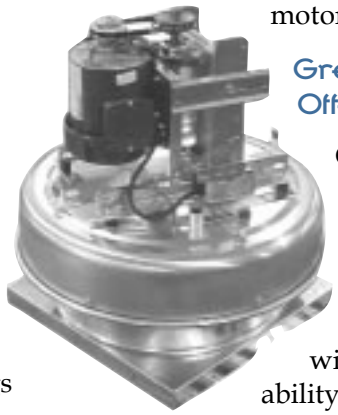
Overload: Thermal and fused overloads are available as safety features with disconnects.

Horsepower: There is a maximum and minimum horsepower designations for each disconnect. The horsepower must fall between these values. The proper disconnect will be selected by Greenheck depending on the fan's motor horsepower.

Disconnects and One-Point Wiring

One-point wiring is a convenient *optional* method of adding value with a time- and money-saving service. By factory-wiring the damper actuator, fan motor, and damper end switch to a single point, we can make the installation of propeller fans faster and easier for the contractor. The option of a NEMA 1 and a NEMA 3R disconnect are available with one-point wiring. If you are looking to use a different disconnect, contact the fan manufacturer.

The following guidelines should be used when using disconnects with one-point wiring. The rule states that the fan motor voltage can be whatever is specified, but the damper actuator voltage and the end switch voltage must be 120 volts. This applies to single speed, either single phase or three phase motors, OR two speed, single phase motors.



Above: Example shown is Greenheck's Model GB-120, roof fan with a mounted NEMA 1 disconnect switch.

Greenheck's Disconnect Offerings

Greenheck offers a wide range of NEMA rated disconnect switches accommodating all fan mounted applications. By allowing mounting and wiring options you have the ability to order disconnects exactly the way they are specified.

Greenheck's CAPS program will assist you in selecting the proper disconnect for your application. Simpy select SWITCHES under the ACCESSORIES tab and choose the NEMA rating, overload protection, type of switch, mounting style, and explosion resistant wiring (if applicable). Greenheck's CAPS program insures the switch will be compatible with the selected fan and motor. If the switch you desire is not available, contact the factory and a special design request can be initiated.

References

NEMA Standards Publication, NEMA 250, Enclosures For Electrical Equipment, Published by: National Electrical Manufacturers Association, Copyright 1998, Section 2 Enclosure Types, Features, and Applications.