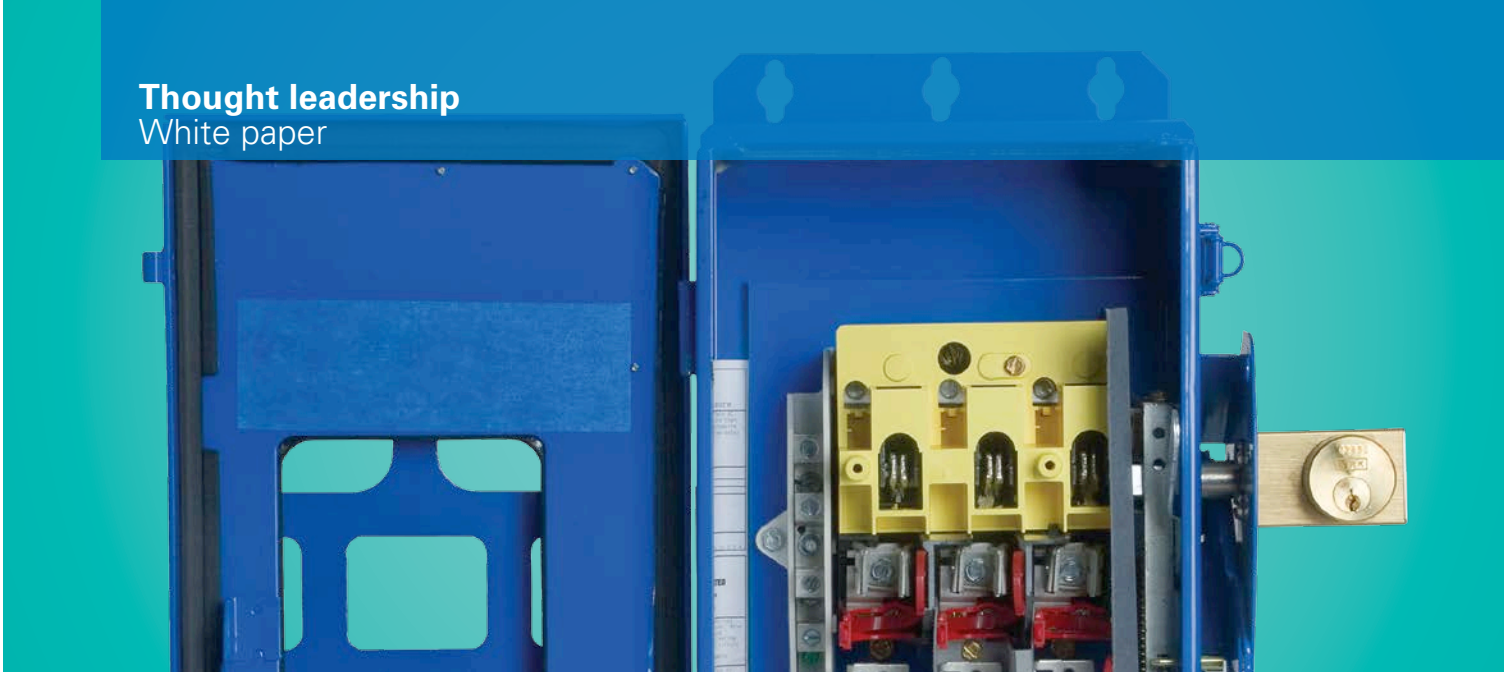
Thought leadership
White paper



Advancing personnel and equipment protection with safety switches

The evolution of safety switch technology and a growing emphasis on personnel protection

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A brief history of safety switches

When Eaton began manufacturing safety switches many decades ago, the devices served as a simple (yet reliable) method of disconnecting manufacturing equipment and heavy machinery from its power source.

On the most basic level, safety switches are still used today to open and close a circuit—whether as a disconnecting means for a service entrance or to facilitate lock-out/tag-out procedures for motors and other critical power system equipment.

However, as modern industrial environments have become more and more safety conscious, it is a higher priority than ever before to create a safer environment for everyone close to, and working on, equipment. As a result, safety switches have evolved alongside the electrical industry's "zero incident" culture to offer more robust protection for both equipment and personnel.

In fact, safety switches are a necessity in all commercial and industrial applications, per the National Electrical Code® (NEC®), established by the National Fire Protection Association (NFPA). According to NEC article 430.102B, a safety switch must be in sight from all motors or manufacturing equipment. The NEC defines "in sight" as visible and not more than 50 feet from the equipment it controls.

At Eaton, we have seen many industry trends that have created needs for specialized versions of safety switches. This whitepaper discusses the most common types of safety switches before detailing modern innovations for enhanced personnel and equipment protection, and provides an overview of custom safety switch options.

Elevator control switch and double-door line isolation safety switch

Powering Business Worldwide

Safety switch application guide

Application/features	General-duty safety switches	Heavy-duty safety switches
Type of facility	Residential, commercial, light industrial	Commercial, institutional, industrial
Maximum voltages	240 Vac—250 Vdc in larger sizes	600 Vac—250 Vdc and 600 Vdc
Short-circuit rating for non-fusible switches	10,000 rms symmetrical amperes	10,000 rms symmetrical amperes. Higher combination ratings available with upstream Eaton molded-case circuit breakers and fuses
Short-circuit rating with standard fuse clips	With Class H fuse clips—10,000 rms symmetrical amperes	Switches with Class H Fuse Clips—10,000 rms amperes 800–1200 A switches with Class L fusing—200,000 rms
Short-circuit rating with fuse options	Class R fuse adaptation and 400–600 A switches with T or J fuse adaptation—100,000 rms amperes	Switches with Class R or Class J fusing and 200–800 A switches with Class T fuse adaptation—200,000 A at 480 V and 100,000 rms symmetrical amperes at 600 V
Ampere sizes	30, 60, 100, 200, 400, 600	30, 60, 100, 200, 400, 600, 800, 1200
Maximum horsepower ratings	200 hp at 240 Vac	250 hp at 240 V, 500 hp at 480 and 600 Vac
UL (NEMA) enclosure types	Type 1—general purpose indoor use Type 3R—rainproof and sleet-resistant	Type 1 indoor, 3R outdoor Type 4 watertight and dust-tight Type 4X watertight, dust-tight and corrosion-resistant Type 12 indoor falling dust, dirt and liquids Type 12/3R convertible to outdoor use Type 7/9 hazardous (classified) locations
Terminals	Box lug (screw pressure) for Al/Cu wire	Box lug (screw pressure) for Al/Cu wire
Electrical interlock—snap-switch type	Field-installed kit, 200–600 A sizes	Field- or factory-installed for all sizes
Control pole interlock	Field-installed kit, 400–600 A sizes	Field- or factory-installed for K-Series switches
Fuse pullers	Not available	Standard in Type 4X and 12 enclosed switches through 200 A field- or factory-installed for all other 30–200 A switches

Choosing the right safety switch for your application

Safety switches are commonly available in both fusible and non-fusible configurations. For both of these options, when the circuit is opened, the safety switch disconnects the load from its source of electrical power, while closing the circuit reconnects the load.

The configurations differ in the aspect that fusible safety switches combine fuses with the switch in a single enclosure, providing an easy means to manually open and close the circuit while the fuses protect against overcurrent and short circuit. In comparison, non-fusible safety switches do not incorporate any fuses into their enclosure and do not provide circuit protection. The sole purpose of a non-fusible safety switch is to provide an easy means to open and close a circuit.

There are many other factors and design considerations to weigh when selecting a safety switch. In addition to solutions specifically designed for heavy-duty and general-duty applications, industry trends have created needs for specialized versions of safety switches. The most common configurations include:

General duty

General-duty safety switches are used in residential and commercial applications. These switches are suitable for light-duty motor circuits and service entrance applications. Fusible (plug or cartridge) and non-fusible switches are available.

Heavy duty

Heavy-duty safety switches are used in commercial, institutional and industrial applications where reliable performance and service continuity are critical. These switches are most often rated 30–1200 A with a visible double-break rotary blade mechanism. All heavy-duty switches are load-break rated.

Double throw

Double-throw safety switches are used to transfer service from a normal power source to an alternate source, or to switch from one load circuit to another. These safety switches have two interlocked switches with a common connection. The interlock ensures that both switches cannot be closed at the same time, preventing them from being operated in parallel. Double-throw safety switches are available in general duty and heavy duty, as well as quick connect.

Quick-connect safety switch

Quick connect

Quick-connect switches provide a safe and quick means of connecting portable generators to facilities, transferring the building to backup power, or providing temporary connection of portable loads.

Elevator control

Elevator control switches or disconnects are a simple, all-in-one solution that help remove the mystery out of meeting the many codes associated with fire protection and safety in elevator shafts.

Receptacle

These heavy-duty switches are prewired and interlocked to polarized receptacles for three-phase, three-wire, grounded type power plugs. Receptacle switches are used for portable power applications such as welders, infrared ovens, batch feeders, conveyors, and truck and marine docks. Receptacles are interlocked to handle mechanisms so that power plugs may not be inserted or removed when the switch is in the ON position unless noted otherwise.

As stated above, the heightened importance of personnel safety and continued commitment to uptime in our modern digital age has increased the demand for power management solutions that go beyond basic switching functions—with features specifically designed to support power system reliability, reduce maintenance risk and simplify labor.

Flex Center switches

At Eaton, we've listened to the evolving challenges of our customers across many industries and have responded with a drastically enhanced portfolio of switching solutions capable of meeting the power management demands of tomorrow. These new technologies include:

Double-door line isolation

One of Eaton's newest offerings, the double-door line isolation switch provides an internal barrier between upper and lower compartments to advance safety through isolation of line-side power. This revolutionary design enables personnel to minimize exposure, maximize uptime and enhance safety while performing maintenance or testing within the load-side fuse compartment.

This switch also provides an enhanced visible means of disconnect as standard on all configurations that allows personnel to clearly see that blades are disengaged from stationary contacts when the switch is OFF. Further, mechanical interlocks prevent the doors from being opened when the handle is in the ON position, although there is a built-in defeater mechanism for user access when necessary.

Line isolation for control panels

Traditional control panels may expose operators to line-side system voltage (i.e., 480 Vac) even when the internal main disconnect is in the OFF position. Many panel-building OEMs and OEM customers are concerned with arc flash hazards and arc flash categories, and may be looking for ways to reduce them.

The solution is the OEM Line Isolation (OLI) switch—a recent addition to Eaton's expanding offering of safer switching devices. The OLI switch provides an external disconnecting means for industrial control panels. The OLI switch allows an operator to access the control panel without exposure to the line-side voltage, thus enhancing safety and allowing for reduced PPE, which improves worker dexterity and mobility.

Shunt trip safety switch

Designed to enhance personnel safety and protect equipment in commercial and industrial applications, Eaton's safety switches with shunt trip technology can be operated electrically and remotely—expanding the range of applications where safety switches can be applied.

These switches enhance safety by providing a means to electrically and remotely open a safety switch, and can be used with emergency stop pushbuttons or other remote signaling means to quickly disconnect power from equipment—providing a perfect solution for critical applications, including oil and gas, industrial plants, solar installations, utilities, commercial construction, and water and wastewater treatment.

Heavy-duty safety switches with enhanced visible blade

These switches provide a highly visible means of disconnect that helps improve personnel safety and equipment protection in industrial, commercial and institutional applications, enabling users to view the trailing edge of the switch blades when in the OFF position.

Heavy-duty safety switches with surge protection

Traditionally, contractors and end-users were faced with challenges when connecting a surge protective device (SPD) to a safety switch—mainly concerning additional lug openings on the switch. The SPD leads were often terminated in the same opening as a power conductor, thus voiding the switch's UL® listing. To help address this challenge, Eaton developed a packaged solution that makes the connection at the factory, resulting in a completely wired, UL®-listed solution.

Integral to the switch, the SPD provides significantly better performance compared to a device that is externally mounted, resulting in better protection for your connected equipment.

Auxiliary power switch

NEC Section 210.63 requires a 125 V, single-phase, 15 A- or 20 A-rated receptacle outlet be installed at an accessible location for the servicing of heating, air-conditioning and refrigeration equipment. The receptacle must be located on the same level and within 25 ft (7.5 m) of the heating, air-conditioning and refrigeration equipment. The receptacle outlet is also not to be connected to the load side of the equipment disconnecting means.

To address this code requirement, Eaton developed the auxiliary power heavy-duty safety switch, which combines a safety switch, 2 kVA control transformer and 15 A GFI receptacle in a single product. The auxiliary circuit is tapped off of the line side of the safety switch and can be operated independently of the main switch circuit. Using the auxiliary power heavy-duty safety switch eliminates the need for running a separate 120 V circuit common to rooftop air-conditioning applications.

OEM Line Isolation switch (OLI)

When "off the shelf" won't work

Eaton's Cleveland, TN, Switching Device Flex Center is a solutions center that designs and modifies safety switches for unique customer needs that are not met by standard products.

The Flex Center is a one-of-a-kind operation that is capable of solving customer issues and has been providing customer solutions since 1998. While you may think that your power switching needs are unlike any other, chances are, the Flex Center staff has already "been there and done that."

Some of our most common safety switch customizations include:

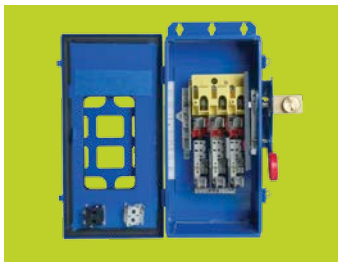
Enclosure options

From dust to high humidity to corrosive chemicals, the industrial environment can tear up equipment—unless you install the right device for the job. By installing the right switching enclosure, you can extend the life of the switch and minimize your downtime.

Special paint colors such as red, orange, yellow, green, black and white are available; other colors are available upon request. Custom color is applied over the standard ANSI-61 gray finish. Custom mounting configurations are also available in the form of mounting flanges or unique brackets that meet the needs of unique installation situations.

More connections than ever before

Safety switches have historically provided very few options when it comes to custom or optional lugs, posing a problem for contractors or end-users when applications require oversized or multiple conductors. Eaton's Switching Device Flex Center is proud to offer a line of UL-listed, heavy-duty safety switches with alternate lug configurations. These switches are offered as a factory-installed solution that is ready to go out of the box.



Flex Center switches with customized specifications

Reliability

At Eaton, we engineer all of our products with reliability in mind so you can depend on clean, uninterrupted power and avoid costly unplanned downtime. For our line of safety switches, we offer a wide range of customization options that go beyond standard configurations to help you improve energy surety.

Common options include:

- 304- and 316-grade stainless steel enclosures
- Seam welding
- Stainless steel mechanism
- Fungus proo¬fing
- Lock-on provisions
- Integrated surge protection

Safety

We understand how important it is to maintain a safe working environment. There is no more important task for plant management than ensuring the safety of the workforce.

The following safety solutions take the guesswork out of many operations associated with power switching to help your employees go home safely every day. Some common safety customizations include:

- Key interlocks
- Pilot lights
- Voltage indicators
- Viewing windows

Auxiliary contacts can be used in control schemes to turn pilot lights on or off, initiate actions, and so on. The benefit to the installer is the time saved by having the contacts installed in the factory.

Additionally, Eaton is proud to offer award-winning enclosed circuit breakers (ECB) with Arcflash Reduction Maintenance System™ as an available integration with our safety switches. The Arcflash Reduction Maintenance System provides the ECB with functionality that allows the operator to put the breaker into a maintenance mode, reducing the amount of available arc flash incident energy downstream.

Summary

Today's zero incident culture demands emphasis on prevention, protection and preparation. Though a commonly overlooked element of plant architecture, safety switches will continue to play a pivotal role in protecting equipment and personnel.

Modern solutions provide a wide range of design innovations that were not once available—creating greater peace of mind and productivity when working on heavy industrial equipment or performing routine plant maintenance.

Why Eaton?

Eaton is dedicated to ensuring that reliable, efficient and safe power is available when it's needed most. With unparalleled knowledge of electrical power management across industries, experts at Eaton deliver customized, integrated solutions to solve our customers' most critical challenges.

Our focus is on delivering the right solution for the application. But, decision-makers demand more than just innovative products—they turn to Eaton for an unwavering commitment to personal support that makes customer success a top priority. For more information, visit Eaton.com/electrical.

For more information on safety switch selection, visit
Eaton.com/switches

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Printed in USA
Publication No. WP008002EN / Z19769
July 2017

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