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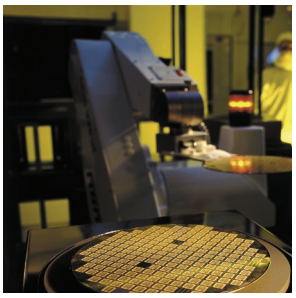
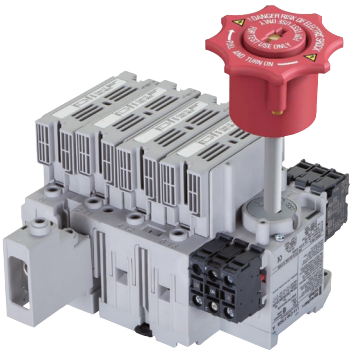




Manual Switching Devices:

Control, Load or Fusible Disconnect Switches… Which is Best For Your Application?

Application Data

Introduction

A variety of manual switching devices are available today for use in control circuits, motor circuits, and as the main control panel disconnecting means. Since the possible applications for these switches overlap, product standards compliance, electrical installation codes / requirements and application parameters must be carefully considered when selecting a manual switching device. This document will give an overview of those important considerations as they relate to the typical products available in the marketplace. While this document gives a general overview of control, load, and fusible disconnect switches, there are certainly exceptions that can be found in specific manufacturer's offerings.

Applicable Standards

Differences in construction, electrical, mechanical and short circuit performance of manual switching devices result in their certification to different standards. This document will not discuss all of the performance and construction differences between control, load, and fusible disconnect switches, or all of the test requirements of the applicable standards, but the major characteristics of the devices and standards requirements will be highlighted. Table A is a quick reference to the applicable standards (and their titles) for these products. The description and application of the switches relative to UL and CSA standards requirements will focus on their use in North America.

International Electrotechnical Commission (IEC) Standards

Control switches meet the requirements of IEC 947–5. These devices have been designed to provide maximum reliability and continuity for carrying low voltage –very often 24V, and low current signals – often milliamperes. Control switches are rated in the following utilization categories: AC–1, AC–2, AC–3, AC–4, AC–11, AC–21A, AC–22A, AC–23A, and DC–1 (see Appendix B for definitions of utilization categories). While these switches have been designed primarily for control applications, they also carry limited horsepower and kilowatt ratings for use in inductive load applications.

Load switches meet the requirements of IEC 947–3, and have been designed primarily for use in inductive applications such as switching motors and as main control panel disconnect devices. Load break switches are rated in the following utilization categories: AC–1, AC–2, AC–3, AC–4, AC–11, AC–15, AC–21A, AC–22A, AC–23A, and DC–1. Load switches have higher current and power ratings than control switches, as well as having higher short circuit withstand ratings.

Fusible disconnect switches, like load switches, meet the requirements of IEC 947–3. Fusible disconnects have been designed primarily for inductive applications and are generally used as main control panel disconnecting devices and as distribution switches. Since fuses install directly on–board these devices, fusible disconnect switches are the best products for use in control panels where fusible short circuit protection is required. Additionally, when manual devices are applied in North America, installation codes and standards requirements are more rigid than the product design standards requirement. Meeting “Service entrance requirements” is an example of the strict installation requirements. Fusible disconnect switches are rated in the following utilization categories: AC–22A, AC–23A. Fusible disconnect switches have higher current and power ratings than load break switches, as well as having higher short circuit withstand ratings.

Underwriters Laboratory (UL) Standards

Control switches (with HP and kW ratings) and load switches both meet the requirements of UL 508, and are classified as manual motor controllers. While they meet the requirements of manual motor controllers, their construction makes them suitable for use in control circuit applications, motor control applications and some control panel disconnect applications. These devices have relatively low short circuit

Applicable Standards
(continued)

withstand ratings, generally 5kA to 10kA, based on the horsepower/kW rating of the switch.

One of the key characteristics of control and load break switches meeting the manual starter requirements is that after the short circuit testing procedure, the contacts of the device may weld, such that the switch is no longer functional. Another key design feature is the devices have industrial control spacings which are 9.5 mm (3/8 inch) through air and 12.7 mm (1/2 inch) across surface between live poles of opposite polarity, for devices rated more than 250V. The significance of the short circuit performance and electrical spacings of these devices will be discussed in greater detail in the Application Specifications section of this document.

"Fusible disconnect switches" as North American customers have come to know them, meet the requirements of UL 98 or UL 1087. Their construction makes them extremely well suited for use in motor control applications and control panel disconnect and distribution applications. These devices have high short circuit withstand ratings, often times 100kA. Like control and load switches, they are rated in maximum operating current and generally horsepower/kW ratings. In contrast to the short circuit performance requirements of manual motor controllers, after short circuit testing of fusible disconnects in accordance with UL 98 and 1087, the contacts of the switch cannot weld, ensuring that the switch is functional even after a short circuit fault, which may be as high as 100kA.

The construction of these devices is also quite different than devices meeting the manual motor controller requirements of UL 508. For fusible disconnects rated more than 250V, electrical spacings are required to be 25.4 mm (1 inch) through air and 50.8 mm (2 inches) across surface between live poles of opposite polarity. These spacings are referred to as "Service Entrance Spacings". These differences will also be addressed in greater detail in the Application Specifications section of this document.

Canadian Standards Association (CSA) Standards

The applicable CSA standard for control and load switches is CSA C22.2 No. 14 and the devices are classified as manual motor controllers (similar to the UL 508 requirements). The electrical spacings and short circuit performance requirements of CSA C22.2 No. 14 are the same as the UL requirements described in the previous section.

The applicable CSA standard for fusible disconnect switches is CSA C22.2 No. 4. The short circuit performance requirements of CSA C22.2 No. 4 are the same as the UL 98 and 1087 requirements described in the previous section. Electrical spacing requirements though are limited to the industrial control spacings of 9.5 mm (3/8 inch) through air and 12.7 mm (1/2 inch) across surface between live poles of opposite polarity, for devices rated more than 250V.

Applicable Standards (continued)

Table A - Applicable Product Standards

Underwriters Laboratories (UL)	UL508	UL508	UL98 or UL1087
Canadian Standard Association (CSA)	CSA C22.2 No. 14	CSA C22.2 No. 14	CSA C22.2 No. 14
International Electrotechnical Commission (IEC)	IEC947-5	IEC947-3	IEC947-3

UL 98: Enclosed and Dead–Front Switches
UL 508: Industrial Control Equipment
UL 1087: Molded–Case Switches
CSA C22.2 No. 14: Industrial Control Equipment
CSA C22.2 No. 4: Enclosed Switches
IEC 947–3: Low–voltage switchgear and controlgear, Part 3: Switches, disconnectors, switch–disconnectors and fuse–combination units.
IEC 947–5: Low–voltage switchgear and controlgear, Part 5: Control Circuit Devices and Switching Elements.

Electrical Codes and Installation Requirements

Electrical Codes and Installation Requirements in North America ①

Article 430 of the U.S. National Electrical Code (NFPA–70), also referred to as the "NEC", defines the requirements for motor branch circuits including control circuits, and the components in those circuits, namely motor controllers and disconnecting means which is the focus of this document.

All controller devices utilized to control a motor must meet the requirements defined in Section G, entitled Motor Controller, of Article 430. The most important requirements of this section can be summarized as follows:

- Each controller must be capable of starting and stopping the motor it controls and it must be capable of interrupting the locked rotor current rating of the motor.
- The controller must have a horsepower rating equal to or greater than the horsepower rating of the motor, at the voltage being utilized in the application.
- The controller must have a voltage rating greater than the application voltage.

① Since the U.S. National Electrical Code and the Canadian Electrical Code are very similar in the area of motor control and disconnecting means requirements, they will be treated in this document as being the same, and will reference specific sections of the U.S. National Electrical Code.

Electrical Codes and Installation Requirements
(continued)

Control switches, load switches, and fusible disconnect switches are all typically rated in horsepower and voltage and can be utilized as the "motor controller" in motor control applications in accordance with the NEC. However, as will be discussed in a later section of this document, due to the construction, performance and features of these products – control and load switches are better suited for use as motor controllers than fusible disconnect switches.

Disconnecting means intended to disconnect motors and controllers from the supply circuit must comply with the NEC requirements specified in Section I, Disconnecting Means, of Article 430. The most important requirements of this section can be summarized as follows:

- A disconnecting means shall be located within the line of sight of the controller motor location, shall be readily accessible, and shall disconnect the controller.
- The disconnecting means shall open all ungrounded supply conductors and shall be designed so that no single pole of the disconnecting means can be operated independently.
- The disconnecting means shall plainly indicate whether it is in the "ON" or "OFF" position.
- The type of disconnecting means shall be one of the following: a motor circuit switch (see Appendix A for definition) rated in horsepower, a circuit breaker, or a molded–case switch, and shall meet appropriate designated standards and has been evaluated and found suitable for use in the application.
- Disconnecting means for single motor circuits rated 600V or less, shall have an ampere rating of at least 115 percent of the motor full load current rating.
- For combination loads (more than one motor or a motor used in conjunction with other loads such as a resistance heater) shall have an ampere rating of at least 115 percent of the application full load current and shall be capable of interrupting the application locked rotor current.

As with the motor controller requirements, control switches, load switches, and fusible disconnect switches meet the requirements of motor circuit switches, and can be utilized as disconnecting means in accordance with the NEC. However, as will be discussed in a later section of this document, due to the construction, performance and features of these products – fusible disconnect switches are best suited for use as a main control panel disconnecting means. Additionally, there are specific applications, such as service entrance applications, where only fusible disconnect switches complying with UL 98 or UL 1087 can be utilized.

Electrical Codes and Installation Requirements
(continued)

International Electrical Codes and Installation Requirements

While there are an extremely large number of regional electrical codes and installation requirements throughout the world, we will utilize IEC 204, Electrical Equipment of Industrial Machines – Part 1 General Requirements, as an "umbrella" to address the requirements of many of these regional codes.

IEC 204 is quite general in specifying requirements for individual electrical components. Paragraph 4.2 states that components and devices shall be suitable for their intended use and shall comply with the relevant IEC standards where they exist. This means:

- Devices used in control circuits shall comply with IEC 947–5.
- Devices used as motor controllers shall comply with IEC 947–3 or 947–4.
- Devices used as disconnecting devices shall comply with IEC 947–3.

With regard to "supply " disconnecting devices, IEC 204 requires that a hand operated disconnecting device be provided for each incoming supply. Additionally, the supply disconnecting device shall be one of the following types:

- A switch–disconnector (see Appendix A for definition), meeting the requirements of IEC 947–3, utilization category AC–23B or DC–23B.
- A disconnector (see Appendix A for definition) which has an auxiliary contact which in all cases causes switching devices (contactors for example) to break the load circuit before the main contacts of the disconnector open.
- A circuit breaker in accordance with IEC 947–2, suitable for isolation in accordance with IEC 947–3.

Additionally, the disconnecting device must have:

- One ON and one OFF position, clearly marked with the symbols "I" and "O".
- A visible gap or a position indication (ON/OFF) which cannot indicate OFF until all contacts are actually open, and isolating distances in accordance with IEC 947–3 are met.
- An external operating handle, black or grey in color unless the disconnector serves as an emergency stop device.
- A means of padlocking the switch in the OFF position.
- A breaking capacity sufficient to interrupt the current of the largest motor when stalled, plus the sum of the normal running currents of all other loads.

Control switches, load switches and fusible disconnect switches carry the appropriate ratings and meet the applicable IEC standards so they can all be used as motor controllers in accordance with IEC 204. However, due to the construction, performance and features of control and load switches, they are best suited for use as motor controllers.

Electrical Codes and Installation Requirements
(continued)

Only load break and fusible disconnect switches meet the switch disconnector and disconnector requirements of IEC 947–3 making them suitable for use as supply disconnecting devices as defined by the requirements of IEC 204.

Typical Applications

Based on the discussion of applicable standards and electrical codes and installation requirements, one could conclude that control switches, load switches, and fusible disconnect switches can be used interchangeably in a very wide variety of applications. With a couple of exceptions as previously noted, these switches can be used interchangeably, but a user's satisfaction with the performance of the switch may vary greatly depending on the application. Following is an overview of typical applications for control, load break, and fusible disconnect switches. A summary of typical applications by switch type can be found in Table B.

Control Circuit Applications

Control circuit applications include the programmed sequence of opening and closing contacts. Control circuits are typically low voltage applications (120V and below), however, higher voltages are used at times (for example, a common control circuit in a typical starter application). Additionally, the current levels in control circuits are generally low, sometimes in the milliampere range. Control circuits typically include energizing solenoids, pilot lights, valves, actuators, starters, relays, instrumentation (ammeter and voltmeter switches) and alarms. Finally, the duty cycle of control circuit devices can be high, hundreds of operations per hour, and total number of operations that devices in control circuits are expected to operate is typically in the hundreds of thousands.

Manual Motor Controller Applications

Manual motor controller applications include the switching (energizing and de–energizing) of motors. The configuration and modularity of control and load break switches makes them well suited for across the line, reversing, two speed, and reduced voltage motor starting applications. However, special attention must be paid to utilizing a separately installed overload relay for overload protection and providing some means of undervoltage protection so that the motor doesn't automatically restart after a power outage. Manual motor controllers are often used in applications up to 600V and 100A. The duty cycle and expected life of manual motor controllers can be similar to control applications, but are typically less severe: duty cycles of ten or twenty operations per hour are common and expected life is up to one hundred thousand operations. Finally, available short circuit fault currents in motor circuits are generally in the 3,000 to 10,000 ampere range for motors with up to 100 ampere full load currents, but can be significantly higher, especially in installations in new facilities.

Typical Applications
(continued)

Control Panel Disconnect and Distribution Applications

Control panel disconnect, motor circuit isolation, and distribution applications include the use of disconnecting devices for supplying current to a single motor starter, group of motor starters, a group of mixed loads (motors and resistive loads), a group of machines or control panels, or a portion of a plant. Typical voltages of control panel disconnect and distribution applications are 380V and greater.

Application currents are also generally much higher than control circuit or manual motor controller applications. The minimum size of disconnecting devices in control panel and distribution applications is typically 30A; application currents up to 400 amperes or more are common.

The duty cycle and expected operating life of disconnecting devices in these applications are significantly lower than those of manual motor controllers and control circuit switches. Control panel and distribution switches are operated infrequently, sometimes only once per day or even less. The lower duty cycle results in a lower expected life, generally in the thousands of operations, usually not more than ten thousand. The other distinguishing characteristic of control panel and distribution applications is the available short circuit current which can be as high as 80,000 amperes or more.

Table B - Typical Applications

Voltage	120V and less	Up to 660V	Up to 660V
Operating Current	10A and less	1A to 100A	20A to 400A
Duty Cycle	per hour	per hour	1-2 operations per day
Expected Life	100,000 operations	100,000 operations	10,000 operations
Available Short Circuit Current	1kA	3kA to 25kA	80kA to 100 kA

Application Specifications

To obtain maximum satisfaction with the type of switch (control switch, load break switch, fusible disconnect switch) selected for any given application, the following application specifications should be carefully considered. Only after considering each application, can the appropriate switch be selected. It is also important to note that some switch characteristics are mutually exclusive – for example, achieving a 80,000 ampere short circuit withstand rating, 100,000 operation electrical endurance, in a 45mm (1.8") wide device isn't possible with traditional electromechanical switching devices. A summary of product features and construction can be found in Table C.

Electrical and Mechanical Endurance Requirements

In applications that require switches with an electrical and mechanical endurance of greater than 10,000 operations, control and load switches are best suited for the application. They are typically capable of performing 100,000 electrical operations and as many as 10 million mechanical operations.

Fusible disconnect switch standards require that devices achieve up to 6,000 electrical operations, and 10,000 mechanical operations. This shorter life requirement is due to the type of application where they are typically utilized – applications that may only require that the switch is operated once a day or less.

Short Circuit Withstandability

The available short circuit fault current in the application is a key parameter in the selection of the proper switching device. Most control and load switches are only capable of withstanding short circuit fault currents of 3kA to 25kA when properly protected by some sort of short circuit protective device (a fuse or circuit breaker).

Fusible disconnect devices on the other hand, often times have short circuit withstand ratings of 80kA or greater, some as high as 200kA. The higher short–circuit withstand rating of fusible disconnect switches is again, a result of where they are typically used – as main disconnecting devices in applications with groups of loads, groups of machines, or as distribution feeders to sections of plants. Many fusible disconnect switches function as the main disconnecting means from the electrical supply entering a facility. The closer a switch gets to the main incoming supply, the higher the available fault current that the switch can be subjected to.

Fusible versus Non–Fusible Devices

A requirement to have fuses installed directly on the switch is an application parameter that provides some guidance in selecting a switch for a given application. Control and load switches are generally non–fusible type devices. Fuses must be installed separately from the switch – which can increase the total installed cost of the control panel because of extra drilling and tapping operations to secure the fuse block on the enclosure mounting panel and the cutting and stripping of wires that are required between the switch and separate fuse block.

Application Specifications
(continued)

Fusible disconnect switches are generally available in fusible as well as non–fusible constructions. Fuses can be installed directly on–board the switch, reducing the installed cost of the control panel because less drilling and tapping is required and no inter–wiring is required.

Environmental Conditions

All installation standards require that control, load, and fusible disconnect switches be installed in appropriate enclosures for the environment. Product standards include electrical clearance and creepage requirements for various environments too. However, some product standards require larger electrical clearances – making them very well suited for severe environments. Control, load, and fusible disconnect switches all meet the minimum electrical spacing requirements for typical industrial applications. However, fusible disconnect switches meeting the requirements of UL 98 or UL 1087 have larger electrical clearances than other industrial control equipment. These larger clearances can provide superior performance in applications where there is high humidity and excessive dust in the air. The combination of humidity and settling dust on equipment increases the possibility of phase–to–phase and phase–to–ground faults. In addition, a fault could occur from a loose strand of a conductor accidentally being grounded or touching another phase. The larger the spacings of fusible disconnect devices, the lower the likelihood of experiencing these faults.

Service Entrance Requirements

North American electrical codes have specific requirements for disconnecting means that are connected directly to the electrical supply from the utility (incoming supply from a substation or transformer). The codes require that these switches meet “Service Entrance” requirements. The primary distinguishing feature of switches meeting service entrance requirements is that they have larger clearances than other industrial control equipment. These larger spacings are 25.4 mm (1 inch) through air and 50.8 mm (2 inches) across surface for devices rated greater than 300V.

Typically, only fusible disconnect switches designed in accordance with UL 98 or UL 1087 satisfy these spacing requirements – and are the only types of switches suitable for installation in service entrance applications.

Enclosure Construction and Panel Layout

Enclosure construction and preferred panel layouts may also influence the type of switch selected for an application. Some applications require that the switch be installed on the door or side panel of an enclosure. The advantage of installing the switch on the door or side panel is that the switch can always be operated, even with the door of the enclosure open. A second advantage is that it does free some enclosure panel mounting panel area for the installation of other components (for example starters, control relays, and terminal blocks). The disadvantage of this type of installation is that the enclosure door can generally be opened without operating or defeating any type of interlock, so the enclosure door can be opened by unauthorized personnel while power is still being supplied to the switch. Additionally, with this

Application Specifications
(continued)

installation method, components are energized on the enclosure door when the door is open – live components can cause danger to personnel working in the area of the control panel. Control and load switches offer the greatest installation flexibility and can be installed on the enclosure door and side panel.

Some installation codes and standards prohibit power on the enclosure door in excess of 120V. For those applications, installing the switch on the enclosure mounting panel is the only way to comply with the installation code. Main disconnecting devices have traditionally been installed on the enclosure mounting plate because it keeps higher voltages away from personnel, and it also simplifies wiring as the main disconnecting devices typically "feed" a number of other panel components. Control, load, and fusible disconnect switches can all be installed on the enclosure mounting plate.

Enclosure Door Interlocking and Padlocking Requirements

Safety to personnel working on control panels or machinery associated with control panels should also have an influence on the type of switch selected for an application. Safety can be enhanced by the ability to padlock switches in the "OFF" condition, and interlocking between the enclosure door and disconnect switch.

Control, load, and fusible disconnect switches can generally all be padlocked in the "OFF" positions. However, control and load switches typically require that a special operating handle be purchased to obtain padlocking functionality. Operating handles for fusible disconnect switches are typically supplied as standard with a padlocking feature.

Interlocking between the enclosure door and disconnect switch (when the switch is installed on the enclosure mounting panel) also enhances safety in an application. When interlocking is provided, personnel trying to gain access to the enclosure must take specific actions to gain entry into the enclosure – helping to ensure that only authorized personnel have access to the equipment inside the enclosure. When the disconnecting device is in the "OFF" position, interlocking is generally only provided by fusible disconnect switches. All types of switches generally provide interlocking in the "ON" position. Many fusible disconnect switches also provide a means of defeating the interlock when the switch is "ON", so that service personnel can gain access to the control panel to take voltage or current measurements, make adjustments, or trouble shoot. In all cases a tool, typically a screwdriver, is required to defeat the interlock when the switch is in the "ON" position.

Application Specifications
(continued)

Range of Product Ratings

Often times it is important to utilize a family of products in a control panel so that product features, method of installation, and appearance are all similar. This requirement makes the range of product ratings available with each type of switch important. Following are typical ranges of each type of switch, certainly there are exceptions, with higher and lower current ratings being available from some manufacturers:

- Control switches are generally available with current ratings from 10A to 25A.
- Load switches are generally available with current ratings from 12A to 100A.
- Fusible disconnect switches are generally available with current ratings from 20A to 400A.

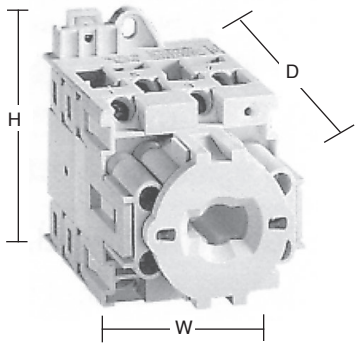
Table C – Product Features/Construction

Electrical Life (operations)	100,000	100,000	6,000
Mechanical Life (operations)	10 million	1 to 1.5 million	10,000
Short Circuit Withstand Rating	3kA to 6kA	5kA to 25kA	80kA to 200kA
Non-Fusible or Fusible Construction	Non-Fusable only	Non-Fusible only	Non-Fusible or Fusible
Meets N. American Service Entrance Requirements	No	No	Yes
Installation Method	Enclosure door or enclosure mounting plate	Enclosure door or enclosure mounting plate	Enclosure mounting plate
Door Interlocking Provided	“ON” position only	“ON” position only	“ON” and “OFF” position
Operating handle can be padlocked “OFF”	Special handle must be purchased	Special handle must be purchased	Provided as standard
Range of product ratings available	10A to 25A	12A to 100A	20A to 400A

Application Specifications
(continued)

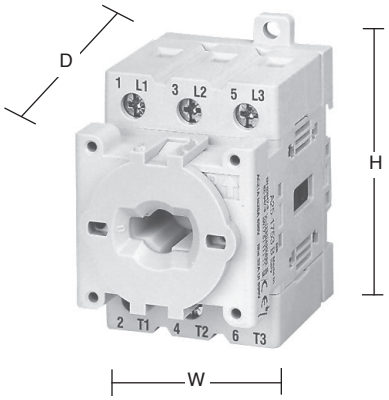
Switch Panel Area Requirements

There is a significant difference in the physical size and panel area requirements of the various types of switches described in this document. The difference in size reflects the differences in performance and construction (for example fusible versus non–fusible) of these devices. Typical dimensions of control, load, and fusible disconnect switches are as follows:



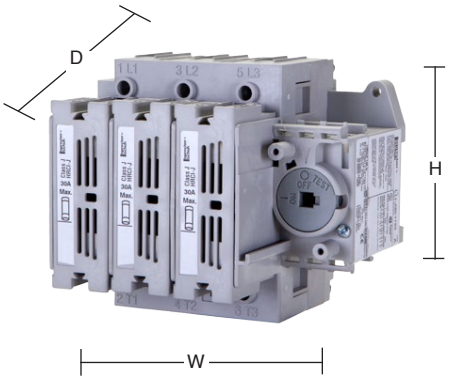
Type L2 Control Switch
3 pole, 20A
Front or base mounting

H	W	D
50 (1-31/32)	49 (1-15/16)	71.5 (2-13/16)



Type L7 Load Switch
3 pole, 20A
Front or base mounting

H	W	D
70 (2-13/16)	45 (1-7/8)	64 (2-5/8)



Type L11 Fusible Switch
3 pole, 30A
Base mounting

H	W	D
108 (4-1/4)	120 (4-3/4)	101 (4)

Conclusion

As described in the previous sections of this document, there are some major differences in the performance, construction, and benefits that can be realized with the different types of switches that can be used as disconnect devices: control switches, load break switches, and fusible disconnect switches. The proper selection of a disconnect device can only be achieved after carefully evaluating the application requirements. Local installation codes and standards requirements must be considered and complied with first and foremost. Secondly, duty cycle, expected life, available short circuit fault current, enclosure construction, fusible or non–fusible construction, service entrance requirements, door interlocking and padlocking requirements, and product range must be considered. Control switches, load switches, and fusible disconnect switches can all be applied effectively when carefully selected for each application.

Appendix A

U.S. National Electrical Code (NEC) Definitions

General–Use Switch:
A switch intended for use in general distribution and branch circuits. It is rated in amperes, and it is capable of interrupting its rated current at its rated voltage.

Motor–Circuit Switch:
A switch rated in horsepower, capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage.

IEC 947–3 Definitions and Utilization Categories

Disconnector:
A mechanical switching device which, in the open position, complies with the requirements specified for the isolating function.

Switch–Disconnector:
A switch which, in the open position, satisfies the isolating requirements specified for a disconnector.

Switch (mechanical):
A mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions, which may include specified operating overload conditions and also carrying, for a specified time, currents under specified abnormal circuit conditions such as those of a short–circuit.

Appendix B

Utilization Categories

The utilization categories define the intended application of the switching device and are given in the following tables. The designation of utilization categories is completed by the suffix A or B according to whether the intended application requires frequent or infrequent operation.

Utilization Categories from IEC 947–3 applicable to load break and fusible disconnect switches.

AC	AC-21A	AC-21B	Switching of resistive loads including moderate overloads
	AC-22A	AC-22B	Switching of mixed resistive and inductive loads including moderate overloads
	AC-23A	AC-23B	Switching of motor loads or other highly inductive loads
DC	DC-21A	DC-21B	Switching of resistive loads including moderate overloads
	DC-22A	DC-22B	Switching of mixed resistive loads and inductive loads, including moderate overloads (e.g., shunt motors)
	DC-23A	DC-23B	Switching of highly inductive loads (e.g., series motors)

① Switch with operating current ratings up to 100A must achieve 10,000 mechanical operations.
② Switch with operating current ratings up to 100A must achieve 2,000 mechanical operations.

Utilization Categories from IEC 947–4 applicable to control and load switches.

Current	Utilization Category	Typical Applications
AC	AC-1	Non-inductive or slightly inductive loads; resistive furnaces
	AC-2	Slip-ring motors; starting, switching off
	AC-3	Squirrel Cage motors; starting, switching off motors while running
	AC-4	Squirrel Cage motors; starting, plugging, inching
DC	DC-1	Non-inductive or slightly inductive loads; resistive furnaces
	DC-3	Shunt motors; starting, plugging, inching and dynamic braking of DC motors
	DC-5	Series-motors; starting, plugging, inching and dynamic braking of DC motors

Appendix B
(continued)

Utilization Categories - (Continued)

Utilization Categories from IEC 947–5 applicable to control switches.

Current	Utilization Category	Typical Applications
AC	AC-12	Control of resistive loads and solid state loads with isolation by opto couplers
	AC-13	Control of solid state loads with transformer isolation
	AC-14	Control of small electromagnetic loads (≤72VA)
	AC-15	Control of electromagnetic loads (≥72VA)
DC	DC-12	Control of resistive loads and solid state loads with isolation by opto couplers
	DC-13	Control of electromagnets
	DC-14	Control of electromagnetic loads having economy resistors in circuit

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Manual Switching Devices
Which is best for your application?

tech-lmsd_v217 10/2017

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Today, Sprecher + Schuh offers a wide range of low-voltage industrial control products, including contactors, a variety of relays, starters, push buttons, switches, terminals and controllers, to name a few. All of our products are crafted with precision and tested rigorously for performance — far exceeding industry standards. Moving forward, we continue along the path of constantly seeking innovative ways to provide solutions for our customers. It is by this philosophy that Sprecher + Schuh has come to be the industrial control manufacturer of choice for many customers around the globe seeking quality, reliability, and a name they can trust.