Instruction Leaflet **IL008064EN**

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Operation and maintenance information for safety switches: general duty, heavy duty, and double throw

Contents

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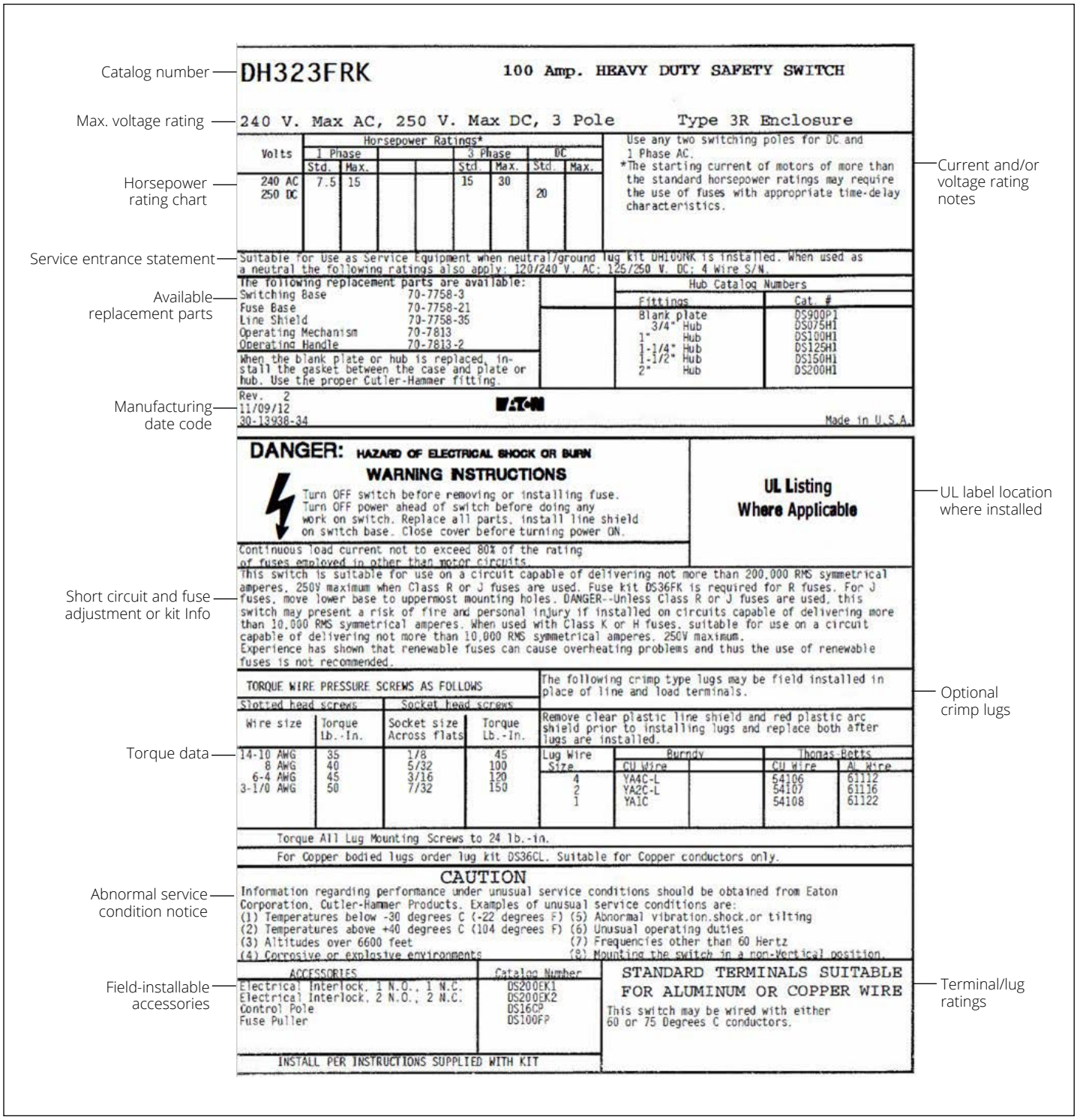


Figure 1. Label for 100 A heavy-duty safety switch

Voltage ratings

Maximum AC voltage ratings for each switch are outlined on the switch's publication. Where DC voltage ratings are applicable, they are noted separately from the AC rating.

The standard maximum voltage ratings are outlined in **Table 1** for safety switches. The publication inside the switch will ultimately determine the switch's maximum voltage rating.

Table 1. Standard maximum voltage ratings

Switch type	Maximum AC rating (with neutral installed)	Maximum DC rating
General duty	240 Vac (120/240 Vac)	250 Vdc
Heavy duty, 240 V	240 Vac (120/240 Vac)	250 Vdc
Heavy duty, 600 V, two-pole	600 Vac (277/480 Vac, 600 Vac)	600 Vdc ①
Heavy duty, 600 V, three+ pole, fusible ②	600 Vac (277/480 Vac, 600 Vac)	—
Heavy duty, 600 V, three+ pole, non-fusible (NF) ②	600 Vac (277/480 Vac, 600 Vac)	250 Vdc
Double throw, 240 V	240 Vac (120/240 Vac)	250 Vdc
Double throw, 600 V	600 Vac (277/480 Vac, 600 Vac)	250 Vdc

① 600 Vdc rating requires two switching poles to be wired in series. Two-pole, 600 V rated heavy-duty safety switches come with a factory-installed jumper between two switching poles, making the two-pole switch capable of interrupting one 600 Vdc circuit. For additional DC options, refer to Eaton's line of DC solar switches. Heavy-duty switches over 600 A are not listed for 600 Vdc applications.

② For three+ pole switches, any two of the switching poles can be used for either DC or single-phase AC applications.

Figure 2. Sample two-pole 600 V heavy-duty safety switch

For a 600 Vdc rating, the first two poles are wired in series with a factory-installed jumper as shown in **Figure 2**. Only the circuit connected to the line and load lugs of these poles wired in series are rated for 600 Vdc.

The 600 Vdc rating is only applied to two-pole, 600 V rated heavy-duty safety switches.

Enclosure ratings

The safety switch enclosure rating listed on the publication is both the UL® and NEMA® environmental rating of that switch.

Single-throw switches listed as Type 12 (3R) can be used as either depending on the installation of the factory-installed drain screw in the bottom end-wall. Type 12 (3R) switches come from the factory as Type 12; if being used as Type 3R, the drain screw should be removed in the field.

Installation of appropriately rated conduit entry hubs or fittings does not impact the enclosure rating of the switch when installed in accordance with the hub manufacturer's instructions. (Example: Type 4X rated hub installed on a Type 4X safety switch enclosure.)

The listing of acceptable hubs on the publication and in Eaton's Commercial Distribution catalog are not exhaustive of acceptable conduit entry fittings. Appropriately rated fittings from other manufacturers can be installed on Eaton safety switches.

Amperage ratings and continuous load current

Non-fusible safety switches are 100% rated devices.

Fusible switch current ratings are limited to 80% of the rating of the fuse for continuous loads other than motor circuits. This limitation applies even when "100% rated" Class L fuses are installed. The NEC® allows the switch size calculation to use up to 100% of the fuse rating for non-continuous loads.

Horsepower ratings

Where horsepower ratings are applicable for a given switch, the maximum horsepower ratings are included in a table on the switch publication for all applicable voltage ratings. Maximum horsepower ratings are based on standard squirrel cage motors as outlined in the NEC motor tables.

The "Standard" column notes the maximum horsepower rating of the switch using "standard" fuses and the "Maximum" column outlines the maximum horsepower rating of the switch when time-delay fuses are installed (see **Table 2**).

Table 2. Horsepower ratings

	Horsepower rating ①			
	Single-phase		Three-phase	
Volts AC	Standard	Maximum	Standard	Maximum
480	25	50	50	125
600	30	50	60	150

① These values are examples; see published ratings on your switch.

Horsepower ratings for safety switches account for typical starting currents (inrush) and potential locked rotor current demands for typical motors. The starting current of motors of more than the standard horsepower ratings may require the use of fuses with appropriate time-delay characteristics.

The UL 98 standard for enclosed switches states that the switch is not to be used as the motor controller over 100 hp. Additionally, the largest horsepower ratings included in the UL 98 standard for switches is 250 hp at 240 V and 500 hp at 480 V or 600 V.

Service entrance requirements

At and below 800 A, all heavy-duty, general-duty, and double-throw safety switches are rated for service entrance when a neutral kit is installed. Switches with factory-installed neutrals will be marked "Suitable for Use as Service Equipment". If the switch does not ship with a factory-installed neutral, the publication inside the switch will state which neutral kit would need to be field installed to make the switch suitable for service entrance.

All neutral kits, whether factory or field installed, will include neutral lugs, bonding kit, and service disconnect sticker for field application when being used as the service entrance disconnect. Grounding lugs are included in safety switches as a standard.

At 1200 A, heavy-duty and double-throw switches cannot be service entrance rated for many applications including 480 Vac where ground fault protection is required. Additionally, there is a requirement for arc energy reduction in 1200 A fusible devices in some areas, which is often supplemental to the overcurrent or short-circuit protection afforded by fuses. Eaton has a separate line of shunt trip safety switches with integral arc-energy reduction and ground fault protection relay options for these service entrance applications.

Line shields

A clear plastic line shield is provided in heavy-duty type switches including heavy-duty type double-throw switches to help prevent incidental contact with incoming line conductors. Line shields are an optional accessory for 200–600 A general-duty safety switches.

Grounding

All Eaton safety switches are provided with standard ground lugs. Optional ground lug kits are available to increase the grounding capacity and can be field or factory installed. The concentric and eccentric knockout rings on a safety switch are not UL listed for a reliable bonding connection. Grounding and bonding lugs are included with factory or field-installable neutral assemblies.

Replacement parts

Some replacement parts are outlined on the publication inside the switch. Where replacement parts are available, they can be replaced in the field, provided proper electrical safety procedures are followed to ensure an electrically safe work environment. Replacement parts are not approved for modifying the original configuration of a safety switch as this would violate the UL listing of the switch.

Additional replacement parts or updated catalog numbers may be available in Eaton's Safety Switch Renewal Parts Guide, publication number RP00801001E.

Short-circuit ratings (fusible and non-fusible)

Non-fusible safety switches may be used on circuits capable of delivering no more than 10,000 rms symmetrical amperes (AC) when properly protected by any overcurrent protective device rated no greater than the ampere rating of the switch. **Table 3** can be used to determine when upstream protection allows the switch to be applied in a circuit capable of delivering more than 10,000 rms symmetrical amperes.

Table 3. Upstream protection application

Eaton non-fusible safety switch ampere rating ①	Max. system voltage AC	Max. short-circuit rating	Upstream device ②		
			Fuse class	Breaker frame Series C/G	Power Defense™
30 and 60	600	10,000	H, K	Any circuit breaker	
		14,000		FDB	PDG2xF
		18,000		FD, EGE	PDG1xF, PDG2xG
		25,000		FDC, HFD, HFDE, EGH	PDG1xM, PDG2xM, PDG2xP
		200,000	R, T, J, L		
100	480	10,000	H, K	Any circuit breaker	
		35,000		EGH, EGS	PDG1xG, PDG1xM
		200,000	R, T, J, L		
	600	10,000	H, K	Any circuit breaker	
		14,000		FDB	PDG2xF
		18,000		FD, EGE	PDG1xF, PDG2xG
		25,000		FDC, HFD, HFDE, EGH	PDG1xM, PDG2xM, PDG2xP
		200,000 ③	R, T, J, L		
200	480	10,000	H, K	Any circuit breaker	
		65,000		HFD, HFDE, HJD, JGH	PDG2xM
		200,000	R, T, J, L		
	600	10,000	H, K	Any circuit breaker	
		14,000		FDB	PDG2xF
		18,000		FD, JD, JGE	PDG2xG
		25,000		FDC, HFD, HFDE, HJD, JGH	PDG2xM, PDG2xP
		200,000	R, T, J, L		
400	480	200,000	R, T, J		
	600	10,000	H, K	Any circuit breaker	
		100,000	R, T, J		
600	480	200,000	R, T, J		
	600	10,000	H, K	Any circuit breaker	
		100,000	R, T, J		
800	480	200,000	L, T		
	600	10,000		Any circuit breaker	
		100,000	L, T		
1200	480	200,000	L, T		
	600	10,000		Any circuit breaker	
		100,000	L, T		

① For use on NEMA 1, 3R, 12/3R, and 4X switches.

② Fuse or circuit breaker rating is not to exceed switch rating.

③ NEMA 12, 4/4X only. NEMA 1, 3R are 100 kAIC at 600 Vac.

Fusible switches are suitable for use on circuits delivering up to 100,000 rms symmetrical amperes (AC) or 200,000 rms symmetrical amperes (AC) depending on the configuration and voltage when the appropriate Class R, J, L, or T fusing is installed. The maximum short-circuit rating of a fusible switch will be noted on the publication.

For general duty, heavy duty (30–600 A), and double throw (30–200 A and 400 A at 240 V), Class "H" fuse clips are supplied as the standard. When Class "H" fuses are used, the switch is rated for a maximum of 10,000 A symmetrical.

DC short-circuit ratings

Safety switches are suitable for use in DC circuits capable of delivering not more than 10,000 A direct current when protected by any UL listed or recognized overcurrent protective device. Fusible switches used in DC applications are also rated for 10 kA provided the installed fuse carries the appropriate DC voltage rating.

Fuse kits and provisions

Fusible safety switches are provided with provisions to accept one class and voltage rating of fuses. Where fuse sizes are differentiated based on maximum voltage rating, the fuse provisions in the safety switch will accommodate fuses with the same maximum AC voltage rating as the switch. **Table 4** outlines the standard fuse provisions for safety switches in addition to optional fuse provisions that can be achieved by reconfiguring the switch or by the installation of an optional kit.

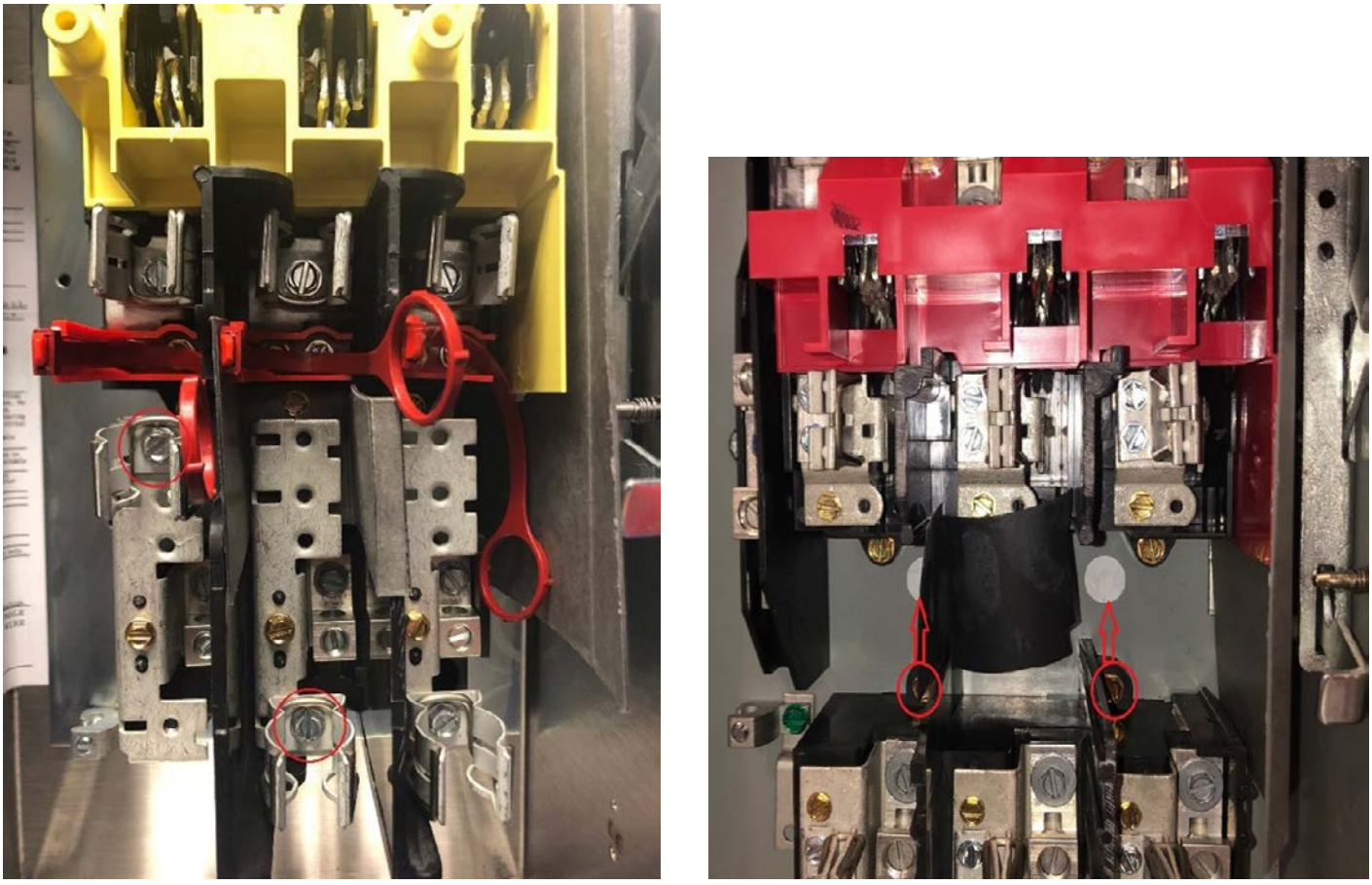
Table 4. Standard fuse provisions for safety switches

Ampere rating	Voltage	Standard factory fuse class ①	Optional R fuse kit ②	Optional T fuse kit	Optional J fuse kit
General-duty (DG) switches fuse class					
30	240	H	**DG030RB**	N/A	N/A
60	240	H	**DS16FK**	N/A	N/A
100	240	H	**DG100RB**	N/A	N/A
200	240	H	**DS46FK**	N/A	N/A
400	240	H	**DS56FK**	**DS526TK**	N/A
600	240	H	**DS66FK**	**DS626TK**	**DS600JK**
Heavy-duty (DH) switches fuse class					
30	240	H	**DS12FK**	N/A	Factory option only
30	600	H	**DS16FK**	N/A	Factory option only
60	240	H	**DS16FK**	N/A	**DS22JK**
60	600	H	**DS26FK**	N/A	Relocate clips ③
100	240/600	H	**DS36FK**	N/A	Relocate base ③
200	240	H	**DS46FK**	**DS426TK**	Relocate base ③
200	600	H	**DS46FK**	**DS466TK**	Relocate base ③
400	240	H	**DS56FK**	**DS526TK**	Relocate base ③
400	600	H	**DS56FK**	**DS566TK**	Relocate base ③
600	240	H	**DS66FK**	**DS626TK**	**DS600JK**
600	600	H	**DS66FK**	**DS666TK**	**DS600JK**
800	240	L	N/A	**DS726TK**	N/A
800	600	L	N/A	**DS766TK**	N/A
1200	240	L	N/A	Relocate bases	N/A
1200	600	L	N/A	N/A	N/A
Double throw (DT) switches fuse class					
30	240	H	**DS12FK**	N/A	Factory option only
30	600	H	**DS16FK**	N/A	Factory option only
60	240	H	**DS16FK**	N/A	Factory option only
60	600	H	**DS26FK**	N/A	Relocate bases ③
100	240/600	H	**DS36FK**	N/A	Relocate bases ③
200	240/600	H	**DS46FK**	N/A	Relocate bases ③
400	240	H	**DS56FK**	N/A	Relocate bases ③
400	600	T	N/A	Standard	**DT400JK**
600	240 (stacked = N1/N3R)	J	N/A	**DT626TK**	Standard
600	600 (stacked = N1/N3R)	J	N/A	**DT666TK**	Standard
600	240 (N12/N4X)	T	N/A	Standard	N/A
600	600 (N12/N4X)	T	N/A	Standard	N/A
800	240	L	N/A	**DS726TK**	N/A
800	600	L	N/A	**DS766TK**	N/A
1200	240	L	N/A	N/A	N/A
1200	600	L	N/A	N/A	N/A

① Where Class H is indicated, Class R fuses will physically fit and can be installed.

② Class R fuse kits are used to reject Class H fuses, and allow only Class R fuses to be installed.

③ Relocation of fuse clips or fuse bases as required to achieve Class J fuse spacing. Class J fuse spacings are illustrated in **Figure 3**.



Photos show how fuse clips should be moved from the standard lower position for Class H fuse spacing to the upper mounting location for Class J fuse installation.

Figure 3. Relocation of fuse clips or fuse bases

Experience has shown that renewable fuses can cause overheating problems and their use is not recommended in safety switches.

Standard lug information

Standard mechanical lugs included in safety switches are suitable for aluminum or copper wire, wire strand Class B and C. Select terminals are acceptable for fine stranded cable; see Eaton publication IL008004EN for more information on the suitability of fine stranded cable. Wire sizing should be based on 60 °C or 75 °C (140 °F or 167 °F) conductor ratings only. The torque values for wire pressure in the provided mechanical lugs is outlined based on switch ampere rating in **Table 5** and **Table 6.**

Table 5. Torque for wire pressure screws 30–1200 A (general duty, heavy duty, and double throw)

Slotted head screws		Socket head screws	
Wire size	**Torque lb-in**	**Socket size across flats**	**Torque lb-in**
14–10 AWG	35	1/8	45
8 AWG	40	5/32	100
6–4 AWG	45	3/16	120
3–1/0 AWG	50	7/32	150
		1/4	200
		5/16	275
		3/8	375
		3/8 (400 A only)	500
		1/2	500

Table 6. Torque for lug mounting screws

Ampere rating	Lug description	Torque value
30–100	All lug mounting screws	24 lb-in
200	Line and load lug mounting screws	8 lb-ft
200	Ground lug mounting screws	24 lb-in
400–1200	Line and load lug mounting screws	29 lb-ft
400–1200	Ground lug mounting screws	45 lb-in

Alternative lug options

Crimp lugs may be field installed in place of the standard mechanical type line and load terminals in some safety switches where outlined by the switch's publication. Suitable crimp lug manufacturer and part numbers are tabulated on the publication. Installation of these crimp lugs ensures that proper mounting and anti-rotation can be retained. Copper wire must be used when crimp lugs are installed.

Some larger, heavy-duty safety switches that allow for the installation of crimp lugs also require a crimp lug landing pad kit. If this kit is required, its part number is outlined on the publication.

For applicable switches, the installation of crimp lugs requires the removal of the clear plastic line shield (where applicable), standard mechanical lugs, and red or yellow plastic arc shield. After installation of the crimp lug, the arc shield and line shield should be re-installed.

Optional copper-bodied mechanical type lugs are available for installation in place of the standard line and load terminals in some switches where outlined by the switch's publication. Copper wire must be used when copper-bodied lugs are installed.

The mechanical lugs provided in safety switches are designed to comply with minimum wire bending space requirements in the enclosure for the maximum conductor capacity allowed by the installed lugs. Alternative lugs with larger than standard capacity are a factory only option as they require oversizing the enclosure to accommodate additional or larger conductors. Installation of alternative or oversized lugs not outlined on the switch's publication would violate the UL listing of the switch.

Mounting and environmental considerations

Information regarding performance under unusual service conditions should be obtained from Eaton. Examples of unusual service conditions are:

- Temperatures below –30 °C (–22 °F)
- Temperatures above 50 °C (122 °F)
- Altitudes over 6600 ft (2011.7 m)
- Corrosive or explosive environments
- Abnormal vibration, shock, or tilting
- Unusual operating duties
- Frequencies other than 60 Hz
- Mounting the switch in a non-vertical position

Generally, the enclosure should be mounted on a flat surface or the mounting must be shimmed; the mounting points must be co-planar. For NEMA 3R applications, the enclosure needs to be level to ensure proper draining of any condensation or collected moisture through the drain hole on the bottom end wall of the enclosure.

Field-installable accessories

The installation of accessories listed on the publication does not impact the UL listing of the switch. Examples of normal field-installable accessories include:

- Neutral kits
- Electrical interlock (auxiliary contacts)
- Control poles
- Fuse pullers
- Bonding kits
- Ground lug kits
- Optional fuse kits
- Optional copper-bodied lug kits
- Optional line shields

Each kit should be installed in accordance with the instructions provided with that kit.

The installation of a "Lock-On" provision to allow padlocking a switch in the ON position is available as a factory or field-installable option. When installing the "Lock-On" provision in the field, the locator nib (indention) provided near the top of the shroud protecting the safety switch handle should be used as the center point for drilling out a hole to accommodate a padlock hasp.

Double-throw wiring configurations

Fusible, double-throw switches up to 400 A can be configured in the field for two sources and one load or two loads and one source depending on the location of internal factory-provided jumpers. Should the switch need to be reconfigured, use the wiring diagrams shown in **Figure 4** to change the location of the jumpers.

Standard fusible, double-throw switches rated 600 A and above are configured for two sources and one load only and cannot be reconfigured in the field. A factory only option for two loads and one source applications is available for 600 A and 800 A double-throw switches.

Non-fusible, double-throw switches can be used for two sources and one load or two loads and one source without being reconfigured.

Inspection and preventive maintenance

Additional information regarding the inspection and preventive maintenance of general-duty, heavy-duty, or double-throw safety switches can be found in the NEMA Standard Publication KS 3-2010 *Guidelines for Inspection and Preventative Maintenance of Switches Used in Commercial and Industrial Applications*.

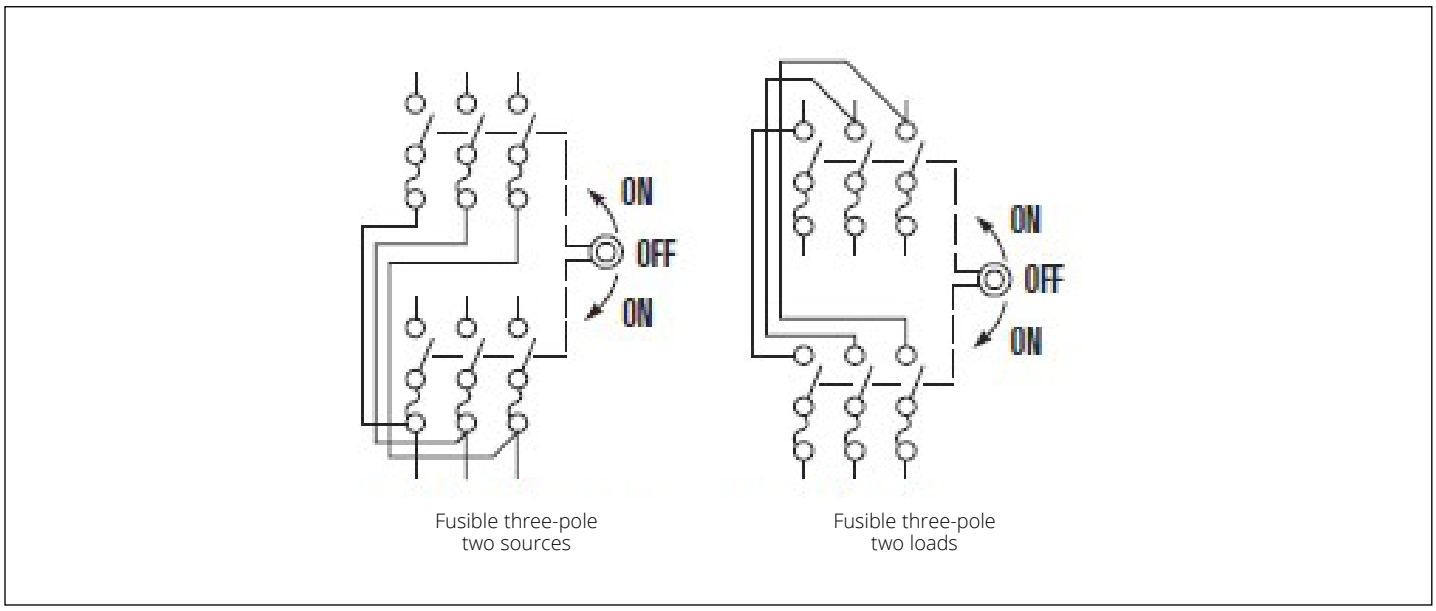


Figure 4. Typical fusible, double-throw schematic diagram

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