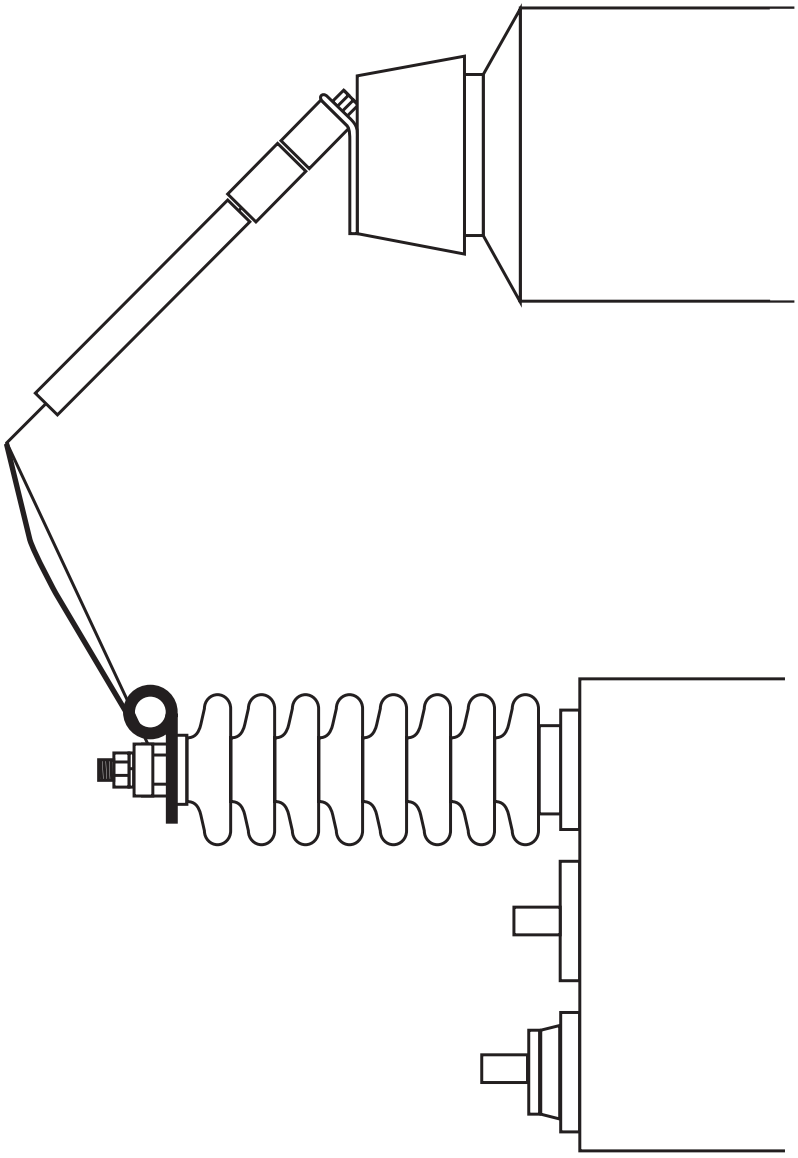
Expulsion fuse installation instructions



Powering Business Worldwide

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Contents

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Eaton's Cooper Power series products meet or exceed all applicable industry standards relating to product safety. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Eaton employees involved in product design, manufacture, marketing and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high-voltage lines and equipment and support our "Safety For Life" mission.

Safety information

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians, who are familiar with this equipment should install, operate and service it.

A competent technician has these qualifications:

- Is thoroughly familiar with these instructions.
- Is trained in industry-accepted high- and low-voltage safe operating practices and procedures.
- Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.
- Is trained in the care and use of protective equipment such as flash clothing, safety glasses, face shield, hard hat, rubber gloves, hotstick, etc.

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Hazard Statement Definitions

This manual may contain four types of hazard statements:

⚠ DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, could result In death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.

Safety instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

⚠ DANGER

Hazardous voltage. Contact with high voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment.

⚠ WARNING

Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage.

⚠ WARNING

This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply may result in death, severe personal injury and equipment damage.

⚠ WARNING

Power distribution equipment must be selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install or maintain this equipment can result in death, severe personal injury, and equipment damage.

Expulsion fuse operation

An expulsion fusing system as used for protecting capacitors consists of three components which include the fuse tube, the fuse link, and the ejector spring (Figure 1). The proper operation of a fuse is dependent upon these components working in close harmony with each other.

Proper assembly of the fusing system is critical to the successful operation of the fusing system whereas incorrect installation may result in severe damage to the fuses, the capacitors, and/or capacitor bank.

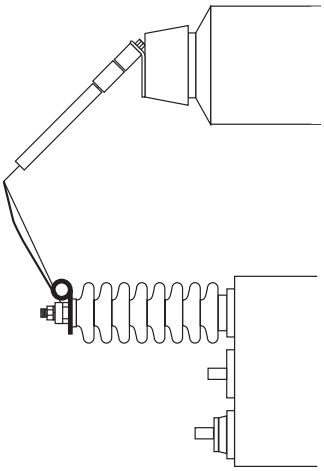

Figure 1. Expulsion fusing system components

When an excessive amount of current flows through the fuse link, the fusible portion of the link melts. This creates an arc where the fuse element was present which maintains a current path through the fuse assembly.

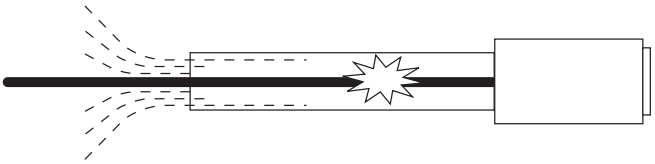

Figure 2. Initial operation of fuse link

The fuse tube is lined with a material which gases freely when heated by the arc. This gas vents through the open end of the fuse tube and forces the severed portion of the fuse link's leader wire towards the end of the tube. Both of these actions assist in the process of arc quenching by lengthening the arc and extinguishing it (Figure 2).

Successful interruption of the circuit will occur when sufficient dielectric strength exists within the gap to prevent re-establishment of the arc once the voltage across the gap begins to build. This interruption occurs either at a system frequency (50 Hz or 60 Hz) current zero or a higher frequency current zero created by the inductance and capacitance of the individual capacitor block.

As the amount of gas generation is dependent upon the amount of current being interrupted, the force with which the leader is ejected from the tube will also vary. Under high energy conditions, the sole purpose of the ejector spring is to control the motion of the ejected leader once it is in free air. For low energy interruptions, the ejector spring also serves to assist in the process of lengthening the arc and becomes an active component in the interruption mechanism of the fusing system.

Each individual capacitor fuse has a specific rating and has been selected based upon the voltage and kvar rating of the capacitor. See **Fuse Tube Ratings** (Table 1) for specific information regarding the interrupting ratings of the fuse tubes. The catalog number of the replacement fuse link, fuse tube, and fuse ejector spring is listed on the index sheet of the capacitor bank instruction manual.

Horizontal fuse installation

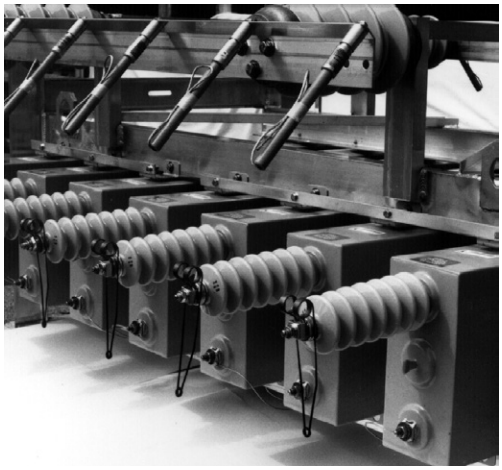

Figure 3.

1. Receiving instructions

Figure 3 illustrates the method used to assemble the fuse prior to shipment of the capacitor bank. The fuse holder, fuse tube, and fuse link are mounted to the fuse bus with the lead wire of the fuse link taped to the fuse tube. This method of shipping prevents damage to the fuse assembly during shipment.

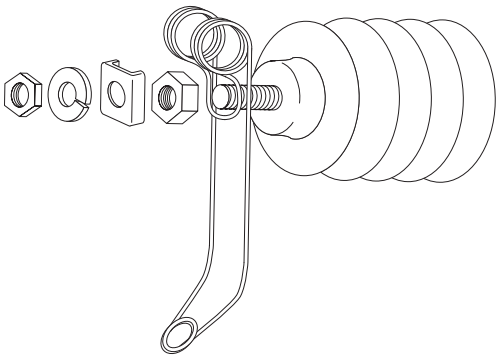

Figure 4.

The ejector spring is mounted to the capacitor terminal, and a heavy hex nut is provided to tighten the ejector spring in place. A clamp, lock washer, and second nut are provided to attach the fuse link lead wire to the capacitor terminal. Figure 4 illustrates the hardware arrangement onto the capacitor terminal.

Note: If the capacitors, fuses and ejector springs are shipped separately to be installed by the customer, all hardware will be included to properly assemble on the capacitor terminal.

2. Ejector spring alignment

The ejector spring and heavy hex nut should be placed on the capacitor terminal in the order shown in Figure 4.

Align the ejector spring horizontally and vertically to achieve two objectives:

A. The ejector spring must move in a true vertical plane as it rotates from its resting position to its working position at the end of the fuse tube.

B. When the ejector spring is rotated up to its working position at the end of the fuse tube, there should be no more than one inch (25.4 mm) from the top of the ejector spring eye to the edge of the fuse tube.

After proper alignment, tighten the inner nut using a torque of 16 to 19 ft-lb (21.7 to 25.8 N-m).

3. Fuse leader assembly

A. Carefully remove the tape from the fuse tube and the leader wire used to secure the wire during shipment.

B. Straighten the fuse link leader such that there are no entanglements (Figure 5).

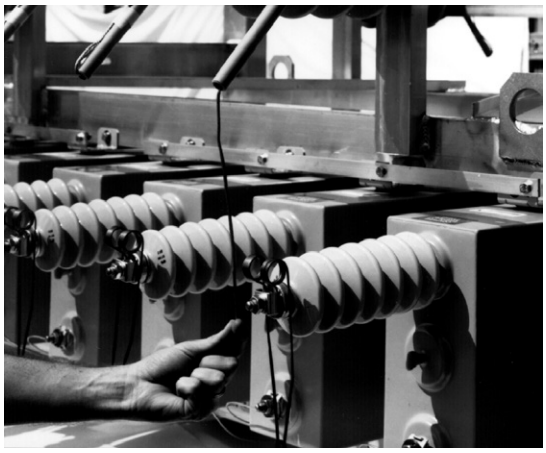

Figure 5.

C. Thread the fuse link lead wire through the eye of the ejector spring as shown in Figure 6. It is important the lead wire be routed over the top of the eye then back through the eye as displayed. Pull the eye of the ejector spring to a point where it touches (or is directly beneath) the end of the fuse tube.

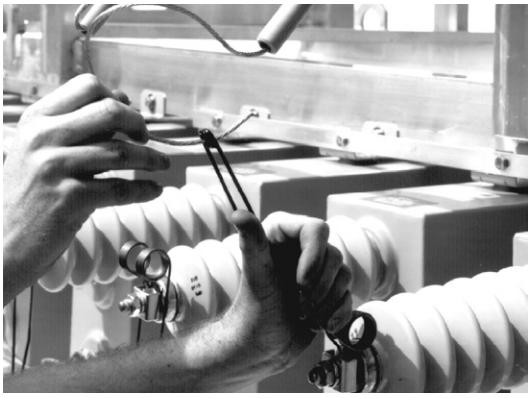

Figure 6.

D. Wrap the end of the fuse link lead wire around the threaded stud of the capacitor terminal (between the heavy hex nut and the clamp) (Figure 7). Place the lock washer on top of the clamp taking care to assure the split in the washer is not aligned with the open end of the clamp. Tighten the outer nut using a torque of 16 to 19 ft-lb (21.7 to 25.8 N-m).

Note: An additional check of the torque may be required after several days. The fuse leader wire may "flow" from the compressed area requiring additional tightening of the outer nut to the proper torque value.

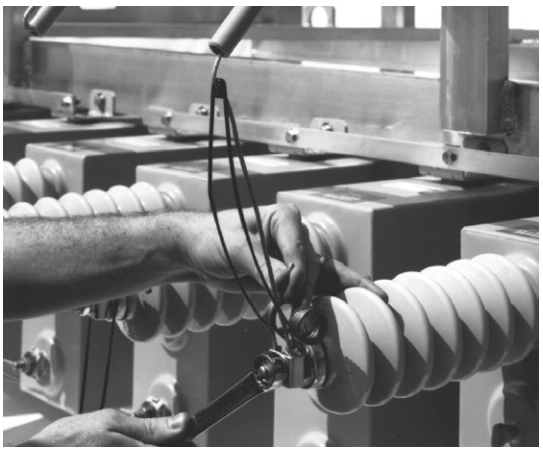

Figure 7.

E. Trim the excess fuse link lead wire (Figure 8). Approximately 3/8 inch (1 centimeter) of lead wire should extend beyond the clamp assembly.

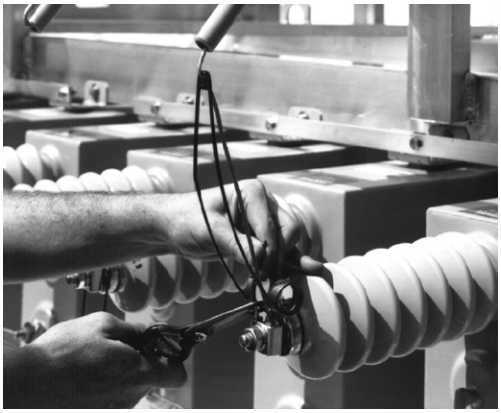

Figure 8.

F. Check the fuse ejector spring for proper working position and alignment.

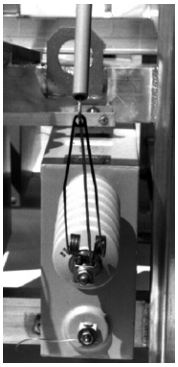

Figure 9.

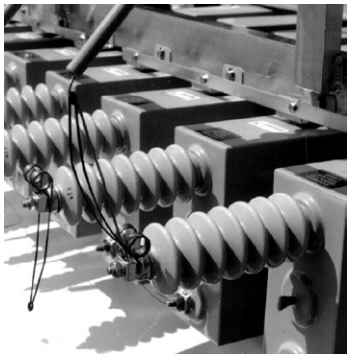

Figure 10.

Vertical fuse installation

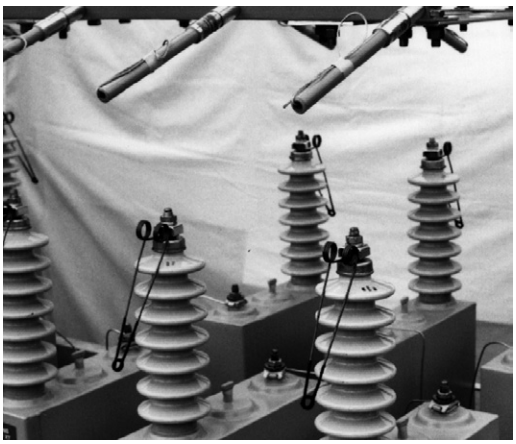

Figure 11.

1. Receiving instructions

Figure 11 illustrates the method used to assemble the fuse prior to shipment of the capacitor bank. The fuse holder, fuse tube, and fuse link are mounted to the fuse bus with the lead wire of the fuse link taped to the fuse tube. This method of shipping prevents damage to the fuse assembly during shipment.

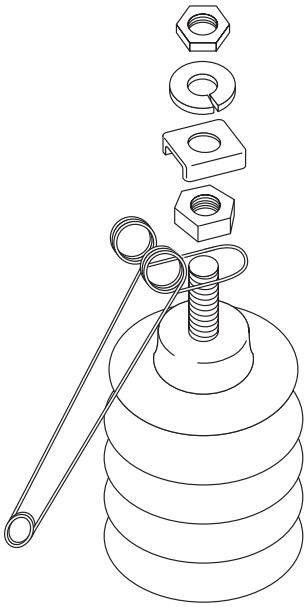

Figure 12.

The ejector spring is mounted to the capacitor terminal, and a heavy hex nut is provided to tighten the ejector spring in place. A clamp, lock washer, and second nut are provided to attach the fuse link lead wire to the capacitor terminal. Figure 12 illustrates the hardware arrangement onto the capacitor terminal.

Note: If the capacitors, fuses and ejector springs are shipped separately to be installed by the customer, all hardware will be included to properly assemble on the capacitor terminal.

2. Ejector spring alignment

The ejector spring and heavy hex nut should be placed on the capacitor terminal in the order shown in Figure 12.

Align the ejector spring horizontally and vertically to achieve two objectives:

A. The ejector spring must move in a true vertical plane as it rotates from its resting position to its working position at the end of the fuse tube.

B. When the ejector spring is rotated up to its working position at the end of the fuse tube, there should be no more than one inch (25.4 mm) from the top of the ejector spring eye to the edge of the fuse tube.

After proper alignment, tighten the inner nut using a torque of 16 to 19 ft-lb (21.7 to 25.8 N-m).

3. Fuse leader assembly

A. Carefully remove the tape from the fuse tube and leader wire used to secure the wire during shipment.

B. Straighten the fuse link leader such that there are no entanglements (Figure 13).

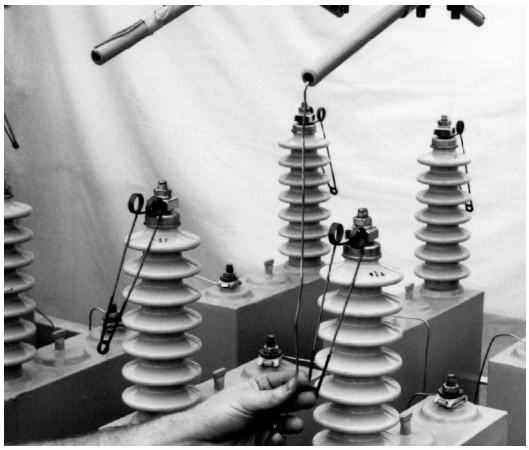

Figure 13.

C. Thread the fuse link lead wire through the eye of the ejector spring as shown in Figure 14. It is important the lead wire be routed over the top of the eye then back through the eye as displayed. Pull the eye of the ejector spring to a point where it touches (or is directly beneath) the end of the fuse tube.

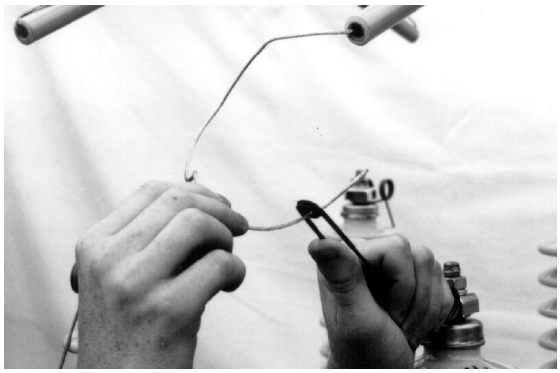

Figure 14.

D. Wrap the end of the fuse link lead wire around the threaded stud of the capacitor terminal (between the heavy hex nut and the clamp) (Figure 15). Place the lock washer on top of the clamp taking care to assure the split in the washer is not aligned with the open end of the clamp. Tighten the outer nut using a torque of 16 to 19 ft-lb (21.7 to 25.8 N-m).

Note: An additional check of the torque may be required after several days. The fuse leader wire may "flow" from the compressed area requiring additional tightening of the outer nut to the proper torque value.

Figure 15.

E. Trim the excess fuse link lead wire (Figure 16). Approximately 3/8 inch (1 centimeter) of lead wire should extend beyond the clamp assembly.

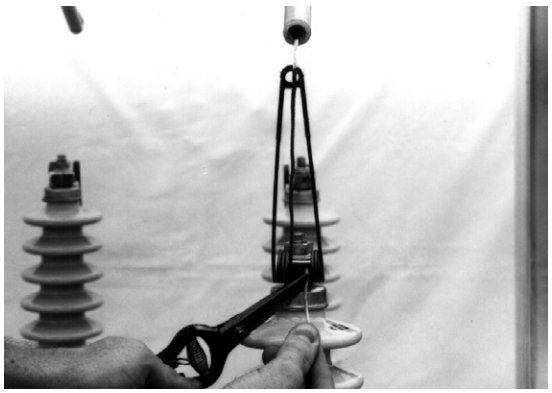

Figure 16.

F. Check the fuse ejector spring for proper working position and alignment.

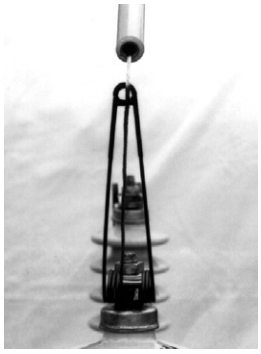

Figure 17.

Figure 18.

Fuse tube ratings

Fuse tube design features

The fuse tube is constructed of bone-grade fiber over-wrapped with epoxy-bonded filament-wound fiberglass or grade XX phenolic. The upper contact, depending on the rating, is either aluminum or tin-plated bronze. The fuseholder accepts ANSI standard removable or non-removable buttonhead fuse links.

The function of the fuse tube is to confine the arc and produce arc-quenching gases which are expelled from the end of the tube.

Voltage stress across the fuse tube is eliminated by the gap between the end of the tube and the capacitor terminal. There is no possibility of tracking and eventual flashover, even after exposure to weather and contaminants. When the spring ejects the leader, positive indication of a blown fuse can also be easily detected from a distance.

Table 1. Fuse tube ratings

Fuse voltage rating (kV)	Capacitor mounting configuration (H or V)*	Current rating (A)	Power frequency interrupting rating (A)		Maximum parallel-connected energy (kJ)**	Catalog number
			Symmetrical	Asymmetrical		
8.7	H	50	3600	5000	20	FN10B4
8.7	H	80	3600	5000	30	FN20B2
8.7	V	50	3600	5000	20	FN10B4
8.7	V	80	3600	5000	30	FN20B2
15.5	H	50	3600	5000	20	FN11B2
15.5	H	80	3600	5000	30	FN20B2
15.5	V	50	3600	5000	20	FN11B2
15.5	V	80	3600	5000	30	FN20B2
23.0	H	50	1800	2500	20	FN11B2
23.0	H	80	1800	2500	30	FN11B3
23.0	V	50	1800	2500	20	FN11B2
23.0	V	80	1800	2500	30	FN11B3

*H = Horizontal, V = Vertical

**When used with the recommended unit spacing per IEEE Std 18-2012 and Eaton's Cooper Power series' type SD, HD or XD capacitor units.

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Printed in USA
Publication No. MN230005EN
November 2016

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