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TECHNICAL MANUAL

INSTALLATION AND REPAIR PRACTICES

VOLUME 1
AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

This manual is one of a series of four volumes.

For U.S. Navy Users Only– This manual supersedes NAVAIR 01–1A–505–1 dated 1 September 2004 with Change 3 dated 15 May 2007.

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PROTECTIVE DEVICES

INSTALLATION AND REPAIR PRACTICES

AIRCRAFT ELECTRIC AND ELECTRONIC WIRING

Reference Material

Alphabetical Index

Record of Applicable Technical Directives

None

Support Equipment Required

Nomenclature	Part No./Type Designation
Collar, Circuiut Breaker Deactivation (White)	12E2081–9
Kit, Safety Lock Circuit Breaker	296050020–1
O–Ring, Safety Lock Circuit Breaker	MS9068–111
Safety Lockout Ring, Circuit Breaker (Red)	S4933959–531
Safety Lock, 3/8” Circuit Breaker	296050002
Safety Lock, 7/16” Circuit Breaker	296050008
Safety Lock Sleeve, Circuit Breaker	296050009
Safety Lock Clip	296050018

Materials Required

None

1. **INTRODUCTION**.

2. This work package (WP) describes the circuit breaker, fuses and limiters for use in the circuitry of aerospace vehicles.

3. **PROTECTIVE DEVICES.** Protective devices are items of electrical equipment such as circuit breakers, fuses, etc., installed in aircraft to protect the electrical system against overloads caused by short circuits or other faults. Protective devices for wired-in equipment shall be connected to the load side of the equipment power switch (main circuit power disconnect). The protective device may be on the line side or the load side of the equipment on-off switch. If possible, mount protective devices in junction boxes or protected areas. If this is not possible, and the devices are to be installed in locations where they may be subject to damage or where the terminals may be dangerous to the personnel, provide a cover to go over the protective device.

4. **AIRCRAFT CIRCUIT BREAKER PROTECTION.**

5. A circuit breaker is used to help provide automatic protection that will limit an electrical fault to a single circuit. It minimizes the danger of smoke and fire to components. Its primary function, however, is to minimize the danger of smoke and fire to the conductors (or cables) leading to and from components. It isolates the fault from the power source so that the non-faulted circuits can be kept functioning in a normal manner. This may not always be achieved by a single circuit breaker, but by a combination of devices, wire size, and routing.

6. **PRACTICAL OVERCURRENT CONCEPTS**. There are two basic principles in use for the protection of electrical and electronic equipment from failures caused by current overloads:

7. **Current Sensing.** The current sensing principle is found in devices such as magnetic or fully ambient compensated circuit breakers. In some applications, practical considerations make it necessary for the circuit breaker and wire to be in entirely different ambient temperatures. In this case it may be necessary to use an ambient insensitive circuit breaker and apply it on the basis of maximum temperature rise expected at any point in the circuit. Increases in the ambient temperature around the circuit breaker will reduce its current trip level.

8. **Combined Current and Temperature Sensing.** Some thermal circuit breakers not only anticipate thermal failures due to overcurrent, but also compensate for variations in the ambient temperature. This compensation helps the circuit breaker follow the changes in wire current carrying capacity due to ambient temperature. These circuit breakers may be located in the same ambient temperature as the wire. They are selected to match the thermal characteristics of the wire being protected.

9. **Arc Fault Sensing.** Thermal circuit breakers are designed to react to the heating effect of current carried by wire; and to protect the wire insulation from thermal damage. These protective devices are not designed to detect or react to the short duration of arcing faults

that typically occur outside (before approaching) the defined trip region, or Time versus Current curve, of the thermal circuit breakers. Arc impedance can reduce low voltage fault current magnitudes appreciably. AFCBs combine active arc fault detection with thermal overload protection into one package. The AFCB provides an equivalent level of thermal protection of existing thermal circuit breakers (typically qualified under AS58091), with the added ability to detect and react to arc fault conditions, thereby mitigating damage that will occur to the wiring system by protracted arcing events. The primary purpose of the AFCB is to mitigate damage to the aircraft wiring from the circuit breaker to the first serial load element (examples: LRU, transformer, ballast, rectifier, or connected equipment, etc.). In doing so, the potential of igniting surrounding materials is reduced, but not eliminated. Use of AFCBs for hazard mitigation/prevention beyond its intended function of mitigating damage to the aircraft wiring should be carefully analyzed and evaluated (SAE AS 5692).

10. **EXTENT OF CIRCUIT PROTECTION**. Equipment and component protection should receive separate consideration. Any protection provided by the circuit breaker is incidental and must not compromise the prime intention of protecting the wiring.

11. **DESCRIPTION**.

12. **INTRODUCTION**. In its simplest form, the circuit breaker is a device to open and close an electrical circuit by non-automatic means, and to open the current automatically on a predetermined overload of current, without injury to itself, when properly applied within its rating. Two most common types of circuit breakers are magnetic and thermal. A protective device is chosen with the lowest rating that will not open inadvertently. It must interrupt the fault or overload current disconnecting the faulted line from the power distribution system before the wire insulation is destroyed. Circuit breakers will be applied within the electrical rating, environmental conditions, and other parameters as described in the applicable Military Specification.

13. **CLASSIFICATION OF CIRCUIT BREAKERS**.

14. **THERMAL**. Thermal circuit breakers generally operate dependent on the heating and subsequent deflection of a bimetallic thermostatic element due to the fault current (resistance heating). Some devices operate with the thermal expansion of a strand wire. Some devices may compensate for ambient temperatures. Thermal circuit breakers are generally not as affected by the start up surges and brief transients as many other devices. Figure 1 shows a typical circuit breaker.

15. **THERMAL-MAGNETIC ASSIST**. Thermal circuit breakers may also include a magnetic assist mechanism used only on high current overloads. However, due to their operating principles, thermal circuit breakers inherently produce less magnetic field interference than magnetic circuit breakers.

16. **MAGNETIC**. Magnetic circuit breakers generally operate using the solenoid principle, where a moveable piece held with a spring may be moved by the magnetic field of a coil energized by the fault current. Some devices may compensate for ambient temperatures. Magnetic circuit breakers often have an instantaneous trip feature that functions during high current overloads. Normally, magnetic circuit breakers are used on the type of current for which they are calibrated.

17. **REMOTE CONTROL CIRCUIT BREAKERS. (RCCB).** These circuit breakers combine the features of a relay (contactor) and circuit breaker. This permits location near the load or power source and control from a remote location such as a cockpit. Control wiring may therefore be of light gauge.

18. **ELECTROMAGNETIC POWER CONTROLLER (EMPC)**. This type of circuit breaker is considered to be electronically controlled, incorporating circuit protection, relay and switch features in a single device. An EMPC is a device that utilizes a solid state sensing mechanism for overcurrent protection. The EMPC may also use solid state switches in combination with discrete contacts to switch the load.

19. **ARC FAULT CIRCUIT BREAKERS.** Arc Fault Circuit Breakers (AFCB) incorporate the functionality of conventional thermal circuit breakers with that of arc sensing capability. AFCBs can trip/open for either thermal or arc events. The AFCB identifies the fault mode by the use of a separate sleeve incorporated in the circuit breaker push button. With a circuit breaker tripped, if thee yellow sleeve is exposed then an arc event was sensed. If the conventional white sleeve is exposed, then a thermal event occurred (Figures 2, 3, and 4).

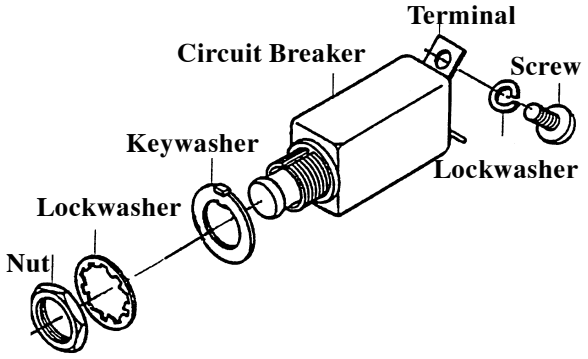


Figure 1. Typical Aircraft Circuit Breaker

20. **SOLID STATE POWER CONTROLLER (SSPC)**. An SSPC is generally considered to be electronically controlled, incorporating circuit protection, relay and switch features in a single device. A SSPC is a device that uses a solid state sensing mechanism for overcurrent protection, and a solid state switching mechanism, employing electromechanical parts.

21. **SPECIAL FEATURES**. Certain features may be incorporated into several classifications of circuit breakers, depending on the particular specification.

22. **Multipole.** A multi-phase circuit breaker has two or more poles controlled by a single-actuating member. It may be used on a multi-phase circuit such that an overload on an individual phase will cause the circuit breaker to open all phases of the circuit. Usually, operating limits and performances are different than single phase circuit breakers. Figure 5 shows a typical multi-phase circuit breaker.

23. **High Vibration.** Circuit breakers identified with a V suffix on the MS specification and ID markings have been designed to operate in a high sine vibration environment. Those additionally identified with a C through K suffix on the MS specification and ID markings have been designed to operate in a random vibration environment.

CAUTION

Some care should be taken to reduce the possibility of extreme side forces on the buttons.

24. **Long Pushbuttons.** Some circuit breakers may have longer push buttons than others. These may be identified with an L suffix on the specification and ID markings.

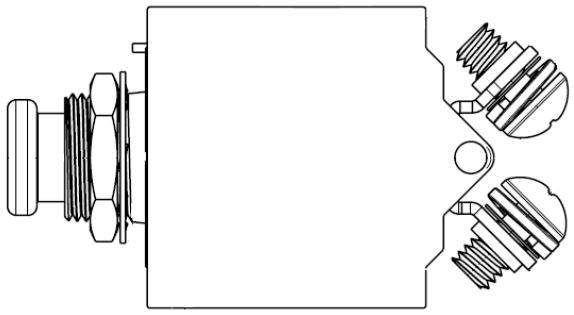


Figure 2. Circuit Breaker Closed / Not Tripped

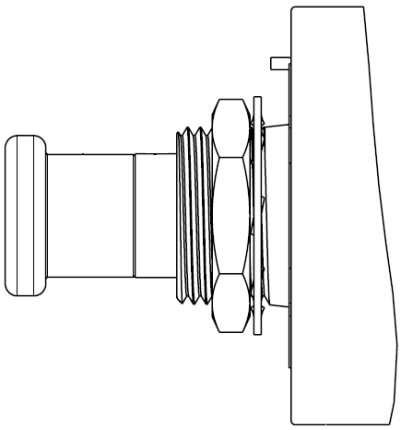


Figure 3. Circuit Breaker Open / Tripped, Thermal Condition Detected

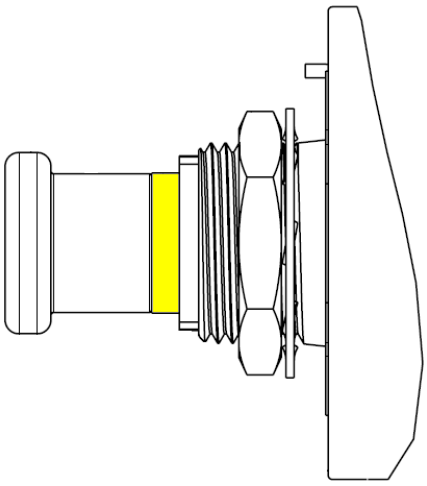


Figure 4. Circuit Breaker Open / Tripped, Arc Fault Condition Detected (Note Yellow Band)

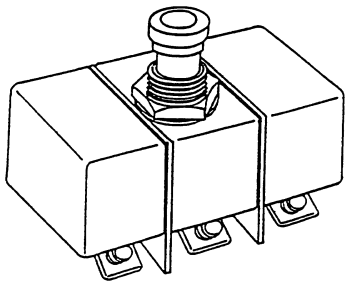


Figure 5. Typical 3 Phase Circuit Breaker

25. **Sealed.** Sealed circuit breakers may be of any type. They are usually sealed against adverse environments and are generally restricted to use on lower power circuits. Non-sealed circuit breakers provide for higher power requirements, but are more restricted as to environment. It is important to handle them carefully so as not to damage the seal.

26. **P Bracket.** Circuit breakers with a special P cover plate mounting bracket are identified with a P suffix on the specification and ID markings. They require different mounting hardware from non-P marked circuit breakers of the same type.

27. **AMPERE RATING**.

28. **DEFINITION**. The nameplate current rating of most circuit breakers is a nominal rating for device identification. The actual usable rating for a particular application may be considerably different from the nameplate rating. The time-current characteristics of the circuit breaker are compared to the time current characteristics (including starting or overload surges) of the equipment, component, and wire. Refer to Safety Factors paragraph 28.

29. **ORIENTATION**. The nominal ampere rating of the circuit breaker is generally marked on the actuator (push button) of the circuit breaker. The ampere rating number is oriented to maximize readability by the user.

30. **SAFETY FACTOR** Safety factor is the value above the steady state application current that helps to ensure that the circuit breaker will handle the application without nuisance trips. Typically a circuit breaker is specified to operate continuously at no more than approximately 80 percent of its nominal rating. This provides a safety factor of 20 percent. Different factors may apply at different ambient temperatures and altitudes.

31. **IDENTIFICATION MARKINGS.** All circuit breakers are permanently and legibly marked. These markings will be resistant to most aircraft fluids. Markings generally include a part number, ampere rating and manufacturers date code.

32. **PART NUMBERS SCHEME FOR THERMAL CIRCUIT BREAKERS.** The following part numbering example for circuit breakers will typically apply:

MS 3320-D 5 A V L

Where:

MS 3320 is the military designation.
D is the random vibration capability.
5 is the ampere rating.
A is for auxiliary terminals.
V is the high sine vibration capability.
L is the pushbutton type.

33. **TERMINALS**

34. **Line** The line side terminal of a circuit breaker is connected to the power source, or to the power source of the electrical system. This terminal may be connected to any bus bar feed system where the system is used.

35. **Load** The load side terminal of the circuit breaker is connected to the load, or to the load side of the electrical system.

36. **SOLID CONNECTIONS.** A solid electrical and mechanical connection of the wire to the circuit breaker is critical for the operation of the breaker. A loose or minimal wire connection can cause increased circuit resistance and create heat. Wire heating near the circuit breaker terminals can cause premature tripping or failure of the breaker. It is equally important to use correct specified size and type of termination, that it be free of corrosion and properly attached.

37. **Markings.** Terminals may be marked LINE or LOAD, 1 or 2, etc., as called out in the circuit breaker specification. It is important that the terminals are wired correctly according to their markings. Circuit breakers with unmarked terminals may or may not have a preferred line or load wiring. Multiphase circuit breakers may have sets of terminals for individual phases or circuits marked A, B, C, etc.

38. **Hardware.** Most terminals are threaded for a specified screw or bolt. It is important to use the specified hardware. Terminal screws that are too short may not hold the terminations properly. Screws that are too long may interfere with or damage the breaker case. Incorrect hardware may also produce excessive, damaging torque.

39. **Captive Nuts.** When available, captive nuts will be solidly attached to the terminals.

CAUTION

The mounting tab should not be used as an anti-rotation tab, as it is not designed to resist the torque that may be transmitted due to rotation of the mounting nut, terminals, or circuit breaker body.

40. **Mounting Tabs.** Mounting Tabs are found on most circuit breakers, and are also called mounting keys. They orient the circuit breaker about the Z-axis through the panel hole.

41. **TRIP BARS.** Trip bars may be used to externally connect the buttons of several circuit breakers, so that they operate together.

42. **OPERATION**

43. The following paragraphs contact information on how circuit breakers may be used, not used, and possible concerns during their lifetime.

44. **AS A SWITCH.** Normally, a circuit breaker should not be used as a switch. Most circuit breakers have a life expectancy of 1/10 or less of the life of a switch. They are not usually snap-action devices and should not be considered as substitutes for switches, unless defined as such in the particular specification. Refer to paragraph 45.

CAUTION

Excessive force, often by using tools to pull the button, can cause hidden damage to the mechanism.

45. **OPENING**. Only reasonable force should be used to open the contacts of a circuit breaker, normally much less than 25 pounds.

46. **RESETTING**. Only reasonable force should be used to reset a circuit breaker, generally less than 25 pounds. They should not be reset by impact. Excessive force can cause hidden damage to the mechanism. Resetting a breaker once may not be a problem, but it should not be held in the set position or repeatedly reset in an effort to get a system to work. Circuit breakers are designed to open if there is an overcurrent. condition. Repeated resetting into an overload condition may allow too much current through the wire, connectors, and the breaker itself. Circuit breakers should not be allowed to develop a history of tripping. A tripped circuit breaker may be faulty, or may be in a faulty or overloaded circuit. A tripped curcuit requires post–flight fault isolation and repair. If a circuit breaker opens (pops) while maintenance is being performed on the aircraft, the opened circuit breaker shall not be reset until the cause is determined. An unexpected popped CB may result from an overloaded or ground fault. A popped fuel system CB should not be reset without following specific guidance in aircraft systems manuals/TOs. General Curcuit Breaker Reset Procedure.

a. Do not push in/close a circuit breaker that is found open until the cause of the open breaker is corrected.

NOTE

For both thermal or arc fault circuit breaker trip events, refer to the applicable troubleshooting/fault isolation procedure for the affected system, or component in the platform–specific maintenance manual.

b. If the open circuit breaker is a part of a 3–phase circuit, open the other two circuit breakers.

WARNING

Failure to ensure that the system is serviceable and without wiring faults prior to closing any circuit breaker may lead to system damage, fire, loss of aircraft and/or personnel injury or death.

c. Close/push in the circuit breakers only after the fault is corrected.

CAUTION

Teasing should be avoided to reduce contact pitting, wear and arcing and to increase the life of the circuit breaker.

47. **TEASING**. Teasing is the slow action of opening or closing a circuit breaker actuator (push-button, toggle, etc.), such that the contacts come in close proximity to each other without engaging the latching mechanism. This action will cause an arc to be drawn across the gap between the contacts, without physically mating or touching each other.

48. **CHANGE IN CHARACTERISTICS.** The operating characteristics of a circuit breaker may change over the life of the device. Heavy fault currents may degrade the current overload sensor. Excessive manual operation may cause dynamic wear of the latching mechanism. Even a circuit breaker that has been dormant for a long period of time may change due to internal spring forces and static wear. This may be reduced by periodic manual operation of the breaker. A suspect breaker should always be replaced.

49. **AIRCRAFT COMPONENTS**

50. The following paragraphs contain information on aircraft parts and components that may have an effect on circuit breakers or their installation.

51. **MOUNTING PANELS**. The spacing of mounting holes for circuit breakers are to be properly spaced to allow sufficient space between successive circuit breakers, in both vertical and horizontal directions. This is important for thermal, dielectric and mechanical reasons.

52. **BOOTS**. Boots may be part of the mounting nut, separate from the nut, or integral to the push-button. Boots protect the circuit breaker and/or seal the panel from environmental conditions.

53. **WIRES**. The aircraft wires form an inherent part of thermally activated circuit breakers. Wires and connection both transfer and produce heat that may affect the calibration of the circuit breaker. Wires are kept as far as possible from the body of the circuit breaker behind the panel.

CAUTION

Mechanical force of bending on the terminals should also be considered when routing larger wires.

54. **WIRE GAUGE**. Wires must be of the correct specified size for the particular circuit breaker. Failure to size the wire properly may adversely affect the operating characteristics of the circuit breaker.

55. **INSULATION**. Wire insulation should be of the proper, specified type for the application. Insulation should not be allowed to touch the case of the circuit breaker. Insulation should be visually examined for cracks, burn marks and other defects.

56. **CRIMPING**. Wires should be stripped and crimped using procedures in WP 009 00.

57. **REPAIR.**

58. **CIRCUIT BREAKER REPAIR**. Most circuit breakers are consumable items and source coded PAOZZ. Only replacements are authorized in the fleet/field.

59. **EVALUATION**. In some cases a circuit breaker may have to be removed for evaluation. If possible, records of the events leading up to the removal of the circuit breaker should be included. If evaluation of operational characteristics is to be performed, it is most important that the circuit breaker not be operated and the case not be opened before returning it for evaluation.

60. **REMOVAL AND INSTALLATION.**

61. Refer to the build up in Figure 6 for the installation and removal of circuit breakers in aircraft panels.

WARNING

Verify that installed circuit breakers are in the OFF position and aircraft external electrical power and battery or batteries are disconnected before proceeding with any of the following instructions or routine maintenance. Failure to do so can result in damage to the equipment and severe injury or death to personnel.

62. **REMOVAL**.

WARNING

To prevent electrical shock, ensure electrical power is off before commencing work.

To prevent fire and damage to electrical equipment, do not replace a circuit breaker with one of a higher amperage rating.

a. Verify all electrical power is off and batteries are disconnected.

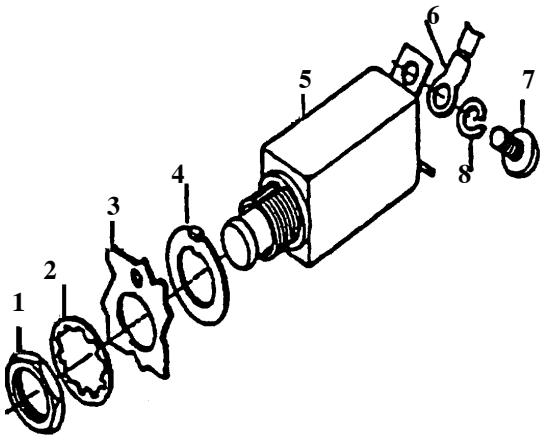
b. After opening the affected circuit breaker panel, but before the start of the maintenance or inspection task, develop and implement a means of covering or protecting the opened panel during the maintenance and inspection process.

c. If a boot is present, carefully remove without damaging. If the boot cannot be removed, carefully pass the boot through the panel-mounting hole. Care should be taken not to puncture or otherwise damage the boot.

d. Refer to Figure 6 to remove nut (1), and lockwasher (2) securing circuit breaker (5) to panel (3). Remove circuit breaker and key washer (4).

e. Remove screws (7). lockwashers (8), and terminals (6) from circuit breaker.

f. Tag and cover terminals with silicone tape.



1. Nut	**5. Circuit Breaker**
2. Lockwasher	**6. Terminal**
3. Panel	**7. Screw**
4. Keywasher	**8. Lockwasher**

Figure 6. Circuit Breaker Installation

63. **INSPECTION**. The following inspections can be used to reveal if the breaker is unserviceable (Refer to Figure 6).

WARNING

Verify that installed circuit breakers are in the OFF position and aircraft external electrical power and battery or batteries are disconnected before proceeding with any of the following instructions or routine maintenance. Failure to do so can result in damage to the equipment and severe injury or death to personnel.

Replacement circuit breakers must have the same electrical characteristics as the circuit breaker being replaced. Failure to maintain characteristics can result in damage to the equipment and severe injury or death to personnel.

NOTE

Refer to WP 004 01 for additional circuit breaker inspection instructions as applicable.

64. **INSTALLATION**.

WARNING

Replacement circuit breakers must have the same electrical characteristics as the circuit breaker being replaced. Failure to maintain characteristics can result in damage to the equipment and severe injury or death to personnel.

a. Replace circuit breakers only with breakers of the same type and current rating as specified by the engineering authority or platform–specific manual/Technical Order.

b. Verify all electrical power is off and batteries are disconnected.

c. Remove silicone tape from terminals.

WARNING

Ensure correct line and load connection. Failure could result in injury to personnel and/or damage to equipment and aircraft.

d. Refer to Figure 6 and install terminals (6), on circuit breaker (5) and secure with lockwashers (8) and screws (7). Remove tags.

e. Place keywasher (4) on circuit breaker and insert through rear of panel (3). Secure with lockwasher (2) and nut (1). The circuit breaker must be held to prevent rotation while tightening the nuts to prevent strain on the mounting key.

f. If required, perform electrical check in accordance with the applicable platform–specific manual or Technical Order.

g. After maintenance on a circuit breaker panel, a thorough inspection should be performed to ensure that no loose foreign objects such as safety wire, nuts, screws, washers, etc., remain in the area that could cause arcing or short circuits if not removed.

h. Remove the applicable cover or circuit breaker protection means installed at the beginning of the task.

Figure 7. Circuit Breaker Lockout Ring

Figure 8. Circuit Breaker Collar

WARNING

Use only red or white teflon devices for deactivating circuit breakers. Do not use black for this purpose. Locking ring must stay securely in place on circuit breaker and prevent circuit breaker from being reset. Failure could cause injury to personnel and/or damage to equipment and aircraft.

65. **CIRCUIT BREAKER LOCKOUT/DEACTIVATION.**

WARNING

Do not use black colored locking or deactivating devices for circuit breakers. Locking / Deactivation device must stay securely in place on circuit breaker and prevent circuit breaker from being reset. Failure could cause injury to personnel and/or damage to equipment and aircraft.

a. Flight Operations.

1. When positive lockout/deactivation of an electrical circuit breaker is required during flight operations, use lockout ring (Figure 7) part number: S–4933959 or lockout collar (Figure 8) part number: 12E2081–9 or 2S308 (NSN: 6110–00–492–9392).

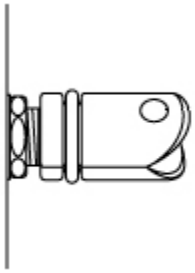


Figure 9. Circuit Breaker Safety Lockout Installed

2. Verify that circuit breakers that require lockout/deactivation are in the OFF (pulled) position.

CAUTION

Do not use any tools to install or remove lockout ring or collar as damage may occur to the circuit breaker.

3. Using slight pressure, snap the lockout ring or collar onto the circuit breaker shaft.

b. Ground Operation Only.

1. When positive lockout/deactivation of an electrical circuit breaker is required during ground operations ONLY, use the lockout ring or collar or the safety lock (Figure 9). For typical circuit breakers (3/8” head size) use part number: 296050002. For larger circuit breaker (7/16” head size) use part number: 296050008.

2. Verify that circuit breakers that require lockout/deactivation are in the OFF (pulled) position.

CAUTION

Do not use any tools to install or remove lockout ring or collar as damage may occur to the circuit breaker.

3. When using the lockout ring or collar apply a slight pressure to snap the lockout device onto the circuit breaker shaft. If using the safety lock, pinch the ends of the safety lockout together and slide over the circuit breaker and release (Figure 10). Safety lock remains secure to circuit breaker (Figure 9).

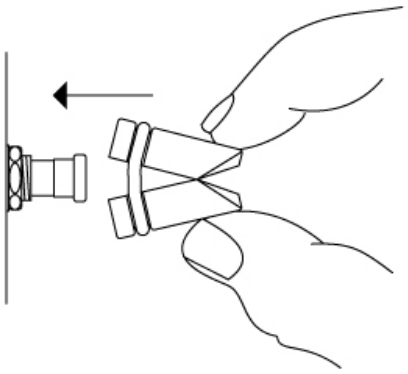


Figure 10. Circuit Breaker Safety Lockout Installation

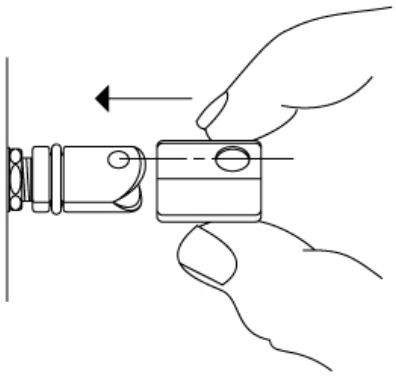


Figure 11. Circuit Breaker Safety Lockout Sleeve Installed

4. An optional sleeve part number: 296050009 may be used on the safety lock to prevent accidental removal (Figure 11). The sleeve is applied by sliding it over the previously installed safety lock making sure the holes are in alignment. Secure the sleeve to the safety lock with string/lacing tape (A–A–52083 or A–A–52084) through the hole.

NOTE

If the optional safety lock clip and condition tag are used then the string/lacing tape is not required.

5. A condition tag (optional) may be attached to any of the locking devices by drilling a small hole (if not provided). Secure the tag with string/lacing tape (Figure 12) or safety lock retaining clip part number: 296050018 (Figure 13).

6. Safety lock kit (for ground use only) contains safety lock, sleeve, condition tags and clips for typical applications (part number: 296050020–1). The replacement safety lock o–ring is part number MS9068–111(NSN: 5331–00–965–0719).

66. **CIRCUIT BREAKER PERMANENT REMOVAL.** When a circuit breaker is removed permanently, a blanking plug shall be installed in the mounting hole. Use blanking plugs suitable for this purpose: Metal Plug, PN NAS451–43 or Rubber Plug, PN G34. Ensure that the applicable CB identification is removed.

67. **CIRCUIT BREAKER IDENTIFICATION.** Ensure that each protective device is identified by a plate or decal, permanently attached to adjacent aircraft structure and completely visible.

Figure 12. Circuit Breaker Safety Lock Installed with Warning Tag using String/Lacing Tape

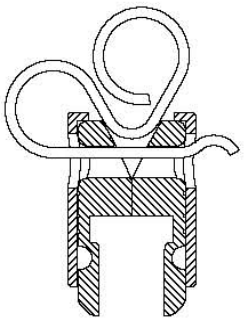


Figure 13. Circuit Breaker Safety Lock Retaining Clip

68. **AIRCRAFT FUSE PROTECTION.**

69. **GENERAL** A fuse is a device that protects a circuit by the melting of its current responsive element when an overcurrent passes through it. Fuses are available in a variety of characteristics to meet the requirements of the circuit designer.

70. **CLASSIFICATION OF FUSES.**

71. **NORMAL**. This type of fuse is often referred to as a “normal opening” fuse and may or may not be current limiting. Normal fuses contain single elements and possess a time-current characteristic curve that is essentially a smooth curve with no discontinuities. Figure 14 shows a typical aircraft fuse.

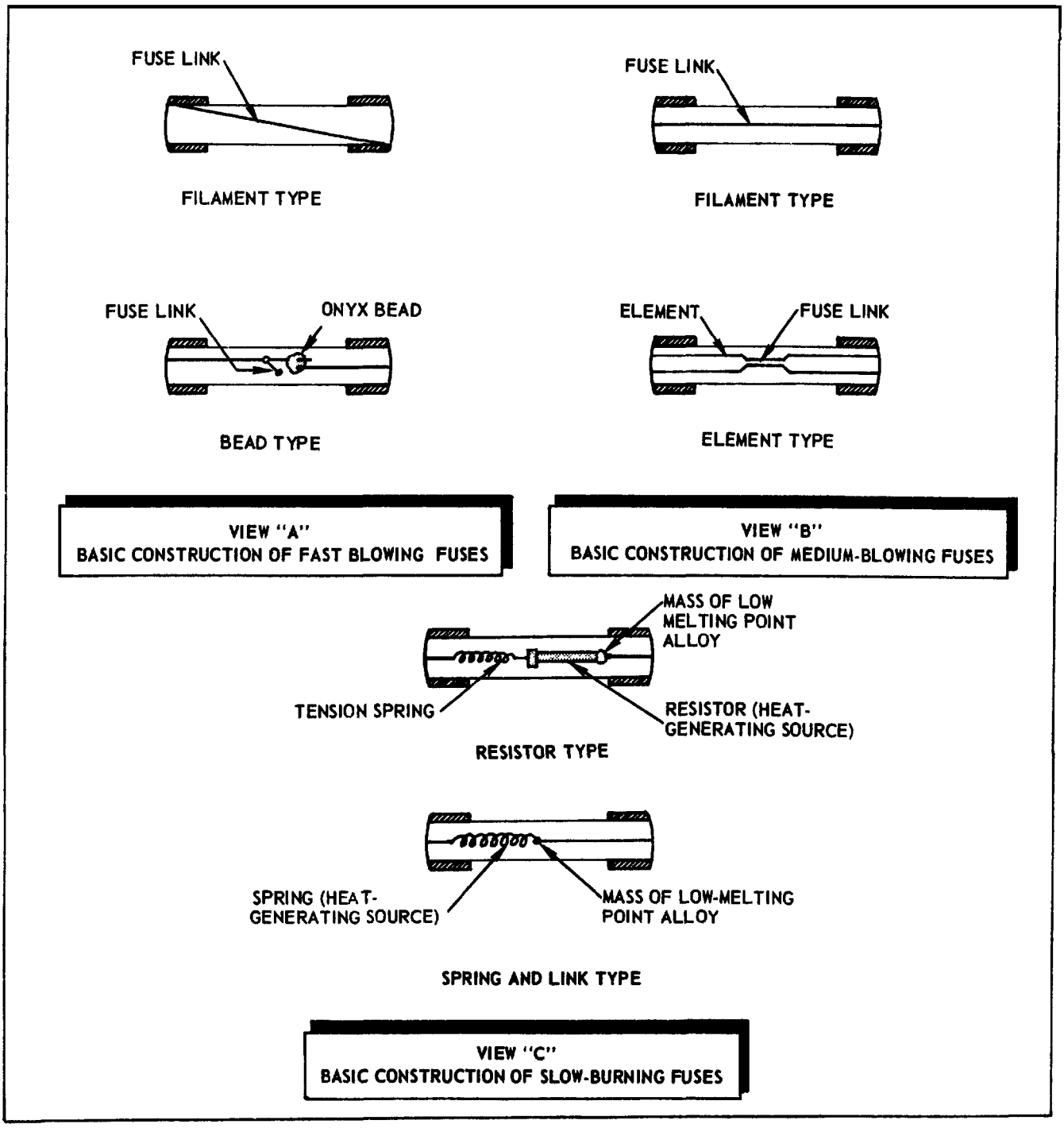


Figure 14. Basic Construction, Views A, B, and C

72. **TIME–DELAY**. Time-delay fuses also may or may not be current limiting. The fuses are often referred to as “dual-element” fuses in that they possess two elements thermal cutout with very high time-lag characteristics which handles harmless transient overloads and blows on continuous light overloads, plus a short-circuit element which blows on heavy overloads and short circuits. The thermal cutout is designed to pass momentary surges such as motor starting transients and switching transients. The time-current characteristics of the time delay fuse show a non-uniform curve with considerable time lag.

73. **VERY FAST ACTING**. These fuses do not possess time-delay features as they are designed to be extremely fast under short-circuit conditions. Very fast-acting fuses are designed to protect semiconductor rectifiers because of their speed of response to overcurrent. These fuses also may or may not be current limiting.

74. **CURRENT LIMITING**. The ability of a fuse to fit into this category depends upon its short-circuit performance. Current limitation is defined as the degree of current-limiting ability a fuse possesses under short-circuit conditions. To be current-limiting, the fuse, under specific short-circuit conditions, must limit the instantaneous peak current to a value less than that which would flow if the fuse were not in the circuit, and it must clear the fault within one-half cycle.

75. **PART NUMBERING SCHEME**. The following part numbering example for fuses will typically apply:

FM08A125V1/2A*

Where:

FM08 is the fuse style.
A OR B is the characteristic.
125V is the voltage rating.
1/2A is the current rating.
* indicates an optional finish.

76. **DEFINITIONS AND DESCRIPTIONS.**

a. Fuse Types and Styles. Fuse types and styles refer to the construction (physical makeup and material) and dimensions of fuses. For example, cartridge fuse mountings may be either knife blade or ferrule type, and the fuse link may be bead, bridge, or some other type of construction. The body of the fuse can be made of glass, ceramic, fiber, or other non–conducting material. To distinguish one type or style from another, the manufacturer usually stamps each fuse with a specific type or style designation. Some common commercial fuse–type designations are MKB, ACX, 3AG, and 3AB; and a few typical military fuse–style designations are F02, F03, and FM09. Each fuse type or fuse style designation denotes a given construction and dimension.

b. Dimensions. Dimensions refer to the length and width (or diameter) of a fuse. The fuse selected for replacement purposes should be one that properly fits into the fuse holder. However, selection of a fuse should not be limited to physical size because it may differ in current, voltage, or blow time characteristics.

c. Current Rating. The current rating is the most commonly used fuse rating. Current ratings are always designated in terms of amperes and may range from 0.002 ampere for sensitive instruments to 600 amperes for high power applications. The current rating indicates the highest value of current that the fuse can carry indefinitely without blowing. Because fuses are the “Safety–Valves of electrical circuits”, it is important to replace a blown fuse with a fuse that has identical fuse current ratings or those required by the design of the equipment.

d. Blow time Characteristics (General). Time and current are the important factors in the operation of a fuse. There is a time and current relationship at which a fuse will operate satisfactorily and will not blow, and still another time and current relationship at which the fuse will blow. The length of time that a fuse carries a quantity of current above its rated value before blowing is known as the blow time characteristic. Some fuses are designed to blow rapidly at certain percent–ages of overloads; other fuses are designed to carry slight overloads for hours without blowing. Still others are designed to handle large surges of current for short periods of time without blowing, and yet protect equipment against excessive current resulting from short circuits or continued overloads. The blow time characteristics are extremely important. Slow blow fuses will not be substituted for fast blow fuses. Temporary substitution of fast blow fuses for slow blow fuses is allowed.

(1) Blow time Characteristics (Commercial). Most commercial fuses fall into one of the following basic types of blow time characteristics: fast blowing, medium blowing, or slow blowing. Other commercial trade names are as follows:

Fast–Blowing	Medium–Blowing	Slow–Blowing
Quick–Blowing	Medium–Acting	Slow–Acting
Instant–Blowing	Medium–Lag	Time–Delay
Fast–Acting		

NOTE

Basic Construction (see Figure 14, Views A, B, and C).

(2) Blow time Characteristics (Military). The blow time characteristics of military fuses are classified on the basis of the amount of current (above that of the actual current rating) that they can safely interrupt, and on their ability to withstand momentary surges of current. All military fuses (fuses manufactured under Military Specification) fall into one of the blow time characteristics in Table 1. Notice that in addition to blow time characteristics, Table 1 lists the characteristic symbols that are stamped on military fuses and the distinguishing properties.

e. Voltage Rating. The fuse voltage rating is the highest voltage at which the fuse can safely interrupt its maxi–mum short circuit current. Since the fuse voltage rating is a design characteristic and is independent of the steady–state, in–circuit voltage, a higher voltage rated fuse may be substituted for a lower voltage rated fuse.

NOTE

It is not permissible to substitute a lower voltage rated fuse for a higher voltage rated fuse. The current rating of the fuse shall not exceed the maximum current rating of the circuit.

77. **FUSES**

78. Fuses used in aircraft are of two types: the cartridge type, installed in the electrical system in an extractor post style fuseholder or in fuse clips; and the enclosed link type (current limiter) installed in a block type fuseholder (see Table 2). Fuses commonly used in aircraft electrical systems are listed in Table 2 by detailed Military Specifications and Military Standard Drawings and in Table 3, which lists cross reference from old military designation to new military designation with superseded commercial equivalent.

Table 1. Military Fuse Blow time Characteristics

Fuse Blow Time Characteristics	Characteristics	Current–Interrupting Capacity	Distinguishing
Fast Blowing	A Symbols	Normal	1. Used in circuits capable of delivering low values of current. Blow instantly at low values of short–circuit current. Properties 2. Intended for general circuit
Time–Lag	B	(Slow–Blow Fuse)	1. These fuses have a built–in delay period. protection. 2. Used in circuits where allowances must be made for momentary surges of current.
Normal–Blowing	C	Very High	1. Used in circuits capable of delivering high values of current. Blow instantly at extremely high values of short–circuit current. 2. Intended for general circuit protection.

Table 2. Fuses Used In Aircraft Electrical Systems

Cartridge Type No.	Style*	Characteristic	Max. Volts	Amperes	Replaces MS Number: Char. A	Char. B
MIL–F–15160/1	FO1	A	250	1/500	90077–1	
		A		1/200	90077–2	
		A		1/100	90077–3	
		A		1/32	90077–4	
		A		1/16	90077–5	
		A		1/10		
		A		1/8	90077–6	
		A		3/16		
		A		2/10		
		A		1/4	90077–7	
		A		3/8	90077–8	
		A		4/10		
		A		1/2	90077–9	
		A	125	6/10		
		A		3/4	90077–10	
		A		8/10		
		A		1	90077–11	
		A		1– 1/4		
		A		1– 1/2	90077–12	
		A		1– 6/10		
		A		2	90077–13	
		A		2– 1/2		
		A		3		
		A		3– 2/10		
		A		4		
		A		5		
		A	32	6		
		A		7		
		A		8		
		A		10		
		A		15		
		A		20		
		A		25		
		A		30		
MIL–F–15160/2	FO2	A, B	250	1/100	90078 – 1–1	90078 – 16–1
		A, B		1/32	– 2–1	– 17–1
		A, B		1/16	– 3–1	– 18–1
		A, B		1/8	– 4–1	– 19–1
		A, B		1/4	– 5–1	– 20–1
		A, B		3/8	– 6–1	– 21–1
		A, B		1/2	– 7–1	– 22–1
		A, B		3/4	– 8–1	– 23–1
		A, B		1	– 10–1	–24–1
		A, B		1 1/2	– 11–1	–
		A, B		2	– 12–1	–
		A		3	– 13–1	–
		A		4	– 14–1	–
		A		5	– 15–1	–
		A		6	–	–

Table 2. Fuses Used In Aircraft Electrical Systems – Continued

Cartridge Type No.	Style*	Characteristic	Max. Volts	Amperes	Replaces MS Number: Char. A	Char. B
		B	125	5	–	–
		A		10	–	–
		A, B	32	10	–	–
		A, B		15	–	–
		A, B		20	–	–
		B	32	8	–	–
MIL–F–15160/3	FO3	A, B	250	1	90079 – 1–1	90079 – 20–1
		A, B		3	– 2–1	–
		A		5	– 3–1	–
		A		8	– 4–1	–
		A		10	– 5–1	–
		A		12	– 6–1	–
		A		15	– 7–1	–
		B	250	1/100	–	90079– 10–1
		B		1/32	–	– 11–1
		B		1/16	–	– 12–1
		B		1/8	–	– 13–1
		B		15/100	–	– 14–1
		B		3/16	–	– 15–1
		B		1/4	–	– 16–1
		B		3/8	–	– 17–1
		B		1/2	–	– 18–1
		B		3/4	–	– 19–1
		B		2 1/2	–	–
		A	125	20	90079 – 8–1	
		A		30	– 9–1	
		B		5		
		B		8		
		B		10		
		B		12		
		B	125	15		
		B		20		
		B		30		
MIL–F–15160/6	FO6	A	250	1	90082 – 1	
		A		2	– 2	
		A		3	– 3	
		A		5	– 4	
		A		10	– 5	
		A		15	– 6	

Table 2. Fuses Used In Aircraft Electrical Systems – Continued

Cartridge Type No.	Style*Characteristic	Max. Volts	Amperes	Replaces MS Number: Char. A	Char. B
MIL–F–15160/7	FO7 A	250	1		
	A		2		
	A		3		
	B	125	1		
	B		2		
	B		3		
	A, B	32	5	90083 –1	90083 –10
	A, B		10	–2	–11
	A, B		15	–3	–12
	A, B		20	–4	–13
	A, B		30	–5	–14
MIL–F–15160/9	FO9 B	250	1/10		90085–36
	B		15/100		90085–37
	B		2/10		90085–38
	B		3/10		90085–39
	B		4/10		90085–40
	B		1/2		90085–41
	B		6/10		90085–42
	B		8/10		90085–43
	A, B		1	90085–9	90085–44
	B		1– 1/8		90085–45
	B		1– 1/4		90085–46
	B		1– 4/10		90085–47
	B		1– 6/10		90085–48
	B		1– 8/10		90085–49
	A, B		2	90085–15	90085–50
	B		2– 1/4		90085–51
	B		2– 1/2		90085–52
	B		2– 8/10		90085–53
	A		3	90085–19	
	B		3– 2/10		90085–55
	A, B		3– 1/2	90085–21	90085–56
	A, B		4	90085–22	90085–57
	B		4– 1/2		90085–58
	A, B		5	90085–24	90085–59
	B		5 6/10		90085–60
	A		5	90085–26	
	A, B		6– 1/4	90085–27	90085–62
	A, B		7	90085–28	90085–63
	A, B		8	90085–29	90085–64
	B		9		90085–65
	A, B		10	90085–31	90085–66
	A		15	90085–32	
	A		20	90085–33	
	A		25	90085–34	
	A		30	90085–35	
	B	125	12		
	B		15		90085–67
	B	32	20		90085–68

Table 2. Fuses Used In Aircraft Electrical Systems – Continued

Cartridge Type No.	Style*Characteristic	Max. Volts	Amperes	Replaces MS Number: Char. A	Char. B
	B		25		90085–69
	B		30		90085–70
MIL–F–15160/10	F10 B	250	1/10		
	B		15/100		
	B		2/10		
	B		3/10		
	B		4/10		
	B		1/2		
	B		6/10		
	B		8/10		
	A, B		1	15453–1	
MIL–F–15160/10	F10 B	250	1– 1/4		
	A, B		2	15453–2	
	B		2– 1/2		
	A, B		3	15453–3	
	B		3– 2/10		
	A, B		4	15453–4	
	A, B		5	15453–5	
	B		5– 6/10		
	A		6	15453–6	
	B		8 1/4		
	A		10	15453–7	
	A	125	12	15453–8	
	A		15	15453–9	
	A		2	15453–10	
	A, B		2– 1/2		
	B		3	15453–3	
	A, B		3– 2/10		
	B		4	15453–4	
	A, B		5	15453–5	
	A, B		5– 6/10		
	B		6	15453–6	
	A		6– 1/4		
	A		8	15453–7	
	A		10	15453–8	
	A		12	15453–9	
	A		15	15453–10	
	B	125	7		
	B		8		
	B		10		
	A		20	15453–11	
	A		25		
	A		30		
MIL–F–23419/9	FM09 A, B	250	1/100		
	A, B		1/32		
	B		1/16		
	A, B		1/10		
	B		1/8		
	B		15/100		
	A, B		3/16		
	B		1/4		
	A, B		3/10		
	A, B		3/8		
	B		1/2		
	A, B		6/10		
	A, B		3/4		
	B		8/10		
	A, B		1		
	A, B		1– 1/4		
	A, B		1– 1/2		

Table 2. Fuses Used In Aircraft Electrical Systems – Continued

Cartridge Type No.	Style*Characteristic	Max. Volts	Amperes	Replaces MS Number: Char. A	Char. B
	B		1– 6/10		
	A, B		2		
	B		2– 1/2		
	B		2– 8/10		
	A, B		3		
	B		3– 2/10		
	A		4		
	A		5		
	A		6		
	A		8		
	A		10		
	A		12		
	A		15		
MIL–F–23419/9	FMO9 B	125	4		
	B		8		
	B		10		
	B		12		
	A, B		15		
	A, B		20		
	A, B		25		
			30		
*A Normal (normal interrupting capacity); for general circuit protection					
*B Time Lag; for circuits containing motors, and circuits where provision must be made for momentary surges.					

2. Enclosed Link Type

MS Part No.		Voltage Rating		Current Rating		
MS28937	–5	115/200 VAC,	28 VDC	5 Amps	24124–5,	24125–5
	–10			10 Amps	–10	–10
	–20			20 Amps	–20	–20
	–30			30 Amps	–30	–30
	–40			40 Amps	–40	–40
	–50			50 Amps	–50	–50
	–60			60 Amps	–60	–60

Table 3. Cross Reference of Military and Commercial Fuse Designations

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED					
(Military New)	81349	96906	71400	71400	75915	75915	75915	98997
F01A250V1/500A [1]	FO1GR002	M590077–	AGX1/500	8AG1/500	361.002		364.002	
F01A250V1/200A	F01GR005	M590077–	AGX1/200	8AG1/200	361.005		364.005	
F01A250V1/100A	F01GR010	M590077–	AGX1/100	8AG1/100	361.010		364.010	
F01A250V1/32A	F01GR031	M590077–	AGX1/32	8AG1/32	361.031		364.031	
F01A250V1/16A	F01GR062	M590077–	AGX1/16	8AG1/16	361.062		364.062	8AG1/16
F01A250V1/10A	F01GR100	5	AGX1/10	8AG1/10	361.100		364.100	8AG1/10
F01A250V1/8A	F01GR125	M590077–	AGX1/8	8AG1/8	361.125	362.125	364.125	8AG1/8
F01A250V3/16A	A	6	AGX3/16	8AG3/16	361.187		364.187	8AG3/16
F01A250V2/10A			AGX2/10	8AG2/10	361.200		364.200	8AG2/10
F01A250V1/4A	F01GR250	M590077–	AGX1/4	8AG1/4	361.250	362.250	364.250	8AG1/4
F01A250V3/8A	F01GR375	M590077–	AGX3/8	8AG3/8	361.375	362.375	364.375	8AG3/8
F01A250V4/10A	A	8	AGX4/10	8AG4/10	361.400		364.400	8AG4/0
F01A250V1/2A	F01GR500	M590077–	AGX1/2	8AG1/2	361.500	362.500	364.500	8AG1/2
F01Al25V6/10A	A	9	AGX6/10	8AG6/10				8AG6/10
F01Al25V3/4A	F01GR750	M590077–	AGX3/4 [3]	8AG3/4 [3]	361.750 [3]	362.750 [3]	364.750 [3]	8AG3/4 [3]
F01Al25V8/10A	A [3]	10 [3]	AGX8/10	8AG8/10 [3]				8AG8/10 [3]
F01Al25V1A	F01G1R00	M590077–	AGX1 [3]	8AG1 [3]	361.001 [3]	362001 [3]	364001 [3]	8AG1 [3]
F01Al25V11/4A	A [3]	11 [3]		8AG11/4 [3]				8AG11/4 [3]
F01Al25V11/2	F01G1R50	M590077–	AGX11/2 [3]	8AG11/2 [3]	36101.5 [3]	36201.5 [3]	36401.5 [3]	8AG11/2 [3]
F01Al25V16/10A	A [3]	12 [3]		8AG16/10 [3]				8AG16/10 [3]
F01Al25V2A	F01G2R00	M590077–	AGX2 [3]	8AG2 [3]	361002 [3]	362002 [3]	364002 [3]	8AG2 [3]
F01Al25V21/2A	A [3]	13 [3]	AGX2 1/2					
F01Al25V3A			AGX3		361003	362003 [3]		
F01Al25V31/2A			AGX3 1/2					
F01Al25V4A			AGX4		361004			
F01Al25V5A			AGX5		361005	362005		
F01A32V6A			AGX6			362006		
F01A32V7A			AGX7					
F01A32V8A			AGX8			362008		
F01A32V10A			AGX10			362010		
F01A32V15A			AGX15			362015		
F01A32V20A			AGX20			362020		
F01A32V25A			AGX25			362025		
F01A32V30A			AGX30			362030		

See Footnotes at the end of the Table

Table 3. Cross Reference of Military and Commercial Fuse Designations (Continued)

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED						
(Military New)	81349	81349	96906	71400	71400	75915	75915	75915	98997
F02A250V1/100A	F02GR010A[1]	F02CR010[1]	MS90078–1[2]	AGC1/100		311.010	312.010	392.010	3AG1/100
F02A250V1/32A	F02GR031A	F02CR031	M590078–2	AGC1/32		311.031	312.031	392.031	3AG1/32
F02A250V1/16A	F02GR062A	F02CR062	M590078–3	AGC1/16	MGB1/16	311.062	312.062	392.062	3AG1/16
F02A250V1/8A	F02GR125A	F02CR125	MS90078–4	AGC1/8	MGB1/8	311.125	312.125	392.125	3AG1/8
F02A250V15/100A				AGC15/100		311.150	312.150	392.150	3AG15/100
F02A250V175/1000A				AGC175/1000		311.175	312.175	392.175	3AG175/1000
F02A250V3/16A				AGC3/16		311.187	312.187	392.187	3AG3/16
F02A250V2/10A				AGC2/10		311.200	312.200	392.200	3AG2/10
F02A250V1/4A	F02GR250A	F02CR250	M590078–5	AGC1/4		311.250	312.250	392.250	3AG1/4
F02A250V3/10A				AGC3/10		311.300	312.300	392.300	3AG3/10
F02A250V3/8A	F02GR375A	F02CR375	M590078–6	AGC3/8		311.375	312.375	392.375	3AG3/8
F02A250V1/2A	F02GR500A	F02CR500	M590078–7	AGC1/2		311.500	312.500	392.500	3AG1/2
F02A250V6/10A				AGC6/10		311.600	312.600	392.600	3AG6/10
F02A250V3/4A	F02GR750A	F02CR750	M590078–8	AGC3/4		311.750	312.750	392.750	3AG3/4
F02A250V1A	F02G1R00A	F02C1R00	M590078–9	AGC1		311001	312001	392001	3AG1
F02A250V0/ 1/4A				AGC1 1/4		3111.25	3121.25	3921.25	3AG1 1/4
F02A250V1/ 1/2A	F02G1R50A	F02C1R50	M590078–10	AGC1 1/2		3111.50	3121.50	3921.50	3AG1 1/2
F02A250V16/10A				AGC16/10		3111.60	3121.60	3921.60	3AG16/10
F02A250V2A	F02G2R00A	F02C2R00	M590078–11	AGC2		311002	312002	392002	3AG2
F02A250V2 1/2A				AGC2 1/2		31102.5	31202.5	39202.5	3AG2 1/2
F02A250V3A	F02G3R00A	F02C3R00	M590078–12	AGC3		311003	312003	392003	3AG3
F02A250V4A	F02G4R00A	F02C4R00	M590078–13	AGC4	MTH4	311004	312004	392004	3AG4
F02A250V5A	F02G5R00A	F02C5R00	M590078–14	AGC5	MTH5	311005	312005	392005	3AG5
F02A250V6A	F02G6R00A	F02C6R00	M590078–15	AGC6	MTH6	311006	312006	392006	3AG6
F02Al25V8A	F02A32V8A	F02D8R00		AGC8	GLH8				
F02Al25V10A	F02A32V10A	F02D10R0		AGC10	GLH10				
F02A32V15A		F02A15R0		AGC15					
F02A32V20A		F02A20R0		AGC20					
F02A32V25A		F02A25R0		AGC25					
F02A32V30A		F02A30R0		AGC30					

See Footnotes at the end of Table

Table 3. Cross Reference of Military and Commercial Fuse Designations (Continued)

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED			
(Military New)	81349	81349	71400	75915	75915	98997
F02B250V 1/100A [1]	F02GR010B [1]	MS90078–16	MDL 1/100	393.010	313.010	3AGTL 1/100 A–250V
F02B250V 1/32 A	F02GR031B	M590078–17 [2]	MDL 1/32	393.031	313.031	3AGTL 1/32 A–250V
F02B250V 1/16 A	F02GR062B	M590078–18	MDL 1/16	393.062	313.062	3AGTL 1/16 A–250V
F02B250V 1/10 A			MDL 1/10		313.100	3AGTL 1/10 A–250V
F02B250V 1/8 A	F02GR125B	M590078–19	MDL 1/8	393.125	313.125	3AGTL 1/8 A–250V
F02B250V 15/100A			MDL 15/100		313.150	3AGTL 15/100A–250V
F02B250V 3/16 A			MDL 3/16		313.187	3AGTL 3/16 A–250V
F02B250V 2/10 A			MDL 2/10		313.200	3AGTL 2/10 A–250V
F02B250V 1/4 A	F02GR250B	M590078–20	MDL 1/4	393.250	313.250	3AGTL 1/4 A–250V
F02B250V 3/10A			MDL 3/10		313.300	3AGTL 3/10 A–250V
F02B250V 3/8 A	F02GR375B	M590078–21	MDL 3/8	393.375	313.375	3AGTL 3/8 A–250V
F02B250V 4/10 A			MDL 4/10		313.400	3AGTL 4/10 A–250V
F02B250V 1/2 A	F02GR500B	M590078–22	MDL 1/2	393.500	313.500	3AGTL 1/2 A–250V
F02B250V 6/10 A			MDL 6/10		313.600	3AGTL 6/10 A–250V
F02B250V 7/10 A			MDL 7/10		313.700	3AGTL 7/10 A–250V
F02B250V 3/4 A	F02GR750B	M590078–23	MDL 3/4	393.750	313.750	3AGTL 3/4 A–250V
F02B250V 8/10 A			MDL 8/10		313.800	3AGTL 8/10 A–250V
F02B250V 1 A	F02G1R00B	M590078–24	MDL 1	393.001	313001	3AGTL 1 A–250V
F02B250V 1 1/4 A			MDL 1 1/4		3131.25	3AGTL 1 1/4 A–250V
F02B250V 1 1/2 A	F02D1R50B	M590078–25	MDL 1 1/2		31301.5	3AGTL 1 1/2 A–250V
F02B250V 1 6/10A			MDL 1 6/10		31301.6	3AGTL 1 6/10A–250V
F02B250V 2 A	F02D2R00B	N590078–26	MDL 2		313002	3AGTL 2 A–250V
F02B250V 2 1/2 A			MDL 2 1/2		31302.5	3AGTL 2 1/2 A–250V
F02B250V 2 8/10A			MDL 2 8/10		31302.8	3AGTL 2 8/10A–250V
F02B250V 3 A	F02D3R00B	M590078–27	MDL 3		313003	3AGTL 3 A–250V
F02B250V 3 2/10A			MDL 3 2/10		31303.2	3AGTL 3 2/10A–250V
F02B125V 4 A			MDX 4		313004 [3]	3AGTL 4 A–250V [3]
F02B125V 5 A			MDX 5		313005 [3]	3AGTL 5 A–250V [3]
F02B125V 6 1/4 A			MDX 6 1/4		3136.25	
F02B25V 7 A			MDX 7		313007	
F02B32V 8 A			MDL 8		313008	3AGTL 8 A32V
F02B32V 10 A			MDL 10		313010	3AGTL 10 A32V
F02B32V 12 A			MDL 12		313012	3AGTL 12 A32V
F02B32V 15 A			MDL 15		313015	
F02B32V 20 A			MDL 20		313020	3AGTL 20 A32V
F02B32V 25 A			MDL 25		313025	
F02B32V 30 A			MDL 30		313030	

See Footnotes at the end of the Table

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

SUPERSEDING NO. (Military New)	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED					
	81349	96906	71400	71400	75915	75915	75915	98997
F03A250V1–4A [1]			ABC1/4	MB01/4	394.250	314.250	3AB 1/4	3AB 1/4
F03A250V1–2A			ABC1/2	MB01/2	394.500	314.500	3AB1/2	3AB 1/2
F03A250V1A			ABC1	MB01	394001	314001	3AB1	3AB1
F03A250V1–1/4A	F03G1R00A [1]	MS90079–1 [2]	ABC11/4	MB011/4	3941.25	3141.25	3AB11/4	3AB11/4
F03A250V1–1/2A			ABC11/2	MB011/2	39401.5	31401.5	3AB1 1/2	3AB11/2
F03A250V2A			ABC2	MB02	394002	314002	3AB2	3AB2
F03A250V3A	F03G3R00A	MS90079–2	ABC3	MB03	394003	314003	3AB3	3AB3
F03A250V4A			ABC4	MB04	394004	314004	3AB4	3AB4
F03A250V5A	F03G5R00A	MS90079–3	ABC5	MB05	394005	314005	3AB5	3AB5
F03A250V6A			ABC6	MB06	394006	314006	3AB6	3AB6
F03A250V8A	F03G8R00A	MS90079–4	ABC8	MB08	394008	314008	3AB8	3AB8
F03A250V10A	F03G10R0A	MS90079–5	ABC10	MB010	394010	314010	3AB10	3AB10
F03A250V12A	F03G12R0A	MS90079–6	ABC12	MB012	394012	314012	3AB12	3AB12
F03A250V15A	F03G15R0A	MS90079–7	ABC15	MB015	394015	314015	3AB15	3AB15
F03Al25V20A	F03D20R0A	MS90079–8	ABC20	MB020	394020	314020	3AB20	3AB20
F03Al25V25A			ABC25	MB025	394025	314025	3AB25	3AB25
F03Al25V30A	F03D30R0A	MS90079–9	ABC30	MB030	394030	314030	3AB30	3AB30
F03B250V1/100A	F03GR010B	MS90079–10	MDA1/100	MDF1/100	390.010	323.010		3ABTL1/100
F03B250V1/32A	F03GR031B	MS90079–11	MDA1/32	MDF1/32	390.031	323.031		3ABTL1/32
F03B250V1/16A	F03GR062B	MS90079–12	MDA1/16	MDF1/16	390.062	323.062		3ABTL1/16
F03B250V1/8A	F03GR125B	MS90079–13	MDA1/8	MDF1/8	390.125	323.125		3ABTL1/8
F03B250V15/100A	F03GR150B	MS90079–14	MDA15/100	MDF15/100	390.150	323.150		3ABTL15/10
F03B250V3/16A	F03GR187B	MS90079–15	MDA3/16	MDF3/16	390.187	323.187		3ABTL3/16
F03B250V1/4A	F03GR250B	MS90079–16	MDA1/4	MDF1/4	390.250	323.250		3ABTL1/4
F03B250V3/10A			MDA3/10	MDF3/10	390.300	323.300		3ABTL3/10
F03B250V3/8A	F03GR375B	MS90079–17	MDA3/8	MDF3/8	390.375	323.375		3ABTL3/8
F03B250V1/2A	F03GR500B	MS90079–18	MDA1/2	MDF1/2	390.500	323.500		3ABTL1/2
F03B250V6/10A			MDA6/10	MDF6/10	390.600	323.600		3ABTL6/10
F03B250V3/4A	F03GR750B	MS90079–19	MDA3/4	MDF3/4	390.750	323.750		3ABTL3/4
F03B250V8/10A			MDA8/10	MDF8/10	390.800	323.800		3ABTL8/10
F03B250V1A	F03G1R00B	MS90079–20	MDA1	MDF1	390001	323001		3ABTL1
F03B250V1 1/4A			MDA11/4	MDF11/4	390.250	3231.25		3ABTL11/4

See Footnotes at the end of the Table

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED					
(Military New)	81349	96906	71400	71400	75915	75915	75915	98997
F03B250V1 1/2A			MDA11/2	MDF11/2	390.500	32301.5		3ASTL11/2
F03B250V1 6/10A			MDA16/10	MDF16/10	390.600	32301.6		3ABTL16/10
F03B250V2A	F03B125V2A		MDA2	MDF2	390002	323002		3ABTL2
F03B250V2 1/2A	F03B125V21/2A		MDA21/2	MDF21/2	39002.5	32302.5		3ABTL21/2
F03B250V2 8/10A	F03B125V28/10A		MDA28/10	MDF28/10	39002.8	32302.8		3ABTL28/10
F03B250V3A [1]	F03GR00B [1]	MS90079–21 [2]	MDA3	MDF3	390003	323003		3ABTL3
	F03B125V3A							
F03B250V3–2/10A	F03B125V32/10A		MDA32/10	MDF32/10	39003.2	32303.2		3ABTL32/10
F03B125V4A			MDA4 [3]	MDF4 [3]	390004	323004		3ABTL4
F03B125V5A	F03G5R00B [3]	MS90079–22 [3]	MIDA5 [3]	MDF5 [3]	390005	323005		3ABTL5
	F03D5R00B							
	F03B32V5A							
F03B125V61/4 A	F03B32V6–1/4A1		MDF6 1/4	MDA6 1/4	3906.25	3236.25		3ABTL6 1/4
F03B125V7A	F03B32V7A		MDF7	MDA7	390007	323007		3ABTL7
F03B125V8A	F03G8R00B [3]	MS90079–23 [2]	MDF8	MDA8	390008	323008		3ABTL8
	F03B32V8A							
F03B125V10A	F03G10R0B [3]	MS90079–24	MDF10 [3]	MDA10 [3]	390010	323010		3ABTL10
	F03B32V10A							
F03B125V12A	F03G12R0B [3]	M590079–25	MDF12 [3]	MDAl2 [3]	390012	323012		3ABTL12
	F03B32V12A							
F03B125V15A	F03G15R0B [3]	M590079–26	MDF15 [3]	MDA15 [3]	390015	323015		3ABTL15
	F03B32V15A							
F03B125V20A	F03D20R0B	M590079–27	MDF20 [3]	MDA20 [3]	390020	323020		3ABTL20
	F03B32V20A							
F03B125V25A	F03D25R0B		MDF25	MDA25	390025	323025		3ABTL25
	F03B32V25A							
F03B125V30A	F03D30R0B	M590079–28	MDF30	MDA30	390030	323030		3ABTL30
	F03B32V30A							

Footnotes

[1] A letter S following the part number signifies silver plating.

[2] A second dash number (–1) signifies silver plating.

[3] Replacement of these commercial superseded fuses and military superseded fuses with the superseding number fuses are in exception to general practices stated herein (see paragraph 18.4 step e). In any other case, application personnel should contact the system manager first before substituting a higher voltage rated fuse with a lower voltage rated fuse.

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

MILITARY SUPERSEDED	SUPERSEDING NO. (Military New)	COMMERCIAL SUPERSEDED	
*F04A5R0A	*F02A 250V 5A	MTH or AGC 5	312 3AG 5A 250V
F04A10R0A	F02A 32V 10A	AGC 10	311 3AG 10A 32V
F04A15R0A	F02A 32V 15A	AGC115	311 3AG 15A 32V
F04A20R0A	F02A 32V 20A	AGC 20	311 3AG 20A 32V
F04A5R00B	F02B 32V 5A	MDL 5	
F04A10R0B	F02B 32V 10A	MDL 10	313 3AG 10A 32V
F04A15R0B	F02B 32V 15A	MDL 15	313 3AG 15A 32V
F04A20R0B	F02B 32V 20A	MDL 20	313 3AG 20A 32V
F05A10R0A	F05A 32V 10A	AGS 10	411 4AG 10A 32V
F05A15R0A	F05A 32V 15A	AGS 15	411 4AG 15A 32V
F05A20R0A	F05A 32V 20A	AGS 20	411 4AG 20A 32V
F05A25R0A	F05A 32V 25A	AGS 25	411 4AG 25A 32V
F05A30R0A	F05A 32V 30A	AGS 30	411 4AG 30A 32V
F05A35R0A	NONE	AGS 35	411 4AG 35A 32V
F05A40R0A	NONE	AGS 40	411 4AG 40A 32V
F05A10R0B	F05B 32V 10A	MDM 10	413 4AG 10A 32V
F05A15R0B	F05B 32V 15A	MDM 15	413 4AG 15A 32V
F05A20R0B	F05B 32V 20A	MDM 20	413 4AG 20A 32V
F05A25R0B	F05B 32V 25A	MDM 25	413 4AG 25A 32V
F05A30R0B	F05B 32V 30A	MDM 30	413 4AG 30A 32V
F05A35R0B	NONE	MDM 35	
F05A40R0B	NONE	MDM 40	

* Indicates voltage change from military superseded fuse to superseding number fuse.
military superseded fuse to superseding number fuse.

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

Superseding No.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED			
(Military New)	81349	96906	71400	75915	75915	98997
F06A250V1A [1]	F06G1R00A [1]	MS90082–1 [2]	ABS1	494001	414001	4AB1
F06A250V2A	F06G2R00A	MS90082–2	ABS2	494002	414002	4AB2
F06A250V3A	F06G3R00A	MS90082–3	ABS3	494003	414003	4AB3
F06A250V5A	F06G5R00A	MS90082–4	ABS5	494005	414005	4AB5
F06A250V10A	F06G10R00A	MS90082–5	ABS10	494010	414010	4AB10
F06A250V15A	F06G15R00A	MS90082–6	ABS15	494015	414015	4AB15

Footnotes
[1] A letter S following the part number signifies silver plating.
[2] A second dash number (–1) signifies silver plating.

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

Superseding No. (Military New)	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED		
	81349	96906	71400	75915	75915
F07A250V1A [1]	F07G1R00A [1]		AGU1	590001	512001
F07A250V2A	F07G2R00A		AGU2	590002	512002
F07A250V3A	F07G3R00A		AGU3	590003	512003
F07A32V5A	F07A5R00A	MS90083–1 [2]	AGU5	590005	512005
F07A32V10A	F07A10R0A	MS90083–2	AGU10	590010	512010
F07A32V15A	F07A15R0A	MS90083–3	AGU15	590015	512015
F07A32V20A	F07A20R0A	MS90083–4	AGU20	590020	512020
F07A32V30A	F07A30R0A	MS90083–5	AGU30	590030	512030
F07B125V1A			MDR1		
F07B125V2A			MDR2		
F07B125V3A			MDR3		
F07B32V5A		MS90083–10	MDR5		
F07B32V10A		MS90083–11	MDR10		
F07B32V15A		MS90083–12	MDR15		
F07B32V20A		MS90083–13	MDR20		
F07B32V30A		MS90083–14	MDR30		

Footnotes

[1] A letter S following the part number signifies silver plating.

[2] A second dash number (–1) signifies silver plating.

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

Military Superseded	Superseded No. (Military New)	Commerical Superseded	Commerical Superseded
F08G1R00A	F07A 250V 1A	AGU 1	512 5AG 1A 250V
F08G2R00A	F07A 250V 2A	AGU 2	512 5AG 2A 250V
F08G3R00A	F07A 250V 3A	AGU 3	512 5AG 3A 250V
*F08D5R00A	*F09A 250V 5A	BAN or **AGU 5	513 5AG 1A 250V
*F08D10R0A	*F09A 250V 10A	BAN or **AGU 10	513 5AG 2A 250V
*F08D15R0A	*F09A 250V 15A	BAN or **AGU 15	513 5AG 3A 250V [3]
*F08D20R0A	*F09A 250V 20A	BAN or **AGU 20	
*F08D25R0A	*F09A 250V 25A	BAN or **AGU 25	
*F08D30R0A	*F09A 250V 30A	BAN or **AGU 30	
F08G1R00B	F09B 250V 1A	FNM or **MDR 1	
F08G2R00B	F09B 250V 2A	FNM or **MDR 2	

Footnotes

* Indicates voltage change from old to new military replacement.

**Indicates that the commercial fuse is of a lower voltage rating than one or both military fuse replacement.

[3] Replacement of these commercial superseded fuses and military superseded fuses with the superseding number fuses are in exception to general practices stated herein (see paragraph 18.4 step e). In any other case, application personnel should contact the system manager first before substituting a higher voltage rated fuse with a lower voltage rated fuse.

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

Military Superseded	Superseded No. (Military New)	Commerical Superseded
*F08G3R00B	*F07B 125V 3A	**MDR 3
F08G5R00B	F09B 250V 5A	FNM or **MDR 5
*F08D10R0B	*F09B 250V 10A	FNM or **MDR 10
F08D15R0B	F09B 125V 15A	FNM or **MDR 15
*F08D20R0B	*F09B 32V 20A	**FNM or **MDR 20
*F08D25R0B	*F09B 32V 25A	**FNM or **MDR 25
*F08D30R0B	*F09B 32V 30A	**FNM or **MDR 30

Footnotes
*Indicates voltage change from old to new military replacement.
**Indicates that the commercial fuse is of a lower voltage rating than one or both military fuse replacement.
[3] Replacement of these commercial superseded fuses and military superseded fuses with the superseding number fuses are in exception to general practices stated herein (see paragraph 18.4 step e). In any other case, application personnel should contact the system manager first before substituting a higher voltage rated fuse with a lower voltage rated fuse.

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED				
(Military New)	81349	96906	96906	71400	72076	75915	71424
F09A250V 1A [1]	F09G1R00A [1]	MS90085–9 [2]	MS90084–1 [1]	BAN 1	M0L 1	525001	
F09A250V 2A	F09G2R00A	MS90085–15	MS90084–2	BAN 2	M0L 2	525002	
F09A250V 3A	F09G3R00A	MS90085–19	MS90084–3	BAN 3	M0L 3	525003	
F09A250V 3 1/2A	F09G3R50A	MS90085–21		BAN 3 1/2	M0L 3 1/2	52503.5	
F09A250V 4A	F09G4R00A	MS90085–22		BAN 4	M0L 4	525004	
F09A250V 5A	F09G5R00A	MS90085–24	MS90084–4	BAN 5	M0L 5	525005	
F09A250V 6A	F09G6R00A	MS90085–26		BAN 6	M0L 6	525006	
F09A250V 6 1/4A	F09G6R25A	MS90085–27		BAN 6 1/4	M0L 6 1/4	5256.25	
F09A250V 7A	F09G7R00A	MS90085–28		BAN 7	M0L 7	525007	
F09A250V 8A	F09G8R00A	MS90085–29		BAN 8	M0L 8	525008	
F09A250V 10A	F09G10R0A	MS90085–31	MS90084–5	BAN 10	M0L 10	525010	
F09A250V 15A	F09G15R0A	MS90085–32	MS90084–6	BAN 15	M0L 15	525015	
F09A250V 20A	F09G20R0A	MS90085–33	MS90084–7	BAN 20	M0L 20	525020	
F09A250V 25A	F09G25R0A	MS90085–34	MS90084–8	BAN 25	M0L 25	525025	
F09A250V 30A	F09G30R0A	MS90085–35	MS90084–9	BAN 30	M0L 30	525030	
F09B250V 1/10A	F09GR100B	MS90085–36		FNM 1/10			
F09B250V 15/100A	F09GR150B	MS90085–37		FNM 15/100			
F09B250V 2/10A	F09GR200B	MS90085–38		FNM 2/10			
F09B250V 3/10A	F09GR300B	MS90085–39		FNM 3/10			
F09B250V 4/10A	F09GR400B	MS90085–40		FNM 4/10			
F09B250V 1/2A	F09GR500B	MS90085–41		FNM 1/2			
F09B250V 6/10A	F09GR600B	MS90085–42		FNM 6/10			
F09B250V 8/10A	F09GR800B	MS90085–43		FNM 8/10			
F09B250V 1A	F09G1R00B	MS90085–44	MS90084–10	FNM 1	MEN 1		
F09B250V 11/8A	F09G1R12B	MS90085–45		FNM 11/8	MEN 11/8		
F09B250V 1 1/4A	F09G1R25B	MS90085–46		FNM 1	MEN 1		
F09B250V 14/10A	F09G1R40B	MS90085–47		FNM 14/10	MEN 14/10		
F09B250V 16/10A	F09G1R60B	MS90085–48		FNM 16/10	MEN 16/10		
F09B250V 18/10A	F09G1R80B	MS90085–49		FNM 18/10	MEN 18/10		
F09B250V 2A	F09G2R00B	MS90085–50	MS90084–11	FNM 2	MEN 2		
F09B250V2 1/4A	F09G2R25B	MS90085–51		FNM 2 1/4	MEN 2 1/4		

Footnotes
[1] A letter S following the part number signifies silver plating.
[2] A second dash number (–1) signifies silver plating.

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

Superseding No.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED				
(Military New)	81349	96906	96906	71400	72076	75915	71424
F09B250V 2 1/2A	F09G2R50B	MS90085–52		FNM 2 1/2	MEN 2 1/2		
F09B250V 28/10A	F09G2R80B	MS90085–53		FNM 28/10	MEN 28/10		
F09B250V 32/10A	F09G3R20B	MS90085–55		FNM 31/10	MEN 31/10		
F09B250V 3 1/2A	F09G3R50B	MS90085–56		FNM 3 1/2	MEN 3 1/2		
F09B250V 4A	F09G4R00B	MS90085–57		FNM 4	MEN 4		
F09B250V 4 1/2A	F09G4R50B	MS90085–58		FNM 4.5	MEN 4 1/2		
F09B250V 5A	F09G5R00B	MS90085–59		FNM 5	MEN 5		
F09B250V 56/10A	F09G5R60B	MS90085–60		FNM 56/10	MEN 56/10		
F09B250V 6 1/4A	F09G6R25B	MS90085–62		FNM 6 1/4	MEN 6 1/4		
F09B250V 7A	F09G7R00B	MS90085–63		FNM 7	MEN 7		
F09B250V 8A	F09G8R00B	MS90085–64		FNM 8	MEN 8		
F09B250V 9A	F09G9R00B	MS90085–65		FNM 9	MEN 9		
F09B250V 10A [1]	F09D10R0B [1]	MS90085–66 [2]	MS90084–14 [1]	FNM 10	MEN 10		
F09B125V 12A	F09D12R0B	– – –	– – –	FNM 12	– – –		
F09B125V 15A	F09D15R0B	MS90085–67	MS90084–15	FNM 15	MEN 15		TRM 15
F09B32V 20A	F09D20R0B	MS90085–68	MS90084–16	FNM 20	MEN 20		TRM 20
F09B32V 25A	F09D25R0B	MS90085–69	MS90084–17	FNM 25	MEN 25		TRM 25
F09B32V 30A	F09D30R0B	MS90085–70	MS90084–18	FNM 30	MEN 30		TRM 30

Footnotes
[1] A letter S following the part number signifies silver plating.
[2] A second dash number (–1) signifies silver plating.

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED
(Military New)	81349	96906	71400
F10A250V 1A [1]	F10G1R00A [1]	MS15453–1 [2]	MIN 1
F10A250V 2A	F10G2R00A	MS15453–2	MIN 2
F10A250V 3A	F10G3R00A	MS15453–3	MIN 3
F10A250V 4A	F10G4R00A	MS15453–4	MIN 4
F10A250V 5A	F10G5R00A	MS15453–5	MIN 5
F10A250V 6A	F10G6R00A	MS15453–6	MIN 6
F10A250V 8A	F10G8R00A	MS15453–7	MIN 8
F10A250V 10A	F10G10R0A	MS15453–8	MIN 10
F10A250V 12A	F10G12R0A	MS15453–9	MIN 12
F10A250V 15A	F10D15R0A	MS15453–10	MIN 15
F10A125V 20A	F10D20R0A	MS15453–11	MIN 20
F10A125V 25A	F10D25R0A		MIN 25
F10A125V 30A	F10D30R0A		MIN 30
F10B250V 1/10A			FNJ 1/10
F10B250V 15/100A			FNJ 15/100
F10B250V 2/10A			FNJ 2/10
F10B250V 3/10A			FNJ 3/10
F10B250V 4/10A			FNJ 4/10
F10B250V 1/2A			FNJ 1/2
F10B250V 6/10A			FNJ 6/10
F10B250V 8/10A			FNJ 8/10
F10B250V 1A			FNJ 1
F10B250V 1 1/4A			FNJ 1 1/4
F10B250V 2A			FNJ 2
F10B250V 2 1/2A			FNJ 2 1/2
F10B250V 3A			FNJ 3
F10B250V 3 2/10A			FNJ 3 2/10
F10B250V 4A			FNJ 4

Footnotes
[1] A letter S following the part number signifies silver plating.
[2] A second dash number (–1) signifies silver plating.

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

SUPERSEDING NO.	MILITARY SUPERSEDED		COMMERCIAL SUPERSEDED
(Military New)	81349	96906	71400
F10B250V 5A			FNJ 5
F10B250V 5 6/10A			FNJ 5 6/10
F10B250V 6 1/4A			FNJ 6 1/4
F10B250V 7A	F10G7R00B		FNJ 7
F10B250V 8A	F10G8R00B		FNJ 8
F10B250V 10A	F10G10A08		FNJ 10

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

SUPERSEDING PART NO.	SUPERSEDED PART NO.				
FM02A125V1/500A	FM02–125V–1/500A	FM02–1/500A	FM02125V1/500A	FM021/500A	M23419/2–001
FM02A125V1/200A	FM02–125V–1/200A	FM02–1/200A	FM02125V1/200A	FM021/200A	M23419/2–002
FM02A125V1/100A	FM02–125V–1/100A	FM02–1/100A	FM02125V1/100A	FM021/100A	M23419/2–003
FM02A125V1/64A	FM02–125V–1/64A	FM02–1/64A	FM02125V1/64A	FM021/64A	M23419/2–004
FM02A125V1/32A	FM02–125V–1/32A	FM02–1/32A	FM02125V1/32A	FM021/32A	M23419/2–005
FM02A125V1/16A	FM02–125V–1/16A	FM02–1/16A	FM02125V1/16A	FM021/16A	M23419/2–006
FM02A125V1/10A	FM02–125V–1/10A	FM02–1/10A	FM02125V1/10A	FM021/10A	M23419/2–007
FM02A125V1/8A	FM02–125V–1/8A	FM02–1/8A	FM02125V1/8A	FM021/8A	M23419/2–008
FM02A125V2/10A	FM02–125V–2/10A	FM02–2/10A	FM02125V2/10A	FM022/10A	M23419/2–009
FM02A125V1/4A	FM02–125V–1/4A	FM02–1/4A	FM02125V1/4A	FM021/4A	M23419/2–010
FM02A125V3/10A	FM02–125V–3/10A	FM02–3/10A	FM02125V3/10A	FM023/10A	M23419/2–011
FM02A125V4/10A	FM02–125V–4/10A	FM02–4/10A	FM02125V4/10A	FM024/10A	M23419/2–012
FNI2A125V1/2A	FM02–125V–5/10A	FN02–5/10A	FM02125V5/10A	FM025/10A	M23419/2–013
FM02A125V6/10A	FM02–125V–6/10A	FM02–6/10A	FM02125V6/10A	FM026/10A	M23419/2–014
FM02A125V3/4A	FM02–125V–3/4A	FM02–3/4A	FM02125V3/4A	FM023/4A	M23419/2–015
FM02A125V1A	FM02–125V–1A	FM02–1A	FM02125V1A	FM021A	M23419/2–016
FM02A125V1–1/2A	FM02–125V–1–1/2A	FM02–1–1/2A	FM02125V1–1/2A	FM021–1/2A	M23419/2–017
FNI2A125V2A	FM02–125V–2A	FM02–2A	FM02125V2A	FM022A	M23419/2–018
FM02A125V3A	FM02–125V–3A	FM02–3A	FM02125V3A	FM023A	M23419/2–019
FM02A125V4A	FM02–125V–4A	FM02–4A	FM02125V4A	FM024A	M23419/2–020
FM02A125V5A	FM02–125V–5A	FM02–5A	FM02125V5A	FM025A	M23419/2–021

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

MILITARY SUPERSEDED	SUPERSEDING NO. (Military New)	SUPERSEDED COMMERCIAL
FM03A 250V 1/100A	FM09A 250V 1/100A	ABC 1/100A
FM03A 250V 1/32A	FM09A 250V 1/32A	ABC 1/32A
FM03A 250V 1/16A	FM09A 250V 1/16A	ABC 1/16A
FM03A 250V 1/8A	FM09A 250V 1/8A	ABC 1/8A
FM03A 250V 1/4A	FM09A 250V 1/4A	ABC 1/4A
FM03A 250V 3/8A	FM09A 250V 3/8A	ABC 3/8A
FM03A 250V 1/2A	FM09A 250V 1/2A	ABC 1/2A
FM03A 250V 3/4	FM09A 250V 3/4A	ABC 3/4A
FM03A 250V 1A	FM09A 250V 1A	ABC 1A
FM03A 250V 1–1/2A	FM09A 250V 1–1/2A	ABC 1–1/2A
FM03A 250V 2A	FM09A 250V 2A	ABC 2A
FM03A 250V 3A	FM09A 250V 3A	ABC 3A
FM03A 250V 4A	FM09A 250V 4A	ABC 4A
FM03A 250V 5A	FM09A 250V 5A	ABC 5A
FM03A 250V 6A	FM09A 250V 6A	ABC 6A
FM03A 250V 8A	FM09A 250V 8A	ABC 8A
FM03A 250V 10A	FM09A 250V 10A	ABC 10A
FM03A 250V 12A	FM09A 250V 12A	ABC 12A
FM03A 250V 15A	FM09A 250V 15A	ABC 15A
FM03A 250V 20A	FM09A 250V 20A	ABC 20A

Table 3. Cross Reference of Military and Commercial Fuse Designations – Continued

MILITARY SUPERSEDED	SUPERSEDING NO. (Military New)	SUPERSEDED COMMERCIAL
FM03A 250V 25A	FM09A 250V 25A	ABC 25A
FM03A 250V 30A	FM09A 250V 30A	ABC 30A
FM06 250V 1/100A	FM09B 250V 1/100A	MDA 1/100A
FM06 250V 1/32A	FM09B 250V 1/32A	MDA 1/32A
FM06 250V 1/16A	FM09B 250V 1/16A	MDA 1/16A
FM06 250V 1/10A	FM09B 250V 1/10A	MDA 1/10A
FM06 250V 1/8A	FM09B 250V 1/8A	MDA 1/8A
FM06 250V 15/100A	FM09B 250V 15/100A	MDA 15/100A
FM06 250V 3/16A	FM09B 250V 3/16A	MDA 3/16A
FM06 250V 2/10A	FM09B 250V 2/10A	MDA 2/10A
FM06 250V 1/4A	FM09B 250V 1/4A	MDA 1/4A
FM06 250V 3/10A	FM09B 250V 3/10A	MDA 3/10A
FM06 250V 3/8A	FM09B 250V 3/8A	MDA 3/8A
FM06 250V 4/10A	FM09B 250V 4/10A	MDA 4/10A
FM06 250V 1/2A	FM09B 250V 1/2A	MDA 1/2A
FM06 250V 6/10A	FM09B 250V 6/10A	MDA 6/10A
FM06 250V 7/10A	FM09B 260V 7/10A	MDA 7/10A
FM06 250V 3/4A	FM09B 250V 3/4A	MDA 3/4A
FM06 250V 1A	FM09B 250V 1A	MDA 1A
FM06 250V 1–1/4A	FM09B 250V 1–1/4A	MDA 1–1/4A
FM06 250V 1–1/2A	FM09B 250V 1–1/2A	MDA 1–1/2A
FM06 250V 1–6/10A	FM09B 250V 1–6/10A	MDA 1–6/10A
FM06 250V 2A	FM09B 250V 2A	MDA 2A
FM06 125V 2–1/2A	FM09B 250V 2–1/24	MDA 2–1/2A
FM06 125V 2–8/10A	FM09B 250V 2–8/10A	MDA 2–8/10A
FM06 125V 3A	FM09B 250V 3A	MDA 3A
FM06 125V 3–2/10A	FM09B 250V 3–2/10A	MDA 3–2/10A
FM06 125V 4A	FM09B 125V 4A	MDA 4A [3]
FM06 125V 5A	FM09B 125V 5A	MDA 5A [3]
FM06 125V 6–1/4A	FM09B 125V 6–1/4A	MDA 6–1/4A [3]
FM06 125V 7A	FM09B 125V 7A	MDA 7A [3]
FM06 125V 8A	FM09B 125V 8A	MDA 8A [3]
FM06 125V 10A	FM09B 125V 10A	MDA 10A [3]
FM06 125V 12A	FM09B 125V 12A	MDA 12A [3]
FM06 125V 15A	FM09B 125V 15A	MDA 15A [3]
FM06 125V 20A	FM09B 125V 20A	MDA 20A [3]
FM06 125V 25A	FM09B 125V 25A	MDA 25A
FM06 125V 30A	FM09B 125V 30A	MDA 30A

Footnotes
[3] Replacement of these commercial superseded fuses and military superseded fuses with the superseding number fuses are in exception to general practices stated herein (see paragraph 18.4 step e). In any other case, application personnel should contact the system manager first before substituting a higher voltage rated fuse with a lower voltage rated fuse.

79. **FUSEHOLDERS**.

80. Extractor post fuseholders in accordance with Military Specification MIL–F–19207 are used in conjunction with cartridge type fuses. Block type fuseholders in accordance with Military Specification MIL–F–5373 are used with enclosed link fuses (see Figures 15 and 16).

81. **AIRCRAFT CURRENT LIMITERS**.

82. **GENERAL**. A limiter is a device that responds only to high values of overcurrent and is applied with this criterion in mind. A limiter is designed specifically with a high temperature melting point to provide protection for electric power distribution systems against short-circuit currents.

83. **CLASSIFICATION OF CURRENT LIMITERS**. There are two basic types of aircraft limiters that are used in aircraft electrical power systems. The most widely used limiter is of the knife blade style and Gives visual indication of a blown limiter by a spring activated pin that extends from the limiter body. The other type of limiter is the bolt-on type with an insulating window covering the link for visual inspection.

84. **APPLICATIONS OF CURRENT LIMITERS**. Limiters are usually applied in aircraft as back-up protection for circuit breakers and in multiple cable circuits for isolating faulted cable.

85. **PART NUMBERING SCHEME**. The following part numbering example for current limiters will typically apply:

MS 28937-10

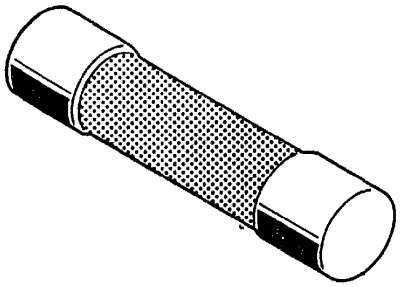
Where:

MS 28937=the military part number
10=amperage rating of the current limiter

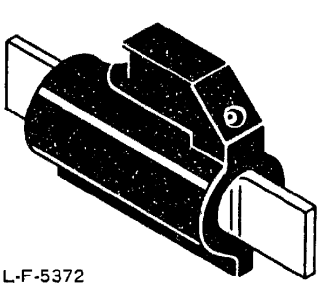
86. **GENERAL SIZING**. Aircraft limners are usually sized according to their tine-current characteristics.

87. **CIRCUIT BREAKER BACK-UP PROTECTION**. Where the available short circuit currents exceed the interrupting rating of a circuit breaker, an aircraft limiter may be used to limit the short-circuit current to within the breaker's capability.

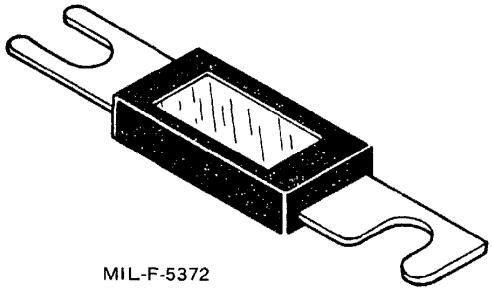
88. **SHORT CIRCUIT PROTECTION**. Where multiple cable runs have been designed into the system, and single cable fault isolation is required, aircraft limiters will be installed at each end of each cable.



CARTRIDGE TYPE



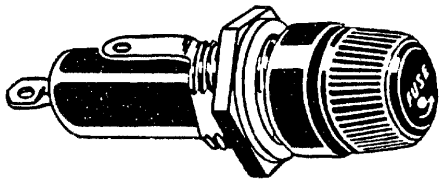
MIL-F-5372



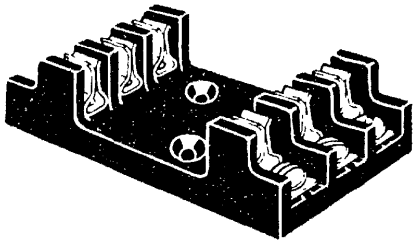
MIL-F-5372

ENCLOSED LINK TYPES

Figure 15. Typical Aircraft Fuses



EXTRACTOR POST TYPE
MIL-F-19207



BLOCK TYPE
MIL-F-5373

Figure 16. Typical Fuse Holders

WARNING

To prevent electrical shock, ensure electrical power is off before commencing work.

To prevent fire and damage to electrical equipment, do not replace a current limiter with one of a higher amperage rating.

89. **MAINTENANCE**. Periodic inspection of the limiter holding device is recommended to insure adequate pressure on the contact making members. Limiter characteristics do not change with age hence, no maintenance is required for those limiters in storage.

90. **IDENTIFICATION.**

a. Military Fuse Designations. Military fuse designations differ from commercial fuse designations and are divided into four parts as follows: (1) style, (2) blowtime characteristics, (3) voltage rating, and (4) current rating. To decode old and new military fuse designations (see Table 4 and 5).

b. Commercial Fuse Designations. Designations of various commercial fuses differ according to the manufacturer. However, when decoded, most of these designations provide the same general information, such as fuse type, current rating, voltage rating, and catalog number (see Table 4 and 5).

91. **GENERAL PRECAUTIONS.**

92. When replacing fuses in aircraft electrical systems, observe the following precautions:

a. Do not use tools except for fuse pullers to remove or insert fuses.

b. Make sure that the new fuse has the same electrical features as the fuse being replaced. The blow time characteristics are extremely important. Slow blow fuses will not be substituted for fast blow fuses. Temporary substitution of fast blow fuses for slow blow fuses is allowed.

c. Make sure that the plating on all metal parts is clean and intact.

d. Make sure that the wire inside the replacement fuse exhibits continuity.

e. Make sure that the replacement fuse has no cracks or breaks.

f. Do not force a fuse into a holder that does not readily accept it; check that a fuse of the correct size is being used.

CAUTION

Cartridge fuses marked F02 and F03 are 1–1/4 inches long and 1/4 inch diameter; fuses marked F05 and F06 are 1–1/4 inches long and 9/32 inch diameter. Do not interchange the two sizes.

g. Inspect fuse holder cap to ensure the rubber grommet is properly installed.

WARNING

Death or injury to personnel and damage to equipment may occur if these instructions are not followed.

h. Panel mounted fuseholder caps of the extractor–post type will be turned by finger pressure only. Use of tools to lock or unlock caps may damage them. The fuseholder cap must retain the fuse when either inserting or removing a fuse. Fuseholder caps which do not securely retain fuses must be discarded and a new fuseholder cap installed.

(1) When installing or removing fuses which are retained in extractor post type fuse holder caps, ensure the fuse remains in the extractor cap.

(2) If the fuse remains in the fuse holder body, the equipment must be disconnected from the power source while attempting to extract the fuse.

Table 4. Voltage Code (Previous)

Voltage Code Letter	Voltage (Volts)
A	32
B	52
C	90
D	125
G	250
H	500
J	1,000
K	2,500
N	5,000
P	10,000

Table 5. Current Code (Previous)

Current Code		Current (Amperes)	
R002	.002	=	1/500
R005	.005	=	1/200
R010	.010	=	1/100
R031	.031	=	1/32
R750	.750	=	3/4
1R50	1.50	=	1 1/2