INCH-POUND

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DETAIL SPECIFICATION

CIRCUIT BREAKER TYPES AQB/NQB, AIR, ELECTRIC, LOW VOLTAGE, INSULATED HOUSING (SHIPBOARD USE), GENERAL SPECIFICATION FOR

Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil.

AMSC N/A FSC 5925

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NOTE: See supplement 1 for list of specification sheets.

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers distribution circuit breakers with housings of insulating material for Naval shipboard use.

1.2 Classification. Circuit breakers are of the following types (see 3.1, 6.2, and 6.4.30).

AQB-A50	AQB-LF250	AQB-LF402
NQB-A50	NQB-A250	NQB-A402
AQB-A51	AQB-A252	AQB-A800
NQB-A51	AQB-LF252	NQB-A800
AQB-A100	NQB-A252	AQB-A802
AQB-LF100	AQB-A253	NQB-A802
NQB-A100	AQB-L253	NQB-A803
AQB-A101	NQB-A253	AQB-A1600
NQB-A101	AQB-A400	NQB-A1600
AQB-A102 (Types E/E1/E2)	AQB-LF400	AQB-A1601
NQB-A102	NQB-A400	NQB-A1601
AQB-A103	AQB-L400 QF	AQB-A1602
AQB-A103RMS	AQB-L400 QM	NQB-A1602
NQB-A103	AQB-LL400QS	AQB-A1604
AQB-LF226	NQB-LL400	NQB-A1604
AQB-A250	AQB-A402	

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

COMMERCIAL ITEM DESCRIPTIONS

A-A-59588 - Rubber, Silicone

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-901 - Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for

MIL-E-917 - Electric Power Equipment Basic Requirements

MIL-DTL-15024	-	Plates, Tags, and Bands for Identification of Equipment, General Specification for
MIL-P-15024/5	-	Plates, Identification
MIL-PRF-15160	-	Fuses: Instrument, Power, and Telephone, General Specification for
MIL-T-16315	-	Transformers, Power, Step-Down (Miscellaneous, Naval Shipboard Use)
MIL-DTL-83734	-	Sockets, Plug-in Electronic Components, Dual-In-Line (DIPS) and Single-In-Line Packages (SIPS), General Specification for

(See supplement 1 for list of specification sheets.)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130	-	Identification Marking of U.S. Military Property
MIL-STD-167-1	-	Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II – Internally Excited)
MIL-STD-461	-	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-1399-300	-	Interface Standard for Shipboard Systems, Section 300, Electric Power, Alternating Current (Metric)
MIL-STD-1686	-	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

U.S. GENERAL SERVICES ADMINISTRATION

GSA Global Supply Catalog

(Copies of this document are available from GSA Global Supply, 501 W. Felix Street, Ft. Worth, TX 76115 or online at www.gsa.gov.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN NATIONAL STANDARDS INSTITUE (ANSI)

ANSI/IEEE C37.09	-	Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis (DoD adopted)

(Copies of this document are available from the American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036 or online at www.ansi.org.)

ASTM INTERNATIONAL

ASTM B700	-	Standard Specification for Electrodeposited Coatings of Silver for Engineering Use

ASTM D412	-	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension. (DoD adopted)
ASTM D624	-	Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers (DoD adopted)
ASTM D2240	-	Standard Test Method for Rubber Property – Durometer Hardness (DoD adopted)
ASTM D5948	-	Standard Specification for Molding Compounds, Thermosetting (DoD adopted)
ASTM F1166	-	Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities (DoD adopted)

(Copies of these documents are available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or online at www.astm.org.)

IPC

IPC CC-830	-	Qualification and Performance of Electrical Insulating Compound for Printed Wiring Assemblies

(Copies of this document are available from IPC, 3000 Lakeside Drive, 309 S, Bannockburn, IL 60015 or online at www.ipc.org.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB-4	-	Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications

(Copies of this document are available from the National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209 or online at www.nema.org.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. The circuit breakers and associated equipment furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualification data set (QDS) before contract award (see 4.2 and 6.3).

3.3 Drawings. When specified (see 6.2), master drawings shall include the typical information as shown in Figure 1.

3.4. General performance requirements. See Tables V and VI for reference to applicable verification paragraphs in Section 4.

3.4.1 Creepage and clearance distances. Creepage and clearance distances shall be in accordance with MIL-E-917. Unless otherwise specified (see 6.2), set C spacings and enclosed type of enclosure apply. Any exposed metallic object, such as mounting screws, shall be considered ground potential.

3.4.2 Insulation. Insulation shall meet the material, dielectric strength, insulation resistance, and temperature rise requirements specified in 3.5.14.

3.4.3 Endurance/manual cycling. Circuit breakers shall have the ability to be cycled continuously for the number and rate of mechanical and electrical endurance operations as shown in the applicable specification sheets (see 3.1) without failure, evidence of undue wear, or development of operating irregularities in any part. See 3.5.19.2 for attachment endurance requirements. Circuit breakers shall have the ability to be manually cycled at various times during qualification testing as required by this specification (see Tables V and VI).

3.4.4 Calibration. Unless otherwise specified herein, circuit breakers shall perform in accordance with the applicable trip curves and/or overcurrent tables (long-time, short-time, instantaneous) in the specification sheets (see 3.1).

3.4.5 Inclination. Circuit breakers, fuse units, attachments, and mounting bases/blocks shall operate in accordance with the requirements specified herein when permanently inclined in any direction to a 45-degree maximum position from the normal vertical or horizontal positions.

3.4.6 Temperature rise. Circuit breakers, attachments, mounting bases/blocks, and insulation shall meet the temperature rise requirements specified in 3.5.14.4, 3.5.18.4, and 3.5.19.1.

3.4.7 Interrupting performance. Circuit breakers shall be able to interrupt an O-CO-CO short-circuit sequence in accordance with the interruption current rating shown in the applicable specification sheets (see 3.1). Circuit breakers with fuse units shall be subjected to additional short-circuit sequences at the current magnitudes shown in the applicable specification sheets (see 3.1).

3.4.8 Shock. Circuit breakers, fuse units, attachments, and mounting bases/blocks shall withstand electrically and mechanically the high impact shock tests of MIL-S-901 for Grade A, Class I, Type C equipment.

3.4.9 Vibration. Circuit breakers, fuse units, attachments, and mounting bases/blocks shall withstand electrically and mechanically the Type I vibration tests specified in MIL-STD-167-1.

3.4.10 Electromagnetic interference (EMI). Circuit breakers with electronic trip units and communications capability (if applicable) shall meet and demonstrate compliance with the applicable emissions and susceptibility requirements and limits of MIL-STD-461 for surface ship, below deck, metallic hull installations. Requirements for EMI test plans shall be as specified in the qualification package.

3.4.11 Voltage-spike. Circuit breakers with electronic trip units and communications capability (if applicable) shall withstand voltage spikes of 2500 volts peak in accordance with MIL-STD-1399-300. Voltage spikes shall not cause failure of trip units, fuse units, and attachments including false tripping.

3.5 Design, construction, and additional performance requirements. See Tables V and VI for reference to applicable verification paragraphs in Section 4.

3.5.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.5.2 Safety. To ensure maximum personnel safety and to minimize equipment casualties, the safety requirements of MIL-E-917 shall be adhered to during design and manufacture. Components shall be free of mercury compounds, and materials shall be asbestos-free.

3.5.2.1 Polyvinyl chloride (PVC). PVC material shall not be used unless it is a part of or integral to the leads of a component or as a constituent or integrated element of a component.

3.5.3 Type NQB circuit breakers. Type NQB circuit breakers (circuit disconnect switch) shall be furnished as specified (see 3.1) and shall conform to the requirements specified for Type AQB circuit breakers, except they shall have no automatic over-current protection.

3.5.4 Ambient temperature operating range. Circuit breakers, fuse units, and attachments shall operate in a temperature range of 0 to 50 °C.

3.5.5 Special tools. Circuit breakers and current limiting fuse units shall be so designed that special tools shall not be required for removal of assemblies from the front of switchboards. A special tool shall be provided for manual operation of an electrically operated circuit breaker from the front of the switchboard. Special tools are defined as those tools not listed in the GSA Global Supply Catalog.

3.5.6 Dimensions (standardized). Outline and mounting dimensions for each type circuit breaker, mounting block, mounting bases/blocks or current limiting fuse unit shall be as specified (see 3.1). Tolerances for outline and mounting dimensions shall be within ±1/32 inch (nonaccumulating) below 24 inches and 1/8 inch for dimensions greater than 24 inches.

3.5.7 Position. Circuit breakers shall be designed for mounting in any position. When mounted vertically, the "on" position (designated by a handle or pushbutton) shall be up.

3.5.8 Current carrying connections. Current carrying connections shall be electrodeposited Type 1, Grade A, B, or C silver coatings as specified in ASTM B700 in areas of current-carrying contact with lugs, terminals, bus ties, and screw bolts. Silver plating shall be in accordance with ASTM B700, with the exception that the silver plate thickness shall be 0.0002 inch or greater.

3.5.9 Arc chamber. Arc chambers shall be constructed to limit the exhaust from the circuit breaker. The circuit breaker design must have ample clearance dimensions to accommodate the exhaust to prevent external damage.

3.5.10 Transformers. Transformers shall meet the minimum requirements of Type CC specified in MIL-T-16315.

3.5.11 Thermoplastic parts. Unless otherwise specified (see 6.2), selected parts (circuit breaker housing excluded) may be made from thermoplastic material.

3.5.12 Painting. Parts not having a corrosion resistant treatment or not fabricated of corrosion resisting material of the types specified in MIL-E-917 shall be painted in accordance with MIL-E-917, except that only one coat of gray enamel shall be applied. Touching up is permitted for marks or scratches due to assembly, testing, or other factory handling.

3.5.13 Operating handle. The operating handle of each circuit breaker shall have a suitably sized hole to allow attachment of a warning tag or a locking device. For stored energy circuit breakers employing other operating means, mechanical or electrical lock off provision shall be provided.

3.5.14 Insulation.

3.5.14.1 Material.

3.5.14.1.1 Circuit breaker and fuse unit housing. Circuit breakers and current limiting fuse units (see 6.4.6) shall be supported and enclosed in a housing which is molded of an insulating material in accordance with ASTM D5948, Types MAT30, MAI60, MAI30, or MMI30. Venting shall not be permitted through openings in the back of the housing or through the front of the housing cover.

3.5.14.1.2 Mounting base/block. See 3.5.18.1 for requirements.

3.5.14.2 Dielectric strength.

3.5.14.2.1 Application points on circuit breaker mounting base/block terminals and ground. Voltage magnitudes of Table I are based on ratings of circuit breaker mounting base/block terminals being used as application points when insulation is in as-new condition. Application points are defined in 4.5.4.3.1.1. Insulation shall be able to withstand without breakdown a sinusoidal wave of at least 60 Hz frequency at the applicable voltage magnitude when applied between required application points. As circuit breakers are cycled and tested for qualification, dielectric strength requirements at 60 percent of the Table I values may apply. See 4.5.4 and Tables V and VI for these test requirements.

3.5.14.2.2 Application points on attachment leads, circuit breaker mounting base/block terminals, and ground. When attachment leads are used as application points, insulation shall be able to withstand without breakdown a sinusoidal wave of at least 60 Hz frequency at 900 volts. Application points are defined in 4.5.4.3.1.2. As circuit breakers are cycled and tested for qualification, dielectric strength requirements at 540 volts may apply. See 4.5.4 and Tables V and VI for these test requirements.

TABLE I Dielectric strength voltage magnitude.

Circuit voltage of equipment	Rms value of dielectric test voltage
Less than 60	500
60–120	900
Over 120 and less than 240	1200
240–480	1500
Above 480	Twice rated voltage plus 1000

3.5.14.3 Insulation resistance. With insulation in as-new condition, insulation resistance shall be greater than 10 megohms between all the measuring points of 4.5.5.2. As circuit breakers and attachments are cycled and tested for qualification, insulation resistance values greater than 1 megohm may apply. See 4.5.5 and Tables V and VI for these test requirements.

3.5.14.4 Temperature rise. Temperature rise shall not exceed the temperature requirements of molding and insulating materials specified in MIL-E-917 in as-new condition. As circuit breakers and attachments are cycled and tested for qualification, temperature rise limits may vary. See 4.5.12 and Table V for these test requirements.

3.5.15 Operating mechanism/closing and opening.

3.5.15.1 Mechanism. The circuit breaker operating mechanism shall be such that the main and arcing contacts shall be quick-make (see 6.4.21) and quick-break (see 6.4.20) under all conditions of manual and automatic operation. They shall be capable of manual operation to the “on” and “off” positions, these positions being prominently marked in such a manner as to be easily and definitely identified. Automatic tripping of non-stored energy circuit breakers shall be clearly indicated by the handle with the trip position at approximately the middle point. Automatic tripping of stored energy circuit breakers without operational handles shall be indicated by other means.

3.5.15.2 Simultaneous operation. Poles of a multiple pole circuit breaker shall open and close simultaneously.

3.5.15.3 Trip free. Circuit breakers shall be mechanically and electrically trip free (see 6.4.27) in any mounting position under all conditions of operation.

3.5.15.4 Manual closing and opening. The following requirements shall be met:

a. Circuit breakers shall open and close manually.

b. The operating handle, or other operating device, shall be of an insulating material and shall not have any metal protruding beyond the circuit breaker cover.

c. Circuit breakers provided with an electric operating mechanism shall include a mechanical means for manual opening or closing. It shall not be necessary to remove the circuit breaker cover or electric operating mechanism to manually operate the circuit breaker.

3.5.16 Overcurrent protection tripping devices. The overcurrent protection devices shall be direct acting thermal magnetic, electronic or a combination thereof and operate in an ambient temperature range of 0 to 50 °C.

3.5.16.1 Thermal magnetic trip devices. Unless otherwise specified (see 3.1), circuit breakers shall have thermal magnetic trip devices combined in a readily replaceable trip unit assembly. For 250 ampere frame sizes and larger, the trip unit assemblies from the same manufacturer shall be interchangeable for ampere ratings within a particular frame size.

3.5.16.1.1 Long-time delay trip element. Tripping characteristics of the long-time delay (LTD) for thermal-magnetic devices shall be based on the current flowing through all poles simultaneously in series and shall be as specified (see 3.1).

3.5.16.1.2 Instantaneous trip device. The instantaneous trip device shall have no intentional time delay (see 6.4.13 shall be provided with trip calibrations as specified (see 3.1). Instantaneous tripping characteristics shall be based on the current flowing through any one pole. Devices having adjustable instantaneous calibrations shall comply with the settings as specified (see 3.1 and 6.2). When the instantaneous trip setting is not specified on an order, circuit breakers shall be shipped with instantaneous at low setting. Accessibility to the adjustable trip unit (see 6.4.29) settings shall be from the front of the circuit breakers or by removal of the circuit breaker molded cover.

3.5.16.2 Electronic trip devices. Circuit breakers with electronic trip devices shall incorporate LTD, short-time delay (STD), and instantaneous trip features as specified (see 3.1 and 6.2). The circuit breaker continuous current rating shall be set by means of a rating plug (adjustable or interchangeable) or adjustable switch. A means for adjustment shall be accessible from the front of the circuit breaker without having to remove the circuit breaker cover. For circuit breakers with fuse units, removal of the fuse unit to adjust the settings is acceptable. A test plug or test jack shall be provided to facilitate the connection of a portable test set. When adjustable settings are not specified on an order, circuit breakers shall be shipped with all adjustable settings in their LOW or MIN position.

3.5.16.2.1 Long-time delay trip element. Tripping characteristics of the LTD shall be based on single-phase current flowing through any one pole and also based on three-phase current flowing through all poles simultaneously.

3.5.16.2.2 Long-time thermal memory. Circuit breakers shall respond to successive long-time over-currents by tripping in shorter time periods. A thermal memory function shall provide for over-temperature protection of load circuits against the effects of repeated overload conditions. The amount of time delay reduction shall be approximately inverse to the amount of time elapsed. When the overload condition returns to normal, the thermal memory shall reset back to the normal LTD setting, provided that another overload is not experienced.

3.5.16.2.3 Instantaneous trip device. The instantaneous trip device shall have no intentional time delay (see 6.4.13). Instantaneous tripping characteristics shall be based on the current flowing through any one pole.

3.5.16.2.4 Short-time delay trip element. STD tripping characteristics shall be as specified based on the current flowing through any one pole.

3.5.17 Current limiting devices.

3.5.17.1 Current limiting fuses. When specified (see 3.1), circuit breakers shall include internally mounted plug-in current limiting fuses to provide short circuit protection at high current values (see Figure 2). Fuses shall be in accordance with MIL-PRF-15160.

3.5.17.1.1 Function of current limiting fuses. Fuses mounted in a circuit breaker shall be readily installed or replaced in the field. In addition to interrupting the circuit, each fuse shall provide a mechanical force to trip the circuit breaker mechanism. The blowing of the various fuse types under short circuit conditions shall occur within the root mean square (rms) asymmetrical ampere values specified (see 3.1).

3.5.17.1.2 Fused circuit breaker characteristics. Fused circuit breakers shall have the following characteristics:

a. Time-current characteristics of the fuses and the circuit breaker shall be coordinated to prevent unnecessary blowing of the fuses and to provide protection to the circuit breaker without damage.

b. The circuit breaker shall safely and satisfactorily clear faults up to the current values at which the fuses will blow (see 3.5.17.1.1). During the circuit breaker performance the fuses shall not blow, be damaged, or change their characteristics.

c. For fault currents above the interrupting ability of the circuit breaker, the time-current characteristics of the fuses shall be such as to provide adequate back-up protection to the circuit breaker on fault currents up to 100,000 amperes AC asymmetrical. Fuses shall clear the fault prior to any damage to the circuit breaker. After clearing a fault, the unblown fuses shall perform their current carrying and interrupting functions.

d. It shall not be possible to install the wrong type current limiting fuses in a specific circuit breaker type.

e. Mounting of the fuses in a fuse unit located at the load terminals shall be such that blown fuses may be replaced quickly without removing the circuit breaker housing cover and without danger to operating personnel.

f. The circuit breaker shall trip automatically when an attempt is made to remove the fuses with their housing.

g. Upon blowing of one or more fuses, the circuit breaker mechanism shall open automatically.

h. The circuit breaker shall not operate to the closed position when one or more fuses are blown unless the damaged fuse or fuses have been replaced.

3.5.17.2 Current limiting fuse units. When specified (see 3.1 and 6.2), current limiting fuse units shall be provided with back-connected removable mountings. Units shall contain three separate nonremovable current limiting fuse elements to provide short circuit protection at high current values. Fuse unit shall be in accordance with MIL-PRF-15160.

3.5.17.2.1 Function of current limiting fuse units. Current limiting fuse units, when connected to the circuit breaker load terminals and the load, shall be readily inserted or removed from their mounting base/block in the field. In addition to interrupting the circuit, each fuse unit shall include mechanical blown fuse element indicators. The blowing of the current limiting fuse unit types under short circuit conditions shall occur within the rms asymmetrical ampere values specified (see 3.1).

3.5.17.2.2 Current limiting fuse unit characteristics. The combination of the current limiting fuse unit and the circuit breaker shall have the following characteristics:

a. Time-current characteristics of the fuse unit and the circuit breaker shall be coordinated to prevent unnecessary blowing of the fuses and to provide protection to the circuit breaker without damage.

b. The circuit breaker shall safely and satisfactorily clear faults up to the current values at which the fuse unit will blow (see 3.5.17.2.1). During the circuit breaker performance, the fuse unit shall not blow, be damaged, or change its characteristics.

c. For fault currents above the interrupting ability of the circuit breaker, the time-current characteristics of the fuse unit shall be such as to provide adequate back-up protection to the circuit breaker on fault currents up to 100,000 amperes AC asymmetrical. The fuse unit shall clear the fault prior to any damage to the circuit breaker.

d. After installation, it shall not be possible to insert a current limiting fuse unit type of a higher crossover current rating into a fuse unit mounting base/block installed to accommodate a fuse unit type which-has a lower crossover current rating.

e. Mounting of the fuse unit shall be such that a blown fuse unit may be replaced quickly without removing the circuit breaker housing or switchboard front panel and without subjecting operating personnel to danger.

3.5.17.3 Integral (fuseless) current limiting devices. Circuit breakers with integral (fuseless) current limiting devices shall interrupt 100,000 amperes AC asymmetrical or more (see 3.1). In addition to interrupting the circuit, integral current limiting devices shall trip the circuit breaker mechanism. The current limiting device shall permit restoration of service by resetting, if necessary, and returning to the “on” position without replacement of any of its parts or elements.

3.5.18 Mounting bases/blocks, mounting arrangements, and circuit breaker/mounting base/block interface connections.

3.5.18.1 Mounting base/block. When specified (see 3.1 and 6.2), mounting bases/blocks shall be provided. Mounting bases/blocks shall be of a molded insulating material as specified in MIL-E-917 with associated metallic parts as specified in 3.1 and shall not cause failure of dielectric strength and insulation resistance requirements of 3.5.14.2 and 3.5.14.3, respectively.

3.5.18.2 Mounting arrangements (circuit breakers and fuse units). Current limiting fuse units shall be back-connected (see 3.5.17.2). Circuit breakers shall be arranged for one of the following three connections between load and power supply as specified (see 3.1 and 6.2).

a. Front connected (see 6.4.9).

b. Back-connected (removable mounting only) (see 6.4.4 and 6.4.23). Back-connected circuit breakers and current limiting fuse units shall permit easy removal from the front of a live switchboard or panel in which they are mounted without need for access to rear of the switchboard or panel and without disturbing the connections or bus work on the rear of the switchboard or panel.

c. Combination (front connected to load and back-connected to the line side).

3.5.18.3 Circuit breaker/mounting base/block interface connections and mounting base/block stud terminals. Slip-type connectors shall be provided on the rear of the circuit breaker to mate with the mounting base/block. The connectors shall permit the ready removal of the circuit breakers or current limiting fuse units without using insulated tools and accomplished by removing the supporting screws and drawing the circuit breaker or current limiting fuse unit out. The female portion of each slip-type connector shall be sized to ensure full contact is obtained with its corresponding male stud portion and shall be enclosed or otherwise protected when it is exposed in order to prevent damage to these parts. Stud terminals shall be provided on rear-connected mounting bases/blocks for rear-connection of cabling or bus bar.

3.5.18.4 Temperature rise. Temperature rise of circuit breaker slip-type connectors and mounting base/block stud terminals shall not exceed 65 °C for equipment in as-new condition. As circuit breakers and attachments are cycled and tested for qualification, temperature rise limits may vary. See 4.5.12 and Table V for these test requirements.

3.5.19 Attachments. Attachments (see 6.4.2) shall include the electric operating mechanism, undervoltage release device, shunt trip, auxiliary switch, handle locking device, and handle boot.

3.5.19.1 Temperature rise. Temperature rise of electric operating mechanisms, undervoltage release devices, shunt trips, and auxiliary switches shall not exceed the requirements of molding and insulating materials specified in MIL-E-917 in as-new condition. As circuit breakers and applicable attachments are cycled and tested for qualification, temperature rise limits may vary. See 4.5.12 and Table V for these test requirements.

3.5.19.2 Endurance. During circuit breaker electrical endurance testing, electric operating mechanisms, undervoltage release devices, and shunt trips shall have the ability to be cycled continuously for the applicable number of endurance operations specified in Tables II, III (a), III (b), and IV. Rate of operations shall be as specified for the circuit breaker electrical endurance test in the applicable specification sheet (see 3.1).

3.5.19.3 Electric operating mechanism. When specified (see 6.2), an electric operating mechanism shall be provided. The attachment shall consist of an assembly including an opening and closing mechanism with its associated devices for mounting on the front of a manually operated circuit breaker except for stored energy circuit breakers where the attachment is internal rather than mounted on the front. The electric operating mechanism shall have the following characteristics:

a. Closing time of the electric closing mechanism at normal voltage shall not exceed 1/2 second.

b. When the circuit breaker trips, the operating mechanism shall be capable of relatching and returning the circuit breaker closing mechanism to the off position.

c. The attachment shall not exceed the height dimensions of the circuit breaker type. The depth of the attachment from the circuit breaker front surface shall not exceed 6-1/4 inches. The width dimension of the circuit breaker type may be exceeded by 7/8-inch maximum on each side.

d. Aluminum may be used wherever feasible to reduce the weight of the attachment.

e. An identification plate shall be provided.

f. The attachment shall pass the tests specified in 4.2.

g. The attachment shall be of open frame construction except that electrical contacts, relays, switches, or brakes that could be affected by dust or other contamination shall be adequately protected.

h. Electrical contacts, relays, switches, or brakes that could be affected by dust or other contamination shall be adequately protected.

i. Means shall be provided for manual closing and opening of the electrically operated circuit breaker. Manual closing and opening shall be from the switchboard front panel. Any special tool necessary to perform the opening or closing shall be furnished with each attachment.

j. A wiring diagram, adequately protected, shall be mounted on or inside the attachment unless the electric operating mechanism is internal hence the diagram shall be mounted on the front of the circuit breaker.

k. The shunt trip of a circuit breaker shall not be used as part of the attachment except when the electric operating mechanism is internal.

l. Motor or solenoid closing and opening is permissible.

m. Where a step-down transformer is required and space permits, the transformer shall be mounted on the attachment. For 450-volt AC operation, a standard 115-volt universal motor with a step-down transformer may be furnished.

n. The circuit breaker shall not have a repeated pumping action when the circuit breaker operates automatically.

o. Nominal control voltages and their range, measured at the terminals of the operating motor or solenoid with full operating current flowing, shall be as specified in Table II.

TABLE II. Electric operating mechanism operational requirements.

DC		AC, 60 Hz		AC, 400 Hz		Endurance
Nominal voltage	**Voltage range**	**Nominal voltage**	**Voltage range**	**Nominal voltage**	**Voltage range**	
120	70–140	115	90–130	115	90–130	4000
250	140–280	450	360–500			4000

3.5.19.4 Undervoltage release devices. An undervoltage release device shall be mounted within the circuit breaker when specified (see 3.1 and 6.2) and shall have the following characteristics:

a. The device shall meet the applicable operational requirements shown in Tables III (a) and III (b). The specified pickup (see 6.4.18) and seal voltages apply to cold coil (room temperature). AC voltages are applicable to 60-Hz circuits only.

b. The device shall be simple and compact.

c. The device shall be capable of being continuously energized at its rated voltage and shall operate directly on the circuit breaker tripping mechanism.

d. The device shall automatically reset; that is, after it has dropped out and tripped the circuit breaker on reduced voltage, it shall be reset by the circuit breaker action upon restoration of voltage to pickup value.

e. Connecting leads, adequately marked, shall extend from the back, end, or sides of the circuit breaker enclosure for a minimum of 30 inches.

f. Coil and connecting leads of each device shall be fully insulated without exposed terminals or connection.

TABLE III (a). Undervoltage release device operational requirements (field replaceable).

Nominal voltage	Voltage range	Pickup and seal V	Dropout voltage	Maximum power watts	Endurance
33 DC	26.4–36.3	22	12–8	2.7	2500
120 DC	95–140	95	80–10	2.7	2500
115 AC	90–135	90	80–10	18.0	2500
450 AC	360–520	360	290–45	18.0	2500

TABLE III (b). Undervoltage release device operational requirements (not field replaceable).

Nominal voltage	Voltage range	Pickup and seal V	Dropout voltage	Maximum power watts	Endurance
120 DC	95–140	95	80–10	12.0	2500
250 DC	175–355	150	100–10	12.0	2500
115 AC	90–135	90	80–10	18.0	2500
450 AC	360–520	360	270–45	18.0	2500

3.5.19.4.1 Time delay. Time delay requirements shall be as follows:

a. With the 33-VDC coil of Table III (a) shunted by a 150-ohm resistor, the circuit breaker shall trip within 67 milliseconds after the voltage is step-reduced from 33 VDC to 3.3 VDC (100 percent to 10 percent). With no shunt resistance connected external to the 33-VDC coil, it shall remain sealed-in during an absence of input voltage for a minimum of 7 milliseconds with the device operating at 26.4 VDC (80 percent).

b. The other undervoltage release devices of Tables III (a) and (b) shall remain sealed-in during an absence of input voltage for a minimum of 7 milliseconds with the device operating at the normal voltages specified in Tables III (a) and III (b).

3.5.19.5 Shunt trip (see 6.4.25). When specified (see 3.1 and 6.2), a shunt trip device shall be provided and shall have the following characteristics:

a. The device shall meet the applicable operational requirements shown in Table IV.

b. The 115-volt, 60-Hz and 450-volt, 60-Hz shunt trip devices shall be field replaceable for circuit breaker frame sizes above 100 amperes. The 28-VDC shunt trip shall also be field replaceable.

c. The device shall be simple and compact and shall be remotely controlled.

d. Coils shall be available for tripping from either an AC or DC voltage source.

e. The shunt trip device shall have a normally open auxiliary switch contact (“a” type) connected in series with its coil.

f. Connecting leads, adequately marked, shall extend from the back, end, or sides of the circuit breaker enclosure for a minimum of 30 inches.

TABLE IV. Shunt trip device operational requirements.

Nominal voltage	Voltage range	Maximum watts during inrush current	Endurance
28 DC	26.4–36.3	90	1500
120 DC	70–140	100	1500
250 DC	175–355	50	1500
115 AC, 60 Hz	90–130	650	1500
115 AC, 400 Hz	90–130	650	1500
450 AC, 60 Hz	360–500	500	1500

3.5.19.6 Auxiliary switches. When specified (see 3.1 and 6.2), circuit breakers shall be provided with an auxiliary switch (see 6.4.3) or switches having the minimum number of contacts as specified. An auxiliary switch or switches shall be mounted within the circuit breaker housing. Connecting leads, adequately marked, shall extend from the enclosure for a minimum of 30 inches. Contacts designated “a” shall be closed when the circuit breaker is closed. Contacts designated “b” shall be closed when the circuit breaker is open. The nominal voltage for the auxiliary switches shall be either 115 or 450 volts for 60 Hz, 115 volts for 400 Hz, or 120 volts for DC. Each contact shall have a minimum continuous current carrying capacity of 10 amperes for AC and 10 amperes for DC.

3.5.19.7 Handle locking device. When specified (see 3.1 and 6.2), a handle locking device (see 6.4.12) shall be provided as a part of the circuit breaker. The device shall be in accordance with Figure 3.

3.5.19.8 Handle boot. When specified (see 3.1 and 6.2), a handle boot (see 6.4.11) shall be provided. The boot shall be molded using silicone rubber having the characteristics specified. The handle boot shall meet the requirements of ASTM D412, D624, D2240, and A-A-59588 as specified (see 3.1). The boot shall fit securely in the opening in a switchboard or panel front and provide a splashproof protective cover over the circuit breaker front. The circuit breaker handle shall be operated through the boot.

3.5.20 Semiconductor devices.

3.5.20.1 Electrostatic discharge susceptible items. Electrostatic discharge control for the protection of electrical and electronic parts, components, assemblies, and equipment shall be in accordance with MIL-STD-1686. Items which are subject to damage by electrostatic discharge, such as metal oxide semi-conductors (MOS) whether installed in equipment or held as parts for original installation or as spares, shall be protected against such damage. The package shall be provided with a warning label for handling with care on electrostatic discharge.

3.5.20.2 Conformal coating. Conformal coating shall be provided for printed wiring in accordance with IPC-CC-830, unless otherwise specified (see 6.2).

3.5.20.3 Sockets. When specified (see 6.2), sockets in accordance with MIL-DTL-83734 shall be used for all dual-in-line package integrated circuit components.

3.5.21 Designation and markings.

3.5.21.1 Construction. Identification plates and other designating markings for circuit breakers shall be in accordance with MIL-STD-130 and Type A, B, or C of MIL-DTL-15024 and MIL-P-15024/5.

3.5.21.2 Location. Unless otherwise specified (see 3.1), information shall be marked on identification plate(s) attached to the equipment. Plates shall be installed on and furnished as part of the equipment. Plates shall be attached to the part of the equipment which will not ordinarily be renewed during normal service life and shall be located in a readily accessible position where they can be read at all times without danger to personnel.

3.5.21.3 Identification marking. Information marked on equipment shall meet requirements of ASTM F1166. Information marked on equipment shall be as specified (see 3.1) and shall include the following for each type of equipment:

a. Circuit breakers with fixed continuous ratings.

(1) Manufacturer’s name and catalog or part number.

(2) Serial number, date code, or objective evidence number (number may be on the identification plate or on the circuit breaker housing).

(3) Year of manufacture.

(4) Nomenclature.

(5) Navy type circuit breaker designation.

(6) Voltage and frequency type(s).

(7) Number of poles.

(8) National stock number.

(9) Blank space for inspector’s stamp.

(10) Identification and rating(s) of all installed attachments (may be on separate identification plate(s) attached to the circuit breaker).

(11) Continuous current rating and type.

(12) The continuous current rating shall also be stamped or engraved on the circuit breaker handle.

b. Circuit breakers with adjustable continuous ratings.

(1) Manufacturer’s name and catalog or part number.

(2) Serial number, date code, or objective evidence number (number may be on the identification plate or on the circuit breaker housing).

(3) Year of manufacture.

(4) Nomenclature.

(5) Navy type circuit breaker designation.

(6) Voltage and frequency type(s).

(7) Number of poles.

(8) National stock number.

(9) Blank space for inspector's stamp.

(10) Identification and rating(s) of all installed attachments (may be on separate identification plate(s) attached to the circuit breaker).

(11) For circuit breakers whose continuous rating is adjustable with selector switches, the current rating (and all other trip unit adjustments) shall be selectable and evident on the front of the circuit breaker.

(12) For circuit breakers whose rating is programmable, a pluggable interface shall be available on the front circuit breaker cover to interconnect it to the programming device using an access hole in the panelboard.

c. Circuit breaker frames used with interchangeable trip units.

(1) Manufacturer's name and catalog or part number.

(2) Serial number, date code, or objective evidence number (number may be on the identification plate or on the circuit breaker housing).

(3) Year of manufacture.

(4) Nomenclature.

(5) Navy type circuit breaker designation.

(6) Voltage and frequency type(s).

(7) Number of poles.

(8) National stock number.

(9) Blank space for inspector's stamp.

(10) Identification and rating(s) of all installed attachments (may be on separate identification plate(s) attached to the circuit breaker).

(11) Frame rating (maximum continuous current of the circuit breaker).

d. Interchangeable trip units.

(1) Manufacturer's name and catalog or part number.

(2) Serial number, date code, or objective evidence number (number may be on the identification plate or on the circuit breaker housing).

(3) Year of manufacture.

(4) Nomenclature.

(5) Navy type circuit breaker designation.

(6) Voltage and frequency type(s).

(7) Number of poles.

(8) National stock number.

(9) Blank space for inspector's stamp.

(10) Identification and rating(s) of all installed attachments (may be on separate identification plate(s) attached to the circuit breaker).

(11) Instantaneous trip ampere settings.

(12) Thermal ultimate trip point at 50 °C in percent.

(13) Short-time pickup and delay settings (where applicable).

(14) Note on trip units with individually adjustable poles as follows:
"CAUTION - Make identical setting on all poles"

(15) Continuous current rating of the trip element (marked in such a manner that it projects through the frame cover for convenient identification).

e. Fuse housing for circuit breakers with replaceable fuses.

(1) Manufacturer's name and catalog number.

(2) Nomenclature.

(3) Navy type circuit breaker designation.

(4) National stock number.

(5) Fuse style number.

(6) National stock number for fuse.

(7) Blank space for inspector's stamp.

(8) Serial number, date code or objective evidence number (number may be on the identification plate or on the fuse housing).

f. Integral fuse units.

(1) Manufacturer's name and catalog number.

(2) Nomenclature and type.

(3) Designation of applicable circuit breaker.

(4) National stock number.

(5) Blank space for inspector's stamp.

(6) Applicable circuit breaker element ratings.

(7) Serial number, date code, or objective evidence number (number may be on the identification plate or on the fuse housing).

g. Fuse unit mounting base/block.

(1) Manufacturer's name and catalog number.

(2) Nomenclature and type.

(3) Designation of applicable circuit breaker.

(4) National stock number.

(5) Blank space for inspector's stamp.

(6) Identification of the appropriate type of fuse unit.

h. Fuse.

(1) Manufacturer's symbol and/or catalog number.

(2) Type or style number.

(3) National stock number.

(4) Date code, serial number, or objective evidence number.

i. Ampere rating markings. The ampere rating or the continuous current rating of all circuit breakers shall be visible without having to remove the circuit breaker front cover. Circuit frame sizes 100 amperes and smaller shall have the ampere rating stamped or engraved on the handle.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Comparison inspection (see 4.3).

c. Conformance inspection (see 4.4).

4.2 Qualification inspection of AQB circuit breakers, mounting bases/blocks, fuses, fuse units and attachments. Qualification inspection shall consist of the examination and tests in the order specified in Tables V and VI. Refer to the applicable circuit breakers individual specification sheet (see 3.1) for additional test information and requirements. Unless otherwise specified herein, no adjustments shall be made to circuit breakers or attachments during or between qualification tests.

4.2.1 Additional attachment qualification requirements. If a vendor wants to qualify an additional attachment not included during initial qualification testing, all circuit breaker samples (see 4.2.3) shall be included and all test requirements of Tables V and VI shall be met. If the circuit breaker or the attachment fails any of the tests, the attachment shall not be qualified. The testing performed on the circuit breakers during the qualification of the additional attachment shall not replace or alter the due date for comparison inspection and qualification retention testing (see 4.2.4). For example, Vendor A successfully performs an initial qualification on a circuit breaker with a shunt trip in 2007. In 2008, Vendor A wants to qualify an undervoltage release for the same circuit breaker. The circuit breaker with undervoltage release installed in applicable samples shall be subjected to all tests in Tables VI and VII. If the circuit breaker or undervoltage release fails any test for any reason, the undervoltage release shall not be qualified. Vendor A is still required to perform comparison inspection and qualification retention testing in 2010 and 2013, respectively, with all qualified attachments (shunt trip and undervoltage release).

TABLE V. Qualification test schedule and sequence (for inspection samples 1A, 2A, and 3A) /1.

Test number	Inspection	Requirement	Verification
1	General examination	See 4.5.1	4.5.1
2	Creepage and clearance distances	3.4.1	4.5.2
3	Trip-free operation	3.5.15.3	4.5.3
4	Attachment voltage range/operating characteristics	3.5.19	4.5.6
4A	Electric operating mechanism	3.5.19.3	4.5.6.1
4A(1)	Voltage range	3.5.19.3p	4.5.6.1.1
4A(2)	Closing time	3.5.19.3a	4.5.6.1.2
4B	Undervoltage release	3.5.19.4	4.5.6.2
4B(1)	Operating voltage range	3.5.19.4a	4.5.6.2.1
4B(2)	Dropout voltage range	3.5.19.4a	4.5.6.2.2
4B(3)	Time delay	3.5.19.4.1	4.5.6.2.3
4C	Shunt trip voltage range	3.5.19.5	4.5.6.3
5	Endurance – circuit breaker (mechanical and electrical)	3.4.3	4.5.9
	Attachment tests performed during circuit breaker electrical endurance:		
5A	Electric operating mechanism endurance	3.5.19.2	4.5.9.2.1
5B	Electric operating mechanism temperature rise	3.5.19.1	4.5.12.2
5C	Undervoltage release endurance	3.5.19.2	4.5.9.2.2
5D	Undervoltage release temperature rise	3.5.19.1	4.5.12.2
5E	Shunt trip endurance	3.5.19.2	4.5.9.2.3
5F	Shunt trip temperature rise	3.5.19.1	4.5.12.2
5G	Auxiliary switch temperature rise	3.5.19.1	4.5.12.2
6	Calibration	3.4.4, 3.5.16	4.5.10
6A	Thermal magnetic trip units	3.5.16.1	4.5.10.1
6A(1)	Long-time delay	3.5.16.1.1	4.5.10.1.1
6A(2)	Instantaneous trip	3.5.16.1.2	4.5.10.1.2
6A(2)(a)	Pickup test	3.5.16.1.2	4.5.10.1.2
6A(2)(b)	Timing test	3.5.16.1.2	4.5.10.1.2
6B	Electronic trip units	3.5.16.2	4.5.10.2
6B(1)	Long-time delay	3.5.16.2.1	4.5.10.2.1
6B(2)	Long-time thermal memory	3.5.16.2.2	4.5.10.2.1.1
6B(3)	Instantaneous trip	3.5.16.2.3	4.5.10.2.2
6B(3)(a)	Pickup test	3.5.16.2.3	4.5.10.2.2
6B(3)(b)	Timing test	3.5.16.2.3	4.5.10.2.2
6B(4)	Short-time delay	3.5.16.2.4	4.5.10.2.3
6B(4)(a)	Pickup test	3.5.16.2.4	4.5.10.2.3
6B(4)(b)	Timing test	3.5.16.2.4	4.5.10.2.3
6B(4)(c)	Resettable delay test	3.5.16.2.4	4.5.10.2.3

TABLE V. Qualification test schedule and sequence (for inspection samples 1A, 2A, and 3A) - Continued.

Test number	Inspection	Requirement	Verification
7	Inclination (includes the following tests)	3.4.5	4.5.11
7A	Manual cycling	3.4.3	4.5.11.1
7B	Attachment voltage range/operating characteristics	3.5.19	4.5.6
7C	Electric operating mechanism	3.5.19.3	4.5.6.1
7C(1)	Voltage range	3.5.19.3p	4.5.6.1.1
7C(2)	Closing time	3.5.19.3a	4.5.6.1.2
7D	Undervoltage release	3.5.19.4	4.5.6.2
7D(1)	Operating voltage range	3.5.19.4a	4.5.6.2.1
7D(2)	Dropout voltage range	3.5.19.4a	4.5.6.2.2
7D(3)	Time delay	3.5.19.4.1	4.5.6.2.3
7E	Shunt trip voltage range	3.5.19.5	4.5.6.3
8	Circuit breaker temperature rise (pre-interruption)	3.4.2 3.4.6 3.5.14.4 3.5.18.4 3.5.19.1	4.5.12
8A	Auxiliary switch rating	3.5.19.6	4.5.8
9	Dielectric strength (full voltage)	3.4.2 3.5.14.2 3.5.18.1	4.5.4
10	Insulation resistance (10-megohm threshold)	3.4.2 3.5.14.3 3.5.18.1	4.5.5
11	Interrupting performance	3.4.7	4.5.13
12	Circuit breaker temperature rise (post-interruption)	3.4.2 3.4.6 3.5.14.4 3.5.18.4 3.5.18.1	4.5.12
13	Dielectric strength (reduced voltage)	3.4.2 3.5.14.2 3.5.18.1	4.5.4
14	Insulation resistance (1-meghom threshold)	3.4.2 3.5.14.3 3.5.18.1	4.5.5
15	Abbreviated calibration	3.4.4	4.5.10.3
16	Handle locking device operation	3.5.19.7	4.5.18
17	Handle boot operation and high temperature endurance	3.5.19.8	4.5.19

NOTE: Refer to the applicable circuit breakers individual specification sheet (see 3.1) for additional test information and requirements.

TABLE VI. Qualification inspection test schedule (for inspection samples 1B, 2B, and 3B).

Test number	Inspection	Requirement	Verification
1	General examination	See 4.5.1	4.5.1
2	Creepage and clearance distances	3.4.1	4.5.2
3	Abbreviated calibration	3.4.4	4.5.10.3
4	Shock	3.4.8	4.5.14
5	Manual cycling	3.4.3	4.5.14.4.2
6	Abbreviated calibration	3.4.4	4.5.10.3
7	Vibration	3.4.9	4.5.15
8	Manual cycling	3.4.3	4.5.15
9	Abbreviated calibration	3.4.4	4.5.10.3
10	Dielectric strength (full voltage)	3.4.2 3.5.14.2 3.5.18.1	4.5.4
11	Insulation resistance (10-megohm threshold)	3.4.2 3.5.14.3 3.5.18.1	4.5.5
12	Electromagnetic interference (electronic trip units only)	3.4.10	4.5.16
13	Voltage spike (electronic trip units only)	3.4.11	4.5.17
14	Calibration (electronic trip units only)	3.4.4, 3.5.16.2	4.5.10
14A	Long-time delay	3.5.16.2.1	4.5.10.2.1
14B	Long-time thermal memory	3.5.16.2.2	4.5.10.2.1.1
14C	Instantaneous trip	3.5.16.2.3	4.5.10.2.2
14C(1)	Pickup test	3.5.16.2.3	4.5.10.2.2
14C(2)	Timing test	3.5.16.2.3	4.5.10.2.2
14D	Short-time delay	3.5.16.2.4	4.5.10.2.3
14D(1)	Pickup test	3.5.16.2.4	4.5.10.2.3
14D(2)	Timing test	3.5.16.2.4	4.5.10.2.3
14D(3)	Resettable delay test	3.5.16.2.4	4.5.10.2.3
14	Calibration (electronic trip units only)	3.4.4	4.5.10
15	Attachment voltage range/operating characteristics	3.5.19	4.5.6
15A	Electric operating mechanism	3.5.19.3	4.5.6.1
15A(1)	Voltage range	3.5.19.3p	4.5.6.1.1
15A(2)	Closing time	3.5.19.3a	4.5.6.1.2
15B	Undervoltage release	3.5.19.4	4.5.6.2
15B(1)	Operating voltage range	3.5.19.4a	4.5.6.2.1
15B(2)	Dropout voltage range	3.5.19.4a	4.5.6.2.2
15B(3)	Time delay	3.5.19.4.1	4.5.6.2.3
15C	Shunt trip voltage range	3.5.19.5	4.5.6.3
16	Dielectric strength (reduced voltage)	3.4.2 3.5.14.2 3.5.18.1	4.5.4

TABLE VI. Qualification inspection test schedule (for inspection samples 1B, 2B, and 3B) - Continued.

Test number	Inspection	Requirement	Verification
17	Insulation resistance (1-megohm threshold)	3.4.2 3.5.14.3 3.5.18.1	4.5.5

4.2.2 Qualification inspection of type NQB circuit breakers. Satisfactory tests performed on an associated Type AQB circuit breaker frame shall be extended to cover the Type NQB circuit breaker.

4.2.3 Samples for qualification inspection. Tests shall be conducted on a sample unit of both the maximum and minimum trip unit rating of each circuit breaker to be qualified. Samples shall include all available attachments (see 4.5.13.2 for samples required for additional interrupting tests). If a sample cannot contain all available attachments, an additional sample shall be provided to accommodate the attachments not permissible in the first sample. Test samples are required as applicable in the following categories:

Sample 1A - One 3-pole AC, 60-Hz circuit breaker of maximum trip unit rating.

1B - One 3-pole AC, 60-Hz circuit breaker of minimum trip unit rating and, if applicable, communications capabilities installed.

2A - One 3-pole AC, 400-Hz circuit breaker of maximum trip unit rating.

2B - One 3-pole AC, 400-Hz circuit breaker of minimum trip unit rating and, if applicable, communications capabilities installed.

3A - One 3-pole DC, circuit breaker of maximum trip unit rating.

3B - One 3-pole DC, circuit breaker of minimum trip unit rating and, if applicable, communications capabilities installed.

Sample types 1A, 2A, and 3A shall be used for the entire test sequence of Table V and sample types 1B, 2B, and 3B shall be used for the entire test sequence of Table VI.

4.2.4 Retention of qualification. At a maximum of three year intervals after qualification, the manufacturer shall provide production line circuit breaker and mounting base test samples with attachments/fuses/fuse units (as applicable) and conduct a comparison inspection (see 4.3). At a maximum of six year intervals, a qualification inspection (see 4.2 through 4.2.3) shall be conducted on production line circuit breaker and mounting base test samples with attachments/fuses/fuse units (as applicable). A qualification inspection may be conducted in lieu of a comparison inspection at the three-year interval. Test reports shall be submitted as specified (see 6.2).

4.3 Comparison inspection. For comparison inspection tests, a circuit breaker sample of each 1A, 2A, and 3A shall be tested. The test shall be in compliance with test numbers 1, 2, 4, 5, 6, 8, and 9 of Table V and test numbers 3 and 4 of Table VI.

4.4 Conformance inspection.

4.4.1 Inspection. Each manufactured unit shall be subjected to the inspection specified in Table VII, unless inspection sampling is otherwise specified (see 6.2).

4.4.2 Rejected units. If a unit is rejected, the contractor shall rework the unit to correct the defects and resubmit the unit for inspection, as specified (see 6.2). Such units shall be separate from new units and shall be clearly identified as a resubmitted unit for inspection. The contractor shall also determine if the identified defect is likely to exist in other in-process and completed units, and inspect and disposition these units if appropriate.

TABLE VII. Conformance inspection.

Unit	Inspection
Circuit breaker frame	4.5.1, 4.5.4
Mounting blocks or base	4.5.1, 4.5.4
Trip unit	4.5.1, 4.5.4, 4.5.10
Fuses (if applicable)	4.5.1
Fuse unit (if applicable)	4.5.1
Attachments	3.5.19.6, 4.5.1, 4.5.4, and Tables II, III, and IV

4.4.3 Conformance production shock testing.

4.4.3.1 Sampling. One circuit breaker shall be selected at random by a Government representative for each frame type produced during a month regardless of feature or attachment and subjected to the production shock test.

4.4.3.2 Production shock test. The shock tests shall be conducted on the sample circuit breakers and attachments. The shock tests of 4.5.14 apply except as modified by the following:

a. The circuit breaker shall be tested in the closed position.

b. No load is necessary except as required for the undervoltage release device.

c. The circuit breaker shall be subjected to one hammer blow of 3-foot drop from each direction – top, back, and side.

d. No adjustment to the circuit breaker is permitted before or during the shock test.

4.4.3.3 Acceptance criteria. The circuit breaker will be acceptable if the following criteria have been met:

a. The circuit breaker shall remain closed during and following the test.

b. The circuit breaker shall be turned off and then on after each hammer blow to verify that the mechanism has not jammed to the extent that it could not trip open.

c. The circuit breaker shall pass an electrical calibration test (both LTD and instantaneous) following the shock test. For electronic trip unit type circuit breakers, actual trip values after the test shall be within specified limits (see 3.1). For thermal magnetic trip unit type circuit breakers, actual trip values after the test shall be ±15 percent of the pre-shock calibration and the circuit breaker trip unit shall have the ability to be readjusted to specified limits (see 3.1).

d. The circuit breaker shall pass the dielectric test following the shock test.

e. Proper undervoltage or shunt trip device operation should be verified following the shock test if an undervoltage or shunt trip device is installed.

4.4.3.4 Action required if failure occurs. In cases where the selected circuit breaker does not meet the acceptance criteria, it shall be analyzed to determine the cause of the failure. The following procedure shall be followed:

a. If the cause can be identified, all circuit breakers of the same frame type shall be reworked and shipment of these shall be suspended until corrective actions have been completed, as specified (see 6.2). After the circuit breakers have been reworked, a sample randomly selected by a Government representative shall be production shock tested to assure that the corrective action is effective. In case further reworking of the circuit breaker is necessary, a sample shall be randomly selected by a Government representative from the reworked lot and subjected to production shock test to assure corrective action is effective.

b. If the cause cannot be identified, an additional circuit breaker of the same frame type shall be randomly selected and subjected to the production shock test. If it passes, production shall continue without disruption of shipments. The circuit breaker that failed for unidentified causes shall be scrapped and a new one supplied by the contractor, at no additional cost to the buyer.

4.4.3.5 Disposition. The circuit breaker and attachments that have been shock tested shall be inspected before shipment to assure they meet the electrical and mechanical requirements specified herein. The circuit breaker shall bear a label containing these words: "This circuit breaker has been production shock tested and is acceptable for use."

4.5 Tests. All tests shall be conducted with the circuit breaker and fuse units (if applicable) installed on the mounting base/block and all applicable attachments installed in the circuit breaker. Test numbers specified in this section refer to those in Tables V and VI as noted. Refer to the applicable circuit breakers individual specification sheet (see 3.1) for additional test information and requirements.

4.5.1 General examination. Circuit breakers and attachments shall be subjected to an examination to visually verify that material, workmanship, and design are in compliance with this specification, the applicable drawings, and MIL-E-917. Examination shall include, but need not be limited to, the following:

a. Verify that design requirements are met (see 3.5.1 through 3.5.5, 3.5.10, 3.5.11, 3.5.18.2).

b. Verify that the circuit breaker has the correct overcurrent protection tripping device installed and when applicable the correct current limiting device installed (see 3.5.16, 3.5.17).

c. Circuit breaker outline and mounting dimensions are as specified (see 3.5.6).

d. All arc chutes installed (see 3.5.9).

e. Correct attachments are installed (see 3.5.19.3 through 3.5.19.8).

f. Control wiring is as specified (see 3.5.19.4, 3.5.19.5).

g. Markings are as specified (see 3.5.21).

h. All cover screws installed and heads not frayed.

i. No cracks in the cover, housing, mounting base/block, and interphase barriers (see 3.5.14.1.1, 3.5.14.1.2).

j. Slip connectors are correct style, properly formed and aligned, mounting screws properly torqued (see 3.5.18.3).

k. Operating handle securely installed: proper hole for tag present; "On" position is up when breaker mounted vertically (see 3.5.7, 3.5.13).

l. Operating mechanism has quick-make, quick-break action and properly latches and unlatches (see 3.5.15.1, 3.5.15.2).

m. No blistering, shadowing, or flaking on plating (see 3.5.8).

n. No blistering, flaking or fading on painted parts (see 3.5.12).

o. Organic materials are properly treated for fungus.

p. Breaker operation is not hindered by an attachment or accessory (see 3.5.15.4).

4.5.2 Creepage and clearance distances. Creepage and clearance distances shall be demonstrated by actual measurement. Measurements shall be in accordance with MIL-E-917.

4.5.3 Trip-free operation. The circuit breaker shall be latched and closed and the operating handle blocked or locked in the on position. The circuit breaker shall be tripped and verification shall be made that the contact arms returned to the open position.

4.5.4 Dielectric strength.

4.5.4.1 Test equipment. Tests for dielectric strength shall be made with an alternating potential from a 1 kilowatt or larger power source having a sinusoidal wave shape. Semiconductors shall be shunted for protection during tests.

4.5.4.2 Voltage magnitude.

4.5.4.2.1 Full voltage. The applicable voltage magnitude specified in 3.5.14.2.1 and 3.5.14.2.2 shall be applied for the following dielectric strength tests:

Table V: Test No. 9

Table VI: Test No. 10

4.5.4.2.2 Reduced voltage. 60 percent of the applicable voltage magnitude specified in 3.5.14.2.1 and 3.5.14.2.2 shall be applied for the following dielectric strength tests:

Table V: Test No. 13

Table VI: Test No. 16

4.5.4.3 Voltage application/duration and pass/fail criteria. The voltage shall be applied for a period of 1 minute without insulation breakdown between the test points and under the conditions specified in 4.5.4.3.1, 4.5.4.3.1.1, 4.5.4.3.1.2, 4.5.4.3.1.2.1, and 4.5.4.3.1.2.2. The applied potential shall be increased gradually until the correct test value is reached.

4.5.4.3.1 Circuit breaker, fuse unit, attachments, and mounting base/block configuration. The circuit breaker shall have all applicable attachments installed and the circuit breaker and fuse unit (if applicable) shall be mated together. This entire configuration shall be installed on the mounting base/block.

4.5.4.3.1.1 Circuit breaker mounting base/block terminals and ground used as test points. The voltage shall be applied between the points marked with an "X" in Tables VIII and IX with the circuit breaker in the state (open, closed) specified in Tables VIII and IX.

TABLE VIII. Dielectric strength test points (mounting base/block terminals and ground) with circuit breaker open.

Circuit breaker open		Mounting base/block load terminals			Ground		
Mounting base/block line terminals		Left pole	Center pole	Right pole			
	Left pole	X			X		
	Center pole		X			X	
	Right pole			X			X
Ground		X					
			X				
				X			

TABLE IX. Dielectric strength test points (mounting base/block terminals and ground) with circuit breaker closed.

Circuit breaker closed		Mounting base/block load terminals		
Mounting base/block line terminals		Left pole	Center pole	Right pole
	Left pole		X	X
	Center pole			X
	Right pole			
Ground		X		
			X	
				X

4.5.4.3.1.2 Attachment leads used as test points.

4.5.4.3.1.2.1 Electric operating mechanism. Tie all electric operator mechanism leads together and apply specified voltage between lead bundle and electric operating mechanism housing.

4.5.4.3.1.2.2 Undervoltage release, shunt trip, and auxiliary switch. With the circuit breaker closed, the voltage shall be applied between attachment leads and mounting base/block line/load side terminals as marked with an "X" in Table X.

TABLE X. Dielectric strength test points (mounting base/block terminals, attachment leads, and ground).

Attachments	Mounting base/block terminals			Ground
	Left pole	Center pole	Right pole	
UVR /1	X	X	X	X
Shunt trip /1	X	X	X	X
Aux switch /1	X	X	X	X

NOTE:

/1 Leads shall be tied together and voltage applied between the tied bundle and the points specified.

4.5.5 Insulation resistance.

4.5.5.1 Test equipment. Insulation resistance shall be measured with a 500-volt insulation resistance testing device.

4.5.5.2 Test points and conditions. Insulation resistance shall be measured between the same test points and under the same conditions as specified in 4.5.4.3.1.

4.5.5.3 Pass/fail criteria.

4.5.5.3.1 10-megohm threshold. The insulation resistance shall be greater than 10 megohms for the following insulation resistance tests:

Table V: Test No. 10

Table VI: Test No. 11

4.5.5.3.2 1-megohm threshold. The insulation resistance shall be greater than 1 megohm for the following insulation resistance tests:

Table V: Test No. 14

Table VI: Test No. 17

4.5.6 Attachment electrical characteristics. Electric operating mechanisms, undervoltage releases, and shunt trips shall be tested to verify they operate in accordance with electrical characteristics specified in Tables II, III (a), III (b), and IV and other electrical characteristics as noted.

4.5.6.1 Electric operating mechanisms.

4.5.6.1.1 Voltage range. Two checks shall be conducted at the minimum, nominal, and maximum voltage in the range. With the circuit breaker in the closed position, the mechanism shall open and reclose the circuit breaker during each check.

4.5.6.1.2 Closing time. Closing time shall not exceed 1/2 second. Closing time shall be measured from the initial rise in the close signal voltage to the first indication of continuity across the circuit breaker poles.

4.5.6.2 Undervoltage release.

4.5.6.2.1 Operating voltage range. With the circuit breaker in the closed position, two checks each shall be conducted at the minimum, nominal, and maximum voltage in the range. The circuit breaker shall not open during any check.

4.5.6.2.2 Dropout voltage range. With voltage in the applicable dropout range, the following criteria shall be met:

a. The undervoltage release shall trip the circuit breaker.

b. The circuit breaker shall not be able to be reclosed.

c. The applicable maximum power requirements shall not be exceeded.

4.5.6.2.3 Time delay. Time delay for undervoltage releases shall be tested to ensure that they meet the requirements as specified in 3.5.19.4.1. Time delay shall be measured from the time that the voltage signal goes to zero to the first indication of circuit breaker opening.

4.5.6.3 Shunt trips. Two checks each shall be conducted at the minimum, nominal, and maximum voltage in the range. The voltage shall be applied with the circuit breaker in the closed position. The circuit breaker shall trip during each check and applicable maximum power requirements shall not be exceeded.

4.5.7 Undervoltage time delay. Time delay for undervoltage releases shall be tested to ensure that it meets the requirements as specified in 3.5.19.4.1. Time delay shall be measured from the time that voltage signal goes to zero to the first indication of circuit breaker opening.

4.5.8 Auxiliary switch rating. One “a” (normally closed) auxiliary switch shall have rated voltage and current applied in accordance with 3.5.19.6. The current and voltage shall be applied for the duration of the circuit breaker pre-interruption temperature rise test. There shall be no pitting or burning noted on the auxiliary switch at the end of the test.

4.5.9 Endurance.

4.5.9.1 Circuit breakers. Circuit breakers shall be subjected to endurance tests of 4.5.9.1.1 and 4.5.9.1.2 without failure or operating irregularities. At the completion of each endurance test, the circuit breakers shall be closely examined to identify any evidence of undue wear or development of operating irregularities in any part.

4.5.9.1.1 Mechanical endurance test.

4.5.9.1.1.1 Test set-up and method of cycling. No current shall be applied to the circuit breaker primary studs. Close-open operation shall be accomplished by the manual operating mechanism on all circuit breakers.

4.5.9.1.1.2 Number and rate of operations. The circuit breaker shall be operated mechanically at any convenient speed for 4000 close-open cycles unless otherwise specified in the applicable specification sheet (see 3.1).

4.5.9.1.2 Electrical endurance test.

4.5.9.1.2.1 Test set-up and method of cycling. Rated voltage, current, and frequency shall be applied as specified in the applicable specification sheet (see 3.1). Power factor lagging for AC circuits shall be 0.75 to 0.8. Close-open operation shall be accomplished using applicable attachments (see 4.5.9.2). DC circuits shall have a resistive load.

4.5.9.1.2.2 Number and rate of operations. The circuit breaker shall be operated electrically for the number of close-open operations and at the rate of operations specified in the applicable specification sheet (see 3.1).

4.5.9.2 Attachments. Applicable attachments shall be used to cycle the circuit breaker during electrical endurance. Rate of operations as specified in the applicable specifications sheets (see 3.1) for the circuit breaker electrical endurance shall be maintained.

4.5.9.2.1 Electric operating mechanism. Electric operating mechanism shall close and reset the circuit breaker for the number of operations specified in Table II.

4.5.9.2.2 Undervoltage release device. Undervoltage release device shall trip the circuit breaker for the number of operations specified in Tables III (a) and III (b).

4.5.9.2.3 Shunt trip. Shunt trip shall trip the circuit breaker for the number of operations specified in Table IV.

4.5.9.2.4 Example. An electrical endurance test procedure for an AQB-A250 circuit breaker with a shunt trip, an undervoltage release device, and an electric operating mechanism would be conducted as follows:

a. Subject the circuit breaker to 1500 trip operations by closing the circuit breaker with the electric motor operator, tripping the circuit breaker by energizing the shunt trip, and resetting the circuit breaker to "OFF" by utilizing the electric motor operator.

b. Subject the circuit breaker to 2500 trip operations by closing the circuit breaker with the electric motor operator, tripping the circuit breaker by de-energizing the undervoltage releases, and resetting the circuit breaker to "OFF" by utilizing the electric motor operator.

4.5.10 Calibration.

4.5.10.1 Circuit breakers with thermal magnetic trip units.

4.5.10.1.1 Long-time delay. Circuit breakers shall be tested in accordance with Table XI. LTD elements shall be tested with current flowing through all three poles in series. The tests shall start with the circuit breaker parts at ambient room temperature. LTD tests shall be conducted at 50±5 °C ambient temperature. Sufficient time between tests shall be allowed for adequate cooling of the circuit breaker.

TABLE XI. Long-time delay testing (thermal magnetic trip units).

Current level applied /1	Actual trip time	Required trip time /2

NOTE:

/1 Current levels as specified in the applicable specification sheets (see 3.1).

/2 Required trip time as specified in the applicable specification sheets (see 3.1).

4.5.10.1.2 Instantaneous trip elements. Tests shall be made on each pole of the circuit breaker at the current and frequencies required for instantaneous tripping to ensure that the calibration is within the limits and tolerances specified in the individual specification sheets (see 3.1). Instantaneous tests shall be conducted at 50±5 °C ambient temperature. The tests shall be performed on each pole a minimum of three times at the instantaneous settings identified in Tables XII and XIII. Sufficient time between tests shall be allowed for adequate cooling of the circuit breaker. The current asymmetry shall not exceed 5 percent on the first two half cycles. The pulse duration shall be between 5 cycles and 10 cycles. The tests shall be in accordance with the pulse method as per NEMA test schedule AB-4 (see 6.4.19).

TABLE XII. Instantaneous pickup testing (thermal magnetic and electronic trip units) /1 /5 /6.

Inst. switch setting /2	Applied current (amps) /3	Trip status					
		Left pole		Center pole		Right pole	
		Required	Actual /4	Required	Actual /4	Required	Actual /4
Min. setting	Min. tol.	No trip		No trip		No trip	
	Max. tol.	Trip		Trip		Trip	
Intermediate setting	Min. tol.	No trip		No trip		No trip	
	Max. tol.	Trip		Trip		Trip	
Max. setting	Min. tol.	No trip		No trip		No trip	
	Max. tol.	Trip		Trip		Trip	

NOTES:

/1 Where applicable, STD and short-time delay pickup (STDPU) settings shall be set to the maximum.

/2 Minimum, intermediate (or as close to middle as possible) and maximum instantaneous setting available on the circuit breaker as specified in the individual specification sheets (see 3.1).

/3 Minimum and maximum tolerance current level as specified in the individual specification sheets (see 3.1).

/4 When the circuit breaker holds at the minus tolerance current level, enter “No Trip” and when the circuit breaker trips at the plus tolerance current level, enter “Trip”. After a no-trip event, cycle the circuit breaker manually from off to on.

/5 For trip units with only a fixed (high) instantaneous trip setting, the pickup setting shall be tested only at that fixed setting.

/6 Not applicable to AQB-A50/51.

TABLE XIII. Instantaneous timing test (thermal magnetic and electronic trip units) /1.

Inst. switch setting /2	Applied current (amps) /3	Actual trip time			Required trip time /4
		Left pole	Center pole	Right pole	
Min. setting					
Intermediate setting					

NOTES:

/1 Where applicable, STD and STDPU settings shall be set to the maximum.

/2 Minimum and intermediate (or as close to middle as possible) instantaneous setting available on the circuit breaker as specified in the individual specification sheets (see 3.1).

/3 Applied current is equal to 3 times the nominal pickup current of the instantaneous setting.

/4 Circuit breakers with thermal magnetic trip units shall trip without intentional delay and shall trip within the times specified in the applicable specification sheet. Circuit breakers with electronic trip units shall trip without intentional delay and shall trip in less time than the fastest published time of the lowest STD band (see 3.1).

4.5.10.2 Calibration of circuit breakers with electronic trip unit.

4.5.10.2.1 Long-time delay. Circuit breakers shall be tested in a 50 °C ambient temperature in accordance with Table XIV (a). Sufficient time between tests shall be allowed for adequate cooling of the circuit breaker. Tests shall be performed on each pole and then on all poles simultaneously using three-phase power (not three poles in series). Sufficient time between tests shall be allowed for adequate cooling of the circuit breaker.

4.5.10.2.1.1 Long-time thermal memory (for circuit breakers with electronic trip units only). Circuit breakers shall be tested for long-time thermal memory in a 50 °C ambient temperature immediately following the highest applied current level test of the long-time calibration test of 4.5.10.2.1 as shown in Table XIV (a). The thermal memory tripping time upon the immediate retest shall be less than the tripping time recorded for the previous LTD tripping event at the highest applied current level.

TABLE XIV (a). Long-time delay and long-time thermal memory testing (electronic trip units).

Current level applied /1	Actual trip time				Required trip time
	Left pole	Center pole	Right pole	All poles (3-phase) /3	
Long-time thermal memory test /2					

NOTES:

/1 Current levels as specified in individual specification sheets (see 3.1).

/2 In accordance with the test specified in 4.5.10.2.1.1.

/3 Three-phase power, not three poles in series.

4.5.10.2.1.1.1 Example of long-time delay and long-time thermal memory testing (AQB-A252 circuit breaker). Table XIV (b) shows how an electronic AQB-A252 circuit breaker would be tested for long-time delay and long-time thermal memory. See AQB-A252 specification sheet to understand how current levels and required trip times are determined.

TABLE XIV (b). Example of long-time delay and long-time thermal memory testing (AQB-A252 circuit breaker).

Current level applied	**Actual trip time**				**Required trip time**
	Left pole	**Center pole**	**Right pole**	**All poles (3-phase)**	
1.35X continuous current setting (CCS)	Enter trip time (must be > 1 hour)	Enter trip time (must be > 1 hour)	Enter trip time (must be > 1 hour)	Enter trip time (must be > 1 hour)	> 1 Hour
1.65X CCS	Enter trip time (must be < 1 hour)	Enter trip time (must be < 1 hour)	Enter trip time (must be < 1 hour)	Enter trip time (must be < 1 hour)	< 1 Hour
4X CCS	Enter trip time (must be 35-55 sec.)	Enter trip time (must be 35-55 sec.)	Enter trip time (must be 35-55 sec.)	Enter trip time (must be 35-55 sec.)	35 -55 sec.
6X CCS	Enter trip time (must be 20-32 sec.)	Enter trip time (must be 20-32 sec.)	Enter trip time (must be 20-32 sec.)	Enter trip time (must be 20-32 sec.)	20 -32 sec.
Long-time thermal memory test (6X CCS)	Enter trip time (must be less than column entry immediately above)	Enter trip time (must be less than column entry immediately above)	Enter trip time (must be less than column entry immediately above)	Enter trip time (must be less than column entry immediately above)	< 6X CCS entries above

4.5.10.2.2 Instantaneous trip elements. Test shall be made in accordance with 4.5.10.1.2.

4.5.10.2.3 Short-time delay. Tests shall be conducted on each pole in accordance with Tables XV, XVI, and XVII in room ambient temperature. The tests of Tables XV, XVI, and XVII shall be repeated for each type of short-time delay curve (flat response, I^2T response, etc.) provided with the circuit breaker. Sufficient time between tests shall be allowed for adequate cooling of the circuit breaker.

TABLE XV. Short-time delay pickup testing (electronic trip units).

STDPU switch setting /1	Applied current (amps)	Trip status					
		Left pole (STD switch set at min.) /4		Center pole (STD switch set at intmd) /3 /4		Right pole (STD switch set at max.) /4	
		Required	Actual /2	Required	Actual /2	Required	Actual /2
Min. setting	90% of STDPU	No trip		No trip		No trip	
	110% of STDPU	Trip		Trip		Trip	
Intermediate setting	90% of STDPU	No trip		No trip		No trip	
	110% of STDPU	Trip		Trip		Trip	
Max. setting	90% of STDPU	No trip		No trip		No trip	
	110% of STDPU	Trip		Trip		Trip	

NOTES:

/1 Minimum, intermediate (or as close to middle as possible) and maximum STDPU setting available on the circuit breaker as specified in the individual specification sheets (see 3.1).

/2 When the circuit breaker holds at the 90% tolerance current level, enter “No Trip” and when the circuit breaker trips at the 110% tolerance current level, enter “Trip”. After a no-trip event, cycle the circuit breaker manually from off to on.

/3 Intermediate (or as close to middle as possible) STD setting available on the circuit breaker as specified in the individual specification sheets (see 3.1).

/4 Duration of applied current shall be one-half (1/2) cycle greater than the circuit breaker STD setting bandwidth maximum as specified in the individual specification sheets (see 3.1).

TABLE XVI. Short-time delay trip time testing (electronic trip units).

Short time pickup switch setting /1	Applied current (amps)	Left pole (short time delay switch set at min.) /4		Center pole (short time delay switch set at intmd) /3 /4		Right pole (short time delay switch set at max.) /4	
		Trip time		Trip time		Trip time	
		Required /2	Actual	Required /2	Actual	Required /2	Actual
Min. setting	3 times STDPU						
Intermediate setting	3 times STDPU						
Max. setting	3 times STDPU						

NOTES:

/1 Minimum, intermediate (or as close to middle as possible) and maximum STDPU setting available on the circuit breaker as specified in the individual specification sheets (see 3.1).

/2 Allowable time band as specified in the individual specification sheets (see 3.1) for short-time tripping.

/3 Intermediate (or as close to middle as possible) STD setting available on the circuit breaker as specified in the individual specification sheets (see 3.1).

/4 Duration of applied current shall be one-half (1/2) cycle greater than the circuit breaker STD setting bandwidth maximum as specified in the individual specification sheets (see 3.1).

TABLE XVII. Short-time resettable delay testing (electronic trip units).

STDPU switch setting /1	Applied current (amps) /2	Trip status					
		Left pole (time delay switch set at min.) /5		Center pole (time delay switch set at intmd.) /4 /5		Right pole (time delay switch set at max.) /5	
		Required	Actual /3	Required	Actual /3	Required	Actual /3
Intermediate setting		No trip		No trip		No trip	
Max. setting		No trip		No trip		No trip	

NOTES:

/1 Intermediate (or as close to middle as possible) and maximum STDPU setting available on the circuit breaker as specified in the individual specification sheets (see 3.1).

/2 Applied current level shall be 120% of the nominal short-time delay pickup current.

/3 If the circuit breaker holds, enter “No Trip” or if the circuit breaker trips enter “Trip”. After a no-trip event, cycle the circuit breaker manually from off to on.

/4 Intermediate (or as close to middle as possible) STD setting available on the circuit breaker as specified in the individual specification sheets (see 3.1).

/5 Duration of applied current shall be one-half (1/2) cycle less than the circuit breaker STD setting bandwidth minimum as specified in the individual specification sheets (see 3.1).

4.5.10.3 Abbreviated calibration testing.

4.5.10.3.1 Long-time delay. LTD calibration shall be tested in accordance with that of 4.5.10.1.1 for thermal magnetic trip unit circuit breakers and in accordance with 4.5.10.2.1 for electronic trip unit type circuit breakers. For calibration testing of thermal magnetic trip unit type circuit breakers after shock (test no. 6 of Table VI) and after vibration (test no. 9 of Table VI), the following caveats apply for thermal magnetic trip unit type circuit breakers only:

a. Actual trip times shall not vary more than ±15% of the specified upper limit (see 3.1) from the actual trip times recorded before shock testing as part of test no. 3 of Table VI.

b. Where no upper limit is specified, the actual trip times shall be greater than the specified lower limit (see 3.1).

c. Readjustment of the circuit breaker trip unit to specified calibration limits (see 3.1) is permissible between test nos. 6 and 7 of Table VI.

4.5.10.3.2 Instantaneous. For thermal magnetic and electronic trip unit circuit breakers, instantaneous calibration shall be in accordance with the test of 4.5.10.1.2 but tested at the intermediate instantaneous setting only. For calibration testing after shock (test no. 6 of Table VI) and after vibration (test no. 9 of Table VI), the following caveats apply for thermal magnetic trip unit type circuit breakers only:

a. The no-trip event shall occur at an applied current level of ±15% of the specified minimum pickup tolerance (see 3.1).

b. The trip event shall occur at an applied current level of ±15% of the specified maximum pickup tolerance (see 3.1).

4.5.10.3.3 Short-time delay. For electronic trip unit type circuit breakers only, STD shall be tested in accordance with 4.5.10.2.3 and Table XV but at the intermediate STDPU setting only.

4.5.11 Inclined operation. With the circuit breaker inclined, forward, backward and to each side at an angle of 45 degrees from the vertical position, the circuit breaker, fuses and fuse units (if applicable), and attachments shall pass the tests specified in 4.5.6 and 4.5.11.1.

4.5.11.1 Manual cycling. The circuit breaker shall be manually cycled three times in each direction of inclination.

4.5.12 Temperature rise.

4.5.12.1 Circuit breaker.

4.5.12.1.1 Test circuit. The circuit breaker shall be operated at rated current and any convenient voltage in a 50 °C ambient. Bus bars shall be used for connecting to the top studs and cable shall be used for connecting to the bottom studs. Size of the bus bar and cable shall be as specified in the applicable specification sheet (see 3.1). The copper cross-section of the leads shall remain constant for at least 3 feet from each stud on the circuit breaker.

4.5.12.1.2 Sensor locations.

4.5.12.1.2.1 Ambient. The ambient temperature shall be determined by two temperature sensors (thermometers, thermocouples, or other approved method). The sensors shall be located within two feet of each side of the circuit breaker at half the depth and half the height of the circuit breaker.

4.5.12.1.2.2 Circuit breaker. The temperature rise shall be determined by sensors located at, but not limited to, the following locations:

a. At the circuit breaker line and load side slip-type connectors on each phase.

b. At the mounting base/block line and load terminals on each phase.

c. At the molded case material nearest the main contacts on each phase.

d. At any point where a current-carrying part is in contact with the insulating material including areas nearest the main contacts.

4.5.12.1.3 Temperature stabilization and temperature rise determination. All temperature readings shall be recorded during the same time frame and shall be of sufficient duration to allow stabilization of the measured temperatures to a rate of rise within 2 °C per hour. Ambient temperature shall be maintained at 50 °C ±5 °C. An average ambient temperature shall be determined by averaging together the ambient sensor readings. The average ambient temperature shall be used to determine the temperature rise of monitoring points specified in 4.5.12.1.2.2.

4.5.12.1.4 Pass/fail criteria.

4.5.12.1.4.1 Pre-interruption. Temperature rise shall not exceed the requirements of molding and insulating materials specified in MIL-E-917. Temperature rise shall not exceed 65 °C rise for terminals and slip type connectors.

4.5.12.1.4.2 Post-interruption. Temperature rise shall not exceed 150 percent of the allowable values specified in 4.5.12.1.4.1.

4.5.12.2 Attachments. Temperature rise of electric operating mechanism, undervoltage release device, shunt trip, and auxiliary contacts shall be measured during electrical endurance testing while the attachments are used to cycle the circuit breaker. Sensors shall be located on the housing of the electric operating mechanism, undervoltage release device, and shunt trip to determine the temperature rise. For auxiliary contacts, a sensor shall be located on insulation material nearest to the "a" contact used as the shunt trip cut-off switch. The temperature rise of attachments shall not exceed the allowable temperature rise of the circuit breaker insulating material specified in 4.5.12.1.4.1.

4.5.13 Interrupting performance. Interrupting tests shall consist of AC or DC tests as applicable. The circuit breaker under test shall be omitted from the test circuit or short circuited during the calibration of the test circuit. Interrupting performance for 400-Hz circuit breakers shall be tested with a 60-Hz power source. Cheese cloth shall be placed around the handle and at the terminals prior to testing.

4.5.13.1 Test circuit.

4.5.13.1.1 AC test circuit. Interrupting tests shall be made in a circuit having a lagging power factor as follows:

Nominal test circuit current	Power factor
0–10,000 amperes	0.45–0.50
10,001–15,000 amperes	0.25–0.30
15,001–above	0.15–0.20

The test circuit current shall be the total rms current including the DC component and shall be taken as the average of all three phases. It shall be measured at 1/2 cycle after the short circuit occurs, and shall be calculated in accordance with the following (refer also to ANSI/IEEE C37.09).

a. Symmetrical waves. Currents which are symmetrical about the zero axis have an rms value equal to the peak-to-peak value divided by 2 $\sqrt{2}$. The peak-to-peak value at the desired instant shall be measured from the envelope of the current wave.

b. Asymmetrical waves. These may be considered as composed of two components, an alternating and a direct component. The alternating component has a peak-to-peak value equal to the distance between the envelopes and has an axis midway between the envelopes. It shall be measured as for the symmetrical waves. The direct component has an amplitude equal to the displacement of the axis of the alternating component. The total rms value of an asymmetrical wave is equal to the square root of the sum of the squares of the symmetrical and direct components taken at the desired instant.

4.5.13.1.2 DC test circuit. The current measured shall be the maximum value. The test circuit shall be adjusted so that the initial rate of current rise shall not be greater than 10 amperes per microsecond with two poles connected in series.

4.5.13.2 Test sequence and pass/fail criteria. At least three interrupting tests shall be made on each type circuit breaker sample except for circuit breakers combined with fuses or current limiting fuse units. For fused circuit breakers, refer to the applicable individual specification sheets (see 3.1) and 3.5.17.1. For circuit breakers combined with fuse units, refer to the applicable individual specification sheets (see 3.1) and 3.5.17.2. Unit operations (see 6.4.31) shall consist of an "O" unit operation followed at a 5-minute interval by a "CO" unit operation followed at a 5-minute interval by a "CO" unit operation. After each interruption the circuit breaker reset time (see 6.4.24) shall be recorded. The circuit breaker shall successfully interrupt during the entire sequence and cheese cloth placed around the handle and at the terminals shall not be ignited. The circuit breaker shall be verified to be in operable condition after the third interruption by manually cycling the circuit breaker.

4.5.14 Shock.

4.5.14.1 Circuit breaker samples, states, and mounting. Circuit breakers on mounting bases/blocks, with attachments, including current limiting fuse units, shall be tested in both the open and closed position in accordance with the high impact shock tests specified in MIL-S-901 for Grade A, Class I, Type C equipment. One sample unit shall be used for testing the entire open and closed condition circuit breaker test series. Multiple sample units to shock test the circuit breaker in the open position and one sample unit to test in the closed position shall not be allowed. Unless otherwise specified (see 3.1), mounting for shock testing AQB circuit breakers shall be in accordance with Figure 4. Where a two circuit breaker mounting base/block or assembly is also involved, it shall be tested for mechanical damage by mounting in a horizontal position on the top supporting channel shown on Figure 4 and two circuit breakers shall be used as dummy weights. Where current limiting fuse units are involved, they shall be included.

4.5.14.2 Equipment energization.

4.5.14.2.1 Circuit breakers.

4.5.14.2.1.1 Thermal magnetic. Thermal magnetic circuit breakers with or without fuse units shall be energized during the test with a 12-volt or less source and current equivalent to 30 to 50 percent of the breakers full-load current.

4.5.14.2.1.2 Electronic. Electronic trip device type circuit breakers with or without fuse units shall be energized with a 12-volt or less source at any convenient current.

4.5.14.2.2 Attachments.

4.5.14.2.2.1 Undervoltage releases. Undervoltage releases shall be energized at nominal voltage of operating range.

4.5.14.2.2.2 Auxiliary switch. Auxiliary switches shall be energized with at least 5 volts in order to clearly determine bounce and chatter during shock.

4.5.14.2.2.3 Electric operating mechanism. Electric operating mechanisms shall be energized with rated voltage at their common terminals in order to detect mal-operation of mechanism controls (relays, limit switches, etc.) that may cause the circuit breaker to change state.

4.5.14.3 Monitoring of main and auxiliary contacts.

4.5.14.3.1 Monitoring equipment. Main and auxiliary contacts shall be monitored by oscillograph, FM tape recorder, or suitable digital data acquisition system. All equipment shall have a minimum frequency response and sampling rate of 2 KHz. Digital signal processing of acquired data shall be capable of producing suitable waveform plots with 0.5 millisecond minimum resolution, and for analysis purposes shall be able to expand contact events with graphical editing to determine time increments of the individual sample points.

4.5.14.3.2 Number of contacts to monitor. Main contacts on each phase shall be monitored during each shock blow. For auxiliary contacts, one “a” contact (normally closed) and one “b” contact (normally open) shall be monitored during each shock blow.

4.5.14.4 Pass/fail criteria.

4.5.14.4.1 Pass/fail criteria during shock. The circuit breaker shall meet the following criteria during shock testing:

a. Circuit breakers shall not change position/state from “on” to “off” or from “off” to “on” during the test. An “off” to “trip” position/state change is permitted.

b. Main and auxiliary contacts shall not close when open.

c. Circuit breaker main and auxiliary contacts shall not open when closed. Momentary opening of the main and auxiliary contacts of less than 0.010-second duration will be acceptable. Multiple contact bounces are acceptable providing that the total elapsed time from the beginning of the first bounce to the end of the last bounce does not exceed 0.015 second for auxiliary contacts and 0.060 second for main contacts.

d. Adjustable trip unit settings shall not change position.

e. Fuse units shall not open the circuit, change protective characteristics, lose filler material, or show signs of deformation.

f. Electric operating mechanism control relays shall not cause the circuit breakers to change position/state.

4.5.14.4.2 Post-shock pass/fail criteria (manual cycling). Immediately after shock testing, the circuit breaker shall be manually cycled from off to on three times without failure or operating irregularities.

4.5.15 Vibration. The circuit breakers on mounting bases/blocks with attachments, including current limiting fuse units, shall be tested in both the open and closed positions in accordance with Type I tests of MIL-STD-167-1. Circuit breaker states, energization, contact monitoring, and pass/fail criteria shall be the same as for shock testing.

4.5.16 Electromagnetic interference (EMI). Circuit breakers with electronic devices shall be tested in accordance with MIL-STD-461 to verify compliance with the requirements specified in 3.4.10. Testing shall not cause false tripping, failure of trip unit, or failure of attachments.

4.5.17 Voltage spike. Circuit breakers with electronic devices shall be tested in accordance with MIL-STD-1399-300. Testing shall not cause false tripping, failure of trip unit, or failure of attachments.

4.5.18 Handle locking device operation. The handle locking device shall be installed with the circuit breaker in the tripped position. An attempt shall be made to manually reset and close the circuit breaker. The circuit breaker shall remain in the tripped position.

4.5.19 Handle boot operation and high temperature endurance.

4.5.19.1 Operation (manual cycling). With the handle boot installed on the circuit breaker handle, the circuit breaker shall be manually cycled from off to on three times without failure or operating irregularities.

4.5.19.2 High temperature endurance. The handle boot shall be subjected to a temperature of 200 °C for a period of 150 hours. There shall be no evidence of aging or effect on the transparency of the material.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Circuit breakers are to be used in electrical power systems to protect against overloads and short circuits and to provide a switch for manually isolating circuits.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Circuit breaker type, AQB or NQB (see 1.2).

c. If required, the specific issue of individual documents referenced (see 2.2.1 and 2.2).

d. Voltage and frequency.

e. Current rating.

f. Title, number, and date of the applicable specification sheet (see 3.1).

g. Whether selected parts (circuit breaker housing excluded) may be made from thermoplastic material (see 3.5.11).

h. Wire coating requirements if other than as specified (see 3.5.20.2).

i. Sockets requirements if other than as specified (see 3.5.20.3).

j. Whether a handle locking device is required (see 3.5.19.7).

k. Mounting requirements (see 3.5.18.2).

l. Adjustable instantaneous trip settings (see 3.5.16.1.2).

m. Adjustable short-time delay pickup and STD (see 3.5.16.2.4).

n. Current limiting fuse units (see 3.5.17.2).

o. Whether an electric operating mechanism is required (see 3.5.19.3).

p. Nominal and operating voltage range for undervoltage tripping devices (see 3.5.19.4).

q. Whether a shunt trip device is required (see 3.5.19.5).

r. Voltage of shunt trip device (see 3.5.19.5).

s. Whether an auxiliary switch is required (see 3.5.19.6).

t. Whether mounting bases/blocks are required (see 3.5.18.1).

u. Whether a handle boot is required (see 3.5.19.8).

v. Creepage and clearance distances, if other than as specified (see 3.4.1).

w. When master drawings are required (see 3.3).

x. EMI control requirements, if other than as specified (see 3.4.10).

y. Endurance test requirements, if other than as specified.

z. Qualification test reports (see 4.2.4).

aa. Conformance inspection sampling requirements, if other than as specified (see 4.4.1).

bb. Requirements for rework and suspension of shipment of circuit breakers when circuit breakers do not meet acceptance criteria (see 4.4.2 and 4.4.3.4).

cc. Packaging requirements (see 5.1).

dd. Provisioning requirements (see 6.5).

ee. Technical manual requirements (see 6.6).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in qualification data set (QDS) No. 17361 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy.mil.

6.4 Definitions. Definitions of various technical terms wherever such terms appear in this specification are in accordance with NEMA Standards Publication AB-1, except as noted below.

6.4.1 AQB circuit breaker. An AQB circuit breaker is a molded case circuit breaker with a trip unit installed.

6.4.2 Attachments. Attachments are accessories or features that enhance the capability of the circuit breaker but are not required for manual operation or to provide overcurrent protection.

6.4.3 Auxiliary switch. An auxiliary switch is a switch mechanically interlocked with the main contacts of the circuit breaker and used for signaling, electrical interlocking, or other purposes.

6.4.4 Back-connected. A back-connected circuit breaker is one on which the main current connections are made from the back of the circuit breaker.

6.4.5 Continuous current rating. The continuous current rating is the stated limit in rms amperes or DC amperes which a circuit breaker will carry continuously under stated ambient conditions without either tripping or exceeding the limit of observable temperature rise.

6.4.6 Current limiting device. A current limiting device is a device which, when interrupting currents in its current limiting range, will reduce the current flowing in the fault circuit to a magnitude substantially less than that obtainable in the same circuit if the device was replaced with a solid conductor having comparable impedance. When the device is a (fuseless) current limiting circuit breaker, it will permit restoration of service by resetting, if necessary, and returning to the “on” position without replacement of any of its parts or elements.

6.4.7 Current limiting fuse unit base. A current limiting fuse unit base is an assembly for mounting the current limiting fuse unit. It is connected between the circuit breaker mounting base/block and the load.

6.4.8 Electric operating attachment. An electric operating attachment consists of either an electric motor or solenoid with associated control devices and mechanical mechanisms readily attachable to a manually operated circuit breaker to provide opening and closing from a remote source.

6.4.9 Front-connected. A front-connected circuit breaker is one on which connections are made from the front without the necessity of access to the rear of the circuit breaker.

6.4.10 Fused circuit breaker. A fused circuit breaker is a device in which the circuit breaker mechanism will open on overloads and low fault currents up to the point where the internal current limiting fuses take over the duty and blow. When a fuse or fuses blow the circuit breaker mechanism opens.

6.4.11 Handle boot. A handle boot is a flexible rubber protective device for the circuit breaker handle.

6.4.12 Handle locking device. A handle locking device is a metal clip which permits securing of the circuit breaker operating handle in either the open or closed position. This device does not affect the mechanically trip free operation of the circuit breaker.

6.4.13 Intentional time delay. Intentional time delay is the specific time value purposely introduced in the tripping of a circuit breaker.

6.4.14 Interrupting rating. The interrupting rating of a circuit breaker is the highest current (rms if AC) at a specified operating voltage which the circuit breaker is required to interrupt under the operating duty specified and with a normal frequency recovery voltage equal to the specified operating voltage. The interrupting rating is based on asymmetrical current. Refer to 4.5.13.1.1.

6.4.15 Low voltage. Low voltage refers to voltages up to and including 1kV.

6.4.16 NQB circuit breaker. An NQB circuit breaker is a molded case circuit breaker with no trip unit installed.

6.4.17 Peak let-through current. Peak let-through current is the maximum instantaneous peak current which passes through the circuit breaker during the total clearing time.

6.4.18 Pickup. The pickup value of the tripping device is the nominal value at which the device will operate.

6.4.19 Pulse method. Pulse method of testing the instantaneous trip is described in NEMA Standards Publication AB-4 and provides two repeatable test results in contrast to run up method which is operator dependant and also is not in accordance with the real current rise in case of short circuit.

6.4.20 Quick-break. A circuit breaker is quick-break when it has a high contact opening speed independent of the operator under all conditions.

6.4.21 Quick-make. A circuit breaker is quick-make when it has high contact closing speed independent of the operator.

6.4.22 Rated short-time current (for AQB-A1602 only). The rated short-time current is the maximum current which a circuit breaker will carry without injury for specified short-time intervals. The rating recognizes the limitations imposed by both thermal and electromagnetic effects.

6.4.23 Removable mounting. Removable mounting applies to a circuit breaker or current limiting fuse unit which has slip (separable) type disconnecting copper connections. Its frame is mounted by means of supporting screws.

6.4.24 Reset time (at interrupting rating). Reset time is the minimum time interval between automatic tripping of the circuit breaker at its full interrupting rating and the condition which will allow reclosing of the operating mechanism.

6.4.25 Shunt trip. Shunt trip signifies the opening of a circuit breaker by energizing a trip coil from a source external to the circuit breaker. The trip coil circuit is closed through a relay, switch, or other means.

6.4.26 Time, interrupting. That time from initiation to cessation of the overload or fault current including detection, unlatching, contact separation, and arcing.

6.4.27 Trip free. A circuit breaker is deemed trip free from the operating handle when the means for operation are such that the contacts cannot be held the closed position under trip conditions. The construction is such that when the operating handle or other manual operating device is held in the on position and the circuit breaker is tripped automatically, the contacts will not automatically return to the closed position.

6.4.28 Tripping time. Tripping time is the total interval of elapsed time from the instant of applying a given overcurrent to the circuit breaker and the completion of the interruption of the circuit at rated voltage.

6.4.29 Trip unit, adjustable. An adjustable trip unit is an assembly containing the automatic trip devices of the circuit breaker with adjustable trip characteristics as described in the requirements of 3.1.

6.4.30 Type. Circuit breaker type is an arbitrary designation used to differentiate performance characteristics.

6.4.31 Unit operations. Unit operations are of two types, namely, an “O” cycle, where the circuit breaker opens the circuit only, and a “CO” cycle, where the circuit breaker closes the circuit followed immediately by its opening without purposely delayed action.

6.5 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified (see 6.2). When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

6.6 Technical manuals. Technical manuals should be furnished as specified (see 6.2).

6.7 Certification data. Certification data sheets should include applicable data listed in the identification plate and classification table shown on Figure 1.

6.7.1 Condition of omission of drawings and certification data sheets. Unless otherwise specified (see 3.3), when a circuit breaker is a part of an assembly (such as a switchboard), individual circuit breaker drawings and certification data sheets need not be furnished. The applicable drawings and certification data sheets should, however, be indicated on the switchboard or assembly drawings, together with complete descriptive data for the circuit breaker.

6.8 Subject term (key word) listing.

Auxiliary switch
Continuous current
Electric operator
Fuses
Handle locking device
Instantaneous tripping
Interchangeable trip units
Interrupting ratings
Long-time delay
Peak let-through current
Short-time delay
Short-time delay pickup
Shunt trip
Undervoltage trip

6.9 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

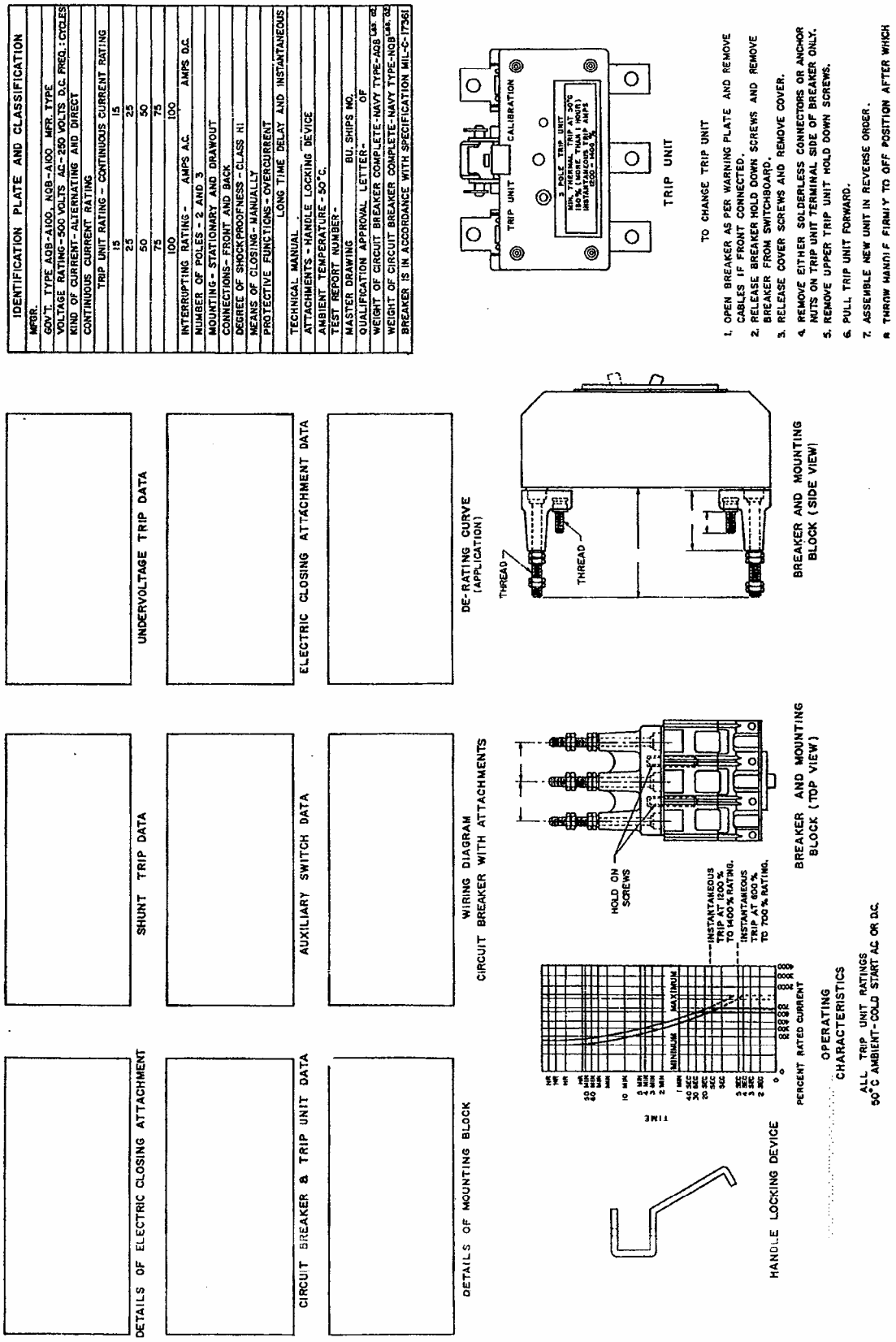

FIGURE 1. Typical master drawing.

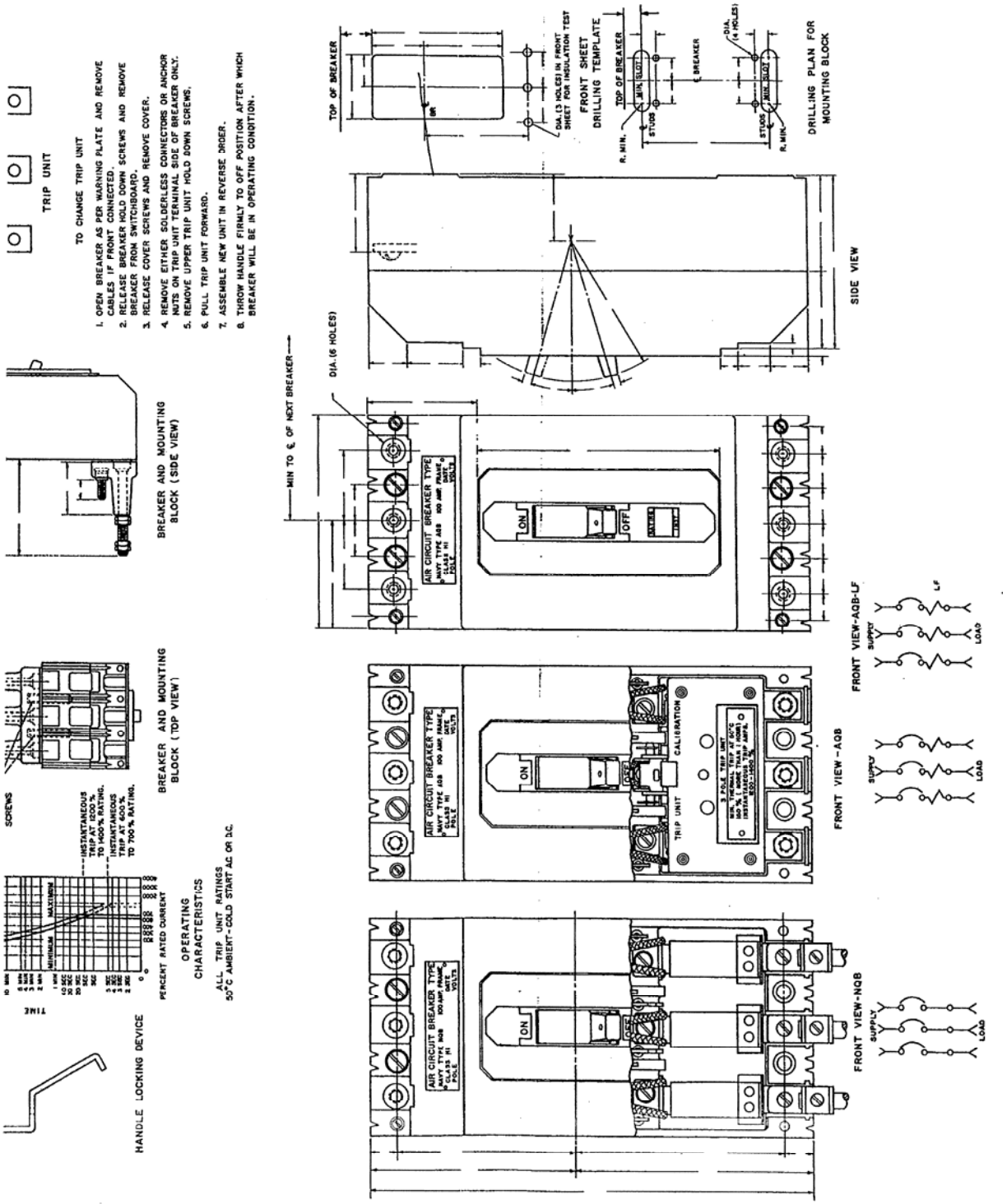

FIGURE 1. Typical master drawing - Continued.

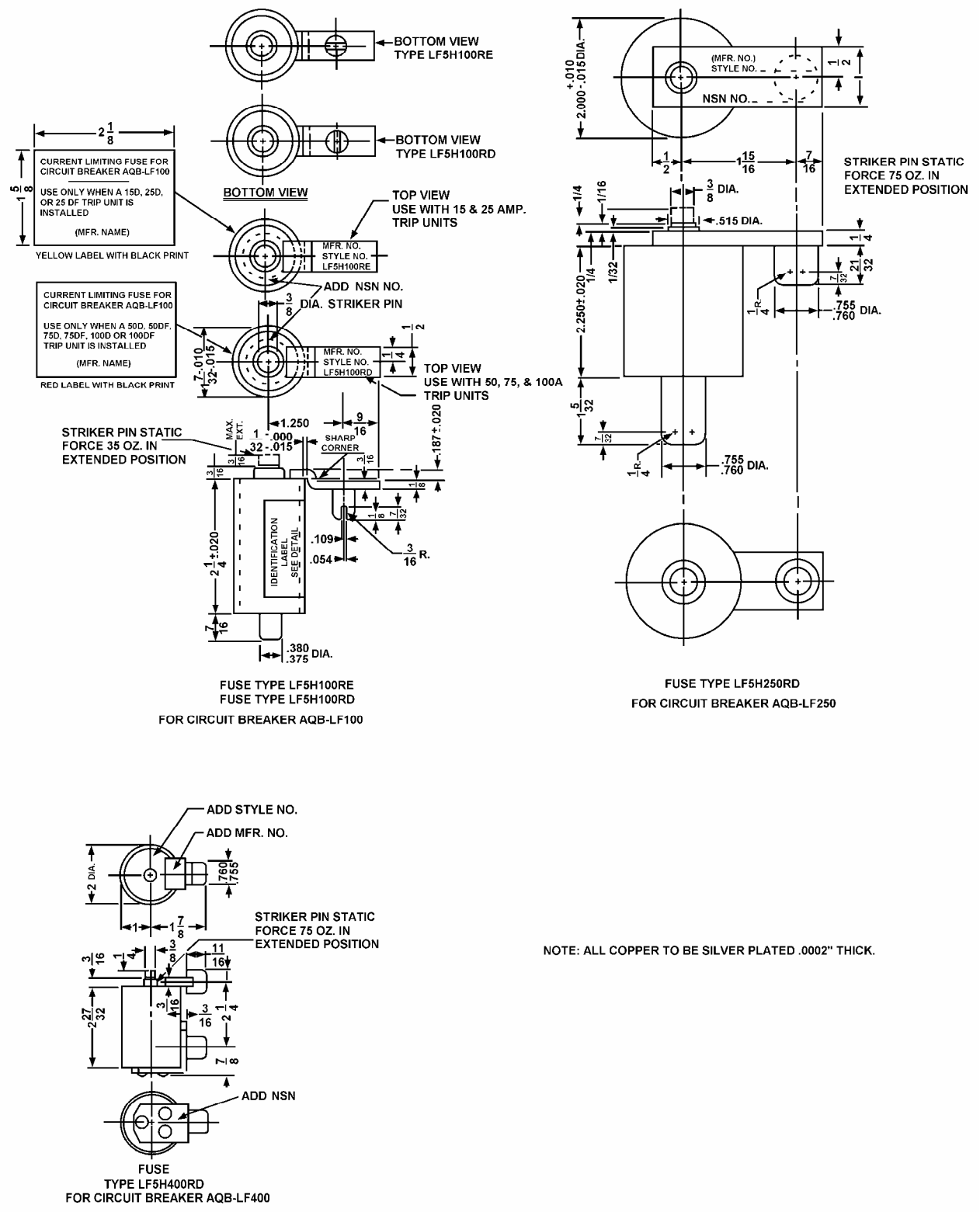

FIGURE 2. Current limiting fuses, outline dimensions.

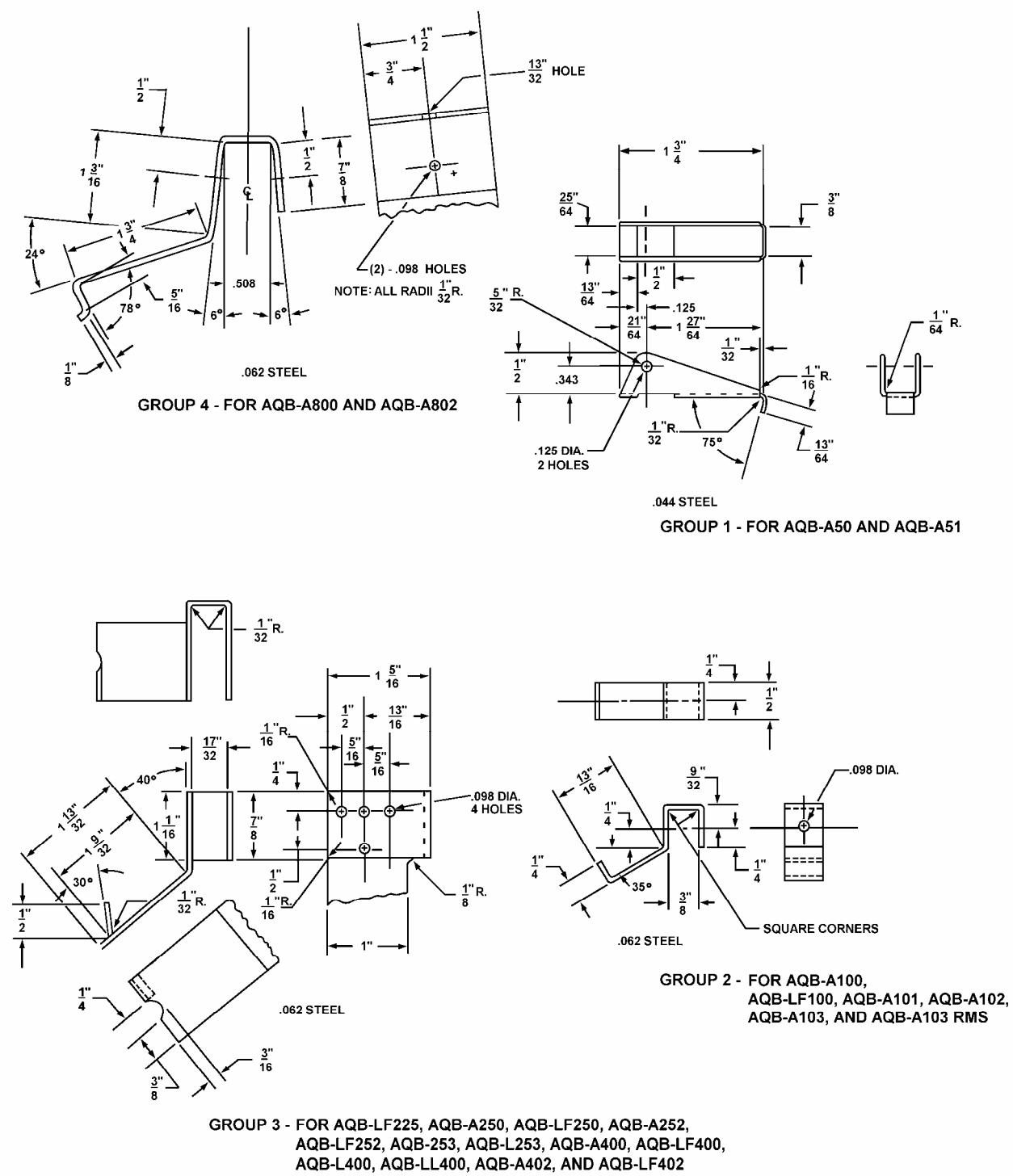

FIGURE 3. Handle locking devices for circuit breakers.

LIST OF MATERIAL

QUANTITIES ARE FOR ONE MOUNTING

PIECE NUMBER	NAME OF PIECE	NO. REQ'D.	MATERIAL	MATERIAL SPECIFICATION	FINISH
1	BACK PLATE 20"x 12"x1/8"	1	STEEL		
2	BACK PLATE 20"x 17 1/2"x 1/8"	1	STEEL		
3	BACK PLATE 20"x24"x1/8"	1	STEEL		
4	FORMED CHANNEL 3 3/8"x1"x3/16"	2	STEEL		
5	FORMED CHANNEL 4"x1 1/2"x3/16"	2	STEEL		
6	FORMED CHANNEL 6"x1 1/2"x3/16"	2	STEEL		
7	ANGLE-2 1/2"x 2 1/2"x 1/4"x34"Lg.	2	STEEL		
8	ANGLE-2 1/2"x2 1/2"x1/4"x34"Lg.	2	STEEL		
9	ANGLE-2 1/2"x2 1/2"x1/4"x34"Lg.	2	STEEL		
10	STD. CHANNEL-4"-7.25LB-28"Lg.	2	STEEL		
11	C.B. CHANNEL-4"-13.8LB.-34"Lg.	2	STEEL		
12	BLOCK-3 1/4"x 1 1/4"x 1 1/2"	4	STEEL		
13	I.P.S. PIPE SPACER-1"-2 15/16"Lg.	8	STEEL		
14	HEX. HD. BOLT 3/4"-10x10"Lg.	4	STEEL HEAT TREATED		
15	HEX. HD. NUT 3/4"-10	8	STEEL HEAT TREATED		
16	HEX. HD. BOLT 3/4"-10x6"Lg.	4	STEEL HEAT TREATED		
17	HEX. HD. BOLT 1/2"-13x5"Lg.	4	STEEL		
18	HEX. HD. NUT 1/2"-13	4	STEEL		
19	HEX. HD. BOLT 3/8"-16x1"Lg.	8	STEEL		
20	HEX. HD. NUT 3/8"-16	8	STEEL		
21	WASHER -2" O.D.x 13/16" I.D.	16	STEEL		
22	WASHER - 1" O.D. x 9/16" I.D.	8	STEEL		
23	WASHER - 1" O.D.x 7/16" I.D.	16	STEEL		

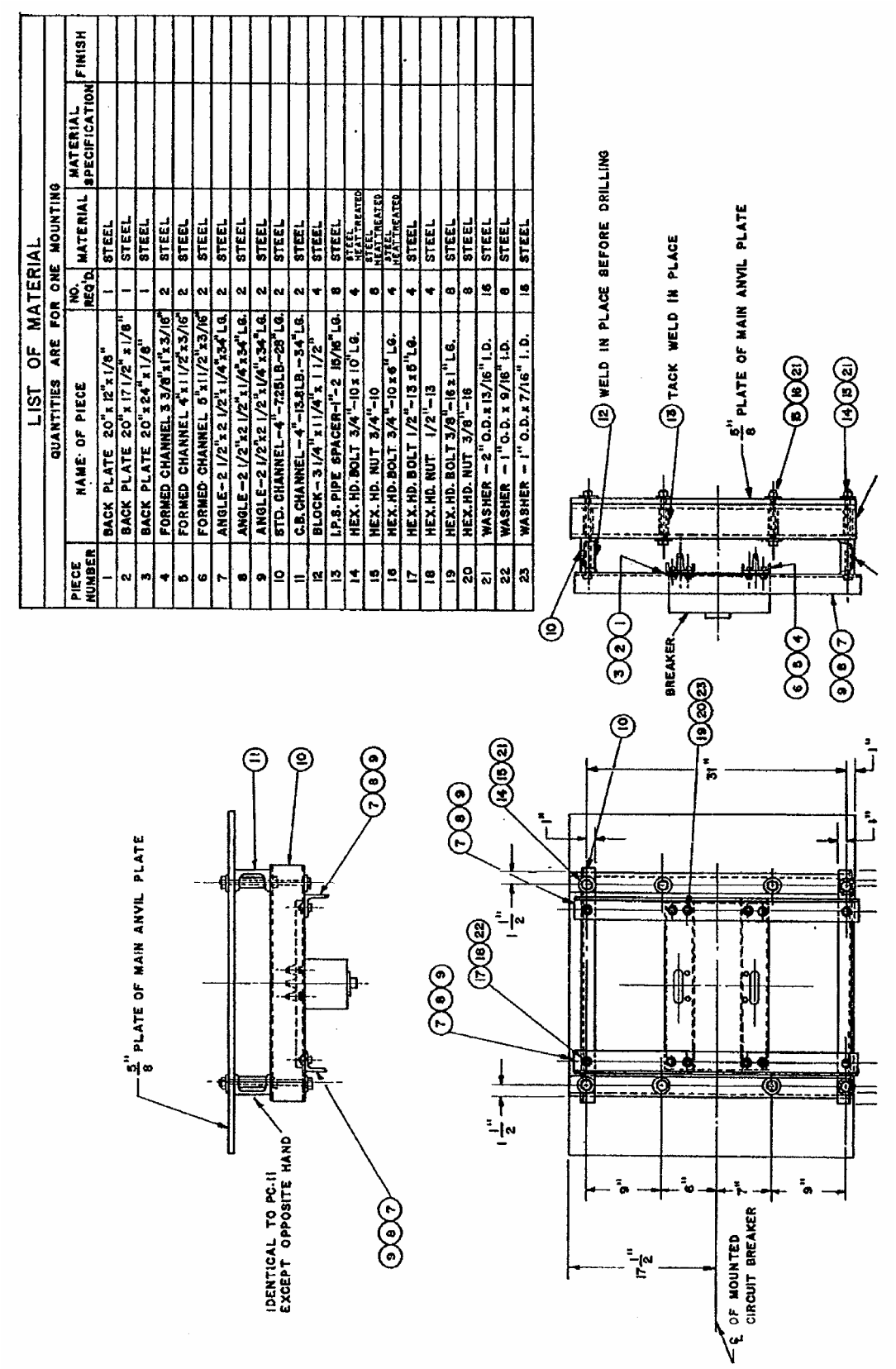

FIGURE 4. Standard mounting for shock testing drawout-mounted type AQB circuit breakers.

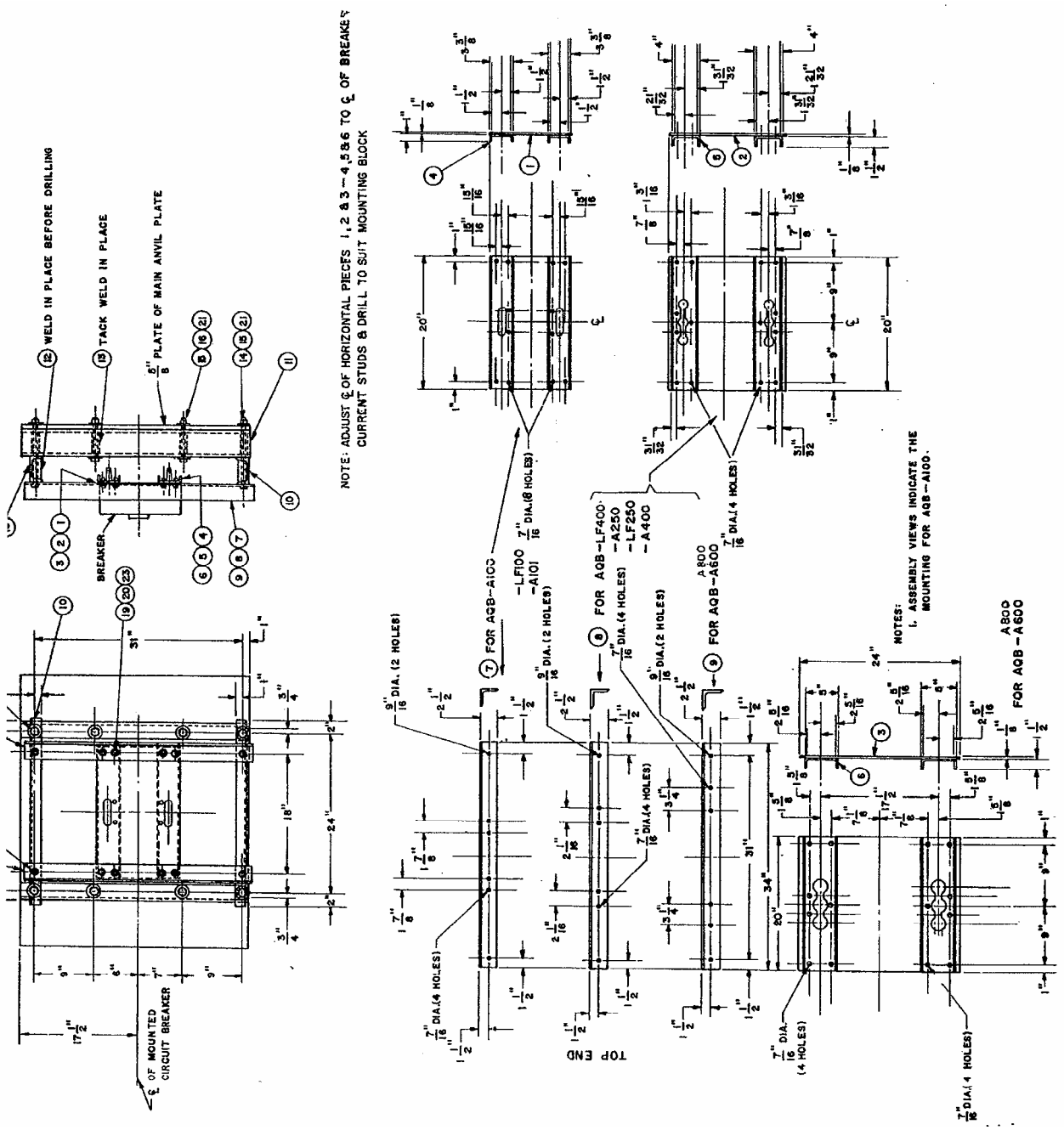

FIGURE 4. Standard mounting for shock testing drawout-mounted type AQB circuit breakers - Continued.

AQB/NQB CIRCUIT BREAKER OBSOLESCENCE AND RELATED INFORMATION

A.1. SCOPE

A.1.1 Scope. **This Appendix is not a mandatory part of the specification. The information contained herein is intended for guidance only.** MIL-DTL-17361G covers different types of AQB/NQB thermal magnetic and electronic circuit breakers. At present, there are only two AQB/NQB circuit breaker vendors, SPD Technologies and Cutler-Hammer (formerly Westinghouse). SPD has made their entire line of thermal magnetic circuit breakers obsolete but continues to manufacture electronic circuit breakers. Cutler-Hammer continues to manufacture a mixture of thermal magnetic and electronic circuit breakers. With obsolescence, there is a chance that a particular SPD thermal magnetic circuit breaker may not be available to use as a replacement for a failed circuit breaker in the field. This appendix provides replacement information to users so that they can make informed decisions if the need arises. Note the following:

a. Electronic circuit breakers are available as replacements for most applications and in some instances may be the only replacement option. Cutler-Hammer may also have a form, fit, and function thermal magnetic circuit breaker as a replacement option depending on the frame size. Sections 2 and 3 of this appendix provide general and detailed information on each circuit breaker frame size for both vendors.

b. To properly assess alternative circuit breakers as possible functional replacements for obsolete circuit breakers, users need to be aware of similarities and differences in attachments (motor operators, undervoltage releases, shunt trips, auxiliary contacts) between SPD and Cutler-Hammer circuit breakers as well as between thermal magnetic and electronic circuit breakers from the same vendor. Section 3 and Tables A-I through A-VI of this appendix provide attachment information.

c. An electronic AQB circuit breaker has several more adjustable settings than a thermal magnetic circuit breaker. Users need guidance on how to set the electronic circuit breaker to ensure that, with regard to instantaneous protection, it is a functional equivalent for the thermal magnetic circuit breaker being replaced. Section A.3.8 and Tables A-VI through A-XVIII of this appendix provide such guidance.

It should not be construed that the nature of the information in this appendix precludes other vendors from qualifying AQB circuit breakers. There are only two manufacturers at present and that fact determines the information currently provided. If another manufacturer qualifies a circuit breaker(s), that circuit breaker(s) information will be included in this appendix for the next revision.

A.2. GENERAL CIRCUIT BREAKER INFORMATION

A.2.1 SPD AQB/NQB circuit breakers.

A.2.1.1 Obsolete thermal magnetic. The following circuit breakers are obsolete:

AQB-A50 and NQB-A50

AQB-A100 and NQB-A100

AQB-LF100

AQB-A101 and NQB-A101

AQB-A250 and NQB-A250

AQB-LF226

AQB-LF250

AQB-A400 and NQB-A400

AQB-LF400

AQB-A800 and NQB-A800

AQB-A1600 and NQB-A1600

A.2.1.2 Electronic. The following circuit breakers are currently available:

AQB-A102 (Types E1 and E2 with continuous current setting (CCS) dial)

AQB-A252 (with rating plug or CCS dial)

AQB-LF252 (with rating plug or CCS dial)

AQB-A402 (with rating plug or CCS dial)

AQB-LF402 (with rating plug or CCS dial)

AQB-A802 (with rating plug)

AQB-A1604 (with rating plug)

NQB versions of the A102, A252, A402, A802, and A1604

The AQB-A102 Type E is obsolete.

A.2.1.3 Miscellaneous information. SPD designates electronic circuit breakers noted above as the "Actron" line. Circuit breaker label plates include this designation.

A.2.2 Cutler-Hammer (formerly Westinghouse) AQB/NQB circuit breakers.

A.2.2.1 Thermal magnetic. The following circuit breakers are currently available:

AQB-A50 and NQB-A50

AQB-A51 and NQB-A51

AQB-A100 and NQB-A100

AQB-LF100

AQB-A101 and NQB-A101

AQB-A250 and NQB-A250

AQB-LF250

AQB-A1600 and NQB-A1600

AQB-A1601 and NQB-A1601

A.2.2.2 Electronic. The following circuit breakers are currently available:

AQB-A103 (with CCS dial)

AQB-A103RMS (with CCS dial)

AQB-A253 (with adjustable rating plug)

AQB-L253 (with adjustable rating plug)

AQB-L400 (with rating plug)

AQB-LL400 (with rating plug)

AQB-A1602 (with rating plug)

NQB-A803 and NQB versions of the A103, A253, LL400, and A1602

A.2.2.3 Miscellaneous information. Note the following:

a. In 1994, Cutler-Hammer took over production of circuit breakers formerly manufactured by Westinghouse. Cutler-Hammer and Westinghouse circuit breakers are interchangeable and use the same part number system. For example, a Westinghouse AQB-A250 circuit breaker with a 125N trip element has part number 313C682G03. A Cutler-Hammer AQB-A250 circuit breaker with a 125N trip element has the same part number.

b. Cutler-Hammer/Westinghouse calls their part number a style number and abbreviated the term with an "S." In Navy logistics documentation, provisioners sometimes carried over the S and included it with the part number. For example, APL 140901259 applies to a Cutler-Hammer/Westinghouse AQB-LF250 circuit breaker. The circuit breaker part number is shown as S313C748G18 on the APL. The actual circuit breaker label plate will not show the S.

c. From now on, this appendix will use “Cutler-Hammer” as the manufacturer designation for both Cutler-Hammer and Westinghouse circuit breakers since the same information applies.

A.3. DETAILED INFORMATION BY FRAME SIZE

This section provides users with detailed information for each AQB/NQB circuit breaker frame size as it relates to obsolescence. It is not meant to be complete. Additional information can be found by consulting the specification sheets of MIL-DTL-17361, vendor catalogs, websites, or by contacting the vendors directly.

A.3.1 50-amp frame. This frame size has been available from vendors as a thermal magnetic design only. There has never been an electronic version.

A.3.1.1 SPD AQB-A50. Note the following:

a. The AQB-A50 is obsolete. Although there is no new production, the stock system and other sources may still have assets.

b. It was available in separate 60Hz AC, 400 Hz AC, and 250 VDC ratings.

c. There were no adjustable settings available. The circuit breaker was delivered with the trip unit amp rating specified by the user.

d. Attachments were not available.

A.3.1.2 Cutler-Hammer AQB-A50 and AQB-A51. Note the following:

a. Cutler-Hammer continues to manufacture the AQB-A50. It is available in separate 60 Hz and 400 Hz AC ratings; there are no DC ratings.

b. Cutler-Hammer continues to manufacture the AQB-A51. It is available in 60 Hz AC ratings; there are no DC or 400 Hz AC ratings.

c. The AQB-A50 has overcurrent protection in two poles and the AQB-A51 has overcurrent protection in all three poles.

d. There are no adjustable settings available for either design. Circuit breakers are delivered with the trip unit rating specified by the user.

e. Attachments are not available for either design.

A.3.1.3 Form, fit, and function replacement considerations (circuit breakers from same vendor). The Cutler-Hammer AQB-A51 is a form and fit replacement for the Cutler-Hammer AQB-A50. To make the Cutler-Hammer AQB-A51 a functional replacement for the Cutler-Hammer AQB-A50 (60 Hz ratings only), the trip unit amp rating must be the same.

A.3.1.4 Form, fit, and function replacement considerations (circuit breakers from different vendors). Note the following:

a. The Cutler-Hammer AQB-A50 is a form and fit replacement for the SPD AQB-A50. To make the Cutler-Hammer AQB-A50 a functional replacement for the SPD AQB-A50 (60 Hz and 400 Hz AC ratings only), the trip unit amp rating must be the same.

b. The Cutler-Hammer AQB-A51 is a form, fit, and function replacement for the SPD AQB-A50. To make the Cutler-Hammer AQB-A51 a functional replacement for the SPD AQB-A50 (60 Hz ratings only), the trip unit amp rating must be the same.

A.3.2 100-amp frame.

A.3.2.1 AQB-A101 thermal magnetic and electronic counterparts.

A.3.2.1.1 SPD.

A.3.2.1.1.1 AQB-A101 (thermal magnetic). Note the following:

a. The AQB-A101 is obsolete. Although there is no new production, the stock system or other sources may still have assets.

b. It was available in dual-ratings (60 Hz AC and 250 VDC) and separate 400 Hz AC ratings.

c. There are three adjustable instantaneous pickup setting dials on the front of the circuit breaker (one on each pole).

d. The circuit breaker was delivered with the trip unit amp rating specified by the user. The trip unit is not adjustable.

e. For some applications, fuse units are used in conjunction with the circuit breaker. The fuse unit is a separate piece that mounts below the circuit breaker on a common mounting base/block; it plugs into the mounting base/block but does not plug into the circuit breaker.

A.3.2.1.1.2 AQB-A102 (electronic). Note the following:

a. The AQB-A102 has gone through three designs: Type E, Type E1, and Type E2. The Type E is obsolete. Although there is no new production of the Type E, the stock system or other sources may still have assets.

b. The label plate for the Type E2 states “AQB-A102 E2”; the Type E and Type E1 label plates only state “AQB-A102”.

c. All designs have separate 60 Hz and 400 Hz AC ratings; there are no DC ratings.

d. All designs use root-mean-square (rms) current sensing.

e. Both designs have field adjustable settings for continuous current, instantaneous pickup, short-time delay pickup, and short-time delay time band. Long-time delay features are fixed on both designs. See MIL-DTL-17361/4 for complete details on available settings.

f. Type E has field adjustable settings for instantaneous pickup and short-time delay pickup only. Type E1 and Type E2 have field adjustable settings for continuous current, instantaneous pickup, short-time delay pickup, and short-time delay time band. Long-time delay features are fixed on all designs.

g. Full range of continuous current settings (15 amps to 100 amps) can be found on the CCS dial of Type E1 and Type E2. However, there is one notable difference between CCS dials: the Type E1 includes a 75-amp setting but does not include an 80-amp setting while the Type E2 includes an 80-amp setting but does not include a 75-amp setting.

h. For some applications, fuse units are used in conjunction with the circuit breaker. The fuse unit is a separate piece that mounts below the circuit breaker on a common mounting base/block; it plugs into the mounting base/block but does not plug into the circuit breaker.

A.3.2.1.2 Cutler-Hammer.

A.3.2.1.2.1 AQB-A101 (thermal magnetic). Note the following:

a. Cutler-Hammer continues to manufacture the AQB-A101.

b. It is available in dual-ratings (60 Hz AC and 250 VDC) and separate 400 Hz AC ratings.

c. There are three adjustable instantaneous pickup setting dials on the front of the circuit breaker (one on each pole).

d. The circuit breaker is delivered with the trip unit amp rating specified by the user. The trip unit is not adjustable.

e. For some applications, fuse units are used in conjunction with the circuit breaker. The fuse unit is a separate piece that mounts below the circuit breaker on a common mounting base/block; it plugs into the mounting base/block but does not plug into the circuit breaker.

A.3.2.1.2.2 AQB-A103 (electronic). Note the following:

a. The AQB-A103 has gone through two designs: AQB-A103 and AQB-A103RMS. Cutler-Hammer continues to manufacture the AQB-A103RMS but the AQB-A103 is obsolete. Although there is no new production of the AQB-A103, the stock system or other sources may still have assets.

b. The label plate states “AQB-A103” or “AQB-A103RMS” as applicable.

c. Both designs have separate 60 Hz and 400 Hz AC ratings; there are no DC ratings.

d. The AQB-A103 uses peak current sensing and the AQB-A103RMS has rms current sensing.

e. There are two frame sizes for each design. One frame size covers the CCS range of 10 amps to 25 amps and the other frame size covers the CCS range of 40 amps to 100 amps. Each frame size has a CCS dial with available settings in the applicable ranges. Care should be taken to ensure that the correct frame size/CCS range is selected for a particular application.

f. For some applications, fuse units are used in conjunction with the circuit breaker. The fuse unit is a separate piece that mounts below the circuit breaker on a common mounting base/block; it plugs into the mounting base/block but does not plug into the circuit breaker.

A.3.2.1.3 Form, fit, and function replacement considerations (circuit breakers from same vendor).

A.3.2.1.3.1 SPD. All three AQB-A102 designs are form and fit replacements for the SPD AQB-A101. Attachments (if applicable) and adjustable settings must be taken into consideration to make the electronic designs functionally equivalent to the thermal magnetic design. See A.3.2.1.5 for attachment information. See A.3.8 and Tables A-VI and A-VII for guidance on how to set the SPD AQB-A102 designs to make them functional replacements for the SPD AQB-A101 (60 Hz and 400 Hz AC ratings only) with respect to CCS and overcurrent protection.

A.3.2.1.3.2 Cutler-Hammer. Both AQB-A103 designs are form and fit replacements for the Cutler-Hammer AQB-A101. Attachments (if applicable) and adjustable settings must be taken into consideration to make the electronic designs functionally equivalent to the thermal magnetic design. See A.3.2.1.5 for attachment information. See A.3.8 and Tables A-VIII and A-IX for guidance on how to set the Cutler-Hammer AQB-A103 designs to make them functional replacements for the Cutler-Hammer AQB-A101 (60 Hz and 400 Hz AC ratings only) with respect to CCS and overcurrent protection.

A.3.2.1.4 Form, fit, and function replacement considerations (circuit breakers from different vendors). Note the following:

a. The Cutler-Hammer AQB-A101 is a form and fit replacement for the SPD AQB-A101. To make the Cutler-Hammer AQB-A101 a functional replacement for the SPD AQB-A101, the trip unit amp ratings and, if applicable, type of attachments and attachment ratings must be the same.

b. All three SPD AQB-A102 designs are form and fit replacements for the Cutler-Hammer AQB-A101. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.2.1.5 for attachment information. See A.3.8 and Tables A-VI and VII for guidance on how to set the SPD electronic designs to make them functional replacements for the Cutler-Hammer AQB-A101 (60 Hz and 400 Hz AC ratings only) with respect to CCS and overcurrent protection.

c. Both Cutler-Hammer AQB-A103 designs are form and fit replacements for the SPD AQB-A101. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.2.1.5 for attachment information. See A.3.8 and Tables A-VIII and IX for guidance on how to set the Cutler-Hammer electronic designs to make them functional replacements for the SPD AQB-A101 (60 Hz and 400 Hz AC ratings only) with respect to CCS and overcurrent protection.

A.3.2.1.5 Attachments. Attachments include shunt trips and auxiliary switches. Important aspects of attachments are ratings and number and type of leads exiting the circuit breaker. These aspects can differ depending on which type of circuit breaker is involved. See A.3.2.1.5.1, A.3.2.1.5.2, A.3.7, and Table A-I for more information on attachments.

A.3.2.1.5.1 Shunt trip leads for SPD AQB-A102. Note the following:

a. For Type E circuit breakers, there were two leads exiting the circuit breaker for any installed shunt trip.

b. For Type E1 and Type E2 circuit breakers made before November 04 and with serial number of less than 642029, there are two leads exiting the circuit breaker for any installed shunt trip.

c. For Type E1 and Type E2 circuit breakers made after November 04 and with serial number of 642029 or greater, there are three leads exiting the circuit breaker for any installed shunt trip.

d. SPD realized that with only two shunt trip leads, the 450VAC, 60Hz rated shunt trip may not always operate properly. They added the third lead to ensure that all shunt trip ratings operate properly. Only two leads are used for any rating. Wiring instructions come with AQB-A102 circuit breakers that tell the user which specific leads are applicable to the shunt trip rating desired and how to handle the unused lead.

A.3.2.1.5.2 Shunt trip and cut-off switch.

a. For SPD and Cutler-Hammer AQB-A101 thermal magnetic circuit breakers with shunt trips, the vendors supply leads for an additional 1a, 1b aux switch where the "a" contact is used as the shunt trip cut-off switch. The remaining "b" contact on this switch is not used in most cases; it is usually tied off when the circuit breaker is installed in the switchboard. As an example, suppose an SPD or Cutler-Hammer AQB-A101 with a 1a, 1b aux switch and shunt trip is needed. The user will see the following leads exiting the circuit breaker:

3 leads for the 1a, 1b switch for customer use

3 leads for the additional 1a, 1b aux switch ("a" contact used for shunt trip cut-off switch and "b" contact tied off and not used)

2 leads for the shunt trip

As another example, suppose an SPD or Cutler-Hammer AQB-A101 with just a shunt trip is needed. The user will see the following leads exiting the circuit breaker:

3 leads for the additional 1a, 1b aux switch ("a" contact used for shunt trip cut-off switch and "b" contact tied off and not used)

2 leads for the shunt trip

b. For SPD and Cutler-Hammer electronic circuit breakers with shunt trips, there are no external leads for a 1a, 1b auxiliary switch where the "a" contact is used as a cut-off switch as there are for the thermal magnetic circuit breakers. The cut-off switch for the electronic circuit breakers is wired internally. As a comparison to the examples above, suppose an SPD AQB-A102 Type E1 (assume it will be a Type E1 manufactured after November 04) or Cutler-Hammer AQB-A103RMS with a 1a, 1b aux switch and shunt trip is needed. The user will see the following leads exiting the circuit breakers:

AQB-A102 Type E1:	3 leads for the 1a, 1b switch for customer use
	3 leads for the shunt trip
AQB-A103RMS:	3 leads for the 1a, 1b switch for customer use
	2 leads for the shunt trip

Note that for the same functionality, there are only 5 or 6 leads exiting the electronic circuit breakers whereas the thermal magnetic circuit breakers have 8 leads exiting. As another example, suppose an SPD AQB-A102 Type E1 (manufactured after November 04) or Cutler-Hammer AQB-A103RMS with just a shunt trip is needed. The user will see the following leads exiting the circuit breaker:

AQB-A102 Type E1:	3 leads for the shunt trip
AQB-A103RMS:	2 leads for the shunt trip

Note that for the same functionality, there are only 2 or 3 leads exiting the electronic circuit breakers whereas the thermal magnetic circuit breakers have 5 leads exiting.

A.3.2.2 AQB-A100 and AQB-LF100. SPD made these circuit breaker designs obsolete many years ago. They are not used in a wide range of ship platforms. Cutler-Hammer continues to manufacture these circuit breakers and they are form, fit, and function replacements for the obsolete SPD designs as long as the trip unit amp ratings are the same (there are no attachments for either design). The Cutler-Hammer circuit breakers should be used as replacements only; they are not recommended for use in new construction.

A.3.3 250-amp frame (thermal magnetic and electronic types).

A.3.3.1 SPD.

A.3.3.1.1 Thermal magnetic.

A.3.3.1.1.1 AQB-A250. Note the following:

a. The AQB-A250 is obsolete. Although there is no new production, the stock system or other sources may still have assets.

b. It was available in dual-ratings (60 Hz AC and 250 VDC) and separate 400 Hz AC ratings.

c. There were three adjustable instantaneous pickup setting dials under the front cover of the circuit breaker (one on each pole).

d. The circuit breaker was delivered with the trip unit amp rating specified by the user. The trip unit was not adjustable but trip units of different amp ratings were available as separate piece parts.

A.3.3.1.1.2 AQB-LF250. Note the following:

a. The AQB-LF250 is obsolete. Although there is no new production, the stock system or other sources may still have assets.

b. It was available in 60 Hz AC ratings only.

c. There were three adjustable instantaneous pickup setting dials under the front cover of the circuit breaker (one on each pole).

d. The circuit breaker was delivered with the trip unit amp rating specified by the user. The trip unit was not adjustable but trip units of different amp ratings were available as separate piece parts.

e. The fuse unit plugged directly into the circuit breaker.

A.3.3.1.1.3 AQB-LF226. Note the following:

a. The AQB-LF226 is obsolete. Although there is no new production, the stock system or other sources may still have assets.

b. It was a modified AQB-LF250 rated at 225 amps.

c. There are currently no form, fit, function replacements for the AQB-LF226.

d. For more information, consult the applicable specification sheet of MIL-DTL-17361 or contact the vendor.

A.3.3.1.2 Electronic.

A.3.3.1.2.1 AQB-A252. Note the following:

a. The AQB-A252 is currently available in two different designs. One design has rating plugs to establish the CCS while the other design has an adjustable dial on the front of the circuit breaker to establish CCS.

b. The rating plug design is available in separate 60 Hz and 400 Hz AC ratings; the CCS dial design has a switch on the front of the circuit breaker to select 60 Hz or 400 Hz frequency. There are no DC ratings for either design.

c. Both designs have field adjustable settings for instantaneous pickup, short-time delay pickup, and short-time delay time band. Long-time delay features are fixed on both designs. See MIL-DTL-17361/6 for complete details on available settings.

d. Both designs are available in an “enhanced” version that includes communications capability.

e. The label plates for both designs state “AQB-A252” but they do have different SPD part numbers. To tell them apart, refer to (a) and (b) above and consult SPD catalogs for part number information.

A.3.3.1.2.2 AQB-LF252. Note the following:

a. The AQB-LF252 is currently available in two different designs. One design has rating plugs to establish the CCS while the other design has an adjustable dial on the front of the circuit breaker to establish the CCS.

b. Both designs are available in 60 Hz AC ratings only.

c. Both designs have field adjustable settings for instantaneous pickup, short-time delay pickup, and short-time delay time band. For the rating plug design, the fuse unit must be removed to access the adjustable settings. Long-time delay features are fixed on both designs. See MIL-DTL-17361/7 for complete details on available settings.

d. Both designs are available in an “enhanced” version that includes communications capability.

e. The label plates for both designs say “AQB-LF252” but they do have different SPD part numbers. To tell them apart, refer to (a) and (c) above and consult SPD catalogs for part number information.

f. The fuse unit plugs directly into the circuit breaker.

A.3.3.2 Cutler-Hammer.

A.3.3.2.1 Thermal magnetic.

A.3.3.2.1.1 AQB-A250. Note the following:

a. Cutler-Hammer continues to manufacture the AQB-A250.

b. It is available in dual-ratings (60 Hz AC and 250VDC) and separate 400 Hz AC ratings.

c. There are three adjustable instantaneous pickup setting dials under the front cover of the circuit breaker (one on each pole).

d. The circuit breaker is delivered with the trip unit amp rating specified by the user. The trip unit is not adjustable but trip units of different amp ratings are available as separate piece parts.

A.3.3.2.1.2 AQB-LF250. Note the following:

a. Cutler-Hammer continues to manufacture the AQB-LF250.

b. It is available in 60 Hz ratings only.

c. There are three adjustable instantaneous pickup setting dials under the front cover of the circuit breaker (one on each pole).

d. The circuit breaker is delivered with the trip unit amp rating specified by the user. The trip unit is not adjustable but trip units of different amp ratings are available as separate piece parts.

e. The fuse unit plugs directly into the circuit breaker.

A.3.3.2.2 Electronic.

A.3.3.2.2.1 AQB-A253. Note the following:

a. There are two separate adjustable rating plugs for this design. One rating plug covers the CCS range of 100 amps to 160 amps and the other rating plug covers the CCS range of 200 amps to 250 amps. Care should be taken to ensure that the correct CCS range is selected for a particular application.

b. It is available in separate 60 Hz and 400 Hz AC ratings; there are no DC ratings.

c. It uses rms current sensing.

d. The circuit breaker has field adjustable settings for short-time delay pickup and short-time delay time band. Long-time delay features are fixed. There is no separate adjustable setting dial for instantaneous but the circuit breaker does have a fixed instantaneous setting of 7500 amps. There is an “INST” setting on the short-time delay band dial to emulate an instantaneous trip function. See MIL-DTL-17361/6 for complete details on available settings.

A.3.3.2.2.2 AQB-L253. Note the following:

a. There are two separate adjustable rating plugs for this design. One rating plug covers the CCS range of 100 amps to 160 amps and the other rating plug covers the CCS range of 200 amps to 250 amps. Care should be taken to ensure that the correct CCS range is selected for a particular application.

b. It is available in 60 Hz AC ratings; there are no DC or 400 Hz AC ratings.

c. It uses rms current sensing and is current limiting; it does not have a fuse unit that plugs into the circuit breaker.

d. The circuit breaker has field adjustable settings for short-time delay pickup and short-time delay time band. Long-time delay features are fixed. There is no separate adjustable setting dial for instantaneous but the circuit breaker does have a fixed instantaneous setting of 7500 amps. There is an “INST” setting on the short-time delay band dial to emulate an instantaneous trip function. See MIL-DTL-17361/7 for complete details on available settings

A.3.3.3 Form, fit, and function replacement considerations (circuit breakers from same vendor).

A.3.3.3.1 SPD.

a. Both SPD AQB-A252 designs are form and fit replacements for the SPD AQB-A250. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.3.5 for attachment information. See A.3.8 and Table A-XII for guidance on how to set the SPD AQB-A252 designs to make them functional replacements for the SPD AQB-A250 (60 Hz and 400 Hz AC ratings only) with respect to CCS and overcurrent protection.

b. Both SPD AQB-LF252 designs are form and fit replacements for the SPD AQB-LF250. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.3.5 for attachment information. See A.3.8 and Table A-X for guidance on how to set the SPD AQB-LF252 designs to make them functional replacements for the SPD AQB-LF250 with respect to CCS and overcurrent protection.

A.3.3.3.2 Cutler-Hammer.

a. The Cutler-Hammer AQB-A253 design is a form and fit replacement for the Cutler-Hammer AQB-A250. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.3.5 for attachment information. See A.3.8 and Table A-XIII for guidance on how to set the AQB-A253 to make it a functional replacement for the Cutler-Hammer AQB-A250 (60 Hz and 400 Hz AC ratings only) with respect to CCS and overcurrent protection.

b. The Cutler-Hammer AQB-L253 will fit into the Cutler-Hammer AQB-LF250 mounting base/block. However, when the switchboard cover is reinstalled after a swap-out, there will be a gap between the bottom of the Cutler-Hammer AQB-L253 and the switchboard cover where the AQB-LF250 fuse unit used to be. Cutler-Hammer manufactures a close-out plate that covers this gap when installed. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.3.5 for attachment information. See A.3.8 and Table A-XI for guidance on how to set the Cutler-Hammer AQB-L253 to make it a functional replacement for the Cutler-Hammer AQB-LF250 with respect to CCS and overcurrent protection.

A.3.3.4 Form, fit, and function replacement considerations (circuit breakers from different vendors). Note the following:

a. The SPD AQB-A252 designs are form and fit replacements for the Cutler-Hammer AQB-A250. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.3.5 for attachment information. See A.3.8 and Table A-XII for guidance on how to set the SPD AQB-A252 designs to make them functional replacements for the Cutler-Hammer AQB-A250 (60 Hz and 400 Hz AC ratings only) with respect to CCS and overcurrent protection.

b. The Cutler-Hammer AQB-A253 is a form and fit replacement for the SPD AQB-A250. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.3.5 for attachment information. See A.3.8 and Table A-XIII for guidance on how to set the Cutler-Hammer AQB-A253 to make it a functional replacement for the SPD AQB-A250 (60 Hz and 400 Hz AC ratings only) with respect to CCS and overcurrent protection.

c. The SPD AQB-LF252 designs are form and fit replacements for the Cutler-Hammer AQB-LF250. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.3.5 for attachment information. See A.3.8 and Table A-X for guidance on how to set the SPD AQB-LF252 designs to make them functional replacements for the Cutler-Hammer AQB-LF250 with respect to CCS and overcurrent protection.

d. The AQB-L253 will fit into the SPD AQB-LF250 mounting base/block. However, when the switchboard cover is reinstalled after a swap-out, there will be a gap between the bottom of the AQB-L253 and the switchboard cover where the AQB-LF250 fuse unit used to be. Cutler-Hammer manufactures a close-out plate that covers this gap when installed. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.3.5 for attachment information. See A.3.8 and Table A-XI for guidance on how to set the Cutler-Hammer AQB-L253 to make it a functional replacement for the SPD AQB-LF250 with respect to CCS and overcurrent protection.

A.3.3.5 Attachments. Attachments include motor operators, undervoltage releases, shunt trips, and auxiliary switches. Important aspects of attachments are ratings and number and type of leads or connectors exiting the circuit breaker. These aspects can differ depending on which type of circuit breaker is involved. See A.3.3.5.1, A.3.3.5.2, A.3.7, and Table A-II for more information on attachments/leads.

A.3.3.5.1 Shunt trip and cut-off switch. Note the following:

a. For SPD and Cutler-Hammer AQB-A250/AQB-LF250 thermal magnetic circuit breakers with shunt trips, the vendors supply leads for an additional 1a, 1b aux switch where the "a" contact is used as the shunt trip cut-off switch. The remaining "b" contact on this switch is not used in most cases; it is usually tied off when the circuit breaker is installed in the switchboard. As an example, suppose an SPD or Cutler-Hammer AQB-A250 with a 1a, 1b aux switch and shunt trip is needed. The user will see the following leads exiting the circuit breaker:

3 leads for the 1a, 1b switch for customer use

3 leads for the additional 1a, 1b aux switch ("a" contact used for shunt trip cut-off switch and "b" contact tied off and not used)

2 leads for the shunt trip

As another example, suppose an SPD or Cutler-Hammer AQB-A250 with just a shunt trip is needed. The user will see the following leads exiting the circuit breaker:

3 leads for the additional 1a, 1b aux switch ("a" contact used for shunt trip cut-off switch and "b" contact tied off and not used)

2 leads for the shunt trip

b. For SPD and Cutler-Hammer electronic circuit breakers with shunt trips, there are no external leads for a 1a, 1b auxiliary switch where the "a" contact is used as a cut-off switch as there are for the thermal magnetic circuit breakers. The cut-off switch for the electronic circuit breakers is wired internally. As a comparison to the examples above, suppose an SPD AQB-A252 or Cutler-Hammer AQB-A253 with a 1a, 1b aux switch and shunt trip is needed. The user will see the following leads exiting the circuit breaker:

3 leads for the 1a, 1b switch for customer use

2 leads for the shunt trip

Note that for the same functionality, there are only 5 leads exiting the electronic circuit breakers whereas the thermal magnetic circuit breakers have 8 leads exiting. As another example, suppose an SPD AQB-A252 or Cutler-Hammer AQB-A253 with just a shunt trip is needed. The user will see the following leads exiting the circuit breaker:

2 leads for the shunt trip

Note that for the same functionality, there are only 2 leads exiting the electronic circuit breakers whereas the thermal magnetic circuit breakers have 5 leads exiting.

A.3.3.5.2 Motor operators.

A.3.3.5.2.1 SPD. Note the following:

a. The motor operators for SPD 250 amp circuit breakers use a cannon plug connector as the interface connection between the motor operator and the switchboard wiring. Individual leads are not provided with the motor operator.

b. In 1996, SPD changed the part of the cannon plug that receives wiring from the switchboard.

c. SPD manufactures motor operators for use with standard circuit breaker designs and separate motor operators for use with "enhanced" circuit breakers (circuit breakers with communications capability).

A.3.3.5.2.2 Cutler-Hammer. Note the following:

a. Cutler-Hammer provides leads with its 250 amp circuit breaker motor operators.

b. One type of motor operator is rated for 450VAC/115VAC with an externally mounted step-down transformer.

A.3.3.5.2.3 Form, fit, and function replacement considerations. Note the following:

a. SPD motor operators are interchangeable between SPD thermal magnetic and standard electronic circuit breakers. For example, the 115VAC, 60Hz/120VDC motor operator used with an SPD AQB-A250 is the same 115VAC, 60Hz/120VDC motor operator used with a standard SPD AQB-A252.

b. The 1996 change to the SPD cannon plug connector can cause form and fit problems in the field. For example, suppose a ship has an SPD AQB-A250 with 115VAC/60Hz/120VDC motor operator installed and the motor operator fails. The replacement motor operator is one made after 1996. There will be an interface problem between the existing switchboard wiring and the motor operator cannon plug. NAVSEA is working with SPD to resolve this issue but in the meantime, users should be aware that rewiring or modification of the switchboard wiring may be necessary to interface properly with the motor operator cannon plug.

c. An SPD AQB-A250 motor operator is not interchangeable with a Cutler-Hammer AQB-A250 motor operator.

A.3.4 400-amp frame (thermal magnetic and electronic counterparts).

A.3.4.1 SPD.

A.3.4.1.1 Thermal magnetic.

A.3.4.1.1.1 AQB-A400. Note the following:

a. The AQB-A400 is obsolete. Although there is no new production, the stock system or other sources may still have assets.

b. It was available in dual-ratings (60 Hz AC and 250 VDC) and separate 400 Hz AC ratings.

c. There were three adjustable instantaneous pickup setting dials under the front cover of the circuit breaker (one on each pole).

d. The circuit breaker was delivered with the trip unit amp rating specified by the user. The trip unit was not adjustable but trip units of different amp ratings were available as separate piece parts.

A.3.4.1.1.2 AQB-LF400. Note the following:

a. The AQB-LF400 is obsolete. Although there is no new production, the stock system or other sources may still have assets.

b. It was available in 60 Hz AC ratings only.

c. There were three adjustable instantaneous pickup setting dials under the front cover of the circuit breaker (one on each pole).

d. The circuit breaker was delivered with the trip unit amp rating specified by the user. The trip unit was not adjustable but trip units of different amp ratings were available as separate piece parts.

e. The fuse unit plugged directly into the circuit breaker.

A.3.4.1.2 Electronic.

A.3.4.1.2.1 AQB-A402. Note the following:

a. The AQB-A402 is currently available in two different designs. One design has rating plugs to establish the CCS while the other design has an adjustable dial on the front of the circuit breaker to establish CCS.

b. The rating plug design is available in separate 60 Hz and 400 Hz AC ratings; the CCS dial design has a switch on the front of the circuit breaker to select 60 Hz or 400 Hz frequency. There are no DC ratings for either design.

c. Both designs have field adjustable settings for instantaneous pickup, short-time delay pickup, and short-time delay time band. Long-time delay features are fixed on both designs. See MIL-DTL-17361/8 for complete details on available settings.

d. Both designs are available in an “enhanced” version that includes communications capability.

e. The label plates for both designs state "AQB-A402" but they do have different SPD part numbers. To tell them apart, refer to (a) and (b) above and consult SPD catalogs for part number information.

A.3.4.1.2.2 AQB-LF402. Note the following:

a. The AQB-LF402 is currently available in two different designs. One design has rating plugs to establish the CCS while the other design has an adjustable dial on the front of the circuit breaker to establish CCS.

b. Both designs are available in 60 Hz AC ratings only.

c. Both designs have field adjustable settings for instantaneous pickup, short-time delay pickup, and short-time delay time band. For the rating plug design, the fuse unit must be removed to access the adjustable settings. Long-time delay features are fixed on both designs. See MIL-DTL-17361/11 for complete details on available settings.

d. Both designs are available in an "enhanced" version that includes communications capability.

e. The label plates for both designs say "AQB-LF402" but they do have different SPD part numbers. To tell them apart, refer to (a) and (c) above and consult SPD catalogs for part number information.

f. The fuse unit plugs directly into the circuit breaker.

A.3.4.2 Cutler-Hammer.

A.3.4.2.1 Thermal magnetic. Cutler-Hammer does not manufacture a 400 amp frame size.

A.3.4.2.2 Electronic (AQB-LL400 and AQB-L400). Note the following:

a. The AQB-LL400 is designated with a "QS" suffix. The AQB-L400 has two separate designs, one designated with a "QF" suffix and the other designated with a "QM" suffix.

b. The AQB-LL400 and AQB-L400 designs are identical with respect to form and fit. However, there are significant functional differences with respect to interruption ratings, short-time delay pickup ranges, and fixed instantaneous pickup settings. See A.3.4.3.2 for details.

c. All designs have rating plugs to establish CCS.

d. All designs are available in 60 Hz AC ratings; there are no DC or 400 Hz AC ratings.

e. All designs have field adjustable settings for short-time delay pickup and short-time delay time band. The long-time delay and instantaneous features are fixed. There is a "MIN" setting on the short-time delay band dial to approximate an instantaneous trip function. See MIL-DTL-17361/9 and MIL-DTL-17361/10 for complete details on available settings.

f. All designs are current limiting; they do not have a fuse unit that plugs into the circuit breaker.

A.3.4.3 Form, fit, and function replacement considerations (circuit breakers from same vendor).

A.3.4.3.1 SPD. Note the following:

a. Both SPD AQB-A402 designs are form and fit replacements for the SPD AQB-A400. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.4.5 for attachment information. See A.3.8 and Tables A-XVI for guidance on how to set the SPD AQB-A402 designs to make them functional replacements for the SPD AQB-A400 (60 Hz and 400 Hz AC ratings only) with respect to CCS and overcurrent protection.

b. Both SPD AQB-LF402 designs are form and fit replacements for the SPD AQB-LF400. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.4.5 for attachment information. See A.3.8 and Table A-XIV for guidance on how to set the SPD AQB-LF402 designs to make them functional replacements for the SPD AQB-LF400 with respect to CCS and overcurrent protection.

A.3.4.3.2 Cutler-Hammer. Note the following:

a. The AQB-LL400 and AQB-L400 designs (QF and QM) are identical with respect to form and fit.

b. The AQB-LL400 and AQB-L400 designs are not functionally equivalent with respect to interruption rating. The AQB-L400 designs have an interruption rating of 150KA and the AQB-LL400 has an interruption rating of 100KA.

c. The AQB-LL400 and AQB-L400 designs are not functionally equivalent with respect to short-time pickup ranges. Also, the two AQB-L400 designs are not functionally equivalent with respect to short-time pickup ranges. The ranges are as follows:

AQB-LL400:	3600–5800 amps
AQB-L400QF:	650–1500 amps
AQB-L400QM:	1700–3200 amps

d. The AQB-LL400 and AQB-L400 designs are not functionally equivalent with respect to fixed instantaneous pickup settings. Also, the two AQB-L400 designs are not functionally equivalent with respect to fixed instantaneous pickup settings. The settings are as follows:

AQB-LL400:	6300 amps
AQB-L400QF:	1850 amps
AQB-L400QM:	3280 amps

A.3.4.4 Form, fit, and function replacement considerations (circuit breakers from different vendors). Note the following:

a. Because of significant dimensional differences, the Cutler-Hammer AQB-LL400 and AQB-L400 cannot be used as form and fit replacements for the SPD AQB-A400.

b. The Cutler-Hammer AQB-LL400 and AQB-L400 are smaller than the SPD AQB-LF400 and do not have a fuse unit like the SPD AQB-LF400. To make them form and fit replacements for the SPD AQB-LF400, an adapter kit supplied by Cutler-Hammer is required. The kit consists of modified line and load side interface connectors and a close-out plate. The connectors allow the Cutler-Hammer AQB-LL400 and AQB-L400 to fit into the SPD AQB-LF400 mounting base/block. The close-out plate covers the gap between the bottom of the Cutler-Hammer AQB-LL400/L400 and the switchboard cover where the SPD AQB-LF400 fuse unit used to be.

c. Attachments (if applicable) and adjustable settings must be taken into consideration to make the Cutler-Hammer circuit breakers functional equivalents to the SPD AQB-LF400. See A.3.4.5 for attachment information. See A.3.8 and Table A-XV for guidance on how to set the Cutler-Hammer AQB-LL400 and AQB-L400 designs to make them functional replacements for the SPD AQB-LF400 with respect to CCS and overcurrent protection.

A.3.4.5 Attachments. Attachments include motor operators, undervoltage releases, shunt trips and auxiliary switches. Important aspects of attachments are ratings and number and type of leads or connectors exiting the circuit breaker. These aspects can differ depending on which type of circuit breaker is involved. See A.3.3.5.1, A.3.3.5.2, A.3.4.5.3, A.3.7, and Table A-III for more information on attachments.

A.3.4.5.1 Shunt trip and cut-off switch. Note the following:

a. For SPD AQB-A400/AQB-LF400 thermal magnetic circuit breakers with shunt trips, the vendor supplies leads for an additional 1a, 1b aux switch where the “a” contact is used as the shunt trip cut-off switch. The remaining “b” contact on this switch is not used in most cases; it is usually tied off when the circuit breaker is installed in the switchboard. As an example, suppose an SPD AQB-A400 with a 1a, 1b aux switch and shunt trip is needed. The user will see the following leads exiting the circuit breaker:

3 leads for the 1a, 1b switch for customer use

3 leads for the additional 1a, 1b aux switch (“a” contact used for shunt trip cut-off switch and “b” contact tied off and not used)

2 leads for the shunt trip

As another example, suppose an SPD or Cutler-Hammer AQB-A400 with just a shunt trip is needed. The user will see the following leads exiting the circuit breaker:

3 leads for the additional 1a, 1b aux switch ("a" contact used for shunt trip cut-off switch and "b" contact tied off and not used)

2 leads for the shunt trip

b. For SPD and Cutler-Hammer electronic circuit breakers with shunt trips, there are no external leads for a 1a, 1b auxiliary switch where the "a" contact is used as a cut-off switch as there are for the thermal magnetic circuit breakers. The cut-off switch for the electronic circuit breakers is wired internally. As a comparison to the examples above, suppose an SPD AQB-LF400 or Cutler-Hammer AQB-LL400 with a 1a, 1b aux switch and shunt trip is needed. The user will see the following leads exiting the circuit breaker:

3 leads for the 1a, 1b switch for customer use

2 leads for the shunt trip

Note that for the same functionality, there are only 5 leads exiting the electronic circuit breakers whereas the thermal magnetic circuit breakers have 8 leads exiting. As another example, suppose an SPD AQB-LF400 or Cutler-Hammer AQB-LL400 with just a shunt trip is needed. The user will see the following leads exiting the circuit breaker:

2 leads for the shunt trip

Note that for the same functionality, there are only 2 leads exiting the electronic circuit breakers whereas the thermal magnetic circuit breakers have 5 leads exiting.

A.3.4.5.2 Motor operators.

A.3.4.5.2.1 SPD. Note the following:

a. The motor operators for SPD 400 amp circuit breakers use a cannon plug connector as the interface connection between the motor operator and the switchboard wiring. Individual leads are not provided with the motor operator.

b. In 1996, SPD changed the part of the cannon plug that receives wiring from the switchboard.

c. SPD manufactures motor operators for use with standard circuit breaker designs and separate motor operators for use with "enhanced" circuit breakers (circuit breakers with communications capability).

A.3.4.5.2.2 Cutler-Hammer. Note the following:

a. Cutler-Hammer provides leads with its 400 amp circuit breaker motor operators.

b. One type of motor operator is rated for 450VAC/115VAC with an externally mounted step-down transformer.

A.3.4.5.2.3 Form, fit, and function replacement considerations. Note the following:

a. SPD motor operators are interchangeable between SPD thermal magnetic and standard electronic circuit breakers. For example, the 115VAC, 60Hz/120VDC motor operator used with an SPD AQB-A400 is the same 115VAC, 60Hz/120VDC motor operator used with a standard SPD AQB-A402.

b. The SPD motor operators for standard circuit breakers are not interchangeable with SPD motor operators for enhanced circuit breakers.

c. The 1996 change to the SPD cannon plug connector can cause form and fit problems in the field. For example, suppose a ship has an SPD AQB-A400 with 115VAC/60Hz/120VDC motor operator installed and the motor operator fails. The replacement motor operator is one made after 1996. There will be an interface problem between the existing switchboard wiring and the motor operator cannon plug. NAVSEA is working with SPD to resolve this issue but in the meantime, users should be aware that rewiring or modification of the switchboard wiring may be necessary to interface properly with the motor operator cannon plug for this scenario.

d. The SPD motor operators are not interchangeable with Cutler-Hammer motor operators.

A.3.4.5.3 Undervoltage releases. Note following:

a. Cutler-Hammer AQB-LL400 and AQB-L400 450VAC undervoltage releases require an externally mounted step-down transformer to bring the voltage down to 115VAC.

b. Because of the undervoltage release transformer requirement, it is strongly recommended that Cutler-Hammer AQB-LL400/L400 circuit breakers undervoltage releases not be used as replacements for obsolete SPD AQB-LF400 circuit breakers in applications where a 450VAC undervoltage release is required.

A.3.5 800-amp frame (SPD thermal magnetic and electronic types). Details of SPD circuit breakers are discussed in this section. At present, Cutler-Hammer only manufactures an NQB-A803; this circuit breaker has no trip unit and it is not a form and fit replacement for the SPD NQB-A800 or NQB-A802.

A.3.5.1 AQB-A800 (thermal magnetic). Note the following:

a. The AQB-A800 is obsolete. Although there is no new production, the stock system or other sources may still have assets.

b. It was available in separate 60 Hz and 400 Hz AC ratings.

c. There were three adjustable instantaneous pickup setting dials under the front cover of the circuit breaker (one on each pole).

d. The circuit breaker was delivered with the trip unit amp rating specified by the user. The trip unit was not adjustable but trip units of different amp ratings were available as separate piece parts.

A.3.5.2 AQB-A802 (electronic). Note the following:

a. The AQB-A802 is available in separate 60 Hz and 400 Hz AC ratings.

b. Rating plugs are used to establish CCS. It has field adjustable settings for instantaneous pickup, short-time delay pickup, and short-time delay time band. Long-time delay features are fixed on both designs. See MIL-DTL-17361/12 for complete details on available settings.

A.3.5.3 Form, fit, and function replacement considerations. The SPD AQB-A802 is a form and fit replacement for the SPD AQB-A800. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.5.4 for attachment information. See A.3.8 and Table A-XVII for guidance on how to set the SPD AQB-A802 to make it a functional replacement for the SPD AQB-A800.

A.3.5.4 Attachments. Attachments include motor operators, undervoltage releases, shunt trips, and auxiliary switches. Important aspects of attachments are ratings and number and type of leads or connectors exiting the circuit breaker. These aspects can differ depending on which type of circuit breaker is involved. See A.3.5.4.1, A.3.5.4.2, A.3.7, and Table A-IV for more information on attachments.

A.3.5.4.1 Shunt trip and cut-off switch. Note the following:

a. For the AQB-800 thermal magnetic circuit breakers with shunt trips, the vendor supplies leads for an additional 1a, 1b aux switch where the “a” contact is used as the shunt trip cut-off switch. The remaining “b” contact on this switch is not used in most cases; it is usually tied off when the circuit breaker is installed in the switchboard. As an example, suppose an AQB-A800 with a 1a, 1b aux switch and shunt trip is needed. The user will see the following leads exiting the circuit breaker:

3 leads for the 1a, 1b switch for customer use

3 leads for the additional 1a, 1b aux switch (“a” contact used for shunt trip cut-off switch and “b” contact tied off and not used)

2 leads for the shunt trip

As another example, suppose an AQB-A800 with just a shunt trip is needed. The user will see the following leads exiting the circuit breaker:

3 leads for the additional 1a, 1b aux switch (“a” contact used for shunt trip cut-off switch and “b” contact tied off and not used)

2 leads for the shunt trip

b. For AQB-A802 circuit breakers with shunt trips, there are no external leads for a 1a, 1b auxiliary switch where the "a" contact is used as a cut-off switch as there are for the thermal magnetic circuit breakers. The cut-off switch for the electronic circuit breakers is wired internally. As a comparison to the examples above, suppose an AQB-A802 with a 1a, 1b aux switch and shunt trip is needed. The user will see the following leads exiting the circuit breaker:

3 leads for the 1a, 1b switch for customer use

2 leads for the shunt trip

Note that for the same functionality, there are only 5 leads exiting the electronic circuit breaker whereas the thermal magnetic circuit breaker has 8 leads exiting. As another example, suppose an AQB-A802 with just a shunt trip is needed. The user will see the following leads exiting the circuit breaker:

2 leads for the shunt trip

Note that for the same functionality, there are only 2 leads exiting the electronic circuit breaker whereas the thermal magnetic circuit breaker has 5 leads exiting.

A.3.5.4.2 Motor operators. Note the following:

a. The motor operators for SPD 800 amp circuit breakers use a cannon plug connector as the interface connection between the motor operator and the switchboard wiring. Individual leads are not provided with the motor operator.

b. In 1996, SPD changed the part of the cannon plug that receives wiring from the switchboard.

c. SPD manufactures motor operators for use with standard circuit breaker designs and separate motor operators for use with "enhanced" circuit breakers (circuit breakers with communications capability).

A.3.4.5.2.1 Form, fit, and function replacement considerations. Note the following:

a. SPD motor operators are interchangeable between SPD thermal magnetic and standard electronic circuit breakers. For example, the 115VAC, 60Hz/120VDC motor operator used with an SPD AQB-A400 is the same 115VAC, 60Hz/120VDC motor operator used with a standard SPD AQB-A402.

b. The SPD motor operators for standard circuit breakers are not interchangeable with SPD motor operators for enhanced circuit breakers.

c. The 1996 change to the SPD cannon plug connector can cause form and fit problems in the field. For example, suppose a ship has an SPD AQB-A800 with 115VAC/60Hz/120VDC motor operator installed and the motor operator fails. The replacement motor operator is one made after 1996. There will be an interface problem between the existing switchboard wiring and the motor operator cannon plug. NAVSEA is working with SPD to resolve this issue but in the meantime, users should be aware that rewiring or modification of the switchboard wiring may be necessary to interface properly with the motor operator cannon plug for this scenario.

A.3.6 1600-amp frame (SPD thermal magnetic and electronic types). Details of SPD circuit breakers are discussed in this section. Cutler-Hammer manufactures an AQB-A1601 thermal magnetic and AQB-A1602 electronic circuit breaker. Since the AQB-A1601 and AQB-A1602 are not replacement options for any obsolete SPD circuit breaker, they are not discussed further in this section. For more details on these circuit breakers, refer to the applicable specification sheets of MIL-DTL-17361 or contact Cutler-Hammer.

A.3.6.1 AQB-A1600 (thermal magnetic). Note the following:

a. The AQB-A1600 is obsolete. Although there is no new production, the stock system or other sources may still have assets.

b. It was available in 60 Hz AC ratings.

c. There were three adjustable instantaneous pickup setting dials under the front cover of the circuit breaker (one on each pole).

d. The circuit breaker was delivered with the trip unit amp rating specified by the user. The trip unit was not adjustable but trip units of different amp ratings were available as separate piece parts.

A.3.6.2 AQB-A1604 (electronic). Note the following:

a. The AQB-A1604 is available in 60 Hz AC ratings.

b. Rating plugs are used to establish CCS. It has field adjustable settings for instantaneous pickup, short-time delay pickup, and short-time delay time band. Long-time delay features are fixed on both designs. See MIL-DTL-17361/13 for complete details on available settings.

c. It is available in an "enhanced" version that includes communications capability.

A.3.6.3 Form, fit, and function replacement considerations. The SPD AQB-A1604 is a form and fit replacement for the SPD AQB-A1600. Attachments (if applicable) and adjustable settings must be taken into consideration to make them functional equivalents. See A.3.6.4 for attachment information. See A.3.8 and Table A-XVIII for guidance on how to set the SPD AQB-A1604 to make it a functional replacement for the SPD AQB-A1600.

A.3.6.4 Attachments. Attachments include motor operators, undervoltage releases, shunt trips, and auxiliary switches. Important aspects of attachments are ratings and number and type of leads or connectors exiting the circuit breaker. These aspects can differ depending on which type of circuit breaker is involved. See A.3.6.4.1, A.3.6.4.2, A.3.7, and Table A-V for more information on attachments.

A.3.6.4.1 Undervoltage release, shunt trip, and auxiliary switch cannon plug connectors and leads. Note the following:

a. For the obsolete AQB-A1600, these attachments were always delivered with cannon plug connectors, not leads.

b. The same attachments for the AQB-A1604 can be ordered with cannon plug connectors or leads.

c. When using the AQB-A1604 to replace an obsolete AQB-A1600 with one or more of these attachments, cannon plug connectors must be specified for the same AQB-A1604 attachments.

A.3.6.4.2 Motor operators. Note the following:

a. The motor operators for SPD 1600 amp circuit breakers use a cannon plug connector as the interface connection between the motor operator and the switchboard wiring. Individual leads are not provided with the motor operator.

b. In 1996, SPD changed the part of the cannon plug that receives wiring from the switchboard.

c. SPD manufactures motor operators for use with standard circuit breaker designs and separate motor operators for use with "enhanced" circuit breakers (circuit breakers with communications capability).

A.3.6.4.2.1 Form, fit, and function replacement considerations. Note the following:

a. SPD motor operators are interchangeable between SPD thermal magnetic and standard electronic circuit breakers. For example, the 115VAC, 60Hz/120VDC motor operator used with an SPD AQB-A1600 is the same 115VAC, 60Hz/120VDC motor operator used with a standard SPD AQB-A1604.

b. The SPD motor operators for standard circuit breakers are not interchangeable with SPD motor operators for enhanced circuit breakers.

c. The 1996 change to the SPD cannon plug connector can cause form and fit problems in the field. For example, suppose a ship has an SPD AQB-A1600 with 115VAC/60Hz/120VDC motor operator installed and the motor operator fails. The replacement motor operator is one made after 1996. There will be an interface problem between the existing switchboard wiring and the motor operator cannon plug. NAVSEA is working with SPD to resolve this issue but in the meantime, users should be aware that rewiring or modification of the switchboard wiring may be necessary to interface properly with the motor operator cannon plug for this scenario.

A.3.7 Attachment tables. Note the following:

a. Consult both the tables and the appendix paragraphs called out in the tables to get a more thorough understanding of attachments.

b. In some cases, differences in attachments may be the sole reason that a particular circuit breaker cannot be used as a replacement for an obsolete circuit breaker.

c. The same information applies to NQB versions of the circuit breakers listed.

TABLE A-I. Attachment information for AQB-A101 circuit breakers and electronic counterparts.

Type of circuit breaker	Shunt trip ratings	Number of shunt trip leads exiting circuit breaker	Auxiliary switch configurations	Number of auxiliary switch leads exiting circuit breaker	Combination of attachments and other information
SPD AQB-A101 (obsolete thermal magnetic)	3 different types: 115VAC, 60 Hz 115VAC, 400 Hz 120VDC	2 leads on all ratings	1a and 1b 2a and 2b	3 leads 6 leads	See A.3.2.1.5
SPD AQB-A102 Type E (obsolete electronic)	One design rated for all the following: 115VAC, 60 Hz 450VAC, 60 Hz 115VAC, 400 Hz 120VDC 250VDC	2 leads	1a and 1b 2a and 2b	3 leads 6 leads	See A.3.2.1.5
SPD AQB-A102 Type E1 (electronic)	One design rated for all the following: 115VAC, 60 Hz 450VAC, 60 Hz 115VAC, 400 Hz 120VDC 250VDC	2 leads for circuit breakers manufactured before 11/04 and with a serial number of less than 642029 (see A.3.2.1.5) 3 leads for circuit breakers manufactured 11/04 and after and with a serial number of 642029 or greater (see A.3.2.1.5)	1a and 1b 2a and 2b	3 leads 6 leads	See A.3.2.1.5

TABLE A-I. Attachment information for AQB-A101 circuit breakers and electronic counterparts - Continued.

Type of circuit breaker	Shunt trip ratings	Number of shunt trip leads exiting circuit breaker	Auxiliary switch configurations	Number of auxiliary switch leads exiting circuit breaker	Combination of attachments and other information
SPD AQB-A102 Type E2 (electronic)	One design rated for all the following: 115VAC, 60 Hz 450VAC, 60 Hz 115VAC, 400 Hz 120VDC 250VDC	2 leads for circuit breakers manufactured before 11/04 and with a serial number of less than 642029 (see A.3.2.1.5) 3 leads for circuit breakers manufactured 11/04 and after and with a serial number of 642029 or greater (see A.3.2.1.5)	1a and 1b 2a and 2b	3 leads 6 leads	See A.3.2.1.5
Cutler-Hammer AQB-A101 (thermal magnetic)	3 different types: 115VAC, 60 Hz 115VAC, 400 Hz 120VDC	2 leads on all ratings.	1a and 1b 2a and 2b	3 leads 6 leads	See A.3.2.1.5
Cutler-Hammer AQB-A103 and AQB-A103rms (both electronic)	115VAC, 60 Hz	2 leads	1a and 1b 2a and 2b	3 leads 6 leads	See A.3.2.1.5

TABLE A-II. Attachment information for AQB-A250/LF250 circuit breakers and electronic counterparts.

Type of circuit breaker	Shunt trip ratings and number of leads exiting circuit breaker	Auxiliary switch configurations and number of leads exiting circuit breaker	Undervoltage release ratings and number of leads exiting circuit breaker	Motor operator ratings and number of leads or type of connector	Combinations of attachments and other information
SPD AQB-A250 (obsolete thermal magnetic)	2 different types (both dual-rated and both have 2 leads): 450VAC, 60 Hz/ 120VDC 115VAC, 60 Hz/ 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	2 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz	2 different types (one type dual-rated): 115VAC, 60 Hz/ 120VDC (cannon plug connector) 115VAC, 400 Hz (cannon plug connector)	See A.3.3.5
SPD AQB-A252 (electronic with rating plug or CCS dial)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 33VDC	2 different types (one type dual-rated): 115VAC, 60 Hz/120VDC (cannon plug connector) 115VAC, 400 Hz (cannon plug connector)	See A.3.3.5
SPD AQB-LF250 (obsolete thermal magnetic)	2 different types (both dual-rated and both have 2 leads): 450VAC, 60 Hz/ 120VDC 115VAC, 60 Hz/ 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	2 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz	N/A	See A.3.3.5
SPD AQB-LF252 (electronic with rating plug or CCS dial)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 33VDC	N/A	See A.3.3.5

TABLE A-II. Attachment information for AQB-A250/LF250 circuit breakers and electronic counterparts - Continued.

Type of circuit breaker	Shunt trip ratings and number of leads exiting circuit breaker	Auxiliary switch configurations and number of leads exiting circuit breaker	Undervoltage release ratings and number of leads exiting circuit breaker	Motor operator ratings and number of leads or type of connector	Combinations of attachments and other information
Cutler-Hammer AQB-A250 (thermal magnetic)	2 different types (both dual-rated and both have 2 leads): 450VAC, 60 Hz/ 120VDC 115VAC, 60Hz/ 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	4 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 33VDC	2 different types (4 leads for each type): 450VAC/115V AC, 60 Hz with externally mounted step-down transformer 115VAC, 60 Hz	See A.3.3.5
Cutler-Hammer AQB-A253 (electronic)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	115VAC, 60 Hz (2 leads)	N/A	See A.3.3.5
Cutler-Hammer AQB-LF250 (thermal magnetic)	2 different types (both dual-rated and both have 2 leads): 450VAC, 60 Hz/ 120VDC 115VAC, 60 Hz/ 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	4 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 33VDC	N/A	See A.3.3.5
Cutler-Hammer AQB-L253 (electronic)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	115VAC, 60 Hz (2 leads)	N/A	See A.3.3.5

TABLE A-III. Attachment information for AQB-A400/LF400 circuit breakers and electronic counterparts.

Type of circuit breaker	Shunt trip ratings and number of leads exiting circuit breaker	Auxiliary switch configurations and number of leads exiting circuit breaker	Undervoltage release ratings and number of leads exiting circuit breaker	Motor operator ratings and number of leads or type of connector	Combinations of attachments and other information
SPD AQB-A400 (obsolete thermal magnetic)	2 different types (both dual-rated and both have 2 leads): 450VAC, 60 Hz/ 120VDC 115VAC, 60 Hz/ 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	2 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz	2 different types (one type dual-rated): 115VAC, 60 Hz/ 120VDC (cannon plug connector) 115VAC, 400 Hz (cannon plug connector)	See A.3.4.5
SPD AQB-A402 (electronic with rating plug or CCS dial)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 33VDC	2 different types (one type dual-rated): 115VAC, 60 Hz/120VDC (cannon plug connector) 115VAC, 400 Hz (cannon plug connector)	See A.3.4.5
SPD AQB-LF400 (obsolete thermal magnetic)	2 different types (both dual-rated and both have 2 leads): 450VAC, 60 Hz/ 120VDC 115VAC, 60 Hz/ 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	2 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz	2 different types (one type dual-rated): 115VAC, 60 Hz/ 120VDC (cannon plug connector) 115VAC, 400 Hz (cannon plug connector)	See A.3.4.5
SPD AQB-LF402 (electronic with rating plug or CCS dial)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 33VDC	2 different types (one type dual-rated): 115VAC, 60 Hz/120VDC (cannon plug connector) 115VAC, 400 Hz (cannon plug connector)	See A.3.4.5

TABLE A-III. Attachment information for AQB-A400/LF400 circuit breakers and electronic counterparts - Continued.

Type of circuit breaker	Shunt trip ratings and number of leads exiting circuit breaker	Auxiliary switch configurations and number of leads exiting circuit breaker	Undervoltage release ratings and number of leads exiting circuit breaker	Motor operator ratings and number of leads or type of connector	Combinations of attachments and other information
Cutler-Hammer AQB-LL400 and AQB-L400 (electronic with rating plug)	2 different types (one is dual-rated and both have 2 leads): 450VAC, 60 Hz/ 115VAC, 60Hz/ 28VDC/120VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	4 different types (2 leads for each type): 450VAC, 60 Hz with externally mounted step-down transformer 115VAC, 60 Hz 250VDC 120VDC	2 different types (4 leads for each type): 450VAC/115V AC, 60 Hz with externally mounted step-down transformer 115VAC, 60 Hz	See A.3.4.5

TABLE A-IV. Attachment information for AQB-A800 and AQB-A802.

Type of circuit breaker	Shunt trip ratings and number of leads exiting circuit breaker	Auxiliary switch configurations and number of leads exiting circuit breaker	Undervoltage release ratings and number of leads exiting circuit breaker	Motor operator ratings and number of leads or type of connector	Combinations of attachments and other information
SPD AQB-A800 (obsolete thermal magnetic)	3 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 120VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	450VAC, 60 Hz (2 leads)	115VAC, 60 Hz/ 120VDC dual-rated (cannon plug connector)	See A.3.5.4
SPD AQB-A802 (electronic with rating plug)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	5 different types (2 leads for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 33VDC	115VAC, 60 Hz/ 120VDC dual-rated (cannon plug connector)	See A.3.5.4

TABLE A-V. Attachment information for AQB-A1600 and AQB-A1604.

Type of circuit breaker	Shunt trip ratings and number of leads or type of connector exiting circuit breaker	Auxiliary switch configurations and number of leads or type of connector exiting circuit breaker	Undervoltage release ratings and number of leads or type of connector exiting circuit breaker	Motor operator ratings and number of leads or type of connector	Combinations of attachments and other information
SPD AQB-A1600 (obsolete thermal magnetic)	4 different types (cannon plug connectors for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC	1a and 1b (cannon plug connector) 2a and 2b (cannon plug connector)	4 different types (cannon plug connectors for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC	2 different types (one type dual-rated): 450VAC, 60Hz (cannon plug connector) 115VAC, 60 Hz/120VDC (cannon plug connector)	See A.3.6.4
SPD AQB-A1604 (electronic with rating plug)	5 different types (cannon plug connector or 2 leads available as option for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 28VDC	1a and 1b (3 leads) 2a and 2b (6 leads)	5 different types (cannon plug connector or 2 leads available as option for each type): 450VAC, 60 Hz 115VAC, 60 Hz 250VDC 120VDC 33VDC	2 different types (one type dual-rated; cannon plug connector or 2 leads available as option for each type): 450VAC, 60Hz (cannon plug connector) 115VAC, 60 Hz/120VDC (cannon plug connector)	See A.3.6.4

A.3.8 Conversion tables.

A.3.8.1 Purpose and limitations. Note the following:

a. Because an electronic circuit breaker has several more settings than a thermal magnetic circuit breaker, the user needs guidance on how to set the electronic circuit breaker to best approximate the instantaneous characteristics of the thermal magnetic circuit breaker being replaced. The conversion tables (Tables A-VI through A-XVIII) provide that guidance.

b. Since the long-time delay features of the thermal magnetic and electronic circuit breakers are not adjustable, only the continuous current rating and instantaneous characteristics of thermal magnetic circuit breakers can be approximated or matched by the electronic circuit breakers. As shown in the conversion tables, the short-time delay features on the electronic circuit breakers are sometimes used to more closely approximate or match the instantaneous characteristics of thermal magnetic circuit breakers. Thermal magnetic circuit breakers do not have short-time delay features.

c. **The fixed long-time delay features are not the same between thermal magnetic and electronic circuit breakers. Users should be aware of this when selecting a replacement circuit breaker and determine any coordination issues that may result from the long-time delay differences.**

d. **The settings in the conversion tables are to be used as recommendations only. They do not replace or supersede circuit breaker settings determined by coordination studies or other analyses.**

A.3.8.2 How to use conversion tables. As an example of how the conversion tables could be used, consider the following scenario:

A hull has thermal magnetic circuit breakers installed throughout the ship. An AQB-A800 circuit breaker malfunctions and cannot be repaired. The ship needs to order another AQB-A800 but determines this frame size is obsolete and there are no replacements available. As an alternative, the ship could use an electronic AQB-A802 which is a form and fit replacement for the obsolete circuit breaker. To make the electronic circuit breaker functionally equivalent with respect to continuous current rating and instantaneous characteristics, the user would note the trip unit amp rating and instantaneous pickup settings on the original AQB-A800 and use Table A-XVII below to set the AQB-A802.

TABLE A-VI. AQB-A101 / A102 conversion settings /1.

AQB-A101 settings (SPD or Cutler-Hammer/Westinghouse)		**SPD AQB-A102 type "E" equivalent settings**		
Trip element	**Instantaneous pickup (amps)**	**Trip element rating**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**
15A	LO (90)	15	6X (90)	5X (75)
15A	HI (195)	15	13X (195)	10X (150)
25A	LO (150)	25	6X (150)	5X (125)
25A	HI (325)	25	13X (325)	10X (250)
50A	LO (300)	50	6X (300)	5X (250)
50A	HI (650)	50	13X (650)	10X (500)
75A	LO (450)	75	6X (450)	5X (375)
75A	HI (975)	75	13X (975)	10X (750)
100A	LO (600)	100	6X (600)	5X (500)
100A	HI (1300)	100	13X (1300)	10X (1000)

NOTE:

/1 See MIL-DTL-17361/4 for complete details on available settings.

TABLE A-VII. AQB-A101 / A102 type "E1" and "E2" conversion settings /1 /2.

AQB-A101 settings (SPD or Cutler-Hammer/Westinghouse)		**SPD AQB-A102 type "E1" and "E2" equivalent settings**			
Trip element	**Instantaneous pickup (amps)**	**Continuous current setting**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
15A	LO (90)	15	3X (300)	6X (90)	1
15A	2 (115)	15	3X (300)	8X (120)	1
15A	3 (140)	15	3X (100)	10X (150)	1
15A	4 (165)	15	3X (300)	10X (150)	2
15A	HI (195)	15	3X (300)	10X (150)	2
25A	LO (150)	25	3X (300)	6X (150)	1
25A	2(190)	25	3X (300)	6X (150)	2
25A	3 (235)	25	3X (300)	8X (200)	2
25A	4 (280)	25	3X (300)	10X (250)	2
25A	HI (325)	25	3X (300)	10X (250)	3
50A	LO (300)	50	3X (300)	6X (300)	1
50A	2 (380)	50	4X (400)	6X (300)	2
50A	3 (470)	50	6X (600)	8X (400)	2
50A	4 (560)	50	6X (600)	10X (500)	2
50A	HI (650)	50	6X (600)	10X (500)	3
75A /2	LO (450)	75	6X (600)	6X (450)	1
75A /2	2 (580)	75	6X (600)	6X (450)	2
75A /2	3 (710)	75	8X (800)	10X (750)	1
75A /2	4 (840)	75	8X (800)	10X (750)	3
75A /2	HI (975)	75	10X (1000)	10X (750)	3
100A	LO (600)	100	6X (600)	6X (600)	1
100A	2 (775)	100	8X (800)	6X (600)	2
100A	3 (950)	100	10X (1000)	8X (800)	2
100A	4 (1125)	100	12X (1200)	10X (1000)	2
100A	HI (1300)	100	12X (1200)	10X (1000)	3

NOTES:

/1 See MIL-DTL-17361/4 for complete details on available settings.

/2 When replacing an AQB-A101 with a 75-amp trip element, use an AQB-A102 Type "E1" circuit breaker.

TABLE A-VIII. AQB-A101 / AQB-A103 conversion settings /1.

AQB-A101 settings (SPD or Cutler-Hammer/Westinghouse)		**Cutler-Hammer AQB-A103 equivalent settings**				
Trip element	**Instantaneous pickup (amps)**	**Frame size**	**Continuous current setting (amps)**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
15 A	LO (90)	25	15	6 (150)	7 (105)	MIN
15 A	2 (115)	25	15	6 (150)	7 (105)	MIN
15 A	3 (140)	25	15	6 (150)	10 (150)	MIN
15 A	4 (165)	25	15	6 (150)	10 (150)	MIN
15 A	HI (195)	25	15	8 (200)	13 (195)	MIN
25 A	LO (150)	25	25	6 (150)	7 (175)	MIN
25 A	2(190)	25	25	8 (200)	10 (250)	MIN
25 A	3 (235)	25	25	10 (250)	10 (250)	MIN
25 A	4 (280)	25	25	12 (300)	13 (325)	MIN
25 A	HI (325)	25	25	15 (375)	13 (325)	MIN
50 A	LO (300)	100	50	6 (600)	7 (350)	MIN
50 A	2 (380)	100	50	6 (600)	7 (350)	MIN
50 A	3 (470)	100	50	6 (600)	10 (500)	MIN
50 A	4 (560)	100	50	6 (600)	13 (650)	MIN
50 A	HI (650)	100	50	8 (800)	13 (650)	MIN
75 A	LO (450)	100	80	6 (600)	5 (400)	MIN
75 A	2 (580)	100	80	6 (600)	7 (560)	MIN
75 A	3 (710)	100	80	8 (800)	10 (800)	MIN
75 A	4 (840)	100	80	8 (800)	10 (800)	MIN
75 A	HI (975)	100	80	10 (1000)	13 (1040)	MIN
100 A	LO (600)	100	100	6 (600)	7 (700)	MIN
100 A	2 (775)	100	100	8 (800)	10 (1000)	MIN
100 A	3 (950)	100	100	10 (1000)	10 (1000)	MIN
100 A	4 (1125)	100	100	12 (1200)	13 (1300)	MIN
100 A	HI (1300)	100	100	15 (1500)	13 (1300)	MIN

NOTES:

/1 See MIL-DTL-17361/4 for complete details on available settings.

TABLE A-IX. AQB-A101 / AQB-A103RMS conversion settings /1.

AQB-A101 settings (SPD or Cutler-Hammer/Westinghouse)		Cutler-Hammer AQB-A103RMS equivalent settings				
Trip element	**Instantaneous pickup (amps)**	**Frame size**	**Continuous current setting (amps)**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
15 A	LO (90)	25	15	6 (150)	7 (105)	MIN
15 A	2 (115)	25	15	6 (150)	7 (105)	MIN
15 A	3 (140)	25	15	6 (150)	10 (150)	MIN
15 A	4 (165)	25	15	6 (150)	10 (150)	MIN
15 A	HI (195)	25	15	8 (200)	13 (195)	MIN
25 A	LO (150)	25	25	6 (150)	7 (175)	MIN
25 A	2(190)	25	25	8 (200)	10 (250)	MIN
25 A	3 (235)	25	25	10 (250)	10 (250)	MIN
25 A	4 (280)	25	25	12 (300)	13 (325)	MIN
25 A	HI (325)	25	25	15 (375)	13 (325)	MIN
50 A	LO (300)	100	50	6 (600)	7 (350)	MIN
50 A	2 (380)	100	50	6 (600)	7 (350)	MIN
50 A	3 (470)	100	50	6 (600)	10 (500)	MIN
50 A	4 (560)	100	50	6 (600)	10 (500)	MIN
50 A	HI (650)	100	50	8 (800)	13 (650)	MIN
75 A	LO (450)	100	75	6 (600)	5 (375)	MIN
75 A	2 (580)	100	75	6 (600)	7 (525)	MIN
75 A	3 (710)	100	75	8 (800)	9 (675)	MIN
75 A	4 (840)	100	75	8 (800)	10 (750)	MIN
75 A	HI (975)	100	75	10 (1000)	13 (975)	MIN
100 A	LO (600)	100	100	6 (600)	7 (700)	MIN
100 A	2 (775)	100	100	8 (800)	10 (1000)	MIN
100 A	3 (950)	100	100	10 (1000)	9 (900)	MIN
100 A	4 (1125)	100	100	12 (1200)	13 (1300)	MIN
100 A	HI (1300)	100	100	15 (1500)	13 (1300)	MIN

NOTES:

/1 See MIL-DTL-17361/4 for complete details on available settings.

TABLE A-X. AQB-LF250 / LF252 conversion settings /1.

AQB-LF250 settings (SPD or Cutler-Hammer/Westinghouse)		SPD AQB-LF252 equivalent settings			
Trip element	**Instantaneous pickup (amps)**	**Continuous current setting/ rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
125L	LO (650)	125	3X (750)	6X (750)	1
125L	2 (780)	125	3X (750)	6X (750)	3
125L	3 (900)	125	4X (1000)	6X (750)	3
125L	4 (1040)	125	4X (1000)	8X (1000)	3
125L	HI (1300)	125	6X (1500)	10X (1250)	1
150L	LO (650)	150	3X (750)	4X (600)	1
150L	2 (780)	150	3X (750)	6X (900)	1
150L	3 (900)	150	4X (1000)	6X (900)	1
150L	4 (1040)	150	4X (1000)	8X (1200)	1
150L	HI (1300)	150	6X (1500)	8X (1200)	2
175L	LO (650)	175	3X (750)	4X (700)	1
175L	2 (780)	175	3X (750)	6X (1050)	1
175L	3 (900)	175	4X (1000)	6X (1050)	1
175L	4 (1040)	175	4X (1000)	6X (1050)	1
175L	HI (1300)	175	6X (1500)	8X (1400)	1
225L	LO (650)	225	3X (750)	3X (675)	1
225L	2 (780)	225	3X (750)	4X (900)	1
225L	3 (900)	225	4X (1000)	4X (900)	1
225L	4 (1040)	225	4X (1000)	4X (900)	3
225L	HI (1300)	225	6X (1500)	6X (1350)	1
250L	LO (650)	250	3X (750)	3X (750)	1
250L	2 (780)	250	3X (750)	3X (750)	1
250L	3 (900)	250	4X (1000)	3X (750)	3
250L	4 (1040)	250	4X (1000)	4X (1000)	3
250L	HI (1300)	250	6X (1500)	6X (1500)	1
125LM	LO (1500)	125	6X (1500)	15X (1875)	1
125LM	2 (1770)	125	8X (2000)	15X (1875)	1
125LM	3 (2025)	125	8X (2000)	15X (1875)	3
125LM	4 (2325)	125	10X (2500)	15X (1875)	3
125LM	HI (3000)	125	15X (3750)	15X (1875)	3

TABLE A-X. AQB-LF250 / LF252 conversion settings - Continued.

AQB-LF250 settings (SPD or Cutler-Hammer/Westinghouse)		**SPD AQB-LF252 equivalent settings**			
Trip element	**Instantaneous pickup (amps)**	**Continuous current setting/ rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
150LM	LO (1500)	150	6X (1500)	10X (1500)	2
150LM	2 (1770)	150	8X (2000)	15X (2250)	1
150LM	3 (2025)	150	8X (2000)	15X (2250)	1
150LM	4 (2325)	150	10X (2500)	15X (2250)	3
150LM	HI (3000)	150	15X (3750)	15X (2250)	3
175LM	LO (1500)	175	6X (1500)	10X (1750)	1
175LM	2 (1770)	175	8X (2000)	10X (1750)	1
175LM	3 (2025)	175	8X (2000)	15X (2625)	1
175LM	4 (2325)	175	10X (2500)	15X (2625)	1
175LM	HI (3000)	175	15X (3750)	15X (2625)	3
225LM	LO (1500)	225	6X (1500)	8X (1800)	1
225LM	2 (1770)	225	8X (2000)	8X (1800)	1
225LM	3 (2025)	225	8X (2000)	10X (2250)	1
225LM	4 (2325)	225	10X (2500)	10X (2250)	1
225LM	HI (3000)	225	15X (3750)	15X (3375)	1
250LM	LO (1500)	250	6X (1500)	6X (1500)	2
250LM	2 (1770)	250	8X (2000)	8X (2000)	1
250LM	3 (2025)	250	8X (2000)	8X (2000)	3
250LM	4 (2325)	250	10X (2500)	10X (2500)	1
250LM	HI (3000)	250	15X (3750)	10X (2500)	3

NOTE:

/1 See MIL-DTL-17361/7 for complete details on available settings.

TABLE A-XI. AQB-LF250 / AQB-L253 conversion settings /1.

AQB-LF250 settings (SPD or Cutler-Hammer/Westinghouse)		Cutler-Hammer AQB-L253 equivalent settings /2			
Trip element	**Instantaneous pickup (amps)**	**Frame size**	**Continuous current setting on adjustable rating plug (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band /3**
125L	Low (650)	250	125	6 (750)	INST
125L	2 (780)	250	125	6 (750)	INST
125L	3 (900)	250	125	8 (1000)	INST
125L	4 (1040)	250	125	10 (1250)	INST
125L	High (1300)	250	125	10 (1250)	INST
150L	Low (650)	250	150	4 (600)	INST
150L	2 (780)	250	150	6 (900)	INST
150L	3 (900)	250	150	6 (900)	INST
150L	4 (1040)	250	150	8 (1200)	INST
150L	High (1300)	250	150	10 (1500)	INST
175L	Low (650)	250	175	4 (700)	INST
175L	2 (780)	250	175	4 (700)	INST
175L	3 (900)	250	175	6 (1050)	INST
175L	4 (1040)	250	175	6 (1050)	INST
175L	High (1300)	250	175	8 (1400)	INST
225L	Low (650)	250	225	3 (675)	INST
225L	2 (780)	250	225	4 (900)	INST
225L	3 (900)	250	225	4 (900)	INST
225L	4 (1040)	250	225	6 (1350)	INST
225L	High (1300)	250	225	6 (1350)	INST
250L	Low (650)	250	250	3 (750)	INST
250L	2 (780)	250	250	3 (750)	INST
250L	3 (900)	250	250	4 (1000)	INST
250L	4 (1040)	250	250	6 (1500)	INST
250L	High (1300)	250	250	6 (1500)	INST
125LM	Low (1500)	250	125	13 (1625)	INST
125LM	2 (1770)	250	125	13 (1625)	INST
125LM	3 (2025)	250	125	13 (1625)	INST
125LM	4 (2325)	NA	NA	NA	NA
125LM	High (3000)	NA	NA	NA	NA
150LM	Low (1500)	250	150	10 (1500)	INST
150LM	2 (1770)	250	150	12 (1800)	INST
150LM	3 (2025)	250	150	13 (1950)	INST

TABLE A-XI. AQB-LF250 / AQB-L253 conversion settings - Continued.

AQB-LF250 settings (SPD or Cutler-Hammer/Westinghouse)		Cutler-Hammer AQB-L253 equivalent settings /2			
Trip element	**Instantaneous pickup (amps)**	**Frame size**	**Continuous current setting on adjustable rating plug (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band /3**
150LM	4 (2325)	250	150	13 (1950)	INST
150LM	High (3000)	NA	NA	NA	NA
175LM	Low (1500)	250	175	8 (1400)	INST
175LM	2 (1770)	250	175	10 (1750)	INST
175LM	3 (2025)	250	175	12 (2100)	INST
175LM	4 (2325)	250	175	13 (2275)	INST
175LM	High (3000)	NA	NA	NA	NA
225LM	Low (1500)	250	225	6 (1350)	INST
225LM	2 (1770)	250	225	8 (1800)	INST
225LM	3 (2025)	250	225	10 (2250)	INST
225LM	4 (2325)	250	225	12 (2700)	INST
225LM	High (3000)	250	225	13 (2925)	INST
250LM	Low (1500)	250	250	6 (1500)	INST
250LM	2 (1770)	250	250	8 (2000)	INST
250LM	3 (2025)	250	250	8 (2000)	INST
250LM	4 (2325)	250	250	10 (2500)	INST
250LM	High (3000)	250	250	12 (3000)	INST

NOTES:

/1 See MIL-DTL-17361/7 for complete details on available settings.

/2 “NA” stands for “Not Applicable”. When used in the table, it means that the AQB-L253 cannot be considered as a replacement for the AQB-LF250 in a particular application because available settings of the AQB-L253 do not match the AQB-LF250 setting within ±20%.

/3 “INST” setting emulates an instantaneous function.

TABLE A-XII. AQB-A250 / A252 conversion settings /1.

AQB-A250 settings (SPD or Cutler-Hammer/Westinghouse)		**SPD AQB-A252 equivalent settings**			
Trip element	**Instantaneous pickup (amps)**	**Continuous current setting/ rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
125N	LO (650)	125	3X (750)	6X (750)	1
125N	2 (780)	125	3X (750)	6X (750)	3
125N	3 (900)	125	4X (1000)	6X (750)	3
125N	4 (1040)	125	4X (1000)	8X (1000)	3
125N	HI (1300)	125	6X (1500)	10X (1250)	1
150N	LO (650)	150	3X (750)	4X (600)	1
150N	2 (780)	150	3X (750)	6X (900)	1
150N	3 (900)	150	4X (1000)	6X (900)	1
150N	4 (1040)	150	4X (1000)	8X (1200)	1
150N	HI (1300)	150	6X (1500)	8X (1200)	2
175N	LO (650)	175	3X (750)	4X (700)	1
175N	2 (780)	175	3X (750)	6X (1050)	1
175N	3 (900)	175	4X (1000)	6X (1050)	1
175N	4 (1040)	175	4X (1000)	6X (1050)	1
175N	HI (1300)	175	6X (1500)	8X (1400)	1
225N	LO (650)	225	3X (750)	3X (675)	1
225N	2 (780)	225	3X (750)	4X (900)	1
225N	3 (900)	225	4X (1000)	4X (900)	1
225N	4 (1040)	225	4X (1000)	4X (900)	3
225N	HI (1300)	225	6X (1500)	6X (1350)	1
250N	LO (650)	250	3X (750)	3X (750)	1
250N	2 (780)	250	3X (750)	3X (750)	1
250N	3 (900)	250	4X (1000)	3X (750)	3
250N	4 (1040)	250	4X (1000)	4X (1000)	3
250N	HI (1300)	250	6X (1500)	6X (1500)	1
100NG	LO (1175)	100	6X (1500)	10X (1000)	3
100NG	2 (1400)	100	6X (1500)	15X (1500)	1
100NG	3 (1620)	100	6X (1500)	15X (1500)	3
100NG	4 (1880)	100	8X (2000)	15X (1500)	3
100NG	HI (2350)	100	10X (2500)	15X (1500)	3
160NG	LO (1950)	150	8X (2000)	15X (2250)	1
160NG	2 (2425)	150	10X (2500)	15X (2250)	3
160NG	3 (2760)	150	10X (2500)	15X (2250)	3
160NG	4 (3200)	150	15X (3750)	15X (2250)	3

TABLE A-XII. AQB-A250 / A252 conversion settings - Continued.

AQB-A250 settings (SPD or Cutler-Hammer/Westinghouse)		SPD AQB-A252 equivalent settings			
Trip element	**Instantaneous pickup (amps)**	**Continuous current setting/ rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
160NG	HI (3900)	150	15X (3750)	15X (2250)	3
100NGH	LO (2020)	100	8X (2000)	15X (1500)	3
100NGH	2 (2225)	100	8X (2000)	15X (1500)	3
100NGH	3 (2530)	100	10X (2500)	15X (1500)	3
100NGH	4 (2840)	100	10X (2500)	15X (1500)	3
100NGH	HI (3420)	100	15X (3750)	15X (1500)	3
160NGH	LO (2020)	150	8X (2000)	15X (2250)	1
160NGH	2 (2225)	150	8X (2000)	15X (2250)	3
160NGH	3 (2530)	150	10X (2500)	15X (2250)	3
160NGH	4 (2840)	150	10X (2500)	15X (2250)	3
160NGH	HI (3420)	150	15X (3750)	15X (2250)	3
125NM	LO (1950)	125	8X (2000)	15X (1875)	3
125NM	2 (2425)	125	10X (2500)	15X (1875)	3
125NM	3 (2760)	125	10X (2500)	15X (1875)	3
125NM	4 (3200)	125	15X (3750)	15X (1875)	3
125NM	HI (3900)	125	15X (3750)	15X (1875)	3
150NM	LO (1950)	150	8X (2000)	15X (2250)	1
150NM	2 (2425)	150	10X (2500)	15X (2250)	3
150NM	3 (2760)	150	10X (2500)	15X (2250)	3
150NM	4 (3200)	150	15X (3750)	15X (2250)	3
150NM	HI (3900)	150	15X (3750)	15X (2250)	3
175NM	LO (1950)	175	8X (2000)	15X (2625)	1
175NM	2 (2425)	175	10X (2500)	15X (2625)	1
175NM	3 (2760)	175	10X (2500)	15X (2625)	3
175NM	4 (3200)	175	15X (3750)	15X (2625)	3
175NM	HI (3900)	175	15X (3750)	15X (2625)	3
225NM	LO (1500)	225	6X (1500)	8X (1800)	1
225NM	2 (1770)	225	8X (2000)	8X (1800)	1
225NM	3 (2025)	225	8X (2000)	10X (2250)	1
225NM	4 (2325)	225	10X (2500)	10X (2250)	3
225NM	HI (3000)	225	15X (3750)	15X (3375)	1
250NM	LO (1700)	250	8X (2000)	6X (1500)	3
250NM	2 (1880)	250	8X (2000)	8X (2000)	1
250NM	3 (2240)	250	10X (2500)	8X (2000)	3

TABLE A-XII. AQB-A250 / A252 conversion settings - Continued.

AQB-A250 settings (SPD or Cutler-Hammer/Westinghouse)		**SPD AQB-A252 equivalent settings**			
Trip element	**Instantaneous pickup (amps)**	**Continuous current setting/ rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
250NM	4 (2625)	250	10X (2500)	10X (2500)	3
250NM	HI (3400)	250	15X (3750)	15X (3750)	1

NOTE:

/1 See MIL-DTL-17361/6 for complete details on available settings.

TABLE A-XIII. AQB-A250 / AQB-A253 conversion settings /1.

AQB-A250 settings (SPD or Cutler-Hammer/Westinghouse)		Cutler-Hammer AQB-A253 equivalent settings /2			
Trip element	**Instantaneous pickup (amps)**	**Frame size**	**Continuous current setting on adjustable rating plug (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band /3**
125N	Low (650)	250	125	6 (750)	INST
125N	2 (780)	250	125	6 (750)	INST
125N	3 (900)	250	125	8 (1000)	INST
125N	4 (1040)	250	125	10 (1250)	INST
125N	High (1300)	250	125	10 (1250)	INST
150N	Low (650)	250	150	4 (600)	INST
150N	2 (780)	250	150	6 (900)	INST
150N	3 (900)	250	150	6 (900)	INST
150N	4 (1040)	250	150	8 (1200)	INST
150N	High (1300)	250	150	10 (1500)	INST
175N	Low (650)	250	175	4 (700)	INST
175N	2 (780)	250	175	4 (700)	INST
175N	3 (900)	250	175	6 (1050)	INST
175N	4 (1040)	250	175	6 (1050)	INST
175N	High (1300)	250	175	8 (1400)	INST
225N	Low (650)	250	225	3 (675)	INST
225N	2 (780)	250	225	4 (900)	INST
225N	3 (900)	250	225	4 (900)	INST
225N	4 (1040)	NA	NA	NA	NA
225N	High (1300)	250	225	6 (1350)	INST
250N	Low (650)	250	250	3 (750)	INST
250N	2 (780)	250	250	3 (750)	INST
250N	3 (900)	250	250	4 (1000)	INST
250N	4 (1040)	NA	NA	NA	NA
250N	High (1300)	250	250	6 (1500)	INST
100NG	Low (1175)	250	100	13 (1300)	INST
100NG	2 (1400)	250	100	13 (1300)	INST
100NG	3 (1620)	NA	NA	NA	NA
100NG	4 (1880)	NA	NA	NA	NA
100NG	High (2350)	NA	NA	NA	NA
160NG	Low (1950)	250	160	13 (2080)	INST
160NG	2 (2425)	250	160	13 (2080)	INST
160NG	3 (2760)	NA	NA	NA	NA

TABLE A-XIII. AQB-A250 / AQB-A253 conversion settings - Continued.

AQB-A250 settings (SPD or Cutler-Hammer/Westinghouse)		Cutler-Hammer AQB-A253 equivalent settings /2			
Trip element	**Instantaneous pickup (amps)**	**Frame size**	**Continuous current setting on adjustable rating plug (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band /3**
160NG	4 (3200)	NA	NA	NA	NA
160NG	High (3900)	NA	NA	NA	NA
125NH	Low (910)	250	125	8 (1000)	INST
125NH	2 (1050)	250	125	8 (1000)	INST
125NH	3 (1180)	250	125	10 (1250)	INST
125NH	4 (1320)	250	125	12 (1500)	INST
125NH	High (1560)	250	125	13 (1625)	INST
150NH	Low (910)	250	150	6 (900)	INST
150NH	2 (1050)	250	150	8 (1200)	INST
150NH	3 (1180)	250	150	8 (1200)	INST
150NH	4 (1320)	250	150	10 (1500)	INST
150NH	High (1560)	250	150	10 (1500)	INST
175NH	Low (910)	250	175	6 (1050)	INST
175NH	2 (1050)	250	175	6 (1050)	INST
175NH	3 (1180)	250	175	8 (1400)	INST
175NH	4 (1320)	250	175	8 (1400)	INST
175NH	High (1560)	250	175	10 (1750)	INST
225NH	Low (910)	250	225	4 (900)	INST
225NH	2 (1050)	250	225	4 (900)	INST
225NH	3 (1180)	250	225	6 (1350)	INST
225NH	4 (1320)	250	225	6 (1350)	INST
225NH	High (1560)	250	225	8 (1800)	INST
250NH	Low (910)	250	250	4 (1000)	INST
250NH	2 (1050)	250	250	4 (1000)	INST
250NH	3 (1180)	250	250	6 (1500)	INST
250NH	4 (1320)	250	250	6 (1500)	INST
250NH	High (1560)	250	250	6 (1500)	INST
100NGH	Low (2020)	NA	NA	NA	NA
100NGH	2 (2225)	NA	NA	NA	NA
100NGH	3 (2530)	NA	NA	NA	NA
100NGH	4 (2840)	NA	NA	NA	NA
100NGH	High (3420)	NA	NA	NA	NA
160NGH	Low (2020)	250	160	13 (2080)	INST

TABLE A-XIII. AQB-A250 / AQB-A253 conversion settings - Continued.

AQB-A250 settings (SPD or Cutler-Hammer/Westinghouse)		Cutler-Hammer AQB-A253 equivalent settings /2			
Trip element	**Instantaneous pickup (amps)**	**Frame size**	**Continuous current setting on adjustable rating plug (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band /3**
160NGH	2 (2225)	250	160	13 (2080)	INST
160NGH	3 (2530)	250	160	13 (2080)	INST
160NGH	4 (2840)	NA	NA	NA	NA
160NGH	High (3420)	NA	NA	NA	NA
250-NGH	Low (2520)	250	250	10 (2500)	INST
250-NGH	2 (2960)	250	250	12 (3000)	INST
250-NGH	3 (3120)	250	250	12 (3000)	INST
250-NGH	4 (3590)	250	250	13 (3250)	INST
250-NGH	High (4200)	NA	NA	NA	NA
125NM	Low (1950)	250	125	13 (1625)	INST
125NM	2 (2425)	NA	NA	NA	NA
125NM	3 (2760)	NA	NA	NA	NA
125NM	4 (3200)	NA	NA	NA	NA
125NM	High (3900)	NA	NA	NA	NA
150NM	Low (1950)	250	150	13 (1950)	INST
150NM	2 (2425)	250	150	13 (1950)	INST
150NM	3 (2760)	NA	NA	NA	NA
150NM	4 (3200)	NA	NA	NA	NA
150NM	High (3900)	NA	NA	NA	NA
175NM	Low (1950)	250	175	13 (2275)	INST
175NM	2 (2425)	250	175	13 (2275)	INST
175NM	3 (2760)	250	175	13 (2275)	INST
175NM	4 (3200)	NA	NA	NA	NA
175NM	High (3900)	NA	NA	NA	NA
225NM	Low (1500)	250	225	6 (1350)	INST
225NM	2 (1770)	250	225	8 (1800)	INST
225NM	3 (2025)	250	225	10 (2250)	INST
225NM	4 (2325)	250	225	12 (2700)	INST
225NM	High (3000)	NA	NA	NA	NA
250NM	Low (1700)	250	250	6 (1500)	INST
250NM	2 (1880)	250	250	8 (2000)	INST
250NM	3 (2240)	250	250	10 (2500)	INST
250NM	4 (2625)	250	250	12 (3000)	INST
250NM	High (3400)	250	250	13 (3250)	INST

TABLE A-XIII. AQB-A250 / AQB-A253 conversion settings - Continued.

NOTES:

/1 See MIL-DTL-17361/6 for complete details on available settings.

/2 “NA” stands for “Not Applicable”. When used in the table, it means that the AQB-A253 cannot be considered as a replacement for the AQB-A250 in a particular application because available settings of the AQB-A253 do not match the AQB-A250 setting within ±20%.

/3 “INST” setting emulates an instantaneous function.

TABLE A-XIV. AQB-LF400 / LF402 conversion settings /1.

SPD AQB-LF400 settings		SPD AQB-LF402 equivalent settings			
Trip element	**Instantaneous pickup (amps)**	**Continuous current setting/ rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
250T	LO (880)	250	3X (1200)	3X (750)	3
250T	2 (1035)	250	3X (1200)	4X (1000)	1
250T	3 (1165)	250	3X (1200)	6X (1500)	1
250T	4 (1325)	250	3X (1200)	6X (1500)	1
250T	HI (1530)	250	4X (1600)	6X (1500)	2
300T	LO (1380)	300	4X (1600)	4X (1200)	3
300T	2 (1610)	300	4X (1600)	6X (1800)	1
300T	3 (1820)	300	6X (2400)	6X (1800)	1
300T	4 (2035)	300	6X (2400)	6X (1800)	3
300T	HI (2280)	300	6X (2400)	8X (2400)	1
350T	LO (1380)	350	4X (1600)	4X (1400)	1
350T	2 (1610)	350	4X (1600)	6X (2100)	1
350T	3 (1820)	350	6X (2400)	6X (2100)	1
350T	4 (2035)	350	6X (2400)	6X (2100)	1
350T	HI (2280)	350	6X (2400)	6X (2100)	1
400T	LO (1380)	400	4X (1600)	3X (1200)	3
400T	2 (1610)	400	4X (1600)	4X (1600)	1
400T	3 (1820)	400	6X (2400)	4X (1600)	3
400T	4 (2035)	400	6X (2400)	6X (2400)	1
400T	HI (2280)	400	6X (2400)	6X (2400)	1
250TM	LO (3190)	250	8X (3200)	15X (3750)	1
250TM	2 (3725)	250	10X (4000)	15X (3750)	1
250TM	3 (4325)	250	10X (4000)	15X (3750)	3
250TM	4 (5175)	250	12X (4800)	15X (3750)	3
250TM	HI (5825)	250	15X (6000)	15X (3750)	2
300TM	LO (3190)	300	8X (3200)	15X (4500)	1
300TM	2 (3725)	300	10X (4000)	12X (3600)	3
300TM	3 (4325)	300	10X (4000)	15X (4500)	1
300TM	4 (5175)	300	12X (4800)	15X (4500)	3
300TM	HI (5825)	300	15X (6000)	15X (4500)	3
350TM	LO (3190)	350	8X (3200)	10X (3500)	1

TABLE A-XIV. AQB-LF400 / LF402 conversion settings - Continued.

SPD AQB-LF400 settings		SPD AQB-LF402 equivalent settings			
Trip element	**Instantaneous pickup (amps)**	**Continuous current setting/ rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
350TM	2 (3725)	350	10X (4000)	10X (3500)	3
350TM	3 (4325)	350	10X (4000)	12X (4200)	3
350TM	4 (5175)	350	12X (4800)	15X (5250)	1
350TM	HI (5825)	350	15X (6000)	15X (5250)	3
400TM	LO (3190)	400	8X (3200)	8X (3200)	2
400TM	2 (3725)	400	10X (4000)	10X (4000)	1
400TM	3 (4325)	400	10X (4000)	10X (4000)	3
400TM	4 (5175)	400	12X (4800)	12X (4800)	3
400TM	HI (5825)	400	15X (6000)	15X (6000)	1

NOTE:

/1 See MIL-DTL-17361/11 for complete details on available settings.

TABLE A-XV. AQB-LF400 / AQB-L400 conversion settings.

SPD AQB-LF400 Settings		Cutler-Hammer AQB-L400/LL400 equivalent settings /1			
Trip element	**Instantaneous pickup (amps)**	**Frame size**	**Rating plug**	**Short-time delay pickup (amps)**	**Short-time delay time band /2**
250T	MIN (880)	L400QF	250Q	2 (860)	MIN
250T	2 (1035)	L400QF	250Q	3 (1070)	MIN
250T	3 (1165)	L400QF	250Q	3 (1070)	MIN
250T	4 (1325)	L400QF	250Q	4 (1280)	MIN
250T	MAX (1530)	L400QF	250Q	HI (1500)	MIN
300T	MIN (1380)	L400QF	300Q	HI (1500)	MIN
300T	2 (1610)	L400QM	300Q	LO (1700)	MIN
300T	3 (1820)	L400QM	300Q	LO (1700)	MIN
300T	4 (2035)	L400QM	300Q	2 (2075)	MIN
300T	MAX (2280)	L400QM	300Q	3 (2450)	MIN
350T	MIN (1380)	L400QF	350Q	HI (1500)	MIN
350T	2 (1610)	L400QM	350Q	LO (1700)	MIN
350T	3 (1820)	L400QM	350Q	LO (1700)	MIN
350T	4 (2035)	L400QM	350Q	2 (2075)	MIN
350T	MAX (2280)	L400QM	350Q	3 (2450)	MIN
400T	MIN (1380)	L400QF	400Q	HI (1500)	MIN
400T	2 (1610)	L400QM	400Q	LO (1700)	MIN
400T	3 (1820)	L400QM	400Q	LO (1700)	MIN
400T	4 (2035)	L400QM	400Q	2 (2075)	MIN
400T	MAX (2280)	L400QM	400Q	3 (2450)	MIN
250TM	MIN (3190)	LL400QM	250Q	HI (3200)	MIN
250TM	2 (3725)	LL400QS	250Q	LO (3600)	MIN
250TM	3 (4325)	LL400QS	250Q	1 (4700)	MIN
250TM	4 (5175)	LL400QS	250Q	3 (5250)	MIN
250TM	MAX (5825)	LL400QS	250Q	HI (5800)	MIN
300TM	MIN (3190)	LL400QM	300Q	HI (3200)	MIN
300TM	2 (3725)	LL400QS	300Q	LO (3600)	MIN
300TM	3 (4325)	LL400QS	300Q	1 (4700)	MIN
300TM	4 (5175)	LL400QS	300Q	3 (5250)	MIN
300TM	MAX (5825)	LL400QS	300Q	HI (5800)	MIN
350TM	MIN (3190)	LL400QM	350Q	HI (3200)	MIN
350TM	2 (3725)	LL400QS	350Q	LO (3600)	MIN
350TM	3 (4325)	LL400QS	350Q	1 (4700)	MIN
350TM	4 (5175)	LL400QS	350Q	3 (5250)	MIN

TABLE A-XV. AQB-LF400 / AQB-L400 conversion settings.

SPD AQB-LF400 settings		Cutler-Hammer AQB-L400/LL400 equivalent settings /1			
Trip element	**Instantaneous pickup (amps)**	**Frame size**	**Rating plug**	**Short-time delay pickup (amps)**	**Short-time delay time band /2**
350TM	MAX (5825)	LL400QS	350Q	HI (5800)	MIN
400TM	MIN (3190)	LL400QM	400Q	HI (3200)	MIN
400TM	2 (3725)	LL400QS	400Q	LO (3600)	MIN
400TM	3 (4325)	LL400QS	400Q	1 (4700)	MIN
400TM	4 (5175)	LL400QS	400Q	3 (5250)	MIN
400TM	MAX (5825)	LL400QS	400Q	HI (5800)	MIN

NOTES:

/1 See MIL-DTL-17361/9 and MIL-DTL-17361/10 for complete details on available settings.

/2 “MIN” setting approximates an instantaneous function.

TABLE A-XVI. AQB-A400 / A402 conversion settings /1.

SPD AQB-A400 settings		SPD AQB-A402 equivalent settings			
Trip element	**Instantaneous pickup (amps)**	**Continuous current setting/ rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
250K	LO (800)	250	3X (1200)	3X (750)	3
250K	2 (1035)	250	3X (1200)	4X (1000)	3
250K	3 (1165)	250	3X (1200)	4X (1000)	3
250K	4 (1325)	250	3X (1200)	6X (1500)	1
250K	HI (1530)	250	4X (1600)	6X (1500)	1
300K	LO (1380)	300	4X (1600)	4X (1200)	3
300K	2 (1610)	300	4X (1600)	6X (1800)	1
300K	3 (1820)	300	6X (2400)	6X (1800)	1
300K	4 (2035)	300	6X (2400)	6X (1800)	3
300K	HI (2280)	300	6X (2400)	8X (2400)	1
350K	LO (1380)	350	4X (1600)	4X (1400)	1
350K	2 (1610)	350	4X (1600)	6X (2100)	1
350K	3 (1820)	350	4X (1600)	6X (2100)	1
350K	4 (2035)	350	6X (2400)	6X (2100)	1
350K	HI (2280)	350	6X (2400)	6X (2100)	1
400K	LO (1380)	400	4X (1600)	3X (1200)	3
400K	2 (1610)	400	4X (1600)	4X (1600)	1
400K	3 (1820)	400	4X (1600)	4X (1600)	3
400K	4 (2035)	400	6X (2400)	4X (1600)	3
400T	HI (2280)	400	6X (2400)	6X (2400)	1
250KM	LO (3190)	250	8X (3200)	15X (3750)	1
250KM	2 (3725)	250	10X (4000)	15X (3750)	1
250KM	3 (4325)	250	10X (4000)	15X (3750)	3
250KM	4 (5175)	250	12X (4800)	15X (3750)	3
250KM	HI (5820)	250	15X (6000)	15X (3750)	3
300KM	LO (3190)	300	8X (3200)	15X (4500)	1
300KM	2 (3725)	300	10X (4000)	12X (3600)	3
300KM	3 (4325)	300	10X (4000)	15X (4500)	1
300KM	4 (5175)	300	12X (4800)	15X (4500)	3
300KM	HI (5820)	300	15X (6000)	15X (4500)	3
350KM	LO (3190)	350	8X (3200)	10X (3500)	1
350KM	2 (3725)	350	10X (4000)	10X (3500)	3
350KM	3 (4325)	350	10X (4000)	15X (5250)	1
350KM	4 (5175)	350	12X (4800)	15X (5250)	1
350KM	HI (5820)	350	15X (6000)	15X (5250)	3

TABLE A-XVI. AQB-A400 / A402 conversion settings - Continued.

SPD AQB-A400 settings		SPD AQB-A402 equivalent settings			
Trip element	**Instantaneous pickup (amps)**	**Continuous current setting/ rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
400KM	LO (3190)	400	8X (3200)	8X (3200)	2
400KM	2 (3725)	400	10X (4000)	10X (4000)	1
400KM	3 (4325)	400	10X (4000)	10X (4000)	3
400KM	4 (5175)	400	12X (4800)	15X (6000)	1
400KM	HI (5820)	400	15X (6000)	15X (6000)	1

NOTE:

/1 See MIL-DTL-17361/8 for complete details on available settings.

TABLE A-XVII. AQB-A800 / A802 conversion settings /1.

SPD AQB-A800 settings		SPD AQB-A802 equivalent settings			
Trip element	**Instantaneous pickup (amps)**	**Rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
400U	LO (1900)	400	3 (2400)	4 (1600)	3
400U	2 (2300)	400	3 (2400)	6 (2400)	1
400U	3 (2700)	400	4 (3200)	6 (2400)	3
400U	4 (3100)	400	4 (3200)	8 (3200)	1
400U	HI (3500)	400	4 (3200)	8 (3200)	3
400UM	LO (3200)	400	4 (3200)	8 (3200)	1
400UM	2 (3600)	400	5 (4000)	8 (3200)	3
400UM	3 (4100)	400	5 (4000)	10 (4000)	1
400UM	4 (5100)	400	6 (4800)	10 (4000)	3
400UM	HI (5600)	400	8 (6400)	10 (4000)	3
500U	LO (1900)	500	3 (2400)	4 (2000)	1
500U	2 (2300)	500	3 (2400)	4 (2000)	3
500U	3 (2700)	500	4 (3200)	6 (3000)	1
500U	4 (3100)	500	4 (3200)	6 (3000)	1
500U	HI (3500)	500	4 (3200)	8 (4000)	1
500UM	LO (3200)	500	4 (3200)	6 (3000)	2
500UM	2 (3600)	500	5 (4000)	8 (4000)	1
500UM	3 (4100)	500	5 (4000)	8 (4000)	1
500UM	4 (5100)	500	6 (4800)	10 (5000)	1
500UM	HI (5600)	500	8 (6400)	10 (5000)	3
600U	LO (1900)	600	3 (2400)	3 (1800)	1
600U	2 (2300)	600	3 (2400)	4 2400)	1
600U	3 (2700)	600	4 (3200)	4 (2400)	3
600U	4 (3100)	600	4 (3200)	6 (3600)	1
600U	HI (3500)	600	4 (3200)	6 (3600)	1
600UM	LO (3200)	600	4 (3200)	6 (3600)	1
600UM	2 (3600)	600	5 (4000)	6 (3600)	1
600UM	3 (4100)	600	5 (4000)	6 (3600)	3
600UM	4 (5100)	600	6 (4800)	8 (4800)	3
600UM	HI (5600)	600	8 (6400)	10 (6000)	1
800	LO (1900)	800	3 (2400)	2 (1600)	3
800	2 (2300)	800	3 (2400)	3 (2400)	1

TABLE A-XVII. AQB-A800 / A802 conversion settings - Continued.

SPD AQB-A800 settings		SPD AQB-A802 equivalent settings			
Trip element	**Instantaneous pickup (amps)**	**Rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
800	3 (2700)	800	4 (3200)	3 (2400)	3
800	4 (3100)	800	4 (3200)	4 (3200)	1
800	HI (3500)	800	4 (3200)	4 (3200)	3
800U	LO (3200)	800	4 (3200)	4 (3200)	1
800U	2 (3600)	800	5 (4000)	4 (3200)	3
800U	3 (4100)	800	5 (4000)	4 (3200)	3
800U	4 (5100)	800	6 (4800)	6 (4800)	3
800U	HI (5600)	800	8 (6400)	6 (4800)	3
800UM	LO (5000)	800	6 (4800)	6 (4800)	1
800UM	2 (6100)	800	8 (6400)	8 (6400)	1
800UM	3 (6700)	800	8 (6400)	8 (6400)	1
800UM	4 (7400)	800	10 (8000)	8 (6400)	3
800UM	HI (8000)	800	10 (8000)	10 (8000)	1

NOTE:

/1 See MIL-DTL-17361/12 for complete details on available settings.

TABLE A-XVIII. AQB-A1600 / A1604 conversion settings /1.

SPD AQB-A1600 settings		SPD AQB-A1604 equivalent settings			
Trip element	**Instantaneous pickup (amps)**	**Rating plug**	**Instantaneous pickup (amps)**	**Short-time delay pickup (amps)**	**Short-time delay time band**
600Y	LO (2000)	600	3X (4800)	3X (1800)	3
600Y	2 (3000)	600	3X (4800)	4X (2400)	3
600Y	3 (4000)	600	3X (4800)	6X (2600)	3
600Y	4 (5000)	600	3X (4800)	8X (4800)	3
600Y	HI (6000)	600	4X (6400)	10X (6000)	1
800Y	LO (2000)	800	3X (4800)	2X (1600)	3
800Y	2 (3000)	800	3X (4800)	4X (3200)	1
800Y	3 (4000)	800	3X (4800)	4X (3200)	3
800Y	4 (5000)	800	3X (4800)	6X (4800)	3
800Y	HI (6000)	800	4X (6400)	8X (6400)	1
1000Y	LO (2000)	1000	3X (4800)	2X (2000)	1
1000Y	2 (3000)	1000	3X (4800)	3X (3000)	1
1000Y	3 (4000)	1000	3X (4800)	4X (4000)	1
1000Y	4 (5000)	1000	3X (4800)	6X (6000)	1
1000Y	HI (6000)	1000	4X (6400)	6X (6000)	1
1200Y	LO (2000)	1200	3X (4800)	2X (2400)	1
1200Y	2 (3000)	1200	3X (4800)	2X (2400)	3
1200Y	3 (4000)	1200	3X (4800)	3X (3600)	3
1200Y	4 (5000)	1200	3X (4800)	4X (4800)	3
1200Y	HI (6000)	1200	4X (6400)	6X (7200)	1
1400Y	LO (4000)	1400	3X (4800)	3X (4200)	1
1400Y	2 (6000)	1400	4X (6400)	4X (5600)	3
1400Y	3 (8000)	1400	5X (8000)	6X (8400)	1
1400Y	4 (10000)	1400	6X (9600)	8X (11200)	1
1400Y	HI (12000)	1400	8X (12800)	8X (11200)	3
1600Y	LO (4000)	1600	3X (4800)	2X (3200)	3
1600Y	2 (6000)	1600	4X (6400)	4X (6400)	1
1600Y	3 (8000)	1600	5X (8000)	6X (9600)	1
1600Y	4 (10000)	1600	6X (9600)	6X (9600)	3
1600Y	HI (12000)	1600	8X (12800)	8X (12800)	1

NOTE:

/1 See MIL-DTL-17361/13 for complete details on available settings.

Preparing Activity:
Navy – SH
(Project 5925-N185-000)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://assist.daps.dla.mil.