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SUPERSEDING
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(See 6.9)

MILITARY SPECIFICATION

CIRCUIT BREAKERS, LOW VOLTAGE, ELECTRIC POWER, AIR, OPEN FRAME, REMOVABLE CONSTRUCTION

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 low voltage, electric power, air circuit breakers with open frame and removable construction, and their attachments, for shipboard use.

1.2 Classification. Circuit breakers shall be of the following types, as specified (see table I, 6.2.1 and 6.6).

ACB-900RC	ACB-2000HRC	ACB-3200HR
ACB-901R	ACB-2000RC	ACB-4000HR
ACB-902R	ACB-2002HRC	ACB-4001R
ACB-1600HRC	ACB-2601R	ACB-6400HR

Designation "C" is optional where shown.

1.2.1 Type designation. Circuit breaker type designations are as follows:

ACB - Denotes an open frame air circuit breaker.
XXXX - Three or four digit number which denotes the rated continuous current of the specific circuit breaker type. When the last number of the circuit breaker type is even (0, 2, 4, 6, 8) the application is for alternating current (a.c.) and when the last number is odd (1, 3, 5, 7, 9) the application is for direct current (d.c.). The final number is used to show a change in physical or electrical design of the same current rating.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

C - This suffix when used, indicates that the circuit breaker is designed for duty as a motor starter and has 3 overcurrent (OC) coils.

H - This suffix indicates that the circuit breaker has a rated a.c. short-circuit current greater than 50,000 amperes (A).

R - This suffix indicates that the circuit breaker is a drawout-mounted device, consisting of a removable component and a stationary component. The stationary component is mounted in an enclosure and the removable component can be withdrawn from the enclosure and stationary component for maintenance purposes.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-S-365	- Silver Plating, Electrodeposited: General Requirements For.
PPP-C-1842	- Cushioning Material, Plastic, Open Cell for Packaging Applications.

MILITARY

MIL-P-116	- Preservation, Methods of.
MIL-B-117	- Bags, Sleeves And Tubing - Interior Packaging.
MIL-S-901	- Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment And Systems, Requirements For (Navy).
MIL-C-915	- Cable And Cord Electrical, For Shipboard Use General Specifications For.
MIL-E-917	- Electric Power Equipment, Basic Requirements (Naval Shipboard Use).
MIL-L-3661	- Lampholders, Indicator Lights, Indicator-Light Housings, And Indicator-Light Lenses, General Specification For.
MIL-L-3661/54	- Lenses, Indicator Light, Style LC40.
MIL-L-3661/61	- Lampholder, Lights, Indicator (Housing), Style LH94.
MIL-L-3661/63	- Lampholder, Lights, Indicator (Housing), Style LH96.
MIL-P-15024	- Plates, Tags And Bands For Identification Of Equipment.
MIL-P-15024/5	- Plates, Identification.
MIL-M-15071	- Manuals, Technical: Equipments and Systems Content Requirements For.
MIL-S-16036	- Switchgear, Power, Naval Shipboard.
MIL-E-17555	- Electronic And Electrical Equipment, Accessories, And Repair Parts; Packaging And Packing Of.

MILITARY (Continued)

MIL-B-81705 - Barrier Materials, Flexible, Electrostatic-free, Heat Sealable.
MIL-P-81997 - Pouches, Cushioned, Flexible, Electrostatic-free, Reclosable, Transparent.

STANDARDS

MILITARY

MIL-STD-105 - Sampling Procedures And Tables For Inspection By Attributes.
MIL-STD-130 - Identification Marking of US Military Property.
MIL-STD-167-1 - Mechanical Vibrations Of Shipboard Equipment (Type I - Environmental And Type II - Internally Excited).
MIL-STD-1285 - Marking for Electrical and Electronic Parts.

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

C37.05 - Values of a Sinusoidal Current Wave and a Normal - Frequency Recovery Voltage for AC High-Voltage Circuit Breakers.
C37.50 - Low-Voltage AC Power Circuit Breakers Used in Enclosures, Test Procedures for.

(Application for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Qualification. Circuit breakers furnished under this specification shall be products which are qualified for listing on the applicable qualified product list at the time set for opening of bids (see 4.3 and 6.3).

3.2 General requirements.

3.2.1 Ungrounded circuits. Circuit breakers shall operate in ungrounded circuits.

3.2.2 Ambient temperature. Circuit breakers and attachments shall operate in an ambient temperature from 0 to 50 degrees Celsius (°C).

3.2.3 Parts. The following parts, when used with circuit breakers and attachments, shall be in accordance with the requirements of MIL-E-917:

Resistors and rheostats
Capacitors
Switches
Motors
Wire
Relays
Terminal boards
Terminal lugs
Semiconductor devices (other than integrated circuits)
Semiconductor integrated circuits

3.2.4 Interchangeability. The circuit breaker assembly, except for location of secondary wiring disconnecting devices shall be readily interchangeable within the same type regardless of the manufacturer (see figures 1 to 9). In no case shall parts be physically interchangeable or reversible unless such parts are also interchangeable or reversible with regard to function, performance and strength.

3.2.5 Safety. To ensure maximum personnel safety and to minimize equipment casualties, the safety requirements of MIL-E-917 shall be adhered to during the design and manufacture of the circuit breakers and their attachments.

3.3 Detail requirements. Unless otherwise specified herein, equipment shall conform to MIL-E-917. Components shall be free of mercury or mercury compounds, and materials shall be asbestos-free.

3.3.1 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.3.2 Ratings of circuit breakers. Circuit breakers and attachments shall conform to the requirements shown in table I, as specified (see 6.2.1).

TABLE I. General ratings of circuit breaker types and attachments.

CIRCUIT BREAKER TYPE:	ACB-	900R	901R	902R	1600HR	2000R	2000HR	2002HR	2601R	3200HR	4000HR	4001R	6400HR
Rated continuous current (See 6.5.15)	(amperes)	900	900	900	1,600	2,000	2,000	2,000	2,600	3,200	4,000	4,000	6,400
Rated maximum voltage[1/] and frequency	a.c.(volts) 60 hertz	500	--	500	500	500	500	500	--	500	500	--	500
	d.c.(volts)		355				--		355			355	--
Max interrupting rating rated symmetrical short-circuit current (amperes)	a.c.(see 6.5.14) 60 hertz	42,000	--	50,000	85,000	50,000	85,000	100,000	--	85,000	85,000	--	100,000
	d.c. (see 6.5.16)	--	50,000	--	--	--	--	--	75,000	--	--	150,000	--
Rated short-time current[2/] (amperes) (see 6.5.17)		25,000	25,000	25,000	50,000	50,000	50,000	100,000	50,000	85,000	85,000	100,000	100,000
Rated short-time current duration (seconds)		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.75	0.75	0.75	0.75
Operating mechanism[3/]	Manual	YES	YES	YES	--	YES	--	--	--	--	--	--	--
	Electric	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Dimensions	Figure no.	1	2	3	4	4	4	5	6	7	7	8	9
Number of poles		3	2	3	3	3	3	3	2	3	3	2	3
Number of overcurrent coils or solid-state sensors		2/3	2	2	2/3	2/3	2/3	2/3	2	2	2	2	3
Overcurrent coils and sensors	Table	IV	IV	IV,V,VI	IV	IV	IV	IV	IV	IV	IV	IV	IV
Time-current characteristics	Figure no.	10	10	10[4/]	10	10	10	13	10	10	10	14	13
	Time band no.	1,2,3	2	1,2,3,4	1,2,3	1,2,3	1,2,3	1,2,3,4	3	2,3,4	2,3,4	1,2,3,4	1,2,3,4

TABLE I. General ratings of circuit breaker types and attachments. - Continued

CIRCUIT BREAKER TYPE:	ACB-	900R	901R	902R	1600HR	2000R	2000HR	2002HR	2601R	3200HR	4000HR	4901R	6400HR
ATTACHMENTS													
Electric closing mechanism (see 3.4.2.2.3.2)		OPTION	OPTION	OPTION	STD	OPTION	STD	STD	STD	STD	STD	STD	STD
Auxiliary switches (see 3.4.2.9)	Number of contacts	8	6	10	8	8	8	12	8	8	8	12	12
Lockout device (see 3.4.2.14)		Optional for all circuit breaker types											
Mechanical position indicator (see 3.4.2.2.4)		Required for all circuit breaker types											
Secondary disconnecting devices (see 3.4.2.7)		Required for all circuit breaker types, unless otherwise specified (see 6.2.1)											
Bypass switch (see 3.4.2.10)		Optional for all circuit breaker types											
Indicator light (see 3.4.2.8)		Provisions for mounting required for all circuit breaker types; Furnished only when specified (see 6.2.1)											
Hold-closed mechanism (see 3.4.2.11)		Opt	Opt	Not Reqd	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Not Reqd	Not Reqd
Undervoltage trip device (see 3.4.2.12)		Optional for all circuit breaker types (see 6.2.1)											
Shunt trip device (see 3.4.2.13)		Required for electrically operated circuit breakers (see 3.4.2.2.3.2)											

(See footnotes at top of next page)

1/ Voltage ratings apply to main current-carrying parts. Operating attachments shall be of voltages specified in 6.2.1.
2/ Ampere values apply to circuit breakers with overcurrent coils or sensors of maximum current rating within the circuit breaker type.
3/ All electrically operated circuit breakers have provision for manual operation in abnormal conditions (see 3.4.2.2.3.2).
4/ When general purpose motor application is specified for circuit breaker type ACB-902R, figure 11 is applicable. When special purpose motor application is specified for circuit breaker type ACB-902R, figure 12 is applicable.

3.3.3 General examination. Circuit breakers and attachments shall pass the general examination of 4.6.1.

3.3.3.1 Creepage and clearance distances. Creepage and clearance distances shall be in accordance with MIL-E-917. Unless otherwise specified (see 6.2.1), set C spacings and enclosed type of enclosure apply. Mounting screws, fittings, handles, and adjusting knobs shall be considered ground potential.

3.3.4 Endurance. Circuit breakers and attachments shall be subjected to the mechanical and electrical endurance tests of 4.6.2 without failure, any evidence of measurable wear, or development of operating irregularities in any part.

3.3.5 Inclined operation. Circuit breakers and attachments shall operate satisfactorily, when subjected to the inclined operation tests of 4.6.3.

3.3.6 Short-time current duty cycle performance. Circuit breakers shall perform their short-time current duty cycle in accordance with the tests of 4.6.4 for the currents and durations shown in table I. They shall not exceed the temperature rise limits of table II during the tests, or after, while carrying rated continuous current. Circuit breakers shall pass the short-circuit current duty cycle performance tests of 4.6.5, after the short-time current duty cycle performance tests.

TABLE II. Temperature rise limits.

Parts	Maximum temperature rise above ambient (°C)	Maximum temperature with 50°C ambient (°C)
Insulation (see 3.4.1.3)		
Class A	65	105
Class B	80	130
Class F	105	155
Class H	130	180
Terminals 1/	70	120
Contacts	80	130
Conducting mechanical joints 1/	80	130

1/ The temperature rise of terminals and mechanical joints shall not exceed 85°C at the end of the 5 minute 150 percent rated current tests of 4.6.6.2.

3.3.7 Interrupting current duty cycle performance. Circuit breakers shall perform their short-circuit current duty cycle in accordance with the tests of 4.6.5, for the currents shown in table I. Circuit breakers shall be in the same mechanical condition after the tests as before the tests. After the tests, circuit breakers shall pass the dielectric withstanding voltage test of 4.6.9 and shall carry rated current at rated voltage, without exceeding 150 percent of the temperature rise values of table II.

3.3.8 Temperature rise performance. Temperature rises shall not exceed the values indicated in table II when circuit breakers and attachments are tested in accordance with 4.6.6 through 4.6.6.3. When a spraytight installation is specified (see 3.4.2.3 and 6.2.1), the maximum allowable ambient temperature shall be 90°C. Circuit breakers and attachments shall pass the insulation resistance test of 4.6.10, after the temperature rise test of 4.6.6.

3.3.8.1 Shunt trip auxiliary contacts temperature rise. The temperature rise of the auxiliary contacts for shunt trip devices shall not exceed the values listed in table II during or after the electrical endurance tests of 4.6.2.2.

3.3.9 Shock. Circuit breakers and attachments shall be subjected to the test specified in 4.6.7, and shall perform as specified in 4.6.7.1. If anti-shock devices are utilized, they shall not interfere with the specified performance of the overcurrent protective devices in the event of simultaneous shock and tripping action.

3.3.10 Vibration. Circuit breakers and attachments shall be subjected to the test specified in 4.6.8, and shall perform as specified in 4.6.8.1.

3.3.11 Dielectric withstanding voltage. With the exception of small motors and solid-state overcurrent trip devices, circuit breakers and attachments shall withstand for a period of 1 minute a 60 hertz (Hz) voltage of twice the normal voltage plus 1000 volts (V) when applied in accordance with the dielectric withstanding voltage tests of 4.6.9, prior to the interrupting current duty cycle performance test of 4.6.5. They shall also withstand 60 percent of the original test voltage when the dielectric withstanding voltage test of 4.6.9 is performed, subsequent to the interrupting current duty cycle performance test. The dielectric withstanding voltage for small motors shall be 900 V.

3.3.12 Insulation resistance. Insulation resistance shall be not less than 10 megohms. Circuit breakers and attachments shall be subjected to the test specified in 4.6.10 immediately after the tests of 4.6.5, 4.6.6, and 4.6.9.

3.3.13 Special tools. Special tools shall not be required for the removal of the circuit breakers from the front of its specified enclosure except for drawout wrench. When special tools are required for maintenance, the tools shall be supplied as specified (see 6.2.1).

3.4 Design and construction.

3.4.1 General design and construction.

3.4.1.1 Painting. Circuit breaker metal parts not having a corrosion resistant treatment, or not fabricated of corrosion resisting material of the types specified in MIL-E-917, shall be prepared and painted in accordance with MIL-E-917, with the exception 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.

3.4.1.2 Silver plating. Current-carrying connections shall be silver-plated in areas of current-carrying contact with lugs, terminals, bus ties, and screw bolts. Silver plating shall be in accordance with QQ-S-365, with the exception that the silver plate shall be not less than 0.0002 inch thick. The contact surfaces of all bus bars shall be silvered up to 1 inch past the joint area.

3.4.1.3 Insulation. Electrical insulation shall be a minimum of class B, in accordance with MIL-E-917, except that coils and wires may be minimum of class A, in accordance with MIL-E-917.

3.4.1.4 Contact replacement. All circuit breaker contacts shall be replaceable in the field.

3.4.1.5 Electrical arc enclosures. Electrical arc enclosures shall confine the arc to the enclosure under all specified operating conditions.

3.4.1.6 Insulated barriers. When specified (see 6.2.1), barriers of insulating material, in accordance with MIL-E-917, shall be provided to prevent arcing from the circuit breaker to the specified enclosure (see 3.4.2.3). The barriers shall be provided as a part of the circuit breaker.

3.4.1.7 Orientation of d.c. poles. When facing the front of d.c. circuit breakers, the left-hand pole shall be the negative pole and the right-hand pole shall be the positive pole.

3.4.2 Detail design and construction.

3.4.2.1 Drawout-mounted construction. Circuit breakers shall be of drawout-mounted construction, consisting of a removable element (see 6.5.18) and a stationary element (see 6.5.20).

3.4.2.1.1 Frame. Circuit breaker frames shall be of steel, open type structure, which provides accessibility for maintenance purposes, adjustment of devices, and necessary replacement of overcurrent protection devices in the field. Heating of the frame, due to stray magnetic fields, shall be kept to a minimum.

3.4.2.1.2 Alinement. Where necessary to preserve alinement, contacts, blocks, and similar parts shall be provided with suitable dowels.

3.4.2.1.3 Withdrawal interlock mechanism. Circuit breakers shall be provided with an interlock device which prevents the circuit breaker from being withdrawn or inserted in the closed position.

3.4.2.1.4 Test position. When specified (see 6.2.1), circuit breakers shall be provided with a test position in addition to the connected and withdrawn positions for its removable component. In the test position, the breaker shall operate manually or electrically without energizing the circuit breaker main contacts. Control circuitry shall remain energized.

3.4.2.2 Operating mechanisms (see 6.5.8).

3.4.2.2.1 Simultaneous operation. All poles of the circuit breaker shall be operated from a common shaft. Arcing contacts shall make contact before and break contact after the main contacts, when making and breaking the circuit.

3.4.2.2.2 Quick-break operation. The operating mechanism of circuit breakers shall be such that the arcing contacts are quick-break under all conditions of manual, electrical and automatic tripping.

3.4.2.2.3 Closing.

3.4.2.2.3.1 Manual closing. Unless otherwise specified (see 6.2.1), circuit breaker types with a rated short-circuit current of 50,000 A or less shall be provided with handles for manual operation. The handles shall be adaptable for dead-front, flush-mounted circuit breaker applications. The force necessary to manually operate the circuit breakers shall not exceed that which can be quickly and readily exerted by a human operator. When the handle is used to charge a closing spring, the position of the charging spring shall be readily discernible.

3.4.2.2.3.2 Electric closing. Circuit breakers with a rated short circuit capacity of 50,000 A or less when specified (see 6.2.1) and with a rated short circuit capacity over 50,000 A shall be electrically operated by means of electric closing devices. These devices may be a motor, solenoid, or stored energy system, which consists of a closing spring (see 6.5.4) or springs charged by an electric motor with an electrical or mechanical closing release (see 6.5.3). The closing device shall permit the main current-carrying contacts to close and carry the specified rated short-time current for the specified time duration (see table I). A repeated closing (pumping action) of the circuit breaker, when closing against a short-circuit (low voltage) condition, shall not be permitted. The closing time, with rated voltage applied, shall not exceed 0.1 second. All wiring and control devices necessary for electric operation, including rectifiers used to supply closing energy, shall be installed on the removable equipment of the circuit breaker. A transformer, when necessary for reducing a circuit breaker's control voltage, may be mounted on the rear of the stationary element of the circuit breaker or supplied loose for mounting in the circuit breaker's enclosure, as specified (see 6.2.1). Electrically operated circuit breakers shall be provided with means for manual maintenance closing and manual opening. A shunt trip device (see 3.4.2.13) shall be provided. A manual operating handle shall be provided for each circuit breaker or for a group of circuit breakers, as specified (see 6.2.1). The nominal control voltage and their ranges, when measured at the terminals of the operating motors or solenoids with full operating current, shall be as specified in table III.

TABLE III. Closing mechanism control voltages.

Direct current		Alternating current	
Nominal volts	Range (volts)	Nominal volts	Range (volts)
120	90 to 130	120	90 to 135
250	175 to 353	450	360 to 500

3.4.2.2.3.3 Circuit breakers with a stored-energy, spring-actuated closing mechanism shall also be provided with a means for slow closing of the main contacts for maintenance purposes, as well as an emergency manual closing under abnormal conditions. The mechanism to charge a stored energy system must be able to sustain an undervoltage condition for 15 seconds without sustaining damage or a need for realinement.

3.4.2.2.4 Mechanical position indicators. Circuit breakers shall be provided with mechanical indicators which show whether the main contacts of the circuit breaker are opened or closed. The indicators shall be plainly visible at a minimum angle of 45 degrees from either side of the indicator, when the circuit breaker is installed in its specified enclosure (see 3.4.2.3).

3.4.2.2.5 Trip-free. Circuit breakers shall be mechanically and electrically trip-free and trip-free in any position, under all conditions of operation.

3.4.2.3 Mounting and dimensions. Maximum outline and mounting dimensions for the circuit breaker types shall be as shown on figures 1 through 9, as applicable. When a MIL-S-16036 standardized switchgear unit or nonstandardized switchgear unit is specified as the enclosure for the circuit breakers (see 6.2.1), the circuit breakers shall be mounted and operated in the switchgear unit. Studs or tapped holes, retainer nuts or threaded inserts shall be provided in the rear of the stationary element as shown in figures 1 through 9 for blind bolting to the switchboard. Bolts shall be provided and shall resist a high impact mechanical shock test, in accordance with the requirements of MIL-S-16036.

3.4.2.4 Electrical connections. Circuit breakers shall be provided with connections on the back side for all cable, bus bar, and secondary wiring. Stud terminals or lug terminals connected to the circuit breaker shall not turn in a manner that will reduce electrical clearances.

3.4.2.5 Wiring. Each device for remote control of the circuit breakers mounted on the removable component of the circuit breaker shall be completely wired and connected to the secondary disconnecting devices. Wires shall be bundled and secured to the maximum extent possible, to prevent damage from vibration. Each wire more than 8 inches long and all wires combined in a bundle shall be marked on each end in compliance with MIL-S-16036.

3.4.2.6 Overcurrent protection. Circuit breakers shall be provided with overcurrent protection as specified (see 6.2.1). Overcurrent protection may be long-time delay (see 3.4.2.6.3), short-time delay (see 3.4.2.6.4), instantaneous (see 3.4.2.6.5), or any combination of these types.

3.4.2.6.1 Overcurrent trip devices. Overcurrent trip devices (see 6.5.10) shall be electromechanical or solid-state (see 1.2 and 6.2.1). All adjustable features shall be readily accessible and insulated for safety of operating personnel. Adjustable settings, other than for long-time delay devices, shall be sealed against tampering with the setting. Trip characteristics, in accordance with 3.4.2.6.3 through 3.4.2.6.5, shall be provided as specified (see 6.2.1).

3.4.2.6.2 Overcurrent coils and overcurrent sensors. Overcurrent coils or overcurrent sensors (see 6.5.12) shall be provided for the circuit breakers as specified (see 6.2.1), with ratings and pickup settings as shown in tables IV, V or VI, as applicable. For circuit breaker type ACB-902R general (table IV), general purpose motor (table V) or special purpose pump motor application (table VI), overcurrent coils shall be provided, as specified (see 6.2.1).

TABLE IV. General ratings and pickup current settings for overcurrent coils and sensors.

Type	Coil or sensor rating 1/	Long time delay setting			Short time delay setting						Maximum instantaneous trip 2/
	Amperes	Amperes			Amperes						Amperes
ACB-900R	320	500	640	840	---	640	840	960	1280	1600	6400
	400	640	840	960	720	800	960	1280	1800	2100	8000
	480	720	960	1280	---	960	1280	1600	2100	2800	9600
	560	840	1120	1400	---	1120	1400	1800	2400	3200	11200
	640	960	1280	1600	---	1280	1600	2100	2800	3600	12800
	800	1280	1600	2100	1200	1600	2100	2400	3200	4000	16000
	900	1320	1800	2340	---	1800	2500	2700	3600	4800	18000
ACB-901R	400	---	---	---	---	800	---	---	---	---	2400
	480	---	---	---	---	960	---	---	---	---	2400
	640	960	---	---	---	1280	---	---	---	---	3200
	900	1320	---	---	---	---	---	2100	---	5400	10000
	3/ 1200	---	---	---	---	---	---	---	---	6000	10000
ACB-902R 4/	100	160	200	250	---	200	250	320	400	500	2000
	160	250	320	400	240	320	400	500	720	840	2300
	250	400	500	640	570	500	640	840	1120	1400	5000
	320	500	640	840	---	640	840	960	1280	1600	6400
	400	640	840	960	---	800	960	1280	1800	2100	8000
	480	720	960	1280	720	960	1280	1600	2100	2800	9600
	560	840	1120	1400	---	1120	1400	1800	2400	3200	11200
	640	960	1280	1600	---	1280	1600	2100	2800	3600	12800
	800	1280	1600	2100	1200	1600	2100	2400	3200	4000	16000
	900	1320	1800	2340	---	1800	2500	2700	3600	4800	18000
ACB-2000R	320	500	640	840	---	640	840	960	1280	1600	6400
	400	640	840	960	---	800	960	1280	1800	2100	8000

See footnotes at end of table.

TABLE IV. General ratings and pickup current settings for overcurrent coils and sensors. - Continued

Type	Coil or sensor rating 1/	Long time delay setting			Short time delay setting						Maximum instantaneous trip 2/
	Amperes	Amperes			Amperes						Amperes
	480	720	960	1120	---	960	1280	1600	2100	2800	9600
ACB-1600HR	560	840	1120	1280	---	1120	1400	1800	2400	3200	11200
	640	960	1280	1600	---	1280	1600	2100	2800	3600	12800
	800	1280	1600	2100	1200	1600	2100	2400	3200	4000	16000
	1000	1600	2100	2400	---	2100	2400	3200	4000	4800	20000
ACB-2000R	1200	1800	2400	2800	1800	2400	2800	3600	4800	6000	24000
ACB-2000HR	1400	2100	2800	3600	---	2800	3200	3600	4800	6000	28000
	1600	2400	3200	4000	2400	3200	4000	4800	6000	8000	32000
ACB-2000RC	2000	3000	4000	5000	---	---	4000	6000	8000	10000	32000
ACB-2000HR	2000	3000	4000	5000	---	---	4000	6000	8000	10000	40000
	300	450	600	750	600	900	1200	1500	---	---	6000
	500	750	1000	1250	1000	1500	2000	2500	---	---	10000
ACB-2002HR	800	1200	1600	2000	1600	2400	3200	4000	---	---	16000
	1200	1800	2400	3000	2400	3600	4800	6000	---	---	24000
	1600	2400	3200	4000	3200	4800	6400	8000	---	---	32000
	2000	3000	4000	5000	4000	6000	8000	10000	---	---	40000
	1600	---	---	---	---	3200	---	---	---	---	8000
ACB-2601R	2600	---	---	---	4000	---	---	---	---	---	14000
	2600	---	---	---	---	---	---	---	10000	12000	22000
	2000	3200	4000	4800	---	4000	4800	6000	8000	---	40000
ACB-3200HR	2400	3600	4800	6000	---	4800	6000	8000	---	---	48000
	2800	4200	5600	6600	---	5600	7000	8400	---	---	56000
	3200	4800	6400	8000	---	6400	8000	9600	---	---	64000
ACB-4000R	4000	6000	8000	10000	---	8000	10000	12000	---	---	68000

See footnotes at end of table.

TABLE IV. General ratings and pickup current settings for overcurrent coils and sensors. - Continued

Type	Coil or sensor rating 1/	Long time delay setting			Short time delay setting						Maximum instantaneous trip 2/
	Amperes	Amperes			Amperes						Amperes
ACB-4001R	400	600	800	1000	800	1200	1600	2000	---	---	4000
	800	1200	1600	2000	1600	2400	3200	4000	---	---	8000
	1200	1800	2400	3000	2400	3600	4800	6000	---	---	12000
	2000	3000	4000	5000	4000	6000	8000	10000	---	---	20000
	4000	6000	8000	10000	8000	12000	16000	20000	---	---	40000
ACB-6400HR	4800	7200	9600	12000	9600	14400	19200	24000	---	---	60000
	5800	8700	11600	14500	11600	17400	23200	29000	---	---	68000
	6400	9600	12800	16000	12800	19200	25600	32000	---	---	68000

1/ Continuous current rating.
2/ The instantaneous trip device shall be capable of being set at the place of manufacture from five times the coil or sensor rating to the maximum pickup setting specified.
3/ Coil rating is special and in excess of the circuit breaker's rated continuous current. When specified, the temperature rise requirements (see 3.3.8) may exceed each limit of table II by 10°C.
4/ See tables V and VI for pickup current settings of overcurrent coils for circuit breaker type ACB-902R when general purpose motor or special purpose motor application is specified (see 3.4.2.6.2 and 6.2.1).

TABLE V. Coil ratings and pickup current settings for overcurrent coils for circuit breaker type ACB-902RC for general purpose motor application.

Coil rating	Adjustable long time delay settings				Short time delay settings				Instantaneous	
									Factory setting	Maximum setting 1/
Amperes	Amperes				Amperes				Amperes	Amperes
125	115	125	140	155	625	750	875	1000	1500	2100
150	135	150	170	185	750	900	1050	1200	1800	2100
200	180	200	225	250	1000	1200	1400	1600	2400	3200
225	200	225	255	280	1125	1350	1575	1800	2600	3200
300	270	300	340	375	1500	1800	2100	2400	3600	5000
350	315	350	395	435	1750	2100	2450	2800	4200	5000
500	450	500	565	625	2500	3000	3500	4000	6000	10000
600	540	600	675	750	3000	3600	4200	4800	7200	11200
900	---	900	985	1125	4500	5400	6300	7200	10800	18000

1/ The instantaneous trip device shall be capable of being set at the factory from five times coil rating to the maximum pickup setting specified.

TABLE VI. Coil ratings and pickup current settings for overcurrent coils for circuit breaker type ACB-902RC for special purpose motor application.

Coil rating	Adjustable long time delay settings				Short time delay settings			Instantaneous	
								Factory setting	Maximum setting 1/
Amperes	Amperes				Amperes			Amperes	Amperes
125	115	125	140	155	---	---	1000	2000	2100
250	250	280	300	320	890	950	1000	2/	5000
900	---	900	985	1125	---	3000	4000	6000	18000

1/ The instantaneous trip device shall be set at the factory from five times coil rating to the maximum pickup setting specified.
2/ 1500, 2800, 3000, 3600.

3.4.2.6.3 Long-time-delay trip element. The long-time-delay trip element shall have the following characteristics:

(a) The operating characteristics shall conform to figure 10, 11, 12, 13 or 14, as applicable to the circuit breaker type, at temperatures between 30 and 70°C. The characteristics apply for single-pole operation, for any two poles in series and for three poles in series.

(b) An adjustable pickup current setting, as specified (see 6.2.1), which is readily accessible and adjustable to values specified in table IV, V or VI, as applicable to the circuit breaker type, for each trip coil or sensor rating. The calibration points shall be marked on a scale in amperes. The maximum error for each calibration point shall not exceed plus or minus 10 percent.

3.4.2.6.4 Short-time-delay trip element. The short-time-delay trip element shall be direct-acting and shall function in accordance with predetermined characteristic time-current trip bands, each having a lower limit determined by the resettable delay time for that particular setting and an upper limit determined by the operating time, including the tolerance permitted in 3.4.2.6.4.1.

3.4.2.6.4.1 Short-time-delay pickup settings. Short-time-delay pickup current settings need not be readily adjustable, but shall be set at the place of manufacture to any of the settings specified in table IV, V or VI, as applicable to the circuit breaker type (see 6.2.1). The maximum error for any current setting shall not exceed plus or minus 10 percent.

3.4.2.6.4.2 Short-time-delay band settings. The operating time need not be readily adjustable, but provision shall be made for the short-time-delay band settings specified in table I. The operating characteristics shall conform to figure 10, 11, 12, 13 or 14, as applicable to the circuit breaker type, at temperatures between 30 and 70°C. The characteristics apply for single-pole operation, for any two poles in series and for three poles in series. Values of operating time and resettable delay shall not fall outside the predetermined short-time-delay band.

3.4.2.6.4.3 Short-time-delay band identification. The short-time-delay band identification number and name, in accordance with figure 10, 12, 13 or 14, as applicable to the circuit breaker type, shall be indicated on the identification plate of the short-time-delay trip element.

3.4.2.6.5 Instantaneous trip element. The instantaneous trip element shall trip the circuit breaker with no intentional time delay. The element may have a pickup current value which is not readily adjustable, but set at the place of manufacture, as specified (see 6.2.1), from five times the trip coil or sensor rating to the maximum instantaneous trip setting specified in table IV, V or VI, as applicable to the circuit breaker type, for each overcurrent coil or sensor rating. The pickup current value setting shall be accurate to within plus or minus 10 percent for settings up to 10 times the trip coil rating and plus or minus 20 percent for settings above 10 times the coil rating.

3.4.2.6.6 Overcurrent trip device operational checks.

3.4.2.6.6.1 Electromechanical overcurrent trip device. Electromechanical overcurrent trip devices shall be so arranged that when the removable component of the circuit breaker is in the withdrawn position, the device can be manually operated to trip the breaker.

3.4.2.6.6.2 Solid-state overcurrent trip device. Solid-state overcurrent trip devices shall have provisions for determining that the device is functioning and that no parts have failed. The devices shall have a power source which can be applied to check the overload calibrations and recalibrate.

3.4.2.7 Secondary disconnecting devices. Unless otherwise specified (see 6.2.1), each manually operated circuit breaker shall be furnished with a secondary disconnecting device consisting of a minimum of seven contacts. Each electrically operated circuit breaker shall be furnished with a secondary disconnecting device consisting of a minimum of 21 contacts. Each contact shall consist of a stationary and movable component and each component shall be provided with a screw-type terminal for fastening of the control wiring. All parts of the circuit breaker which require connection to external wiring shall be connected to the secondary disconnecting devices of the circuit breaker.

3.4.2.7.1 Location and rating. Connections for external wiring to the secondary disconnecting device shall be located on the back of the circuit breaker. The screw terminals shall be readily accessible for making the wiring connections or for maintenance inspection. The wiring connections for ACB-902 shall be accessible from the front. Each contact shall have a rated continuous current of 15 A and a rated short-time current of 250 A for 3 seconds. The contacts shall have a voltage rating of 500 V for a.c. circuit breakers and 250 V for d.c. circuit breakers.

3.4.2.8 Indicator light. Unless otherwise specified (see 6.2.1), circuit breaker face plates shall have provisions for the mounting of one indicator light in ACB-902R and two lights, type LH94/4 of MIL-L-3661/61 for a.c. circuit breakers or type LH96/6 of MIL-L-3661/63 for d.c. circuit breakers. The indicator light shall be provided only when specified (see 6.2.1), with a lens style LC40 of MIL-L-3661/54. Lens coloring shall be as specified (see 6.2.1).

3.4.2.9 Auxiliary switches. Unless otherwise specified (see 6.2.1), circuit breakers shall be provided with an auxiliary switch having the minimum sets of contacts shown in table I. The sets of contacts shall consist of an equal number of "a" and "b" stages.

3.4.2.9.1 Location and contacts. The auxiliary switch shall be mounted for access from the front of the circuit breaker and shall be so arranged that the switch cover or complete switch can be removed within the width of the circuit breaker base. Each stage of the auxiliary switch shall be a complete pole and convertible to either an "a" or "b" contact. Auxiliary switches shall have a minimum rated continuous current of 15 A and a rated voltage of 500 V for a.c. circuit breakers and 250 V for d.c. circuit breakers. Auxiliary switches shall interrupt the current specified in table VII. These switches shall pass the tests of 4.6.2 and 4.6.5 without requiring realinement or replacement.

TABLE VII. Interrupting current ratings for auxiliary switches.

Rated volts	Non-inductive (amperes)	Inductive 1/ (amperes)
120 d.c.	11	6.25
250 d.c.	2	1.75
115 a.c.	75	15.00
450 a.c.	25	5.00

1/ The inductance represents the circuit breaker shunt trip coil and shall be used for test purposes (see 4.6.18).

3.4.2.10 By-pass switch. Normally closed limit switches shall be mounted on the stationary component or stationary secondary disconnect and have a conductive rating equal to the interrupting rating of table VII, and be readily wired to the stationary terminals of the secondary disconnect. These switches shall pass the tests for auxiliary switches without the need for alinement or replacement. The switch shall activate between the test position of the circuit breaker and the disconnect point of the secondary disconnects. The switches shall only be furnished when specified (see 6.2.1).

3.4.2.11 Hold-closed mechanism. Circuit breakers shall have provisions for the installation of a hold-closed mechanism (see 6.5.6). The hold-closed mechanism shall be provided only when specified (see 6.2.1).

3.4.2.12 Undervoltage trip device. When specified (see 6.2.1), an undervoltage trip device shall be provided. The device shall be simple and compact without intentional time delay in tripping and shall be connected to either the line or load terminals, as specified (see 6.2.1). The device shall have a continuous duty rating and shall operate directly on the trip mechanism of the circuit breaker. The nominal voltages and operating voltage ranges shall be as specified in table VIII (see 6.2.1). The specified pickup voltages shall apply to a cold coil (approximately 25°C).

TABLE VIII. Voltages for undervoltage trip devices.

Nominal voltage	Operating voltage range	Pickup volts (maximum)	Dropout voltage range
250 d.c.	175 to 355	175	100 to 25
450 a.c.	360 to 500	360	290 to 45
120 a.c.	90 to 135	90	Above 15

3.4.2.12.1 Automatic reset. The device shall automatically reset; after it has dropped out and tripped the circuit breaker on reduced voltage, it shall reset automatically on restoration of voltage to the pickup level. The reset may be electrical or mechanical by circuit breaker action.

3.4.2.12.2 Protection of the device. When the device is mounted in the open, at the front of the circuit breaker, the device and connecting wires shall be fully insulated without exposed terminals and connections. The word "DANGER" shall be marked in red on the device.

3.4.2.13 Shunt trip device. When specified (see 6.2.1), a shunt trip device shall be provided. The device shall be simple and compact and shall have remote control. Devices shall be available for tripping from either an a.c. or d.c. voltage source, and in some instances, both may be required on the same breaker, when specified (see 6.2.1). The nominal voltages and their operating ranges shall be as specified in table IX (see 6.2.1).

TABLE IX. Voltages for shunt trip devices.

Direct current		Alternating current	
Nominal voltage	Operating voltage range	Nominal voltage	Operating voltage range
1/ 20S	25 to 180	115	80 to 130
120	70 to 140	450	360 to 500
250	175 to 355		

1/ For use on circuit breakers to be tripped from variable voltage exciters. Unless otherwise specified (see 6.2.1), the tripping current shall not exceed 30 A at the maximum voltage.

3.4.2.14 Undervoltage lockout device. When specified (see 6.2.1), the undervoltage lockout device shall be capable of continuous energization. When energized the lockout device shall not affect the circuit breaker operation. The lockout device shall not trip a closed circuit breaker. It will prohibit closing of an open circuit breaker when deenergized.

3.5 Designation and marking. 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-P-15024 and MIL-P-15024/5. Plates shall be installed on and furnished as part of the circuit breaker. Plates shall be attached to the part of the circuit breaker which will not ordinarily be renewed during normal service life, and be located in a readily accessible position where they can be read at all times without danger to personnel.

3.5.1 Markings for attachments and small components. Markings for attachments and small components shall be in accordance with MIL-STD-1285.

3.5.2 Identification plates. The data marked on identification plates shall include the following:

Data	On removable element	On components 1/
Nomenclature of the item	x	x
Manufacturer's name and catalog number	x	x
Manufacturer's type	x	x
Year of manufacture	x	
Manufacturer's serial number	x	
Navy circuit breaker type designation	x	
Rated voltage and frequency	x	x
Number of poles	x	
Current rating(s)	x	x
Calibration		x
National stock number	x	x
Blank space for Government inspector's stamp	x	x

1/ Components include attachments and other circuit breaker parts, such as auxiliary switches, overcurrent protection devices, shunt trip devices, undervoltage trip devices, relays, closing motors and solenoids, and rectifiers.

3.5.3 Warning plate. Circuit breakers shall be provided with a plate to warn that if the power source is connected to the circuit breaker bottom studs, most of the current-carrying parts are alive, even though the circuit breaker is in the open position. The word "WARNING" shall be in prominent red letters. The warning plate shall be located where it can be easily read by an operator.

3.5.4 Information plate. An information plate containing instructions for positioning of the circuit breaker in the test position, shall be provided where applicable (see 3.4.2.1.4).

3.6 Technical data. The contractor shall prepare drawings, certification data sheets, and technical manuals in accordance with the data ordering documents included in the contract (see 6.2.2, 6.2.2.1, 6.2.2.2, and 6.2.2.3).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Inspection system. The contractor shall establish and maintain an inspection system program plan in accordance with the data ordering document included in the contract or order (see 6.2.2).

4.2 Classification of inspection. Inspections requirements specified herein are classified as follows:

(a) Qualification inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 Qualification inspection. Qualification inspection shall be conducted at a laboratory satisfactory to the Naval Sea Systems Command (NAVSEA) (see 6.3), on sample units produced with equipment and procedures used in production. Qualification shall consist of the examination and tests of table XI for circuit breakers and table XII for the attachments.

4.3.1 Sample size. One circuit breaker of each type, in accordance with table X, shall be subjected to qualification inspection. Long-time-delay, short-time-delay, and instantaneous overcurrent trip devices shall be provided for each test sample. Each test sample shall include one attachment of each type and rating.

4.3.2 Authorization for qualification tests. Prior to authorization of qualification tests, two copies of the drawings specified in 3.6 shall be submitted to NAVSEA for review.

TABLE X. Circuit breaker test samples.

Number of sample units	Applicable sample note	ACB-900R	ACB-901R	ACB-902R	ACB-2000HR ACB-1600HR	ACB-2000R	ACB-2002HR	ACB-2601R	ACB-3200HR	ACB-4000HR	ACB-4001R	ACB-6400HR
1	1	x		x		x						
1	2				x							
1	3								x	x		
1	4		x					x				
1	5										x	
1	6						x					x

Sample note 1 - A.c., electrically operated circuit breaker, 3-pole, with maximum trip coil rating, having the short-time-delay element set at maximum time band (no. 1), the pickup set at the standard setting which most closely approximates 400 percent of trip coil rating, and with the instantaneous trip set at the maximum pickup.

Sample note 2 - Same as sample note 1, except minimum time band (no. 3).

Sample note 3 - Same as sample note 1, except special maximum time band (no. 4).

Sample note 4 - D.c., electrically operated circuit breaker, 2-pole, with maximum trip coil rating, having the short-time-delay element set at minimum time band (no. 3), the pickup set at the standard setting which most closely approximates 400 percent of the trip coil rating, and with the instantaneous trip set at the maximum pickup.

Sample note 5 - A.c., electrically operated circuit breaker, 3-pole, with maximum sensor rating, having the short-time-delay element set at minimum time band (no. 1), the pickup set at the standard setting which most closely approximates 4 times the sensor rating, and with the instantaneous trip set at the maximum pickup.

Sample note 6 - A.c., electrically operated circuit breaker, 3-pole, with maximum trip coil rating, having the short-time-delay element set at maximum time band (no. 4), the pickup set at the standard setting which most closely approximates 400 percent of trip coil rating, and with the instantaneous trip set at the maximum pickup.

4.3.2 Inspection routine. Circuit breakers shall be subjected to the inspections specified in table XI. Attachments shall be subjected to the inspections specified in table XII. Tests may be in any convenient order except as otherwise noted.

TABLE XI. Qualification inspection of circuit breakers.

Inspection	Requirement paragraph	Test method paragraph
General examination	3.3.3	4.6.1
Endurance	3.3.4	4.6.2
Inclined operation	3.3.5	4.6.3
Short-time current duty cycle performance	3.3.6	4.6.4
Interrupting current duty cycle performance	3.3.7	4.6.5
Temperature rise	3.3.8	4.6.6, 4.6.6.2
Shock	3.3.9	4.6.7
Vibration	3.3.10	4.6.8
Dielectric withstanding voltage	3.3.11	4.6.9
Insulation resistance	3.3.12	4.6.10
Test position	3.4.2.1.4	4.6.11
Trip-free operation	3.4.2.2.5	4.6.12
Calibration of overcurrent trip devices	3.4.2.6	4.6.13

TABLE XII. Qualification inspection of attachments.

Inspection	Requirement paragraph	Lockout mechanism	Electric closing mechanism	Mechanical position indicator	Secondary disconnecting device	Indicator light	Auxiliary switches	Hold-closed mechanism	Undervoltage trip device	Shunt trip device
General examination	3.3.3	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1
Endurance	3.3.4	-	4.6.7	4.6.7	-	-	4.6.7	-	4.6.20	4.6.21
Inclined operation	3.3.5	4.6.3	4.6.3	-	4.6.3	4.6.3	4.6.3	4.6.3	4.6.3	4.6.3
Temperature rise	3.3.8	4.6.6	4.6.6	-	4.6.6	4.6.6	4.6.6	-	4.6.6	4.6.6
Shock	3.3.9	4.6.7	4.6.7	4.6.7	4.6.7	4.6.7	4.6.7	4.6.7	4.6.7	4.6.7
Vibration	3.3.10	4.6.8	4.6.8	4.6.8	4.6.8	4.6.8	4.6.8	4.6.8	4.6.8	4.6.8
Dielectric withstanding voltage	3.3.11	4.6.9	4.6.9	-	4.6.9	4.6.9	4.6.9	4.6.9	4.6.9	4.6.9
Insulation resistance	3.3.12	4.6.10	4.6.10	-	4.6.10	4.6.10	4.6.10	4.6.10	4.6.10	4.6.10
Operation	1/	4.6.14	4.6.15	-	4.6.16	4.6.17	4.6.18	4.6.19	4.6.20	4.6.21
Interrupting performance	3.4.2.9	-	-	-	-	-	4.6.18	-	-	-
Voltage range	2/	-	4.6.15	-	-	-	4.6.18	-	4.6.20	4.6.21
Closing time	3.4.2.2.3.2	-	4.6.15	-	-	-	-	-	-	-

1/ Refer to requirement paragraphs listed in table I.
2/ Table III for electric closing mechanism; 3.4.2.9.1 for auxiliary switches; table VIII for undervoltage trip device and table IX for shunt trip device.

4.3.3 Failures. One or more failures shall be cause for refusal to grant qualification approval.

4.4 Quality conformance inspection.

4.4.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspection of 4.4.1.2 and 4.4.1.3.

4.4.1.1 Inspection lot. An inspection lot shall consist of all circuit breakers and attachments of the same type, design, voltage, frequency, and current rating, produced under the same conditions, and offered for inspection at one time.

4.4.1.2 Group A inspection. Group A inspection shall consist of the general examination test specified in 4.6.1.

4.4.1.2.1 Sampling plan. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II. The acceptable quality level (AQL) shall be 1.5.

4.4.1.2.2 Rejected lots. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected. Such lots shall be separate from new lots and shall be clearly identified as reinspected lots.

4.4.1.3 Group B inspection. Group B inspection shall consist of the inspections specified in table XIII, in the order shown, and shall be made on sample units which have been subjected to and have passed the group A inspection.

TABLE XIII. Group B inspection.

Item	Inspection	Requirement paragraph	Test method paragraph
Circuit breakers	Dielectric withstanding voltage	3.3.11	4.6.9
	Calibration of overcurrent trip devices	3.4.2.6	4.6.13
Lockout mechanism Electric closing mechanism Secondary disconnecting devices Indicator light Auxiliary switches Hold-closed mechanism Undervoltage trip device Shunt trip device	Dielectric withstanding voltage	3.3.11	4.6.9
Electric closing mechanism Auxiliary switches Undervoltage trip device Shunt trip device	Voltage range	1/	4.6.15 4.6.18 4.6.20 4.6.21

1/ See note 2 of table XII.

4.4.1.3.1 Sampling plan. Samples subjected to group A inspection shall be subjected to group B inspection.

4.4.1.3.2 Failures. If one or more sample units fail to pass group B inspection, the sample shall be considered to have failed and the entire lot shall be rejected.

4.4.1.3.3 Rejected lots. If an inspection lot is rejected, the contractor may rework it to correct the defect, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.5 Inspection of packaging. Sample packages and packs and the inspection of the preservation-packaging, packing, and marking for shipment and storage shall be in accordance with the preparation for delivery requirements of the documents specified in the contract.

4.6 Test procedures.

4.6.1 General examination. Circuit breakers and attachments shall be subjected to a thorough examination to determine that the material, workmanship, safety to operating personnel, design, and construction are in conformance with this specification and the applicable drawings. The examination shall be conducted using the classifications of defects in table XIV, for guidance.

TABLE XIV. Classifications of defects for general examination.

Categories	Defects	Applicable paragraph
Critical		
1	Creepage and clearance distances not as specified.	3.3.3.1
2	Insulation not as specified.	3.4.1.3
3	Arc enclosures not adequate.	3.4.1.5
4	Insulated barriers not as specified.	3.4.1.6
5	Orientation of d.c. circuit breaker poles not as specified.	3.4.1.7
6	Electrical connections not as specified.	3.4.2.4
Major		
101	Silver plating not as specified.	3.4.1.2
102	Contacts not readily replaceable.	3.4.1.4
103	Circuit breaker frame not as specified.	3.4.2.1.1
104	Alinement not as specified.	3.4.2.1.2

TABLE XIV. Classifications of defects for general examination. - Continued

Categories	Defects	Applicable paragraph
Major		
105	Manual handle not adaptable for dead-front, flush-mounted circuit breaker application.	3.4.2.2.3.1
106	All electric closing devices not mounted on the removable element of the circuit breaker; control transformer located not as specified.	3.4.2.2.3.2
107	Shunt trip device not provided for an electrically operated circuit breaker.	3.4.2.2.3.2
108	Manual operating handles not provided as specified for electrically operated circuit breakers.	3.4.2.2.3.2
109	Mechanical position indicator not provided.	3.4.2.2.4
110	Outline and mounting dimensions not as specified.	3.4.2.3
111	Wiring not as specified.	3.4.2.5
112	Devices for overcurrent protection are not provided as specified.	3.4.2.6
113	Secondary disconnecting devices not provided as specified.	3.4.2.7
114	Provisions for indicator light or indicator light not furnished as specified.	3.4.2.8
115	Auxiliary switches not provided as specified.	3.4.2.9
116	By-pass switches not provided as specified.	3.4.2.10
117	Provisions for hold-closed mechanism or hold-closed mechanism not furnished as specified.	3.4.2.11
118	Undervoltage trip not provided as specified.	3.4.2.12
119	Shunt trip not provided as specified.	3.4.2.13
120	Undervoltage lockout device not provided as specified.	3.4.2.14
Minor		
201	Designation and marking not as specified.	3.5
202	Special tools required to remove the circuit breaker from the front of its enclosure.	3.3.13
203	Painting not as specified.	3.4.1.1

4.6.2 Endurance. Circuit breakers shall be subjected to the endurance tests of 4.6.2.1 and 4.6.2.2 under the following standard conditions:

(a) Mechanical endurance test - no power applied to the circuit breaker primary studs, close-open operation shall be accomplished by the manual operating mechanism on all circuit breakers.
(b) Electrical endurance test - power applied to the circuit breakers, at rated voltage and current, as specified in table XV.

At the completion of each endurance test, the circuit breakers shall be closely examined to identify any evidence of measurable wear or development of operating irregularities in any part.

TABLE XV. Circuit breaker electrical endurance test cycles of operation.

Circuit breaker type	Total number of close-open cycles	Amperes circuit breaker close	Amperes on circuit breaker open	Maximum a.c. power factor (lagging) or d.c. time constant (X/R)
ACB-900R	4,000	900	900	1/
ACB-900RC	10,000	6,000	900	1/
ACB-901R	4,000	900	900	0.02 to 0.06
ACB-902R	25,000	5,400	900	1/
ACB-1600HR	1,000	8,000	1,600	1/
ACB-1600HRC	10,000	8,000	1,600	1/
ACB-2000R	1,000	2,000	2,000	1/
ACB-2000RC & HRC	10,000	8,000	2,000	1/
ACB-2002HRC	10,000	8,000	2,000	1/
ACB-2601R	1,000	2,600	2,600	0.02 to 0.06
ACB-3200HR	1,000	3,200	3,200	0.8
ACB-4000HR	1,000	4,000	4,000	0.8
ACB-4001R	4,000	4,000	4,000	0.02 to 0.06
ACB-6400HR	1,000	6,400	6,400	0.8

1/ The lagging power factor for circuit breaker close shall be 0.25 maximum and for circuit breaker open shall be 0.80 maximum.

4.6.2.1 Mechanical endurance test. Circuit breakers shall be operated at any convenient speed of operation for at least 1,000 close-open operation cycles.

4.6.2.2 Electrical endurance test. Circuit breaker types rated up to 1,600 A shall be operated four times a minute for 10 minutes, in accordance with 4.6.2 and table XV. Circuit breaker types rated above 1,600 A shall be operated three times a minute for 10 minutes in accordance with 4.6.2 and table XV. The circuit breakers shall be electrically operated when an electric operator is provided. The remainder of the tests for all circuit breaker types shall be conducted at no less than one close-open operation every 2 minutes. When more than one auxiliary trip device is provided, the tripping shall be equally divided among the devices.

4.6.2.3 Endurance test sequence. The endurance test shall proceed all other operational tests except the operational tests may be included in the total count of the endurance test.

4.6.3 Inclined operation. Circuit breakers and attachments shall be subjected to an inclined operation test. The test shall be conducted with the circuit breaker inclined forward, backward, and to each side, at an angle of 30 degrees from the vertical position. The circuit breaker shall carry its rated continuous current when inclined in each of the four directions. The following values shall be determined when the circuit breaker is inclined in each of the four directions, in accordance with the tests for calibration of overcurrent trip devices (see 4.6.13):

(a) Each overcurrent trip element pickup current setting.
(b) Operating time of the long-time-delay element at 150 percent of pickup current.
(c) Operating time of the short-time-delay element at 250 percent of pickup current.

All specified attachments shall be operated when the circuit breaker is inclined in each of the four directions.

4.6.4 Short-time duty cycle performance. Circuit breakers shall be subjected to their rated short-time current, as shown in table I, at rated voltage, for a period of current flow with time duration as shown in table I. Temperature rise shall be measured during the test and the circuit breakers shall be subjected to the temperature rise test of 4.6.6, after this test. The short-circuit duty cycle performance tests of 4.6.5 shall be conducted after the short-time duty cycle performance test.

4.6.4.1 Short-time current characteristics. The short-time current is expressed in root mean square (rms) symmetrical A and is measured from the envelope of the available current wave at 0.5 cycles after current is established. For three-phase circuits, the symmetrical current value shall be the average of the phase currents. Circuit breakers shall perform their short-time current duty cycle with all degrees of current asymmetry produced by three-phase circuits, having a short-circuit lagging power factor of 0.15 or greater (X/R ratio of 6.6 or less).

4.6.4.2 Short-time current a.c. test circuit. A.c. test circuits shall be in accordance with the test circuits for the interrupting duty cycle performance tests (see 4.6.5).

4.6.4.3 Short-time current d.c. test circuit. D.c. circuit breakers may be tested for the required short-time current on an a.c. circuit in which the peak currents do not exceed the specified level of short-time current.

4.6.5 Interrupting current duty cycle performance. Circuit breakers shall be subjected to their rated short-circuit current, as shown in table I, at rated voltage, in accordance with the duty cycle of 4.6.5.1. Temperature rise shall be measured after the test in accordance with 4.6.6. Circuit breakers shall be subjected to the dielectric withstanding voltage test of 4.6.9 following the test. No repairs or replacement of parts shall be required after the test for the circuit breakers to perform as specified.

4.6.5.1 Interrupting current duty cycle. The short-circuit current duty cycle of circuit breakers with instantaneous overcurrent trip elements, shall consist of an opening operation, followed by a 2-minute interval, then by a close-open operation and after a 5-minute interval, by another close-open operation.

4.6.5.2 Interrupting current characteristics. The short-circuit current is expressed in rms symmetrical amperes and is measured from the envelope of the available current wave at 0.5 cycle after current is established. For three-phase circuits, the symmetrical current value shall be the average of the phase currents. Circuit breakers shall perform their short-circuit current duty cycle with all degrees of current asymmetry produced by three-phase circuits, having a short-circuit power factor of 0.15 lagging or greater (X/R ratio of 6.6 or less). The rms symmetrical current that verifies the short-circuit and short-time (see 4.6.4) current rating shall be calculated in accordance with ANSI C37.05.

4.6.5.3 Interrupting current a.c. test circuit. A.c. test circuit and test procedures shall be in accordance with the requirements of ANSI C37.50, as modified by the requirements of this specification.

4.6.5.4 Interrupting current d.c. test circuit. In d.c. test circuits, the test shall be performed on a one-pole basis. The current measured shall be the maximum value. The test circuit shall be so adjusted that the initial rate of current rise is within the limits of 2,000,000 and 3,000,000 A per second.

4.6.6 Temperature rise. Circuit breakers and attachments shall be operated in their specified enclosures (see 3.4.2.3) at maximum rated continuous current on all main contacts, overcurrent coils and auxiliaries which can be energized continuously until a constant temperature is reached. Enclosure provisions of the circuit breaker and attachment shall be as specified (see 6.2.1). If no enclosures are specified, test enclosures simulating the minimum volume compartment of a MIL-S-16036 standardized switchgear unit shall be used. The observed temperature rises shall not exceed the values specified in 3.3.8. The following test conditions shall be observed:

(a) Temperature rises shall be determined by thermocouples and thermometers. The bulbs shall be placed in such a position that they make the maximum practicable contact with the parts whose temperature is to be measured, and shall be attached in accordance with ANSI C37.50. Temperature of auxiliary contacts and switches do not require monitoring.
(b) Circuit breaker enclosures shall be protected from drafts and from abnormal heat convection by a shield, if necessary.
(c) Copper 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 table XVI. The copper cross-section of the leads shall remain constant for at least 3 feet from each stud on the circuit breaker.
(d) Temperature rise shall be recorded at the hottest point where the current-carrying part is in touch with insulating material. All coils shall be measured by the resistance method.

Circuit breakers shall pass the insulation resistance test of 4.6.10, after the temperature rise test.

TABLE XVI. Sizes of cables and bus bars for making temperature rise test.

Circuit breaker type	Continuous current rating (amperes)	Cable quantity per terminal	Cable size 1/	Bus bar quantity per phase	Bus bar size (inches) 2/
ACB-900RC	900	3	300 MCM	1	2.5 x 1/4
ACB-901R	900	3	300 MCM	1	2.5 x 1/4
ACB-902R	900	3/3	300 MCM	2	1.5 x 1/4
ACB-1600HRC	1600	4	400 MCM	2	3.0 x 1/4
ACB-2000HRC	2000	5	400 MCM	2	4.0 x 1/4
ACB-2000RC	2000	5	400 MCM	2	4.0 x 1/4
ACB-2002HRC	2000	5	400 MCM	2	4.0 x 1/4
ACB-2601R	2600	3/7	400 MCM	3	3.0 x 1/4
ACB-3200HR	3200	8	400 MCM	2	6.0 x 1/4
ACB-4000HR	4000	3/10	400 MCM	4	6.0 x 1/4
ACB-4001R	4000	3/10	400 MCM	4	6.0 x 1/4
ACB-6400HR	6400	3/16	400 MCM	4	8.0 x 1/4

1/ Information regarding cable is contained in MIL-C-915. Cable shall be stripped 2 feet or less.
2/ Information regarding bus bars is contained in MIL-S-16036.
3/ Connect with bus adapter of minimum length possible.

4.6.6.1 Duration of test. The continuous-current test shall be performed for such a period of time that the temperature rise of the terminals of the test enclosure will not have increased by more than 1.0°C during each of two successive 30-minute intervals as indicated by three successive readings. If the temperature rise at the end of the second interval is equal to the established limits, and if the temperature rise has increased since the previous reading, the test shall be continued.

4.6.6.2 Temperature rise above rated current. Immediately following the temperature rise test, rated continuous current of the circuit breakers (see 4.6.5), an additional test of 5 minutes duration shall be conducted with the current increased to 150 percent on all main contacts and spare auxiliary contacts. At the end of this test the temperature rise of the hottest terminal shall not exceed the value in 3.3.8.

4.6.6.3 Auxiliary devices temperature rise. The temperature rise of the auxiliary devices shall be observed during the electrical endurance test of 4.6.2.

4.6.7 Shock. The circuit breakers with attachments shall be mounted in the bottom compartment of the switchgear unit as specified in 3.4.2.3, (see 6.2.1) and shall withstand the grade A, type I shock requirements of MIL-S-901. Circuit breakers shall be tested in the closed position, while carrying their rated continuous current, and retested in the open position. All attachments shall be energized to simulate actual operating conditions. A separate test sample may be submitted, or the circuit breaker repaired and recalibrated, prior to the submission for retest in the open position. Circuit breaker automatic overcurrent trip devices shall be actuated during a maximum blow on the shock machine, in order to ensure that the specified trip performance is achieved. After the shock tests, circuit breakers shall be checked at several calibration points to determine that the calibration falls within the limits of the specified time bands.

4.6.7.1 Performance under shock tests. When subjected to the H.I. shock tests of 4.6.7, the circuit breaker:

(a) Shall not open when closed.
(b) Shall not close when open.
(c) Shall continuously perform its intended functions with no more than minor adjustments. The calibration shall remain within the specified limits.

Momentary opening of main and auxiliary contacts of not more than 0.02 second is acceptable. No closing of contacts from the open position shall be accepted. A recording oscillograph, or similar instrument, shall be utilized to check the operation of the circuit breaker under shock. Vibration test shall follow this test.

4.6.8 Vibration. Circuit breakers with attachments shall be mounted as specified in 4.6.7, and shall be subjected to type I vibration tests of MIL-STD-167-1. The switchgear unit shall be supported at each corner near the top of the circuit breaker compartment, by a 0.375-inch by 4-inch iron angle brace, extending diagonally on a 30 degree angle to the platform of the vibration machine. The tests shall be performed with the circuit breakers in the open position and repeated with the circuit breakers in the closed position. During the closed-position test, the circuit breakers shall carry their rated continuous current. Attachments shall be energized during all tests, to simulate actual operating performance.

4.6.8.1 Performance under the vibration tests. The items listed in 4.6.7.1 and applicable to shock tests are also applicable to the vibration tests, with the exception that no contact opening or chatter shall be accepted during the tests.

4.6.9 Dielectric withstanding voltage. Dielectric withstanding voltage tests of circuit breakers and attachments shall be made in accordance with MIL-E-917, except as modified by this specification. Test voltages shall be as specified in 3.3.11. Semiconductors shall be shorted during this test. Points of application of test voltages shall be as follows:

(a) Circuit breakers open - between live parts and metal parts, which are considered ground potential; between line and load terminals.
(b) Circuit breakers closed - between live parts and metal parts, which are considered ground potential; between terminals of opposite polarity.

4.6.10 Insulation resistance. Insulation resistance of circuit breakers and attachments shall be measured with a 500 V test potential, in accordance with MIL-E-917. The insulation resistance shall be measured between poles, and between poles and ground, when the circuit breakers are closed, and from line to load terminals of each pole when the circuit breakers are open.

4.6.11 Test position. When circuit breakers are provided with a test position (see 3.4.2.1.4 and 6.2.1), the circuit breakers shall be placed in the test position and operated manually and electrically, as specified for the circuit breaker type (see 6.2.1). No energization of the main contacts shall be observed. Control circuitry shall be operated to verify energization.

4.6.12 Trip-free operation. Circuit breakers shall be opened manually (when manual operation is specified) and electrically while the electric closing operations are being performed, to ensure that the circuit breakers are trip-free in all positions. This shall be done once each at start, mid and end of closing cycles. The anti-pump feature shall be checked at this time.

4.6.13 Calibration of overcurrent trip devices. Tests for the calibration of overcurrent trip devices shall be made to determine that the trip devices are in accordance with 3.4.2.6. The short-time delay and instantaneous portions of the trip characteristics shall be determined by suddenly applied symmetrical currents. The tests shall determine the calibration on the basis of any one pole and two poles in series, and three poles in series when three overcurrent coils are furnished.

4.6.13.1 Solid-state overcurrent trip devices. Solid-state overcurrent trip devices may be tested with the circuit breakers blocked in the closed position. Timing shall be measured from the time when the pickup current level is reached to the activation of the circuit breaker trip device. Actual impacting of the main contact latch of the circuit breaker, by activation of the circuit breaker trip device, shall be observed.

4.6.13.2 Time-current trip characteristics. Circuit breakers for qualification inspection shall be tested to obtain the following:

(a) Time delayed trip elements.

(1) Complete time-current trip band, with the long-time-delay trip element set at minimum pickup current setting; the short-time-delay trip element set at the standard pickup setting, which most closely approximates 400 percent of trip coil, or four times the sensor rating; and with the instantaneous trip element set at the maximum pickup current setting.

(2) Time-current trip band with the long-time-delay element set at maximum pickup current setting, and the short-time-delay and instantaneous trip elements set as in (a). Sufficient data shall be obtained to determine the change in the trip band caused by the change in the pickup setting of the long-time-delay element.

(3) Pickup current for each calibration. For the tests in (1) and (2), at least three settings at minimum, middle and maximum of each operating time and resettable delay shall be taken at minimum and maximum) current values, so that the limits of each time-current trip band may be determined throughout the entire operating range. A minimum of five readings shall be taken for each calibration.

(b) Instantaneous trip elements. At least 3 readings each at minimum, middle, and maximum shall be taken of the current required for instantaneous tripping of the circuit breakers, to determine that the setting is within the specified limits. Special care shall be exercised when the instantaneous element is set at a high value, to avoid damage to the circuit breaker.

4.6.14 Withdrawal lockout mechanism. With the removable components of the circuit breakers in the connected position and the circuit breaker in the closed position, an attempt shall be made to withdraw the removable components of the circuit breaker to determine whether the withdrawal lockout mechanism meets the requirements of 3.4.2.1.3. The test shall be repeated with the removable components in the withdrawn position, while insertion of a closed circuit breaker is attempted.

4.6.15 Electric closing mechanism. Closing operation within the applicable voltage range of table III shall be observed. The time required for the closing of electrically operated circuit breaker shall be measured from the moment that nominal voltage is applied to the closing circuit (see 3.4.2.2.3.2). When a charging mechanism is provided, the circuit breaker shall be electrically operated by reducing the voltage below the minimum operating voltage, in increments of approximately 1 percent of operating voltage, until the charging mechanism fails to operate. This voltage shall be held for 15 seconds without damage or misalinement of any part of the circuit breaker. This test may be done during the final 25 operations of the endurance test (see 4.6.2).

4.6.16 Secondary disconnecting devices. Contacts of secondary disconnecting devices shall be subjected to a short-time current of 250 A at rated voltage for 3 seconds. No welding together, burning, or pitting of the contacts shall be observed.

4.6.17 Indicator light. When furnished (see 3.4.2.8 and 6.2.1), the indicator light shall be energized to verify functionability.

4.6.18 Auxiliary switches. Auxiliary switches shall be opened while carrying the applicable non-inductive and inductive currents in table VII and 3.4.2.7.1. A circuit with the inductance of the circuit breaker shunt trip coil, shall be used as the test circuit. No burning or pitting of the contacts shall be observed. This test may be done as part of endurance test (see 4.6.2).

4.6.19 Hold-closed mechanism. When furnished (see 3.4.2.10 and 6.2.1), the hold-closed mechanism shall be operated while an overload condition is simulated, to determine that the circuit breakers can be closed from an open position or held closed. Release of the hold-closed mechanism shall result in the opening of the circuit breaker.

4.6.20 Undervoltage trip device. When furnished (see 3.4.2.12 and 6.2.1), the undervoltage trip device shall be operated to determine that the device operates in the applicable operating voltage range, trips the circuit breakers below the applicable maximum dropout voltage, and picks up at the applicable minimum pickup voltage. The device shall be operated for 5 unit operations each at minimum and maximum operating voltages. This test may be done during final 25 operations of the endurance test (see 4.6.2).

4.6.21 Shunt trip device. When furnished (see 3.4.2.13 and 6.2.1), the shunt trip device shall be operated to determine that the device trips the circuit breaker in the applicable operating voltage range. The device shall be operated for 5 unit operations each at minimum and maximum voltage. This test may be done during final 25 operations of the endurance test (see 4.6.2).

4.6.22 Undervoltage lockout device. When furnished (see 3.4.2.14 and 6.2.1), the undervoltage lockout device shall be operated to determine that the device operates in the applicable operating voltage range, picks up below the applicable maximum pick up voltage and permits closing of the circuit breaker. Prohibits closing of the circuit breaker when deenergized.

5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government acquisitions. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in section 2, see 6.5.)

5.1 Preservation-packaging, packing and marking. Circuit breakers, attachments, and manuals shall be preserved-packaged level A or C, packed level A, B, or C as specified (see 6.2.1) and marked in accordance with MIL-E-17555. Special marking shall be as specified (see 6.2.1).

5.2 Use of loose-fill material.

5.2.1 For domestic shipment and early equipment installation and level C packaging and packing. Unless otherwise specified by the contracting activity (see 6.2.1), use of loose-fill material for domestic shipment, early equipment installation, level C packaging, and packing applications such as cushioning, filler, and dunnage is prohibited. When specified, unit packages and containers (interior and exterior) shall be marked and labelled as follows:

"CAUTION

Contents cushioned etc. with loose-fill material.
Not to be taken onboard ship.
Remove and discard loose-fill material before shipboard storage.
If required, recushion with cellulosic material bound fiber,
fiberboard, or transparent flexible cellular material."

5.2.2 For level A packaging and level A and B packing. Use of loose-fill material is prohibited for level A packaging and level A and B packing applications such as cushioning, filler, and dunnage.

5.3 Sensitive electronic items.

5.3.1 Lead and terminal protection. Lead or terminal configurations shall be maintained as manufactured without causing loads or stresses capable of causing damage to the item. Protection shall be by means of a carrier, container design, or inserts of noncorrosive, electrostatic-free supporting materials. Materials used to maintain item position and lead or terminal configuration shall permit item removal and replacement without damage to the item.

5.3.1.1 Carrier. Carriers, when used for additional protection of miniature electronic items, shall be of such strength to prevent damaging resonances, shocks, and electrostatic charges to the sensitive item(s). Anchoring or securing of the item, leads, or terminals within the carrier by means of tape or adhesive is prohibited. The carrier shall maintain physical separation and manufactured configuration of the item leads or terminals during packaging, handling, transportation, storage/stowage, and for testing operations. The carrier shall permit safe and easy removal, inspection, and item replacement, and shall be designed without sharp edges to preclude subsequent damage to the item and packaging materials methods.

5.3.2 Wraps and cushioning materials. Wraps and cushioning, when required for additional protection, shall be noncorrosive and in compliance with the requirements of MIL-P-116, and shall not crumble, flake, powder, or shed. Wraps or cushioning in direct contact with the electrostatic sensitive item(s) shall conform to the electrostatic protection requirements specified herein (see 5.3.4).

5.3.3 Unit protection. Unless otherwise specified (see 6.2.1), sensitive electronic items subject to degradation from electrostatic, electromagnetic forces, or both shall be unit protected in accordance with methods IA or II of MIL-P-116, except as specified under detail requirements (see 5.3.4).

5.3.4 Electrostatic protection. Items adversely affected by electrostatic field forces shall be provided an initial wrap of material conforming to MIL-B-81705, type II, or cushioned in material conforming to PPP-C-1842, type III, style A or B, and unit packaged in heat-sealed bags conforming to MIL-B-117, type I, class F, style 1. Alternatively, reclosable cushioned pouches conforming to MIL-P-81997, type I or II may be used in lieu of the initial wrap or cushioning. Noncorrosive conductive material(s) shall be applied to all exposed leads and connector pins to maintain a common potential. This is to protect the item(s) from electrostatic charge(s) that may be encountered during handling.

5.3.4.1 Packaging materials. Packaging materials currently covered by title, scope, or intended use under Government specification(s), but modified as electrostatic-free material(s), or newly developed electrostatic-free packaging material(s) not covered by a Government packaging material specification(s) are encouraged for use. Use of such modified or newly developed electrostatic-free packaging material(s) will be permitted subject to the contracting officer's determination that (a) the physical properties of such material(s) are equal to or better than similarly constructed material(s) covered under a required Government packaging material specification and, (b) that such materials satisfy the electrostatic decay rate requirement of MIL-B-81705. The material manufacturer/supplier or contractor shall furnish to the Government inspector for review, documented proof of conformance to the requirements specified herein, certified by an acceptable testing laboratory. Upon submission for acceptance, copies of the contractor's document proof shall be forwarded to the contracting officer packaging activity. The decision of the contracting officer shall be final as to the acceptability or non-acceptability of the packaging material and the decision shall not be subject to review under the disputes clause of the contract. When such materials are acceptable, unit packaging shall be in accordance with the procedures for electrostatic protection.

5.3.5 Electromagnetic protection. Unless otherwise specified (see 6.2.1), item(s) subject to damage by electromagnetic forces shall be unit packaged in heat-sealed, barrier bags conforming to MIL-B-117, type I or II, class E, style 1 or type I, class F, style 1. When MIL-B-117, type I or II, class E, style 1 bags are selected and used, the barrier material shall also contain a laminate of aluminum foil as well as meeting the requirements of MIL-B-117.

5.3.6 Electromagnetic and electrostatic protection. When the item(s) requires both electromagnetic and electrostatic protection, unit packaging shall be as specified under electrostatic protection (see 5.3.4).

6. NOTES

6.1 Intended use. Circuit breakers and their attachments covered by this specification are intended for use in Naval shipboard applications, as a device which:

(a) Maintains a closed circuit when closed.
(b) Maintains an open circuit when open.

(c) Interrupts the circuit under normal operation (current not in excess of the rated continuous current of the circuit breaker) and under abnormal conditions (currents in excess of the rated continuous current of the circuit breaker, such as a short circuit) in accordance with the intended operation of the trip devices. In application, circuit breakers are selected whose rated short-circuit current is as great or greater than the maximum current which they may be called upon to interrupt.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

(a) Title, number, and date of this specification.
(b) Type required (see 1.2 and table I).
(c) Creepage and clearance set spacings and enclosure type, if other than set C spacings and enclosed type of enclosure (see 3.3.3.1).
(d) Quantity of special tools, if required (see 3.3.13).
(e) Insulated barriers, if required (see 3.4.1.6).
(f) Test position, if required (see 3.4.2.1.4).
(g) Manual operation for circuit breaker types ACB-900RC, ACB-901R, ACB-902R or ACB-2000RC, if not required (see 3.4.2.2.3.1).
(h) Electrical operation and voltage rating for circuit breakers, if required (see 3.4.2.2.3.2).
(i) Mounting location of transformer, if required, for electric closing power (see 3.4.2.2.3.2).
(j) Number of manual operating handles required for electrically operated circuit breakers (see 3.4.2.2.3.2).
(k) Applicable switchgear unit for circuit breaker enclosure (see 3.4.2.3).
(l) Types of overcurrent protection required (see 3.4.2.6):

(1) Overcurrent coil rating and use - (see 3.4.2.6.2)
(2) Long-time-delay - required pickup current setting (see 3.4.2.6.3).
(3) Short-time-delay - required pickup current setting (see 3.4.2.6.4.2) and time band (see 3.4.2.6.4.1).
(4) Instantaneous - required pickup current setting (see 3.4.2.6.5).

(m) Secondary disconnecting devices, quantity required (see 3.4.2.7).
(n) Indicator light with lens color, if required; indicate special type, if required (see 3.4.2.8).
(o) Special auxiliary switches, if required (see 3.4.2.9).
(p) By-pass switches, if required (see 3.4.2.10).
(q) Hold-closed mechanism, if required (see 3.4.2.11).
(r) Undervoltage trip device, if required; voltage rating and connection to line or load terminals (see 3.4.2.12).
(s) Shunt trip device, if required (see 3.4.2.2.4.2 and 3.4.2.13); voltage rating. If 120S nominal voltage selected, specify whether trip current exceeds 30 A (see table IX).

(t) Undervoltage lockout device, if required (see 3.4.2.14).
(u) Enclosure provision for temperature rise tests (see 4.6.6).
(v) Enclosure provision for shock tests (see 4.6.7).
(w) Preservation-packaging, packing and marking (see 5.1).
(x) Special marking (see 5.1).
(y) Loose-fill material used, if specified (see 5.2.1).
(z) Unit protection method other than specified (see 5.3.3).
(aa) Unit packaging other than specified (see 5.3.5).

6.2.2 Data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DAR 7-104.9 (n)(2) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification is cited in the following paragraphs:

Paragraph no.	Data requirements title	Applicable DID no.	Option
3.6	Drawings, engineering and associated lists	DI-E-7031	Level 3 Design activity designation - contractor Drawing number - contractor Parts list - contractor Delivery of hard copy - contracting activity
3.6	Certification data/report	UDI-A-23264	Include classification table figure 15
3.6	Manual, technical: preliminary final	 DI-M-2043 DI-M-2044	 MIL-M-15071, type I
4.1.1	Inspection system program plan	DI-R-4803	MIL-I-45208
4.1.2	Reports, test	DI-T-2072	-

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5000.19L., Vol. II, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2.2.1 Drawings. Drawings shall include the minimum information shown on figure 15. When a circuit breaker is a part of an assembly, such as a switchgear unit, individual circuit breaker drawings need not be furnished. The applicable drawings shall, however, be indicated on the switchgear or assembly drawings together with complete descriptive data for the circuit breaker.

6.2.2.2 Certification data. Certification data sheets shall include applicable data listed on the identification plate and classification table shown on figure 15.

6.2.2.3 Manuals. A separate technical manual shall be prepared for each circuit breaker type. These manuals shall be bound as a separate book and titled in accordance with MIL-S-16036, to be inserted in the switchboard technical manual.

6.2.2.4 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of this specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List QPL-17587 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. The activity responsible for the Qualified Products List is Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362, and information pertaining to qualification of products may be obtained from that activity. Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.3.1).

6.3.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

6.4 Disposition of tested circuit breakers. Circuit breakers which have passed qualification tests may be given a class B overhaul and sold to the Government for use as a replacement circuit breaker. These circuit breakers are not to be used for new ships unless otherwise exempted by the cognizant Supervisor of Shipbuilding.

6.5 Definitions. Circuit breaker terminology used in this specification is in accordance with common commercial technology, except as noted below. Commonly used terms can be found in ANSI C37.100.

6.5.1 By-pass switch. A by-pass switch is a normally closed limit switch connected to the stationary secondary contacts in parallel with a normally closed auxiliary switch.

6.5.2 Charging motor. A charging motor is the motor which moves the closing spring or springs to the position necessary, so that the spring(s) has (have) sufficient force to close the circuit breaker.

6.5.3 Closing release. A closing release is an electrical or mechanical device which releases the charged springs to close the circuit breaker contacts.

6.5.4 Closing spring. A closing spring is a spring which supplies power for closing the circuit breaker.

6.5.5 Enclosure. See MIL-STD-108.

6.5.6 Hold-closed mechanism. A hold-closed mechanism is a mechanism which renders the trip device and trip-free mechanism ineffective, thus permitting the circuit breaker to be closed from the open position or be held closed when in the closed position against an overload, as long as the handle of the hold-closed device is held in position by the operator.

6.5.7 Lockout mechanism. A lockout mechanism mechanically prevents the circuit breaker from closing, either electrically or manually.

6.5.8 Operating mechanism of a circuit breaker. The operating mechanism of a circuit breaker is a power-operated or manual mechanism, by which the contacts of all poles of the circuit breaker are actuated.

6.5.9 Operating time of a circuit breaker. The operating time of a circuit breaker is the total time interval of elapsed time, from the moment of energizing the circuit breaker's trip coil to the completion of the interruption of the circuit at rated voltage.

6.5.10 Overcurrent device. An overcurrent device is an assembly which detects a current exceeding a predetermined value and which will directly initiate an operation of the circuit breaker trip mechanism.

6.5.11 Overcurrent coil. Overcurrent coil is a thermal or magnetic overcurrent device.

6.5.12 Overcurrent sensors. Overcurrent sensors are elements associated with electrical overcurrent trip devices, which sense current magnitude and supply a corresponding signal to an electrical network.

6.5.13 Pick-up setting. The average minimum current required to activate a trip element between 30 and 70°C ambient temperature.

6.5.14 Rated a.c. short-circuit current. The rated a.c. short-circuit current of a circuit breaker is the stated limit of available (prospective) current, at which it shall be required to perform its short-circuit current duty cycle at rated maximum voltage and frequency under the prescribed test conditions.

6.5.15 Rated continuous current. The rated continuous current of a circuit breaker is the stated limit in rms amperes at rated frequency, or d.c. amperes, which a circuit breaker will carry continuously under stated ambient conditions without either tripping or exceeding the limit of observable temperature rise.

6.5.16 Rated d.c. short-circuit current. The rated d.c. short-circuit current of a circuit breaker is the designated limit in available (prospective) sustained current at the specified operating voltage, at which it shall be required to perform its short-circuit current duty cycle at rated maximum voltage, under the prescribed test conditions.

6.5.17 Rated short-time current. The rated short-time current of a circuit breaker is the designated limit of available (prospective) current at which it shall be required to perform its short-time current duty cycle at rated maximum voltage under the prescribed test conditions.

6.5.18 Removable element of a circuit breaker assembly. The removable element of a circuit breaker assembly is that portion which carries the circuit-switching and circuit-interrupting devices and the removable part of the primary and secondary disconnecting devices. It can be withdrawn from the stationary element for maintenance purposes.

6.5.19 Resettable delay of a circuit breaker. Resettable delay is defined as the maximum time the circuit breaker will carry current in excess of the pickup current setting and still reset when the circuit current is suddenly reduced without interruption to the rated continuous current of the circuit breaker.

6.5.20 Stationary component of a circuit breaker assembly. The stationary component of a circuit breaker assembly is that portion which is bolted to its enclosure and to which external current-carrying connections are made. The removable component of the circuit breaker assembly can be inserted (connected) into the stationary component or withdrawn (disconnected) from it.

6.5.21 Terminal. The terminal is the end of the stationary primary disconnect to which external bus or cable connections are made.

6.5.22 Total clearing time of a circuit breaker. Total clearing time is the maximum time, measured from when current reaches a trip value, until the interruption is completed and consists of the mechanical operating time, the arcing time and the intentional delay time of the circuit breaker. The total clearing time is represented by the upper limit of the time band envelope on the applicable time-current characteristic curve.

6.5.23 Trip device, a.c. solid-state overcurrent. An a.c. solid-state overcurrent trip device obtains its tripping energy from the circuit breaker current via an overcurrent sensor. This energy is supplied to an electrical network, which in turn operates a trip mechanism.

6.5.24 Trip device, d.c. solid-state overcurrent. A d.c. solid-state overcurrent trip device obtains its tripping energy from a preferred control source and senses current levels via a low-powered sensor. This energy and signal is supplied to an electrical network, which in turn operates a trip mechanism.

6.5.25 Trip device, electromechanical overcurrent. An electromechanical overcurrent trip device operates directly by circuit breaker current to mechanically trip the circuit breaker on overcurrent. The current through the circuit breaker directly provides the magnetic force to trip the circuit breaker.

6.5.26 Type. The circuit breaker type is a designation used to differentiate performance characteristics.

6.5.27 Undervoltage lockout device. A solenoid device which will trip the circuit breaker when the voltage to the device falls below a predetermined value.

6.5.28 Withdrawal interlock mechanism. A mechanical device which will prevent the main studs from being disconnected while the circuit breaker is closed.

6.6 Cross reference of classification. The following is a comparison of the classification between MIL-C-17578A(SHIPS) and MIL-C-17587B(SH).

MIL-C-17857A(SHIPS)	MIL-C-17857B(SH)
ACB 640R	ACB 900R
ACB 900RC	ACB 900RC
ACB 901R	ACB 901R
ACB 1600R	ACB 2000R
ACB 1600HR	Deleted
ACB 1600HRC	ACB 1600HRC
ACB 2601R	ACB 2601R
ACB 3200HR	ACB 3200HR
ACB 4000HR	ACB 4000HR

The closing circuit of electrically operated circuit breakers of types ACB 640R, replaced by ACB 900R and ACB 1600R, replaced by ACB 2000R, requires an additional state-of-the-art modification. In order for these types to be used as direct replacement of a wiring change must be made.

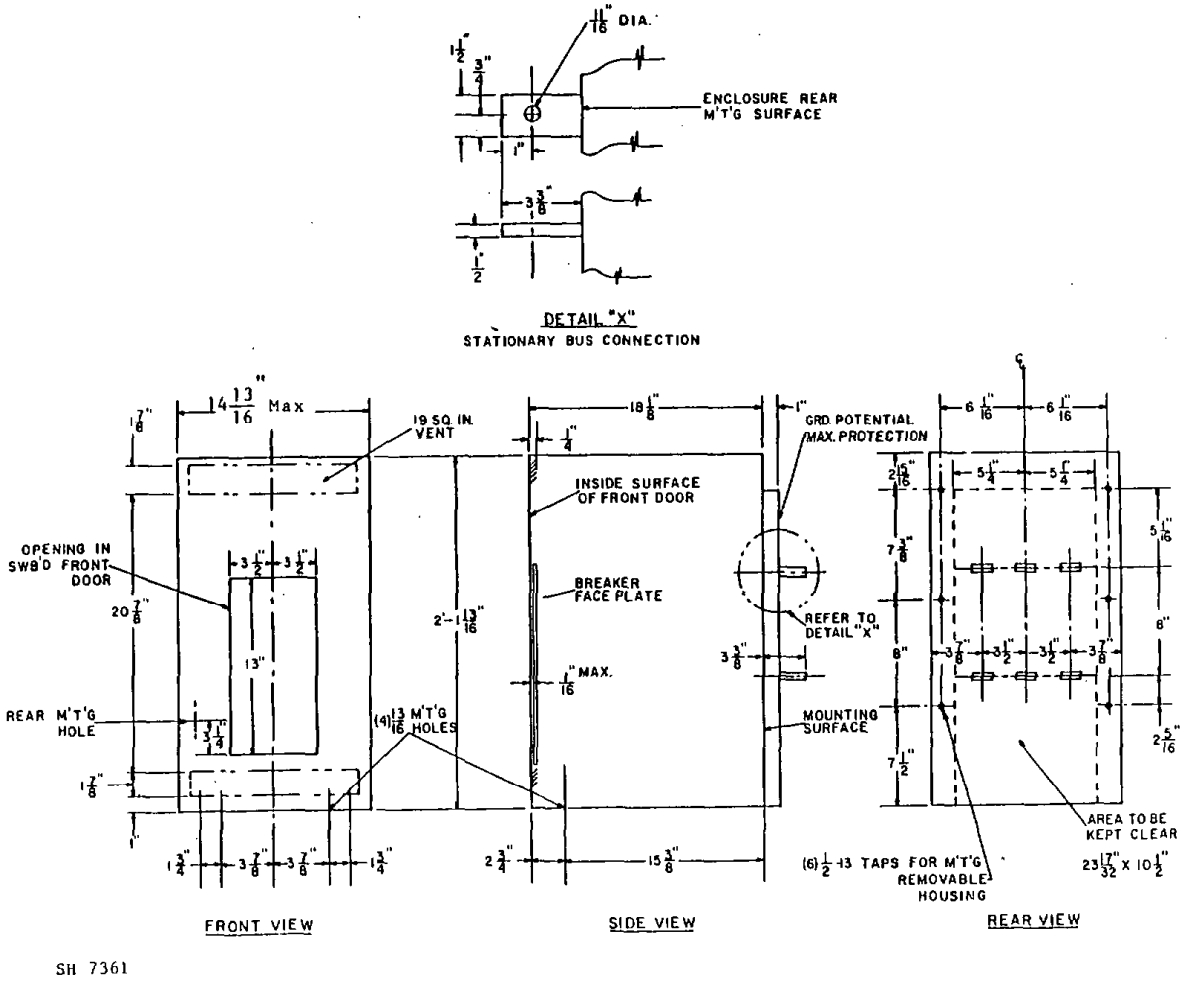
6.7 Sub-contracted material and parts. The preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.8 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

6.8.1 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.

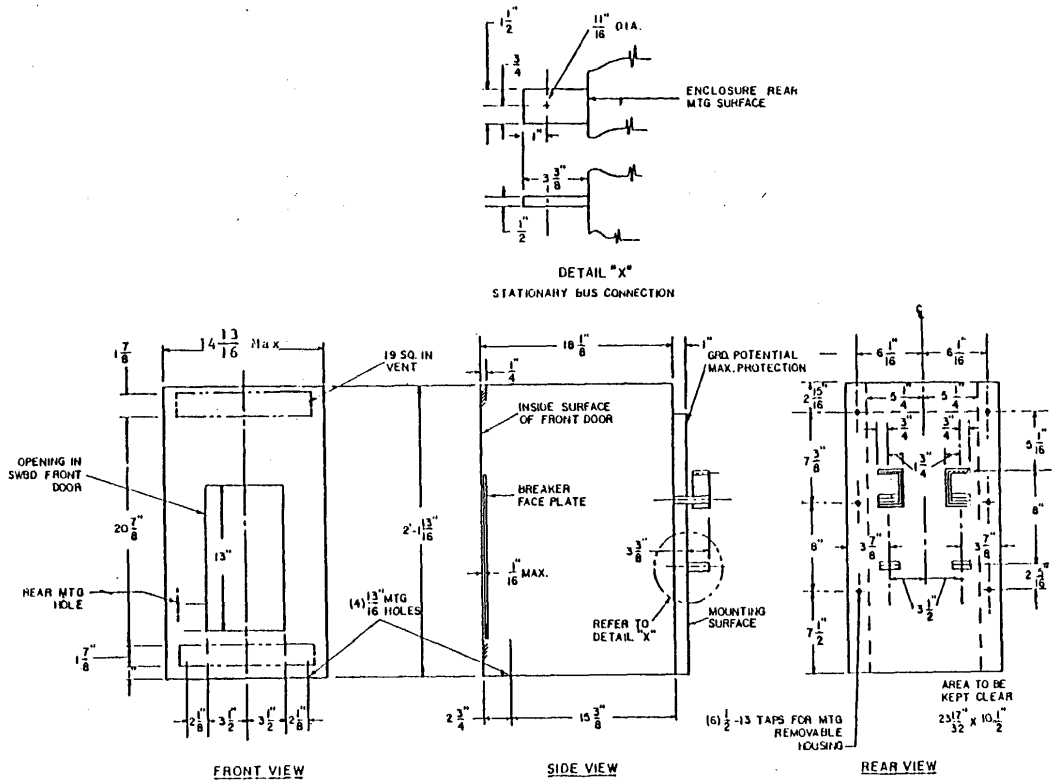
6.9 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 5925-N086)



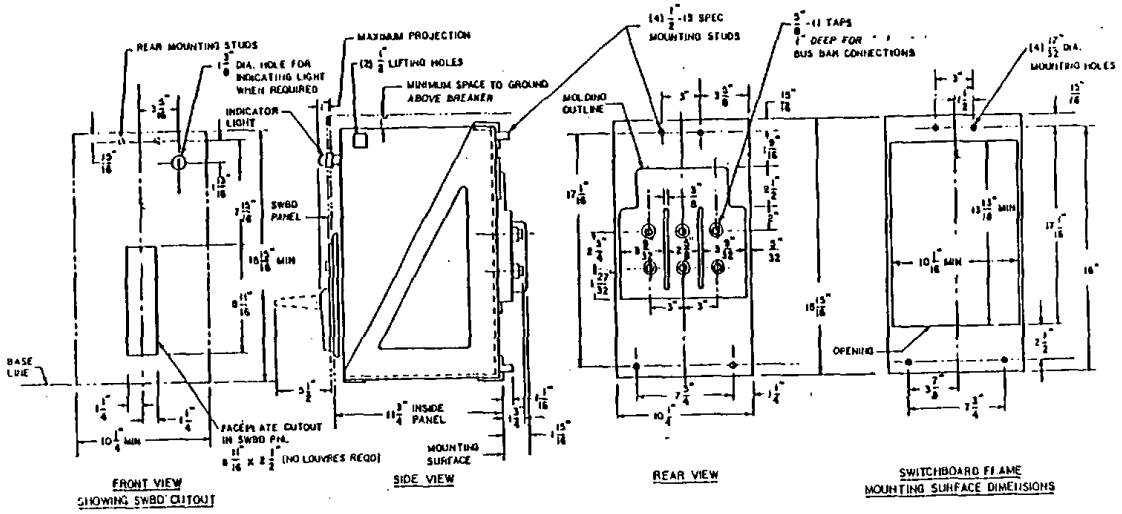
SH 7361

FIGURE 1. Outline and mounting dimensions for circuit breaker type AC3-900R.



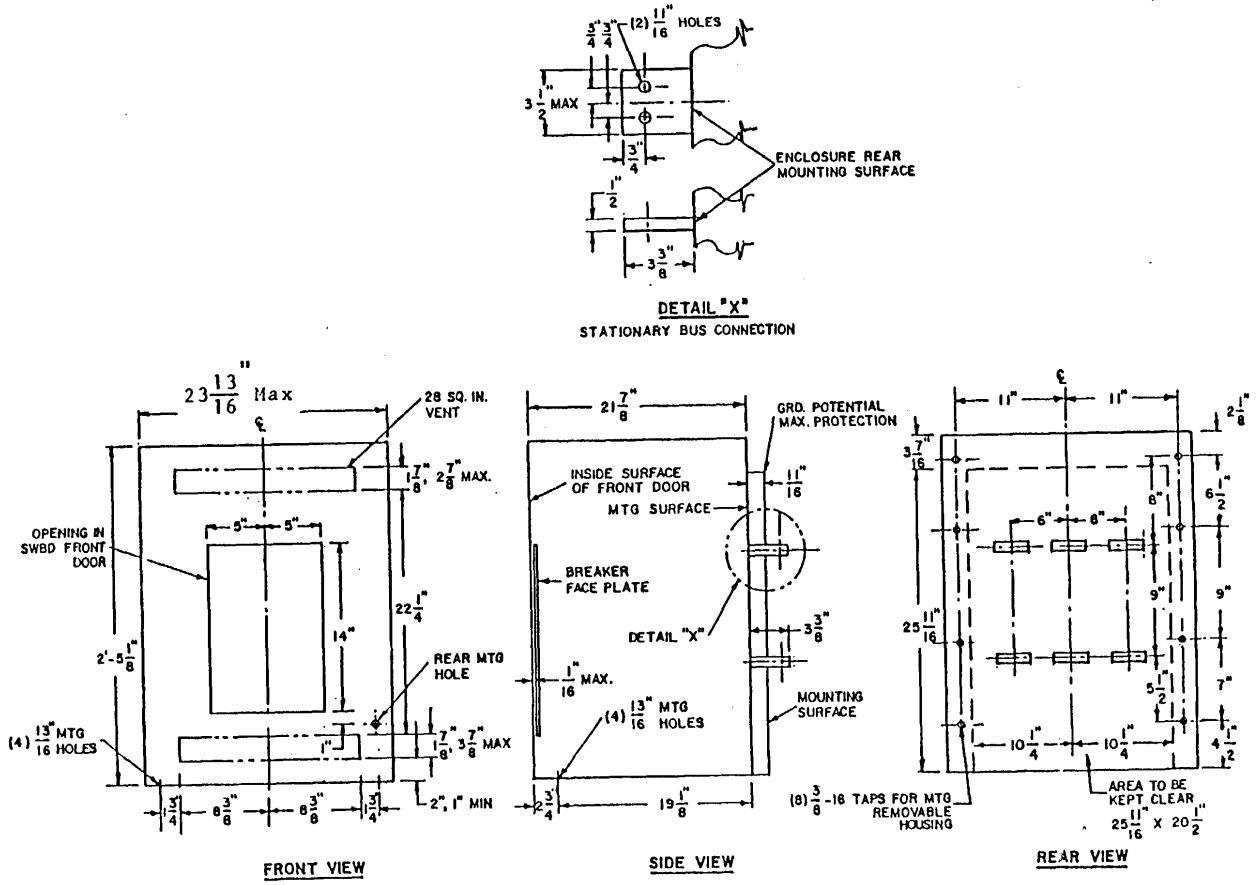
SH 12118

FIGURE 2. Outline and mounting dimensions for circuit breaker type ACB-901R.



SH 12119

FIGURE 3. Outline and mounting dimensions for circuit breaker type ACB-902R.



SH 12120

FIGURE 4. Outline and mounting dimensions for circuit breaker types ACB-1600HR, ACB-2000R, and 2000HR.

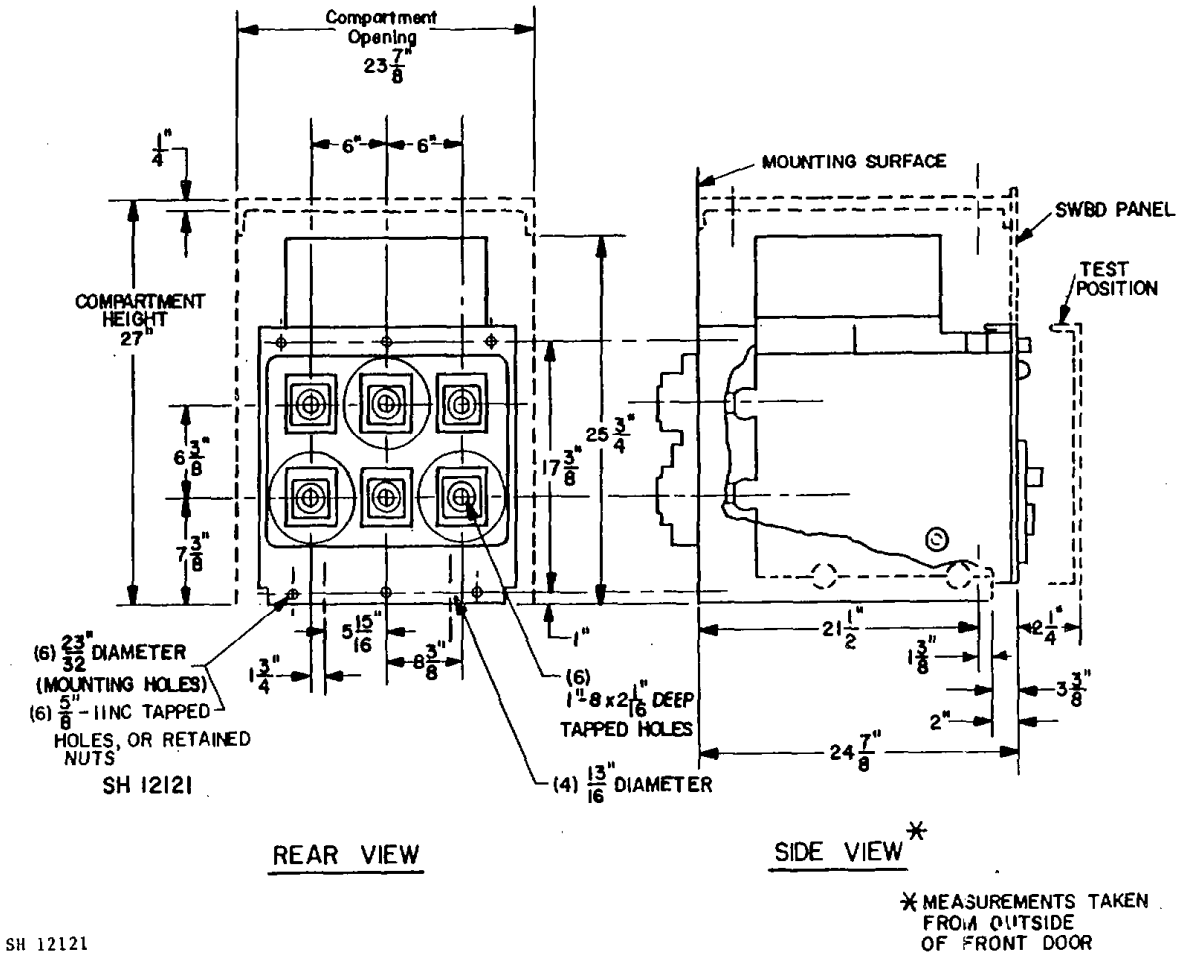
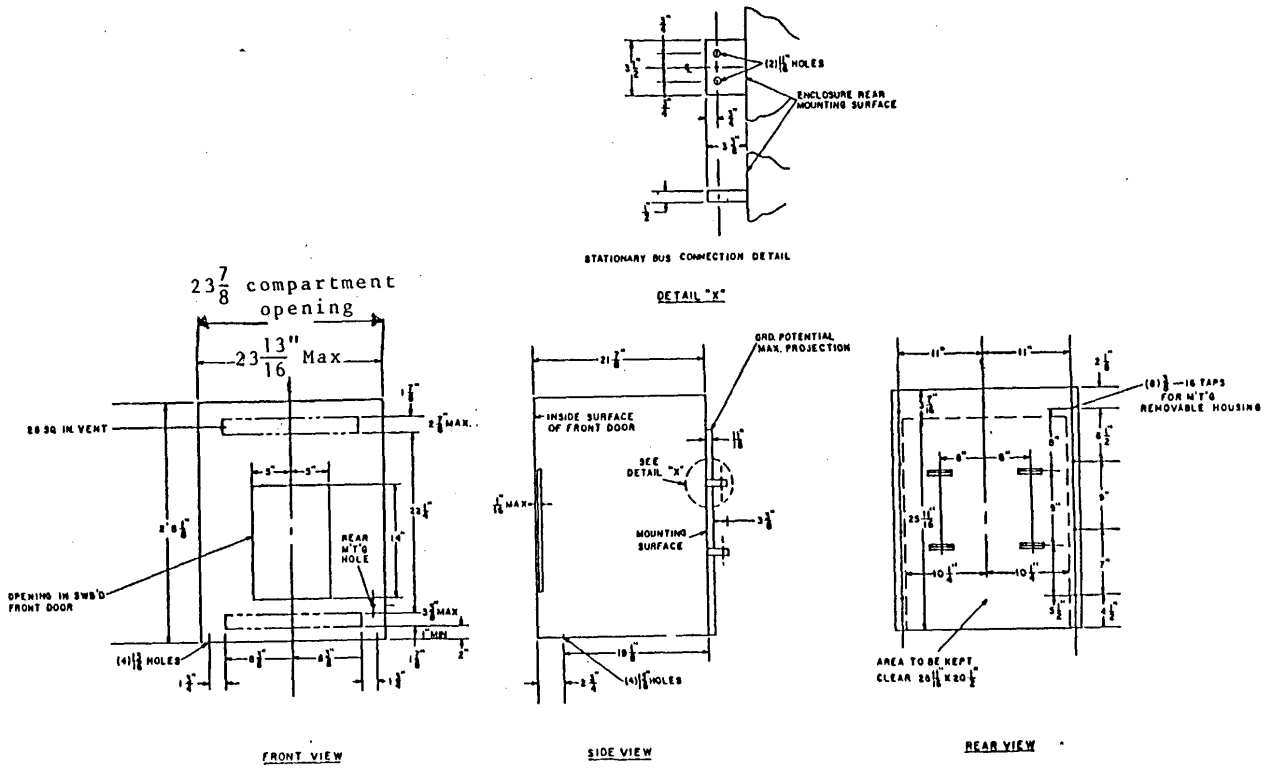
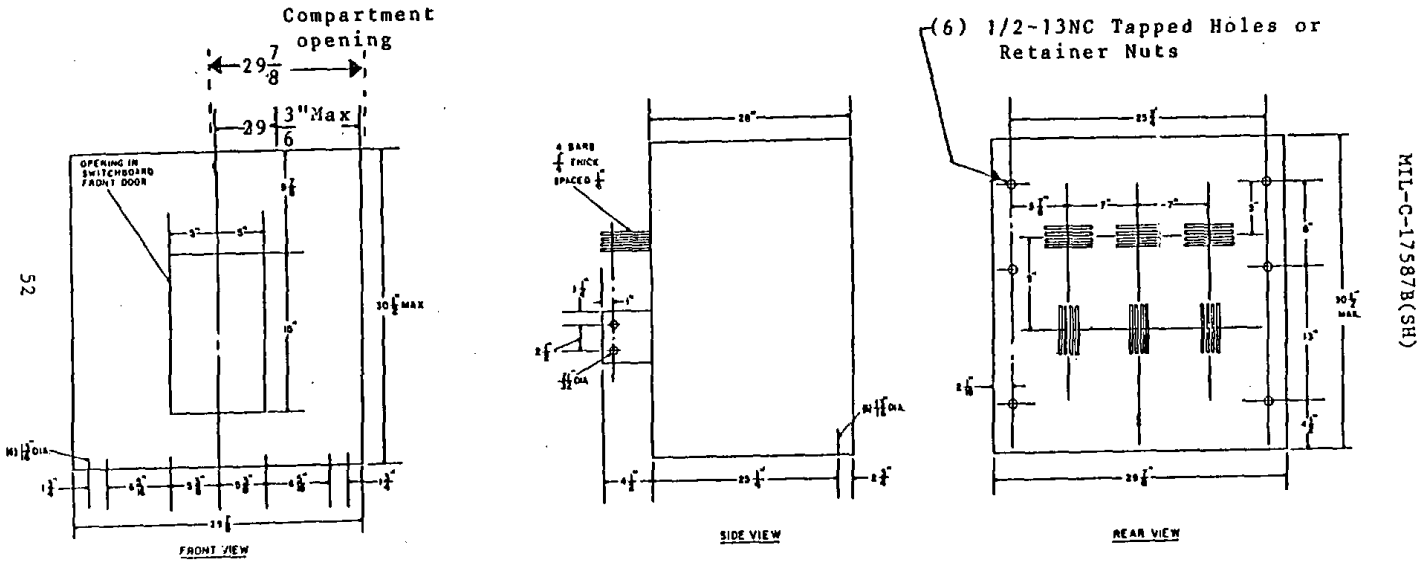


FIGURE 5. Outline and mounting dimensions for circuit breaker type ACB-2002HR.



SH 7363

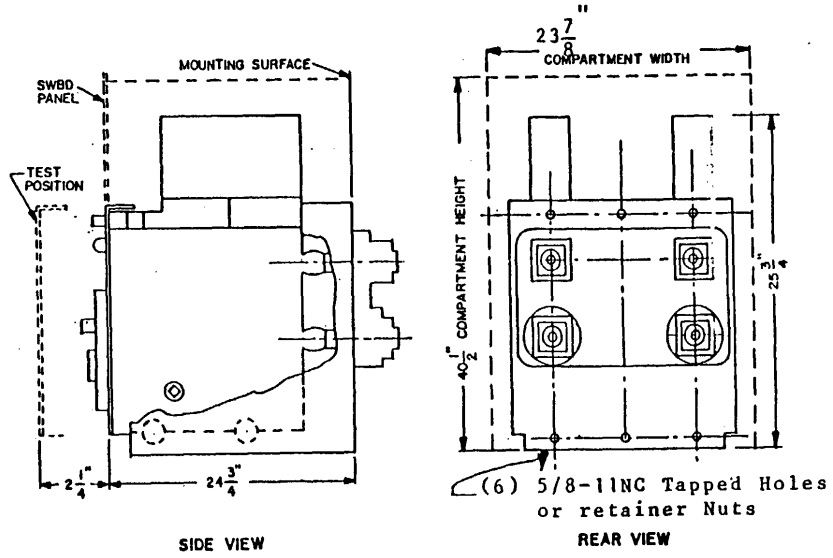
FIGURE 6. Outline and mounting dimensions for circuit breaker type ACB-2601R.



SH 12122

FIGURE 7. Outline and mounting dimensions for circuit breaker types ACB-3200HR and ACB-4000HR.

ONLY DRAWING INFORMATION AVAILABLE



SH 12123

FIGURE 8. Outline and mounting dimensions for circuit breaker type ACB-4001R.

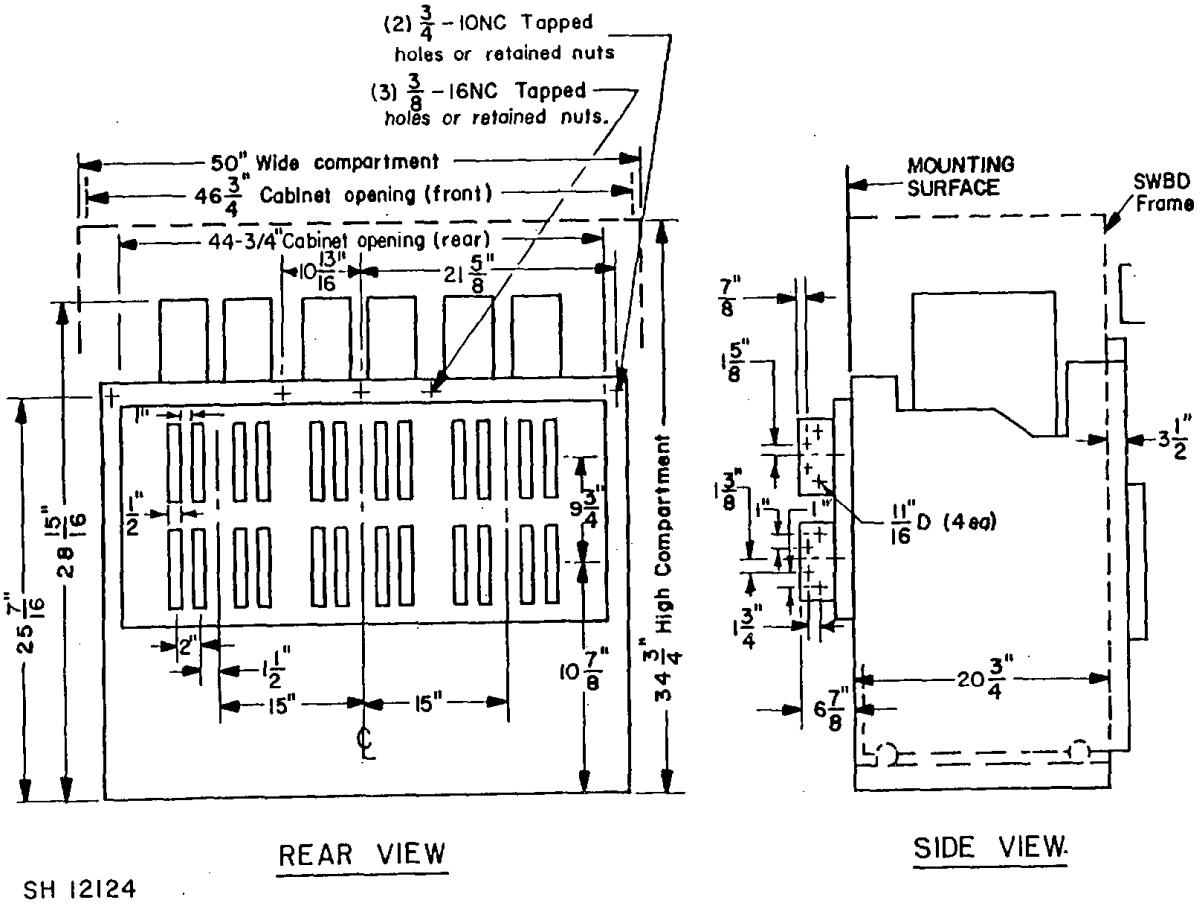


FIGURE 9. Outline and mounting dimensions for circuit breaker type ACB-6400.

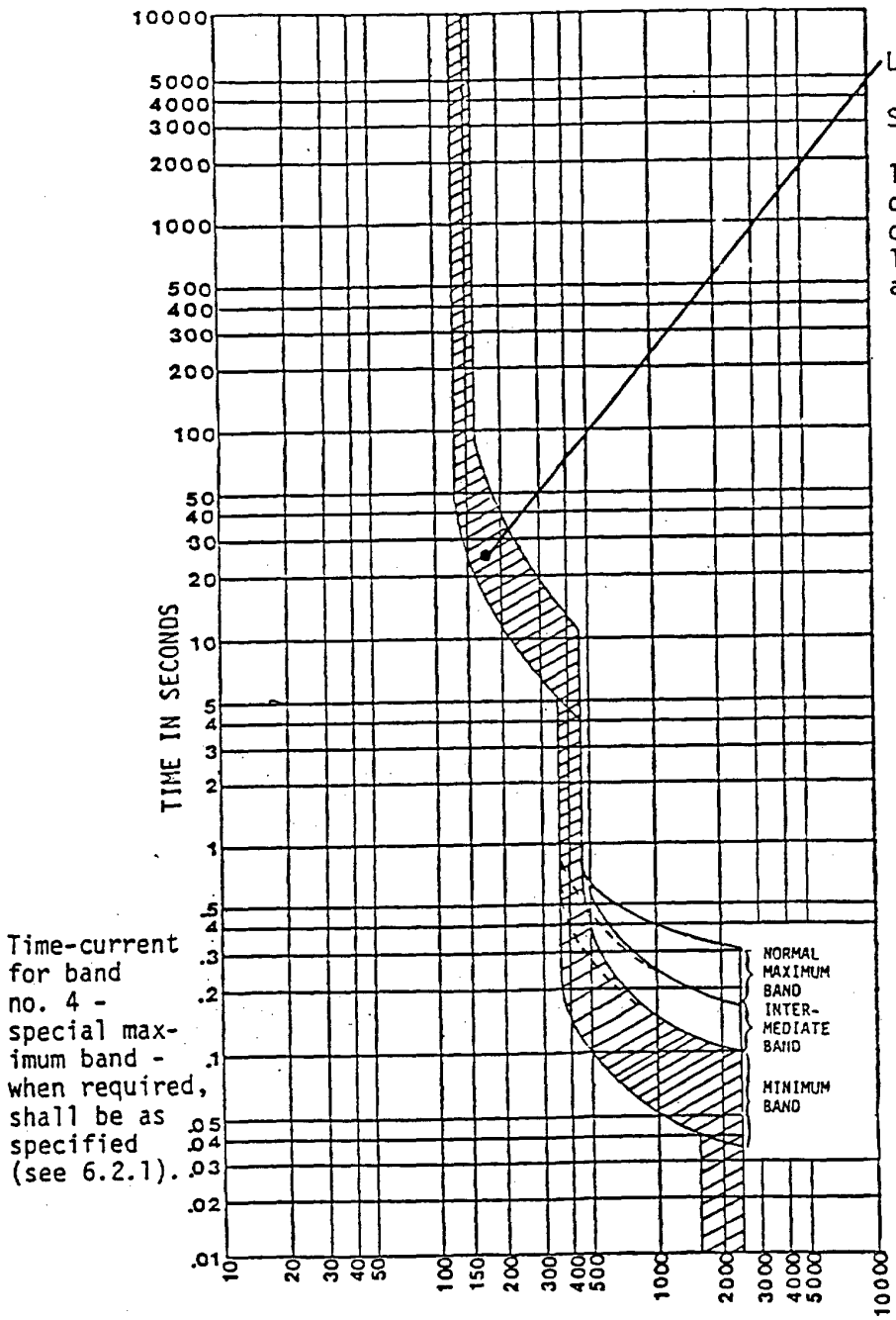
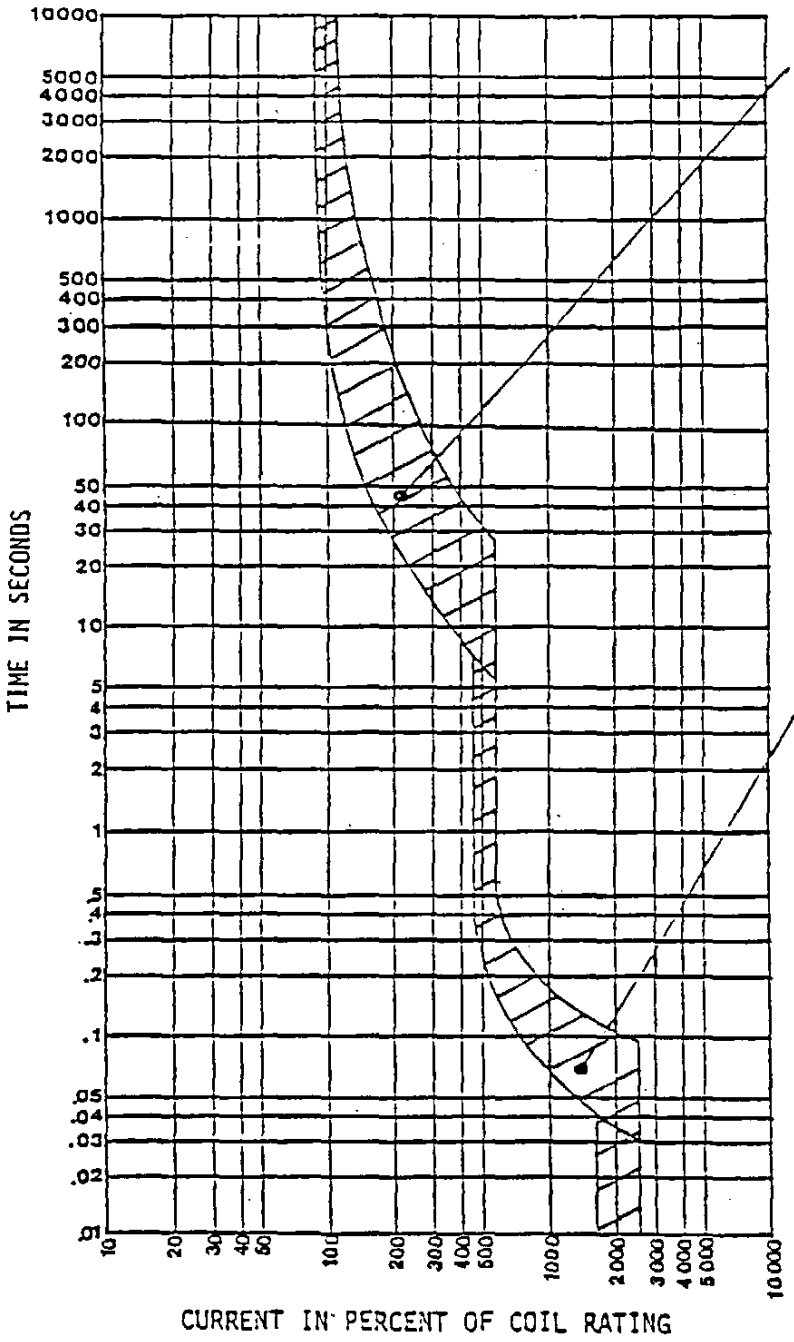


FIGURE 10. Time-current characteristics curve for circuit breaker types ACB-900R, ACB-901R, ACB-902R, ACB-1600HR, ACB-2000R, ACB-2601R, ACB-3200HR, and ACB-4000HR.



LONG TIME DELAY

SPECIFIED CALIBRATION

20 - 150 seconds at 225% of coil roting with pickup of long-time delay at 100% and short-time delay at 500%.

SHORT TIME DELAY

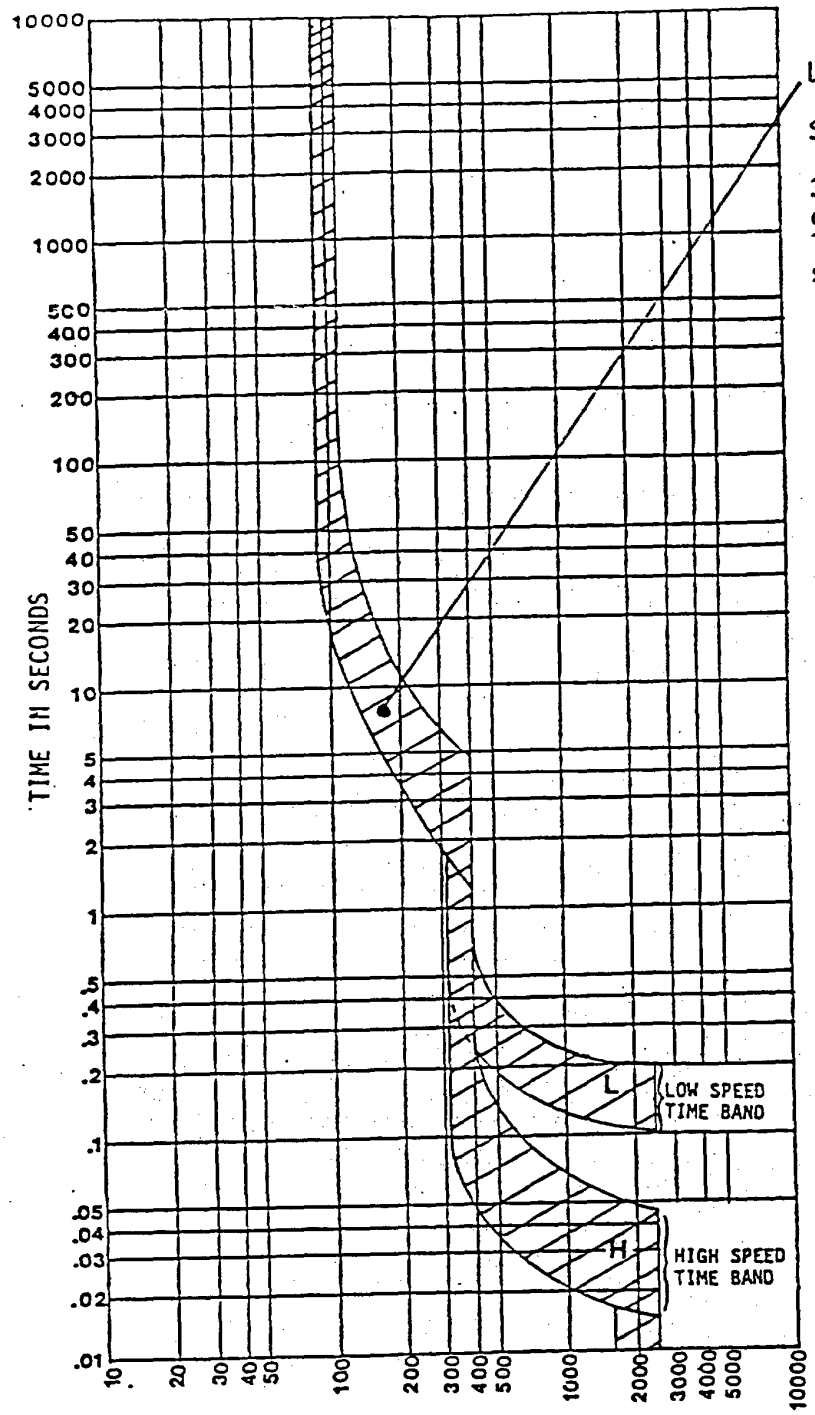
SPECIFIED CALIBRATION

(Based on pickup of short-time delay at 500% and instantaneous at 2000%)

Current % of Pickup	Time Band (sec)
160%	0.080 - 0.210
300%	0.048 - 0.140

SH 12126

FIGURE 11. Time-current characteristics curve for circuit breaker type ACB-902R for general motor applications.



LONG TIME DELAY

SPECIFIED CALIBRATION

3 - 10 seconds at 225% of coil roting with pickup of long-time delay at 100% and short-time delay at 350%.

SHORT TIME DELAY

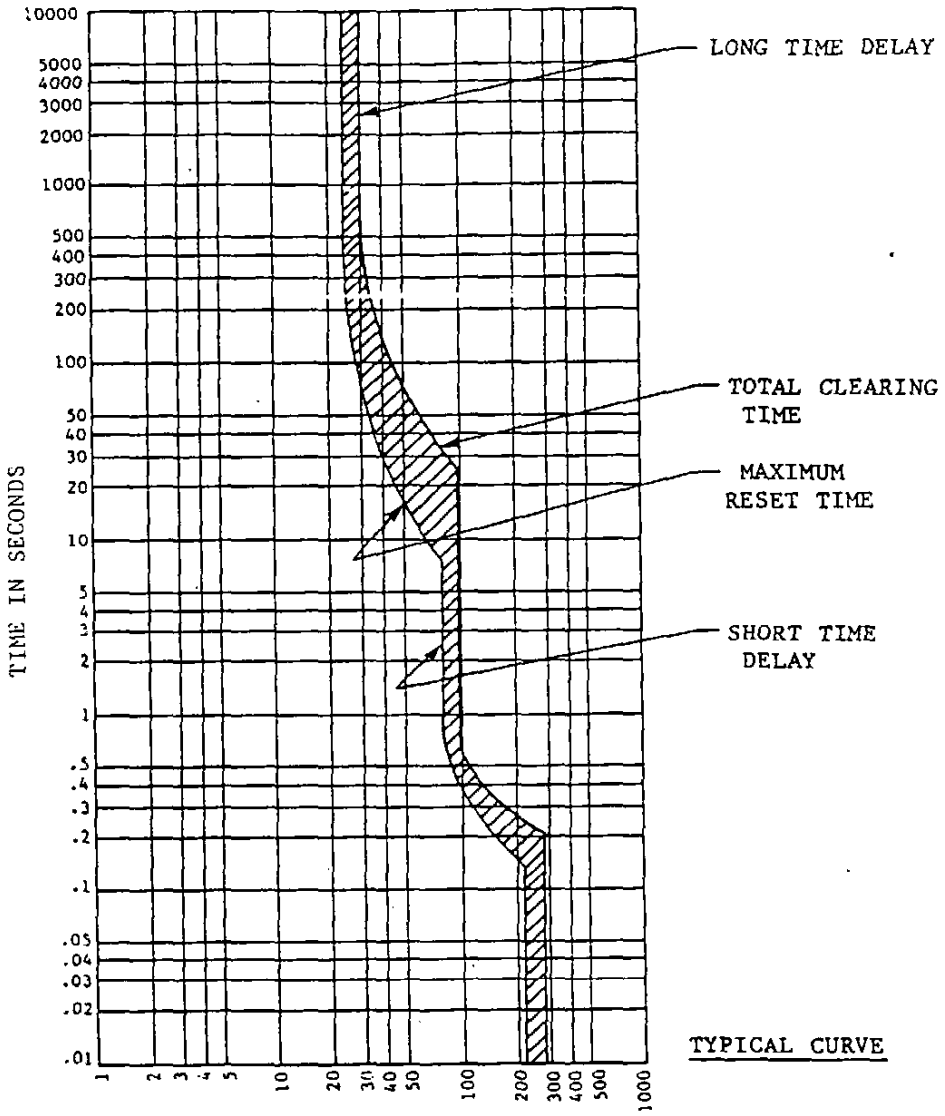
SPECIFIED CALIBRATION

(Based on pickup of short-time delay at 350% and instantaneous at 2000%)

Current % of Pickup	Time Band (sec)	
	H	L
200%	0.070 - 0.110	0.180 - 0.310
400%	0.018 - 0.070	0.120 - 0.230

SH 12128A

FIGURE 12A. Time-current characteristics curve for circuit breaker type ACB-902R for special purpose motor applications.



TYPICAL CURVE

SPECIFIED CALIBRATION

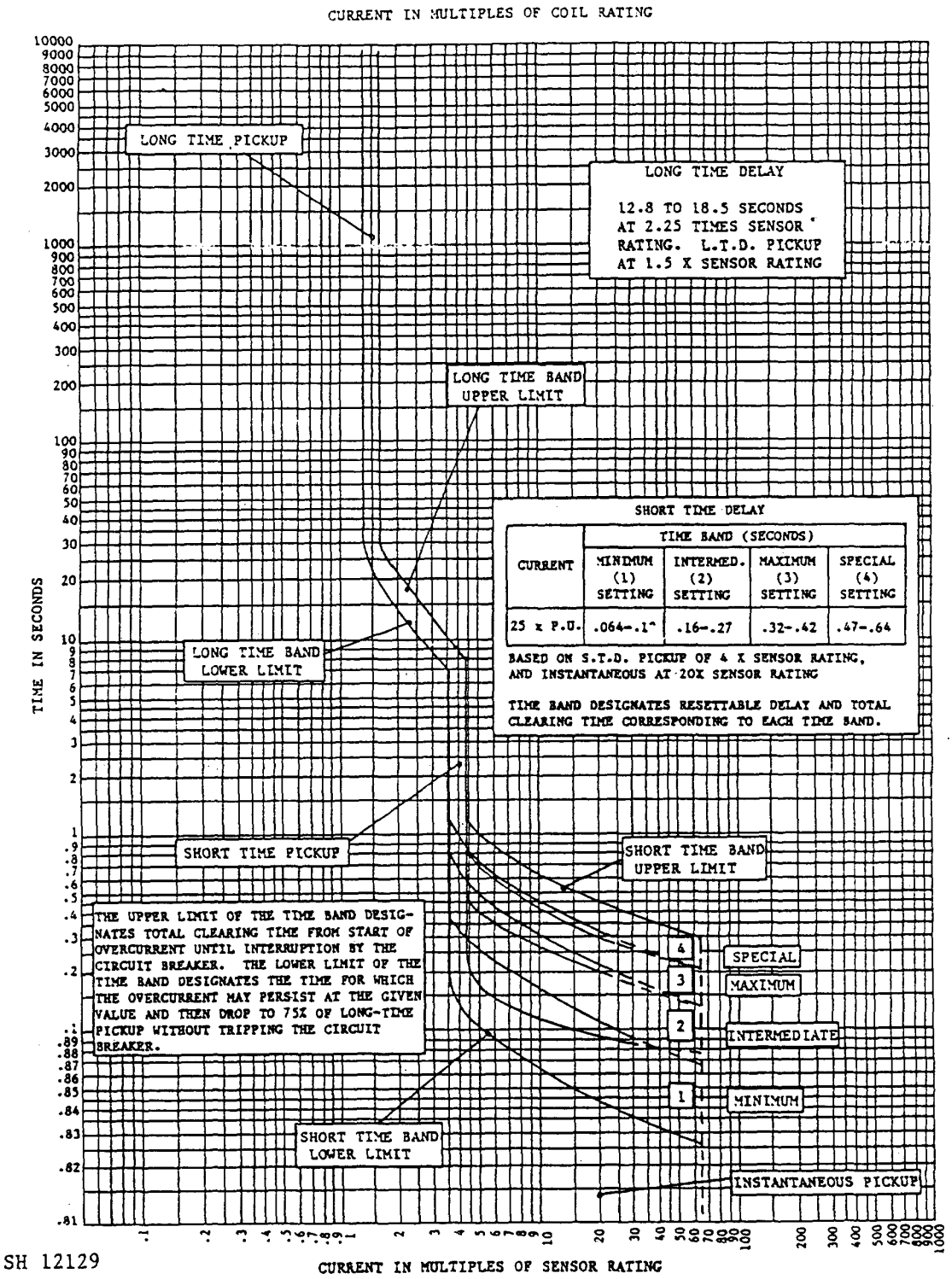
LONG TIME DELAY
10 TO 40 SECONDS
AT 700 AMPERES
DELAY SET 280 AMPERES

SHORT TIME DELAY
10.2 TO 16.8 CYCLES
OR .170 TO .280 SECONDS
AT 1980 AMPERES
DELAY SET 990 AMPERES

Coil turning	Ovct. coil rating	Long time: Calib. points adjust	Long time: Spring dwg. no.	Short time: Calib. points	Short time: Spring dwg. no.	Instantaneous: Calib. range (specify one point)	Instantaneous: Spring dwg. no.
Four	250	250 280 300 320	650216-A24	890 950 1000 Time Band "L"	650220-A17	1500-2800 3000-3600	173631-B 173631-B 176798-B

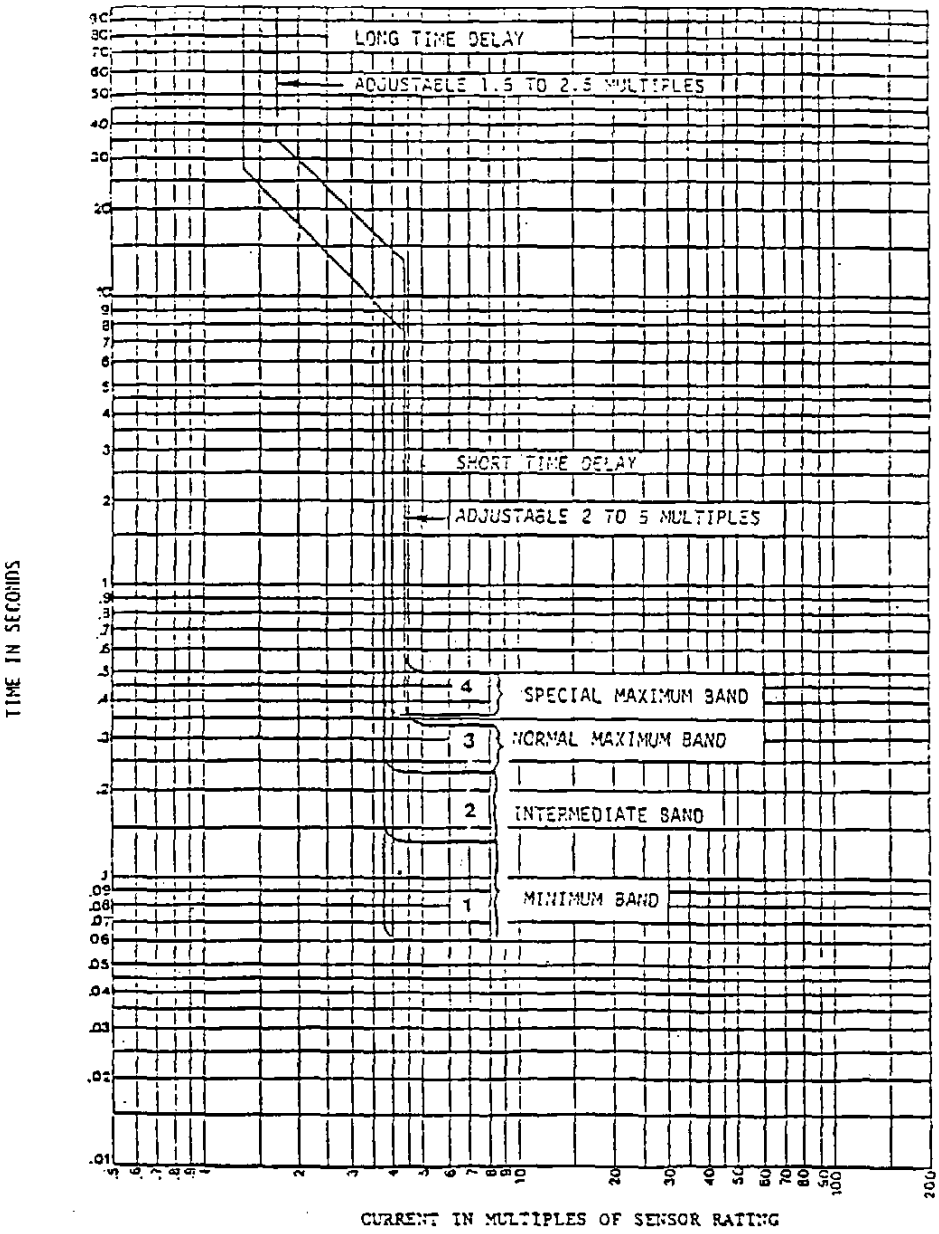
SH 12128 B

FIGURE 12B. Special purpose motor pick-up settings overcurrent coils.



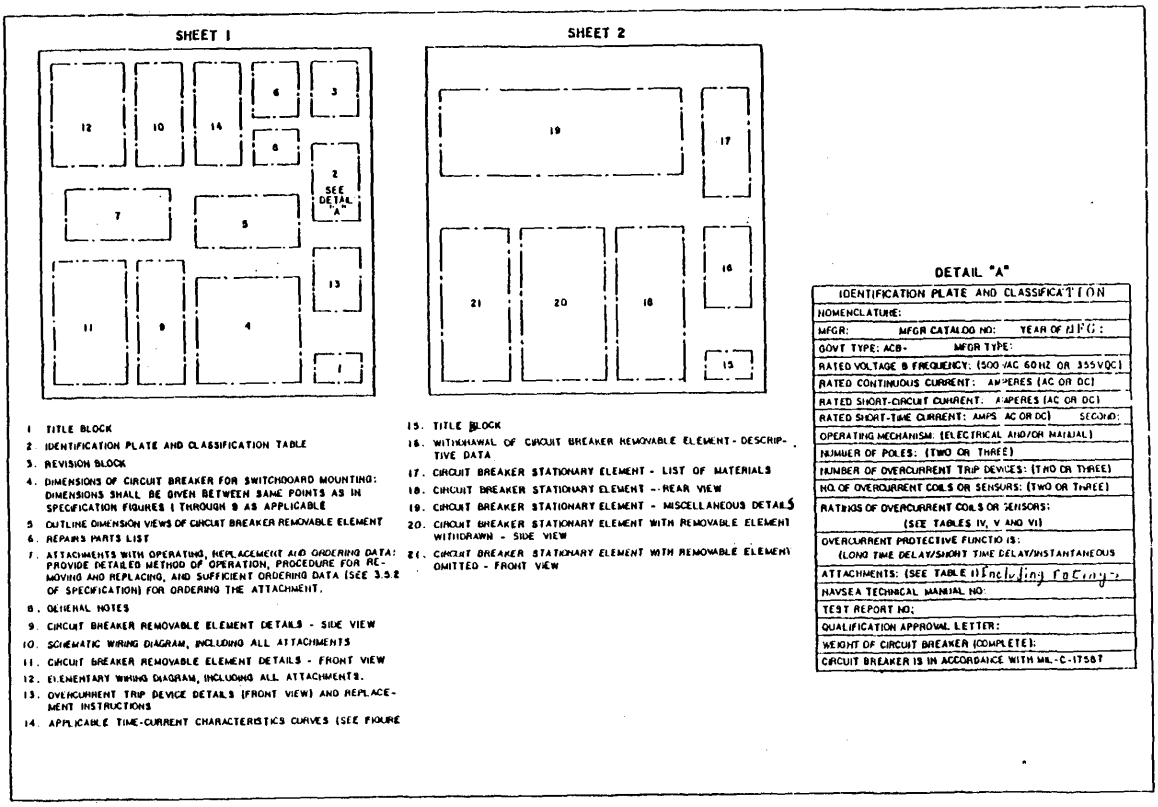
SH 12129

FIGURE 13. Time-current characteristics curve for circuit breaker types ACB-2002HR and ACB-6400HR.



SH 12130

FIGURE 14. Time-current characteristics curve for air circuit breaker type ACB-4001R.



1 TITLE BLOCK
2 IDENTIFICATION PLATE AND CLASSIFICATION TABLE
3. REVISION BLOCK
4. DIMENSIONS OF CIRCUIT BREAKER FOR SWITCHBOARD MOUNTING: DIMENSIONS SHALL BE GIVEN BETWEEN SAME POINTS AS IN SPECIFICATION FIGURES 1 THROUGH 9 AS APPLICABLE
5 OUTLINE DIMENSION VIEWS OF CIRCUIT BREAKER REMOVABLE ELEMENT
6. REPAIRS PARTS LIST
7. ATTACHMENTS WITH OPERATING, REPLACEMENT AND ORDERING DATA: PROVIDE DETAILED METHOD OF OPERATION, PROCEDURE FOR REMOVING AND REPLACING, AND SUFFICIENT ORDERING DATA (SEE 3.5.2 OF SPECIFICATION) FOR ORDERING THE ATTACHMENT.
8. GENERAL NOTES
9. CIRCUIT BREAKER REMOVABLE ELEMENT DETAILS - SIDE VIEW
10. SCHEMATIC WIRING DIAGRAM, INCLUDING ALL ATTACHMENTS
11. CIRCUIT BREAKER REMOVABLE ELEMENT DETAILS - FRONT VIEW
12. ELEMENTARY WIRING DIAGRAM, INCLUDING ALL ATTACHMENTS.
13. OVERCURRENT TRIP DEVICE DETAILS (FRONT VIEW) AND REPLACEMENT INSTRUCTIONS
14. APPLICABLE TIME-CURRENT CHARACTERISTICS CURVES (SEE FIGURE
15. TITLE BLOCK
16. WITHDRAWAL OF CIRCUIT BREAKER REMOVABLE ELEMENT - DESCRIPTIVE DATA
17. CIRCUIT BREAKER STATIONARY ELEMENT - LIST OF MATERIALS
18. CIRCUIT BREAKER STATIONARY ELEMENT - REAR VIEW
19. CIRCUIT BREAKER STATIONARY ELEMENT - MISCELLANEOUS DETAILS
20. CIRCUIT BREAKER STATIONARY ELEMENT WITH REMOVABLE ELEMENT WITHDRAWN - SIDE VIEW
21. CIRCUIT BREAKER STATIONARY ELEMENT WITH REMOVABLE ELEMENT OMITTED - FRONT VIEW

SH 7364

FIGURE 15. Typical master diagram.

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