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SUPERSEDING
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(See 6.8)

MILITARY SPECIFICATION

CIRCUIT BREAKERS (AUTOMATIC - ALB-1) AND SWITCH, TOGGLE (CIRCUIT BREAKER, NON-AUTOMATIC - NLB-1) AIR, INSULATED HOUSING, 125 VOLTS AND BELOW, A.C. AND D.C., (NAVAL SHIPBOARD USE)

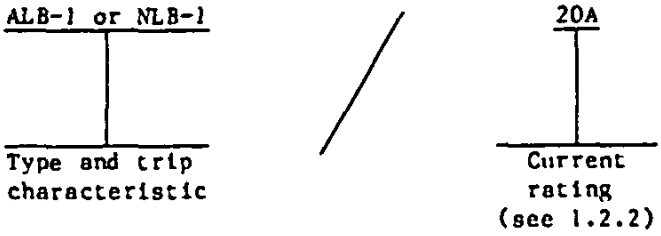
This specification is approved for use within the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

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

1.2 Classification. Circuit breakers (see 6.4.2) shall be of the types (see 6.4.28), current ratings, voltages, trip characteristics, and interrupting capacities with mounting bases as specified in 1.2.1 through 1.2.2. A circuit breaker rating shall be for 60 hertz (Hz), 400 Hz alternating current (ac) and direct current (dc) applications.

1.2.1 Type designation. The type designation shall be in the following form, as specified (see 6.2.1):



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 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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The type is identified by a three letter symbol and a number as shown in table I. The first letter identifies the operation and trip characteristic:

A denotes automatic trip at currents in excess of the specified rated values (see tables II, III, and IV).
N denotes the nonautomatic trip (cross-line interrupting switch).
The letters LB denote low voltage circuit breakers.
1 denotes the circuit breaker has one pole.

TABLE I. Type designation.

Type	Operation	Maximum trip element (or switch) rating amperes (frame size (see 6.4.5))
ALB-1	Automatic	50
NLB-1	Nonautomatic	50

1.2.2 Current rating. The current rating is identified by a number followed by the letter A, which identifies the maximum continuous current rating (see 6.4.4) of the device in amperes. The symbol 5A, for instance, identifies a 5 ampere (ac or dc) continuous current rating.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issues of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

QQ-S-365 - Silver Plating, Electrodeposited; General Requirements for.

MILITARY

MIL-M-14 - Molding Plastics and Molded Plastic Parts, Thermosetting.
MIL-S-901 - Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
MIL-E-917 - Electrical Power Equipment, Basic Requirements (Naval Shipboard Use).
MIL-P-15024 - Plates, Tags and Bands for Identification of Equipment.

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MIL-P-15024/5 - Plates, Identification.
MIL-E-17555 - Electronic and Electrical Equipment, Accessories and Repair Parts, Packaging and Packing of.

STANDARDS

MILITARY

MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).
MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.

(Copies of specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Circuit breakers furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time set for opening of bids (see 4.4 and 6.3).

3.2 Materials. Materials shall be selected from those listed in MIL-E-917 or as noted herein. Substitutes shall be as specified in MIL-E-917. Even though substitute material is authorized for use, the finished product shall conform to requirements specified herein and perform their specified functions. Components shall be free of mercury or mercury compounds and cadmium plating. Materials shall be asbestos-free.

3.2.1 Insulation. The insulation system used in the construction of circuit breakers, including plastic material used for the enclosure, shall meet minimum class B insulation requirements with individual materials having a temperature index of 130 degrees Celsius (°C) or higher, as specified in MIL-E-917.

3.2.2 Metals. Metals shall be of a corrosion-resistant type or shall be treated to resist corrosion as specified in MIL-E-917.

3.2.2.1 Dissimilar metals. Dissimilar metals in contact with each other shall be selected to conform to the requirements of MIL-E-917.

3.2.2.2 Current carrying connections. Current carrying connections shall be silver-plated in accordance with QQ-S-365. The plating shall equal or exceed 0.0002-inch thick and shall not show a tendency to peel or crack. Threaded surfaces shall have a silver thickness of at least 0.0002 inch.

3.2.3 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and may 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 Design and construction. Circuit breakers shall have the physical dimensions specified on figure 1.

3.3.1 Voltage. Circuit breakers shall be rated at 125 volts alternating current (Vac) and 125 volts direct current (Vdc).

3.3.2 Frequency. Circuit breakers shall operate on 60 Hz, 400 Hz ac and dc.

3.3.3 Housing. Circuit breakers shall be supported and enclosed in a housing made of molded insulating material in accordance with MIL-M-14, types MAT 30, MAI 60, MAI 30 or MMI 30.

3.3.3.1 Electrical insulation. Current carrying parts shall be fully enclosed within the housing (except terminals for connection to external circuits) and shall be inaccessible without dismantling the circuit breaker. The actuating handle shall be of an insulating material and shall not have any metal protruding above the circuit breaker cover.

3.3.3.2 Arc enclosure. Arcing contacts shall be shielded to confine the arc to the arc enclosure.

3.3.4 Operation.

3.3.4.1 Mechanism. The operating mechanism (see 6.4.10) shall be such that the contacts shall be quick-make (see 6.4.15) and quick-break (see 6.4.14) under all conditions of manual and automatic operation. They shall be capable of manual operation to the "on" and "off" positions, these positions being prominently marked in such a manner as to be easily and definitely identified. Assuming an approximate midposition, automatic tripping (see 6.4.1) of a circuit breaker shall be clearly indicated by the handle. The reset mechanism of type ALB-1 shall retain the actuating handle in the closed position after tripping occurs and shall not affect subsequent performance of the circuit breaker.

3.3.4.2 Trip free feature (type ALB-1 only) (see 6.4.23). Circuit breakers shall operate so that the mechanism cannot be held closed by physically holding the actuating handle in the closed position when carrying overload current which would normally automatically trip the breaker to the open position.

3.3.4.3 Trip indication (type ALB-1 only). Circuit breakers shall operate so that when the contacts open automatically on overload, the actuating handle shall indicate the operation by moving to the mid "trip" position (see 3.3.4.1).

3.3.4.4 Handle yoke. A handle yoke shall allow mechanical linking for opening and closing two or three circuit breakers at one time (see 6.4.7). A hole shall penetrate each circuit breaker handle to accommodate the handle yoke (see figure 1A).

3.3.5 Threaded and current carrying parts. Threaded parts and fasteners shall be in accordance with MIL-E-917. Current carrying threaded parts shall be silver-plated in accordance with QQ-S-365 (see 3.2.2.2).

3.3.6 Soldering. Soldering, when used, shall be in accordance with MIL-E-917.

3.3.7 Welding and brazing. Welding and brazing, when used, shall be in accordance with MIL-E-917.

3.4 Mounting and connections.

3.4.1 Mounting. Circuit breakers shall incorporate a plug-in current contact on the line side for mounting and removal from the front of panels by means of mounting bases (see figure 1D).

3.4.1.1 Mounting bases. Mounting bases shall allow electrical and mechanical connections of ALB-1 and NLB-1 circuit breakers. The mounting bases shall be constructed of material as specified in 3.3.3 and 3.3.5. Unless otherwise specified (see 6.2.1), mounting bases shall not be provided as a part of circuit breakers.

3.4.1.2 Special tools. The circuit breakers shall not require special tools for removal or installation.

3.4.2 Terminals and connectors. The plug-in terminal for types ALB-1 and NLB-1 shall permit the circuit breakers to be readily removed from the front of an energized panel on which they are mounted without access to the rear of the panel and without disturbing the connections or bus work on the rear of the panel. Lug terminals or studs connected to the circuit breaker or its mounting base shall not turn to reduce the electrical clearances.

3.4.3 Mounting position. Circuit breakers shall be capable of being mounted in any position. When mounted vertically, the "on" position shall be up. When mounted horizontally, the "on" position shall be toward the line side.

3.4.4 Interchangeability. Circuit breakers shall be interchangeable within the same type designation regardless of manufacturer. The overall dimensions and mounting details (including mounting base) shall be as specified on figure 1.

3.5 Trip element (type ALB-1). Type ALB-1 shall be furnished with integral, noninterchangeable, direct acting overcurrent trip element (see 6.4.13) with ratings as specified (see table II).

TABLE II. Types ALB-1 and NLB-1 current rating and interrupting/ withstand capacity characteristics.

Type designation	Current rating (per pole) amperes, ac rms or dc	Rated interrupting capacity amperes	
		60 and 400 Hz (rms)	Dc (maximum)
ALB-1/5A	5	1500	1500
ALB-1/10A	10	5000	2500
ALB-1/15A	15	5000	2500
ALB-1/20A	20	5000	2500
ALB-1/25A	25	5000	2500
ALB-1/30A	30	5000	2500
ALB-1/35A	35	5000	2500
ALB-1/40A	40	5000	2500
ALB-1/45A	45	5000	2500
ALB-1/50A	50	5000	2500
1/ NLB-1/50A	50	5000	2500

1/ The NLB-1/50A shall have a maximum withstand capacity in lieu of an interrupting capacity.

3.5.1 Thermal trip element. Thermal trip element shall operate in accordance with the requirements of this specification in an ambient temperature of 50°C. Tripping characteristics of the thermal element (see 6.4.21) shall be as specified (see table III) when tested in accordance with 4.8.4.

TABLE III. Type ALB-1 time delay series trip characteristics (thermal and thermal-magnetic elements).

Percent of rated current	Tripping time 1/
	50°C ambient
115	Not less than 1 hour
138	Less than 1 hour
200	Between 10 and 210 seconds

1/ The circuit breaker ratings shall not vary by more than 5 percent for each 10°C change in ambient temperature.

3.5.2 Thermal-magnetic element (see 6.4.22). In addition to the thermal element, the circuit breakers shall be provided with a magnetic instantaneous trip element (see table IV). Instantaneous (see 6.4.8) trip setting shall be some current value below the specified interrupting performance rating of the circuit breaker.

TABLE IV. Type ALB-1 instantaneous trip characteristics (thermal-magnetic and magnetic elements).

Type designation	Trip element rating-amperes	Maximum	
		Test current-amperes	Time-seconds
ALB-1	All	800	0.028

3.5.3 Trip element calibration. When circuit breakers are tested in accordance with 4.8.4, the tripping time (see 6.4.27) shall be as specified in tables III and IV. Circuit breakers shall also trip within these specified limits when subjected to the trip free calibration test specified in 4.8.4.4.

3.6 Interrupting performance rating. Interrupting performance rating of the circuit breakers shall be in accordance with table II.

3.7 Temperature rise. Circuit breakers shall operate (in an ambient of 50°C) with maximum temperature rises at the hottest point, where the current carrying part is in touch with the insulating material as follows:

(a) Contacts: 70°C.
(b) Terminals and slip type connectors: 65°C - Temperature rise on front of breaker at lug connection and on back of breaker at the stationary part of the slip type connector.

3.8 Dielectric withstanding voltage. Circuit breakers shall withstand a maximum dielectric withstanding voltage of 1250 volts for qualification inspection and a minimum of 750 volts after interrupting performance (see 4.8.2).

3.9 Insulation resistance. When circuit breakers are tested as specified in 4.8.3, the insulation resistance shall be not less than 100 megohms initially and not less than 10 megohms after shock or interrupting performance tests.

3.10 Creepage and clearance distances. Creepage and clearance distances shall be in accordance with MIL-E-917. Requirements for class 1 enclosures and set C spacings shall apply. Mounting screws, fittings, handles, and adjusting knobs shall be considered ground.

3.11 Vibration. The circuit breakers shall meet the type I vibration requirements of 4.8.9.

3.12 Shock. Circuit breakers shall meet the shock requirements of 4.8.10.

3.13 Inclination. Circuit breakers shall operate in accordance with the requirements specified herein when subjected to the inclination test of 4.8.11.

3.14 Endurance. Circuit breakers shall withstand a minimum of 10,000 cycles of make and break operations when tested in accordance with 4.8.7.

3.15 Designation and marking. Identification plates and other designation markings shall be in accordance with type A, B, or C of MIL-P-15024 and MIL-P-15024/5. These plates shall be installed and furnished as part of the circuit breakers.

3.15.1 Identification marking. Identification markings for circuit breakers shall be provided on an identification plate (located on either side of the molded enclosure) attached to the circuit breaker cover. Data on the identification plate shall consist of the following:

(a) Manufacturer's name.
(b) Manufacturer's part number.
(c) Government type designation.
(d) National stock number.
(e) Voltage and kind of current (60 or 400 Hz, ac and dc).
(f) Element rating - The element rating shall be stamped or engraved on the circuit breaker operating handle.

3.16 Technical data. The contractor shall prepare drawings and technical manuals in accordance with the data ordering documents included in the contract or order (see 6.2.2), and as specified in 3.16.1 and 3.16.2.

3.16.1 Drawings. Drawings shall include the information shown on figure 2 (see 6.2.2).

3.16.2 Technical manuals. When specified (see 6.2.1), technical manuals shall be furnished (see 6.2.2).

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 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Inspection system. The contractor shall provide and maintain an inspection system acceptable to the Government for supplies and services covered by this specification. The inspection system shall be as specified in the data ordering document (see 6.2.2).

4.1.3 The contractor shall prepare test reports in accordance with the data ordering document (see 6.2.2).

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

(a) Qualification inspection (see 4.4).
(b) Quality conformance inspection (see 4.5).
(c) Comparison inspection (see 4.7).

4.3 Test conditions. Except for those tests where the following factors are the variables, tests shall be conducted with the circuit breakers operating under the following conditions:

(a) The ambient temperature shall be 25 ± 3°C, and the relative humidity shall be between 25 and 50 percent.
(b) The supply voltage shall be the rated operating voltage.
(c) The supply frequency shall be the rated operating frequency.

4.4 Qualification inspection. Qualification inspection shall be conducted at a laboratory satisfactory to the Naval Sea Systems Command (NAVSEA). Qualification inspection shall consist of the examination and tests specified in table V. Examination and tests shall be conducted in the order listed in table V.

TABLE V. Qualification inspection of circuit breakers.

Inspection	Requirement paragraph	Inspection paragraph	Sample units						
			1	2	3	4	5	6	7
GROUP 1									
Visual and mechanical examination	3.2, 3.3 and 3.4	4.8.1	X	X	X	X		X	X
Calibration	3.5	4.8.4	X	X	X	X		X	X
Dielectric withstanding voltage	3.8	4.8.2	X	X	X	X		X	X
Insulation resistance	3.9	4.8.3	X	X	X	X		X	X
Inclination	3.13	4.8.11	X	X	X	X		X	X
Safety	3.17	4.8.1	X	X	X	X		X	X
GROUP 2									
Creepage and clearance	3.10	4.8.5	X		X			X	
Temperature rise	3.7	4.8.6	X		X			X	
Endurance	3.14	4.8.7	X		X			X	
Interrupting performance	3.6	4.8.8	X		X			X	
Dielectric withstanding voltage	3.8	4.8.2	X		X			X	
Insulation resistance	3.9	4.8.3	X		X			X	
Temperature rise	3.7	4.8.6	X		X			X	

TABLE V. Qualification inspection of circuit breakers. - Continued

Inspection	Requirement paragraph	Inspection paragraph	Sample units						
			1	2	3	4	5	6	7
GROUP 3									
Vibration	3.11	4.8.9					X		
Shock	3.12	4.8.10					X		
Calibration	3.5	4.8.4					X		
Dielectric withstanding voltage	3.8	4.8.2					X		
Insulation resistance	3.9	4.8.3					X		
Temperature rise	3.7	4.8.6					X		

4.4.1 Samples for qualification inspection. Examination and tests shall be conducted on a sample unit of each type circuit breaker listed in 1.2 together with associated mounting bases (see figure 1). List samples required are as follows:

Sample no. 1 - 60 Hz maximum trip element current rating.
Sample no. 2 - 60 Hz minimum trip element current rating.
Sample no. 3 - dc maximum trip element current rating.
Sample no. 4 - dc minimum trip element current rating.
Sample no. 5 - any rating within the maximum and minimum range for which qualification is sought.
Sample no. 6 - 400 Hz maximum trip element current rating.
Sample no. 7 - 400 Hz minimum trip element current rating.

4.4.1.1 Minimum sample size shall be five samples (samples 1 through 5). For 400 Hz, two additional samples (samples 6 and 7) shall be submitted.

4.4.2 Extent of qualification. Current rating range of any one circuit breaker type shall be between the two extreme current ratings (highest and lowest) which pass the qualification inspection. Qualification of the type ALB-1 circuit breaker shall include qualification of the type NLB-1 circuit breaker.

4.5 Quality conformance inspection. Quality conformance inspection shall consist of the tests specified in 4.6.

4.5.1 Lot. Circuit breakers of same element rating offered for delivery at one time by any one manufacturer shall be considered a lot.

4.5.2 Sampling. A random sample of units shall be selected from each lot as specified in table VI and subjected to the examination and tests specified in 4.6.

TABLE VI. Sampling for quality conformance inspection.

Number of items in lot offered for inspection	Number of items in sample
8 and under	2
9 - 15	3
16 - 25	5
26 - 40	8
41 - 65	13
66 - 110	20
181 - 300	30
301 - 500	40
Over 501	50

4.5.2.1 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. Such resubmittal lots shall be separate from new lots and shall be clearly identified as reinspected lots.

4.6 Inspection. Sample units selected in accordance with 4.5.2 shall be examined and tested as specified in table VII. Test cables shall be as shown on figure 3.

TABLE VII. Quality conformance inspection.

Examination or test	Requirement paragraph	Inspection paragraph
Visual and mechanical examination	3.2, 3.3 and 3.4	4.8.1
Calibration	3.5	4.8.4
Insulation resistance	3.9	4.8.3
Dielectric strength	3.8	4.8.2

4.7 Comparison inspection. At a maximum of 3-year intervals during which circuit breakers and attachments have been acquired under this specification, the manufacturer shall provide circuit breaker test samples with attachments and conduct tests at its expense. Sample units subjected to comparison inspection shall not be delivered on a contract or order.

4.7.1 Comparison inspection samples. One of each circuit breaker sample numbers 1, 3, and 6 specified in 4.4.1 shall be subjected to the tests shown in table V.

4.7.2 Comparison inspection of type NLB-1 circuit breakers. Satisfactory tests performed on an associated type ALB-1 circuit breaker frame shall be extended to cover the type NLB-1 circuit breaker.

4.7.3 Quality conformance production shock testing. A sample size in accordance with table VI shall be selected at random each month during production of ALB-1 and subjected to production shock testing.

4.7.3.1 Test periods shall begin with the first production run circuit breaker. Circuit breakers produced during the time period shall be tested during that time period. The manufacturer shall conduct the shock tests on the sample circuit breakers and file the data as production shock test records. The following tests shall apply:

(a) The circuit breaker shall be tested in the closed position.
(b) The circuit breaker shall be tested when mounted in its vertical and closed position and no load voltage is necessary.
(c) The circuit breaker shall be subjected to one hammer blow of a 3-foot drop from each direction - top, back, and side.

4.7.3.2 Acceptance criteria. The circuit breakers will be acceptable if the following criteria have been met:

(a) The circuit breaker remained closed during and following the test.
(b) The circuit breaker shall be turned off and then on after each hammer blow to verify that the mechanism has not jammed to the extent that it could not trip off.
(c) The circuit breaker shall pass long time and instantaneous calibration test after shock and remain within plus 15 percent of preshock calibration.
(d) The circuit breaker shall pass dielectric test after the shock test.

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

(a) If the cause can be identified, the circuit breaker shall be reworked and shipment shall be suspended until corrective actions have been completed. After the circuit breaker has been reworked, a randomly selected sample shall be production shock tested to confirm that the corrective action is effective. In case further reworking of the circuit breaker is necessary, a sample shall be randomly selected from the reworked lot and subjected to production shock test to confirm that the corrective action is effective.
(b) If the breaker fails but the cause cannot be identified, an additional breaker of the same ampere rating shall be randomly selected and subjected to the production level shock test. If it passes, production shall continue without disruption of shipments. The breaker which failed for unidentified cause and which could not be corrected shall be scrapped.

4.7.3.4 Disposition. The shock tested circuit breaker shall be inspected before shipment to insure it meets the electrical and mechanical requirements of the specification. It shall be identified as a breaker that went through a production shock test. Shock tested breakers that meet these requirements are acceptable for delivery.

4.8 Examination and test.

4.8.1 Visual and mechanical examination. Circuit breakers shall be examined to verify that materials, design, construction, and workmanship are in accordance with the requirements of 3.2 through 3.4.4. Physical dimensions shall be measured on two different circuit breakers of the same type for comparison inspection or quality conformance inspection.

4.8.2 Dielectric withstanding voltage. Circuit breakers shall be tested in accordance with method 301 of MIL-STD-202. There shall be no evidence of flashover, mechanical damage, arcing, or insulation breakdown. The following details shall apply:

(a) Magnitude of test voltage - 1,250 volts, except after interrupting performance test (see 4.8.8) the test voltage shall be 750 Vac.
(b) Points of application of test voltage:
With circuit breaker open
(1) Between live parts and metal parts which are considered ground potential.
(2) Between line and load terminals.
With circuit breaker closed
(1) Between live parts and metal parts which are considered ground potential.
(2) Between terminals of opposite polarity.
(c) Examination after test - circuit breakers shall be examined for evidence of flashover, mechanical damage, arcing, and insulation breakdown.
(d) As an alternative for production testing the circuit breaker may be tested for 1 second with a voltage 20 percent higher than that specified for the 60-second test.

4.8.3 Insulation resistance. Circuit breakers shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:

(a) Test condition B (500 volts).
(b) Point of measurement:
With circuit breaker open
(1) Between line and load terminals.
With circuit breaker closed
(1) Between pole and ground.

4.8.4 Calibration. Circuit breakers shall be tested with current flowing through the circuit breaker in an ambient temperature of 50 ± 5°C. Tests shall start with the circuit breaker parts at this ambient temperature. Calibration tests may be conducted at normal room ambient temperature if the appropriate correction factor for the deviation from the 50°C ambient temperature is applied (see 3.5.1).

4.8.4.1 Time delay trip characteristics (thermal). Circuit breakers shall be tested to determine that the tripping time at 115, 138, and 200 percent of rated current is in accordance with table III, as applicable.

4.8.4.2 Instantaneous trip characteristics. Instantaneous trip characteristics shall be tested by suddenly applying current of pre-calibrated value in accordance with table IV. The maximum current value test shall be performed followed after a cooling period of at least 15 minutes, by the minimum current value test.

4.8.4.3 Number of measurements. In order to determine the trip characteristics as specified in 4.8.4.1 and 4.8.4.2, one reading shall be taken at 115 percent of rated current and at least three readings shall be taken at 138 and 200 percent of rated current for the time delay trip and at the minimum current value for instantaneous trip.

4.8.4.4 Trip free calibration. The circuit breaker actuating handle shall be physically held in the closed position when the circuit breaker is subjected to one of the calibration measurements of 4.8.4.2 at both minimum and maximum current value.

4.8.5 Creepage and clearance. Creepage and clearance distances shall be demonstrated by actual measurement to be in accordance with 3.10.

4.8.6 Temperature rise. Circuit breakers shall be measured for temperature rise as specified in the "temperature measurement" section of MIL-E-917, for conformance to the requirements of 3.7.

4.8.7 Endurance. Circuit breakers shall be subjected to a total of 10,000 cycles of make and break operations with the circuit breakers energized at rated current and voltage (see 4.8.7.1 and 4.8.7.2) throughout the cycling period, at a uniform rate of 8 to 10 operations per minute. The endurance test shall simulate manual operation of the circuit breaker. Proper mechanical and electrical operation shall be monitored throughout the test. At the conclusion of the cycling, circuit breakers shall be examined for electrical and mechanical damage or loose parts.

4.8.7.1 Ac endurance test. Circuit breakers shall be subjected to the endurance test specified in 4.8.7 at a rated current and voltage at a frequency of 60 or 400 Hz, as applicable. The initial 5000 cycles of operation shall be at a lagging power factor (pf) between 0.9 and unity. The second 5000 cycles of operation shall be at a lagging pf between 0.75 and 0.8.

4.8.7.2 Dc endurance test. Circuit breakers shall be subjected to the endurance test specified in 4.8.7 at rated dc and voltage with a resistive load.

4.8.8 Interrupting performance. Circuit breakers shall be subjected to the ac or dc interrupting performance test (see 4.8.8.2 and 4.8.8.3). There shall be no failure, no evidence of objectionable mechanical damage or loosening of parts. The test circuit shall be calibrated to the specified interrupting capacity current in accordance with table II at rated voltage. The circuit breaker under test shall be omitted from the test circuit or short circuited, during the calibration of the test circuit. Circuit breakers shall also meet the following requirements after the interrupting performance rating test:

(a) Dielectric withstanding voltage (see 3.8) test potential 750 volts.
(b) Insulation resistance shall equal or exceed 10 megohms.
(c) Temperature rise (see 3.7). The rated temperature rise specified in 3.7 may be exceeded, provided the total temperature (ambient plus temperature rise) remains within 150 percent of the temperature specified in 3.7.

4.8.8.1 Test sequence (interrupting performance tests). Interrupting performance tests shall consist of one "O" unit operation (see 6.4.29) followed by two "CO" unit operations followed by two "O" unit operations for a total of five interrupting tests. There shall be a 2-minute interval between the first "O" unit operation and the first "CO" unit operation. Subsequent unit operations shall be conducted at 5-minute intervals. Cheese cloth placed around the actuating handle and at the terminals shall not be ignited, and the circuit breaker shall be mechanically and electrically operable at the conclusion of the test. After interrupting performance, circuit breakers shall be subjected to the following tests:

(a) Insulation resistance (see 4.8.3).
(b) Dielectric withstanding voltage (see 4.8.2).
(c) Temperature rise (see 4.8.6).

4.8.8.2 Ac test. Ac interruption tests shall be made in a circuit having a lagging pf between 0.45 and 0.50. The test circuit current shall be the total root mean square (rms) current, including the dc component. It shall be measured at an instant 1/2 cycle after the short circuit occurs, and shall be calculated in accordance with the following:

(a) Symmetrical waves. Currents which are symmetrical about the zero axis have an rms value equal to the peak-to-peak value divided by 2 times the square root of 2. Peak-to-peak value at the desired instant shall be measured from the envelope of the current wave.
(b) Asymmetrical waves. These may be considered as composed of two components, an alternating and a direct component. The alternating component has a peak-to-peak value equal to the distance between the envelopes and has an axis midway between the envelopes. It shall be measured as for the symmetrical waves. The direct component has an amplitude equal to the displacement of the axis of the alternating component. The total rms value of an asymmetrical wave is equal to the square root of the sum of the symmetrical and direct components taken at the desired instant.

4.8.8.3 Dc test. For dc interrupting tests, 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 amperes per second.

4.8.9 Vibration. Circuit breakers with associated mounting bases shall be tested in both the open and closed position in accordance with type I requirements of MIL-STD-167-1. There shall be no evidence of electrical or mechanical damage or loosening of parts. Circuit breakers shall also meet the following requirements:

(a) When tested in the open position, the current carrying contacts shall not close.
(b) When tested in the closed position, contacts shall not open in excess of 0.02-second duration nonaccumulative.
(c) Circuit breakers shall be capable of fully meeting performance requirements noted herein.

During the testing the circuit breakers shall be mounted in a vertical position, on a rigid plate without the use of resilient mountings. The circuit breakers shall be carrying rated continuous current at any convenient voltage (rated or below) during tests in the closed position. Closed contacts shall be monitored for momentary opening. After the vibration test, the circuit breakers shall be examined for evidence of mechanical damage or loosening of parts.

4.8.10 Shock. Circuit breakers shall be tested in both the open and closed position in accordanace with the shock test specified in MIL-S-901. Tests as specified in MIL-S-901, for grade A, class I, type C equipment are applicable. There shall be no evidence of electrical or mechanical damage or loosening of parts. The design of anti-shock devices, where used, shall be such that they shall not interfere with the specified tripping performance of the circuit breaker. Circuit breakers shall also meet the following requirements:

(a) When tested in the open position, the current carrying contacts shall not close.
(b) When tested in the closed position, the current carrying contacts shall not open in excess of 0.02-second duration for a single hammer blow.
(c) Calibration after the shock test shall vary not more than plus 15 percent from the values measured prior to shock test (see 3.5.1 and 3.5.3).
(d) Insulation resistance after the shock test shall be not less than 10 megohms (see 3.9).
(e) Dielectric withstanding voltage (see 3.8).

Mounting for shock testing shall be in accordance with fixture 6E of MIL-S-901. Circuit breakers shall be carrying rated continuous current during shock tests when in the closed position. After each shock machine hammer blow, the circuit breaker handle shall be operated in order to check proper operation of the latching mechanism. A recording oscillograph, or other means, shall be utilized to monitor the contacts during shock test. Monitoring means shall be sufficiently sensitive to detect momentary opening of closed contacts of 0.02 second or more. After shock test, circuit breakers shall be subjected to the following examinations and tests:

(a) Examination for evidence of mechanical damage or loosening of parts (see 4.8.1).
(b) Calibration (see 4.8.4).
(c) Insulation resistance (see 4.8.3).
(d) Dielectric withstanding voltage (see 4.8.2).

4.8.11 Inclination. Circuit breakers shall be tested to determine that the tripping time at 115, 138, and 200 percent of rated current is in accordance with table III in each position of inclination. The position of inclination shall be 45 degrees in any direction from the normal vertical position. This test may be combined with the test specified in 4.8.4.1 as one of the three measurements specified in 4.8.4.3, or may be conducted as a separate additional calibration.

4.8.12 Handle yoke operation. Circuit breakers shall be tested with two- and three-circuit breaker handle yokes to ensure simultaneous close and open operations (see 3.3.4.4).

4.9 Packaging inspection. Sample packages and packs and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.7).

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

6. NOTES

6.1 Intended use. The principal application of circuit breakers covered by this specification is to provide overcurrent protection, high speed clearing of faults, and as circuit disconnect switches in 125 Vac (60 or 400 Hz) or 125 Vdc circuits where the available short circuit current is less than the specified circuit breaker interrupting capacity (see table II).

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 designation (see 1.2.1).
(c) Mounting bases if required and the configuration (see 3.4.1.1).
(d) Number of technical manuals required (see 3.16.2).
(e) Levels of preservation-packaging and packing required (see 5.1).
(f) Special marking required (see 5.1).
(g) Repair parts required (see 6.5.2).

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, 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 Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) 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 are cited in the following paragraphs.

Paragraph no.	Data requirement title	Applicable DID no.	Option
3.16	Drawings, engineering and associated lists	DI-E-7031	Level 3 Design activity designation - Contractor Design number - Contractor Certification data sheets - Required
3.16	Manuals, technical, preliminary	DI-M-2043	MIL-M-15071, type I
4.1.2	Inspection system program plan	DI-R-4803	----
4.1.3	Reports, test	DI-T-2072	MIL-STD-831
4.1.3	Report, equipment shock test	UDI-T-23753	----

(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 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of the 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 Qualification. 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 Qualified Products List QPL-17588 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 purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101, 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 Definitions.

6.4.1 Automatic tripping. Automatic tripping is the opening of a circuit breaker under predetermined or other conditions without the intervention of an operator.

6.4.2 Automatic circuit breaker (ALB). An ALB is a device designed to manually open and close a circuit and to open the circuit automatically on a predetermined overcurrent and time duration within its rating without damage to itself when properly applied within its rating.

6.4.3 Nonautomatic circuit breaker. A nonautomatic circuit breaker is a device designed to manually open and close a circuit (within its rating) without an automatic tripping feature.

6.4.4 Continuous current rating. Continuous current rating is maximum dc or rms current, in amperes, at rated frequency which a device or an assembly will carry continuously without exceeding the specified limits of temperature rise.

6.4.5 Frame size. Frame size is a term applied to a group of molded case circuit breakers which are physically interchangeable with each other. Frame size is expressed in amperes and corresponds to the largest ampere rating available in the group. The same frame size designation may be applied to more than one group of circuit breakers. These groups may or may not be physically interchangeable with each other, whether furnished by one manufacturer or various manufacturers.

6.4.6 Front connected. A front connected circuit breaker is one in which the terminals for connecting or disconnecting conductors are accessible from the front of the circuit breaker.

6.4.7 Handle yoke. A handle yoke is a rigid, metallic mechanical connector used for interlocking operating handles of two or three separate circuit breakers to provide simultaneous open and close operations.

6.4.8 Instantaneous. Instantaneous is a term indicating that essentially no delay is purposely introduced in the action of the device.

6.4.9 Interrupting rating. (See 6.4.16.)

6.4.10 Operating mechanism. Operating mechanism of a circuit breaker is a manual mechanism by which the contacts of all poles are actuated.

6.4.11 Operating duty. Operating duty of a circuit breaker is the capability to perform a maximum specified number of unit operations at stated intervals.

6.4.12 Operating time. Operating time is the total interval of elapsed time from the moment of energizing the trip coil to the completion of the interruption of the circuit at rated voltage.

6.4.13 Overcurrent trip element. Overcurrent trip element is a device which, for a given pole of a circuit breaker, detects overcurrent and transmits the energy necessary to trip the circuit breaker automatically. It may actuate the breaker operating mechanism directly or may form part of a trip unit.

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

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

6.4.16 Rated interrupting current (interrupting rating). Rated interrupting current is the maximum current at rated voltage which a circuit breaker is required to interrupt under the operating duty specified and with a normal frequency recovery voltage not less than the rated voltage.

6.4.17 Removable mounting. Removable mounting applies to a circuit breaker which has slip (separable) type disconnecting copper connections and its frame is mounted by supporting screws or other similar means.

6.4.18 Reset time. Reset time is the minimum time interval between automatic tripping of the circuit breaker at its full interrupting rating and ability to operate the manual resetting of the operating mechanism.

6.4.19 Series overcurrent tripping. Series overcurrent tripping signifies the tripping of a circuit breaker by a trip element in series with the main circuit, responsive to an increase in the main circuit current.

6.4.20 Terminal, stud. Stud terminal is an item of electrically conductive material designed for permanent or semi-permanent connections to project through or into a panelboard, or mounting, and to which an electrical conductor can be attached by means of soldering, clamping, or screwing, to facilitate the distribution, continuation, or ending of an electrical circuit.

6.4.21 Thermal element. Thermal element denotes thermal responsive protective device which under overload and short circuit conditions causes the circuit breaker mechanism to trip.

6.4.22 Thermal-magnetic element. Thermal-magnetic element denotes a combination thermal responsive and magnetic loop protective device which under overload condition trips the circuit breaker mechanism with time delay and under short circuit conditions the mechanism is tripped without intentional time delay.

6.4.23 Trip free. Trip free is when the tripping mechanism can trip even though the manual operating lever is held in the closed position.

6.4.24 Trip free in any position. A circuit breaker is trip free in any position when it is free to trip at any part of the closing operation.

6.4.25 Trip unit. A trip unit is a self-contained assembly of a circuit breaker comprising the means for actuating the operating mechanism to open the circuit breaker contacts automatically. It contains one or more overcurrent trip elements.

6.4.26 Tripping. Tripping is the automatic opening of a circuit breaker due to an overcurrent or remote and manual trip actuation.

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

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

6.4.29 Unit operation. Unit operation consists of one of the following:

(a) Tripping on overcurrent without purposely delayed action.
(b) Closing followed immediately by its tripping on overcurrent without purposely delayed action.

The letter "O" signifies the unit operation of the circuit breaker - OPENING. The letters "CO" signify the unit operation of the circuit breaker - CLOSING - OPENING.

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

6.5.1 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.

6.5.2 Repair parts. When specified (see 6.2.1), one complete circuit breaker should be furnished as a repair part for each 10 or less circuit breakers of a specific type designation (see 1.2.1).

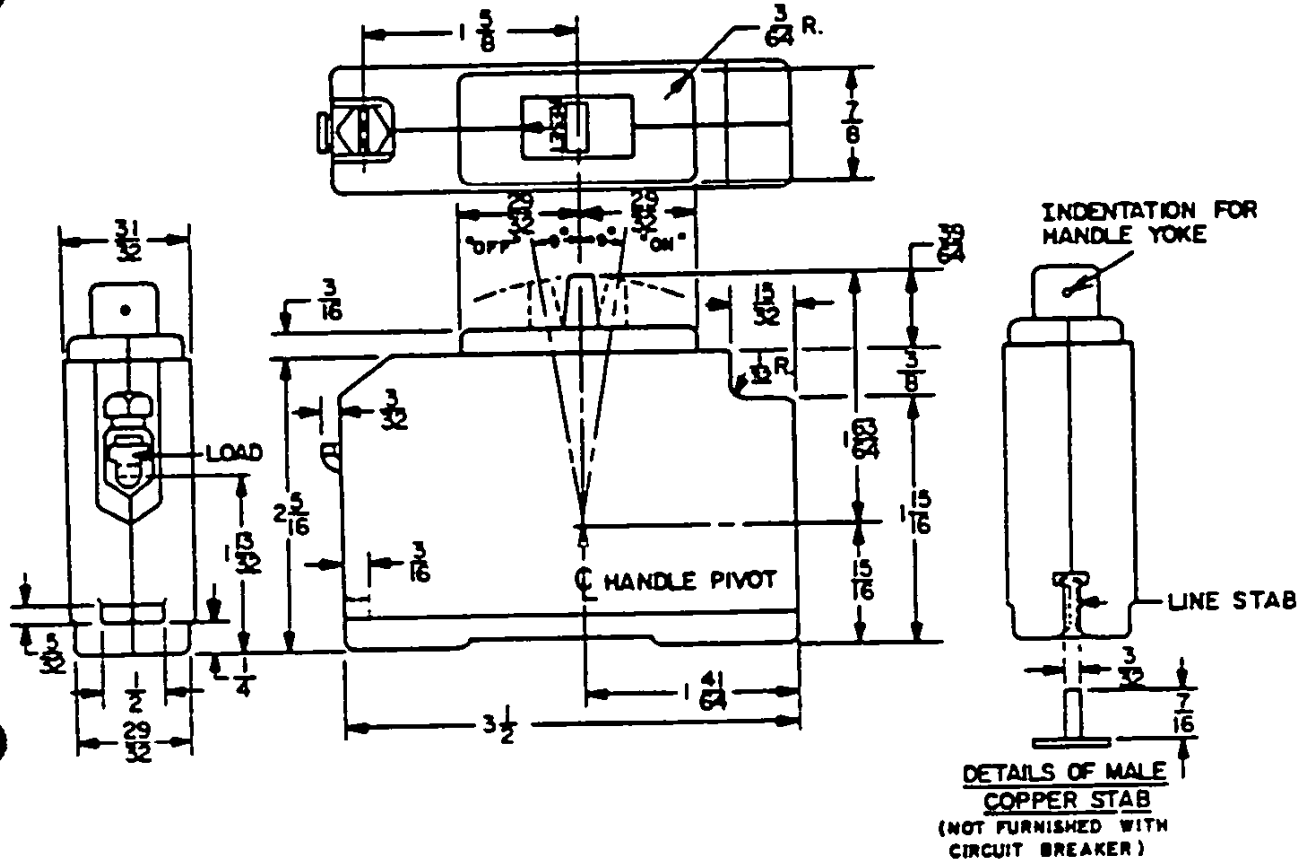
6.6 Replacement. Types ALB-5, ALB-10, NLB-5, and NLB-10 of MIL-C-17588C(SH) were deleted by MIL-C-17588D(SH) and replaced by circuit breakers in accordance with MIL-C-17361D(SH) as follows:

MIL-C-17588C(SH)	MIL-C-17361D(SH)
ALB-5	AQB-A50
ALB-10	AQB-A101
NLB-5	NQB-A50
NLB-10	NQB-A101

6.7 Sub-contracted material and parts. The packaging 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 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.

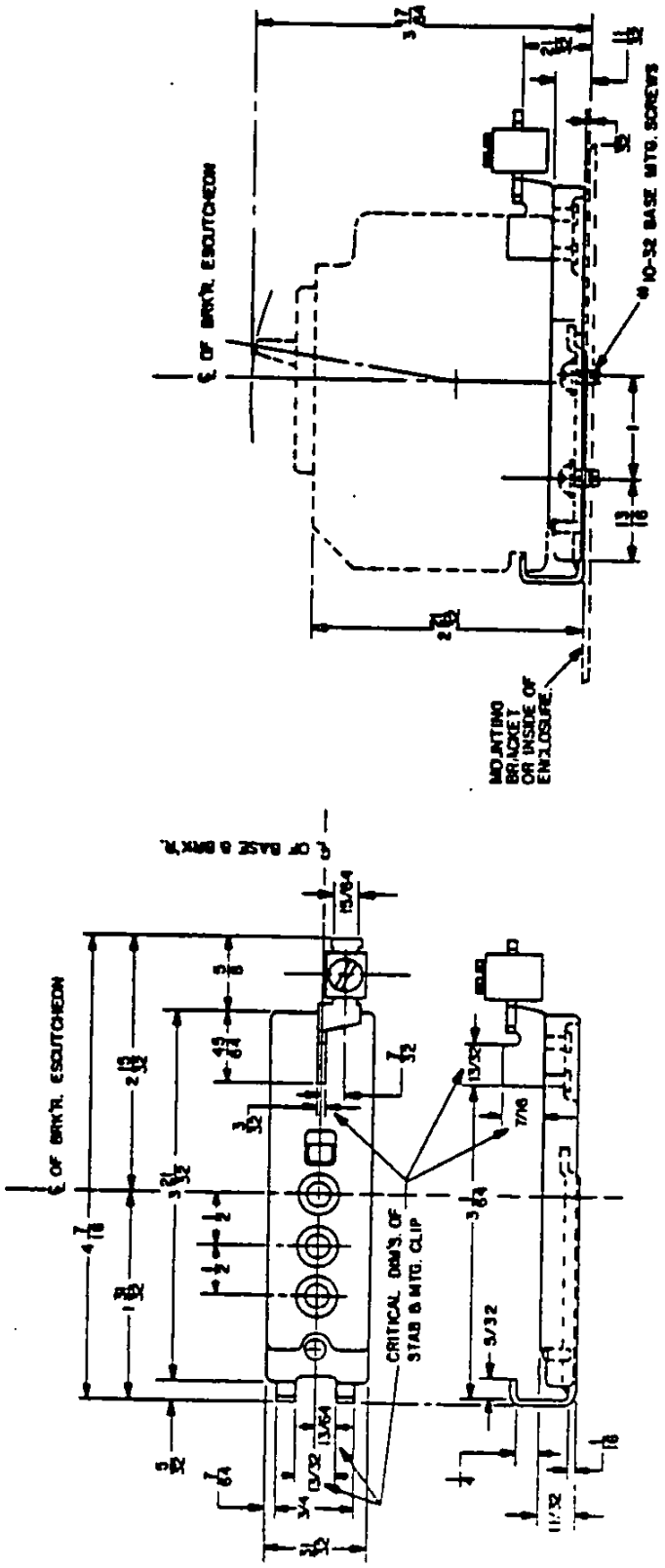
Preparing activity:
Navy - SH
(Project 5925-N095)



SH 10590

1A. Outline dimensions.

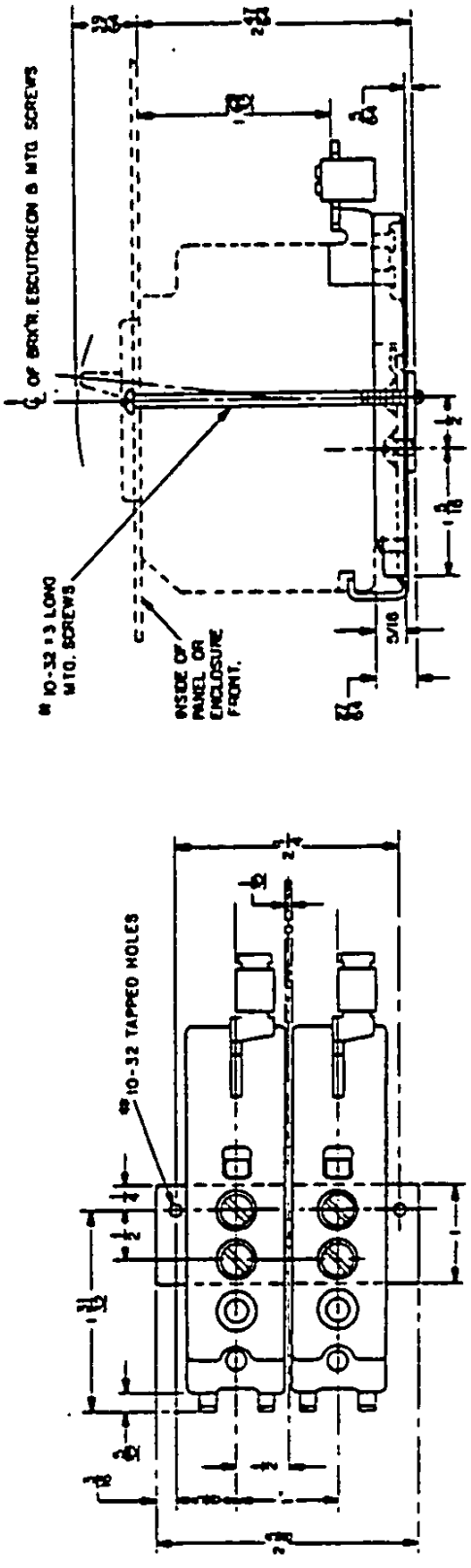
FIGURE 1. Type ALB-1, thermal-magnetic, enclosed, trip free (single pole) and type NLB-1, switch, toggle (nonautomatic).



SH 10591

18. Outline dimensions for mounting bases for one circuit breakers.

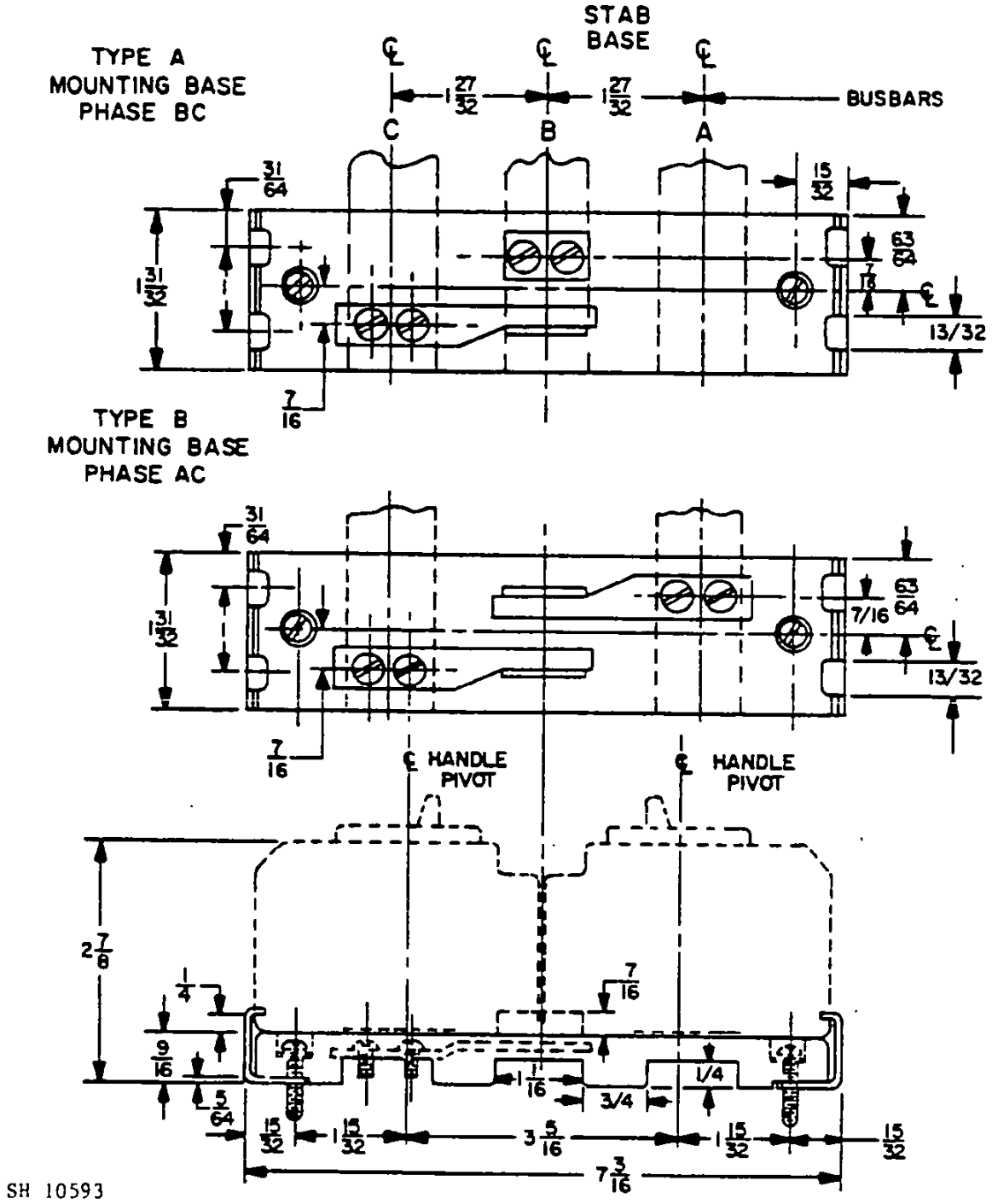
FIGURE 1. Type ALB-1 thermal-magnetic, enclosed, trip free (single pole) and type NLB-1, switch, toggle (nonautomatic). - Continued



SH 10592

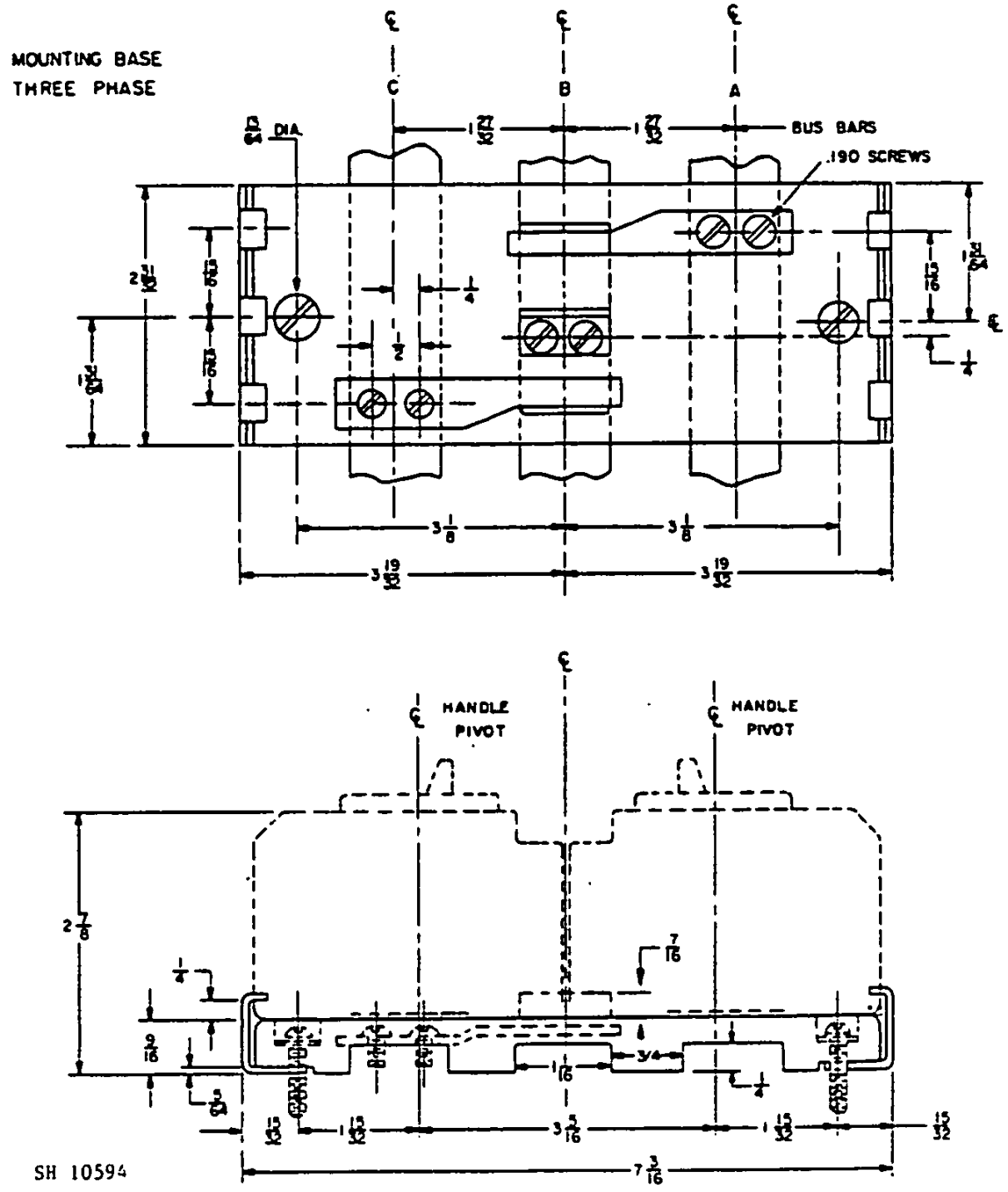
10. Outline dimensions for mounting bases for two circuit breakers.

FIGURE 1. Type ALB-1 thermal-magnetic, enclosed, trip free (single pole) and type NLB-1, switch, toggle (nonautomatic). - Continued



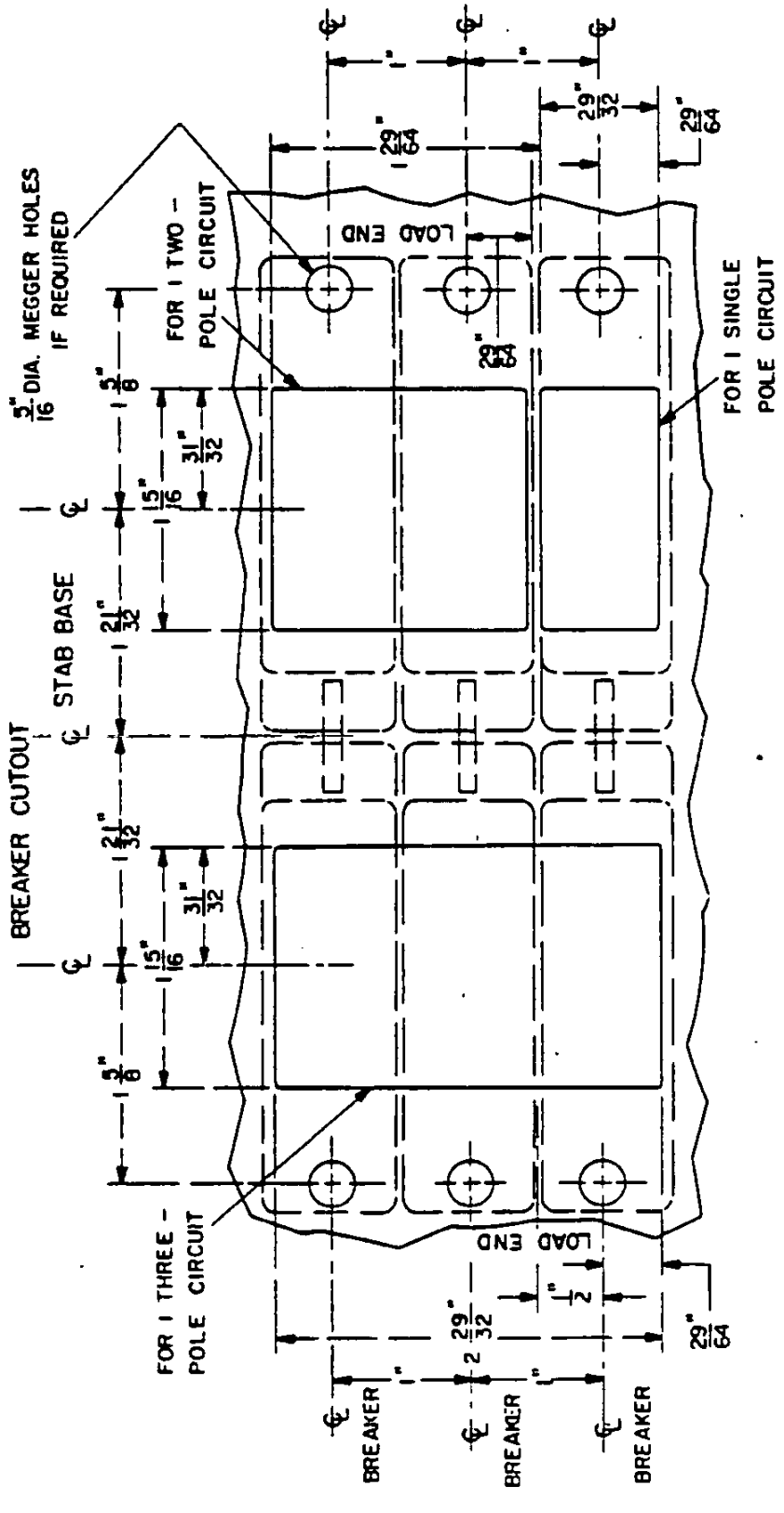
1D. Outline dimensions for mounting bases for four circuit breakers.

FIGURE 1. Type ALB-1, thermal-magnetic, enclosed, trip free (single pole) and type NLB-1, switch, toggle (nonautomatic). - Continued



1E. Outline dimensions for mounting bases for six circuit breakers.

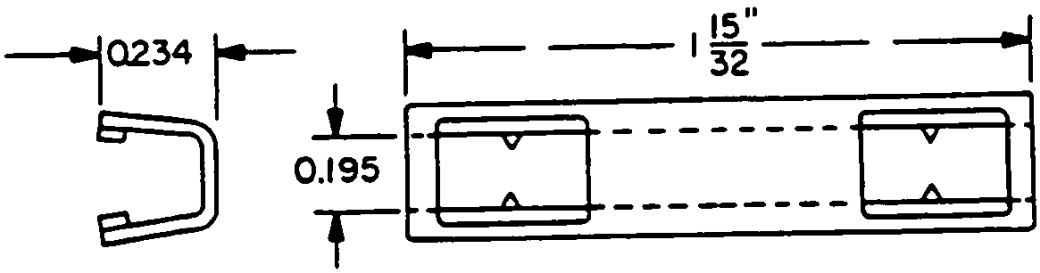
FIGURE 1. Type ALB-1, thermal-magnetic, enclosed, trip free (single pole) and type NLB-1, switch, toggle (nonautomatic). - Continued



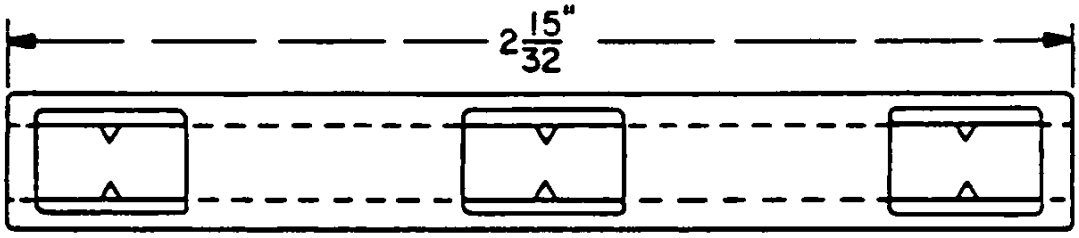
1F. Front panel cutouts.

FIGURE 1. Type ALB-1, thermal-magnetic, enclosed, trip free (single pole) and type NLB-1, switch, toggle (nonautomatic). - Continued

SH 10595



HANDLE YOKE, TWO POLE APPLICATION



HANDLE YOKE, THREE POLE APPLICATION

SH 10596

1G. Handle yokes.

FIGURE 1. Type ALB-1, thermal-magnetic, enclosed, trip free (single pole) and type NLB-1, switch, toggle (nonautomatic). - Continued

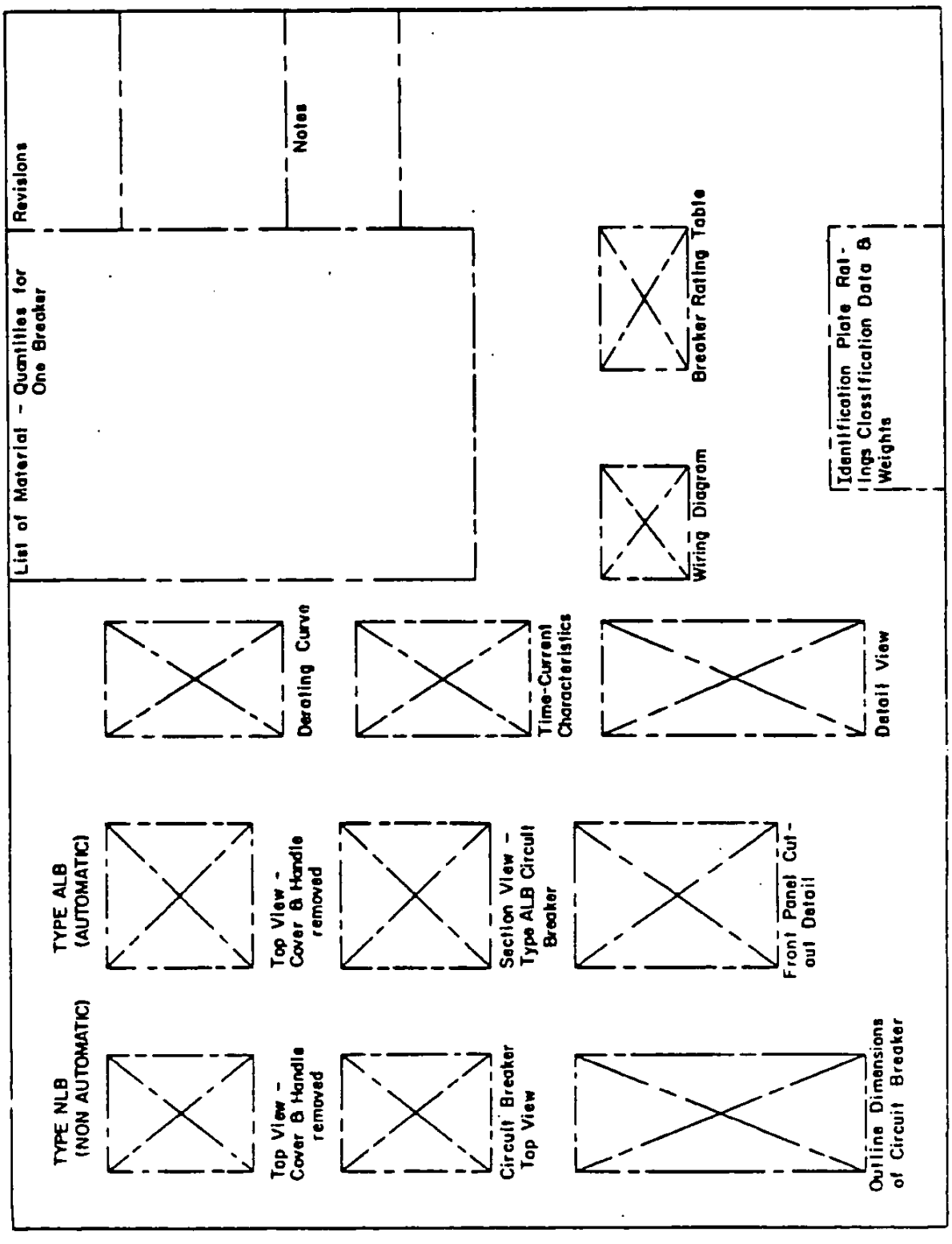
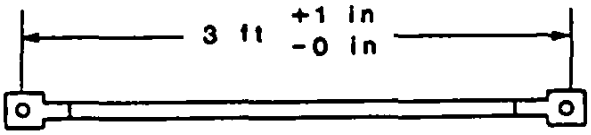


FIGURE 2. Drawing format.



Terminal size shall conform to cable size

Insulated cable copper conductor nominal size	Circuit breaker current rating amperes
10	40 - 50
12	30 - 35
14	10 - 25
16	5

SH 1320152

FIGURE 3. Test cables.