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UL 1066A

OUTLINE OF INVESTIGATION

FOR

US NAVAL COMMERCIAL OFF THE SHELF (COTS) DESIGNATED
THREE-POLE LOW-VOLTAGE AC POWER CIRCUIT BREAKERS,
DRAWOUT-MOUNTED TYPE, AND ACCESSORIES/FUNCTIONAL
COMPONENTS FOR USE ON NON-NUCLEAR NAVAL COMBATANT SHIPS

ISSUE NO. 1

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Summary of Topics

*This is the first issue of the Outline of Investigation for US Naval COTS
Designated Three-Pole Power Circuit Breakers for Use on Non-Nuclear
Naval Combatant Ships.*

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INTRODUCTION

1 Scope

1.1 These requirements cover three-pole low-voltage AC power circuit breakers, drawout-mounted type, and applicable accessories/functional components intended for use aboard non-nuclear Naval combatant ships in electrical assemblies (such as switchgear, switchboards, and load centers) installed on shock isolators (mounts).

1.2 Successful initial qualification testing and requalification testing of circuit breakers/ accessories/functional components to the requirements of this Outline shall allow their use in shock-mounted electrical assemblies in non-nuclear Naval combatant ships.

2 Normative References

2.1 This Outline references the following COTS specifications:

- a) UL 1066, Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
- b) UL 1066 Supplement SA, Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures (Naval Use)
- c) IEC 60947-2, Low-voltage switchgear and controlgear – Part 2: Circuit-breakers
- d) ANSI C37.50 Low-Voltage AC Power Circuit Breakers Used in Enclosures-Test Procedures
- e) IEEE C37.100 Standard Definitions for Power Switchgear

2.2 This Outline references the following military specifications/documents. Specifications/documents can be accessed at <https://assist.daps.dla.mil/quicksearch/>.

- a) MIL-E-917, Electric Power Equipment, Basic Requirements
- b) MIL-HDBK-454, General Guidelines for Electronic Equipment
- c) MIL-STD-1399-300B, Interface Standard Section 300B, Electric Power, Alternating Current
- d) MIL-STD-202, Test Method Standard, Electronic and Electrical Component Parts
- e) MIL-STD-130, Department of Defense Standard Practice, Identification Marking of U.S. Military Property
- f) MIL-STD-461, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
- g) DI-EMCS-80200, Electromagnetic Interference Test Report (EMITR)
- h) DI-EMCS-80201, Electromagnetic Interference Test Procedures (EMITP)
- i) MIL-STD-108, Definitions of and Basic Requirements for Enclosures for Electrical and Electronic Equipment

3 Glossary

3.1 See IEEE C37.100 for standard definitions for power switchgear except as modified or added to by the requirements of this Outline.

3.2 **CONNECTED POSITION** – That position of the removable element (circuit breaker) in which both primary and secondary disconnecting devices are in full contact.

3.3 **CRADLE** – The stationary element mounted in electrical assemblies for drawout-mounted type circuit breakers without the necessity of unbolting connections or mounting supports.

3.4 **DISCONNECTED POSITION** – That position in which the primary and secondary disconnecting devices of the removable element (circuit breaker) are separated by a safe distance from the stationary element (cradle) contacts.

3.5 **ELECTRONIC DEVICES** – Active electrical components such as transistors, diodes and integrated circuits, and associated passive interconnection technologies as would typically be found on a printed circuit board.

3.6 **TEST POSITION** – That position in which the primary disconnecting devices of the removable element (circuit breaker) are separated by a safe distance from those in the stationary element (cradle), and some or all of the secondary disconnecting devices are in operating contact.

3.7 **WITHDRAWN POSITION** – That position in which the primary and secondary disconnecting devices of the removable element (circuit breaker) are separated by a safe distance from the stationary element (cradle) and the removable element (circuit breaker) is fully extended on the cradle rails/tray.

CONSTRUCTION

4 General

4.1 General

4.1.1 Circuit breakers and required accessories/functional components shall meet the construction requirements of UL 1066 except as modified or added to by the requirements of this Outline.

4.1.2 Required accessories shall include auxiliary switches and undervoltage release devices.

4.1.3 Required functional components shall include the power operated mechanism, shunt trip devices, mechanical operations counter, cell switch, racking position indicator, stored energy (springs charged) indicator, primary and secondary disconnects, manual trip, ground connection, and contact position (open/closed) indicator.

4.1.4 The following materials and coatings are non-preferred and shall be identified in the qualification and requalification reports:

- a) Navy-prohibited materials as defined by MIL-E-917 including estimated maximum weight per circuit breaker and per accessory/functional component.
- b) Insulating materials which contain halogens, e.g. chlorine, fluorine, and bromine, which evolve gases during combustion including estimated maximum weight per circuit breaker and per accessory/functional component.

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c) Corrosion-susceptible materials and coatings that are not in accordance with MIL-E-917 requirements.

d) Organic materials not inherently fungus resistant or validated to be fungus resistant. Refer to MIL-HDBK-454, Guideline 4.

e) Lead free solder.

4.1.5 All printed circuit boards shall be conformal coated.

4.1.6 Aluminum or aluminum alloy conductors or terminals shall not be used.

4.1.7 Minimum design creepage and clearance distances shall be identified in the qualification and requalification reports. Creepage and clearance distances that are not in accordance with MIL-E-917 Set C, and enclosed requirements shall be clearly identified as maintenance items.

4.1.8 In order to comply with the anti-rolling/retention tests specified in Section 7, manual or automatic means may be used to prevent the circuit breaker from moving.

4.1.9 Circuit breakers over 200 pounds shall be provided with construction suitable for overhead lifting.

4.1.10 A long time delay calibration setting or settings shall be provided to allow circuit breakers to remain closed for 5 minutes at 150 percent of maximum continuous current rating.

4.2 Drawout-mounted

4.2.1 Circuit breakers shall be drawout-mounted type.

4.2.2 Circuit breaker/cradle configurations shall be provided with connected, test, and disconnected, and withdrawn positions as defined in Section 3. The connected, test, and disconnected positions shall be shown on the racking position indicator. If the disconnected and withdrawn positions are the same for a particular design, the manufacturer shall state this in the qualification report.

4.2.3 When in the connected position, the circuit breaker shall operate manually and electrically and the circuit breaker main contacts and control circuitry shall be energized.

4.2.4 When in the test position, the circuit breaker shall operate manually and electrically without energizing the circuit breaker main contacts. Control circuitry shall remain energized.

4.2.5 When in the disconnected position, the circuit breaker main contacts and control circuitry shall not be energized. The circuit breaker shall operate manually.

4.2.6 When in the withdrawn position, the circuit breaker will be in the disconnected position and fully extended on the cradle rails/tray.

RATINGS

5 General

5.1 The circuit breakers shall be rated 508 VAC as defined by UL 1066.

5.2 The circuit breakers shall be rated 60 Hz as defined by ANSI C37.50.

5.3 Recommended frame sizes are shown in Table 5.1.

Table 5.1
Recommended circuit breaker frame sizes and short-circuit and short-time current ratings

Frame size (Amps)	AC Voltage 60 Hz (Nominal)	60 Hz Short-circuit current rating O-CO-CO test sequence (rms symmetrical kA)	60 Hz Short-time current rating for 1 second duration (rms symmetrical kA)
2000	480	85	85
4000	480	85	85
4800	480	85	85

5.4 The short-circuit and short-time current ratings as defined by UL 1066 and this Outline shall be stated by the manufacturer in rms symmetrical amperes. Recommended short-circuit and short-time current ratings are shown in Table 5.1. Short-circuit and short-time current ratings greater than those shown in Table 5.1 may be substituted.

5.5 The recommended nominal operating voltage for accessories and applicable functional components is 120 VAC.

5.6 Details on proposed frame sizes, ratings, and nominal operating voltages that are not in accordance with 5.5 and Table 5.1 shall be submitted to Naval Sea Systems Command (NAVSEA) Electrical Systems Technical Warrant Holder (TWH) and TWH representative prior to the start of testing. NAVSEA Electrical Systems TWH or TWH representative shall provide final approval of new circuit breaker characteristics prior to the start of testing.

PERFORMANCE

6 Base Design

6.1 Circuit breakers shall comply with the performance requirements in IEC 60947-2 and/or UL 1066 and in addition shall comply with performance requirements in Sections 7 and 8 of this Outline.

7 Initial Qualification Testing

7.1 General

7.1.1 Test Programs Q1, Q2, Q3, and Q4 shall be conducted as defined by this Outline and in the order shown in Tables 7.1 – 7.4, respectively. All tests for a particular test program shall be conducted on one (1) test sample. A new test sample may be used for each test program. One (1) test sample may be used for multiple test programs at the discretion of the manufacturer.

Table 7.1
Initial qualification test program Q1
(See Section 7.2 for details)

Test program Q1
1. Dielectric withstand voltage (full voltage) 2. Voltage spike (circuit breakers with electronic devices only) 3. Circuit breaker electrical endurance and selected accessory/functional component temperature rise 4. Verification of accessories/selected functional components 5. Circuit breaker and selected accessory/ functional component temperature rise at 50°C ambient and 100 percent maximum continuous current rating on main contacts (includes electrical cycling verification) 6. Circuit breaker temperature rise at 50°C ambient and 150 percent maximum continuous current rating on main contacts for 5 minutes (includes long-time delay verification) 7. Calibration at 50°C ambient 8. Rack-out position verification (includes anti-rolling and cradle strength verification) 9. Rack-in position verification 10. Mechanical racking endurance 11. Inclined operation (includes calibration, electrical cycling, opening/closing time, and anti-rolling verification) 12. Dielectric withstand voltage (reduced voltage)

Table 7.2
Initial qualification test program Q2
(See Section 7.3 for details)

Test program Q2
1. Dielectric withstand voltage (full voltage) 2. Circuit breaker mechanical endurance 3. Short-time current rating 4. Short-circuit current rating (O-CO-CO test sequence) 5. Circuit breaker temperature rise at 50°C ambient and 100 percent maximum continuous current rating on main contacts 6. Dielectric withstand voltage (reduced voltage)