

MILITARY SPECIFICATION  
SYNCHRONIZING CONTROL EQUIPMENT, 60 CYCLES,  
450 VOLTS, NAVAL SHIPBOARD

1. SCOPE

1.1 This specification covers general requirements for generator synchronizing monitor protective equipment for use with generator sets rated up to 2500 kilowatts (kw), 450 volts, 3 phase, 60 cycle.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein:

SPECIFICATIONS

MILITARY

- MIL-R-11 - Resistors, Fixed, Composition (Insulated), General Specification for.
- MIL-R-22 - Resistors, Variable (Wirewound, Power Type).
- MIL-C-25 - Capacitors, Fixed, Paper-Dielectric, Direct Current (Hermetically Sealed in Metallic Cases), General Specification for.
- MIL-R-26 - Resistors, Fixed, Wirewound (Power Type).
- MIL-R-94 - Resistors, Variable, Composition, General Specification for.
- MIL-I-631 - Insulation, Electrical, Synthetic-Resin Composition, Nonrigid.
- MIL-S-901 - Shock Tests, H. I. (High Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
- MIL-E-917 - Electric Power Equipment, Basic Requirements (Naval Shipboard Use).
- MIL-D-963 - Drawings, Electrical, Hull and Mechanical Equipment for Naval Shipboard Use.
- MIL-R-2033 - Relays for Naval Shipboard Electrical Service.
- MIL-E-2036 - Enclosures for Electric and Electronic Equipment, Naval Shipboard.
- MIL-C-2174 - Controllers, Direct-Current, Naval Shipboard.
- MIL-C-2212 - Controllers, Alternating-Current, Naval Shipboard.
- MIL-C-3965 - Capacitors, Fixed, Nonsolid Electrolytic (Tantalum, Foil and Sintered-Slug), General Specification for.
- MIL-P-15024 - Plates, Identification-Information and Marking for Identification of Electrical, Electronic and Mechanical Equipment.
- MIL-M-15071 - Manuals, Equipment and Systems.
- MIL-R-15109 - Resistors and Rheostats (Naval Shipboard Use).
- MIL-P-15137 - Provisioning Technical Documentation for Repair Parts for Electrical and Mechanical Equipment (Naval Shipboard Use).
- MIL-S-15291 - Switches, Rotary, Snap Action.
- MIL-S-16036 - Switchgear, Power, Naval Shipboard.
- MIL-I-16104 - Indicators, Synchronization.
- MIL-T-16784 - Terminal Boards.
- MIL-E-17555 - Electronic and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of.
- MIL-S-18396 - Switches, Meter and Control, Naval Shipboard.
- MIL-R-19523 - Relays, Auxiliary, Naval Shipboard.
- MIL-M-23313 - Maintainability Requirements for Shipboard and Shore Electronic Equipment and Systems.

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THIS DOCUMENT CONTAINS 14 PAGES.

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## MIL-S-24188(SHIPS)

## STANDARDS

## MILITARY

- MIL-STD-16 - Electrical and Electronic Reference Designations.
- MIL-STD-167 - Mechanical Vibration of Shipboard Equipment.
- MIL-STD-242 - Electronic Equipment Parts (Selected Standards).
- MIL-STD-761 - Electric Power, Alternating Current for Shipboard Use, Characteristics and Utilization of.

## HANDBOOK

## MILITARY

- MIL-HDBK-217 - Reliability Stress and Failure Rate Data for Electronic Equipment.

## DRAWINGS

## BUREAU OF SHIPS

- 9000-S6201-74453 - Navy Standard Switchboard Units.
- 9000-S6202-73907 - Light, Indicator, Switchboard, 2 Lamp - SPF, Types B-27A through B-27G.

## PUBLICATIONS

- NAVSHIPS-93820 - Handbook for Prediction of Shipboard and Shore Electronic Equipment Reliability.

(Copies of specifications, standards, drawings and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. - The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

## OFFICIAL CLASSIFICATION COMMITTEE

Uniform Freight Classification Ratings, Rules and Regulations.

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd Street, New York, N. Y. 19916.)

## 3. REQUIREMENTS

3.1 General requirements. - This synchronizing control equipment is intended for mounting in the generator switchboard and arranged to electrically prevent closing of the generator circuit breaker, bus tie circuit breaker or shore power circuit breaker unless the energized systems are properly synchronized. The control equipment shall perform its function through control of power to the breaker closing coil and shall be designed to operate on either 450 or 115 volts alternating current (a. c.).

NOTE: In general, three components should comprise one complete unit: one device with all operating components and terminal board for input and output signals; one operating switch with "operating", "test", and "off" positions; one transfer switch suitable for connecting the equipment to generator circuit breakers, shore power circuit breakers or bus tie circuit breakers with input signals appropriately connected to generator and bus circuitry.

The control equipment shall be arranged for back of the board mounting. The switches shall be arranged for back of switchboard mounting with operating handles at front of board. The equipment shall be designed to withstand frequent use for long periods under service conditions without benefit of overhaul and with limited maintenance. The environmental conditions are outlined herein and the functional requirements are set forth in the individual equipment specifications. The final product shall reflect the utmost in simplicity, have maximum reliability and be easy to install and maintain.

3.1.1 Reliability and maintainability. - It is imperative that reliability of operation be considered of prime importance in the design and manufacture of the equipment. The contractor shall employ all reasonable methods possible in the process of manufacture which will assure quality and maximum reliability consistent with the state of the art. In the functional application of parts to equipment circuits, adequate factors of safety shall be provided by suitable derating from parts specification values where required in order to ensure high equipment reliability under all service conditions. The design shall include all possible features which will result in reliable and stable operation with reduced requirements for adjustment and alignment, reduced requirements for maintenance and simplified maintenance, thus reducing requirements for highly skilled maintenance personnel.

3.1.1.1 The reliability for the synchronizing control equipment shall be predicted in terms of mean time between failure (MTBF). The reliability (R) of the synchronizing control equipment is the probability of the synchronizing control equipment operating without failure for a specified period of time (t). For a predicted MTBF, the reliability is given by

$$R = e^{-t/MTBF}$$

The MTBF shall be predicted using method D of NAVSHIPS 93820. Failure rate data used shall be as given in NAVSHIPS 93820, MIL-STD-242 and MIL-HDBK-217, choosing the rate which most nearly corresponds to the application conditions of a given part in the power supply. If parts are used for which no failure rate data is given in the above sources, failure rate data from other sources may be used, but justification for its applicability shall be provided. For parts for which no failure rate data is available, a failure rate shall be estimated, and the basis for the estimate stated. The derating factor which is used for each part shall be stated in the reliability calculations. The stress levels at which each part is operating shall be stated. The stress levels shall be those obtained from test insofar as such information is available. In those instances where test data is not available, design data shall be used. The stress levels shall be identified as whether from test or from design.

3.1.1.2 The reliability prediction shall be made for the continuous operating mode of this specification.

3.1.1.3 A mode failure is defined as occurring when the collective or individual component performance degrades below the operating requirements of this specification.

3.1.1.4 The maintainability of the synchronizing control equipment shall be predicted in terms of geometric mean time to repair (MTTRG). The MTTRG shall be determined in accordance with maintainability evaluation procedure specified in MIL-M-23313. The failure rates used shall be those which have been determined in the reliability prediction.

3.1.1.5 The contractor's report on reliability and maintainability factors and calibrations shall be submitted with the detail drawings for review and approval action.

3.1.2 Life. - The equipment shall be designed for an expected 30-year life based on an average of, but not limited to, 10 operations per day.

3.1.3 Fail safe design. - The design of the equipment shall be such that failure of parts or sub-assemblies will not result in unsafe operating condition of the generating system. Fail safe features shall not cause undue complexity or excessive increase in size or weight.

3.2 Environmental conditions. - All of the requirements of the individual specifications shall be met under any combination of the environmental conditions specified in 3.2.1 through 3.2.6.

3.2.1 Temperature conditions. -

3.2.1.1 Ambient temperature. - Equipment shall be designed for an ambient temperature of 65°C.