

## IEEE Standards Interpretation for IEEE Std 45™-2002 IEEE Recommended Practice for Electric Installations on Shipboard

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### Interpretation Request #1

Electric propulsion and maneuvering system, subclause 31.15.1 (Generators and motors), states that "Generators and motors should successfully pass the following tests at the place of manufacture" and continues to list a required battery of tests for propulsion motors. Clause 13. Motors, subclause 13.16 Tests, states that "Prior to delivery, tests should be performed to ensure that the machine is in accordance with these recommendations and operates at its specified rating. When a machine is a duplicate of one already tested, only such check tests need be made as may be necessary to demonstrate that the machine operates successfully.

Does the allowance of type testing for motors, as laid out in subclause 13.16, also apply to propulsion motors covered by subclause 31.15.1, or should each propulsion motor undergo the tests listed in subclause 31.15.1?

### Interpretation Response

No. Duplicate motor testing requirements as delineated in Clause 13 are not enough for propulsion motor. The propulsion motors are often custom designed due to the power range and propulsion service requirements. The propulsion motor cooling system testing, full load testing, overload testing and propulsion duty cycle load testing require extensive preparation. Third party certification is necessary for the propulsion motor manufacture and testing. In general, the motor manufacturer prepares detail motor test procedures for all propulsion motors for customer and regulatory body approval. The manufacturer usually follow the approved test procedure which usually witnessed and certified by authorized third party having jurisdiction in this field, such as ABS, Lloyd's, DNV, etc. If certain tests are not to be performed due to cost consideration, the certifying authority may consider waiver of certain requirements in writing.

As an example, the ABS class ship must follow the ABS requirement for manufacture and testing the propulsion motors in accordance with ABS certification requirement.

The propulsion motor procurement cost estimate should include manufacture and testing.

References a, b, and c are the IEEE Std 45 pertinent clauses provided for information in support of the response.

References:

a. IEEE-45-2002- Clause 31-Electric Propulsion 31.15 Tests 31.15.1 Generators and motors Generators and motors should successfully pass the following tests at the place of manufacture. The following tests should be conducted in accordance with IEC60034 or IEEE Std 112-1996, IEEE Std 115-1995, or ANSI/NEMA MG 1-1998, as applicable:

- a) Temperature rise under rated load or rated current conditions
- b) Dielectric strength of insulation
- c) Overload capacity, as specified.

b. IEEE-45-1998 Clause 36-Electric Propulsion 36.18 Tests-generators and motors Generators and motors should successfully pass the following tests at the place of manufacture. The following tests should be conducted in accordance with IEEE Std 112™-1996, IEEE Std 115™-1995, or ANSI/NEMA MG 1-1993, as applicable:

- a) Temperature rise under full-load conditions
- b) Dielectric strength of insulation
- c) Overload capacity, as specified
- d) Cold resistance of all circuits
- e) Electrical balance
- f) Mechanical balance

c. IEEE-45-2002 Clause 13-Motor-13.16 Tests Prior to delivery, tests should be performed to ensure that the machine is in accordance with these recommendations and operates at its specified rating. When a machine is a duplicate of one already tested, only such check tests need be made as may be necessary to demonstrate that the machine operates successfully. Spare parts should be given a regular insulation resistance test, but need not be given any running test. Tests should be conducted in accordance with the following:

- a) For single-phase motors, ANSI/NEMA MG-1-1998
- b) For polyphase induction motors, IEEE Std 112-1996
- c) For synchronous motors, IEEE Std 115-1995
- d) For dc motors, ANSI/NEMA MG-1-1998

- e) For IEC motors, IEC 60034
- f) For chemical duty motors up to and including 373 kW (500 HP), IEEE Std 841-2001
- g) For chemical duty motors above 373kW (500 HP), API Std 541

The tests that should be performed are

- Temperature-rise
- Insulation resistance
- High potential -Overload
- Commutation test

### **Interpretation Request #2**

Clarification of Clause 34 in IEEE Std 45-2002 is requested concerning the testing of switchboards.

### **Interpretation Response**

Low-voltage switchboards (600 V ac and less for ANSI; 1000 V ac and less for IEC)—description and requirements Switchboards operating at a root-mean-square (RMS) voltage less than 1000 V should meet the requirements of UL 891 or IEC 60947 for dead-front switchboards or IEEE Std C37.20.1-1993, UL 1558-1999, or IEC 60947 for low-voltage, metal-enclosed power circuit breaker switchgear. Circuit breakers installed in low-voltage switchboards should meet the following requirements for the class of service intended:

- Power circuit breakers installed in low-voltage switchboards should meet the requirements of IEEE Std C37.13-1990 or IEC 60947-2. When installed in low-voltage, metal-enclosed switchgear in accordance with IEEE Std C37.20.1-1993 or IEC 60947-2, these breakers shall be drawout type.
- Power circuit breakers with proper insulation barriers may also be installed in dead-front switchboards per UL 891-1998 or IEC 60947-2. These breakers shall be drawout type.
- Low-voltage molded or insulated case circuit breakers installed in switchboards shall meet the requirements of UL 489-1996 including all marine supplements, or shall meet the requirements of IEC 60947-2 including the additional performance requirements as defined in the marine supplements of UL 489-1996. The insulated case circuit breakers shall be drawout type, and the molded case breakers shall be mounted on marine dead-front removable (plug-in) connectors (both line and load) to facilitate maintenance and replacement without a complete switchboard outage.
- All buses, both power and grounding, within the switchboard shall be copper. All joints shall be either tin-plated or silver-plated and installed using nuts, bolts, and Belleville-type washers or similar locking means.

- Terminal blocks should be provided on the framework or on interior panels mounted to the framework, closely adjacent to the wiring loop to hinged panels for disconnecting the wires.
- Properly marked terminal blocks should be provided for all outgoing instrument and control wires, and for wire connections from one shipping section of the switchboard to another.
- Current transformer (CT) secondary windings shall not be fused. The secondary leads of current transformers shall be wired through current transformer shorting terminal blocks prior to connecting to components or terminal blocks.
- Internal switchboard wiring for control and instrument circuits should be either Type SIS, wire type equivalent to SIS and meeting the VW-1 flame test requirement, or one conductor wire meeting the requirements of IEC 60502-1 and IEC 60332-1. Minimum sizes shall be as follows: For control circuits 15 AWG (1.5 mm<sup>2</sup> for IEC wiring systems; see 1.7), for instrument circuits 18 AWG (1.0mm<sup>2</sup>), or as allowed by IEEE Std C37.20-1987 or IEC 60947.
- Connections to hinged panels should be with extra-flexible type wire.
- Where twisted and shielded pairs are required for analog and digital signals within the switchboard, minimum #18 AWG (1.0 mm<sup>2</sup>) conductors may be used. Circuit speed and the reduction of noise may require the use of shield over the individual pairs. For other cable types such as ribbon, fiber optic, and computer, used in low-power instrumentation, monitoring, or control circuits, the size of the wire should be based on manufacturer's recommendation.
- All groups of internal wiring should be adequately secured to the switchboard panels or framework in such a manner as to prevent chafing, cutting of the insulation, or excessive motion caused by vibration.
- All power cables should be secured adequately to prevent motion caused by vibration and to withstand the maximum short-circuit current.