



# Standard Specification for Insulation Resistance Monitor for Shipboard Electrical Motors and Generators<sup>1</sup>

This standard is issued under the fixed designation F1134; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

<sup>ε1</sup> NOTE—Editorial correction made throughout in August 2015.

## 1. Scope

1.1 This specification covers monitoring devices (monitors) for the automatic detection and signaling of low insulation resistance values in idle electrical motors or generators, or both.

1.2 Monitors are intended for permanent installation in both existing or new panels and controller enclosures designed for marine application.

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

1.4 The following safety hazards caveat pertains only to the test method described in this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 *UL Standard*:<sup>2</sup>

[UL 94 Test for Flammability of Plastic Materials for Parts in Devices and Appliances](#)

### 2.2 *IEEE Standards*:<sup>3</sup>

[IEEE 45 Recommended Practice for Electrical Installations on Shipboard](#)

[IEEE 100 Standard Dictionary of Electrical and Electronics Terms](#)

### 2.3 *Government Standard*:<sup>4</sup>

[Title 46 Code of Federal Regulations Shipping](#)

## 3. Terminology

3.1 *Definitions*—In general, definitions shall be in accordance with IEEE 100 (see Section 2).

### 3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *idle machine*—rotary machine, when not rotating, owing to the absence of energy.

3.2.2 *monitor*—device, generally located in a motor starter, control panel, or main switchboard, that senses the leakage resistance of electrical machine windings to ground, while the monitored machine stands idle.

## 4. Monitor Classification

4.1 *Type*—The insulation resistance monitors covered by this specification shall be of the following types:

4.1.1 *Type I*—Alternating current motor monitors.

4.1.2 *Type II*—Alternating current generator monitors.

4.1.3 *Type III*—Direct current motor monitors.

4.1.4 *Type IV*—Direct current generator monitors.

4.2 *Duty Rating*—All monitors shall be capable of continuous duty operations as defined in accordance with IEEE 100.

## 5. Ordering Information

5.1 Monitoring devices shall be ordered by including the following information:

5.1.1 *Purpose or Use of Monitor(s)*—Application as motor or generator monitor.

5.1.2 Line voltage and frequency.

5.1.3 Control voltage and frequency.

5.1.4 Type of starter (if motor monitor).

5.1.5 Winding configuration (if motor monitor).

5.1.6 Location of monitor.

5.1.7 *Sensitivity*—Set for 1 megohm (optional setting, if requested, from 0.1 to 5 M $\Omega$ ).

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.10 on Electrical.

Current edition approved May 1, 2015. Published June 2015. Originally approved in 1988. Last previous edition approved in 2012 as F1134 – 12. DOI: 10.1520/F1134-15E01.

<sup>2</sup> Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, <http://www.ul.com>.

<sup>3</sup> Available from Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., P.O. Box 1331, Piscataway, NJ 08854-1331, <http://www.ieee.org>.

<sup>4</sup> Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

5.1.8 Remote monitoring devices.

5.1.9 Special options requested (that is, test buttons, elevated ambient temperature usage, and so forth).

## 6. Materials and Manufacture

6.1 *General*—Materials used in the construction of insulation resistance monitors are to be manufactured and tested in accordance with IEEE 45. Materials conforming to other recognized standards will be subject to approval by the procuring agency, provided they are not less effective.

6.2 *Flame-Retardant Materials*—Enclosure materials used in the construction of the monitors are to be flame-retardant in accordance with UL 94, and have a minimum flame rating of 94V-1 for monitors being installed within a motor controller enclosure, or switchgear-type enclosure, or a minimum rating of 94-5V for monitors not installed within such an enclosure.

6.3 *Electrical Insulation*—Electrical insulation materials used and application thereof shall be in accordance with the requirements of IEEE 45.

6.4 *Current Carrying Terminals*—All monitor current carrying terminals shall be made of corrosion resistant material in accordance with CFR 46, Subchapter J.

6.5 *Electrical Isolation*—Monitors shall isolate their measuring circuit from the line voltage, while the motor is operating, by the use of an integral isolating relay.

## 7. General Design Requirements

7.1 *Environment:*

7.1.1 *Temperature*—The rating of the monitor shall be based on an ambient temperature of 50°C (122°F).

7.1.1.1 *Operating Temperature Range*—Monitors shall operate over the range from 0 to 50°C (32 to 122°F). (See 10.1.2 for operation range.)

7.1.2 *Sealing*—Upon final assembly, the monitor housing shall protect the internal components against foreign matter and shall be constructed so as to prevent tampering.

7.1.3 *Inclination*—Monitors shall operate at inclination angles up to 60° in any direction from the normal operating position.

7.1.4 *Humidity*—Monitors shall operate at a constant relative humidity of up to minimum 90 %.

7.1.5 *Vibration*—Monitors shall operate in the presence of acceptable operational shipboard vibration without mechanical damage, control chatter, or other defects.

7.2 *Operating Voltage/Accuracy:*

7.2.1 *Monitor Relays*—Monitor relays shall pick up and hold from 80 % rated line voltage upwards with the coil at its maximum operating temperature and shall operate satisfactorily in the range from 80 to 120 % of rated line voltage.

7.2.2 *Design Voltage Characteristics*—Monitors shall be designed for application on 60 Hz AC and DC current systems and be designed to operate on electrical systems having standard voltages acceptable to the U.S. Coast Guard. (See 46 CFR 111.)

7.2.3 *Operating Accuracy*—Monitors shall alarm within ±10 % of the ordered set point indicated on the label plate, when operated in accordance with 7.2.1.

7.3 *Installation Instructions:*

7.3.1 The monitor vendor shall submit complete installation instructions with each monitor shipped including drawings as necessary, denoting the following information:

7.3.1.1 Application as a motor or generator monitor.

7.3.1.2 Line voltage level to be applied to monitor.

7.3.1.3 Type designation of monitor supplied.

7.3.1.4 Clearly identify where the connections are to be made to the equipment being monitored.

## 8. Construction Specifications

8.1 *General:*

8.1.1 Monitors shall be designed for ease of installation requiring no special tools and shall be fitted with a fastening device compatible with the vibration criteria established for marine applications.

8.1.2 Indication of a condition representing a low insulation value as detected by the monitor shall be displayed by means of an illuminated device mounted on the body of the monitor.

8.1.3 The monitor shall include voltageless terminals to which remotely located audible or visual indicators, or both, can be connected through the use of control cabling. Relay contacts for this function shall have contacts with a switching power of 1000 W AC, 100 W DC for a resistive load.

8.1.4 Electrical interface with the monitor shall be through the use of terminals (or terminal strips), screws and lugs (solderless crimp or solder types). Splicing will not be used. The size of terminals and conductors for interfacing the monitoring shall be suitable to carry the maximum currents expected during operation.

8.1.5 The monitor's sensing circuit should be limited to the following levels:

8.1.5.1 *Voltage*—a minimum of 500 VDC.

8.1.5.2 *Current*—not to exceed 200 μA.

8.1.6 Monitors shall be designed to provide a range of insulation resistances to be monitored based on the type of monitor ordered. However, each individual monitor shall be designed for one or two specific resistance values, and these values shall be marked on the label plate of the device.

## 9. Workmanship, Finish, and Appearance

9.1 All workmanship shall be of acceptable commercial marine standard in all respects and all materials. Components or parts specified shall be new and unused, except for normal testing, as required.

## 10. Test Methods

10.1 *Routine Tests*—Subject each monitor offered for delivery to the following tests:

10.1.1 Visual and mechanical examination.

10.1.2 Operational performance test.

10.2 *Visual and Mechanical Examination*—Examine the monitor devices to verify that the materials, design, construction, dimensions, weight, marking, and workmanship are in conformance with the vendor's drawings.

10.3 *Operational Performance*—Test all functions of the completely assembled devices over the specified line voltage range (rated line voltage  $\pm 20\%$ ). Accuracy of alarm shall be as stated in 7.2.3.

## 11. Product Marking

11.1 Each monitor device shall be identified with a permanently applied and clearly marked labelplate indicating the following information:

- 11.1.1 Manufacturer's name and address.
- 11.1.2 Type designation.
- 11.1.3 Applicable specification number(s).
- 11.1.4 Serial number.

11.1.5 Monitor supply voltage.

11.1.6 Monitor control voltage.

11.1.7 Insulation resistance value below which the alarm should be activated.

11.1.8 Ratings and configurations of alarm relay contacts.

11.1.9 Temperature rating.

11.1.10 Date of final test.

## 12. Keywords

12.1 electrical generator; electrical motors; insulation; low insulation resistance values; marine controller enclosures; resistance monitor; shipboard generator; shipboard motors

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