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An American National Standard

METRIC

Standard Specification for Electrical Insulation Monitors for Monitoring Ground Resistance in Active Electrical Systems [Metric][1]

This standard is issued under the fixed designation F 1207M; 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 (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers electrical insulation monitoring devices, intended as permanently installed units, for use in the detection of ohmic insulation faults to ground in active, ac ungrounded electrical systems.

1.2 *Limitations*—This specification does not cover devices which are not intended for operation for: dc ungrounded systems or ac ungrounded systems with dc components unless ac to dc conversion is isolated from the monitored system with transformers.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 The following precautionary caveat pertains only to the test methods portion, Section 9, of 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:*

UL 1053 Ground-Fault Sensing and Relaying Equipment[2]

3. Terminology

3.1 *Definitions:*

3.1.1 *ac internal resistance*—a monitor's impedance between the measuring terminals and ground terminals.

3.1.2 *ac ungrounded electrical system*—a monitored system that has no intentional connection from phase or neutral to ground and can continue to perform normally if one conductor becomes connected to ground.

3.1.3 *dc internal resistance*—a monitor's ohmic resistance between the measuring and ground terminals.

3.1.4 *input voltage*—the supply voltage at the terminals of an insulation monitor.

3.1.5 *measuring voltage*—the output dc voltage from the insulation monitor that is superimposed between the ac ungrounded system and ground.

3.1.6 *nominal contact voltage*—the voltage rating for a monitor's internal relay contacts.

3.1.7 *nominal frequency*—the frequency of a monitored system.

3.1.8 *nominal voltage*—the voltage (phase-to-phase) of a monitored system.

3.1.9 *response value*—the adjustable or preset set point value of system insulation resistance for which an insulation monitor will provide alarm indication.

3.1.10 *system insulation resistance*—the total insulation resistance to ground to be monitored which is measured by dc voltage.

4. Monitor Classification

4.1 *Type 1*—Insulation monitor for 115-V, 3-phase or single-phase, 60-Hz, ac ungrounded electrical systems.

4.2 *Type 2*—Insulation monitor for 115-V, 3-phase or single-phase, 400-Hz, ac ungrounded systems.

4.3 *Type 3*—Insulation monitor for 440-V, 3-phase or single-phase, 60-Hz, ac ungrounded systems.

4.4 *Type 4*—Insulation monitor for 440-V, 3-phase or single-phase, 400-Hz, ac ungrounded systems.

4.5 *Type 5*—Insulation monitor for up to 1000-V, 3-phase or single-phase, 50 to 400-Hz, ac ungrounded systems.

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[1] 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.

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[2] Available from Underwriters Laboratories, Inc., 333 Pfingsten Rd., Northbrook, IL 60062.

5. Ordering Information

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

5.1.1 Nominal voltage and frequency.

5.1.2 Response value/set point range in kilohm.

5.1.3 Special options, that is, test buttons, ohmeters, visual indicators, and so forth.

6. Requirements

6.1 The measuring voltage shall not increase more than 10 % when the monitor is supplied with 110 % of the input voltage.

6.2 The monitor shall be capable of both continuous and on-demand operation.

6.3 The monitor shall have provisions for an external (remote) audible or visual alarm to operate when the resistance value falls below the response value or a remote indication of the insulation value of the ac ungrounded system in kilohms, or both.

6.4 The ac internal resistance shall be at least 250-Ω/V nominal voltage. The minimum resistance shall not be less than 15 kΩ.

6.5 The dc internal resistance shall be at least 30-Ω/V nominal voltage and shall limit the measuring dc output current from exceeding 12 mA.

6.6 The monitor's response tolerance shall not exceed ±5 % of the set point value at room temperature (25 ± 5°C (72 ± 9°F)) and rated input voltage.

6.7 When specified, insulation monitors shall be furnished with adjustable response values and designed to preclude tampering or unauthorized changes.

6.8 The insulation monitor shall reliably function in an ambient temperature range from 0 to 50°C (32 to 122°F). Storage temperatures of −20 to +60°C (−4 to 140°F) must not damage the insulation monitors.

6.9 Insulation monitors shall include a built-in test device or be equipped with connection provisions for a test device to be furnished with the equipment which can verify the monitor's proper functioning. If the monitor is equipped with a built-in test device, the value of the test resistor shall be marked on the monitor.

6.10 Insulation monitors shall include an integral visual indicator or external connection provisions for external annunciation of the monitor's set-point response.

6.11 If the insulation monitor includes an ohmmeter for the insulation resistance indication, the meter's tolerance (actual rather than indicated values) shall not exceed ±5 % for:

6.11.1 An insulation monitor with one preset response value at this value.

6.11.2 An insulation monitor with adjustable response value at the midpoint of the adjustment range.

6.11.3 Conditions of room temperature (as specified in 6.6) and rated input voltage.

6.12 Built-in relays for connection to external alarms shall have a switching capacity of at least 2 A at 250-V ac or 0.5 A at 120-V dc.

6.13 Between isolated, outgoing circuits and between these circuits and extraneous conductive parts, insulation monitors shall have creepage and air gap separation in accordance with UL 1053 for voltages up to 300 V. For higher nominal voltages, see IEC Report 664.[3]

7. Product Marking

7.1 The following data shall be identified on an insulation monitor's enclosure:

7.1.1 Name of manufacturer.

7.1.2 Type of monitor.

7.1.3 Connection diagram.

7.1.4 Nominal voltage rating.

7.1.5 Input voltage.

7.1.6 Nominal frequency.

7.1.7 Response value or range.

7.1.8 Test resistance value in accordance with 6.9.

7.1.9 Serial number, or year of production.

8. Equipment Manual

8.1 The manufacturer's equipment manual shall provide the following information in addition to that required in 7.1:

8.1.1 Description of operation.

8.1.2 Values for ac and dc internal resistance.

8.1.3 Connection diagram.

8.1.4 Nominal value of dc measuring voltage, based on possible supply voltages.

8.1.5 Maximum dc measurement current at short-circuit conditions.

8.1.6 Nominal contact voltage and current ratings for integral relays in accordance with 6.12.

8.1.7 A note advising that external dc voltage applied to the monitor's measuring terminals may falsify the indication or destroy the insulation monitor.

8.1.8 Magnitude of external dc voltages, independent of their polarity, which may continuously be applied to the insulation monitor without damaging it.

9. Test Methods

9.1 *Type Test*—Perform type testing of insulation monitors to confirm that the response tolerances stipulated are not exceeded and that the requirements of Section 6 are met. A newly developed monitor shall be in complete compliance with the following:

9.1.1 The measuring devices used for testing shall enable a slow stepless or step-by-step alteration of the simulated insulation resistance. On testing, the resistance shall be decreased slowly and the insulation monitor's response shall be observed.

9.1.2 Voltage measurements shall be taken to confirm that the requirements of 6.1 and 8.1.4 are met. The voltmeter's internal resistance shall have a minimum value not less than 100 times the dc internal resistance of the measuring circuit.

9.1.3 The ac internal resistance specified in 6.4 shall be verified with an rms milliampmeter and a power supply having

[3] *Insulation Coordination within Low-Voltage Systems Including Clearances and Creeping Distances for Equipment, IEC Report 664*, International Electrotechnical Commission, 1980.

an output rated at nominal voltage and nominal frequency, an internal resistance of under 10 Ω, and a harmonic distortion of less than 5 %. The rms milliampmeter shall be connected between the monitor's measuring terminal(s) and output terminal of the power supply. The other output terminal of the power supply shall be connected to the monitor's ground terminal. The monitor's internal impedance, χ, shall be calculated as follows:

$$\chi = \frac{\text{nominal voltage}}{\text{ac rms current}}$$

9.1.4 When insulation monitors have steplessly adjustable response values, test at least five points within the marked adjustment range in order to verify the requirements of 6.6. For this purpose, test the ranges' starting and final points and uniformly distributed points within the range.

9.2 *Production Test*—The production test proves the correct quality and functioning of new monitors. Each insulation monitor shall be subjected to these tests.

9.2.1 Visually examine each monitor to verify appropriate markings as specified in Section 7.

9.2.2 Perform routine tests at room temperature (25 ± 5°C (72 ± 9°F)) with rated input voltage and by a measuring device complying with the requirements of 9.1.1.

9.2.3 When the insulation monitors have a steplessly adjustable response value, test the response at the range's starting and final points.

9.2.4 Perform a voltage withstand test on the monitor to verify that the monitor is able to withstand an ac test voltage equal to twice the nominal voltage plus 1000 V for a period of 1 s without any breakdown or flashover. Perform the tests as follows:

9.2.4.1 Bridge all primary terminals.

9.2.4.2 Bridge all electronic terminals.

9.2.4.3 Bridge all relay contacts.

9.2.4.4 Apply the test potential as follows: (*a*) between bridged primary terminals and bridged electronic terminals; (*b*) between bridged primary terminals and bridged relay contacts; and (*c*) between bridged electronic terminals and bridged relay contacts.

9.2.4.5 Connect all bridged circuits together.

9.2.4.6 Apply test potential between the connected, bridged circuits and all dead metal parts that may become live (for example, enclosures).

9.2.5 Verify that the built-in test device is properly functioning.

9.2.6 If indicating instruments are built into the insulation monitor, verify that these instruments do not exceed the response tolerances specified in 6.11.

10. Keywords

10.1 active ac electrical system; electrical; electrical insulation; electrical insulation monitor; ohmic insulation faults; shipboard; ungrounded electrical systems