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Standard Specification for the Manufacturing of High-Voltage Proximity Alarm to be used for the Detection of Overhead High Voltage Alternating Current (AC)[1]

This standard is issued under the fixed designation F3283/F3283M; 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 non-contact high-voltage proximity alarms used to detect high voltage alternating current (ac) on overhead power lines. The high-voltage proximity alarm (HVPA) is limited to the detection of voltage greater than 600 V ac at power system frequencies between 50 Hz to 60 Hz.

1.2 High-voltage proximity alarms provide audible/visual alerts and may have the ability to limit movement of equipment.

1.3 The use, installation, and maintenance of these high-voltage proximity alarms are beyond the scope of this specification. This standard does not purport to address installation, in service care or use.

1.4 This standard demonstrates the high voltage proximity alarm (HVPA's) ability to detect an E-field, and not the effects of various configurations of multiple power lines.

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.6 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Specific warnings are given in 9.1.4 and 10.9.2.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Terminology

2.1 *Definitions:*

2.1.1 *alternating current (ac) voltage, n*—potential difference in charge between two connected points in which the direction of current flow alternates.

2.1.2 *audible alarm indication, n*—audible alarm that is initiated when a predetermined threshold is met.

2.1.3 *configuration, n*—closely coupled and non-closely coupled equipment; for example, outriggers or steel treads for closely coupled equipment, and rubber tires for non-closely coupled as specified by the HVPA manufacturer; specifically excludes equipment intended to work closer than 10 ft to an overhead ac power line.

2.1.4 *direct current (dc) voltage, n*—potential difference in charge between two connected points in which the direction of current flow does not change.

2.1.5 *E-field, n*—electric force per unit change.

2.1.6 *equipment, n*—specific types of equipment that the manufacturer endorses.

2.1.7 *function kick out system (optional), n*—system by which the equipment operated is being forcibly shut down by the high-voltage proximity alarm, also known as auto-shutdown.

2.1.8 *high voltage, n*—any measured voltage higher than 600 V ac.

2.1.9 *high voltage proximity alarm, n*—device that provides a warning of general proximity to a power line also referred to as HVPA for proximity warning device.

2.1.10 *information screen, n*—panel area, in which images, data, or both, are displayed to the operator.

2.1.11 *limitation, n*—threshold, parameters on both at which the high-voltage proximity alarm will not reliably function above or below, or both.

2.1.12 *operational check, n*—physical verification of components to be used in conjunction with a self-test function.

[1] This specification is under the jurisdiction of ASTM Committee F18 on Electrical Protective Equipment for Workers and is the direct responsibility of Subcommittee F18.35 on Tools & Equipment.

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2.1.13 *performance test, n*—specific to type of equipment endorsed by the manufacturer and should follow appropriate manual instructions.

2.1.14 *power line, n*—cable or conductor carrying electrical power typically supported by pylon or poles.

2.1.15 *range control, n*—ability of an operator to modify the threshold settings of a high voltage proximity alarm.

2.1.16 *self-test function, n*—manual or automatic verification process, or both, by the high voltage proximity alarm.

2.1.17 *sensor, n*—device that is used to detect the strength of an E-field.

2.1.18 *SPF, n*—Spruce/Pine/Fir.

2.1.19 *threshold, n*—point at which, based on E-field strength, the high-voltage alarm will enter into an alarm state.

2.1.19.1 *Discussion*—This point may or may not be modifiable by the operator.

2.1.20 *visual alarm indication, n*—sequence of flashing or solid light(s), or both, that notify an operator or ground personnel, or both, of current conditions/status.

3. Significance and Use

3.1 This manufacturing specification establishes requirements for the testing of HVPA used to alert operators and ground personnel of the general proximity to an overhead energized conductor with non-contacting methods.

4. Type of High-Voltage Proximity Alarm

4.1 E-field detection.

5. Material

5.1 Control box should be made from impact-resistant material and be free of defects that might adversely affect the unit's mechanical and electrical properties. The alarm system being tested will differ dependent upon the manufacturer of the product.

6. Performance Requirements

6.1 The manufacturer shall clearly specify the limits of performance of each high voltage proximity alarm within the instructions as follows:

6.1.1 Operating voltage range or ranges,
6.1.2 Operating temperature range,
6.1.3 Operating humidity range,
6.1.4 Storage temperature range,
6.1.5 Storage humidity range,
6.1.6 Any limitations of use,
6.1.7 E-field detection range, and
6.1.8 Applicable equipment approved by the manufacturer.

7. Workmanship, Finish, and Appearance

7.1 Workmanship and finish shall be of such quality as to ensure safe operation of the unit. Appearance shall be the prerogative of the manufacturer.

TEST METHODS

8. Testing Scenario and Rationale

8.1 Demonstrate that the high voltage proximity alarm meets the requirements of providing visual and audio warning to the proximity of an energized conductor based on the minimum rating of the manufacturer's equipment. This testing scenario is meant to create a repeatable E-field for testing purposes only. This controlled E-field environment also gives a corresponding benchmark for the test distance as shown in 8.1.1. The test does not cover the distance that can be achieved for various environmental factors.

8.1.1 *Calculation for the Test Distance Required for Alarm Activation*—This testing scenario is meant to create a repeatable E-field for testing purposes.

$$TD = \frac{TV \times MC}{V} \tag{1}$$

where:

MC = minimum clearance = 10 ft;
V = nominal voltage of overhead power line (based on manufacturer's minimum equipment rating, with consideration from 6.1.1);
TV = actual test voltage (the voltage used by the testing agencies). The test voltage range must be between 50 % to 100 % of the manufacturer's voltage rating (V) with an absolute minimum of 2000 V. If the manufacturer's rating is below 2000 V then the TV must be set at the minimum rated voltage specified by the manufacturer. Test voltage tolerance of ±2 %; and
TD = test distance (radial distance).

NOTE 1—MC and TD have the same unit of measure.

8.1.1.1 The following example illustrates the required test distance from which the high voltage proximity alarm threshold is reached:

MC = 10 ft;

V = 7.2 kV (voltage based on manufacturer's minimum equipment rating);

TV = 4.4 kV (voltage use by the testing agencies due to capacity and availability); and

$$TD = \frac{(4.4\ \text{kV})\ (10\ \text{ft})}{7.2\ \text{kV}}$$

TD = 6.1 ft = 73.3 in. (radial distance).

8.1.1.2 6.1 ft (TD) is the theoretical distance at which the high voltage proximity alarm threshold is reached based on the manufacturer's minimum equipment rating and TV used. The "test pass" is if the alarm provides a visual and audio warning.

8.1.2 *Calculation for Horizontal Distance from the Test Distance*—The radial distance for the E-field as illustrated in Fig. 1. The Pythagorean theorem can be used to derive the horizontal distance to the overhead power line as denoted with x.

$$TD^2 = x^2 + 5^2 \tag{2}$$

$$x = \sqrt{TD^2 - 5^2} \tag{3}$$