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Standard Specification for High Voltage Detectors—Part 1 Capacitive Type to be Used for Voltages Exceeding 600 Volts AC¹

This standard is issued under the fixed designation F1796; 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 portable, live-line tool-supported, direct-contact type capacitive voltage detectors to be used on electrical systems both indoors and outdoors for ac voltages from 600 V to 800 kV with frequency of $60\pm 5/60$ Hz. The function of the voltage detector is limited to the detection of the presence or absence of nominal operating voltage.

1.1.1 Two types of voltage detectors are provided and are designated as Type I, audible/visual and Type II, numeric, with or without audible.

1.1.2 Two styles of voltage detectors, differing in wet conditions characteristics, are provided and are designated as Style A, indoor use and Style B indoor/outdoor use.

1.2 The use and maintenance of these high voltage detectors and any necessary insulated tool handles are beyond the scope of this specification.

1.3 *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.*

NOTE 1—Except where specified, all voltage defined in this specification refer to phase-to-phase voltage in a three-phase system. Voltage detectors covered by this specification may be used in other than three-phase systems, but the applicable phase-to-phase or phase-to-ground (earth) voltages shall be used to determine the operating voltage.

1.4 *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. Referenced Documents

- 2.1 *ASTM Standards*:²
<https://www.astm.org/standards/F1796-19>
F819 **Terminology Relating to Electrical Protective Equipment for Workers**
- 2.2 *ANSI Standard*:³
ANSI C84.1 Voltage Ratings for Electric Power Systems and Equipment

3. Terminology

3.1 Definitions:

- 3.1.1 *capacitive voltage detector*—a device that relies on current passing through stray capacitance to ground.
- 3.1.2 *clear indication*—a specific condition that detects and indicates the voltage state at the contact electrode.
- 3.1.3 *clear perception*—the ability by the user to determine that the voltage detector is in its operating position.
- 3.1.4 *contact electrode*—the bare conductive part of the conductive element that establishes the electrical connection to the component to be tested.

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 For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

3.1.5 *indicator*—part of the voltage detector that indicates the presence or absence of the nominal operating voltage or the measured voltage at the contact electrode.

3.1.6 *indoor style*—a detector designed for use in dry conditions, normally indoors.

3.1.7 *interference field*—electrical field affecting the indication.

3.1.8 *interference voltage*—voltages other than the signal voltage capable of making the device operate.

3.1.9 *limit marking*—distinctive location or mark to indicate to the user the physical limit to which the detector may be inserted between live components or may touch them.

3.1.10 *nominal operating voltage*—a nominal value consistent with the latest revision of ANSI C84.1.

3.1.11 *outdoor style*—a detector designed for use either indoors or outdoors.

3.1.12 *response time*—time delay between sudden change of the voltage state on the contact electrode and the associated clear indication.

3.1.13 *testing element*—built in or external device, by means of which the functioning of the voltage detector can be checked.

3.1.14 *threshold voltage*—minimum voltage between the line component and earth (ground) required to give a clear audible or visual indication, or both; or numeric indication, corresponding to specific conditions as defined in corresponding test (see *clear indication* and *clear perception*).

3.1.15 *voltage detector*—a device for indicating the presence or absence of nominal design or operating voltage or the measured voltage.

3.1.16 *voltage, nominal design*—a nominal value consistent with the latest revision of ANSI C84.1, assigned to the circuit or system for the purpose of conveniently designating its voltage class.

3.1.17 *voltage range*—value of voltage generally agreed upon by manufacturer and customer, to which certain operating specifications are referred.

3.2 Tests:

3.2.1 *acceptance test*— a test made at the option of the purchaser.

3.2.2 *design test*— a type test made on a specimen treated as representative of an industrial product. These tests will not generally be repeated in quantity production unless a change in the design is implemented.

3.2.3 *performance test*— a test performed to indicate normal operation of the instrument.

3.2.4 *routine test*— a type test made regularly on production material.

4. Significance and Use

4.1 This specification establishes requirements for the design and testing of high voltage detectors, used in the electrical power industry, to determine the presence or absence of nominal operating voltage or the measured voltage.

5. Type of Detector

5.1 Capacitive

5.1.1 *Type I – Direct Contact*—Operates without the need for a ground lead, but requires physical contact with the component to be tested; with an audible/visual indicator.

5.1.2 *Type II – Direct Contact*— Operates without the need for a ground lead, but requires physical contact with the component to be tested; with a numeric value indicator, with or without audible.

6. Ordering Information

6.1 Orders for high voltage detectors under this specification shall include this ASTM designation and the following information:

6.1.1 Type,

6.1.2 Style,

6.1.3 Voltage range,

6.1.4 Catalog number/s.

7. Marking

7.1 Labeling:

7.1.1 Instructions for indoor and outdoor testing use and maintenance of the voltage detectors shall be included with each unit. Whenever practicable, instructions for use and testing shall be printed on a permanent-type label and attached to the unit.

7.1.2 Voltage range, manufacturer and a general statement regarding any use precautions or limitations shall be permanently marked on each unit.

8. Specifications

- 8.1 The manufacturer shall clearly specify the limits of performance of each voltage detector within the instructions as follows:
- 8.1.1 Operating voltage range or ranges,
 - 8.1.2 Operating temperature range,
 - 8.1.3 Operating humidity range,
 - 8.1.4 Storage temperature range,
 - 8.1.5 Storage humidity range, and
 - 8.1.6 Any limitations in use.

9. Workmanship, Finish, and Appearance

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

10. Testing

10.1 *General*—Tests shall be performed on a detector that has been completely assembled. Tests shall be carried out under the following ambient test conditions:

- 10.1.1 Ambient temperature 59 to 95°F (15 to 35°C).
- 10.1.2 Relative humidity 45 to 75 %.

10.2 *Methods*—Unless otherwise specified, tests shall be carried out using a 60 Hz ac power source. Tests shall be performed in dry conditions.

- 10.2.1 The maximum test voltage level shall be reached within 10 to 20 s.
- 10.2.2 An acceptable tolerance of $\pm 3\%$ is allowed for all required values.

10.3 *Design Test*—At least two (2) units shall be tested to ensure that design specifications are achieved.

10.3.1 *Type I Voltage Test (Audible/Visual Indication)*—Each unit shall be subjected to the phase to ground voltage necessary to verify the unit’s threshold voltage. The voltage(s) noting if the unit is designed to indicate phase to ground or phase to phase equivalent. The activation threshold voltage V_t shall satisfy the following relationship $\pm 10\%$: meet the manufacturer’s published specification $\pm 30\%$.

$$\text{Threshold voltage} = 0.3 \text{ to } 0.45 \times \text{minimum nameplate voltage}$$

10.3.2 *Type II Voltage Test (Numeric Indication)*—Each unit shall be subjected to the voltage necessary to verify the unit’s nominal design voltage range/s, within $\pm 30\%$ of applied voltage.

NOTE 2—Type II voltage detectors may indicate the design voltage in phase-to-phase or phase-to-ground values.

10.3.3 *Temperature Dependence of the Indication*—The detector shall operate correctly in the temperature range of the climatic category according to **Table 1**. The numeric or threshold voltage shall not vary by more than $\pm 10\%$, with respect to the numeric or threshold voltage measured when tested at the minimum and maximum temperature. The detector shall be subjected to the maximum and minimum temperature extremes for 24 h and immediately subjected to a numeric or threshold voltage test. The numeric or threshold voltage is not to deviate $\pm 10\%$ from the previously tested and recorded test report when conducted under the standard atmospheric conditions as stated in **10.1**.

10.3.4 *Low Temperature Impact*—The procedure outlined in **10.3.5** shall be followed after exposure to $-20^\circ\text{C}/-4^\circ\text{F}$ for 24 h.

10.3.5 *Drop/Impact*—The test surface shall be concrete or steel and smooth, hard and unpliable. The height of the fall shall be 3 ft. The unit shall be dropped twice: once in the horizontal position and once in the vertical. The vertical drop shall be made on the contact electrode if present. It is acceptable if the contact electrode bends, as long as the unit continues to operate. The unit shall be considered to have passed the test if there is no significant mechanical damage and the unit meets the requirements of **10.6**.

10.3.6 *Humidity*—The detector is to be exposed to a minimum of 96 % humidity for 24 h. The detector is considered to have passed if it meets the same criteria as outlined in **10.3**.

10.3.7 *Wet Test*—Style B units identified for “outdoor use” shall be tested using the Rain/Wet Test described in **Annex A1**.

10.3.8 *Battery Life Test*—For detectors equipped with internal test functions, the detector shall be submitted to a battery life test where after exposure to the standard atmosphere test conditions in **10.1**, the self-test functions of the detector are activated and allowed to deplete the battery which was determined to be “new” and “fresh” at insertion. The detector’s self-test functions must last for 5 min of continuous use. The performance requirements are outlined in **10.6**.

TABLE 1 Climatic categories

| Temperature | |
|----------------|------------|
| Temperature° C | °F |
| -20 to +55 | -4 to +131 |