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Standard Practice for Commercial Application of Electric Security Fences¹

This standard is issued under the fixed designation F3296; 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 The purpose of this practice is to provide advice for the selection and use of electric security fences to deter, detect, and delay an unauthorized breach of the perimeter in a commercial application.

1.2 *Units*—The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this standard. The tolerance on physical dimensions is $\pm 10\%$ unless otherwise specified.

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.*

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 *BSI Standard*:²

BS EN 60335-2-76 Household and similar electrical appliances – Safety – Part 2-76: Particular requirements for electric fence energizers

2.2 *IEC Standards*:³

IEC 60335-1 Household and similar electrical appliances – Safety – Part 1: General requirements

IEC 60335-2-76 Household and similar electrical appliances – Safety – Part 2-76: Particular requirements for electric fence energizers

¹ This practice is under the jurisdiction of ASTM Committee F33 on Detention and Correctional Facilities and is the direct responsibility of Subcommittee F33.06 on Control Systems.

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² Available from British Standards Institution (BSI), 389 Chiswick High Rd., London W4 4AL, U.K., <http://www.bsigroup.com>.

³ Available from International Electrotechnical Commission (IEC), 3, rue de Varembe, 1st Floor, P.O. Box 131, CH-1211, Geneva 20, Switzerland, <http://www.iec.ch>.

2.3 *NFPA Standard*:⁴

NFPA 70 National Electrical Code

2.4 *UL Standard*:⁵

UL 69 Standard for Electric-Fence Controllers

3. Terminology

3.1 *Definitions*:

3.1.1 *electric fence energizer, n*—electrical device that is used to convert continuous power to a short-duration pulse using a fast-discharge electrical storage unit; it is also known as a controller.

3.1.2 *electric security fence zone, n*—predetermined section of the fence line that is monitored separately from another section of the fence line.

3.1.3 *grippler, n*—wire torque-tensioning device that incorporates a ceramic roller as the main tension ratchet part.

3.1.4 *pulse, n*—burst of electricity for a short period of time on a regular interval as opposed to continuous power.

3.1.5 *pulse rate, n*—number of pulses per second.

3.1.6 *security alarm panel, n*—device that detects a drop in the power of the pulse and, based on a specific algorithm, initiates an alarm.

4. Significance and Use

4.1 Electric security fences, in view of their high-deterrent impact, are a safe method to reduce security costs or enhance existing security. They are deployed in a wide variety of environments and geographies. In particular, electric security fences are used to decrease the need for security guards and other security systems.

4.2 This practice provides information to users and manufacturers of electric security fences, filling a void.

4.3 International standards exist at the International Electrotechnical Commission (IEC) and the British Standards Institution (BSI) (see Section 2) that cover some aspects of these systems.

⁴ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

⁵ Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, <http://www.ul.com>.

4.4 A standard issued by Underwriters Laboratories (UL) (UL 69) covers electric-fence controllers to be used on lighting or line circuits in accordance with the National Electrical Code, NFPA 70. However, UL 69 covers specifically electric-fence controllers used only for the control of animals. Its requirements cover portable and permanently mounted electric fence controllers with peak-discharge or sinusoidal-discharge output for indoor or outdoor use, including battery operated controllers intended to operate from battery circuits of 42.4 V or less, line-operated controllers intended to operate from circuits of 125 V or less, combination controllers intended to operate from either a battery or a line circuit, and photovoltaic module battery operated controllers. The scope states that the requirements of UL 69 do not cover electric fence controllers for the continuous (uninterrupted) current type or intermediate equipment, such as a converter, a rectifier, or the like, that is sometimes used between the primary source of supply and an electric fence controller and is investigated only as part of a complete controller. UL 69 also states that the requirements do not cover electric fence controllers for use with electrified security fences.

4.5 In contrast to UL 69, this practice specifically addresses the use of electric security fences in a commercial application.

NOTE 1—Extensive research on the safety of pulsed electrical devices, which are used in electric fence controllers, is found in work by Amit Nimunkar and John Webster.⁶ This research provides background on the safety of electric security fences and is of value to those wishing to understand the basic science behind these systems.

5. Key Features

5.1 Electric security fences have the following key components: (1) a wire fence array (Section 6), (2) a controller (or electric fence energizer) that continuously monitors an electric fence and generates an alarm when pre-programmed conditions are met (Section 7), (3) one or more electric fence access gates (to provide access to the facility), and (4) electric fence insulators (to maximize return voltage). The electric security fence system shall be designed such that, when tested by operating the energizer at the rated voltage with a 500 Ω load connected across the terminals, the output characteristics are:⁷

5.1.1 The pulse repetition rate shall not exceed 1 Hz;

5.1.2 The impulse duration of the impulse shall not exceed 10 ms;

5.1.3 For energy limited energizers, the energy/impulse shall not exceed 5 J;

5.1.4 For current limited energizers, the output current shall not exceed:

5.1.4.1 The value specified in Eq 1, where impulse duration is measured in ms and output current is measured in mA:

$$\text{impulse duration} = 41.885 \times 10^3 \times (\text{output current})^{-1.34} \quad (1)$$

5.1.4.2 For an impulse duration of less than 0.1 ms, 15 700 mA.

NOTE 2—IEC 60335-2-76 provides background for safe use including

⁶ Nimunkar, A. J., and Webster, J. G., “Safety of pulsed electric devices,” *Physiol. Meas.*, Vol 30, 2009, pp. 101–114.

⁷ Source IEC 60335-2-76.

range of maximum current and duration combinations, maximum frequency of pulse, and maximum energy per pulse.

5.2 All energized wires in a multi-energizer system shall be energized simultaneously. Pulse repetition rates less than 1 Hz shall be allowed.

5.3 The energizer shall be able to function in operating environment with temperature ranges of –10 to +40°C and noncondensing 0 to 95 % humidity.

5.4 Each energizer shall have a backup power supply appropriate for the site-specific application under full load in the event of a mains power failure, if applicable. Eight hours of battery power shall be the minimum; additional coverage is encouraged.

5.5 *Key Additional Features*—The following additional features shall be allowed to aid redundancy, ease of use, and maintenance with the tradeoff being increasing complexity and cost.

5.5.1 Independent single or switchable energizers that increase cost and complexity, however, enhance redundancy. When an energizer fails, at least a portion of the system will remain active.

5.5.2 Auxiliary supervised alarm inputs to allow for the setting of multiple trigger points for alarms. This can be helpful in minimizing false alarms and giving early warning of potential maintenance needs.

5.5.3 Programmable outputs to allow for integration with other security systems such as gates or cameras.

5.5.4 Illuminated indicators on the energizer to allow for ease of monitoring proper system function, monitoring, and indication of alarms. They may be used to show pulse rate, return pulse, high-voltage (HV) alarm, output on, data received, data transmitted, and tamper.

5.6 The system shall incorporate lightning suppression per the manufacturer’s specifications. This can be achieved in multiple ways providing varying degrees of protection.

6. Wire Fence Array

6.1 The electric security fence shall be separated from the public by means of a physical barrier not less than 1.5 m high or an equivalent natural barrier. Physical barriers are typically constructed of various materials.

6.2 The configurations of the wire array shall be allowed to vary to suit different applications.

6.3 To ensure an effective system and minimize maintenance cost, all metals in contact with the fence array shall be a material to minimize electrolysis.

6.4 The following additional features shall be allowed, as they aid redundancy, ease of use, and maintenance with the tradeoff being increasing complexity and cost.

6.4.1 There are two main configurations of electric security fence, freestanding or attached to an existing fence, wall, or supporting structure. While it is possible that there will be some cost differences between the type, selection is usually based on site considerations. The most common configuration for the security fence is to be freestanding.

6.4.2 Wire shall comply with the manufacturer's specifications. A variety of wire types and gauges of wire are allowed. The choice is driven by the site's requirements and the entirety of the manufacturer's system.

6.4.3 The wire spacing and configuration shall be allowed to vary to suit different applications. Normally, the spacing shall be between a minimum of 50 mm and a maximum of 230 mm. The objective is to maximize the effectiveness of the security while minimizing initial and ongoing maintenance cost.

6.4.4 Fence infrastructure shall be to the electric security fence manufacturer's specifications.

7. Controls

7.1 There are many methods of control to suit different applications. To ensure an effective system, maximize up time, and minimize maintenance cost, the following design limitations shall be met:

7.1.1 Commercially accepted security communications protocols such as copper, fiber, wireless, and ethernet, and

7.1.2 The security alarm panel or software design control system shall monitor tamper alarms and the event log.

8. Training

8.1 To maximize effectiveness and minimize maintenance cost, effective training shall be done appropriate to the employ-

ee's responsibilities. Training shall be consistent with the user's training policy and procedures.

9. Maintenance

9.1 The following shall be minimum maintenance frequencies.

9.1.1 The following should be done daily:

9.1.1.1 A fence line visual inspection should be done daily to remove trash, repair any attempts to compromise the system, and note situations proactively that might compromise the system such as vegetation growth.

9.1.2 The following shall be done monthly:

9.1.2.1 An alarm test in each zone in addition to the daily maintenance. This shall be done by shorting a wire to electrical ground or touching wire to wire using an approved testing tool recommended by manufacturer.

9.1.3 The following should be done annually:

9.1.3.1 Inspect batteries for signs of apparent wear, tampering, or damage.

10. Signage

10.1 Warning signs shall be placed at intervals not exceeding 19 m and on every gate.

11. Keywords

11.1 electric security fence; energizer; return voltage

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