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Standard Specification for Computer-vision Drowning Detection Systems for Residential Swimming Pools¹

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INTRODUCTION

Preventive measures like fences, safety covers, or alarms are widely available, but drowning incidents still occur either because these measures fail to prevent unsupervised access to the pool, or because access to the pool was authorized and these means were disabled/deactivated/opened. Computer-vision-based drowning detection systems for residential pools stay active also during pool use and can alert both upon entrance to the pool and upon extended submersion, and by that act as a complementary safety means for physical barriers.

1. Scope

1.1 This specification covers performance requirements for computer-vision-based drowning detection systems for residential swimming pools.

1.2 The devices described include systems that detect the potential for drowning and signal within 30 s that a person is drowning or exhibiting a drowning behavior.

1.3 The devices shall provide indication of low visibility conditions to the users.

1.4 The devices shall not produce safety hazards by virtue of their connectivity.

1.5 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.6 *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

F2208 [Safety Specification for Residential Pool Alarms](#)

[F3463 Guide for Ensuring the Safety of Connected Consumer Products](#)

2.2 ANSI Standards:³

[ANSI Z535.4 Product Safety Signs and Labels](#)

[ANSI Z535.6 Product Safety Information and Product Manuals, Instructions, and Other Collateral Materials](#)

2.3 Federal Code:

[47 CFR Part 15 Federal Communications Commission—General—Radio Frequency Devices⁴](#)

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *computer vision/camera based systems*—devices that include at least one camera that acquires images or video, and a processor that runs algorithms that analyze the images/video and infer about content and actions in the scene.

3.1.2 *drowning*—full submersion with no significant movement for 30 s.

3.1.3 *drowning alert*—a notification that will be given when somebody is suspected of drowning.

3.1.4 *entry alert*—a notification that will be given when somebody enters the pool.

3.1.5 *false alarm*—receiving entry alert when no human entered the pool and/or receiving drowning alert when no human is in a drowning situation.

3.1.6 *full submersion*—full body under the water surface.

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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 (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from Government Printing Office (GPO) at <https://www.ecfr.gov/current/title-47/chapter-I/subchapter-A/part-15?toc=1>.

3.1.7 *home unit*—device that is located inside the house and sounds an alarm in case of a drowning incident.

3.1.8 *household paired devices*—all smartphones that have installed the manufacturer application (app) and paired to the pool unit, and optionally smartwatches, tablets, or other smart devices.

3.1.9 *Internet of Things, IoT*—system of connected products (consumer and non-consumer) that transfer data at local, national, and global levels.

3.1.10 *pool unit*—device which has the computer-vision camera and is installed in the pool.

3.1.11 *risk mitigation controls*—features (for example, systems, devices, and processes) within a connected consumer product or system designed to mitigate one or more specific risk of harm.

4. Performance Requirements

4.1 General:

4.1.1 Notification of first entry into the water shall be made within 20 s.

4.1.2 Alert of a drowning shall sound immediately upon detection of drowning, which shall sound in the pool unit and in the home unit.

4.1.3 Physical hazards can be created through system connectivity performance or its operations status. The devices and connectivity shall be tested and evaluated to prevent connectivity and cybersecurity vulnerabilities and weaknesses that could compromise the performance related issues. Section 5 (Procedure) and Section 6 (Conformity Assessment) of Guide F3463 provides guidelines for remote updates, software, firmware, and cybersecurity risk test procedures.

4.1.4 Both entrance and drowning alerts shall sound at the pool area by the pool unit and also inside the house by an RF-connected home unit.

4.1.4.1 The pool unit shall have a minimum sound pressure rating of 85 dBA at 3 m (9.8 ft).

4.1.4.2 The home unit shall have a minimum sound pressure rating of 65 dBA at a distance of 1 m (3.2 ft).

4.1.5 In addition, the system shall have Wi-Fi or cellular connectivity and shall send notifications to all household paired devices.

4.1.6 Entry alerts shall be short and last for 1 s to 3 s when entry is first detected in a pool that has had no person in the pool for at least 5 min.

4.1.7 Drowning alerts shall last as long as the subject is detected in drowning situation.

4.1.8 If the device is battery operated, there shall be a low-battery indicator. A low-battery condition is defined as an inability to meet the requirements of 4.1.4. Once the device is in low-battery mode, the operability light shall go off and the pool unit shall send out periodic beeping noise to indicate low-battery status. The home unit shall also indicate the low-battery status. Additionally the low-battery notification shall be sent to all household paired devices.

4.1.9 Device manufacturers who employ wireless communication (radio frequency (RF)) shall comply with all relevant

provisions of 47 CFR Part 15 (FCC) rules for unlicensed radio frequency devices including the required compliance labeling and statement.

4.1.10 Device shall indicate if it is on/off.

4.1.10.1 The operational condition of the device shall be indicated with an energized lamp or other distinctive indicator, visible from a distance of 3 m $\pm$ 0.3 m (9.8 ft $\pm$ 1 ft) at angles of 45° $\pm$ 5° perpendicular to the unit to indicate the operability of the product, at an ambient light environment of at least 10 760 lux (1000 fc) illuminance. Additionally when the device turns off for any reason, the home unit shall indicate that the pool unit is off and a notification shall be sent to all household paired devices.

4.1.11 The computer-vision and artificial intelligence (AI) algorithm to detect drowning shall run on the pool unit itself and not on a cloud by means of an internet connection.

5. Test Procedure

5.1 Test Setup:

5.1.1 *Pool Dimensions*—All testing shall be done in a minimum 4.87 m by 9.75 m (16 ft by 32 ft) swimming pool with a minimum depth of 1 m (3.3 ft) and maximal depth of 2.5 m (8.2 ft). Any pool shape is sufficient as long as the pool measures at some point (16 ft by 32 ft) with the defined depth, and testing must, at a minimum, be performed at this subsection of the pool.

5.1.2 Equipment Required:

5.1.2.1 *Child Intrusion Simulator*—Rescue Timmy.

5.1.2.2 *Adult Intrusion Simulator*—Adult water rescue manikin with the size of approximately 1.65 m by 0.58 m by 0.22 m (65 in. by 23 in. by 9 in.) with full submersion option, available commercially.

5.1.2.3 *Dark-color Child Intrusion Simulator*—Rescue Timmy with elastane fabric tied on the manikin.

5.1.2.4 *Cleaning Robot*—Fully automatic cleaning robot for residential pool, cleaning the floor and walls, working on a electric cord, with a size of approximately 0.55 m by 0.50 m by 0.30 m (22 in. by 20 in. by 12.5 in.).

5.1.2.5 All dolls shall be filled up with water before the tests so that if left inside the pool they will sink to the bottom.

5.1.3 *Device Installation*—The tested device shall be installed according to the manufacturer recommended instructions.

5.2 *Good Visibility Conditions*—All tests in this section shall be performed in moderate to good visibility conditions, that is, turbidity with a range of up to 0.6 NTU (nephelometric turbidity unit) in clean water and good lighting of at least 10 000 lux (930 fc) illuminance. Prior to the tests, fully submerge the test doll body in the pool in the point that is most distant from the device. Acquire a picture using a water-resistant camera placed near the system to check if Timmy is clearly seen in the picture.

5.2.1 Entrance Tests:

5.2.1.1 Divide the pool to a 2 by 4 grid. Each square of 2.44 m by 2.44 m (8 ft by 8 ft). Perform one time in each grid entry for each of the three dolls. Submerge the doll vertically with water up to the armpit height for 20 s and then repeat