Designation: F3566 − 22

Standard Performance Specifications and Test Methods for Walk-Through Metal Detectors Used in Safety and Security[1]

This standard is issued under the fixed designation F3566; 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 standard applies to all walk-through metal detectors that are used to find metal contraband concealed or hidden on people.

1.2 This standard describes baseline acceptable technical performance requirements, which includes metal object detection performance, safety (electrical, mechanical, fire), electromagnetic compatibility, environmental conditions and ranges, and mechanical durability. The requirements for metal detection performance are unique and, therefore, test methods for these parameters are provided, including the design of test objects. An agency or organization using this standard is encouraged to add their unique operationally-based requirements to those requirements listed in this baseline technical performance standard.

NOTE 1—For ease of use, steps of test procedures in this standard are indicated by numbered lists.

1.3 This standard describes the use of threat object exemplars, instead of actual threat objects, to test the detection performance of walk-through metal detectors.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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.*

1.6 *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 *ANSI Standards:*[2]

ANSI S1.4 Part 1: R19 Edition Sound Level Meters - Part 1: Specifications

ANSI/NEMA WD 6 American National Standards Institute/ National Electrical Manufacturing Association, Wiring Devices - Dimensional Specifications

2.2 *CIE Standards:*[3]

ISO/CIE 23539 Photometry — The CIE System of Physical Photometry

2.3 *IEC Standards:*[4]

CISPR 16-2-1 + AMD1 Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements

CISPR 16-2-3 Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements

IEC 60068-2-27 Basic Environmental Testing Procedures, Part 2-27: Tests – Test Ea and guidance: Shock

IEC 60068-2-30 Environmental Testing, Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)

IEC 60529 Ed 2 Degrees of Protection Provided by Enclosures (IP Code)

IEC 61000-4-2 Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test

IEC 61000-4-3 Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test

IEC 61000-4-4 Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test

IEC 61000-4-5 Ed 3.1 Electromagnetic compatibility (EMC)

[1] These performance specifications are under the jurisdiction of ASTM Committee F12 on Security Systems and Equipment and are the direct responsibility of Subcommittee F12.60 on Controlled Access Security, Search, and Screening Equipment.

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[2] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[3] Available from U.S. National Committee of the CIE (International Commission on Illumination), C/o Alan Laird Lewis, 282 E. Riding, Carlisle, MA 01741, http://www.cie-usnc.org.

[4] Available from International Electrotechnical Commission (IEC), 3, rue de Varemb, 1st floor, P.O. Box 131, CH-1211, Geneva 20, Switzerland, https://www.iec.ch.

- Part 4-5: Testing and measurement techniques - Surge immunity test

IEC 61000-4-6 Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields

IEC 61000-4-8 Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test

IEC 61000-4-11 Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests

IEC 61000-6-1 Electromagnetic compatibility - Generic Immunity Standard, Part 1: Residential, Commercial, and Light Industry

IEC 61000-6-3 Electromagnetic compatibility - Generic Emission - Emission Standard for Residential, Commercial, and Light-Industrial Environments

IEC 61010-1+AMD1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

IEC 623691 Evaluation of human exposure to electromagnetic fields from short range devices (SRDs) in various applications over the frequency range 0 GHz to 300 GHz - Part 1: Fields produced by devices used for electronic article surveillance, radio frequency identification and similar systems

2.4 *IEEE Standards:*[5]

IEEE C95.1 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

IEEE C95.6 Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0–3 kHz

2.5 *ISO Standards:*[6]

ISO 10012 Measurement Management Systems — Requirements for measurement processes and measuring equipment

ISO 14117 Active implantable medical devices — Electromagnetic compatibility — EMC test protocols for implantable cardiac pacemakers, implantable cardioverter defibrillators, and cardiac resynchronization devices

ISO 14708-1 Implants for surgery — Active implantable medical devices — Part 1: General requirements for safety, marking and for information to be provided by the manufacturer

ISO 14708-2 Implants for surgery — Active implantable medical devices — Part 2: Cardiac pacemakers

ISO 14708-3 Implants for surgery — Active implantable medical devices — Part 3: Implantable neurostimulators

ISO 14708-4 Implants for surgery — Active implantable medical devices — Part 4: Implantable infusion pumps

ISO 14708-5 Implants for surgery — Active implantable medical devices — Part 5: Circulatory support devices

ISO 14708-6 Implants for surgery — Active implantable medical devices — Part 6: Particular requirements for active implantable medical devices intended to treat tachyarrhythmia (including implantable defibrillators)

ISO 14708-7 Implants for surgery — Active implantable medical devices — Part 7: Particular requirements for cochlear implant system

ISO 17025 General Requirements for the Competence of Testing and Calibration Laboratories

2.6 *Military Standards:*[7]

MIL–STD–810H: Method 501.7 Military Standard, Test Method Standard for Environmental Engineering Considerations and Laboratory Tests, Method 501.7, High Temperature

MIL–STD–810H: Method 502.7 Military Standard, Test Method Standard for Environmental Engineering Considerations and Laboratory Tests, Method 502.7, Low Temperature

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *alarm, n*—an indication that informs the operator of an event, such as metal detection or a walk-through metal detector (WTMD) status change.

3.1.2 *body simulant, n*—a material engineered to simulate the average electrical conductivity and magnetic permeability of the human body; the average electrical conductivity is 0.8 S/m ± 0.2 S/m and the average magnetic permeability is 1.26×10^{-6} H/m ± 5×10^{-7} H/m.

3.1.3 *clean test subject, n*—a person who carries no electrically conductive or magnetizable objects such as metallic belt buckles, metal buttons, cardiac pacemaker, coins, metal-frame eyeglasses, hearing aid, jewelry, keys, pens and pencils, shoes with metal arches or supports, metallic surgical implants, undergarment support metal, metal zippers, or similar items, which would significantly alter the signal produced when the person carries a test object; the height and mass of the clean test subject should be 180 cm ± 5 cm and 80 kg ± 10 kg.

3.1.3.1 *Discussion*—Alternative: A clean test subject may be replaced by a human body simulator that approximates the mass and mass distribution of an average adult male. See 5.4.1.11.

3.1.4 *detection, n*—the discovery or finding of a metallic object; the detection of a metallic object is typically transmitted to the operator by some type of alarm, typically a visual or audible alarm (see 4.11.2).

3.1.5 *detection signal, n*—the electrical signal generated by the sensor or sensor circuit of the WTMD and caused by a metallic object interacting with the magnetic field generated by the WTMD; the detection signal is the basis on which an alarm is activated.

3.1.6 *detector platform, n*—a nonconductive, nonmagnetic platform on which the WTMD rests; the detector mount locates

[5] Available from Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., Piscataway, NJ 08854-4141, http://www.ieee.org.

[6] Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, https://www.iso.org.

[7] Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, http://www.access.gpo.gov.

the detector floor at a height of 32.5 cm and contains grooves or a shelf located at 10 cm below its top surface to facilitate the metal floor test of 5.7.1.2.

3.1.7 *measurement coordinate system, n*—a mutually orthogonal three-dimensional Cartesian coordinate system referenced to the detector axis and the detector plane; the three axes are labeled x-axis, y-axis, and z-axis; the y-axis is parallel to the detector axis, and the x- and z-axes are in the detector plane; the orientation of the test objects and direction of the magnetic field is referenced to the measurement coordinate system (See Fig. 1.).

3.1.8 *object size class, n*—a classification method based on grouping exemplars of commonly encountered objects that may be either commercially available or readily fabricated from available materials and that are related to customer applications and object sizes; a WTMD may meet the requirements for one or all size classes, as defined below.

3.1.8.1 *Size-1, adj*—represents threat items such as very-large steel handguns, and similarly sized objects, or larger; the primary threats considered are steel weapons and ferromagnetic and nonferromagnetic metal components of an improvised explosive device (IED) that are detectable by a WTMD; these IEDs may include person-worn devices (suicide vests) or bag-carried devices depending on specific situational concepts of operation; detection of this size of threat is typically encountered at building or site/facility checkpoint entry locations where the purpose is to prevent entrance of weapons that can cause mass casualties at a distance from the weapon; typical locations may include but are not limited to schools, sports venues, government buildings and campuses; see 6.2.1 for dimensions and materials of construction for Size-1 test objects.

3.1.8.2 *Size-2, adj*—represents threat items such as large handguns, and similarly sized objects, that may be constructed of ferromagnetic and/or nonferromagnetic metal; detection of this size of threat is typically encountered at building entry locations where the purpose is to prevent entrance of weapons that can cause a limited number of casualties at a distance from the weapon; typical locations may include but are not limited to schools, sports venues, government buildings and campuses; see 6.2.2 for dimensions and materials of construction for Size-2 test objects.

3.1.8.3 *Size-3, adj*—represents threat items such as small handguns, and similarly sized objects, that may be constructed of ferromagnetic and/or nonferromagnetic metal; detection of this size of threat is typically encountered at building entry locations where the purpose is to prevent entrance of weapons that can cause a limited number of casualties at a distance from the weapon; typical locations may include but are not limited to schools, sports venues, government buildings and campuses, and air, water, and land travel and transportation venues and facilities; see 6.2.3 for dimensions and materials of construction for Size-3 test objects.

3.1.8.4 *Size-4, adj*—represents threat items such as long knives with blade lengths between about 12 cm and 7.5 cm, and similarly sized objects, up to the size of a Size-3 test object, that may be constructed of ferromagnetic and/or nonferromagnetic metal; detection of this size of threat is typically encountered at building entry locations where the purpose is to prevent entrance of weapons that can cause a limited number of casualties in close proximity to the weapon; typical locations may include but are not limited to schools, courthouses, jails, and air, water, and land travel and transportation venues and

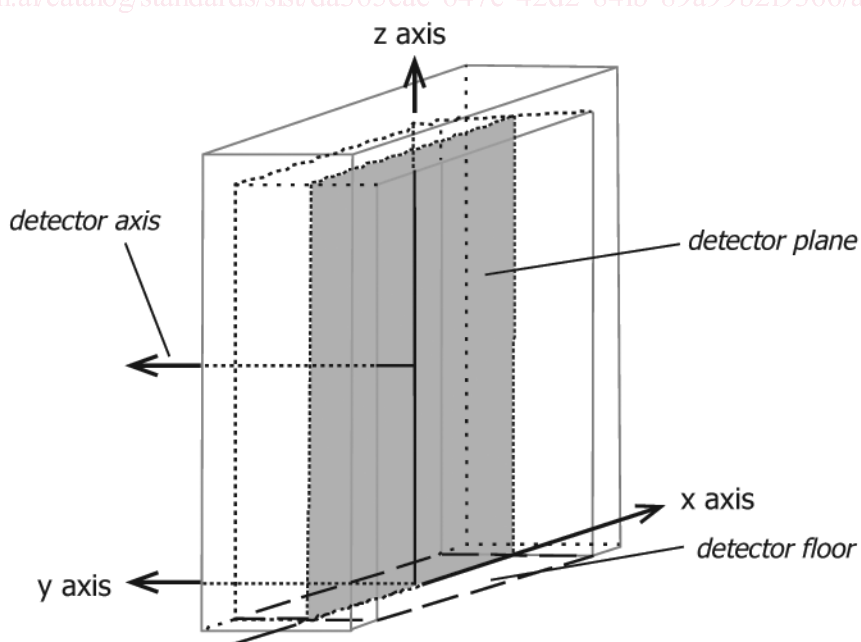

FIG. 1 Diagram of Walk-through Metal Detector showing the Detector Plane, the Detector Axis, the Detector Floor, and the x, y, and z axes of the Measurement Coordinate System

facilities; see 6.2.4 for dimensions and materials of construction for Size-4 test objects.

3.1.8.5 *Size-5, adj*—represents threat items such as knives with blade lengths of about 7.5 cm and disassembled handguns of about 5.7 cm long, and similarly sized objects, up to the size of a Size-4 test object, that may be constructed of ferromagnetic and/or nonferromagnetic metal; detection of this size of threat is typically encountered at building or room entry locations where the purpose is to prevent entrance of weapons that can cause a limited number of casualties in close proximity to the weapon; typical locations may include but are not limited to courthouses, jails, high-security courtrooms, and air, water, and land travel and transportation venues and facilities; see 6.2.5 for dimensions and materials of construction for Size-5 test objects.

3.1.8.6 *Size-6, adj*—represents threat items such as knives with blade lengths between about 7.5 cm and 6.5 cm, and similarly sized objects, up to the size of a Size-5 test object, that may be constructed of ferromagnetic and/or nonferromagnetic metal; detection of this size of threat is typically encountered at building or room entry locations where the purpose is to prevent entrance of weapons that can cause a limited number of casualties in close proximity to the weapon; typical locations may include but are not limited to courthouses, jails, and high-security courtrooms; see 6.2.6 for dimensions and materials of construction for Size-6 test objects.

3.1.8.7 *Size-7, adj*—represents small-sized threat items such as, but not limited to, short knives having blade lengths less than or equal to 6.5 cm, screw-driver bits, and similarly sized objects, up to the size of a Size-6 test object, that may be constructed of ferromagnetic and/or nonferromagnetic metal; detection of this size of threat is typically encountered at building or room entry locations where the purpose is to prevent entrance of weapons that can cause a limited number of casualties in close proximity to the weapon; typical locations may include but are not limited to correctional institutions; see 6.2.7 for dimensions and materials of construction for Size-7 test objects.

3.1.8.8 *Size-8, adj*—represents small-sized threat items such as, but not limited to, short knives having blade lengths less than or equal to about 5.7 cm, 0.22 caliber rounds, and similarly sized objects, up to the size of a Size-7 test object, that may be constructed of ferromagnetic and/or nonferromagnetic metal; detection of this size of threat is typically encountered at correctional facilities where the purpose is to prevent use of weapons that can cause a limited number of casualties in close proximity to the weapon; typical locations may include but are not limited to correctional institutions; see 6.2.8 for dimensions and materials of construction for Size-8 test objects.

3.1.9 *specific test measurement location, n*—the nine positions in the x-z plane (the x-z plane is parallel to the detector plane) through which the test object(s) shall be passed; the specific test measurement locations are based on the size of the average male person and are defined at points along the x and z axes of the measurement coordinate system; there are two locations at ankle height separated approximately by hip width, two at hip height separated approximately by hip width, two at shoulder height separated approximately by torso width, one at top of head height centered along the z-axis, one at slightly below armpit height centered along the z-axis, and one at crotch height centered along the z-axis (see Fig. 2); the specific test measurement locations are a subset of the test measurement grid locations.

3.1.10 *test measurement grid location, n*—the positions on a 5 cm ± 0.1 cm grid, measured from the detector floor (z = 0 cm) midway (x = 0 cm) between the inside surfaces of the WTMD columns, in the x-z plane (the x-z plane is parallel to the detector plane) through which the test object(s) shall be passed; the test measurement grid locations are located within the rectangular region bounded by 0 cm + 1.0 cm / - 0 cm and 180 cm ± 1.0 cm, or the maximum height as specified by the WTMD manufacturer, on the z-axis and, on the x-axis, by 10 cm ± 1.0 cm from the inside surfaces of each of the WTMD columns (sides); if the outer limits for x-axis are not on a 5 cm grid, the outer limits will be defined as those closest to the 10 cm offset but on the 5 cm grid.

3.1.11 *test object, n*—an item that is used to test the WTMD detection performance; test objects accurately simulate the electromagnetic properties of an actual threat or contraband item, such as a weapon or an item that can be used to defeat security devices; the test objects are described in Section 6.

3.1.11.1 *innocuous-item test objects, n*—test objects that are used to test the discrimination performance of the object size class Size-1, Size-2, and Size-3.

3.1.12 *test object axes, n*—the three mutually orthogonal axes of the test object that are referenced to and have a one-to-one correspondence to the axes of the measurement coordinate system.

3.1.13 *three-axis positioning system, n*—a system providing three mutually orthogonal directions of linear translation and that is used to place test objects in the magnetic field of the WTMD; a Cartesian robot may be used as the three-axis positioning system but is not required.

3.1.14 *walk-through metal detector (WTMD), n*—a device using magnetic induction to detect metallic objects; the device is an active detector that generates energy within the portal region of the detector; the interaction of the generated magnetic field with certain types of objects in the portal region of the detector and the ability to detect this interaction is the basis of operation for the WTMD.

3.1.14.1 *detector axis, n*—an imaginary line passing through and perpendicular to the detector plane that is centered vertically and horizontally within the portal of the WTMD and points in the direction of the test subjects motion through the portal (see Fig. 1).

3.1.14.2 *detector floor, n*—the bottom plane of the WTMD portal, which rests on the top surface of the detector platform (see 3.1.9.)

3.1.14.3 *detector plane, n*—an imaginary plane (two-dimensional surface) that is parallel to the portal of the WTMD and that bisects the sensor region into two symmetric halves;

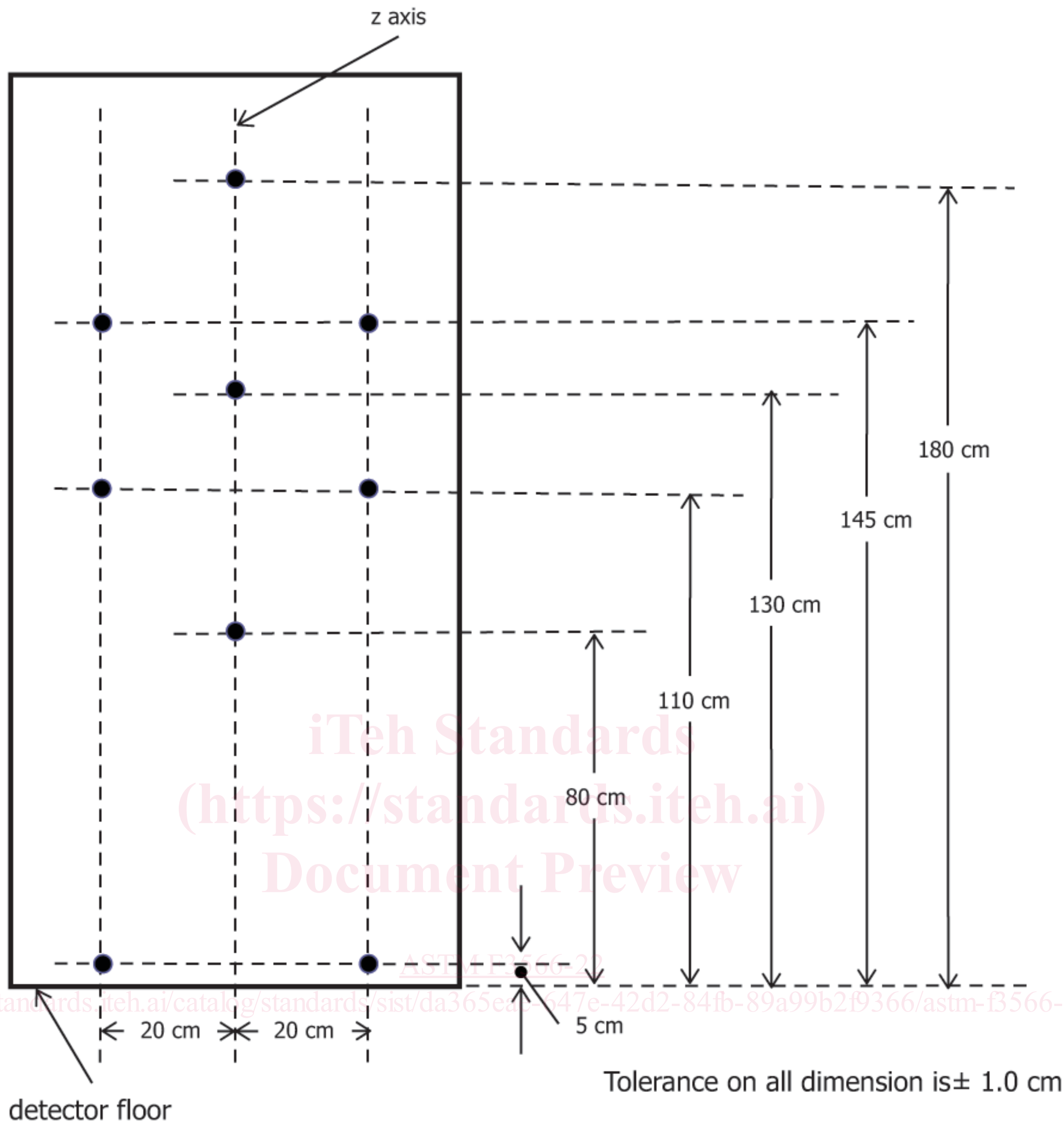

FIG. 2 Specific Test Measurement Locations (indicated by dots) for Detection Performance Tests where the Outer Box Represents the Inside Dimensions of the Walk-through Metal Detector

the detector plane contains two orthogonal axes labeled the x-axis and the z-axis (see Fig. 1).

4. Requirements

NOTE 2—The WTMD shall meet or exceed the requirements and specifications stated in this section.

4.1 *General Test Conditions and Requirements:*

4.1.1 *Testing and Calibration Laboratories*—Laboratories performing testing and calibration of the WTMD or its components, or both, shall meet the requirements of ISO 17025.

4.1.2 *Measurement Equipment and Processes*—All measurement equipment and processes shall be certified to ISO 10012.

4.2 *Safety Specifications and Requirements:*

4.2.1 *Electrical*—The WTMD shall comply with IEC 61010-1, Section 6, Protection against electrical shock.

4.2.2 *Mechanical*—The WTMD shall meet the requirements of IEC 61010-1, Section 7, Protection against mechanical hazards.

4.2.3 *Thermal*—The WTMD shall meet the requirements of IEC 61010-1, Section 10, Equipment temperature limits and resistance to heat.

4.2.4 *Fire*—The WTMD shall be tested to demonstrate fire retardance as specified in IEC 610101:2001, Section 9, Protection against the spread of fire. The result of this test is a pass if the detector complies when tested as specified.

4.2.5 *Human Exposure:*

4.2.5.1 *Magnetic Field Exposure*—The magnitude of the electromagnetic field generated by the WTMD shall be measured using the methods in 4.2.2 or 4.2.3 of the IEC 62369-1 Edition 1.0 for the exposure limits specified for general public exposure in the ICNIRP guidelines[8] (see Appendix X3). If adherence to this requirement has not been demonstrated, the manufacturer shall provide a warning with the WTMD instructions that states, "This device has not been demonstrated as being safe for use on people with active implanted or body-worn, or both, medical devices."

4.3 *Power Requirements:*

4.3.1 *AC Power Operation*—If the WTMD has the option to operate on ac power, then the WTMD shall be tested for ac power operation as described in 5.3.1. The detector shall operate at power line voltages that are equal to ±10 % of the nominal value, V_{nom}, and with variations in frequency of approximately ±5 % of the nominal value, f_{nom}.

4.3.2 *Battery Backup*—If the WTMD has a battery-back up unit, it shall automatically switch to provide power to the metal detector in the event that the AC voltage falls below the minimum voltage specified by the manufacturer. The battery back-up shall be capable of providing at least 20 min of uninterrupted power to a fully functional and operational WTMD as tested according to 5.3.2.

4.4 *Detection Performance Requirements*—The WTMD shall meet the detection performance requirements for each size class for which it is intended to operate.

NOTE 3—The WTMD sensitivity settings shall be the same for all testing per 4.4 requirements.

4.4.1 *Detection Sensitivity*—The WTMD shall exhibit an average probability of detection, $p_{d,sens}$, ≥ 0.95 with an average confidence level of 0.95 for the test objects in each size class specified by the manufacturer, when the test object is moving at a speed of 1 m/s ± 0.05 m/s and when tested in accordance with 5.4.2.

4.4.2 *Discrimination*—The WTMD shall exhibit an average probability of false alarm, p_{fa}, of less than 0.15 (or 15 %) with an average confidence level of 0.95 for the innocuous item test objects for each size class specified by the manufacturer moving at a speed of 0.5 m/s ± 0.1 m/s when tested according to 5.4.3.

4.4.3 *Throughput Rate*—The WTMD shall exhibit an average probability of detection, p_d, ≥ 0.95 for each size class specified by the manufacturer for the following throughput rates, r_{tp}:

4.4.3.1 $r_{tp} \geq 50$ persons/min for a Size-1 or Size-2 test object moving at 1.0 m/s ± 0.1 m/s at each specific test measurement location when tested according to 5.4.4; and

4.4.3.2 $r_{tp} \geq 25$ persons/min for a Size-3 or Size-4 test object moving at 0.5 m/s ± 0.1 m/s at each specific test measurement location when tested according to 5.4.4.

[8] ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz), *Health Physics*, 74(4): 494 – 522, 1998.

4.4.4 *Zonal Detection and Object Location (if provided)*—If the WTMD indicates the location of a metallic object within the portal region of the detector, the following requirements shall be met:

4.4.4.1 The WTMD shall comply with all other detection performance requirements of 4.4.1.

4.4.4.2 The horizontal span (S_x) of each zone region in the portal shall be equal, the sum of the horizontal spans of the zone regions along the x-axis of the portal shall equal the width of the portal, and the width of the portal shall be spanned by at least one zone.

4.4.4.3 If applicable, the sum of the vertical spans (S_z) of the zone regions along the z-axis of the portal shall equal the height of the portal, and the height of the portal shall be spanned by at least three zones.

4.4.4.4 The positioning accuracy of any metallic objects of the appropriate object size class shall be ± 0.5 S_x in the x-axis direction and ± 0.5 S_z in the z-axis direction.

4.4.4.5 The WTMD shall indicate the location of a test object of the appropriate size class by highlighting the corresponding zone and as tested per 4.4.1.

4.5 *Environmental Conditions and Ranges*—The WTMD and all of its components and interconnections shall meet the requirements of this section. The requirements given in this section shall be applied appropriately for either indoor, sheltered outdoor, or outdoor detector models. The tests identified in this section shall be performed on the same unit. The detector, after being tested for each and any of the tests listed in this section, shall meet or exceed the $p_{d,sens}$ requirement given in 4.4.1.

NOTE 4—The intended operating environment for the WTMD shall be specified by the manufacturer as indoor, outdoor sheltered, or outdoor, and the device shall meet the requirements of 4.4.1 after the environmental testing.

4.5.1 *Indoor Operating Temperature Stability and Range*—The WTMD shall be tested in accordance with MIL-STD-810H: Method 501.7, Procedure II, at 46 °C ± 3 °C after being exposed to that temperature continuously for 24 h ± 1 h. The WTMD shall be tested at 46 °C ± 3 °C after this nominal 24-h exposure and shall exhibit no observable changes in the detection performance specification given in 4.4.1. The detector then shall be cooled to 0 °C ± 3 °C within 4 h ± 0.5 h and tested in accordance with MIL-STD-810H: Method 502.7, Procedure II, at 0 °C ± 3 °C after being exposed to that temperature continuously for 24 h ± 1 h. The WTMD shall be tested at 0 °C ± 3 °C after this nominal 24-h exposure and shall exhibit no observable changes in the detection performance specification given in 4.4.1.

4.5.2 *Outdoor Operating Temperature Stability and Range*—The WTMD shall be tested in accordance with MIL-STD-810H: Method 501.7, Procedure II, at 55 °C ± 3 °C after being exposed to that temperature continuously for 24 h ± 1 h. The WTMD shall be tested at 55 °C ± 3 °C after this nominal 24-h exposure and shall exhibit no observable changes in the detection performance specification given in 4.4.1. The detector then shall be cooled to -20 °C ± 3 °C within 4 h ± 0.5 h and tested in accordance with MIL-STD-810H: Method 502.7, Procedure II, at -20 °C ± 3 °C after being exposed to that temperature continuously for 24 h ± 1 h. The WTMD shall be tested at -20 °C ± 3 °C after this nominal 24-h exposure and shall exhibit no observable changes in the detection performance specification given in 4.4.1.

4.5.3 *Storage Temperature Stability and Range*—The WTMD shall be tested in accordance with MIL-STD-810H: Method 501.7, Procedure II, at 65 °C ± 3 °C after being exposed to that temperature continuously for 24 h ± 1 h. The detector then shall be cooled to -37 °C ± 3 °C within 4 h ± 0.5 h and tested in accordance with MIL-STD-810H: Method 502.7, Procedure II, at -37 °C ± 3 °C after being exposed to that temperature continuously for 24 h ± 1 h.

4.5.4 *Relative Humidity Stability and Range*—The WTMD shall be tested in accordance with the requirements of IEC 60068-2-30, Environmental Testing, Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle). The most severe test described in IEC 60068-2-30, Section 5.2 b shall be used; six cycles at 55 °C. The temperature transition set forth in IEC 60068-2-30, Section 7.3.3, Variant 2 shall be followed.

4.5.5 *Ingress Protection (Indoor)*—The WTMD shall meet or exceed the requirements specified in IEC 60529, *Degrees of Protection Provided by Enclosures (IP Code)*, classification IP41.

4.5.6 *Ingress Protection (Sheltered Outdoor)*—The WTMD shall meet or exceed the requirements specified in IEC 60529, *Degrees of Protection Provided by Enclosures (IP Code)*, classification IP53.

4.5.7 *Ingress Protection (Outdoor)*—The WTMD shall meet or exceed the requirements specified in IEC 60529, *Degrees of Protection Provided by Enclosures (IP Code)*, classification IP55.

4.6 *Mechanical Specifications and Requirements*—The WTMD or all of its components and their interconnections shall meet the requirements of this section. The detector, after being tested for each and any of the tests listed in this section, shall exhibit no observable changes in the detection performance specification given in 4.4.1.

4.6.1 *Portal Dimensions*—The WTMD shall be designed so the interior of the portal through which people will walk has the following dimensions:

4.6.1.1 *Height,* minimum: 195 cm,

4.6.1.2 *Width,* minimum: 71 cm, unless required to comply with the American Disabilities Act minimum width of 81 cm, and

4.6.1.3 *Depth,* maximum: 91 cm.

4.6.2 *Shock*—The WTMD shall be tested in accordance with the requirements of IEC 60068-2-27 using the half-sine pulse shape with a nominal peak acceleration of 5 g (50 m/s^2) and nominal pulse duration of 30 ms. The detector shall exhibit no observable changes in the requirements of 4.2.2 and 4.4.1.

4.7 *Electromagnetic Interference Requirements:*

4.7.1 *Radiated Emissions:*

4.7.1.1 The WTMD shall be tested as specified in CISPR 16-2-3 for the frequency ranges and limits given in Table 1 of IEC 61000-6-3.

4.7.2 *Conducted Emissions:*

4.7.2.1 *ac Mains*—The WTMD shall be tested as specified in CISPR 16-2-1 + AMD1 for the frequency ranges and limits given in Table 1 for the ac Mains Port of IEC 61000-6-3.

4.7.2.2 *Signal and Control Ports*—The WTMD shall be tested as specified in CISPR 16-2-1 + AMD1 for the frequency ranges and limits given in Table 1 for the Signal, Control, DC Power Input or Output Ports of IEC 61000-6-3.

4.7.3 *Radiated RF Electromagnetic Field Immunity*—The WTMD shall be tested as specified in IEC 61000-4-3 for Level 2 (3A/m), for the requirements given in Table 1, entry 1.2, of IEC 61000-6-1.

4.7.4 *60 Hz Radiated Magnetic Field Immunity*—The WTMD shall be tested as specified in IEC 61000-4-8 for testing at 60 Hz, Level 2 (3A/m), and continuous exposure for 30 min ± 5 min for the requirements given in Table 1, entry 1.1, of IEC 61000-6-1.

4.7.5 *Electrostatic Discharge Immunity*—The WTMD shall be tested as specified in IEC 610004-2 for the requirements given in Table 1, entry 1.5, of IEC 61000-6-1.

4.7.6 *Fast Transient Immunity*—The WTMD shall be tested as specified in IEC 61000-4-4 for the requirements given in Table 2, entry 2.2; Table 3, entry 3.3; and Table 4, entry 4.5, of IEC 61000-6-1.

4.7.7 *Surge Immunity*—The WTMD shall be tested as specified in IEC 61000-4-5 for the requirements given in Table 3, entry 3.2 and Table 4, entry 4.4, of IEC 61000-6-1.

4.7.8 *RF Common Mode*—The WTMD shall be tested as specified in IEC 61000-4-6 for the requirements given in Table 2, entry 2.1; Table 3, entry 3.1; and Table 4, entry 4.1, of IEC 61000-6-1.

4.7.9 *Voltage Interruptions and Dips*—The WTMD shall be tested as specified in IEC 61000-4-11 for the requirements given in Table 4, entries 4.2 and 4.3, of IEC 61000-6-1.

4.8 *Metallic Interference Requirements:*

4.8.1 *Metallic Stationary-Object Interference*—The WTMD shall exhibit an average probability of detection, $p_{d,sens}$, ≥0.95 with an average confidence level of 0.95 for the steel-handgun exemplar in its given orientation, unless otherwise specified by the user of the standard, with the test object moving at a speed of 1.0 m/s ± 0.05 m/s and when tested in accordance with 5.7.1.1, 5.7.1.2, and 5.7.1.3, and shall not produce an alarm when no test object is presented to the detector.

4.8.2 *Metallic Moving-Objects/Metal-Door Interference*—The WTMD, when adjusted to meet the requirements of 4.4.1, shall exhibit an average probability of false alarm, $p_{fa,md}$, ≤0.20 with an average confidence level of 0.95 when tested in accordance with 5.7.2.

4.9 *Multiple Threat Object Interference*—The WTMD, when adjusted to meet the requirements of 4.4.1, shall exhibit an average probability of detection, $p_{d,moi}$, ≥0.95 with an average confidence level of 0.95 when tested in accordance with 5.8.

4.10 *Body Interference*—The WTMD, when adjusted to meet the requirements of 4.4.1, shall exhibit an average probability of false alarm, $p_{fa,bi}$, ≤0.01 with an average confidence level of 0.95 when tested in accordance 5.9.

4.11 *Functional and Operational Requirements:*

4.11.1 *Program Storage*—The WTMD shall have a means of storing the program and detection sensitivity settings in the event of loss or disruption of ac power as tested according to 5.4.

4.11.2 *Alarm Requirements*—The WTMD shall provide visual and audible alarms in the event that a metallic object within the appropriate size range is detected. The magnitude of this alarm shall be in proportion to the size, proximity, orientation, and material of the metallic object.

4.11.2.1 *Audible Alarms*—All audible alarms (other than an earphone), unless it is external to the WTMD, shall produce an alarm-state sound pressure level of at least 75 dB ± 5 dB at 0.8 m ± 0.08 m from the WTMD as measured in accordance with 5.6.1. For status indicators, the audible alarm shall be a two-state audible alarm: active (alarm state) and inactive (nonalarm state). For metal object warning, the audible alarm shall be a two-state audible alarm. The two-state alarm indicator shall produce no sound in the nonalarm state.

4.11.2.2 *Visible Alarms*—Any visible alarm, unless it is external to the WTMD, shall produce an illumination of $\geq 10\ lm/m^2$ when tested in accordance with 5.6.2. The visual alarms shall be a two-state visual alarm: active (illuminating) and inactive (nonilluminating).

4.11.2.3 *Metal-Object-Detection Alarms*—The WTMD shall have a two-state audible alarm and a visual alarm that shall alarm to indicate the presence of a test object in the portal region, as tested in accordance with 5.6.3. The alarm state for the metal-object-detection visual alarm shall be active (illuminating), and the nonalarm state shall be inactive (nonilluminating). The metal object-detection-visual alarm shall be distinct from any other visual alarms.

4.11.2.4 *System-Status Alarms*—The WTMD shall have a two-state audible alarm or a visible alarm to indicate the operational state of the WTMD and shall be activated if the operational state of the WTMD can cause a degradation of the detection performance required by this standard, as tested in accordance to 5.6.4. The system-status visual alarm shall be inactive (nonilluminating) if the system status is acceptable and shall be active (illuminating) if a system status problem exists. The system-status visual alarm shall be distinct from any other visual alarms.

4.11.2.5 *Detection-Ready-State-Violation Alarm*—The WTMD shall have a two-state audible alarm or a visual alarm to indicate passage of a person through the portal of the WTMD when it was not in the ready state as tested in accordance to 5.6.5, and shall be activated if a person attempts to pass through the portal of the WTMD when it is not in the ready state. The visual alarm shall be active (illuminating) if a person attempts to pass through the portal of the WTMD when it is not in the ready state, and inactive (nonilluminating) otherwise.

4.11.2.6 *Speed-Range-Violation Alarm*—If provided, the WTMD shall contain a visual alarm that is activated if the speed of a person walking through the portal of the WTMD is outside the speed range of 0.2 m/s ± 0.1 m/s to 2.0 m/s ± 0.1 m/s. The testing shall be performed per 5.10 at speeds of 0.05 m/s ± 0.02 m/s and 3.0 m/s ± 0.1 m/s.

4.11.3 *Communication*—The WTMD shall have an electrical connector from which either an analog or digital output signal is obtained. This signal represents the magnitude of the detector response to a test object and is the signal upon which an alarm is based. If the output signal is analog, the connector shall be coaxial where the inner conductor provides the signal path and the outer conductor of the connector provides signal ground or return.

5. Test Methods

5.1 No information is presented about either the precision or bias of the test methods described in this standard for measuring the detection performance of a WTMD because the test results are binary, reflecting either a detection event or a no-detection event and, thus, are nonquantitative.

5.2 *General Requirements:*

5.2.1 All tests shall be performed on the same WTMD unit. All test dates shall be recorded and reported.

5.2.2 *Position of WTMD*—The distance between any metal object other than a test object shall be at least 32.5 cm from the detector floor, at least 50 cm from the topmost part of the WTMD, and at least 0.8 m from any side or outward projections of any side of the WTMD.

5.2.3 *Environmental Conditions*—At the time of the tests, the ambient temperature shall be in the range specified in 4.5 for the appropriate application (indoor, sheltered outdoor, or outdoor); the relative humidity shall be noncondensing.

5.2.4 *Installation*—The WTMD shall be installed according to the manufacturers instructions. Any setup or calibration adjustments specified in the operator's manual shall be performed if required.

5.3 *Power Tests:*

5.3.1 *AC Power Test:*

(1) Connect the WTMD to an ac power source that provides an adjustable voltage and frequency output.

(2) Set the power source to the nominal operating ac voltage, V_{nom}, and frequency, f_{nom}, specified by the WTMD manufacturer.

(3) Using a test object corresponding to the size classification being tested, identify the location (vertically and horizontally) in the portal that when this test object is passed through the WTMD it causes an alarm. Record and use this location for the following steps.

(4) Pass the selected test object through the WTMD at the location identified in 5.3.1 step *(3)*.

(5) Record and report an alarm.

(6) Set the ac power source to output approximately 0.9 V_{nom} at f_{nom}.

(7) Repeat 5.3.1 steps *(4)* and *(5)*.

(8) Set the ac power source to output approximately 1.1 V_{nom} at f_{nom}.

(9) Repeat 5.3.1 steps *(4)* and *(5)*.

(10) Set the ac power source to output approximately 1.0 V_{nom} at 0.95 f_{nom}.

(11) Repeat 5.3.1 steps *(4)* and *(5)*.

(12) Set the ac power source to output approximately 1.0 V_{nom} at 1.05 f_{nom}.

(13) Repeat 5.3.1 steps *(4)* and *(5)*.

(14) If an alarm is not observed from 5.3.1 step *(4)* and its repeats, the ac power test fails.

5.3.2 *Battery Backup Test:*

(1) Ensure the WTMD is operating properly by noting an alarm when a test object is passed through WTMD.

(2) Disconnect the WTMD from the ac power and leave disconnected for approximately 20 min.

(3) Pass the same test object used in 5.3.2 step *(1)* through the WTMD.

(4) Record and report whether an alarm was generated or not.

(5) If an alarm was not observed in 5.3.2 step *(4)*, the battery backup test fails.

5.4 *Detection Performance Tests*—The detection performance shall be evaluated by the test methods described in this section.

NOTE 5—For WTMDs that contain more than one generator or sensor, or both, the detector response that is recorded shall be the one from which an alarm is derived.

5.4.1 *Test Objects and Equipment:*

5.4.1.1 *Test Objects*—See Section 6.

5.4.1.2 *Three-Axis Positioning System*—The three-axis positioning system shall meet the following requirements:

(1) Displacement, x-axis: ≥1 m,
(2) Displacement, y-axis: ≥1.5 m,
(3) Displacement, z-axis: ≥2 m,
(4) Position accuracy, each axis: 1 mm,
(5) Position repeatability, each axis: 1 mm, and
(6) Maximum slew speed, y-axis: ≥2 m/s.

5.4.1.3 *Magnetic Field Sensor*—The magnetic field sensor shall have a frequency response bandwidth at least five times greater than the bandwidth of the generated magnetic field, provide a rms voltage output, and have dimensions less than or equal to 4 cm by 4 cm by 4 cm.

5.4.1.4 *Voltmeter*—The ac voltmeter shall have a bandwidth at least five times greater than the bandwidth of the generated magnetic field, allow computer control and data retrieval, and have a variable gain input with at least 10-bit resolution full scale.

5.4.1.5 *Microphone (audible alarms)*—The microphone is the audible alarm indication detector. It shall be used to detect an audible positive alarm indication, be capable of detecting the audible alarm indication as described in 4.11.2.1, and provide an analog output that can be interfaced to the computer controller (see 5.4.1.9).

5.4.1.6 *Light Detector (visible alarms)*—The light detector is the visible alarm indication detector. It shall be used to detect a visible positive alarm indication, be capable of being attached directly to the visual alarm indicator, and provide an analog electrical output that can be interfaced to the computer controller (see 5.4.1.9).

5.4.1.7 *Illumination Meter*—The illumination meter is used to measure the brightness of the visible alarm indicators and shall be capable of measuring light levels of 25 lm/m^2 and 1000 lm/m^2 with an error of not more than 10 %. The integrated spectral response shall be within 10 % of the Commission Internationale de l'Eclairage (CIE, the International Commission on Illumination) photopic curve found in ISO/CIE 23539:2005, Photometry – The CIE System of Physical Photometry.

5.4.1.8 *Detector Platform*—Requirements defined in 3.1.4.

5.4.1.9 *Test Object Support Platform*—The test object support platform shall be constructed of nonconductive, nonmagnetic materials. The purpose of this platform is to provide a rest for the test objects at the test measurement location (see Fig. 2) heights of: 80 cm ± 1 cm, 130 cm ± 1 cm, and 180 cm ± 1 cm.

5.4.1.10 *Computer Controller*—The computer controller shall have installed and operational all necessary hardware and software for providing instrument control and data acquisition.

5.4.1.11 *Human Body Simulator*—The human body simulator shall be constructed of material with a conductivity of approximately 0.8 S/m over the range of 100 Hz to 3 MHz. The human body simulator shall be equipped with nonmetallic casters and a means to push it through the detector at speeds between 0.2 m/s ± 0.1 m/s and 2.0 m/s ± 0.1 m/s.

5.4.2 *Detection Sensitivity Test:*

5.4.2.1 *Initial Procedures:*

(1) Ensure that the voltmeter, alarm detector, and three-axis positioning system are connected to the computer controller and that the detection signal output connector (see 4.11.3) is connected to the voltmeter (for analog signals) or to the computer (for digital signals).

(2) Turn on the voltmeter, alarm detector, computer controller, and positioning system and verify proper operation of the measurement system.

(3) Ensure that the WTMD is securely located and positioned in the measurement coordinate system.

(4) Attach the test object with the proper orientation to the positioning system.

(5) Turn on the WTMD and ensure that its output functions properly by noting a change in the magnitude of the detection signal and activation of the alarm as a metal object is brought near the detector.

(6) Ensure that the test object does not hit any objects while in motion.

(7) Compute the number of tests, N_T, according to Annex A1 for $p_0 = p_{d,sens}$.

(8) Compute the number, n_{xz}, of entry-point locations using:

$$n_{xz} = \left(rnd\left\{ \frac{W_{prtl} - 2x_{off}}{x_{inc}} \right\} + 1 \right) \left(rnd\left\{ \frac{H_{prtl}}{z_{inc}} \right\} + 1 \right), \quad (1)$$

where W_{prtl} is the width of the portal in millimeters, H_{prtl} is the height of the portal in millimeters, x_{inc} = 50 mm unless otherwise specified by the user of the standard, z_{inc} = 50 mm unless otherwise specified by the user of the standard, x_{off} is the offset between the inside surface of the portal and where measurements will be taken, and x_{off} = 50 mm unless otherwise specified by the user of the standard, and the function $rnd\{a\}$ returns a rounded-down integer value of a.

(9) Compute the number of scans, $n_{s,k}$, according to Annex A2 using the N_T computed in step *(7)*, n_{xz} computed in step *(8)*, $n_{o,k}$ = 1, and n_{spd} = 1.

5.4.2.2 *Performing the Measurement:*

NOTE 6—The scan limits for the x-axis scan shall be the boundaries of the test measurement grid locations.

NOTE 7—The center for both the x and z direction scans shall be the detector axis (see Fig. 1).

(1) Set the computer program to perform a 1.5 m long y-axis scan at the specified speed that is perpendicular to, passes through, and is centered at the detector plane.

(2) Set the x-axis and z-axis positions to the most negative scan limits.

(3) Perform a y-axis scan.

(4) Record any alarm in each of the forward and reverse directions using the alarm detector.

(5) Repeat *(3)* and *(4)* for $n_{s,k}$ times, as computed in 5.4.2.1 step *(9)*.

(6) Compute and record the average and standard deviation of the results from step *(5)*.

(7) Move the x-axis in 5 cm ± 0.1 cm increments.

(8) Repeat steps *(3)*, *(4)*, *(5)*, and *(6)*.

(9) Repeat steps *(7)* and *(8)* until the x-axis positive scan limit is reached.

(10) Move the z-axis in 5 cm ± 0.1 cm increments.

(11) Set the x-axis position to the most negative scan limit.

(12) Repeat steps *(9)*, *(10)*, and *(11)* until the z-axis positive scan limit is reached.

(13) Compute $p_{d,sens}$ according to Annex A3 using the alarm data from step *(4)* and any of its repeats, n_{xz} as computed in 5.4.2.1 step *(8)*, n_{spd} = 1, n_{obj} = 2, n_{orient} = 1, and $n_{s,k}$ as computed in 5.4.2.1 step *(9)*, and report this value of $p_{d,sens}$.

5.4.3 *Discrimination Test:*

5.4.3.1 *Initial Procedures:*

(1) Perform 5.4.2.1 steps *(1)* through *(6)*.

(2) Compute the number of tests, N_T, according to Annex A1 for $p_0 = 1 - p_{fa}$.

(3) Compute the number of scans, $n_{s,k}$, according to Annex A2 using the N_T computed in step *(2)*, n_{xz} = 1, $n_{o,k}$ = 1, and n_{spd} = 1.

5.4.3.2 *Performing the Measurement:*

(1) Set the computer program to perform a 1.5 m long y-axis scan that is perpendicular to, passes through, and is centered at the detector plane at the x-axis position of 0 cm ± 0.5 cm centered on the z-axis and z-axis position of 60 cm ± 0.5 cm.

(2) Attach the innocuous item test object to human body simulator at the locations specified in Section 6.

(3) Attach the three-axis positioning system to the human body simulator at the designated location on the human body simulator.

(4) Perform the y-axis scan.

(5) Record any alarms using the alarm detector as the y-axis scan is being performed.

(6) Repeat steps *(3)* and *(4)* $n_{s,k}$ times, as computed in 5.4.4.1 step *(4)*.

(7) Compute $p_{d,innoc}$ according to Annex A3 using the alarm data from step *(4)* and any of its repeats, n_{xz} = 1, n_{obj} = 1, n_{orient} = 1, and $n_{s,k}$ as computed in 5.4.4.1 step *(4)*.

(8) Compute p_{fa} using:

$$p_{fa} = 1p_{d,innoc}. \quad (2)$$

5.4.4 *Throughput Rate Test:*

NOTE 8—A forward-going scan direction moves the test object farther away from the three-axis positioning system and through the WTMD portal. A backward-going scan direction moves the test object through the WTMD portal and closer to the three-axis positioning system.

NOTE 9—The delay is the difference between the stopping time of the forward-going scan and the starting time of the backward-going scan.

NOTE 10—This procedure requires two test objects. The first test object is a Size-2 test object with the specified orientation and is attached to the positioning system. The second test object is a Size-1 test object that is not attached to the positioning system but rests on the support platform. The second test object is pushed by the first test object through the detector portal during the forward-going scan.

5.4.4.1 *Initial Procedures:*

(1) Perform 5.4.2.1 steps *(1)* through *(6)*.

(2) Position the test object support platform such that the detector axis is parallel to the top surface of the support platform, the detector plane is perpendicular to the top surface of the support platform, and the z-axis position of a specific test measurement location is centered to within 1 cm of the center of the support platform, and the detector plane bisects the top surface of the support platform.

NOTE 11—The test object support platform shall be constructed from nonelectrically conductive nonmagnetic materials.

(3) Compute the number of tests, N_T, according to Annex A1 for $p_0 = p_d$.

(4) Compute the number of scans, $n_{s,k}$, according to Annex A2 using the N_T computed in step *(3)*, n_{xz} = 9, $n_{o,k}$ = 1, and n_{spd} = 1.

5.4.4.2 *Performing the Measurement:*

(1) Attach the first test object to the positioning system.

(2) Set the computer program to perform a 1.5 m long y-axis scan at the specific test measurement location given by $(xz)_i$, where x and z are the positions for each of the ith specific test measurement locations.

(3) Set the y-axis scan position to -0.75 m ± 1 cm from the detector plane.

(4) Set the test object support platform to the same z-axis position as the specific test measurement location used in step *(1)*.

(5) Place the second test object on top of the test object support platform and ensure its orientation is correct.

(6) Push the second test object up against the first test object.

(7) Perform the forward-going y-axis scan.

(8) Record any alarm using the alarm detector as the forward-going y-axis scan is being performed.

(9) Record the time at which the forward-going y-axis scan terminated.

(10) Wait for 2.0 s ± 0.05 s. This wait time is the delay, $t_{d,(xz)i}$ where $(xz)i$ refers to the ith specific test measurement location.

(11) Perform the backward-going y-axis scan.

(12) Record any alarm using the alarm detector as the backward-going y-axis scan is being performed.

(13) Repeat steps *(5)* through *(12)* $n_{s,k}$ times, as computed in 5.4.4.1 step *(4)*.

(14) Compute $p_{d,(xz)i}$ according to Annex A3 using the alarm data from step *(12)* and any of its repeats, n_{xz} = 9, n_{obj} = 1, n_{orient} = 1, and $n_{s,k}$ computed in 5.4.4.1 step *(4)*.

(15) Decrease $t_{d,(xz)i}$ by 0.1 s ± 0.01 s.

(16) Repeat steps *(5)* through *(15)* until $p_d < 0.95$ with an average confidence level of 0.95 for the backward-going y-axis scan.

(17) Record $t_{d,(xz)i}$ from step *(15)*, the $p_{d,(xz)i}$ computed in step *(16)*, and $(xz)i$ from step *(2)*.

(18) Repeat steps *(2)* through *(17)* for the other specific test measurement locations.

(19) Compute the delay, $t_{d,max}$, by selecting the maximum of the $t_{d,(xz)i}$ and adding 0.1 s to correct for the additional delay introduced by step *(15)*.

(20) Compute r_{tp} by dividing 60 s/min by $t_{d,max}$ from step *(19)*.

5.5 *Program Storage Test:*

NOTE 12—The WTMD shall have a means of storing the program and detection sensitivity settings in the event of loss or disruption of ac power to maintain the calibration and setup of the walk-through metal detector parameters.

(1) Ensure the detector is operating properly by noting an alarm when a test object is passed through it.

(2) Set the WTMD to operate for a specific size class and record all program parameters stored by the detector.

(3) Disconnect the WTMD from the ac power and leave disconnected for approximately 5 min.

(4) Reconnect the WTMD to the ac power and turn it on.

(5) Record program parameters and compare to those parameters recorded prior to ac power interruption.

(6) Report the results of the comparison from 5.5 step *(5)*.

5.6 *Alarm State Tests:*

5.6.1 *Audible Alarm Test:*

(1) Position the sound pressure level meter microphone 0.80 m from the detector.

(2) Measure the sound pressure level with the detector power applied and the audible alarm in the nonalarm state.

(3) Cause the detector to produce an alarm, and again measure the sound pressure level.

(4) Record the sound pressure levels.

NOTE 13—Perform the test in an anechoic chamber or at an outdoor location, at least 6 m from any large object, where the ambient sound pressure level at the time of the test is not more than 53 dB_{SPL}.

NOTE 14—The sound pressure level meter shall comply with ANSI S1.4:1983, *Specifications for General Purpose Sound Level Meters*, for type 1, A-weighting, reference pressure 20 µPa.

5.6.2 *Visible Alarm Test:*

(1) Position the WTMD with its visual alarm indicator 0.20 m ± 0.05 m from the illumination meter, at a test site where the ambient illumination is 1000 lm/m^2 ± 100 lm/m^2.

(2) Turn on the WTMD and move a metal object near the WTMD to cause it to alarm.

(3) Record and report the illumination meter reading.

5.6.3 *Metal Object Detection Indicator Test:*

(1) Passing a Size-2 test object through the WTMD portal at a speed greater than or equal to 0.2 m/s and less than or equal to 2.0 m/s.

(2) Record the alarms.

5.6.4 *System Status Alarm Test:*

(1) Set the WTMD to be in a system failure mode.

(2) Record the system-status alarm.

(3) Remove the failure mode.

(4) Record the system-status alarm.

NOTE 15—The manufacturer shall provide instructions for forcing the detector into a system failure.

5.6.5 *Detection-Ready-State-Violation Alarm Test:*

(1) Turn the WTMD power from off to on.

(2) Verify that the WTMD enters a ready mode by not displaying a ready-state violation alarm.

(3) Ensure the WTMD is operating properly by noting a positive alarm when a Size-2 test object is carried through the detector by a clean test subject.

(4) Note whether the detection ready state violation alarm is activated immediately after the clean test subject passes through the detector.

(5) Once the alarm is deactivated, have the clean test subject carrying a Size-2 object walk through the detector.

(6) Repeat 5.6.5 step *(4)*.

(7) Record and report the results.

5.7 *Metal Interference Tests:*

5.7.1 *Metallic Stationary-Object Interference Tests:*

5.7.1.1 *Test for Operation Near a Stationary Metal Object:*

NOTE 16—The effects of the proximity of a metal wall or floor on the performance of the WTMD is assessed using a metal test panel.

(1) Position the metal test panel such that its large surfaces are perpendicular to the detector plane, the x-axis of the measurement coordinate system passes through the center of the metal test panel, and the x-axis separation between the metal test panel and the closest surface of the WTMD is 30 cm ± 1 cm.

(2) Record and report any alarms after the panel is positioned.

(3) Test the WTMD according to the requirements of 4.4.1 for the steel-handgun exemplar in its allowed orientation without moving the metal test panel.

(4) Report test results of step *(3)*.

(5) Repeat *(1)* through *(3)* for the other side of the WTMD.

(6) Report test results of step *(5)*.

NOTE 17—The metal test panel shall be cold-finished sheet carbon steel AISI C1015 to C1020 with dimensions of 1 m ± 0.01 m by 1 m ± 0.01 m by 1.25 mm ± 0.13 mm and may be mounted in a nonelectrically conductive, nonmagnetizable frame to prevent bowing and bending of the metal test panel.

5.7.1.2 *Test for Operation Near a Steel Floor:*

NOTE 18—The effects of the proximity of a steel reinforced floor on the performance of the walk-through metal detector is assessed using a metal test panel.

(1) Position the metal test panel such that it is parallel to and 10 cm ± 1 cm below the detector floor (see Fig. 1).

(2) Note and record any positive alarm indication after the panel is positioned.

(3) Readjust the floor gain control of the metal detector, if necessary, note the new gain settings.

(4) Test the WTMD according to the requirements of 4.4.1 for the steel-handgun exemplar in its allowed orientation without moving the metal test panel.

(5) Report test results of step *(4)*.

NOTE 19—The test floor shall be cold-finished sheet carbon steel AISI C1015 to C1020 with dimensions of 1 m ± 0.01 m by 1 m ± 0.01 m by 2 mm ± 0.2 mm.