Designation: F2542 – 05 (Reapproved 2012)

Standard Test Methods for Physical Assault on Ventilation Grilles for Detention and Correctional Facilities[1]

This standard is issued under the fixed designation F2542; 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 These test methods cover requirements for simulated service tests and testing equipment for determining the performance characteristics of ventilation grilles used in secure areas, including detention and correctional facilities. The testing equipment provides for the setup and testing of specimen grilles and mounting systems. It is recognized that, in order to meet the intent of these test methods, ventilation grilles must be compatible with the level of performance require by Test Methods F2322.

1.2 It is the intent of these test methods to ensure that security ventilation grilles meet minimum performance levels to control the passage of unauthorized materials into secure areas, to confine inmates, to resist vandalism, and to delay or frustrate escape, or both. It is also the responsibility of the user of these test methods to insure that the grille selected is appropriate, based on relevant regulatory, health, and safety concerns and requirements. Such concerns include, but are not limited to, injury and suicide avoidance. These test methods do not quantify such concerns.

1.3 Take care to provide access to return and exhaust ducts for cleaning as required by NFPA 90A. If access cannot be provided though an interstitial space behind walls or ceiling, the use of filter grilles needs to be considered as an option. When filter grilles are provided, filters shall have a minimum UL-900 class 2 rating, and a filter replacement program needs to be in place at the facility.

1.4 Airflow performance shall be catalogued in accordance with ASHRAE 70–91. Manufacturer's catalog data must include grade level achieved.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F2322 Test Methods for Physical Assault on Vertical Fixed Barriers for Detention and Correctional Facilities

2.2 *NFPA Standard:*[3]

NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems

2.3 *UL Standard:*[4]

UL-900 Standard for Air Filter Units

2.4 *ASHRAE Standard:*[5]

ASHRAE 70–91 Method of Testing for Rating the Performance of Air Outlets and Inlets

3. Terminology

3.1 *Definitions:*

3.1.1 *bars*—method of reinforcement or prevention of egress installed in the sleeve. Bars may be of a material, size, shape, and spacing as selected by the manufacturer to provide the desired test results and meet applicable federal, state, and local jail and prison standards.

3.1.2 *diffuser*—ceiling-mounted device designed to provide deflection of air flow.

3.1.3 *filter grille*—grille incorporating a replaceable filter in the grille sleeve or body.

[1] These test methods are under the jurisdiction of ASTM Committee F33 on Detention and Correctional Facilities and are the direct responsibility of Subcommittee F33.04 on Detention Hardware.

Current edition approved June 1, 2012. Published August 2012. Originally approved in 2005. Last previous edition approved in 2005 as F2542 – 05. DOI: 10.1520/F2542-05R12.

[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 National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02269-9101.

[4] Available from Underwriters Laboratories (UL), Corporate Progress, 333 Pfingsten Rd., Northbrook, IL 60062.

[5] Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329.

3.1.4 *forcible egress*—opening created in the specimen which allows a 5 in. × 8 in. × 8 in. (127 mm × 203 mm × 203 mm) rigid rectangular box to be passed through with force not exceeding 10 lbf (44.5 N).

3.1.5 *grille, security grille, or ventilation grille*—device installed to allow passage of air while protecting ventilation openings.

3.1.6 *grille face*—portion of grille exposed to the occupied space.

3.1.7 *manufacturer*—party responsible for the construction, fabrication, or supply of the test specimens used to conduct the tests.

3.1.8 *mounting method*—method of retaining a device in a wall or ceiling. Typical methods may include angles welded to the sleeve, a sleeve formed to capture the wall or ceiling, or imbed masonry anchors, or both.

3.1.9 *openings*—passageways in the grille face, allowing flow of air through a device.

3.1.10 *sleeve*—portion of the grille that attaches to the face that can be used to connect ductwork, and provide a means to affix the grille into the wall, ceiling, or structure.

3.1.11 *suicide avoidance*—punched plate with through penetrations not exceeding 3⁄16 in. diameter, or another acceptable technology, such as multiple passageways, as deemed acceptable by the approving authority.

3.1.12 *test completion*—conduct one test sequence for each grille.

3.1.13 *testing laboratory*—accredited independent third party testing laboratory.

3.1.14 *transfer grille*—device with two exposed faces serving adjacent spaces, providing a means for air movement from one space to the other, due to room pressure differences.

3.1.15 *vandalism*—opening created in the specimen which allows a 2 in. (51 mm) rigid cube to be passed through with force not exceeding 10 lbf (44.5 N).

4. Significance and Use

4.1 A major concern for administration officials is security of barriers used in detention/correctional facilities. These test methods are designed to identify the security levels for ventilation grilles mounted within these barriers.

4.2 The purpose of these tests is to approximate levels of abuse to which grilles will potentially be subjected in the field, and to provide assurance of protection to the public, facility administrative personnel, and inmates.

5. Sampling

5.1 Specimens shall be constructed in accordance with 6.1 and shall be representative of grilles made by the manufacturer.

5.2 One specimen for of size 16 × 16 in. (406 × 406 mm) to be offered for each grade.

6. Specimen Preparation

6.1 *Construction:*

6.1.1 Grilles must be available in 4 in. (101 mm) increments. Manufacturers shall be permitted to offer intermediate sizes also, at their discretion.

6.1.2 Openings in face shall not exceed 3⁄16 in. (4.76 mm) diameter. Multiple passageways with 3⁄16 in. (4.76 mm) maximum openings are also acceptable.

6.1.3 Air flow performance shall be cataloged in accordance with ASHRAE Standard 70-91 and need to include filter pressure loss if the grille is so equipped.

6.1.4 Where bars are required for purpose of testing, they must be located no more than 5 in. (127 mm) maximum behind face.

6.2 *Test Fixture*—Fixture shall be fabricated of structural steel, shall be large enough to accommodate the specimen and allow for mounting of the specimen in a method common to detention and corrections installations.

7. Procedures

VANDALISM PRYING TEST

7.1 *Scope*—Simulate attack with common hand tools.

7.2 *Significance and Use*—Crowbar, screwdriver, and pliers are used to remove face or create an opening.

7.3 *Apparatus:*

7.3.1 A10 in. (254 mm) screwdriver,

7.3.2 A24 in. (610 m) crowbar, and

7.3.3 A8 in. (203 m) pliers.

7.3.4 *Procedure:*

7.3.4.1 Test must be conducted prior to the Vandalism Impact Test.

7.3.4.2 Specimen must remain in fixture for use in the Vandalism Impact Test.

7.3.4.3 Attack grille with tools for time required in Table 1.

7.3.4.4 Specimen is exposed to the Prying Test at each successive grade level. The specimen is deemed to have failed if a 2 in. (51 mm) cube can be passed through any opening in the face with a force not exceeding 10 lbf (44.5 N). The specimen will be classed at the highest Vandalism Prying Test grade level achieved prior to failure.

7.3.4.5 Transfer grilles must have both faces of a single specimen tested for the appropriate grade. If the grille is symmetrical in all aspects of construction and mounting method, then testing on one face is permitted for Grade Levels 3 and 4.

VANDALISM IMPACT TEST

7.4 *Scope*—This test is designed to evaluate the ability of a specimen to resist an attack that uses common hand tools.

TABLE 1 Security Level

	Grade 1	Grade 2	Grade 3	Grade 4
Vandalism Prying Test	45 min	30 min	20 min	10 min
Vandalism Impact Test	200 blows	150 blows	100 blows	50 blows
Egress Test	400 additional blows	200 additional blows	Not required	Not required

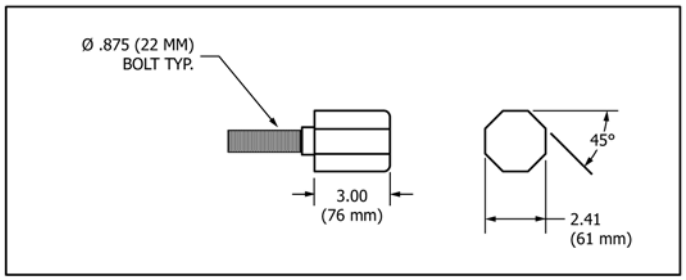

FIG. 1 Blunt Impactor

7.5 *Significance and Use*—This test method is designed to simulate a field situation where a 10 lb (4.54 kg) sledgehammer is used to attack the grille face. Specimen must resist attack without allowing passage of a 2 in. (51 mm) cube through the grille face with a force not exceeding 10 lbf (44.5 N).

7.6 *Apparatus:*

7.6.1 *Impact Test Apparatus*—Steel impact ram shall be equipped to be incorporated into a hinged or pivoted swinging pendulum equipped with a blunt impactor (Fig. 1). The system shall be capable of delivering 200 lbf (271.2 J) of energy. Combined weight of impact ram (Fig. 2 and Fig. 3) and blunt impactor shall be 80 ± 0.25 lb (36.3 ± 0.10 kg). The drop height of the ram shall be 31 ± 1 in. (762 ± 25.4 mm). The angle of the suspension rods, cable, arm, or chains shall be no more than 45° off vertical when the ram is in the raised position (see Fig. 3). All pivot points in the suspension system must be in good repair and well lubricated to minimize friction losses that could reduce the impact energy being delivered to the test specimen.

7.6.2 *Blunt Impactor*—Impactor shall be fabricated from C1010-1020 carbon steel and shall have an impact surface area of 4 ± 0.04 $in.^2$ (101.6 ± 1.0 mm^2) and shall have rounded edges similar to a 10 lb (4.54 kg) sledgehammer head. Impactor shall be adjustable to provide impact to specimen face, then adjust to impact bars from front or rear of grille as required for the Egress Test.

7.6.3 *Fixture*—Fixture shall be of sufficient size to contain test specimen and of a design to accommodate the mounting method with which the specimen will be tested. Fixture shall be rigidly constructed and reinforced, and secured to wall or floor to insure all forces are transmitted to test specimen (see Fig. 4 and Fig. 5).

7.7 *Procedure:*

7.7.1 Install specimen in structural steel fixture using the mounting system as designed for field installation.

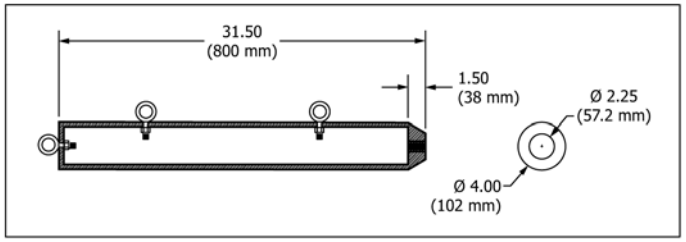

FIG. 2 Ram

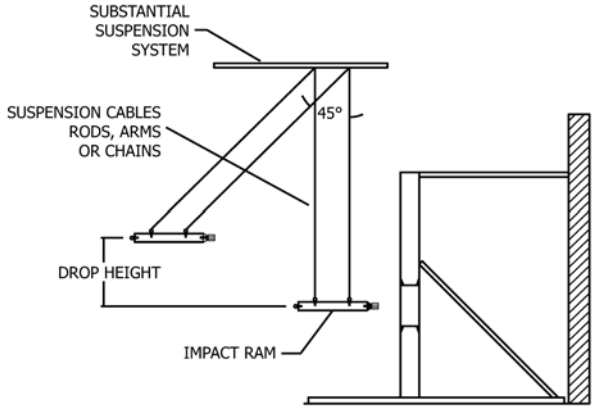

FIG. 3 Fixture and Ram Side View

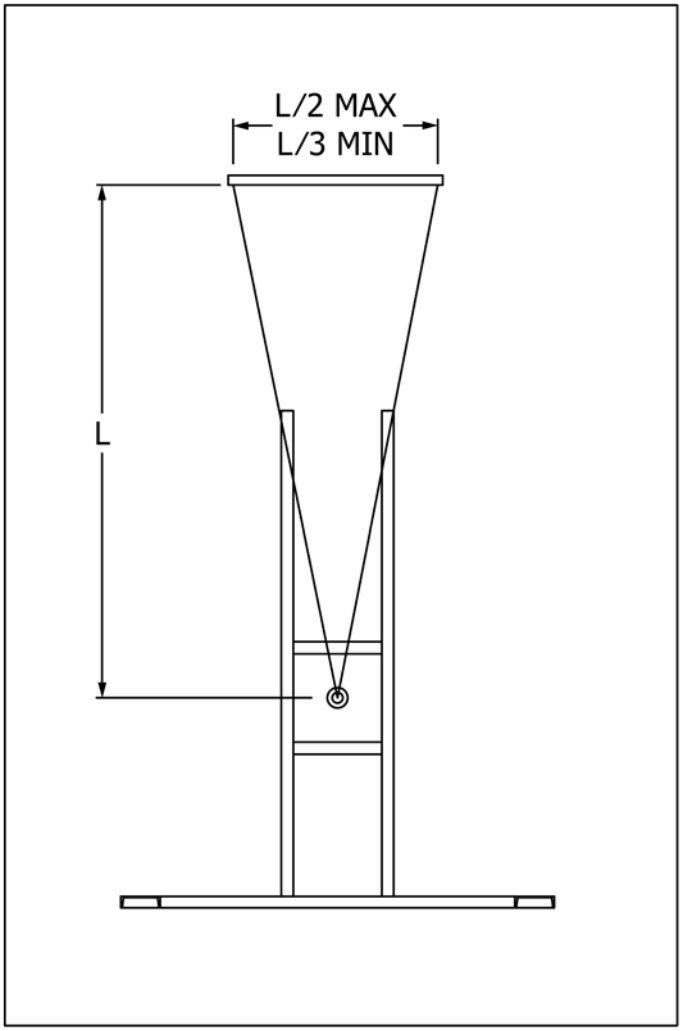

FIG. 4 Fixture and Ram—Front View

7.7.2 Align impactor to provide blows to center of the specimen face plate.

7.7.3 Strike face with number of blows as indicated in Table 1.

7.7.4 Specimen is exposed to the Vandalism Impact Test at each successive grade level. The specimen is deemed to have failed if a 2 in. (51 mm) cube can be passed through any

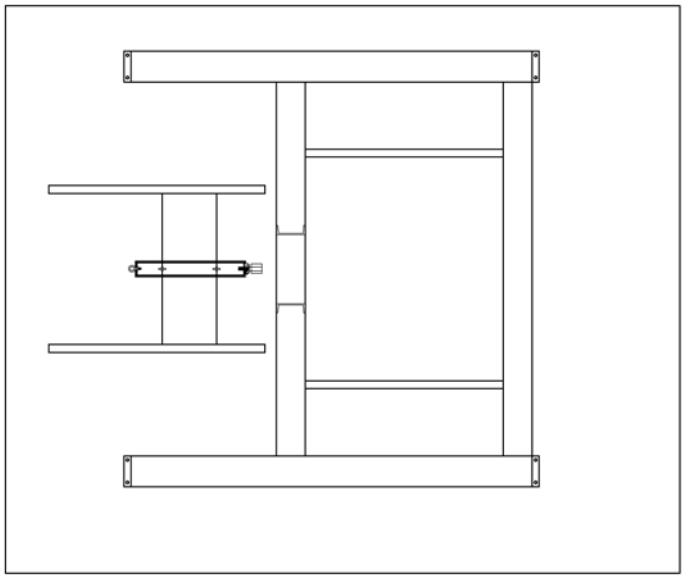

FIG. 5 Fixture and Ram—Top View

opening in the face with a force not exceeding 10 lbf (44.5 N). The specimen will be classed at the highest Vandalism Impact Test grade level achieved prior to failure. This test is followed by the Egress Impact Test.

7.7.5 Transfer grilles must have both faces of one specimen tested for the appropriate grade. If the grille is symmetrical in all aspects of construction and mounting method, then testing on one face is permitted for Grade Levels 3 and 4.

EGRESS TEST

7.8 *Scope*—Determine the ability of a grille to resist an additional attack that simulates common hand tools.

7.9 *Significance and Use*—Simulate a 10 lb (4.54 kg) sledgehammer attack on the grille face after the initial vandalism impact attack.

7.10 The specimen that passed the Vandalism Impact Test must remain in fixture for the Egress Test face impact.

7.11 *Apparatus*—Impact ram with blunt impactor as described for Vandalism Impact Test.

7.12 *Procedure:*

7.12.1 The Egress Impact Test includes a series of blows to the face of the grille as indicated in Table 1. If at any time during this test the face becomes deformed enough to allow a 2 in. (51 mm) cube to pass through with a force not exceeding 10 lbf (44.5 N), the test must be suspended and a portion of the face cut away sufficient to allow direct impact on the bars in the sleeve. The impactor must then be adjusted to provide the required impact to the bars for the duration of the face impact test. The specimen is deemed to have failed if a 5 in. × 8 in. × 8 in. (127 mm × 203 mm × 203 mm) rigid rectangular box can be passed through the security bars of the grille with force not exceeding 10 lbf (44.5 N). The specimen will be classed at the highest Egress Impact Test grade level achieved prior to failure.

8. Certification

8.1 The manufacturer shall provide test reports by an independent testing laboratory that certify that specimen(s) were successfully tested in accordance with these test methods and which comply with section.

9. Report

9.1 *Report the following information:*

9.1.1 Name and address of laboratory.

9.1.2 Date laboratory completed tests.

9.1.3 Name and address of manufacturer.

9.1.4 Description and identifying information, such as model number of the test specimen.

9.1.5 Size of the specimen tested measured as the outside dimension of the sleeve.

9.1.6 Material and thickness of the face plate.

9.1.7 Size of perforations or size and shape of passageways in face.

9.1.8 Material and thickness of the sleeve.

9.1.9 Method of forming sleeve (bending, welding).

9.1.10 Method of attachment of the face to the sleeve, including size and spacing of welds.

9.1.11 Description of the method used to retain a hinged or removable face, including details of hinges and latching mechanisms.

9.1.12 Description of mounting method used, including size and spacing of welds.

9.1.13 Diagrams, details, and photographs of testing equipment.

9.1.14 Specifications and details of the grille tested, including mounting method.

9.1.15 All related test data, including resulting grade level achieved (Table 1).

9.2 Provide the following:

9.2.1 Still color photographs of the salient stages of the test such as:

9.2.1.1 Initial penetration, and

9.2.1.2 Conclusion of test.

9.2.1.3 Each penetration which allows forcible egress shall be reported, including photographs.

9.2.2 Video recording of the entire test(s) is recommended.

10. Precision and Bias

10.1 *Precision and Bias*—No information is presented about the precision or bias of the prying test, impact test, or egress test within these test methods since the test results are non-quantitative.

11. Keywords

11.1 correctional facility; detention facility; egress test; impact test; security diffuser; security grille; security register; security transfer grille; suicide avoidance; vandalism impact test; ventilation grille

APPENDIXES

(Nonmandatory Information)

X1. APPLICATIONS AND REQUIREMENTS

X1.1 Security grade requirements shown in Table 1 are comparable to the security grade requirements described in the following related standards: Test Methods F2322.

X2. APPARATUS

X2.1 Test equipment suitable for use in evaluating ventilation grilles is included in this Appendix. While certain commercial instruments are identified to adequately describe the test equipment, in no case does such identification imply recommendation or endorsement, nor does it imply that the material or equipment described is necessarily the best for this purpose.

X2.2 Figs. 1-5 show the fixtures and equipment necessary to carry out the test methods described in 7.6 and 7.11.

X2.3 *Manufacturer's Procedure*—The manufacturer may elect to contract with the testing laboratory to provide the manufacturer with a certified procedure and security labeling service for construction of tested assemblies with factory follow-up inspection service as an option.

X3. ATTACK WEAPONS

X3.1 These test methods address only those threats to ventilation grilles which would be anticipated based on the limited weapons, tools, and resources available to inmates within detention and correctional facilities. Where a grille is also accessible to external assault with weapons tools, and resources available in the free world outside the facility, consider applying additional standards that address that type of assault.

X4. REPRESENTATIVE BARRIER DURATION TIME

X4.1 The element of time is based upon historical testing observation that indicates that sustained manpower can deliver 400 blows of 200 lbf (271.2 J) each in 45 min. The element of time assigned to the various grades of grilles is adjusted to achieve more manageable time periods than calculations provide. The amount of time is estimated and is offered solely as supplementary design information to assist the user in matching security grades with the attack resistance times and staff response times required for each area of the facility.