Designation: F2781 – 15

# Standard Practice for Testing Forced Entry, Ballistic and Low Impact Resistance of Security Fence Systems[1]

This standard is issued under the fixed designation F2781; 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 forced entry resistance of fence systems is evaluated relative to three levels of forced entry threat using the limited hand tool inventory outlined in Table 1. It also establishes a system for rating the forced entry resistance of those systems (see Table 2). The tools specified to be used for testing at each threat level are those that are known to have a maximum destructive effect on structures and their subassemblies and are readily available to aggressors categorized as posing that level of threat.

1.1.1 *Low Threat Level (L)*—Specifically exempted from the inventory of available tools for the low (L) threat level category are power tools (gasoline, electric or hydraulic), and devices requiring more than one person to transport and operate.

1.1.2 *Medium Threat Level (M)*—Specifically exempted from the inventory of available tools for the medium (M) threat level category are power tools requiring an outside power source or self contained gasoline or battery driven tools and devices requiring more than two persons to transport and operate.

1.1.3 *Aggressive Threat Level (A)*—Specifically exempted from the inventory of available tools for the high (H) threat level category are devices requiring more than two persons to transport and operate.

1.2 The ability of a fence system to offer protection from bullets fired from a rifle or handgun would be beneficial particularly in Border Fence areas where security personnel can be targets during patrol activities. Accordingly, a limited test using a .38 Special handgun and a 7.62-mm rifle is performed to determine if any level of protection is provided by the fence system.

1.3 The ability of a fence system to provide impact resistance from a 4000 pound mass vehicle moving at a velocity of 20 MPH at a modest cost will provide relative guidance as to the strength of a security fence system in resisting low impact situations.

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

F1233 Test Method for Security Glazing Materials And Systems

2.2 *SAE Standard:*[3]

SAE J972 Moving Rigid Barrier Collision Tests

2.3 *U.S. Military Standards:*[4]

MIL-STD-662F Department of Defense Test Method Standard V50 Ballistic Test for Armor

2.4 *U.S. Dept. of Justice:*[5]

NIJ Standard 0108.01 National Institute of Justice Ballistic Resistant Protective Materials

## 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *test director*—the individual identified by the independent testing laboratory as being responsible to complete the specified tests and to document the results.

3.1.2 *forced entry*—creating a four square feet opening.

## 4. Summary of Practice

4.1 For each rating a structured portion and a discretionary portion as described in 4.2 and 4.3 is required.

4.2 The structured portion of the test provides for a zero to five minute test with specific tools selected as the most debilitating from the tool list in Table 1, regardless of the fence system being tested.

[1] This practice is under the jurisdiction of ASTM Committee F14 on Fences and is the direct responsibility of Subcommittee F14.50 on High Security Fences and Perimeter Barriers.

Current edition approved Nov. 1, 2015. Published December 2015. Originally approved in 2009. Last previous edition approved in 2010 as F2781 - 10. DOI:10.1520/F2781-15.

[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 SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, http://www.sae.org.

[4] Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

[5] Available from National Institute of Justice (NIJ), 810 7th St., NW, Washington, DC 20531, http://nij.gov.

4.3 Following the structured portion of the test, the discretionary portion of the test provides up to 55 minutes of testing, optimizing forced entry efforts by selecting any (or all) tools from the applicable category of the list (low (A), medium (B), or aggressive (C)). Selection of tools is based on the perception of the test director as to which tools will most effectively result in a forced entry.

4.4 Testing of security fence systems in accordance with the requirements of this test method shall result in a rating reflecting the severity of the threat and the cumulative penetration resistance time (see Table 2).

4.5 The times used to establish the protection ratings of Table 2 range from 0–60 minutes and are intended to reflect the elapsed time of forced entry resistance necessary for a response force to arrive and counter the threat with additional defensive personnel and equipment. It is important to recognize that the lowest threat level time will establish the maximum time limit for a greater threat level.

4.6 The ballistic is intended to provide the probability of a person standing behind the secure fence side from being hit with a bullet fired by a 38-caliber hand gun or a .30-06 rifle.

4.7 The impact test is intended to provide relative guidance as to the strength of a fence system to absorb 53.5 K-ft-lbs of kinetic energy.

## 5. Significance and Use

5.1 The success or failure of any attempt to forcefully penetrate a fence system is dependent upon three primary factors that collectively define the threat—the tools and devices employed, the number of aggressors, and their level of sophistication.

5.2 Normally, a test procedure of this scope would be supported by years of laboratory testing intended to qualify and accurately reproduce the destructive effects of a variety of tools, implements, and devices. However, rapidly changing social conditions have created an immediate need for building components resistant to evolving forced entry techniques. Accordingly, the procedures presented herein are based more on field experience than laboratory analysis. They are more representative than inclusive, are intended to provide a basis for the comparative evaluation of different fence systems using forced penetration procedures, ballistic tests and impact testing, and are not primarily intended to be used to establish or confirm the absolute prevention of forced entries.

**TABLE 1 Schedule of Testing—All Levels of Threat Severity**
(See Sections 8 and 14 for unabridged tool list.)

| | Time of Application (minutes) | | | | | |
|---|---|---|---|---|---|---|
| | Structured Testing | | | Discretionary Testing | | |
| Tool(s) | L | M | A | L | M | A |
| Crowbar 5 lb by 28 in. (2) | 3-5 | 3-5 | 3-5 | 0-55 | 0-55 | 0-55 |
| Cold Chisels and Hammer (2) | 3-5 | 3-5 | 3-5 | 0-55 | 0-55 | 0-55 |
| Hacksaw and Two HSS Blades | 3-5 | 3-5 | 3-5 | 0-55 | 0-55 | 0-55 |
| Sledgehammer 16 in. by 6 lb | 3-5 | 3-5 | 3-5 | 0-55 | 0-55 | 0-55 |
| Fire Axe 36 in. by 6 lb | 3-5 | 3-5 | 3-5 | 0-55 | 0-55 | 0-55 |
| Bolt Cutter (2) | 3-5 | 3-5 | 3-5 | - | 0-55 | 0-55 |
| Fire Axe 36 in. by 10 lb | - | 3-5 | 3-5 | - | 0-55 | 0-55 |
| Hole Saw 2 in. (1) and Jigsaw | - | 0-5 | 0-5 | - | 0-55 | 0-55 |
| Pry Bar 30 in. Steel (2) | - | 0-5 | 0-5 | - | 0-55 | 0-55 |
| Sledgehammer 30 in. by 12 lb | - | 0-5 | 0-5 | - | 0-55 | 0-55 |
| Steel Wedge 6 in. long (2) and Plate Shears | - | 0-5 | 0-5 | - | 0-55 | 0-55 |
| Circular Saw 8 in., 1100 W, and 3 Blades (1) | - | 0-5 | 0-5 | - | - | 0-55 |
| Disc Grinder 5 in., 1100 W, and 3 Blades (1) | - | 0-5 | 0-5 | - | - | 0-55 |
| Rotary and Hammer Drill 750 W and 5 Drill Bits, ½ in. (1) | - | - | 0-5 | - | - | 0-55 |
| Hole Saw Greater than 2 in. (1) | - | 0-5 | 0-5 | - | - | 0-55 |
| Steel Pinch Bar 60 in. long (2) | - | - | 0-5 | - | - | 0-55 |

**TABLE 1** *Continued*

| Tool(s) | Time of Application (minutes) | | | | | |
|---|---|---|---|---|---|---|
| | Structured Testing | | | Discretionary Testing | | |
| | L | M | A | L | M | A |
| Reciprocating Saw 750 W and 3 Carbide Blades (1) | - | 0-5 | 0-5 | - | - | 0-55 |
| Sledgehammer 30 in. by 15 lb (1) | - | - | 0-5 | - | - | 0-55 |
| Oxyacetylene Torch with 80 $ft^3$ Oxygen and 40 $ft^3$ Acetylene Tanks (1) | - | - | 0-5 | - | - | 0-55 |
| Cut-Off Saw 5 KW or HD Gasoline 18 in. Dia. and 3 Blades (1) | - | - | 0-5 | - | - | 0-55 |
| Breaker (1900 W) 30 lb with 3 Bits (1) | - | - | 0-5 | - | - | 0-55 |
| Scissor Jack 1500 lb with 4 in. min retraction and 8 in. Stroke (1) | - | - | 0-5 | - | - | 0-55 |
| Adhesive Tape (1) | - | - | - | 0-55 | 0-55 | 0-55 |
| Fishing Line (250') | - | - | - | 0-55 | 0-55 | 0-55 |
| Grappling Hook (1) | - | - | - | 0-55 | 0-55 | 0-55 |
| 5-in. Knife (1) | - | - | - | 0-55 | 0-55 | 0-55 |
| 8 in. Std and Self Grip Pliers (2) | - | - | - | 0-55 | 0-55 | 0-55 |
| 10 in. Multiple Slip Pliers (2) | - | - | - | 0-55 | 0-55 | 0-55 |
| 10 in. Pipe Wrench (2) | - | - | - | 0-55 | 0-55 | 0-55 |
| 1.660 in. O.D. by 12 ft. pipe (2) | - | - | - | 0-55 | 0-55 | 0-55 |
| 8 in. Plate Shears (1) | - | - | - | 0-55 (1) | 0-55 (1) | 0-55 (2) |
| Screwdrivers 7 in.,10 in., and 16 in. (1) | - | - | - | 0-55 | 0-55 | 0-55 |
| Cordless ½ in. Drill with spare power pack and carbide bits (1) | - | - | - | 0-55 | 0-55 | 0-55 |
| Butane Torch (1) | - | - | - | 0-55 | 0-55 | 0-55 |
| Rope (1) | - | - | - | 0-55 | 0-55 | 0-55 |



**TABLE 2 Forced Entry Resistant Ratings**

| Threat Level | Active Test Personnel | Resistance Time (minute) | | | Rating |
|---|---|---|---|---|---|
| | | Structured Test | Discretionary Test | Cumulative | |
| Low (L) | 2 | Less than 5 | 0 | Less than 5 | L0 to L4.9 |
| | | 5 | Less than 5 | Less than 10 | L5 to L9.9 |
| | | 5 | 5 to 9.9 | Less than 15 | L10 to L14.9 |
| | | 5 | 10 to 14.9 | Less than 20 | L15 to L19.9 |
| | | 5 | 20 to 25 | 30 | L20 to L30 |
| | | 5 | 31 to 55 | 60 | L31 to L60 |
| Medium (M) | 2 | Less than 5 | 0 | Less than 5 | M0 to M4.9 |
| | | 5 | Less than 5 | Less than 10 | M5 to M9.9 |
| | | 5 | 5 to 9.9 | Less than 15 | M10 to M14.9 |
| | | 5 | 10 to 14.9 | Less than 20 | M15 to M19.9 |
| | | 5 | 20 to 25 | 30 | M20 to M30 |
| | | 5 | 31 to 55 | 60 | M31 to M60 |

**TABLE 2** *Continued*

| Threat Level | Active Test Personnel | Resistance Time (minute) | | | Rating |
|---|---|---|---|---|---|
| | | Structured Test | Discretionary Test | Cumulative | |
| Aggressive (A) | 4 | Less than 5 | 0 | Less than 5 | A0 to A4.9 |
| | | 5 | Less than 5 | Less than 10 | A5 to A9.9 |
| | | 5 | 5 to 9.9 | Less than 15 | A10 to A14.9 |
| | | 5 | 10 to 14.9 | Less than 15 | A15 to A19.9 |
| | | 5 | 20 to 25 | 30 | A20 to A30 |
| | | 5 | 31 to 55 | 60 | M31 to A60 |

5.3 The test requirements specified herein have been established for use in evaluating the penetration resistance characteristics of standard fence systems to be used in commercial, government and military installations.

5.3.1 The success of any forced entry threat is dependent on the cumulative effect of the implements used, the elapsed time, and the sophistication and motivation of the personnel affecting the forced entry.

5.3.2 Absolute penetration resistance from forced entry by a determined and well-equipped attack group is impossible.

5.3.3 Aggressor groups range from unsophisticated criminals and vandals to organized criminals.

5.3.4 Attempts to force an entry may be thwarted by increasing the time necessary to affect such an entry and by early detection. Intrusion sensors positioned as far as possible from the protected environment in conjunction with optimal structural and component design will maximize the time available for a response force to intercept the intruders.

5.4 The procedures of this test method are intended to evaluate the time necessary for vandals and unsophisticated criminals to forcefully penetrate security fence systems by using manually operated tools—defined as a low, medium, or aggressive forced entry threat.

## 6. Documentation of Test Materials

6.1 *Configuration Documentation*—All materials and assemblies to be tested shall conform to and be in compliance with the latest revision of the appropriate publication or specification governing the fence system configuration. The following documents shall apply:

6.1.1 *Standard Commercial Materials*—Commercial materials used in fabricating security fence systems will conform to the configuration and performance standards established for that material by ASTM International.

6.1.2 *Non-Standard Materials*—All materials and subassemblies used in the fabrication of forced entry barriers whose nature and configuration are not otherwise controlled by recognized industrial, government, or manufacturer's specifications will be accompanied by full disclosure drawings and specifications.

6.1.2.1 *Component Material Details*—Specific industrial specifications, including size, thickness composition, etc.

6.1.2.2 Make, model number, serial numbers, and date of manufacture (as appropriate).

6.1.2.3 Construction instructions, including weldments, bolting, bonding materials, etc.

6.1.3 *Proprietary Information*—None of the requirements of 6.1.1 through 6.1.2.3 are intended to compromise or circumvent a manufacturer's proprietary rights with respect to any feature, configuration, material, or design. Those portions of the design disclosure documentation considered proprietary would be clearly marked or eliminated from the disclosure documentation with an appropriate explanation. All submitted documentation, however, would accurately represent the sample tested.

## 7. Sampling, Test Specimens, and Test Units

7.1 *Sample Size*—In order to facilitate test standardization all test samples will conform to the sizes specified in 7.1.1.

7.1.1 A minimum lateral area of 96 in. high and 30 ft in length. The requirements of this section and the procedures of the test method are intended to minimize test costs by conducting as much testing on single test segments, if possible. Impact Tests shall target the impact location of the vehicle at the midpoint of the 30 ft. length to avoid contacting the vertical posts and performed after penetration tests have been completed to minimize costs of material and repair labor.

7.1.2 *Test Environment*—The location of the test shall be in a natural environment where the temperature minimum is not less than 40°F and the maximum is 95°F during the performance of the test. All tested materials and tools will be temperature conditioned in this environment for a minimum of 24 h immediately prior to initiation of any test. The area immediately adjacent to the test sample extending 6 ft to the left and right of either vertical edge of the sample, 10 ft from the assault face of the sample, and 10 ft above the horizontal surface supporting the test (attack) personnel, shall be free of any and all obstructions and appurtenances.

## 8. Preparation of Apparatus

8.1 *Tools, Devices and Materials:*

8.1.1 Analysis of many of the aggressive actions against installations that have resulted in forced entry has produced an extensive list of tools and implements that are readily accessible to aggressor groups. From this comprehensive listing, tools and devices have been categorized as to the likelihood of their use and forced entry threat severity. While infinite in type, size, and construction, all can be categorized with respect to their principal effect and function—prying, screwing, pulling, shearing, cutting, and impacting. Additionally, certain tools have been identified as those which are not actually tools, but which have a debilitating effect on protective barriers and are readily available (that is, ropes, and so forth). While no attempt will be made to completely list all the tools and implements which can be utilized to effect forced entry, Table 1 presents those tools and implements which have been determined to be readily available and representative of the most effective of forced entry tools for the very low, low, medium, and high threat severity categories, respectively.

8.1.2 All tools proposed for use in this test are to be clean and verified for proper operation prior to commencement with the test.

8.2 *Low Threat Severity Category Tools:*
8.2.1 *Adhesive Tape.*
8.2.2 *Fishing Line.*
8.2.3 *Grappling Hook.*
8.2.4 *Knife,* 5 in.
8.2.5 *Standard and Self-Gripping Pliers,* 8 in.
8.2.6 *Multiple Slip Pliers,* 10 in.
8.2.7 *Pipe Wrench,* 10 in.
8.2.8 *Pipe,* 1.660 in. O.D. by 12 ft.
8.2.9 *Plate Shears,* 8 in.
8.2.10 *Screwdrivers,* 7 in., 10 in., and 16 in. long.
8.2.11 *Crowbar,* 5 lb, 28 in.
8.2.12 *Cold Chisels,* 10 in. long by 1 in. wide.
8.2.13 *Drill,* cordless, ½ in., spare power pack, and carbide drill bits.
8.2.14 *Butane Torch.*
8.2.15 *Hacksaw,* two HSS blades.
8.2.16 *Sledgehammer,* 16 in., 6 lb.
8.2.17 *Rope,* 20-ft length of ½-in. diameter manila rope, (4-lb).
8.2.18 *Fireman's Axe,* 36 in., 6 lb.
8.2.19 *Pipe Cutter,* 4 in. O.D.
8.2.20 *Bolt Cutter.* 12 in.
8.2.21 *Fence Pliers,* 10 in.
8.2.22 *Cable Ratchet,* 2000 lb capacity.

8.3 *Medium Threat Severity Category Additional Tools:*
8.3.1 *Bolt Cutter,* 20 in.
8.3.2 *Disc Grinder,* 12 V with spare power pack and three cutting discs.
8.3.3 *Drill Bits,* 5.5 in., carbide.
8.3.4 *Axe,* 36 in., 10 lb.
8.3.5 *Hole Saw,* 2 in.
8.3.6 *Steel Pry Bar.*
8.3.7 *Jigsaw,* cordless, 12 V, and three carbide blades.
8.3.8 *Plate Shears,* 12 in.
8.3.9 *Sledgehammer,* 30 in., 12 lb.
8.3.10 *Pipe,* 1.660 in. O.D. by 20-ft long.
8.3.11 *Steel Wedges,* 6-in. long.
8.3.12 *Circular Saw,* cordless, 18 V, 8-in. diameter, and three blades.
8.3.13 *Disc Grinder,* 18 V with spare power pack and three cutting discs.
8.3.14 *Jigsaw,* cordless, 18 V with spare power pack, and three carbide blades.
8.3.15 *Reciprocating Saw,* cordless, 18 V with spare power pack, and three carbide blades.
8.3.16 *Proof Test Grade 100 Alloy Chain,* 20 ft, 7⁄32 in., 5400 lb minimum.

8.4 *Aggressive Threat Severity Category Additional Tools:*
8.4.1 *Circular Saw,* 1100 W, 8-in. diameter, and three blades.
8.4.2 *Disc Grinder,* 1100 W, 5-in. diameter and three discs.
8.4.3 *Rotary and Hammer Drill,* 750 W, five drill bits, ½-in. carbide.
8.4.4 *Hole Saw,* greater than 2 in.
8.4.5 *Steel Pinch Bar,* 60-in. long.
8.4.6 *Reciprocating Saw,* 750 W and three carbide blades.
8.4.7 *Sledgehammer,* 30 in., 15 lb.
8.4.8 *Oxyacetylene Torch,* with 80-ft$^3$ oxygen tank, 40-ft$^3$ acetylene tank, and 20 ft of hose (119.0 lb).
8.4.9 *Cut-Off Saw,* 5 KW or HD Gasoline 18-in. diameter, with three blades.
8.4.10 *Breaker,* (1900 W), 30 lb with three bits.
8.4.11 *One Scissor Jack,* 1500 lb capacity with a minimum retraction and an 8-in. stroke.

## 9. Ballistic Equipment

9.1 *Ballistic Firing Devicesin accordance with Test Method F1233*—Firearms or test barrels suitable for use with the following calibers of ammunition producing minimum velocities as required:
9.1.1 *.38 Special*—158 grain (10.2 g), lead.
9.1.2 *.308 Winchester (7.62 mm, M80 Ball)*—147 grain (9.5 g), full metal casing.

9.2 *Ammunition/Standard Specification Ballistic Protection Levels*—All ammunition used in conducting tests within this test method shall be manufactured in compliance with current configurations and standards established by the Sporting Arms and Ammunition Manufacturer's Institute (SAAMI) or United States Military Specifications as applicable, except as may be noted within this test method. This test method shall be defined by the following ballistic threat levels:
9.2.1 *Caliber .38 Special/Handgun*—Ammunition conforming to SAAMI Specifications for caliber .38 Special, 158 grain, lead round nose producing, velocities of 875 ft/s (±25 ft/s) at 15 ft from the muzzle.
9.2.2 *Caliber 7.62 mm Steel Jacketed NATO/Rifle*—Ammunition conforming to U.S. Military specifications for caliber 7.62 mm NATO, M80 ball producing velocities of 2550 ft/s and 2320 ft/s (±50 ft/s) at 15 ft from the muzzle.

9.3 *Witness Material in accordance with NIJ Standard 0108.01*—The witness plate shall be 0.020 in. (0.51 mm) thick aluminum sheet. The minimum size of the witness plate shall be 9 by 12 in. (229 by 305 mm) for half-scale testing or 18 by 24 in. (457 by 610 mm) for full-scale testing. The witness plate shall be made of 2024-T3, 2024-T4 or 5052 aluminum alloy sheet, and shall be located 5 ft (half scale) or 10 ft (full scale) behind and parallel to the test sample.

9.4 *Instrumentation:*
9.4.1 *Photosensitive Triggering Screens (or similar)*—Either high-velocity lumiline screens, infrared ballistic screens, or electrical contact screens which either open or close an electrical circuit by passage of the projectile through the detector shall be used. Contact screens may consist of metallic foils separated by a thin insulating layer, or may consist of a circuit printed on paper with the circuit spacing such that the projectile passing through the screen will "break" the circuit.
9.4.2 *Chronograph*—The chronograph shall have a precision of 1 ms and an accuracy of 2 ms. Its triggering devices shall be of either the photoelectric or conductive screen types

as described in 9.4.1. Chronograph or electronic timers used shall be calibrated and certified for accuracy.

9.5 *Test Frame and Stand in accordance with MIL-STD-662F and NIJ Standard 0108.01:*

9.5.1 The sample shall be mounted rigidly (bolted or clamped) to the test fixture to produce a zero degree (for handgun testing) and five degree (for rifle testing) to the path of the bullet. The frame supports and clamps or mounting fixtures must be capable of retaining the sample and withstanding shock resulting from ballistic impact by the test projectiles. The test sample mount shall be capable of adjustment for moving the sample in the vertical or horizontal directions so that the point of impact can be located anywhere on the sample. Photosensitive triggering screens shall be positioned 5 and 15 ft from the threat side of the sample which, in conjunction with an elapsed time counter or direct reading chronograph, shall be used to determine bullet velocities 10 ft from the strike face of the sample. The test weapon shall be rigidly mounted at a distance of 25 ft from the muzzle to the target area of the test assembly. The test weapon shall be aimed to produce a zero degree obliquity trajectory to the target area within the tolerances of this test method.

9.5.2 The witness material shall be securely positioned parallel to, at 5 ft (half-scale) or 10 ft (full-scale) behind (protected side), the target area of the test assembly. The center of the witness panel should be directly behind the desired point of impact.

9.5.3 Should there be reason to suspect bullet flight stabilities; the test director is obligated to implement a paper witness panel, positioned 3 ft in front of the target area. This witness panel shall be inspected following each test firing as to indication of a yawed projectile. Evidence of a yawed or unstable projectile shall constitute an unfair hit, and shall require retesting.

9.5.4 Due to limitations in range space, the dimensions for the chronographs and target holder in relation to the gun system are approximate. Alternate dimensions can be used (with the exception of the witness plate location) as long as the intent of this test specification is met.

## 10. Impact Test Equipment

10.1 *Bogie Vehicle*—A bogie vehicle is used for impact testing. The vehicle should be fabricated in accordance with SAE specification J972 and equipped with a 6-in. tall by 42-in. wide steel bumper. The sharp corners of the bumper should be rounded off. The impact bumper should be positioned to impact the fence system at 24 in. above grade. Fig. 1 illustrates a photograph of the bogie vehicle and of the bogie vehicle's bumper height in relation to the fence system. The wheelbase of the bogie is to be 114 ±6 in. Four wheels of 7.00-15 size are to be attached to two 3500 lb rated axles with a 4 inch inverted drop. The center of gravity of the bogie should be along its central axis at 24 ± 4 in. above the grade to minimize the potential for rear wheels to break the contact with the pavement during the impact. The bogie vehicle weight should be capable of being ballasted to the proximity weight of 4000 lb required for the impact test. The bogie vehicle weight must be confirmed with four current calibrated platform scales (Detecto, Model 954F 100P).

## 11. Instrumentation for All Threat Severity Categories Including Ballistic and Impact Testing

11.1 In order to comply with the full range of test requirements of this test, the following support instrumentation, materials, and equipment must be available to the test director.

11.1.1 *Instrumentation*—The following instrumentation is the minimum instrumentation required to meet the testing requirements of this standard.

11.1.1.1 *Video Camera*—Digital recording media onto CD.

11.1.1.2 *Still Camera*—Still photography camera utilizing digital recording media.

11.1.1.3 *Timing Device*—Stopwatch, 60 second sweep hand, stop-reset capable or equivalent.

## 12. Testing Guidelines

12.1 *General Test Sequence*—All samples submitted for testing shall be in compliance with 6.1.1. The forced entry testing of all samples shall begin with a structured portion of testing as outlined in Tables 1 and 3 and continue through the discretionary portion of testing (Tables 1 and 3) or until forced entry has been achieved.

12.2 *Sequence of Testing*—Forced entry testing in accordance with this standard shall be conducted in two phases:

12.2.1 *Structured Testing*—The testing of the sample shall be strictly limited to the tools, times and procedures of the test methods section.

**FIG. 1 Bogie Vehicle Used to Simulate an Impact Vehicle**