Designation: F2369 – 04 (Reapproved 2016)

Standard Safety Specification for Non-Integral Firearm Locking Devices[1]

This standard is issued under the fixed designation F2369; 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.

INTRODUCTION

This specification is intended to establish means of determining whether locking devices applied to a firearm adequately serve the purpose of deterring the unauthorized use of firearms.

Subcommittee F15.53 on Non-Integral Firearm Locking Devices has been working to develop a performance standard for these products. Our first meeting was held in April 2001, after the Consumer Products Safety Commission and others requested that ASTM organize an effort to develop a standard for gun locks. Representatives of manufacturers, purchasers, user groups, and others have voluntarily contributed their time and energy toward a common goal.

The subcommittee defined the scope of their work to exclude lock boxes, and Subcommittee F15.55 has since been formed to work on a standard for those products. Subcommittee F15.53 decided to target a single, minimum performance standard for all devices, as opposed to defining several "grades" or performance levels. Finally, the subcommittee focused on test methods that were objective, realistic, reliable, and repeatable.

1. Scope

1.1 This specification covers non-integral locking devices used to increase safety on unloaded firearms.

1.2 This specification contains functional, operational, and safety requirements for non-integral firearm locking devices. Included are function descriptions, force tests, and surreptitious entry tests as set forth in Section 5.

1.3 The specification is intended to apply only to non-integral locks or locking mechanisms applied to, in, around, or about a firearm, either external to the firearm or by some method of introduction to or within the firearm. The specification is not intended to set evaluation standards by which safety levers, firing pin blocks, or other traditional discharge prevention mechanisms are evaluated, notwithstanding the fact that these mechanisms may prevent inadvertent discharge. This specification is not applicable to devices used for, or intended for, the prevention of theft or other intentional misuse of firearms.

NOTE 1—Tests described are laboratory type tests and although they may simulate some field conditions, they do not duplicate all field test conditions.

NOTE 2—There is no apparent comparable ISO/IEC standard.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.5 The following precautionary caveat pertains only to the test method portions of this specification. *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]

F883 Performance Specification for Padlocks

NOTE 3—A shock impact fixture and a cutting fixture are illustrated and detailed in Specification F883. Fixtures shall be constructed utilizing the same designs as illustrated and detailed in Specification F883.

2.2 *ASME Standards:*

ASME B107.20M Pliers (Lineman's, Iron Worker's, Gas, Glass, Fence, and Battery)[3]

ASME B107.25M Pliers—Performance Test Methods[3]

[1] This specification is under the jurisdiction of ASTM Committee F15 on Consumer Products and is the direct responsibility of Subcommittee F15.53 on NonIntegral Firearm Locking Devices.

Current edition approved Oct. 1, 2016. Published October 2016. Originally approved in 2004. Last previous edition approved in 2010 as F2369 – 04 (2010). DOI: 10.1520/F2369-04R16.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

NOTE 4—A cable cutting fixture shall be constructed that meets the requirements of ASME B107.20M. One example implementation of a fixture designed to meet these requirements is detailed in Appendix X2.

2.3 *ANSI Standard:*
ANSI Z535.4 Product Safety Signs and Labels[4]

3. Terminology

3.1 *Definitions of Firearms Terms Specific to this Standard:*

3.1.1 *action*—combination of the receiver or frame and breech bolt together with the other parts of the mechanism by which a firearm is loaded, fired, and unloaded.

3.1.2 *barrel*—part of a firearm through which a projectile or shot charge travels under the impetus of powder gases. It may be rifled or smooth bore.

3.1.3 *cartridge*—single round of ammunition consisting of the case, primer, and propellant with or without one or more projectiles. It also applies to a shotshell.

3.1.4 *case*—main body of a single round of ammunition into which other components are inserted to form a cartridge. It usually refers to centerfire and rimfire cartridges and serves as a gas seal during firing of the cartridge. It is usually made of brass, steel, copper, aluminum, or plastic, and is also referred to as a shell case.

3.1.5 *chamber*—in a rifle, shotgun, or pistol, the rearmost part of the barrel that has been formed to accept a specific cartridge or shotshell. In a revolver, the holes in the cylinder that have been formed to accept a cartridge.

3.1.6 *firearm*—assembly of a barrel and action from which a projectile is propelled through a deflagration (burning) of propellant.

3.1.7 *primer*—cartridge ignition component consisting of brass or gilding metal cup, priming mixture, anvil, and foil disc, which fires the cartridge when struck with sufficient force.

3.1.8 *shotgun*—smooth bore shoulder firearm designated to fire cartridges containing numerous pellets or a single slug.

3.1.9 *shotshell*—round of ammunition containing multiple pellets, or designed for use in a shotgun.

3.1.10 *trigger guard*—rigid loop that partially surrounds the trigger to reduce the possibility of accidental discharge.

3.2 *Descriptions of Firearms Locking Device Terms Specific to this Standard:*

3.2.1 *case*—housing or body of a lock or latch.

3.2.2 *disabled*—defeating the firearm locking device, thereby rendering the firearm capable of firing.

3.2.3 *firearms locking device*—device that is non-integral to the firearm, that locks and that is intended to deter unauthorized users from firing a firearm.

3.2.4 *key*—object intended by the manufacturer to be inserted into the keyway as a means to lock or unlock the locking device.

3.2.5 *keyway*—opening in a lock cylinder that is shaped to accept a key bit, blade, or other unique device used to lock or unlock the device.

3.2.6 *plug*—part of a lock cylinder which contains the keyway.

3.2.7 *properly installed*—firearms locking device is installed according to the instructions that accompany the locking device.

3.2.8 *shackle*—part of a padlock that passes through an opening in an object or fits around an object and is ultimately locked into the case.

4. General Requirements

4.1 Removal shall be by key, combination, or other unique method, or a combination thereof, as defined by the instructions accompanying the locking device.

4.2 Each combination locking device shall open with only one of a minimum of 1000 actual combinations.

4.3 Key locking devices shall have a minimum of 130 actual key codes and the operability of each firearm locking device shall be limited to only one of these key codes.

4.4 Locking devices that function by insertion into the chamber or barrel of a firearm shall not be of such a color or design that they may be confused for a cartridge or shotshell. The purpose is to prevent an observer from seeing a live cartridge or shell in the chamber and thinking it is the firearm locking device.

4.5 When used in the manner designed and intended by the manufacturer, the firearm locking device shall be capable of repeated use and shall pass the testing procedures described in this specification.

4.6 The firearm locking device, when properly installed on a firearm, shall not be disabled through disassembly of the firearm, and subsequent reassembly of that firearm.

5. Testing Procedures

5.1 *General:*

5.1.1 All tests shall be conducted within the following tolerances as applicable:

5.1.1.1 Force: 0.5 % of working range.

5.1.1.2 Height: ±6 mm (0.25 in.).

5.1.1.3 Torque: 4.0 % of reading.

5.1.1.4 Weight: ±10 g (0.02 lb).

5.1.2 All tests shall be conducted at temperatures between 16 and 27°C (61 to 81°F).

5.1.3 Each test in this section shall be performed on a locking device that has been subjected only to the preconditioning specified in 5.1.5.

5.1.4 Test methods shall be performed on each firearm locking device model submitted for testing pursuant to this standard in an attempt to disable the device.

5.1.5 Open and close locking device fully 100 times prior to testing.

5.2 *Picking or Manipulating Test:*

5.2.1 *Picking Test*—This test does not apply if the device does not have a keyway. The firearms locking device shall

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

resist picking with the use of paper clips (jumbo size), paper clips (#1 size), and small screwdrivers that fit in the keyway for 2 min with each of these tools. Time shall be counted only while tools are in contact with the lock. If the lock is disabled during the 6 min of manipulation, picking tests are performed on three additional samples. Failure occurs if any one of the three additional samples is disabled.

5.2.2 *Combination Manipulation Test*—This test does not apply if the device does not have a combination lock mechanism. The firearms locking device shall resist manual manipulation by dialing the combination wheels or pushing the combination buttons or manipulating other combination lock means by hand for 2 min. Manipulation is limited to the combination mechanism. Time shall be counted only while hands are manipulating the lock. Failure occurs if the lock is disabled without the proper combination being entered during 2 min of manipulation.

5.3 *Shock Test:*

5.3.1 Using the shock impact fixture referenced in 2.1, drop a 1 kg (2.2 lb) weight from a distance of 1 m (39.4 in.) five times onto the firearm locking device, which is oriented so that a flat blade screwdriver can impinge upon and penetrate along the rotation axis into the keyway, or for a combination lock, onto the combination mechanism. Additionally, using the shock impact fixture, drop a 1 kg (2.2 lb) weight from a distance of 1 m (39.4 in.), five times to the side opposite the keyway or the combination mechanism, of a firearm locking device using the anvil rod (see Specification F883, Detail 5).

NOTE 5—If this second shock test on the side opposite the keyway or combination mechanism is not possible, the tester is to use discretion and hit the most vulnerable side. Failure occurs if the firearm locking device is disabled by the shock test.

5.4 *Tensile Test*—Specific fixtures may be required to allow application of the required force to the individual components.

5.4.1 For firearm locking devices that have clamping components, support the firearm locking device in a fixture designed to enable application of forces in tension along a central axis of the mating locking components of the firearm locking device. Apply 1000 N (225 lb) of force slowly along the central axis of the firearm locking device locking components without interfering with or giving support to any of the mating locking components of the firearm locking device. Failure occurs if the firearm locking device is disabled by the tensile test.

5.4.2 For firearm locking devices that have cable locking components, support the firearm locking device in a fixture designed to enable application of forces in tension along a central axis. Apply 1000 N (225 lb) of force slowly along the axis. Failure occurs if the firearm locking device is disabled by the tensile test.

5.5 *Cutting Test:*

5.5.1 *Shackle Cutting Test*—This test does not apply if the device does not have a shackle. The shackle of the firearm locking device shall withstand cutting through when two blades made of steel, hardened to a minimum hardness of Rc50, are used in conjunction with the blade positioning holder of the cutting fixture. The shearing assembly must then be placed in a device having a compression load capability and compressed with a force of 4450 N (1000 lb). See Specification F883 for details. Failure occurs if the firearm locking device is disabled.

5.5.2 *Cable Cutting Test*—This test does not apply if the device does not have a cable. Use a fixture that meets the requirements of ASME B107.20M, Sections 4.2 Wire Cutting, 4.3 Paper Cutting, 5.1 Cut Test, and 5.2 Hardness Test for Type 1 (Lineman's) Pliers in accordance with ASME B107.25M, Sections 5.2.1 Wire Cut Test, 5.2.2 Paper Cut Test, and 5.3.3.2 Jaws (Pliers Hardness Test). The cable of a firearm locking device shall withstand cutting through with a machine force of 3336 N (750 lbf) applied gradually over not less than 10 s, for a duration of 30 s with the firearm locking device supported on both sides of the point of the shear cut with allowance for blade clearance. Failure occurs if the firearm locking device is disabled.

5.6 *Cable Lock Impact Test:*

5.6.1 This test does not apply if the device does not have a cable. The test shall be performed using a cable lock impact test fixture. One such example is shown in Appendix X3. The cable of the lock shall be attached to the test fixture so that the nearest surface of the body of the lock is 50 mm (1.9 in.) from the cable-clamping point on the fixture. The lock shall be oriented so that the side of the lock impacts the anvil squarely. The test fixture will be set so that the lock achieves a speed of 10 to 11.5 m/s (33 to 38 ft/s) before striking the anvil. Perform three tests on each surface, excluding the surface(s) where the cable attaches to the body of the lock and the surface opposite the surface where the cable attaches to the body of the lock. Failure occurs if the firearm locking device is disabled.

5.7 *Trigger Lock Impact Test:*

5.7.1 This test does not apply if the device does not lock the trigger or trigger guard. A handgun trigger guard fixture is shown in Appendix X1. The lock shall be affixed to the handgun trigger guard fixture in accordance with the instructions accompanying the locking device. The handgun trigger guard fixture shall be attached to the test fixture drop mechanism so that the side projection of the trigger lock will impact the edge of the anvil. The test fixture will be set so that the lock is dropped 1.5 m (59 in.) before striking the anvil. Perform three drops at each orientation and perform the test so that the lock is impacted in six directions 90° apart (once for each direction in the *XYZ* axes). Failure occurs if the trigger lock is disabled, or if the halves of the trigger lock separate from the surface of the handgun trigger guard fixture by 5 mm (0.2 in.) or more.

5.8 *Plug Torque Test:*

5.8.1 This test does not apply if the device does not have a keyway. Install the firearm locking device in a rigid fixture, such as a vise, to support it firmly but not to restrict free rotation of the plug in the cylinder. Insert a screwdriver with the largest flat blade (but not to exceed ⅝ in. or 16 mm) that will fit into the keyway, so that a torque load of 10 Nm (89 in.-lbf) can be applied to the plug. Failure occurs if the firearm locking device is disabled.

5.9 *Sawing Test*—This test does not apply if the test cannot be performed on device. The sawing test is designed to determine the locking device's resistance to sawing of exposed components. Exposed components may include, but are not limited to, cables, lock bodies, and hinges.

5.9.1 The testing agent shall accomplish the test using a new standard carbon steel hacksaw blade with 32 teeth per inch (2.54 cm) with a constant vertical downward force of 44.5 N (10 lb).

5.9.2 Sawing tests shall be performed using a handheld saw. The test shall consist of 120 cycles with no time limit. One cutting cycle is defined as the combination of one 6-in. forward and one 6-in. backward cutting motion. The saw attack may consist of a series of separate 120 cutting cycle attacks, but in no instance shall more than 120 cutting cycles be applied to any one "specified" location. For example, the testing agent may identify (specify) the hinge and lock body areas of a locking device as vulnerable to attack. A total of 120 cutting cycles may be applied to the hinge of the device and an additional 120 cutting cycles may be applied to the lock body of the device.

5.9.3 The locking device shall be held with an appropriate fixture to hold the device steady while sawing. If the saw test is being conducted on a flexible component of the locking device, then the flexible component shall be clamped as shown in Appendix X4. The saw blade shall be applied to the flexible component in accordance with Appendix X4.

5.9.4 At the conclusion of the saw test, the testing agent shall manipulate the locking device for 1 min by hand in an attempt to disable the locking device. Failure occurs if the locking device is disabled.

6. Instructions and Labeling

6.1 *Instructions:*

6.1.1 All product instructions shall be consistent with ANSI Z535.4.

6.1.2 Instructions shall be provided to the consumer on how to install the firearm locking device, how to engage and disengage the locking mechanism, and how to check to ensure the device is functioning properly when installed and the locking mechanism engaged. Text and visual depiction is required.

6.1.3 Each firearm locking device shall include conspicuous and legible instructions for the consumer and at a minimum shall include the following information (not necessarily verbatim):

6.1.3.1 Read all instructions BEFORE using this firearm locking device. KEEP INSTRUCTIONS FOR FUTURE USE.

6.1.3.2 **WARNING**—Using this device on a loaded firearm may result in discharge which may cause death or serious injury. Completely unload the firearm before installing this device.

6.1.3.3 Read the owner's manual and instructions supplied with your firearm before attempting to operate the firearm and before attempting to install this firearm locking device.

6.1.3.4 Always keep the muzzle pointed in a safe direction when handling any firearm.

6.1.3.5 Always store unloaded and locked firearms in a safe place, inaccessible to children and other unauthorized persons. Store ammunition in a separate locked or secure location.

6.1.3.6 Do not store the key or combination to the firearm locking device in the same place as your firearm.

6.1.3.7 While your firearm lock is an important part of rendering your firearm inaccessible to children and other unauthorized persons, it is not a substitute for safe and responsible firearm handling and proper storage.

6.2 *Product Labeling:*

6.2.1 All product labels shall comply with ANSI Z535.4.

6.2.2 If practicable, the manufacturer or make and model, including traceability information (such as lot number, date code, or serial number) of the firearm locking device shall appear on the product.

6.3 *Package Labeling:*

6.3.1 All package labels shall comply with ANSI Z535.4.

6.3.2 Products complying with all requirements of this provisional standard may be labeled or marked "Meets requirements of ASTM F2369" or equivalent.

6.3.3 When a compliance statement is made, the package labeling must clearly identify the intended applications and indicate that the product may not be appropriate for other firearms.

7. Keywords

7.1 firearms; gun locks; guns; safety standard; security devices

APPENDIXES

(Nonmandatory Information)

X1. HANDGUN TRIGGER GUARD FIXTURE

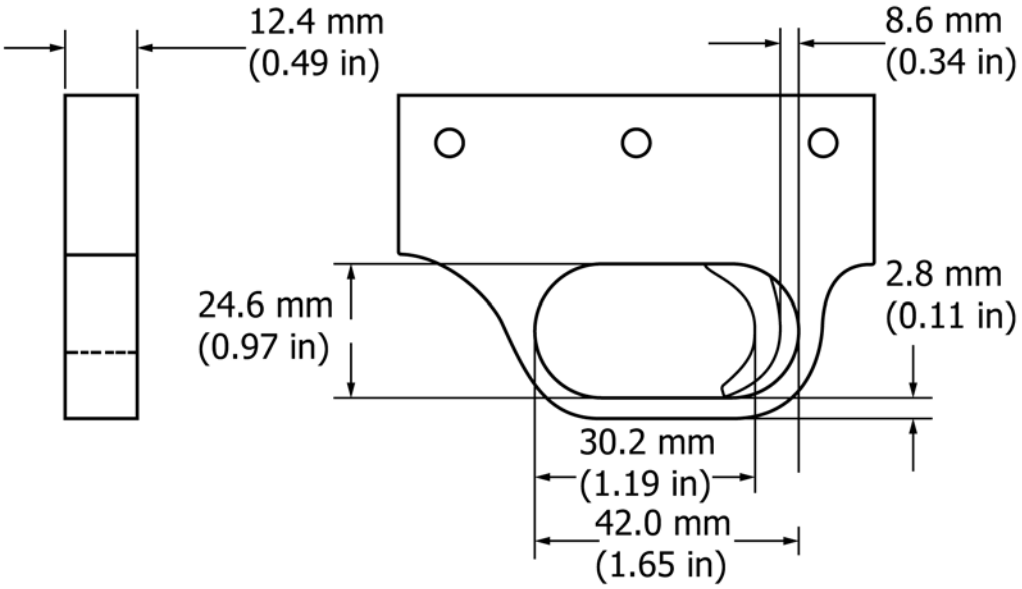


FIG. X1.1 Trigger Guard Dimensions

X2. EXAMPLE IMPLEMENTATION OF A CABLE CUTTING FIXTURE

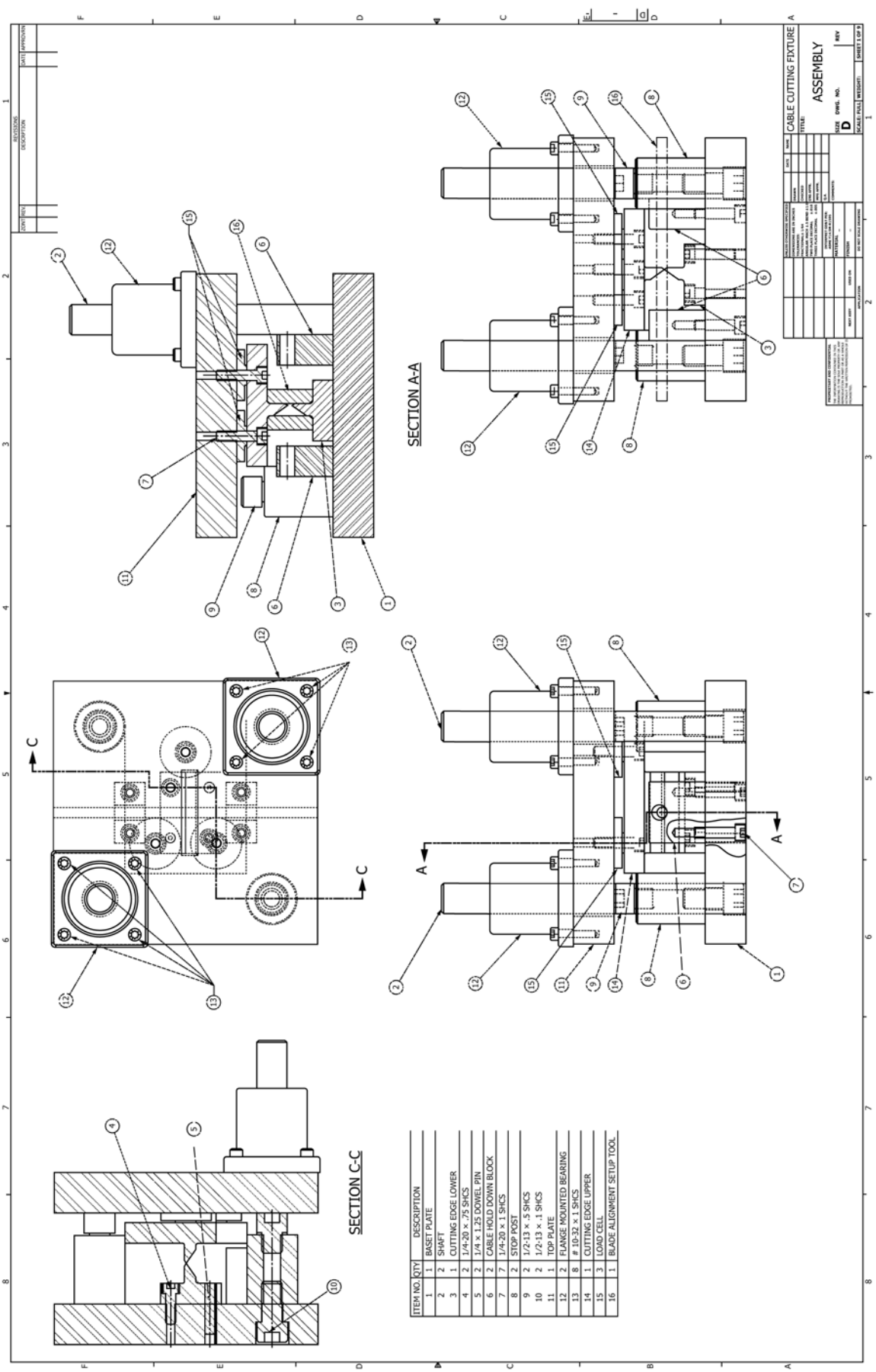


FIG. X2.1 Cable Cutting Fixture Assembly

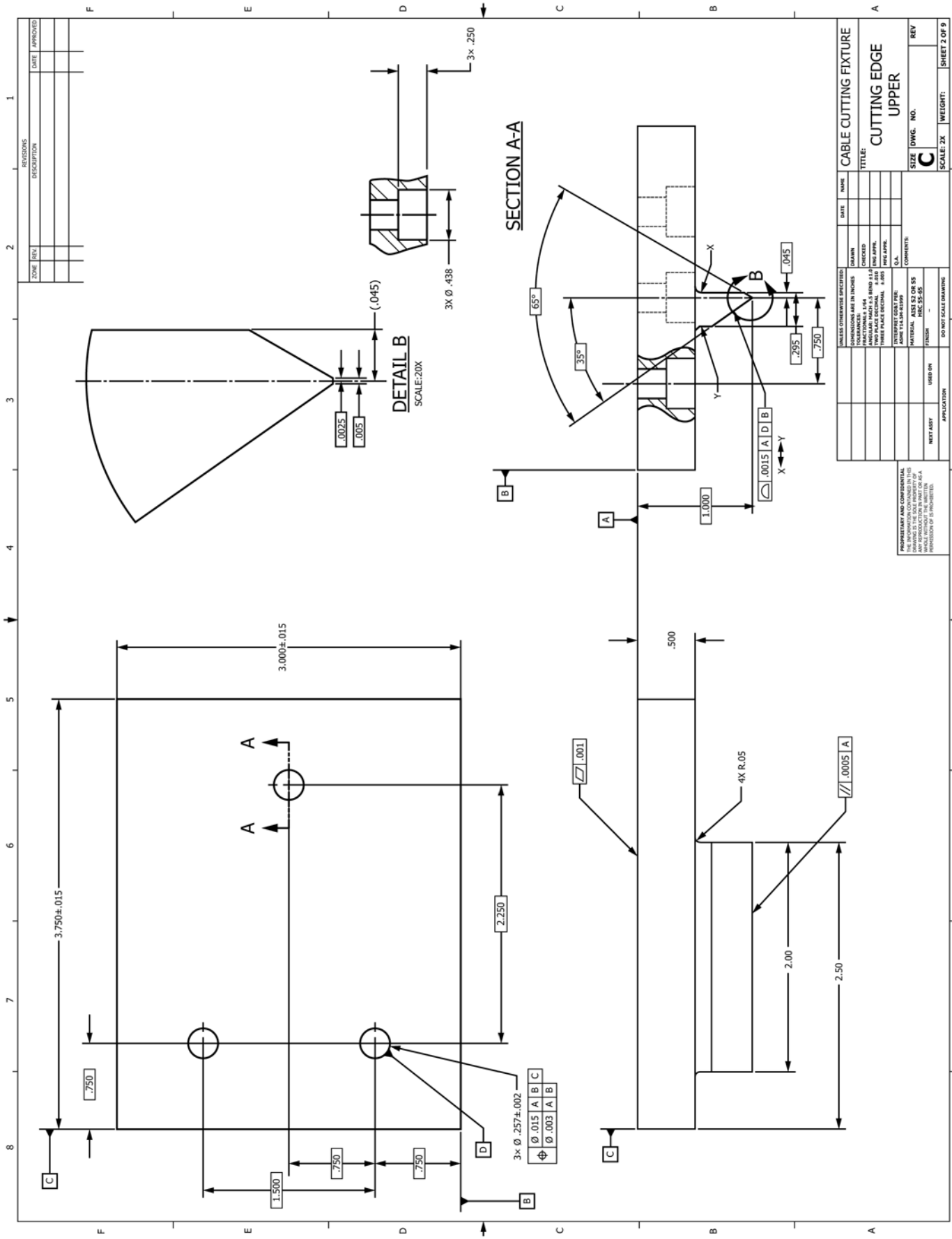


FIG. X2.2 Drawing of Upper Cutting Edge

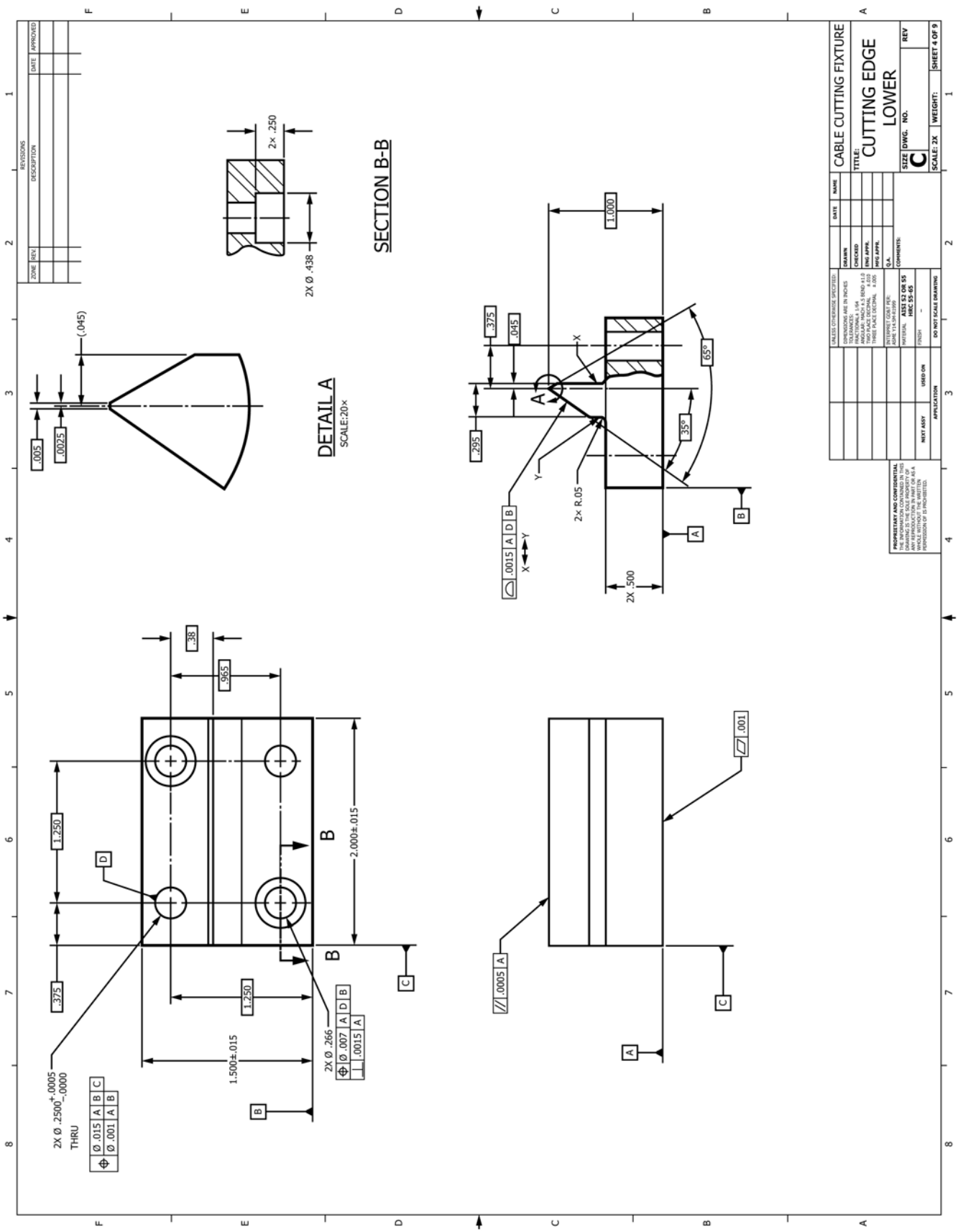


FIG. X2.3 Drawing of Lower Cutting Edge

X3. EXAMPLE IMPLEMENTATION OF A CABLE LOCK IMPACT TESTING FIXTURE

X3.1 *Disclaimer*:

X3.1.1 Any mention of commercial products is for information only; it does not imply recommendation or endorsement, nor does it imply that the products mentioned are necessarily the best available for the purpose.

X3.2 *Description of Prototype Cable Lock Impact Test Fixture*:

X3.2.1 The cable lock impact fixture was developed by modifying a commercial standard clay target trap (thrower).

X3.2.2 Modifications involved fabricating a cable clamp and a clamp holder. The clamp holder is bolted to the swinging arm of the trap, and it receives the cable clamp. Additionally, a custom spring must be built for the trap, as the OEM spring is too strong.

X3.2.3 An impact test setup will also require a solid work surface onto which a steel anvil and rubber padding are positioned.

X3.2.4 The modified target thrower is fastened above the table surface. A speed measurement system is also fastened to the work surface and positioned such that the speed measurement is made very near the impact point. The heights of the trap, anvil, rubber padding, and speed measurement system may have to be adjusted for proper clearances. Once done, no further adjustments should be necessary.

X3.2.5 For information purposes, the prototype trap/impact fixture was mounted on a spacer block 6 in. off the table surface. This provides a clearance of approximately 2.5 in. between the swinging arm and the table surface when the impact test is in progress.

X3.2.6 The steel anvil used measures 5 in. long, 8 in. wide, and 3 in. high. The prototype unit included a 0.5 in. rubber sheet under the steel anvil to shim it to the correct height (that is, top surface of steel anvil is 3.5 in. above table surface). The rubber padding is positioned under the swinging arm so as not to interfere with the swing arc, but still provide cushioning to the swing arm very soon after the cable lock strikes the steel anvil. The rubber padding measures 6 in. long, 12 in. wide, and 3 in. high.

X3.3 *Preliminary Methodology*:

X3.3.1 After setting up the impact fixture described in the drawing package, some adjustments may be necessary.

X3.3.2 Install a cable lock in the cable clamp by loosening the cable clamp thumb screw to provide needed clearances. The recommended method for holding the cable lock is to thread the free end of the cable lock up through both channels of the cable clamp and then back down through the cable trough (under the thumb screw pad). Lock the free end of the cable in the lock body. Slide the lock body/cable in or out of the cable channel so that the lock body is positioned approximately 2 in. from the cable clamp. Turn the thumb screw to clamp the free end side of the cable to the cable clamp.

X3.3.3 Fully insert the cable clamp into the clamp holder. Rotate the cable clamp to the desired orientation (any of eight are possible) and turn the thumb screw to clamp the cable clamp to the clamp holder. Generally, the most stringent strike orientation positions the free end of the cable above the fixed end of the cable.

X3.3.4 Ensure that both thumb screws are tight. Confirm that the steel anvil is positioned correctly (in terms of height) so that the speed measurement is completed very shortly before the impact. Also, confirm that the steel anvil is positioned correctly (in terms of horizontal distance to the lock) so that the entire side of the lock body, and not the cable, will strike squarely on the anvil.

X3.3.5 Cock the trap mechanism. Reset the velocity timer system (if necessary). Ensure that there are no obstructions in the swing path and that no personnel are near the impact location (potential hazards due to flying debris, broken parts, etc.).

X3.3.6 Release the trap mechanism. Record strike speed and result of impact event (that is, the lock was or was not disabled). Adjust spring tension to fine-tune speeds if necessary.

TABLE X3.1 Component Details

Component	Number	Notes
Sporting Clay Thrower[A,B]	TC-22-2259-127 Post Mount	Purchased from[A]
Custom Spring[A,C]	20 POUND	Spring Rate (lbf/in.) 20 Speed (ft/s) 34.3
Thumb Screws (Dog Point): Fluted Knob ¼ in.-20 × 1 in. long, Heat-Treated Steel Stud with Black-Oxide Finish; Steel Knob with Black-Oxide Finish, Tip Dia. 0.156 in.[A,D]	93005A551	The Clamp Holder requires one Thumb Screw, which is used to secure/release the Cable Clamp
Thumb Screws with Removable Swivel Pads: Fluted Knob ¼ in.-20 × 1-3⁄16 in. long, Steel with Black-Oxide Finish, Pad Dia. 5⁄16 in.[A,D]	90165A412	The Cable Clamp requires one Thumb Screw, which is used to secure/release the cable lock
Speed Measurement System[A,E]	Projectile Velocity Measurement Unit (dual-laser break beam) Hand Set (Controller, for reading the time)	Consists of a dual-laser break beam unit and a remote display timer

[A] If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee[1], which you may attend.
[B] The sole source of supply of the apparatus known to the committee at this time is Cabela's, 400 East Avenue A, Oshkosh, NE 69190, website: www.cabelas.com.
[C] The sole source of supply of the apparatus known to the committee at this time is Kirk-Habicht Company, 8905 Kelso Drive, Baltimore, MD 21221, website: www.kirk-habicht.com.
[D] The sole source of supply of the apparatus known to the committee at this time is McMaster-Carr, 6100 Fulton Industrial Blvd., Atlanta, GA 30336, website: www.mcmaster.com.
[E] The sole source of supply of the apparatus known to the committee at this time is Almec E.A.S. Ltd, Knowl Piece, Wilbury Way, Hitchin, Herts, SG4 0TY, United Kingdom.

NOTE 1—The clamp holder is firmly attached to the swinging trap arm with two bolts and nuts (7⁄16 in.) and serves as the receiver, or mounting block, for the cable clamp.

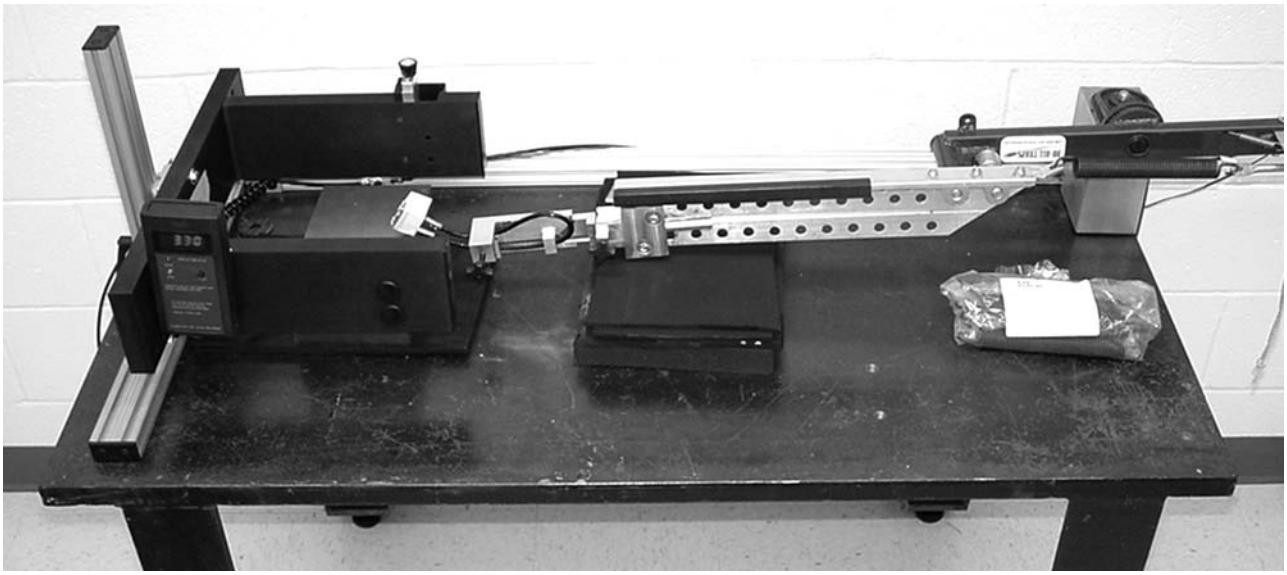


FIG. X3.1 Photograph of One Example Implementation of an Impact Test Fixture

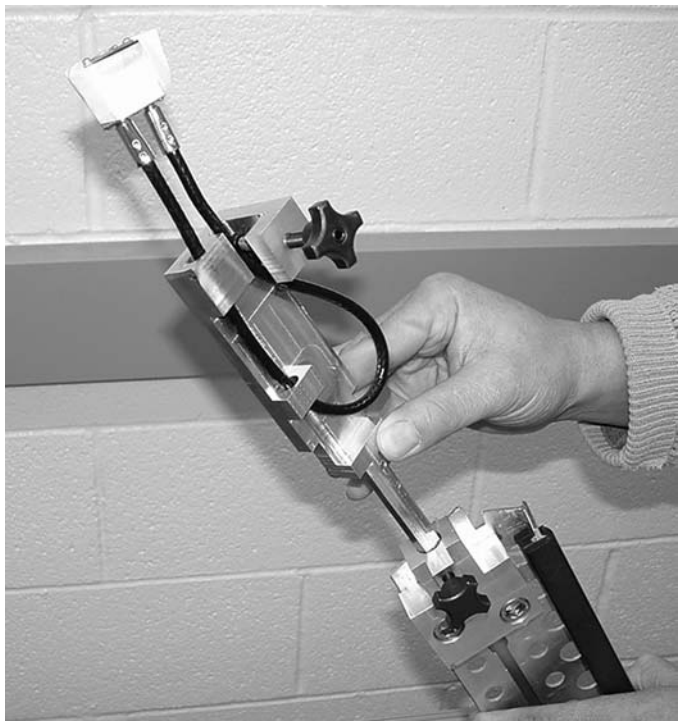


FIG. X3.2 Close Up of Cable Lock Installed in Cable Clamp Holding Fixture

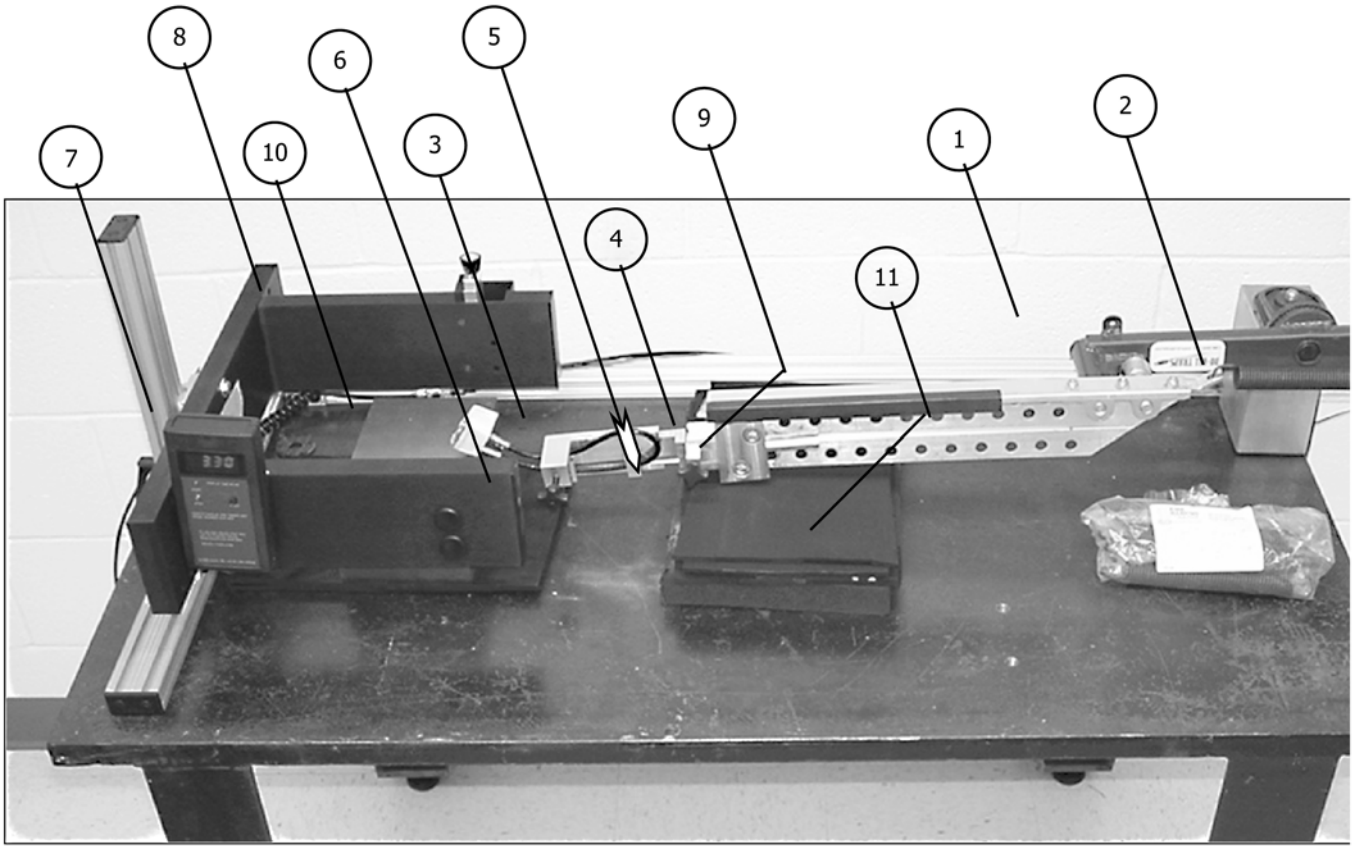
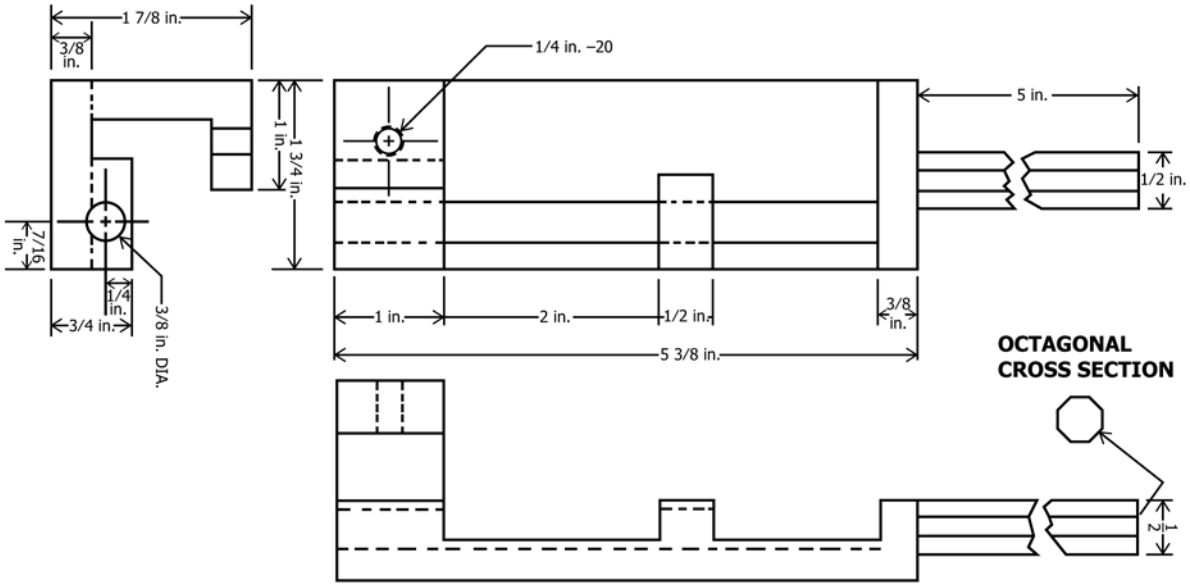


FIG. X3.3 Assembly Picture of Cable Lock Impact Test Fixture

Item	Part Description	Part Name	Quantity
1	P/N: TC-22–2259–127	Sporting Clay Thrower[A,B]	1
2	P/N: 20 POUND	Custom Spring[A,C]	1
3	SK-OLES-04	Cable Clamp	1
4	SK-OLES-05	Clamp Holder	1
5	P/N: 93005A551	Thumb Screw for Clamp Holder[A,D]	1
6	P/N: 90165A412	Thumb Screw for Cable Clamp[A,D]	1
7	P/N: ALM 3903	Remote Timer Display for Speed Measurement Unit[A,E]	1
8	P/N: ALM 3902	Laser Speed Measurement Unit[A,E]	1
9		7/16 in. bolts and nuts	2 each
10		Steel Anvil	1
11		Rubber Padding	1

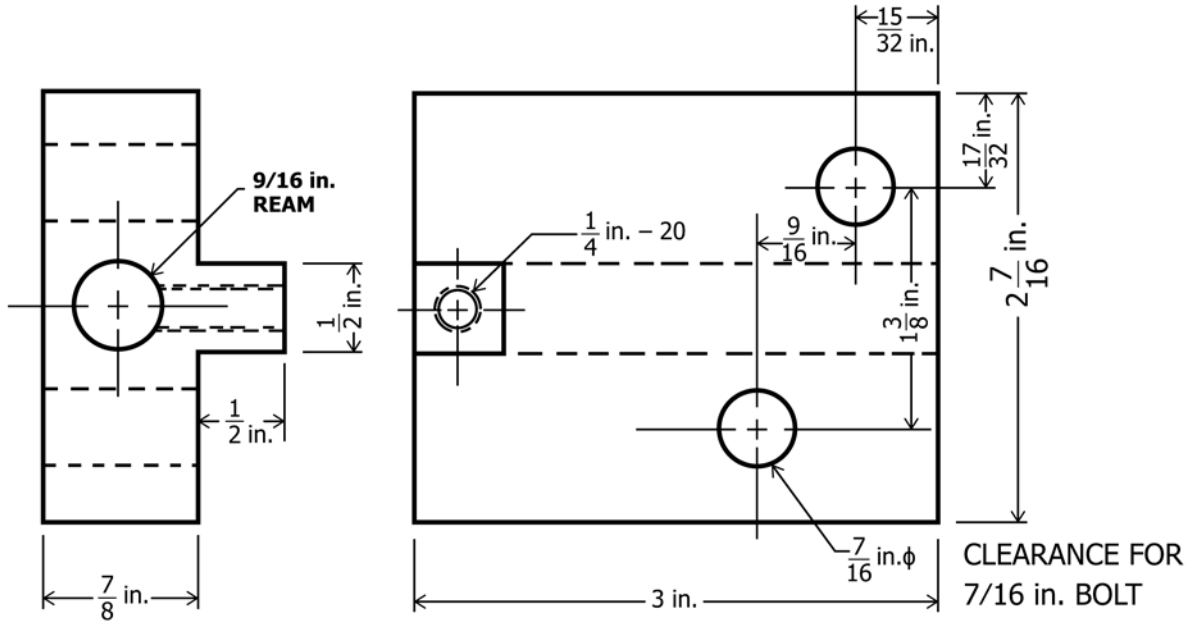
[A] If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee[1], which you may attend.
[B] The sole source of supply of the apparatus known to the committee at this time is Cabela's, 400 East Avenue A, Oshkosh, NE 69190, website: www.cabelas.com.
[C] The sole source of supply of the apparatus known to the committee at this time is Kirk-Habicht Company, 8905 Kelso Drive, Baltimore, MD 21221, website: www.kirk-habicht.com.
[D] The sole source of supply of the apparatus known to the committee at this time is McMaster-Carr, 6100 Fulton Industrial Blvd., Atlanta, GA 30336, website: www.mcmaster.com.
[E] The sole source of supply of the apparatus known to the committee at this time is Almec E.A.S. Ltd, Knowl Piece, Wilbury Way, Hitchin, Herts, SG4 0TY, United Kingdom.

ALTERNATIVE CABLE TROUGH:
Rather than flat trough, alternative is radius of 3/16 in. to give semi-circular trough. Aluminum wall thickness below trough to be maintained at 3/8 in.



NOTES: BREAK ALL SHARP EDGES

FIG. X3.4 Cable Clamp Used on Cable Lock Impact Test Fixture



NOTES: BREAK ALL SHARP EDGES

FIG. X3.5 Clamp Holder Used on Cable Lock Impact Test Fixture

X4. SAW TEST APPLIED TO CABLE COMPONENTS

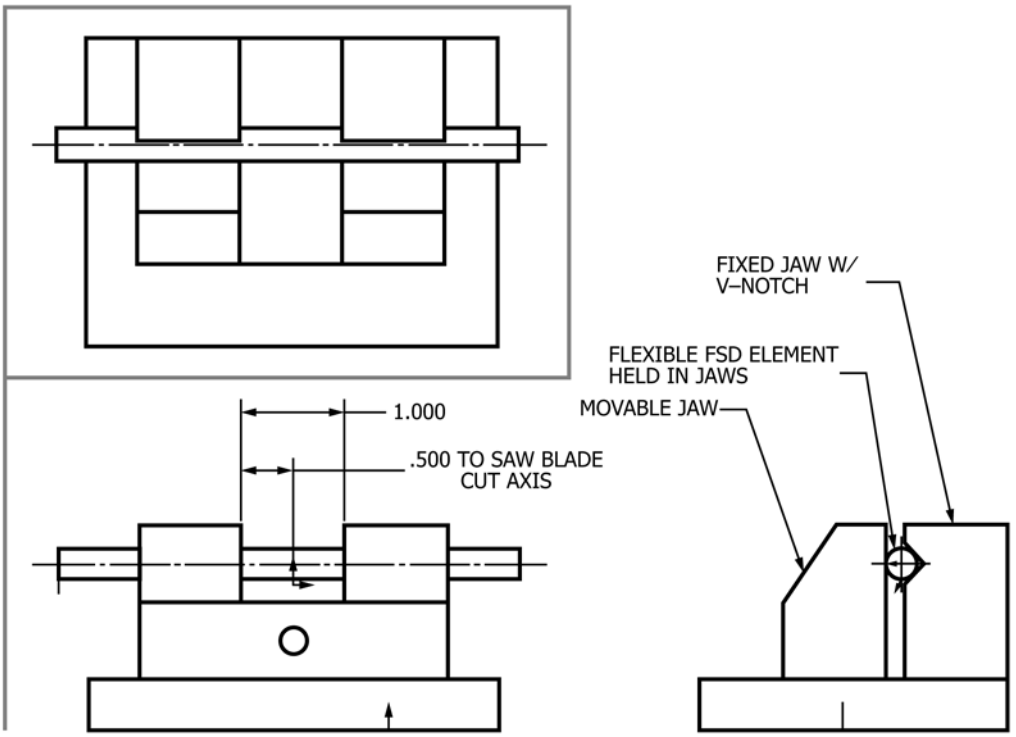


FIG. X4.1 Saw Test Applied to Cable Components