Designation: F883 – 13

Standard Performance Specification for Padlocks[1]

This standard is issued under the fixed designation F883; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers environmental, functional, operational, and security requirements for padlocks. Included are function descriptions, cycle tests, operational tests, environmental tests, forcing tests, and surreptitious entry tests. No effort has been made to include criteria for specially made padlocks used by the Department of Defense or others in highly sensitive locations.

1.2 This specification describes and grades various levels of performance to provide users of the specification with criteria upon which to select suitable padlocks.

1.3 Tests described are laboratory tests and although they simulate field conditions as to attacks or the environment, they do not duplicate these conditions. Tests described are repeatable in the laboratory.

1.4 Some users of this specification may wish to use padlocks that have special attributes not related to security. These are found in 4.3.

1.5 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are provided for information only.

1.6 The following precautionary caveat pertains only to the test method portions, Sections 8 – 11, of this specification: *This standard does not purport to address 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]

B117 Practice for Operating Salt Spray (Fog) Apparatus

G154 Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

2.2 *ANSI Standard:*[3]

A 156.5 Standard for Auxiliary Locks and Associated Products

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *acceptance testing, v*—to assure by documented testing that a padlock meets specific tests of Specification F883 as agreed to by the buyer and seller.

3.1.2 *bump key, n*—lock picking key with uniform steeples between cuts that is forced further into the lock via impact.

3.1.3 *cam, n*—lock or cylinder component which transfers the rotational motion of a key or cylinder plug to the bolt works of a lock.

3.1.4 *case, n*—housing or body of a lock or latch.

3.1.5 *certified, v*—to assure by documented testing that a padlock meets all test requirements appropriate to its grading.

3.1.6 *clevis, n*—fastener attached to a padlock case or shackle for connection of a chain, designed to prevent displacement of a padlock.

3.1.7 *cylinder, n*—complete operating unit which usually consists of the plug, shell, tumblers, springs, plug retainer, a cam/tailpiece or other actuating device, and all other necessary operating parts.

3.1.8 *cylinder bitting, n*—group of numbers that represent the bitting of a key or the tumblers, or both, of a lock or cylinder.

3.1.9 *decode, v*—to determine a key combination by physical measurement of a key or cylinder parts, or both.

3.1.10 *heel, n*—part of a padlock shackle that normally is retained in the case when in the unlocked position.

3.1.11 *impression technique, v*—means of fitting a key directly to a locked cylinder by manipulating a blank in the keyway and cutting the blank where the tumblers have made marks.

[1] This specification is under the jurisdiction of ASTM Committee F12 on Security Systems and Equipmentand is the direct responsibility of Subcommittee F12.50 on Locking Devices.

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

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

3.1.12 *keyway, n*—opening in a lock or cylinder that is shaped to accept a key bit or blade of a proper configuration.

3.1.13 *lock bumping, n*—picking technique that utilizes a configured key forcefully impacted into the keyway.

3.1.14 *padlock, n*—detachable and portable lock with a shackle that locks into its case. Components performing the same purpose of a shackle but differing in design are sometimes used instead of a shackle.

3.1.15 *pick, v*—to manipulate tumblers in a keyed lock mechanism through the keyway, without obvious damage, by means other than the specifically designed key.

3.1.16 *plug, n*—part of a cylinder which contains the keyway, with tumbler chambers usually corresponding to those in the cylinder shell.

3.1.17 *plug retainer, n*—cylinder component that secures the plug in the shell.

3.1.18 *pull bump key, n*—lock picking key that must be pulled from the lock one space position between impacts.

3.1.19 *push bump key, n*—lock picking key that centers itself after each impact.

3.1.20 *rap, v*—to unlock a padlock shackle from its case by striking the case in order to disengage the locking mechanism.

3.1.21 *removable cylinder, n*—cylinder that can be removed from a locking device by a key or tool, or both.

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

3.1.23 *shroud, n*—material on a padlock body specifically added to protect the shackle from physical attack.

3.1.24 *tailpiece, n*—actuator attached to or part of the rear of the cylinder.

3.1.25 *toe, n*—part of a padlock shackle that is normally released from the case in the unlocked position.

3.1.26 *tumbler, n*—movable obstruction of varying size and configuration in a lock or cylinder that makes direct contact with the key or another tumbler and prevents an incorrect key or torquing device from activating the lock or other mechanism.

4. Classification of Functions

4.1 *Types of Padlocks:*
4.1.1 *Type P01*—Key operated.
4.1.2 *Type P02*—Combination operated.

4.2 *Grades*—Six levels of performance are described in this specification with Grade 1 the lowest and Grade 6 the highest.

4.3 *Options:*
4.3.1 *Option A*—Key is captive in cylinder when padlock is unlocked.
4.3.2 *Option B*—Removable cylinder.
4.3.3 *Option C*—Changeable combination.
4.3.4 *Option D*—Combination operated with key control.
4.3.5 *Option E*—Corrosion resistant.
4.3.6 *Option F*—Provided with nonferrous shackles.
4.3.7 *Option G*—Environmental resistant.

5. General Requirements

5.1 *Inferences*—Cylinder picking, impressioning, rapping, decoding, and shackle shimming are described in this specification. Since the skill of the person doing the testing has a direct bearing on the resulting times of the tests, one of each test shall be conducted by a minimum of three different persons having experience of not less than three years of approximately the same skill level and the results averaged for determining relative levels of performance.

5.2 Key bumping is a subjective test to be conducted using bump keys designed for the lock or cylinder being tested and an impact device as outlined in Section 7.

5.3 *Tolerances:*
5.3.1 *Fixture Tolerances*—All tolerances shall follow standard machining practices unless otherwise specified.
5.3.2 *Test Set up Tolerances:*
5.3.2.1 *Force:* 0.5 % of working range.
5.3.2.2 *Height:* ±3 mm (0.12 in.).
5.3.2.3 *Torque:* 4.0 % of reading.
5.3.2.4 *Weight:* ±10 g (0.02 lbs).

5.4 *Temperature*—All tests shall be conducted between 16° and 27°C (61° and 81°F).

5.5 *Test Reports*—All test reports shall be dated.

6. Test Specimens

6.1 Select specimens for test at random from the manufacturers' finished stock of each size and model being certified by the manufacturer.

6.2 Padlocks or cylinders are permitted to be used for multiple tests if previous tests would not influence subsequent test results.

6.3 Select four padlocks or cylinders for the forcing tests. For surreptitious entry tests, select five padlocks or cylinders for each test required. Select one padlock or cylinder for the cycle test.

6.4 Each lock submitted for bump testing shall be supplied with seven cut keys that operate the lock.

6.5 When appropriate, select one padlock for the salt spray test (Option E) and three for the environmental tests (Option G).

7. Preparation of Apparatus

7.1 *Tensile Loading Device*—Provide a tensile loading device having a load and force measuring capacity of 44 500 N (10 000 lbf).

7.2 *Shock Impactor:*
7.2.1 Provide a fixture as illustrated in Fig. 1 which allows the weights described in (7.2.2) to be properly guided to strike the anvil rod which will be placed in direct contact with the top surface of a padlock using the mounting block described in (7.2.3).
7.2.2 Make a set of weights as shown in Fig. 1, with a central hole in each that allows the weight selected to free fall and strike the top surface of the anvil rod.

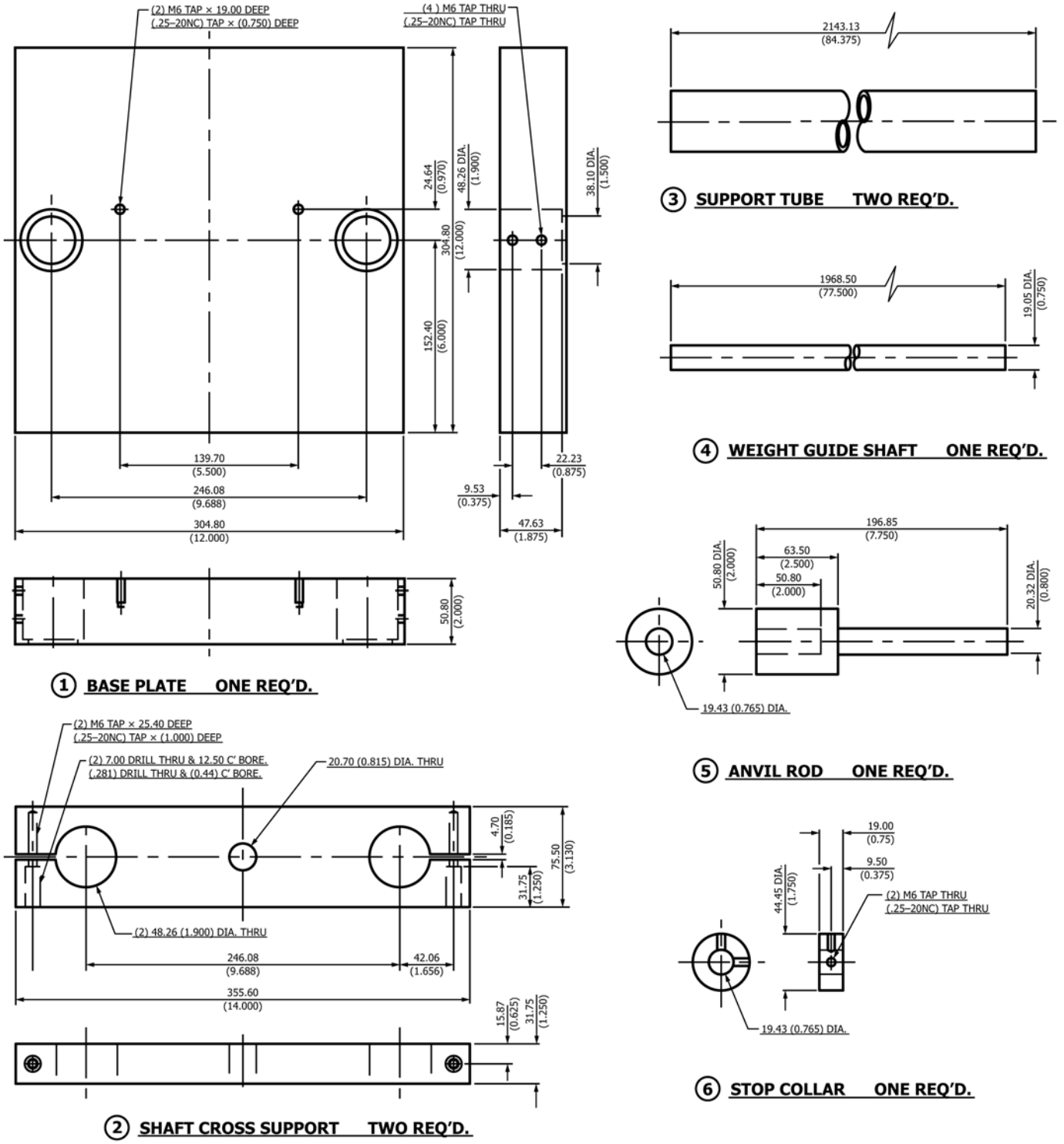


FIG. 1 (Sheet 1) Shock Impactor (See Table 5 for Bill of Material)

7.2.3 Make a mounting block that will support the specimen on the mounting block when being subjected to the required shock load (see Table 1).

7.3 *Key Bumping:*

7.3.1 Each locksmith performing the test shall use two of the supplied keys to fabricate his own pull bump key and push bump key.

7.3.2 Both a pull bump key and a push bump key shall be used to test a lock or cylinder for bump resistance by each of three locksmiths.

7.3.2.1 A torque bar is permitted to be used if the test person prefers that method.

7.3.2.2 A single impact cycle consists of having a bump key fully inserted into the keyway and withdrawing it one cut

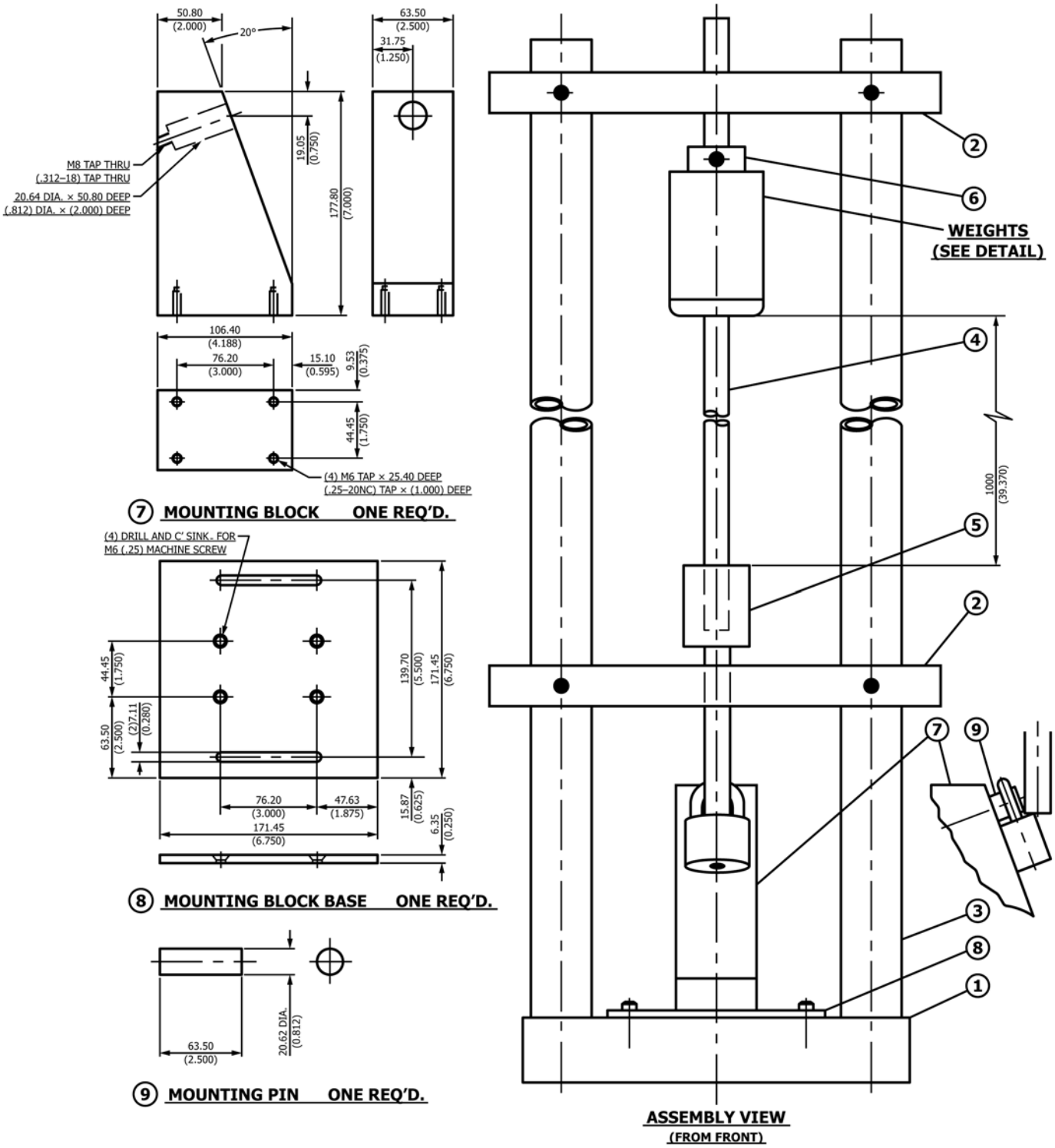


FIG. 2 (Sheet 2) Shock Impactor (See Table 5 for Bill of Material)

position for the pull type, inserting the key fully into the keyway and then releasing it to allow the pins to center it for the push type, impacting the end of the key to drive it fully into the keyway while torque is applied. If the cylinder or lock operates after the impact, it failed the test at that cycle and shall be given the appropriate grade level for the last cycle that did not accomplish operation. If it did not operate, a new cycle shall be achieved until the lock or cylinder reaches Grade 6.

7.3.3 Provide various mounting blocks for locks or cylinders as required by the test person if rigid mounting is preferred.

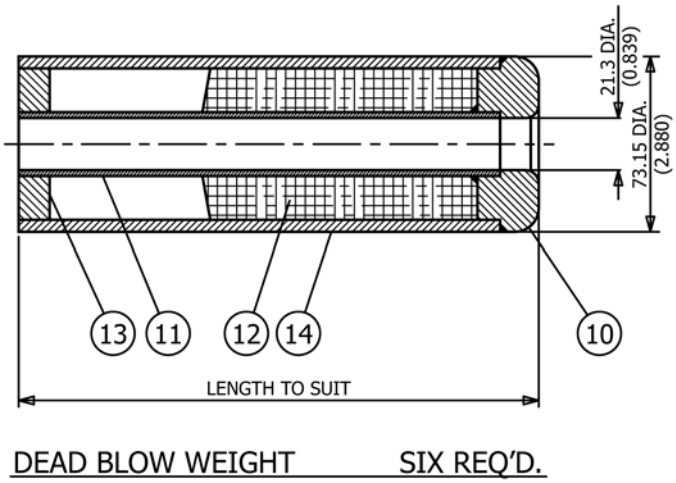


FIG. 3 (Sheet 3) Shock Impactor (See Table 5 for Bill of Material)

TABLE 1 Forcing Tests Required Values

Forcing Tests	Units	Grades					
		1 (F1)	2 (F2)	3 (F3)	4 (F4)	5 (F5)	6 (F6)
Tensile Force	newtons	1000	2500	5000	9000	20 000	40 000
	(lbf)	(225)	(560)	(1125)	(2000)	4500)	(9000)
Shock test blows		5	5	5	5	5	5
Shock test weights	kilograms	1	2	3	4	5	6
	(lbs)	(2.2)	(4.4)	(6.6)	(8.8)	(11.0)	(13.2)
Shock test heights	meters	1	1	1	1	1	1
	(in.)	(39.4)	(39.4)	(39.4)	(39.4)	(39.4)	(39.4)
Plug pull test	newtons	1000	1500	2000	3000	6000	12 000
	(lbf)	(225)	(337)	(450)	(675)	(1350)	(2700)
Plug torque test	newton-meters	10	15	20	25	30	35
	(lbf-in.)	(89)	(133)	(177)	(221)	(266)	(310)
Shackle cutting	newtons	4450	9000	13 500	18 000	31 000	45 000
force test	(lbf)	(1000)	(2000)	(3000)	(4000)	(7000)	(10 000)

7.3.4 The impact device shall be a non-metal instrument with a weight not to exceed 0.25 lb.

TEST METHODS

8. Forcing Tests (see Table 1)

8.1 *Tensile Test* (Does not apply if test cannot be performed) (see 7.1)—Support the locked padlock in a fixture bearing against the top surface of the case without interfering with the shackle or giving support through the top of the case to the shackle retaining mechanism. Apply the required force slowly along the vertical centerline of the padlock in a direct and equal tension on each leg of the shackle. Failure occurs if the padlock opens.

8.2 *Shock Test*—Using the impactor (7.2) drop the weight the required number of times on the top of the locked padlock case. Failure occurs if the padlock opens.

8.3 *Plug Pulling Test*—Drill the keyway with a No. 20 (0.161 in.) diameter drill and insert a Type AB No. 12 screw at least 19 mm (0.75 in.) deep. Apply the required tension (7.1) axially between the case and the installed screw. Failure occurs if the cylinder plug or cylinder assembly completely separates from the case, or if the padlock can be opened by manipulation with a screwdriver at the conclusion of the test.

NOTE 1—Some cylinders are of a configuration such that a different attachment may be needed in order to apply the required loads.

8.4 *Plug Torque Test:*

8.4.1 Install the padlock in a rigid fixture such as a vise to support it firmly but not restrict free rotation of the plug in the cylinder.

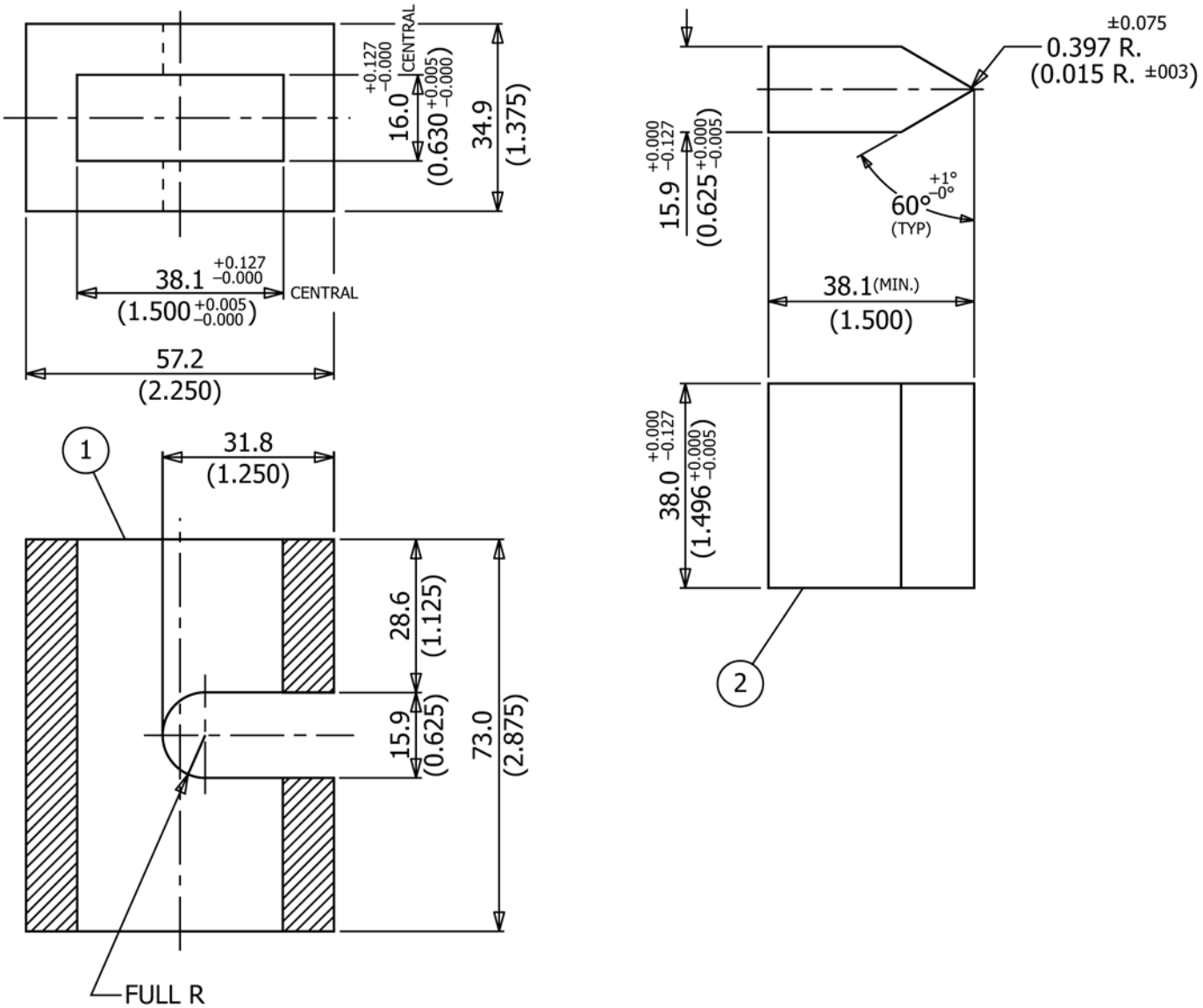
8.4.2 Insert a blade type tool into the keyway, so that a torque load can be applied to the plug. Failure occurs if the padlock opens.

8.5 *Shackle Cutting Test* (Does not apply if test cannot be performed)—Shackles shall withstand cutting through when 2 shearing blades made of a steel hardened to a minimum hardness of Rc 50, are used in conjunction with the blade positioning holder, is placed in a tensile loading device (7.1) having a compression load capability and compressed with the required force. See Fig. 4 for details. Failure occurs if the shackle is cut through. Padlocks specified with Option F are not subject to 8.6.

9. Surreptitious Entry Tests (see Table 2)

9.1 *Picking or Manipulating Test:*

9.1.1 Cylinders in padlocks shall resist picking (see 5.1) for the required time. Combination padlocks shall resist manual manipulation (see 5.1) for the required time.



NOTE 1—Item No. 1 may be made as a multi-piece part that could be assembled by either bolt or weld construction.

FIG. 4 (Sheet 1) Shackle Cutting Fixture and Blades (See Table 6 for Bill of Material)

TABLE 2 Surreptitious Entry Tests Required Values

Surreptitious Entry Tests	Grades					
	1 (S1)	2 (S2)	3 (S3)	4 (S4)	5 (S5)	6 (S6)
Picking or Manipulation, min	½	1	2	4	8	15
Bump Key Attack, min	2 ½	5	7 ½	10	12 ½	15
Impressioning or Decoding min	N/A	N/A	2	4	8	15
Shackle Shimming Test min	½	1	2	4	8	15
Drilling and Shimming min	N/A	N/A	N/A	4	8	15
Rapping min	N/A	N/A	2	4	8	15

9.1.2 Cylinders or padlocks submitted for test containing pin tumblers shall be loaded using one each of the three or four mid-range bittings available unless such a combination would not normally be supplied as a stock product. Cylinders in padlocks containing other tumbler elements shall be loaded using maximum ranges. If lock design and cylinders used are the same in several different sizes of padlocks submitted for testing, only a total of five samples of any size or sizes need to be tested.

9.1.3 The tools used for this test shall be manual manipulating tools required by the operator, providing no visible marks are left detectable by the unaided eye.

9.2 *Cylinder Impressioning and Decoding Tests:*

9.2.1 Cylinders shall resist successful impressioning and decoding (see 5.1) for the required time.

9.2.2 Padlocks with cylinders submitted for test shall be loaded in accordance with 9.1.2.

9.3 *Shackle Shimming Test*—Insert any shim stock selected (see 5.1) that can be inserted in the clearance between the shackle and the case in either or both of the case shackle holes of a locked padlock and manipulate for the required time.

9.4 *Cylinder Drilling and Shimming Test:*

9.4.1 Use hand-held tools.

9.4.2 Load cylinders in accordance with 9.1.2.

9.4.3 Cylinders in locked padlocks hanging from a hasp shall resist drilling and shimming for the required time. Results of the drilling test shall not be obvious to the unaided eye.

9.5 *Rap Test:*

9.5.1 Use hand-held tools.

9.5.2 Padlocks shall resist successful rapping on the cylinder and case (see 5.1) for the required time.

9.6 *Key Bumping Test*—The testing person must change the order of testing for 9.6.1 and 9.6.2 to use the most likely successful bumping attack first.

9.6.1 A lock or cylinder not previously bump tested by the locksmith is permitted to be mounted in a block if the testing person prefers that method and have the prepared pull bump key inserted. A prepared pull bump key is permitted to have a hole drilled in the bow for mounting a weight bar.

9.6.2 A lock or cylinder bump tested per 9.6.1 is permitted to be mounted in a block if the testing person prefers that method and have the prepared push bump key inserted. A prepared push bump key is permitted to have a hole drilled in the bow for mounting a weight bar.

9.6.3 Impacts with the impact device shall be by hand using a rapping motion which ensures that the impact device applies force to the bump key a single time and does not allow bouncing impact of the impact device.

9.6.4 Impacts to the key shall be performed at a minimum rate of 4 per minute. Any accelerated rate of impact is permitted to be used during the test to achieve the quantity of impacts required by the stated minimum rate/time requirement for a given grade level, that is, 10 impacts in 2.5 min by each type of bump key without operation = Grade 1, or 10 impacts by each type of bump key in less than 2.5 min without operation = Grade 1.

9.6.5 The torque applied to the bump key during the impact testing shall be no less or no greater than the testing person has found optimum from past experience.

9.6.6 If the cylinder or lock is not operated by the bump key within 10 impact cycles of either type of bump key, the lock is classed as Grade 1. Locks or cylinders that are operated by either type of bump key in 10 or less impacts will be qualified as having Grade zero bump resistance.

9.6.7 The test described in 9.6.4 – 9.6.6 shall be repeated through 10 complete impact cycles with each type bump key for each Grade level from 2 through 6 or until operated by a bump key. A cylinder or lock that is operated by either type of bump key on the 11th through 20th cycle will be qualified as Grade 1, 21st through 30th = Grade 2, 31st through 40th = Grade 3, 41st through 50th = Grade 4, 51st through 60th = Grade 5. Any cylinder or lock that resists operating for a total of 60 impacts by each type of bump key shall be qualified as Grade 6.

9.6.8 The test shall be repeated for each of the remaining cylinders.

9.6.9 At the conclusion of testing by each locksmith the seventh cut key shall be used to verify that the lock or cylinder still functions.

9.6.10 Failure of the lock or cylinder to function does not constitute failure of the testing since it provides a detection method of a bumping attempt.

9.6.11 A lock or cylinder which captures the bump key to prevent an unlocking motion using a bump key shall be classed as Grade 6.

10. Cycle Test (see Table 3)

10.1 *Keyed Padlocks:*

10.1.1 Prior to conducting the cycle test, insert key into each padlock cylinder 25 times and manually rotate both clockwise and counterclockwise (if possible, otherwise in the direction of opening) after each insertion.

10.1.1.1 Operate the required number of cycles at a rate not to exceed 10 cycles/min. Lubrication shall not be added during the test.

10.1.1.2 At the beginning and the end of the cycle test, cylinders shall meet the operational tests as described in ANSI A 156.5. The required values for these tests are expressed in Table 3 of this specification and are not the same as in ANSI A 156.5.

10.1.1.3 Failure occurs if the test cannot be completed, the padlock does not operate at the conclusion of the test, the key breaks, or the requirements of 10.1.1.2 are not attained.

10.1.2 *Non-Key Retaining Padlocks*—In a test fixture which will horizontally hold the padlock and mechanically operate the key, activate through a cycle consisting of the following:

10.1.2.1 Fully inserting the key in the keyway.

TABLE 3 Cycle Tests Required Values

Cycle Tests	Grades					
	K1	K2	K3	K4	K5	K6
Keyed Padlocks (× 1000)	1	10	25	50	75	100
Force to Insert Key Maximum (all Grades)	←		12 N (3 lbf)			→
Force to Extract Key Maximum (all Grades)	←		12 N (3 lbf)			→
Torque to Rotate Cylinder Plug Maximum, Newton Metres (ozf-in.)	0.17 (24)	0.17 (24)	0.13 (18)	0.13 (18)	0.08 (11)	0.08 (11)
Combination Padlocks (× 1000)	1	10	25	50	75	100

TABLE 4 Required Values for Corrosion and Environmental Tests

	Grades					
Corrosion Testing	C1	C2	C3	C4	C5	C6
Salt Spray						
Cumulative time (h)	120	144	168	192	216	240
Environmental Testing	G1	G2	G3	G4	G5	G6
Dry contaminant testing						
Grit size[A]	16	16	30	30	100	100
Cumulative time (h)	0.5	1	1.5	2	2.5	3
Weathering Testing	W1	W2	W3	W4	W5	W6
Salt spray (fog)						
cumulative time (h)	96	192	288	384	480	576
UV light/condensed moisture condensation						
cumulative time (h)	16	32	48	64	80	96
UV light						
cumulative time (h)	32	64	96	128	160	192
Exposure totals						
cumulative time (h)	144	288	432	576	720	864
Freeze Testing	Z1	Z2	Z3	Z4	Z5	Z6
Min. Temperature (°F)	N/A	N/A	N/A	+15	–15	–45

[A] Screen media prior to reuse.

10.1.2.2 Rotating the key and cylinder plug the necessary number of degrees to open the padlock either clockwise or counterclockwise.

10.1.2.3 Allowing the shackle to extend, if spring loaded, or not, moving the shackle to its full extension.

10.1.2.4 Retracting the key from the plug until the key tip no longer touches the front tumbler.

10.1.2.5 Reengaging the shackle to the locked position.

10.1.3 *Key Retaining Padlocks*—In a test fixture that will hold the padlock horizontally and mechanically operate the key, activate through a cycle consisting of the following:

10.1.3.1 Fully inserting the key in the keyway.

10.1.3.2 Rotating the key and plug the amount and direction necessary to open the padlock.

10.1.3.3 Allowing the shackle to extend, if spring loaded, or if not, moving the shackle to its full extension.

10.1.3.4 Reengaging the shackle to the locked position. Rotate key in plug to home position.

10.1.3.5 Retracting the key from the plug until the key tip no longer touches the front tumbler.

10.2 *Combination Padlock*—Cycle single dial and multiple disk padlocks in alternate directions for the required number of cycles at a rate not to exceed 10 cycles per minute, with no more than a 2 s dwell. One cycle is equal to the number of revolutions necessary to upset all combination disks. At the conclusion of the test, failure occurs if the test cannot be completed or the padlock does not operate at the conclusion of the test. Lubrication shall not be added during the test.

11. Corrosion and Environmental Tests

11.1 *Corrosion Resistant*—Salt spray test (see Table 4).

11.1.1 After an exposure of the required number of hours, padlocks shall operate.

11.1.2 Test one padlock, suspended by nylon cord in the vertical upright position.

11.1.3 Conduct the test and clean for 10 min in accordance with Section 12 and Appendix X3.6 of Practice B117. Failure of any lock to unlock and relock within 1 min indicates failure.

11.2 *Dry Contaminant Environment Test* (see Table 4)*:*

TABLE 5 Bill of Material (Figs. 1-3)

Detail No.	No. Required	Description	Material[A]
1	1	base plate	aluminum
2	2	shaft cross support	aluminum
3	2	support tube	aluminum pipe/bar
4	1	weight guide shaft	steel
5	1	anvil	steel[B]
6	1	stop collar	aluminum
7	1	mounting block	steel[B]
8	1	mounting block base	aluminum
9	1	mounting pin	steel[B]
10	6	weight nose	steel or aluminum
14	6	weight shell	steel or aluminum
12	[C]	shot	lead or steel
11	6	weight core	steel
13	6	weight cover	hard rubber

[A] Note that all materials are suggested materials only. Substitutions are permitted when and if function and safe usage of the fixture are not affected.
[B] Use a material that is able to provide shock resistance.
[C] Amount necessary to fill six weights.

TABLE 6 Bill of Material (Fig. 4)

Detail No.	No. Required	Description	Material[A]
1	1	body	steel
2	2	blade	steel (Rc 50 min)

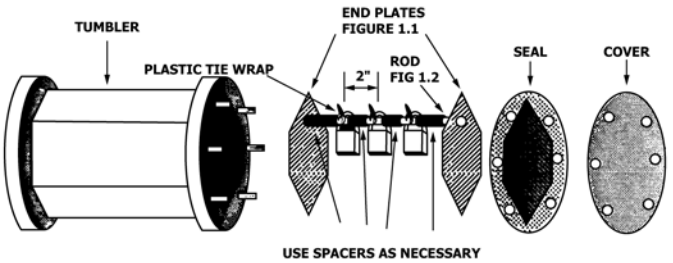
[A] Note that all materials are suggested materials only. Substitutions are permitted when and if function and safe usage of the fixture are not affected.

11.2.1 *Procedure*—Dry contaminant exposure consists of placing padlocks in a tumbler ⅓ full of silicon carbide grit. The tumbler rotates for a designated time then the padlocks are removed and evaluated.

11.2.2 The tumbler must be a hexagonal drum with 274 in.^{3} of volume, motor driven to rotate at 40 r/min.

11.2.3 Five padlocks are placed in the tumbler, equally spaced approximately 2 in. along a 0.5-diameter rod. Secure the shackle to the rod with a plastic tie wrap. Position the padlocks apart from each other with the use of a spacer collar assembled on the rod between the padlock shackles. The drum will be filled ⅓ full of grit and rotated. See Table 4 for various applications of grit size-exposure conditions assigned for each performance level. (See Figs. 5 and 6.)

11.2.4 The failure of a padlock to unlock and relock after exposure constitutes failure at that grade level.



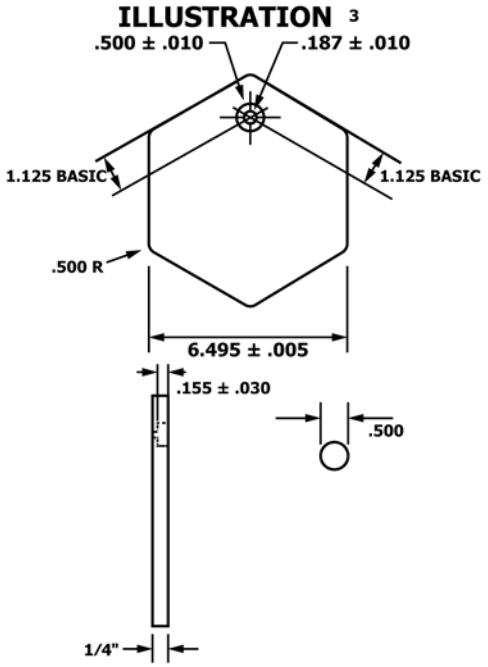
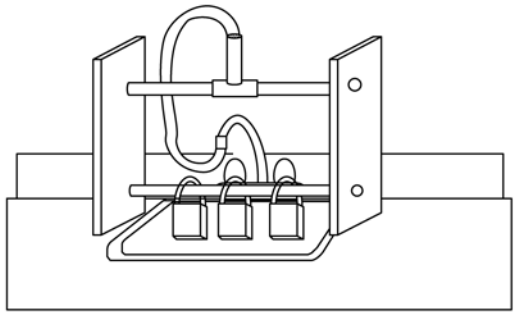


FIG. 5



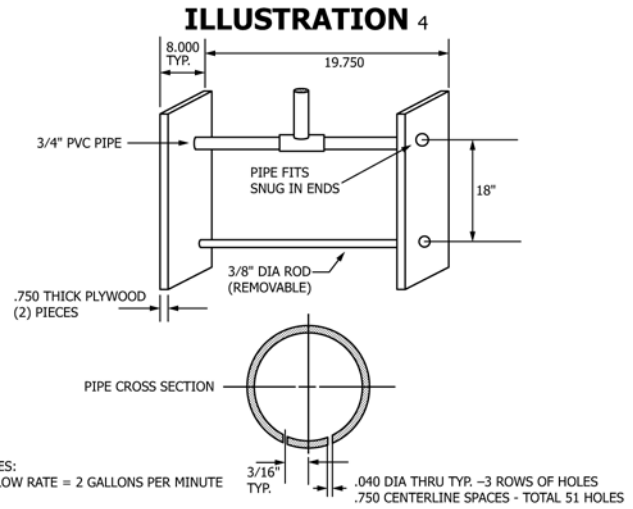


FIG. 6

11.2.5 The padlocks must pass the previous grade level test successfully before being tested to the next grade level.

11.3 *Weathering-Corrosion Environment Test:*

11.3.1 *Procedure*—Three padlocks are exposed to sequential cycles of salt spray (see 11.1.3) and condensation-ultra violet radiation (Practice G154). At the conclusion of the condensation-ultra violet radiation phase of the test, the padlocks are unlocked and relocked to check operation.

11.3.2 See Table 4 for number of exposure hours for a specific grade.

11.3.3 Failure of any lock to unlock and relock within 1 min indicates failure.

11.3.4 The padlocks must pass the previous grade level test successfully before being tested to the next grade level.

11.4 *Wet Freezing Environment Test* (see Table 4)*:*

11.4.1 *Procedure*—Three padlocks are exposed to wet freezing conditions at three low temperatures.

11.4.2 Tap water application must be by subjecting padlocks to spray for 1 min from 18 in. with the device shown in Fig. 6. Spray rate is to be 2 gal/min. Drain the padlocks for 2 min. Maintain an upright position throughout.

11.4.3 Freezing is to follow the outline in Table 4. The temperature within the cold chamber must be at the temperature required for the grade being tested. The padlock must remain within the chamber until the test specimen has reached the same temperature.

11.4.4 Failure of any lock to unlock and relock within 1 min after test exposure constitutes the failure at that temperature.

11.4.5 The padlocks must pass the previous grade level test successfully before being tested to the next grade level.

12. Acceptance Criteria

12.1 A failure of any one padlock in the forcing or cycle tests constitutes a failure of the complete test. See Section 9 for acceptance criteria for surreptitious entry tests.

12.2 Successfully passing the Salt Spray Test (Option E) and Environmental Tests (Option G), or both, for any one model constitutes acceptance for all sizes in the model tested, providing the materials used for all sizes are the same.

12.3 Padlocks shall meet all the required values set forth in Tables 1-4 as applicable in order to qualify for the applicable grade level of 1 through 6.

12.4 Users may want padlocks exceeding the required criteria of one or more of the tests in a given grade level. Manufacturers may identify the grade level and levels of performance exceeding the requirements for that class (see Appendix X1).

13. Precision and Bias

13.1 Where dimensions and weights are described for various test apparatus and no maximums or minimums are given, a combined bias of ±2 % is permitted.

14. Keywords

14.1 cutting shackle; padlock impact; padlock testing; salt UV testing; shackle wedge

APPENDIX

(Nonmandatory Information)

X1. USERS GUIDE

X1.1 Padlock Class Rating

X1.1.1 Padlocks meeting all the requirements of one of the Grades 1 through 6 shall be so rated.

X1.1.2 A padlock complying with one of the grades may exceed the requirements for that grade in the surreptitious entry test category or the forcing test category.

X1.1.3 A rating beyond 1 through 6 may be used by some manufacturers. For example, a padlock designated as Grade 3 may also have the parenthetical designation (F5S3). This would mean the padlock met the requirements for forcing test of Grade 5. Users of padlocks not overly concerned with surreptitious entry attack but wanting relatively high resistance to forcing would find such a padlock more useful than one rated Grade 3.

X1.1.4 The environmental tests listed in Table 4 are optional tests to be specified as needed by users of this standard. Taking into account the manner of padlock class rating as explained in X1.1.1 – X1.1.3, combining requirements of forcing tests, surreptitious entry tests and environmental tests in varying grade levels for each category can result in specifying padlocks that do not exist. If the product desired is not readily related to a known padlock, individual manufacturers should be consulted.

X1.2 Options

X1.2.1 Under the function description, several optional features are described, including one for corrosion resistant criteria for padlocks used in an exterior or corrosive environment, one for nonferrous shackles used in situations where it is desirable for the shackle to be easily severed, one for those wishing a removable core feature, and others.

X1.2.2 These should be specified by indicating the function required with optional feature(s) desired. For example: “Provide function P01 with options B, E and F.”

X1.3 Chains

X1.3.1 If chains attached to the padlock are required, they must be so specified.

X1.4 Keys

X1.4.1 Two keys are customarily furnished with each padlock. If more or less are required, they must be so specified.

X1.5 Hasps

X1.5.1 Hasps are not addressed in this standard. The strength and fastening system of a hasp must be compatible with the grade of padlock in order to maintain the integrity of the locking system.

X1.6 Sizes

X1.6.1 Padlocks are generally sized according to the width of the case. As this width increases, the diameter of the shackle and the vertical and horizontal clearance between the shackle and the case increases. As the diameter of the shackle gets larger, its resistance to cutting attack because of greater mass becomes higher. Consequently, the same series of padlocks may have a low grade rating in a small size and an increasingly higher rating in subsequently larger sizes.

X1.7 Safe Key or Combination Changes

X1.7.1 Safe key or combination changes (those that do not interchange) are not unlimited and vary according to the number of tumblers in a cylinder or a combination mechanism. While this is not a function of the security of a single lock

under this Standard, it becomes important in a system incorporating many locks which have different keys or combinations for each lock. Anyone using this standard for procurement purposes must specify the number of safe changes required.

X1.7.2 Unless unique methods are used which are generally proprietary, any simple 6 pin master keyed system is limited to approximately 4000 safe key changes. If a relatively high security system is wanted and the system is still to be master keyed, safe changes are reduced to about 1000. If a 4 or 5 pin tumbler system is used, the safe key changes are again substantially reduced.

X1.7.3 No master key at all is best for achieving the goal of higher security, but may be inappropriate for efficient administration of the system.

X1.7.4 If requirements appear to be complex, individual specialists or manufacturers should be consulted.

X1.8 Tests

X1.8.1 The forcing tests included in this standard were devised so as to be accurately repeatable in a laboratory environment. The nature of the forces and loads imposed are intended to encourage the production of a padlock which will withstand a balanced variety of attacks. Criteria selected is based on guarding against known attack methods employed with the greatest frequency. Users of this standard with special needs may wish to impose additional cutting or forcing tests.