



## Standard Specification for Rescue Carabiners<sup>1</sup>

This standard is issued under the fixed designation F 1956; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This specification covers six mechanical tests, one corrosion resistance test, and the minimum performance requirements for these tests. This specification applies to carabiners designed specifically for use by rescue personnel during both training exercises and actual rescue operations. This specification does not apply to recreational use carabiners.

1.2 Two different types of carabiners are defined in this specification, a heavy-duty rescue carabiner and a light-duty rescue carabiner.

1.3 The values stated in SI units are to be regarded as the standard.

1.4 Tests contained herein are destructive in nature. Carabiners subjected to any of these tests shall not be used in any way after testing except in evaluation the results of such testing.

1.5 This specification does not imply approval of any method of use of rescue carabiners. In addition, the tests described are laboratory tests and do not duplicate field conditions. Furthermore, the test load values contained herein are not to be interpreted as the forces which a rescue carabiner may be subjected to, or may be expected to sustain, in actual field use.

1.6 This standard may involve hazardous materials, operations, and equipment. *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:

B 117 Practice for Operating Salt Spray (Fog) Apparatus<sup>2</sup>

E 4 Practices for Force Verification of Testing Machines<sup>3</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *carabiner*—a load-bearing, connective device with a self-closing gate.

3.1.2 *heavy-duty rescue carabiner*—a carabiner that meets the specifications for a heavy-duty rescue carabiner as defined in Section 8.

3.1.3 *light-duty rescue carabiner*—a carabiner that meets the specifications for a light-duty rescue carabiner as defined in Section 8.

3.1.4 *locking carabiner*—a carabiner with a locking mechanism which reduces the possibility of a gate being opened inadvertently. A locking mechanism requires at least two different consecutive manual actions to open the gate (see appendix).

3.1.5 *non-locking carabiner*—any carabiner that does not have a locking mechanism that reduces the possibility of a gate being opened inadvertently.

3.1.6 *rescue carabiner*—a carabiner intended for life support in rescue systems. It may be classified as heavy-type or light duty.

3.1.7 *ultimate strength*—the maximum force sustained by a carabiner during an ultimate force test, prior to failure.

3.1.7.1 *failure*—the point at which some part of the carabiner physically breaks or distorts to an extent that the test members are released.

### 4. Significance and Use

4.1 *Gate Function Load Test*—This test verifies that the gate can be opened (with the gate locking mechanism in the unlocked position) and that the gate can not be opened (with the gate locking mechanism in the locked position) while loaded with Function Test Force #1 along the major axis.

4.2 *Gate Locking Mechanism Function Load Test*—This test verifies that the gate locking mechanism can be unlocked, after Function Test Force #2 has been applied along the major axis and released.

4.3 *Major Axis Gate Closed Function Load Test*—This test verifies that the gate functions as originally intended, after Function Test Force #3 has been applied and released.

4.4 *Major Axis Gate Closed Ultimate Strength Test*—This test is intended to show the ultimate strength of the carabiner in the major axis with the gate closed.

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<sup>2</sup> Annual Book of ASTM Standards, Vol. 03.02.

<sup>3</sup> Annual Book of ASTM Standards, Vol. 03.01.

**4.5 Major Axis Gate Open Ultimate Strength Test**—This test is intended to show the ultimate strength of the carabiner in the major axis with the gate open.

**4.6 Minor Axis Gate Closed Ultimate Strength Test**—This test is intended to show the ultimate strength of the carabiner in the minor axis with the gate closed.

**4.7 Corrosion Test**—This test is intended to verify that the carabiner is produced from a corrosion-resistant material, or adequately covered with a protective coating.

## 5. Apparatus and Conditions

**5.1 Tensile Test Machine**—The tension testing machine shall be maintained in good operation condition, used only in the proper loading range, and calibrated periodically in accordance with the latest revision of Practices E 4.

### 5.2 Test Fixtures and Supplies:

**5.2.1** There are four test pins required, two test pins with  $6 \pm 0.05$ -mm radii and two test pins with  $5 \pm 0.05$ -mm radii. Test pins must be AISI SAE Type 01 Tool Steel (commonly purchased as 01 Drill Rod) heat treated to a minimum Rockwell hardness, C scale 60. The mean surface roughness,  $R_a$  must not exceed  $0.8 \mu\text{m}$  and the peak to valley height,  $R_{\text{max}}$ , must not exceed  $6.3 \mu\text{m}$ . The fixture must be designed to prevent the test pins from rotating and so that the carabiner is free to locate itself on the test pins when force is applied. See Figs. 1 and 2.

**NOTE 1**—Test pin cross section is not required to be round. Any cross section necessary to prevent test pin failure or any design to prevent test pin rotation is acceptable, as long as the contact point (between test pin and carabiner) of the test pin has the specified radius, material type, hardness, and surface roughness.

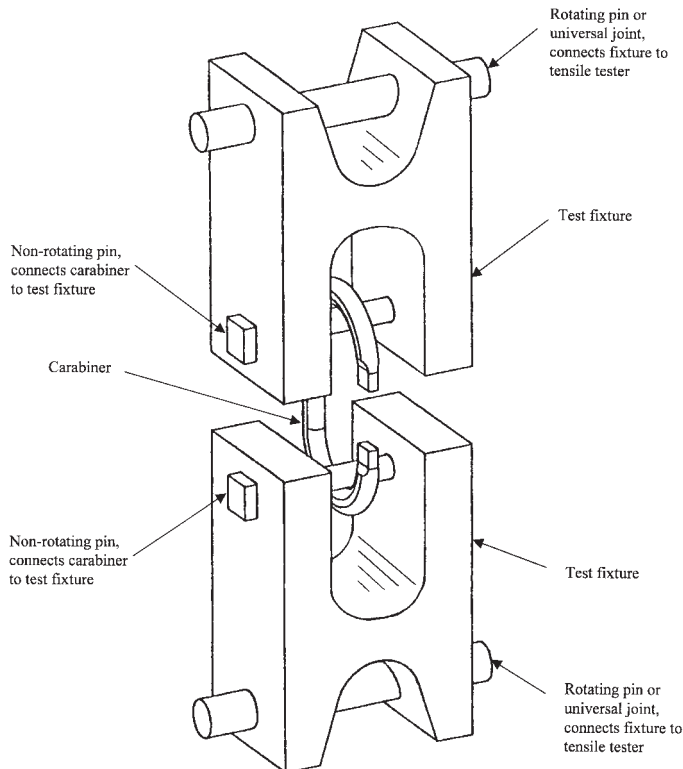


FIG. 1 Major Axis Test Setup

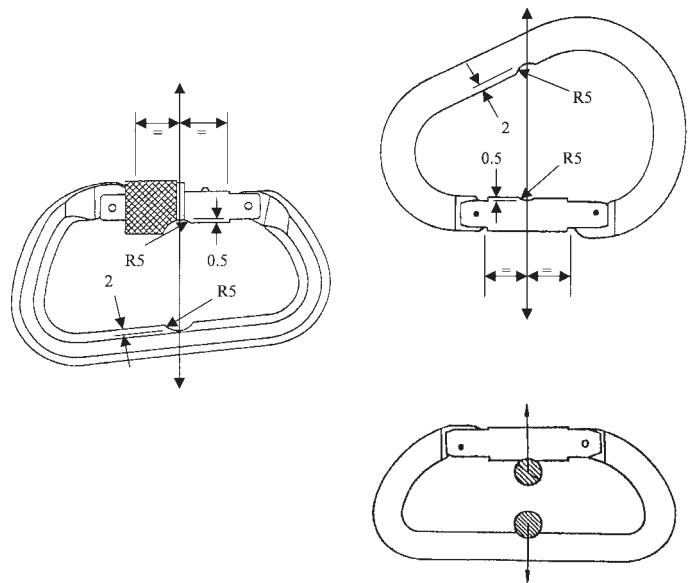


FIG. 2 Test Fixture

### 5.2.2 Molybdenum-Based Grease.

### 5.3 Test Conditions:

**5.3.1** The ambient temperature, test samples, test fixture, and supplies shall be between  $15$  and  $23^\circ\text{C}$  ( $59$  and  $73^\circ\text{F}$ ).

**5.3.2** All six mechanical tests must be conducted with the force applied parallel to the gravitational pull of the earth.

## 6. Hazards

Carabiners may disengage or eject parts from the test fixture. Use a safety screen and wear safety glasses while testing. Do not perform these tests alone.

## 7. Sampling

**7.1 Sample Selection**—Randomly select the carabiners in accordance with 7.2.2. Each user of this test method may specify the lot size from which the carabiners are to be selected.

### 7.2 Number of Samples:

**7.2.1** The same number of carabiners must be used for each of the tests in this specification.

**7.2.2** A minimum of five carabiners will be used, in sequence, for the Gate Function Load Test, Gate Locking Mechanism Function Load Test, Major Axis Gate Closed Function Load Test, and Major Axis Gate Closed Ultimate Strength Test. A minimum of five carabiners will be used for the Major Axis Gate Open Ultimate Strength Test. A minimum of five carabiners will be used for the Minor Axis Gate Closed Ultimate Strength Test. A minimum of five carabiners will be used for the Corrosion Test.

**7.2.3** Label the randomly selected carabiners 1 through X (X being the total number of carabiners selected).

## 8. Performance Specifications

### 8.1 Gate Function Load Test:

**8.1.1** With the gate locking mechanism in the unlocked position and Function Test Force #1 applied along the major axis, each carabiner gate shall open and close as designed and

with the same quality and performance as before the test. The use of tools or any device other than finger pressure is not allowed.

8.1.2 With the gate locking mechanism in the locked position and Function Test Force #1 applied along the major axis, the gate must not open. (The use of tools or any device other than finger pressure is not allowed.)

8.2 *Gate Locking Mechanism Function Load Test*—When a locking carabiner’s gate locking mechanism is advanced to its fully locked position, while the Function Test Force #2 is applied along the major axis. The gate locking mechanism must be able to be returned to its unlocked position after the force is removed. (The use of tools or any device other than finger pressure is not allowed.)

8.3 *Major Axis Gate Closed Function Load Test*—Each of the carabiners subjected to Function Test Force #3 shall show no evidence of distortion that impairs the designed function after the test is conducted.

8.4 *Major Axis Gate Closed Ultimate Strength Test*—Each of the carabiners subjected to this test shall have an ultimate strength equal to or greater than the major axis gate closed minimum ultimate strength listed in Table 1.

8.5 *Major Axis Gate Open Ultimate Strength Test*—Each of the carabiners subjected to this test shall have an ultimate strength equal to or greater than the major axis gate open minimum ultimate strength listed in Table 1.

8.6 *Minor Axis Gate Closed Ultimate Strength*—Each of the carabiners subjected to this test shall have an ultimate strength equal to or greater than the minor axis gate closed minimum ultimate strength listed in Table 1

8.7 *Corrosion Test*—Each of the carabiners subjected to the corrosion test shall not have more than light-surface corrosion following the test. In addition, each carabiner gate shall open and close with the same quality and performance as before the test. (The use of tools or any device other than finger pressure is not allowed.) Furthermore, each gate locking mechanism must be able to move through its full range of travel with the same quality and performance as before the test. (The use of tools or any device other than finger pressure is not allowed.)

## 9. Procedure

### 9.1 *Gate Function Load Test:*

9.1.1 Open and close the gate and gate locking mechanism to feel the action of each carabiner prior to conducting this test. Record any interferences in the report.

9.1.2 Apply molybdenum-based grease to the test pins at the point of contact between the test pins and the carabiner.

9.1.3 Unlock the gate locking mechanism and position the carabiner on the 6-mm radius test pins, as shown in Fig. 1. Position the spine of the carabiner against the test pins.

9.1.4 Load the carabiner along the major axis at a rate of  $5 \pm 1$  mm/min until Function Test Force #1 is reached.

9.1.5 While maintaining the force, open and close the gate and check that the gate functions as it did prior to the application of Test Force #1 (The use of tools or any device other than finger pressure is not allowed). Record whether the gate opens or close, or both, and the actual test force applied to the carabiner in the report.

9.1.6 While maintaining the force, lock the gate locking mechanism. (The use of tools or any device other than finger pressure is not allowed.) Verify that with the gate locking mechanism in the locked position, the gate does not open. (The use of tools or any device other than finger pressure is not allowed.) Record whether the gate opens in the report.

9.1.7 Release the test force at a rate of 120 mm/min maximum, as necessary, so as not to cause shock loading on the carabiner.

### 9.2 *Gate Locking Mechanism Function Load Test:*

9.2.1 Using the same carabiners as used in 9.1. Apply molybdenum-based grease to the test pins at the point of contact between the test pins and the carabiner.

9.2.2 Unlock the gate locking mechanism and position the carabiner on the 6-mm radius test pins, as shown in Fig. 1. Position the spine of the carabiner against the test pins.

9.2.3 Load the carabiner along the major axis at a rate of  $10 \pm 5$  mm/min until Function Test Force #2 is reached.

9.2.4 While maintaining the force, lock the gate mechanism. (The use of tools or any device other than finger pressure is not allowed.) Record the actual test force applied to the carabiner in the report.

9.2.5 Release the test force at a rate of 120 mm/min, maximum, as necessary, so as not to cause shock loading on the carabiner.

9.2.6 Unlock the gate locking mechanism. (The use of tools or any device other than finger pressure is not allowed.) Record whether the gate locking mechanism can be returned to its unlocked position in the report.

### 9.3 *Major Axis Gate Closed Function Load Test:*

9.3.1 Using the same carabiners as used in 9.1 and 9.2, apply molybdenum-based grease to the test pins at the point of contact between the test pins and the carabiner.

9.3.2 Unlock the gate locking mechanism and position the carabiner on the 6-mm radius test pins, as shown in Fig. 1. Position the spine of the carabiner against the test pins.

**TABLE 1 Function Test Forces and Minimum Ultimate Strengths**

| Carabiner Type              | Function Test Forces <sup>A</sup> |                     |                     | Minimum Ultimate Strength |                          |                          |
|-----------------------------|-----------------------------------|---------------------|---------------------|---------------------------|--------------------------|--------------------------|
|                             | #1                                | #2                  | #3                  | Major Axis Gate Closed    | Major Axis Gate Open     | Minor Axis Gate Closed   |
| Heavy-Duty Rescue carabiner | 1.33 kN (300 lbf)                 | 10.68 kN (2400 lbf) | 26.69 kN (6000 lbf) | 40.03 kN (9000 lbf), min  | 10.68 kN (2400 lbf), min | 10.68 kN (2400 lbf), min |
| Light-Duty rescue carabiner | 0.8 kN (180 lbf)                  | 7 kN (1575 lbf)     | 14 kN (3145 lbf)    | 20 kN (4495 lbf), min     | 7 kN (1575 lbf), min     | 7 kN (1575 lbf), min     |

<sup>A</sup> $\pm 5$  %.



9.3.3 Load the carabiner along the major axis at a rate of  $20 \pm 5$  mm/min until Function Test Force #3 is reached.

9.3.4 Release the test force at a rate of 120 mm/min, maximum, as necessary, so as not to cause shock loading on the carabiner.

9.3.5 Open and close the gate and check the carabiner for evidence of distortion that impairs the designed function. Record whether the gate functions and also note any distortion to the carabiner that impairs the designed function in the report.

**9.4 Major Axis Gate Closed Ultimate Strength Test:**

9.4.1 Using the same carabiners as used in 9.1, 9.2, and 9.3 apply molybdenum-based grease to the test pins at the point of contact between the test pins and the carabiner.

9.4.2 Lock the gate locking mechanism and position the carabiner on the 6-mm radius test pins, as shown in Fig. 1. Position the spine of the carabiner against the test pins.

9.4.3 Load the carabiner along the major axis at a rate of  $30 \pm 5$  mm/min until failure.

9.4.4 On the test report, record the maximum force sustained.

**9.5 Major Axis Gate Open Ultimate Strength Test:**

9.5.1 Secure the gate in the open position.

9.5.2 Apply molybdenum-based grease to the test pins at the point of contact between the test pins and the carabiner.

9.5.3 Position the carabiner on the 6-mm radius test pins, as shown in Fig. 1. Position the spine of the carabiner against the test pins.

9.5.4 Load the carabiner along the major axis at a rate of  $30 \pm 5$  mm/min until failure.

9.5.5 On the test report, record the maximum force sustained.

**9.6 Minor Axis Gate Closed Ultimate Strength Test:**

9.6.1 Apply molybdenum-based grease to the test pins at the point of contact between the test pins and the carabiner.

9.6.2 Position the carabiner on the 5-mm radius test pins as shown in Fig. 2. Verify that the gate locking mechanism is in the locked position. In order to avoid movement of the carabiner with respect to the test pins, machine notches in the body and the gate as shown in Fig. 2. If the internal clearance between the gate and the spine does not accommodate two 5-mm radius test pins, modify the pins so that they can be positioned as shown in Fig. 2.

9.6.3 Load the carabiner along the minor axis at a rate of  $30 \pm 5$  mm/min until failure.

9.6.4 On the test report, record the maximum force sustained.

**9.7 Corrosion Test:**

9.7.1 Verify that the gate locking mechanism is in the locked position. Conduct a 50-h salt spray test in accordance with Practice B 117.

9.7.2 After the test, visually inspect the carabiner for signs of corrosion. Open and close the gate and check that the gate functions as it did prior to the salt spray test. Move the gate locking mechanism from its locked position to its fully unlocked position and check that the gate locking mechanism functions as it did prior to the salt spray test.

9.7.3 Record whether there is light surface-type corrosion, whether the gate functions as it did prior to the salt spray test, and whether the gate locking mechanism functions as it did prior to the salt spray test in the report.

## 10. Certification

10.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing the purchased lot have met the requirements of this specification. Certifications may be written by the contracted laboratory or the company who manufactured the carabiners. When specified in the purchase order or contract, a report of the test results shall be furnished.

## 11. Report

11.1 Report the following information:

11.1.1 Name of the laboratory or agency that performed the mechanical test.

11.1.2 Date of testing.

11.1.3 Manufacturer or brand and model of carabiners tested.

11.1.4 Information required by Practices E 4 for test machine.

11.1.5 Name of test administrator

11.1.6 Identification of lot and size of lot tested.

**11.2 Results of Gate Function Load Test:**

11.2.1 Actual function test force applied.

11.2.2 Gate opens / gate does not open.

11.2.3 Gate closes / gate does not close.

11.2.4 With gate locking mechanism locked, gate opens / gate does not open.

**11.3 Results of Gate Locking Mechanism Load Test:**

11.3.1 Actual function test force applied.

11.3.2 Gate locking mechanism can / can not be moved to the unlocked position.

**11.4 Results of Major Axis Gate Closed Function Load Test:**

11.4.1 Actual function test force applied.

11.4.2 Gate opens / gate does not open.

11.4.3 Distortion to carabiner that impairs designed function.

**11.5 Major Axis Gate Closed Ultimate Strength Test:**

11.5.1 Maximum force sustained.

**11.6 Major Axis Gate Open Ultimate Strength Test:**

11.6.1 Maximum force sustained.

**11.7 Minor Axis Gate Closed Ultimate Strength Test:**

11.7.1 Maximum force sustained.

**11.8 Corrosion Test:**

11.8.1 Light surface-type corrosion.

11.8.2 Gate opens/closes.

11.8.3 Gate locking mechanism moves through its full range of travel.

## 12. Precision and Bias

12.1 It is not practical to specify the precision of the procedure in this specification for measuring the ultimate strengths of carabiners because insufficient laboratory or inter-laboratory test data exists at this time.

**APPENDIXES****(Nonmandatory Information)****X1. RESPONSIBILITY FOR QUALITY ASSURANCE**

X1.1 Quality assurance is solely the responsibility of the manufacturer and is not addressed by this specification.

**X2. GATE LOCKING MECHANISM**

X2.1 A locking mechanism requires at least two different consecutive manual actions open the carabiner gate. One manual action to release the gate locking mechanism and one different manual action to open the carabiner gate.

**X3. HEAVY-DUTY AND LIGHT-DUTY CARABINERS**

X3.1 All mechanical tests, the corrosion test, performance requirements, and procedures contained in this specification apply to heavy-duty and light-duty carabiners. Users of this specification must specify which type of carabiner is being submitted before testing begins.

**X4. LOCKING AND NON-LOCKING CARABINERS**

X4.1 For simplification this specification has been written in the context for testing of locking carabiners. However, this specification can be used for non-locking carabiners as well. For testing of non-locking carabiners, disregard all test procedures and performance specifications which require a gate locking mechanism.

**X5. UNANTICIPATED FAILURE**

X5.1 If any of the carabiners used in the sequence testing for 9.1-9.3, or 9.4 fail prior to completion of all four tests. It is up to the discretion of the user of this specification as to whether they want to continue testing.

**X6. CORROSION TEST**

X6.1 Practice B 117 was chosen as the standard test method for corrosion, because it is an established, widely used, accepted, and repeatable test. It is applicable to the testing of ferrous and nonferrous metals and is also used to test inorganic and organic coatings, especially where the tests are the basis for material or product specifications.

X6.2 The 50-h time duration for Practice B 117 was adopted from NFPA 1983 and has been used for a number of years. Representative hardware samples, which have been tested in accordance with Practice B 117 for 50 h, have proven to be adequately coated for severe field service applications.

**X7. PARTS OF A CARABINER**

X7.1 See Fig. X7.1.



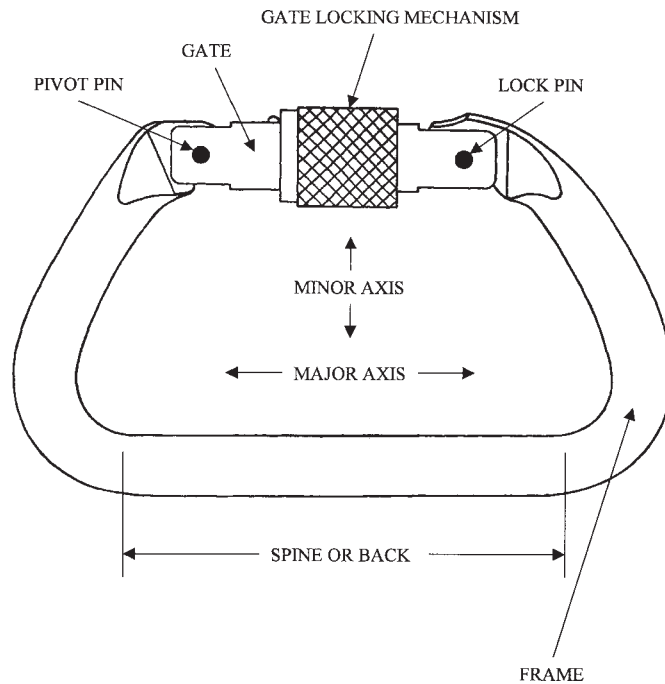


FIG. X7.1 Parts of a Carabiner

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