



Standard Specification for Climbing and Mountaineering Carabiners¹

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1. Scope

1.1 This specification covers six mechanical tests and the minimum performance requirements for carabiners designed specifically for the sports of climbing and mountaineering.

1.2 Two different types of carabiners are defined in this standard, non-locking carabiners and locking carabiners.

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 evaluating the results of such testing.

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

1.6 This specification is limited to carabiners made of steel or aluminum alloys only.

2. Referenced Documents

2.1 ASTM Standards:

- E 4 Practices for Load Verification of Testing Machines²
- F 1772 Terminology Relating to Climbing and Mountaineering Practices³
- F 1775 Specification for Labeling of Climbing and Mountaineering Equipment³

2.2 Other Standard:

- EN 566:1994 Slings [preliminary]

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *carabiner, n*—a self-closing gated, load-bearing, connective device. Some carabiner models may have *cocking* or *blocking* devices, that when activated, override the self-closing features.

3.1.2 *failure, n*—an arbitrary point beyond which a material or product ceases to be functionally capable of its intended use. In this application, the point at which some part of the carabiner physically breaks or distorts to an extent that the test members are released.

3.1.3 *locking carabiner, n*—a carabiner with a mechanism that reduces the possibility of a gate being opened inadvertently. A locking mechanism requires at least two different consecutive manual actions to open the gate.

3.1.4 *nonlocking carabiner, n*—any carabiner that does not have a mechanism that reduces the possibility of a gate being opened inadvertently.

3.1.5 *normal body weight, n*—a standardized weight that represents a *typical* climber, defined as Function Test Force No. 1.

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

4. Significance and Use

4.1 *Gate Function During Body Weight Test*—This test simulates a climber's body weight of Function Test Force No. 1 and verifies that the gate functions as intended under body weight force.

4.2 *Major Axis Gate Closed 70 % Force Test*—This test verifies that the gate functions as originally intended after Function Test Force No. 2 has been applied and released.

4.3 *Locking Mechanism Test*—This test verifies that the locking mechanism keeps the gate in the locked position between forces of 0 kN and Function Force Test No. 3.

4.4 *Major Axis Gate Closed Ultimate Strength Test*—This test is intended to show the force required to physically fail the carabiner.

4.5 *Major Axis Gate Open Ultimate Strength Test*—This test simulates a potential inadvertent use of a carabiner. It is intended to show the force required to physically fail the carabiner.

4.6 *Minor Axis Gate Closed Ultimate Strength Test*—This test simulates a potential inadvertent use of a carabiner. It is intended to show the force required to fail physically the carabiner along the minor axis.

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² *Annual Book of ASTM Standards*, Vol 03.02.

³ *Annual Book of ASTM Standards*, Vol 15.07.

5. Responsibility for Quality Assurance

5.1 Quality control is solely the responsibility of the manufacturer or purchaser, or both, and is not addressed by this specification.

6. Apparatus and Condition

6.1 *Tensile Tester*, capable of calibration in accordance with Practices E 4 to the ultimate strength of all carabiners tested.

6.2 *Test Fixtures and Supplies:*

6.2.1 There are four total test pins required, two pins with 6 ± 0.05 -mm radius and two pins with 5 ± 0.05 -mm radius. Pins must be alloy steel and heat-treated to 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_{max} , must not exceed $6.3 \mu\text{m}$. The fixture should be designed in such a way that the pins do not rotate and that the carabiner is free to locate itself on the pins when the force is applied. See Figs. 1 and 2.

6.2.2 *Molybdenum-Based Grease.*

6.3 *Test Conditions*—The ambient temperature shall be between 15 and 23°C.

7. Hazards

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

8. Sampling

8.1 *Number of Tests*—The number of samples for testing will be specified by the manufacturer’s quality assurance program. A minimum of five will be used, in sequence, for the gate function during body weight, major axis gate closed 70 %, and major axis gate closed ultimate strength tests. A minimum of five will be used for the major axis gage open ultimate strength test. A minimum of five will be used for the minor axis gate closed ultimate strength test.

9. Performance Specifications

9.1 *Gate Function During Body Weight Test:*

9.1.1 Function Test Force No. 1 will be used for this test. Each of the carabiners subjected to the body weight test shall show no evidence of distortion that impairs the designed function.

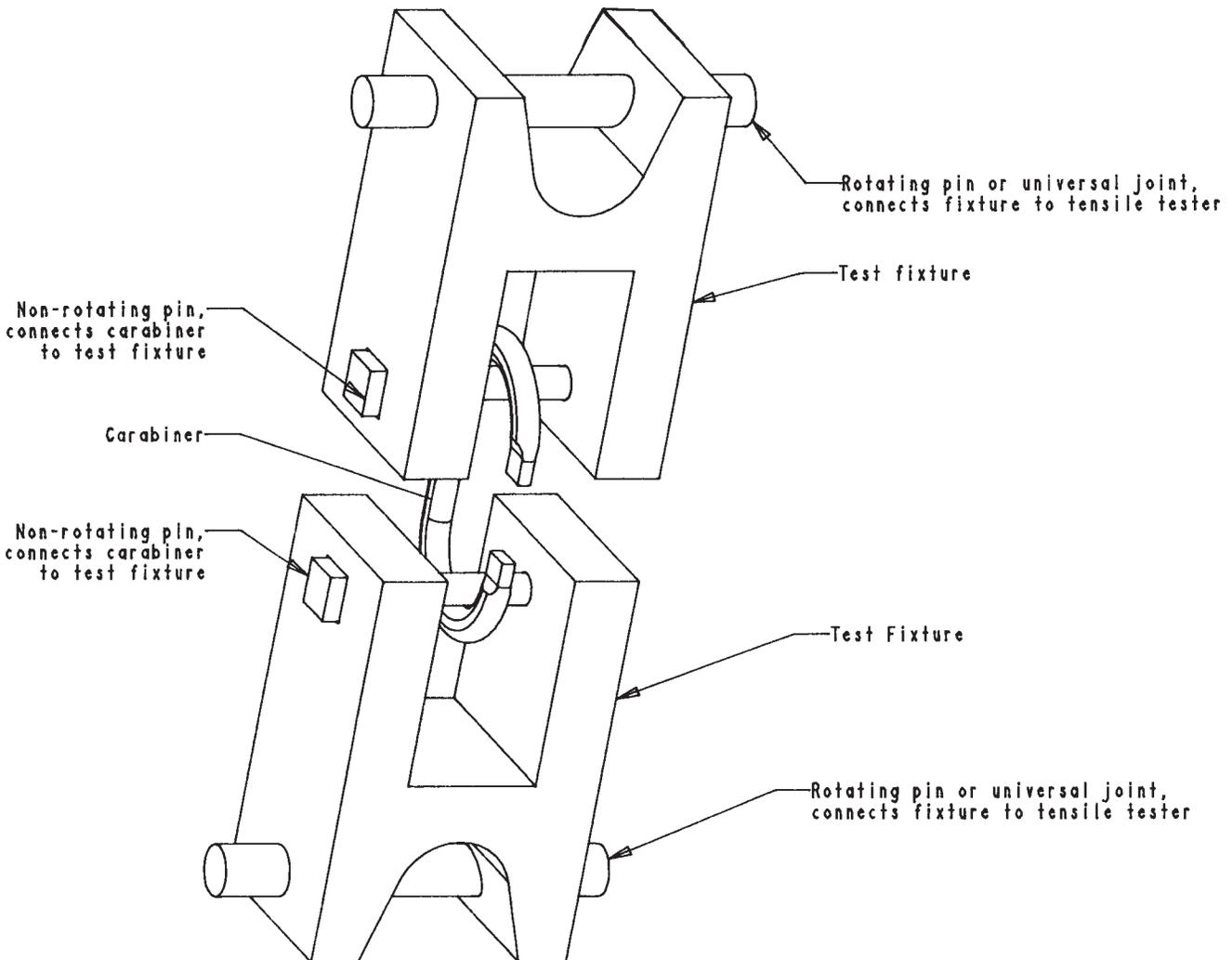
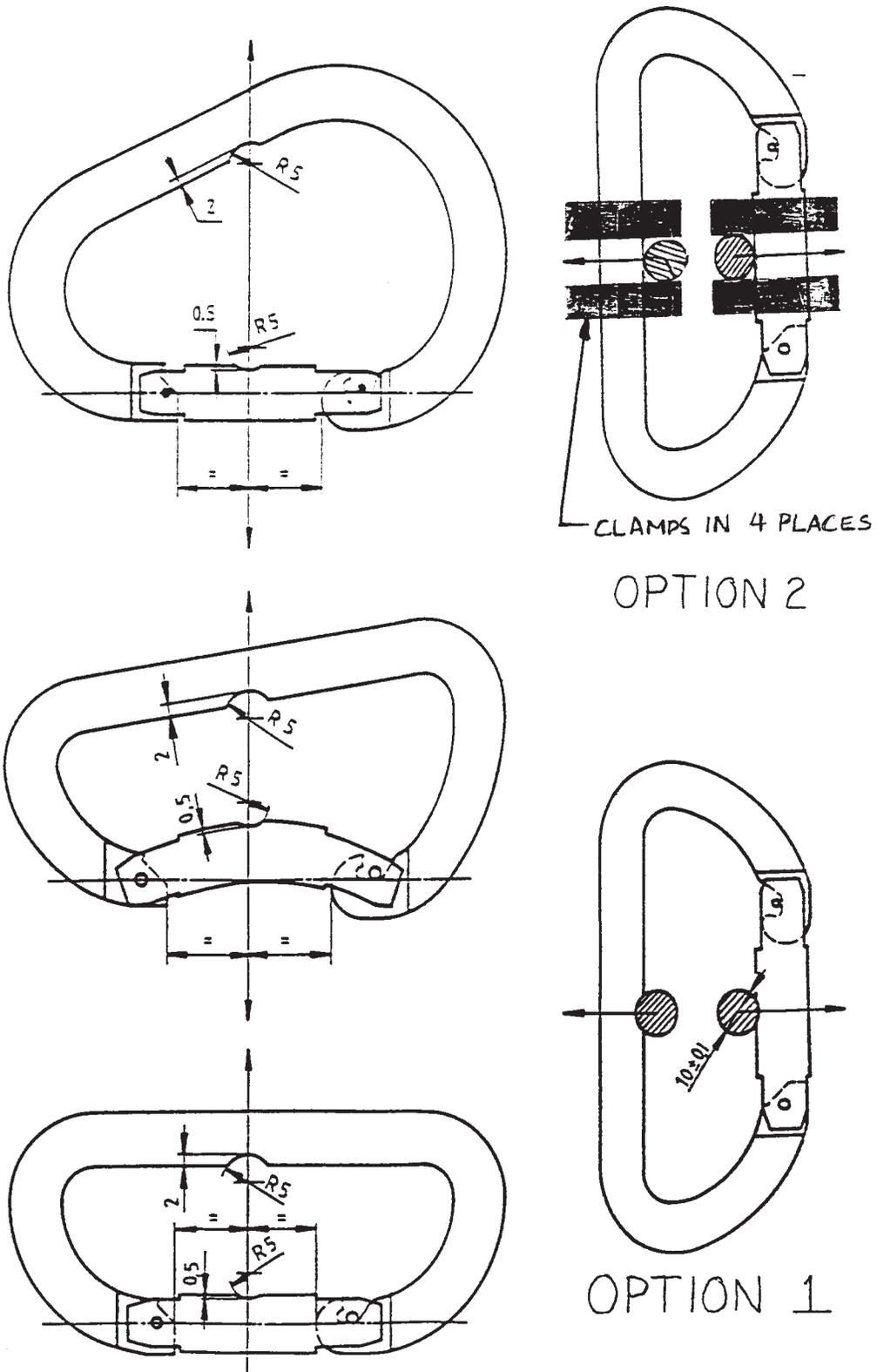


FIG. 1 Major Axis Test Set-Up



NOTE—Dimensions in millimetres.
FIG. 2 Minor Axis Tests

9.1.2 While the body weight force is applied, the carabiner gate shall open and close as designed and with the same quality and performance as before the test.

9.1.3 When a locking carabiner is locked while the body weight force is applied, the locking mechanism must be able to be rotated to its unlocked position by hand after the force is removed.

9.2 *Major Axis Gate Closed 70 Force Test*—Function Test Force No. 2 will be used for this test. Each of the carabiners subjected to the 70 % force test shall show no evidence of distortion that impairs the designed function after the test is conducted. The locking mechanism of a locking carabiner shall open and close as originally intended and with the same quality and performance as before the test.

9.3 *Locking Mechanism Test*—Function Test Force No. 3 will be used for this test. With the locking mechanism in the locked position and an inward force of 50 N applied to the center of the gate, the gate must not open as Function Test Force No. 3 is applied to the major axis of the carabiner. When the load is released, the gate and locking mechanism must be fully functional.

9.4 *Major Axis Gate Closed Ultimate Strength Test:*

9.4.1 Each of the nonlocking carabiners subjected to this test shall have an ultimate strength equal to or greater than the major axis gate closed minimum ultimate strength for nonlocking carabiners listed in Table 1.

9.4.2 Each of the locking carabiners subjected to this test shall have an ultimate strength equal to or greater than the major axis gate closed minimum ultimate strength for locking carabiners listed in Table 1.

9.5 *Major Axis Gate Open Ultimate Strength Test:*

9.5.1 Each of the nonlocking carabiners subjected to this test shall have an ultimate strength equal to or greater than the major axis gate open minimum ultimate strength for nonlocking carabiners listed in Table 1.

9.5.2 Each of the locking carabiners subjected to this test shall have an ultimate strength equal to or greater than the major axis gate open minimum ultimate strength for locking carabiners listed in Table 1.

9.6 *Minor Axis Gate Closed Ultimate Strength Test:*

9.6.1 Each of the nonlocking carabiners subjected to this test shall have an ultimate strength equal to or greater than the minor axis gate closed minimum ultimate strength for nonlocking carabiners listed in Table 1.

9.6.2 Each of the locking carabiners subjected to this test shall have an ultimate strength equal to or greater than the minor axis gate closed minimum ultimate strength for locking carabiners listed in Table 1.

TABLE 1 Function Test Forces and Minimum Ultimate Strengths^A

Carabiner Type	Function Test Forces			Minimum Ultimate Strength		
	No. 1	No. 2	No. 3	Major Axis Gate Closed	Major Axis Gate Open	Minor Axis Gate Closed
Nonlocking carabiner	0.8 kN	14 kN	7 kN	20 kN min	7 kN min	7 kN min
Locking carabiner	0.8 kN	14 kN	7 kN	20 kN min	7 kN min	7 kN min

^A See Appendix X1 for more information.

10. Procedure

10.1 *Gate Function During Body Weight Test:*

10.1.1 Grease the test pins where the carabiner comes in contact with the pins.

10.1.2 Position the carabiner on the 6-mm radius test pins as shown in Fig. 1. Position the test pins against the spine of the carabiner. If the carabiner has a captive sling that is intended to be loaded directly, apply the test force directly to the sling by one of the 5-mm radius test pins in accordance with prEN 566. If the carabiner has provision for a semicaptive sling, apply the test force to a short sling by one of the 5-mm radius test pins.

10.1.3 Load the carabiner to within 2 % of the Function Test Force No. 1, without going above it, at a rate of 10 ± 5 mm/min.

10.1.4 *Nonlocking Test*—While maintaining the force, open and close the gate and check that gate functions as originally intended. On the report, record whether gate opens or closes as intended and the actual tensile force applied.

10.1.5 *Locking Test*—While maintaining the force with the locking mechanism unlocked, open and close the gate and check that the gate functions as originally intended. On the report, record whether gate opens or closes as intended and the actual force applied. Engage the locking mechanism to its locked position by hand. Release the force.

10.1.6 For locking carabiners, release the locking mechanism by hand. On the test report, record whether the mechanism can or cannot be unlocked by hand.

10.2 *Major Axis Gate Closed 70 % Force Test:*

10.2.1 Perform the first two steps as described in 10.1.

10.2.2 Load the carabiner to within 2 % of the Function Test Force No. 2, without going above it, at a rate of 10 ± 5 mm/min.

10.2.3 Release the force on the carabiner.

10.2.4 Open and close the gate and check that the gate functions as originally intended.

10.2.5 On the report, record whether the gate opens or closes as intended and the actual force applied.

10.3 *Locking Mechanism Test:*

10.3.1 Perform the first two steps as described in 10.1.

10.3.2 Engage the locking mechanism to the locked position.

10.3.3 Apply a continuous force of 50 N towards the spine at the center of the gate.

10.3.4 Load the carabiner to within 2 % of the Function Test Force No. 3, without going above it, at a rate of 10 ± 5 mm/min.

10.3.5 Verify that the gate does not open from 0 to Function Test Force No. 3. Release the force.

10.3.6 When the load is released, the gate and locking mechanism must be fully functional.

10.3.7 On the report, record whether the gate opened or did not open. Record if the locking mechanism is fully functional or not fully functional.

10.4 *Major Axis Gate Closed Ultimate Strength Test:*

10.4.1 Perform the first two steps as described in 10.1.

10.4.2 Load the carabiner at a rate of 30 ± 5 mm/min, until failure.

10.4.3 Record the ultimate strength on the test report.

10.5 *Major Axis Gate Open Ultimate Strength Test:*

10.5.1 Perform the first two steps as described in 10.1.

10.5.2 Load the carabiner at a rate of 30 ± 5 mm/min with the gate latched open by suitable means, until failure.

10.5.3 Record the ultimate strength on the report.

10.6 *Minor Axis Gate Closed Ultimate Strength Test:*

10.6.1 Position the carabiner on the 5-mm radius test pins as shown in Fig. 2 (see Appendix X2 for further explanation). For locking carabiners, test the carabiners with the locking mechanism in the locked position. In order to avoid movement of the test pins during the test, use one of the two options. Option 1: Machine notches in the body and the gate as shown in Fig. 2. Option 2: Use clamps to position the test pins 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.

10.6.2 Load the carabiner at a rate of 30 ± 5 mm/min, until failure.

10.6.3 Record the ultimate strength on the report.

11. Product Marking

11.1 All identification markings of product shall be in accordance with Specification F 1775.

12. Certification

12.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been tested or inspected in this specification and the requirements of this specification have been met. When specified in the purchase order or contract, a report of the results shall be furnished.

13. Report

13.1 Report the following information:

13.1.1 Name of the laboratory or agency that performed the mechanical tests.

13.1.2 Date of testing.

13.1.3 Manufacture or brand and model of carabiners tested.

13.1.4 Information required by Practices E 4 for test machine.

13.1.5 Name of test administrator.

13.1.6 Identification of lot and size of lot tested.

13.2 *Results of Gate Function Under Body Weight Test:*

13.2.1 Actual force applied.

13.2.2 Gate opens/gate does not open.

13.2.3 Gate closes/gate does not close.

13.2.4 With locking mechanism locked: Gate opens/gate does not open.

13.2.5 Locking mechanism can/cannot be unlocked.

13.3 *Results of Major Axis Gate Closed 70 % Force Test:*

13.3.1 Actual force applied.

13.3.2 Gate opens/gate does not open.

13.3.3 Gate closes/gate does not close.

13.4 *Results of Locking Mechanism Test:*

13.4.1 Gate opened/did not open.

13.4.2 Locking mechanism fully or not fully functional.

13.5 *Major Axis Gate Closed Ultimate Strength Test:*

13.5.1 Ultimate Strength.

13.6 *Major Axis Gate Open Ultimate Strength Test:*

13.6.1 Ultimate Strength.

13.7 *Minor Axis Gate Closed Ultimate Strength Test:*

13.7.1 Ultimate Strength.

14. Precision and Bias

14.1 It is not practical to specify the precision of the procedure in this specification for measuring the ultimate strengths of carabiners because insufficient intralaboratory or interlaboratory test data exists at this time.

15. Keywords

15.1 carabiner; ice climbing; mountaineering; rock climbing

APPENDIXES

(Nonmandatory Information)

X1. HISTORY OF MOUNTAIN CLIMBING STANDARDS FORCE MINIMUMS

X1.1 The original dynamic rope standard was created around 1970. Among other specifications to meet UIAA standards, the rope must limit the maximum impact force on the first drop tower test to less than 12 kN. This maximum force amount was arrived at from studies for paratroopers. It was determined that the human body in a harness could sustain a 12-kN force of short duration without injury. The UIAA standard dynamic rope must limit the maximum impact force of a falling (80 kg) climber in a worst case leader fall to the same 12 kN. Therefore, the maximum force that can be passed

on to the climber in a very severe fall is 12 kN.

X1.2 The minimum value for carabiners is based on the same maximum impact force possible when using a mountaineering dynamic rope. If the climber exerts a force of up to 12 kN on the rope, the carabiner may see up to 2/3 again (1/3 is lost as friction in the carabiner) that amount of force when it is used at a directional anchor. Therefore, $(12 \text{ kN} + (2/3 \times 12 \text{ kN})) = 20 \text{ kN}$. This 20-kN force is the minimum allowed for UIAA lightweight carabiners.

X2. EXPLANATION OF MINOR AXIS LOAD APPLICATION POINTS

X2.1 For the Minor Axis Test, the load application point was chosen for the following reasons:

X2.1.1 Not all carabiners have gate pins to use as measurement points.

X2.1.2 The frame opening center is defined as the load application point because it is easily definable for differences between designs,

X2.1.3 It is repeatable between manufacturers.

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