



Standard Test Method for Verification of Ski Binding Test Devices¹

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1. Scope

1.1 This test method defines procedures to determine agreement between a standard apparatus for measuring the release moments of ski bindings and a test device of unspecified design.

1.2 This test method also covers procedures for checking agreement between individual devices of identical but unspecified design, intended for determining the release moments of ski bindings.

1.3 Values expressed in newton meters, newtons, and centimeters are to be regarded as the standard.

1.4 Values expressed in units of torque may be converted to the appropriate force values when devices which indicate force are used.

1.5 *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

- E4 Practices for Force Verification of Testing Machines
- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E74 Practice of Calibration of Force-Measuring Instruments for Verifying the Force Indication of Testing Machines
- E456 Terminology Relating to Quality and Statistics
- F504 Test Method for Measuring the Quasi-Static Release Moments of Alpine Ski Bindings
- F1061 Specification for Ski Binding Test Devices
- F1063 Practice for Functional Inspections and Adjustments of Alpine Ski/Binding/Boot Systems

¹ This test method is under the jurisdiction of ASTM Committee F27 on Snow Skiing and is the direct responsibility of Subcommittee F27.10 on Binding Test Procedures.

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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.

F1064 Practice for Sampling and Inspection of Complete and Incomplete Alpine Ski/Binding/Boot Systems in Rental Applications

3. Terminology

3.1 *Definitions*—The terms and abbreviations used in this document are defined in accordance with Test Method F504, Specification F1061, Terminology E456, Practices E4, and Practice E74.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *a*—difference between the calibration of the specific device tested for agreement with an instrument of the type described in Test Method F504 and the calibration of an individual device of the same design.

3.2.2 *d*—agreement between the test device and the standard apparatus described in Test Method F504 and Section 9 of this test method.

3.2.3 *r*—imprecision of the device tested.

3.2.4 *operating range (OR)*—the portion of the full range of the device which may be employed in accordance with Practices F1063 and F1064. OR shall be defined by the user in accordance with the Inspection section of Annex 2 of Practices F1063 and F1064.

3.2.5 *recommended operating range (ROR)*—the portion of the full range of the test device that is in accordance with Proposed Specification P 193.

3.2.6 *reference binding*—a binding or group of bindings used in the verification of a test device.

3.2.7 *standard apparatus*—laboratory equipment including a test frame and instrumentation used as the basis for comparison with the test device.

3.2.8 *test device*—a machine for determining the release moments of ski/boot/binding systems.

3.3 Symbols:

3.3.1 M_z —a moment in a horizontal plane as shown in the figure in Test Method F504, which illustrates terminology relating to the boot/ski system.

3.3.2 M_y —a moment in a vertical plane with the ski as shown in the figure in Test Method F504, which illustrates terminology relating to the boot/ski system.

4. Significance and Use

4.1 Results obtained by this test method can be used to determine the suitability of specific test device designs in measuring the release moments of ski/boot/binding systems.

4.2 This test method provides a means by which manufacturers of test devices and manufacturers of releasable ski bindings can provide compatible instructions to facilities which perform the final inspection of the complete boot/binding/ski system prior to use.

4.3 This test method is not appropriate for determining precision between operators.

5. Apparatus

5.1 *Test Ski*—The test ski shall meet the stiff ski definition in the portion of the Apparatus Section of Test Method **F504** pertaining to skis and bindings.

5.2 *Test Sole*—The test sole shall meet the requirements in the portion of the Apparatus Section of Test Method **F504** pertaining to boots, and shall be of a design compatible with the reference binding. The test sole may be modified to establish necessary interfaces with the standard apparatus and test device providing such modifications do not influence the proper function of the reference binding.

5.3 *Test Frame and Instrumentation:*

5.3.1 All apparatus shall meet the portions of the Apparatus Section of Test Method **F504** pertaining to cable, instrumentation, and load application.

5.3.2 Devices shall be employed to monitor cable tension. Differences of more than 5 % in cable tension at the attachment points with the ski may significantly bias results.

5.4 *Reference Binding*—The reference binding shall be of the type specified by the manufacturer of the test device.

6. Preparation of Apparatus

6.1 Mount the reference binding on the test ski and fit to the test sole in accordance with the specification of the binding manufacturer.

6.2 Lubricate all interfaces within the reference binding and all areas of sliding contact between test sole and binding with a compatible grease.

6.3 Calibrate the binding in tests 1.1 and 2.1 (and 2.2 if appropriate) of Test Method **F504**, using the standard apparatus.

6.3.1 The calibration of the reference binding shall be as specified by the test device manufacturer.

NOTE 1—Practices **E4** and Practice **E74** may be used as general guides in developing calibration procedures.

6.4 Condition the binding prior to each test series by causing the mechanism to release three times in the appropriate direction.

7. Conditioning

7.1 Unless the test device is to be used at other than normal room temperatures, conduct all tests at a temperature of $23 \pm 5^\circ\text{C}$ and a relative humidity of $50 \pm 5\%$. Do not vary

temperature over the course of the test by more than 2°C and humidity by more than 5 %.

8. Procedure

8.1 Perform five repetitions of the following procedure:

8.1.1 Using the standard apparatus, perform three repetitions of a test required for Type I, II, or III devices, and perform three repetitions of the analogous test on the test device.

8.1.1.1 Randomly select which series of three tests will be conducted first.

8.1.1.2 From the Table on Load Application of Test Method **F504**, use tests 1.1 and 1.2 for Type I devices, tests 2.1 and 2.2 (if appropriate) for Type II devices and tests as specified by the test device manufacturer for Type III devices.

8.1.1.3 Follow the test device manufacturer's instructions for conducting analogous tests.

8.2 Perform the procedure in **8.1-8.1.1.3** at the beginning, middle, and end of the ROR. If the reference binding cannot be adjusted for release over the full ROR, perform the test(s) at 10 or 90 % of the limit(s) of the reference binding as appropriate.

8.2.1 Immediately before and after each cycle of **8.1-8.1.1.3**, measure and record the calibration of the test device, in accordance with the method specified by the test device manufacturer. Use a dead weight or instrument which is accurate to within 1 %.

NOTE 2—Practice **E74** may be used as a general guide for selecting calibration devices.

8.2.1.1 Check the calibration of the test device at both extremes and the middle of the ROR and at 10 and 90 % of full scale unless such values fall within the ROR.

8.3 Repeat the steps given in **8.2** for all appropriate tests listed in **8.1.1.2**.

8.4 Make and record all readings to a resolution of one half the smallest scale division of the test device unless otherwise specified in the operating instructions for the test device. Read the data recorded by the standard apparatus to a significance of 2 % of the lower limit of the ROR.

9. Calculation

9.1 Determine the middle quantitative value (median) of each test series (three repetitions of each test constitute a series) and use it for all calculations.

9.2 Calculate the mean and standard deviations for the test device and the standard apparatus in each cycle of **8.1**.

9.2.1 Calculate the standard deviation, in percent, as follows:

$$s = \frac{0.43R}{\bar{X}} \times 100$$

where:

\bar{X} = mean, and

R = range of observations.

9.3 Calculate d for each cycle of **8.1**, in percent, as follows:

$$d = \frac{\bar{X}_{td} - \bar{X}_{sa}}{\bar{X}_{sa}}$$

where:

sa = standard apparatus, and

td = test device.

9.4 Calculate r for each cycle of 8.1, in percent, as follows:

$$r = \sqrt{s_{sa}^2 - S_{td}^2}$$

if $S_{sa} > S_{td}$, then $r = 0$

9.5 Plot a calibration curve for each cycle of 8.3 in terms of the data recorded in 8.2.1. By the least squares method, fit a second order polynomial equation to the data.

10. Report

10.1 Prepare a clear and complete report of each verification of a test device including:

10.1.1 Name of the calibrating agency,

10.1.2 Date of verification,

10.1.3 Test device description and serial number,

10.1.4 Reference binding,

10.1.5 Temperature at which tests were conducted.

10.1.6 ROR, d , and r for all test series listed by test method, and the point in the ROR, (lower, middle, or upper), and

10.1.7 All calibration curves and their equations.

11. Precision and Bias

11.1 Repeatability and reproducibility will be determined.

11.2 The bias of this test method has not been determined.

ANNEX

(Mandatory Information)

A1. CALIBRATION OF SKI BINDING TEST DEVICES

A1.1 Scope

A1.1.1 This test method covers procedures for checking agreement between individual devices of identical but unspecified design, intended for determining the release moments of ski bindings.

A1.2 Procedure

A1.2.1 From the calibration curves, determine the loads which correspond to the lower and upper limits and middle of the ROR.

NOTE A1.1—Averaging calibration curves derived for positive and negative moments may be appropriate.

A1.2.2 By the method employed in 8.2.1 and using the loads determined in A1.2.1, check the calibration of the test device and record the values indicated by the specific device at each test point in the ROR.

A1.3 Calculation

A1.3.1 For upper, middle, and lower test points, calculate the difference, in percent, of a between the moment derived from the calibration curve and the moment indicated by the test device, using the following equation:

$$a = \frac{M_d - M_t}{M_t} \times 100$$

where:

M_d = moment indicated by the test device, and

M_t = moment derived from the calibration curve.

A1.4 Report

A1.4.1 Prepare a clear and complete report of the calibration of each test device including:

A1.4.1.1 Name of calibrating agency,

A1.4.1.2 Date of calibration,

A1.4.1.3 Test device description, serial number, and location,

A1.4.1.4 Test loads, test points and calibration method, and

A1.4.1.5 ROR, and a_l , a_m , a_u for each classification,

where:

l = lower,

m = middle, and

u = upper.

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