Designation: F 1017 – 86 (Reapproved 1994)

Standard Test Method for Testing Lateral Toe Release of Adult Alpine Ski Bindings Under Impact Loading[1]

This standard is issued under the fixed designation F 1017; 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 test method covers an impact test for establishing the maximum impulse for retention of a test ski on the standard boot in the lateral direction at the boot toe.

1.2 The test provides a measure of the release and retention boundary for lateral release of the toe of a ski binding at a particular ski binding setting.

1.3 *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:*

F 939 Practice for Selection of Release Torque Values for Alpine Ski Bindings[2]

F 944 Specification for Properties of Adult Alpine Ski Boots[2]

3. Terminology

3.1 *contact material*—the contact material is the material interface between the pendulum contact tip and the side wall of the test ski. The contact material specification in conjunction with the pendulum release angle determines the duration and the magnitude of the impulsive force during the impact test.

3.2 *impact*—a force whose duration of application is short relative to the capacity of the ski binding-pendulum system to respond to the force is an impact force.

3.3 *impulse*—the integral of the force history during the time of contact between the pendulum tip and the contact material is termed the impulse.

3.4 *test ski*—an aluminum, U-shaped channel is termed the test ski. The tip and the tail of the test ski refer to the extreme points along the length of the channel in front of and behind the ski binding that is mounted on the channel.

3.5 *test boot*—the test boot is an ASTM sole in accordance with Specification F 944, backed by a steel plate 216 ± 4 × 57 ± 3 × 10.0± 1 mm[3]. The ASTM sole is bolted to the plate which is used for rigidly holding the test sole to the boot support.

3.6 *goniometer*—the instrument used to measure the angle of the pendulum shaft relative to the vertical equilibrium axis at the pendulum bearing is called the goniometer.

3.7 *pendulum shaft*—the long, circular cylinder connecting the pendulum block to the pendulum bearing is termed the pendulum shaft.

3.8 *contact tip*—the contact tip on the pendulum block is a steel hemispherical tip of hardness Rc 45 and diameter 10.0 ± 0.5 mm.

3.9 *pendulum block*—the rigid mass on the free end of the pendulum shaft and upon which the contact tip is rigidly mounted is termed the pendulum block.

3.10 *impact location*—the point on the test ski side wall where the impact occurs is the impact location. The impact location is 10 ± 1 mm from the U-channel base and 10 ± 1 mm from the ski tip.

3.11 *binding release*—if, upon execution of an impact test, the test ski either separates completely from the test boot or the test ski is off-set from at the boot toe by 5 mm or more and no visible recentering of the test ski on the test boot is observed for a period of up to 10 s, the binding is defined to have released the test ski from the test boot.

3.12 *pendulum tower*—the structure supporting the pendulum bearing, shaft and block is termed the pendulum tower.

3.13 *pendulum release angle*—the angle between the pendulum shaft and the vertical when the pendulum shaft is released from rest.

3.14 *pendulum bearing*—the bearing mounted on the pendulum tower and supporting the pendulum shaft is termed the pendulum bearing.

3.15 *boot support*—the structure required to rigidly hold and position the test boot is the boot support.

3.16 *pendulum rebound angle*—the maximum angle between the pendulum shaft and the vertical, following impact of the contact tip and contact material during a test, is the pendulum rebound angle.

3.17 *percentage rebound*—the impact resilience of the contact material is determined from the percentage rebound, *R*;

$$R = \{[1 - \cos(\theta_{reb})]/[1 - \cos(\theta_{rel})]\} \times 100$$

where:

θ_{reb} = is the pendulum rebound angle, and

[1] This test method is under the jurisdiction of ASTM Committee F-27 on Snow Skiing and is the direct responsibility of Subcommittee F27.10 on Binding Test Procedures.

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[2] *Annual Book of ASTM Standards*, Vol 15.07.

θ_{rel} = is the pendulum release angle.

4. Summary of Test Method

4.1 The ski binding is mounted on a standard test ski defined in 6.1.

4.2 The ski release binding is adjusted for a static release according to Test Method F 939. The release setting is recorded.

4.3 The test ski is mounted on the standard boot sole in accordance with Specification F 944. The sole is rigidly fixed during testing.

4.4 The contact material between the test ski and the pendulum impact is according to the specifications in 6.7.

4.5 The standard pendulum applies impulsive loading to the test ski at the lowest point of the pendulum arc.

4.6 The pendulum pivot friction and the contact material are evaluated according to 6.6.1 and 6.7.3 prior to and following test of ski release bindings. Records of the evaluations are maintained.

4.7 The pendulum release angle is decreased from a value sufficient to guarantee release of the binding following a single impact of the test ski until the maximum angle for which retention of the binding is obtained. The release angle causing ski binding to release at the release-retention boundary is recorded.

5. Significance and Use

5.1 This test method is designed to simulate the lateral impulsive loading at the toe of a ski binding during skiing. The test permits the evaluation of a ski binding's release and retention properties under expected loading rates. The test permits comparison of the release at the toe caused by lateral impulse to the ski for different binding system designs.

5.2 The release and retention functions of ski bindings are multifaceted and complex. The functions involve combinations of static and dynamic loading in varied release directions of the boot relative to the ski. This impulsive test method evaluates an important ski binding function, but it should not be interpreted as conclusively evaluating the binding impulse release behavior in general. The test evaluates the release and retention function of the binding in a single mode of binding release. Other static and dynamic retention and release tests are not excluded by this standard test.

6. Apparatus

6.1 *Test Ski*—The test ski is a U-shaped channel section of aluminum with dimensions: length 500 ± 2 mm, width 62 ± 2 mm, height 35 ± 5 mm and wall thickness 3.6 ± 0.6 mm. The toe of the boot sole shall be located 75.0 ± 1 mm from the tip of the test ski. The mass of the test ski will be 610 ± 150 g.

6.2 *Test Boot*—The boot shall conform to Specification F 944 except when the binding manufacturer specifies modifications for the boot design.

6.3 *Pendulum Tower*—The pendulum tower shall be sufficiently rigid as to not participate in the impact response of the test ski. The smallest characteristic frequency of the tower in transverse bending should be 100 Hz.

6.3.1 One configuration for the tower consists of a structure of four steel plates welded into the form of a hollow, square cylinder with external square cross-section dimensions 254 ± 2 × 254± 2 mm^2 and length 1220 ± 2 mm. The plate thickness is 9.5 ± 0.5 mm. An additional steel plate of dimension 330 ± 2 × 330 ± 2 × 25 ± 1 mm^3 is welded to the bottom of the cylinder, and a plate of dimension 305 ± 2 × 381 ± 2 × 13.0± 0.5 mm^3 is welded to the top. The latter two plate surfaces are approximately parallel and perpendicular to the long axis of the cylinder. The base plate is drilled to allow bolting the tower rigidly to a concrete foundation at four or more places. The top plate forms a nearly rigid foundation for the pendulum bearing system.

6.3.2 The pendulum bearing base shall allow adjustment of the pendulum height and position by movement of the pendulum bearing in the plane of the pendulum motion. Adjustment of height is required to guarantee proper impact of the contact tip with the impact location for bindings of different height. Adjustment of the horizontal position is required to guarantee impact occurs at the bottom of the pendulum arc.

6.4 *Pendulum Shaft*—The pendulum shaft is a circular, steel cylinder of mass 2.3 ± 0.1 kg. The shaft is 1000± 2 mm long with O.D. = 40.0 ± 0.1 mm and I.D. = 35.0± 0.1 mm. The shaft is mounted in the pendulum bearing so that it swings in a single vertical plane normal to the test ski.

6.4.1 The fundamental natural frequency of the pendulum shaft, block, and bearing system in bending is approximately 10 Hz.

6.4.2 The pendulum shaft is rigidly secured to the pendulum block on the end of the shaft furthest from the pendulum bearing. The pendulum block mass is 3.0 ± 0.1 kg. The contact tip is rigidly fixed to the pendulum block.

6.4.3 The length from the center of the pendulum bearing to the point of impact on the contact tip is 1025 ± 5 mm.

6.5 *Boot Support*—The test boot support holds the test boot sole rigidly.

6.5.1 The support structure is constructed of heavy, steel plate and it is mounted in a concrete foundation to maintain rigidity during impact.

6.5.2 The support adjustment allows movement of the boot sole in the longitudinal direction for positioning the impact location relative to the contact tip.

6.6 *Pendulum Bearing*—A roller bearing of inner race diameter at least 12.0 ± 0.5 mm diameter supports the pendulum shaft on the pendulum tower.

6.6.1 The pendulum bearing function is evaluated by free vibration test of the complete pendulum tower, shaft and block system. No test ski or boot is involved. The pendulum is released from rest at a pendulum release angle of 12.0 ± 0.5°. The pendulum shall execute at least 60 complete oscillations before coming to rest at the vertical equilibrium. The number of oscillations is recorded.

6.7 *Contact Material Specification*—The contact material is chosen to produce a loading separation time from 20 to 100 ms