	'AVALANCHE RESCUE SHOVELS' Climbing and Mountaineering Equipment	UIAA 156
<h2>Foreword</h2> <p>This UIAA Standard is only published in the English language version, which is the master text. For any validations in translation, the UIAA Safety Commission should be contacted via the UIAA Office in Bern, Switzerland.</p> <p>UIAA Standards are the only 'globally recognized' standards for mountaineering equipment.</p> <p>The UIAA Standards are reviewed at intervals to see whether they meet the latest technical requirements and revised if necessary.</p> <p>The UIAA invites manufacturers of mountaineering and climbing equipment worldwide to become members of the UIAA Safety Commission as Safety Label Holders. Members can participate in discussions on standard requirements, test methods and revisions thereof (see the "General Regulations for the UIAA Safety Label").</p> <p>A complete list of UIAA Standards for mountaineering and climbing equipment can be found on the UIAA website.</p> <p>This standard has been created and updated based on scientific research coordinated and funded by UIAA, as a service to all mountaineers.</p>		
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1. General Remarks on the UIAA Trademark and UIAA Label

1.1 The UIAA Trademark (see section 5.1.) is copyright protected internationally. The UIAA Label is only given to items of mountaineering and climbing equipment upon approval of prospective label holder's application from the UIAA.

1.2 The procedure to be followed by a manufacturer, when applying for a UIAA Label, is laid down in the "General Regulations for the UIAA Safety Label Certification"

2. Scope

This standard specifies safety requirements and test methods for snow shovels used in avalanche rescue to dig out buried people, and/or for training purposes.

3. Definitions

Within this specification, the following definitions apply:

3.1 Nomenclature

3.1.1 Shovel: the whole tool when made up by several parts.

3.1.2 Blade: the tool part designed to penetrate the snow pack, cut it, and carry slices.

3.1.3 Shaft: the tool part(s) connecting the handle to the blade.

3.1.4 Handle: the shaft end, opposite to the blade, designed to be easily held by the hand.

3.1.5 Rescue: operations required to save the life of a buried person.

3.2 Geometry

Refer to

Figure 1

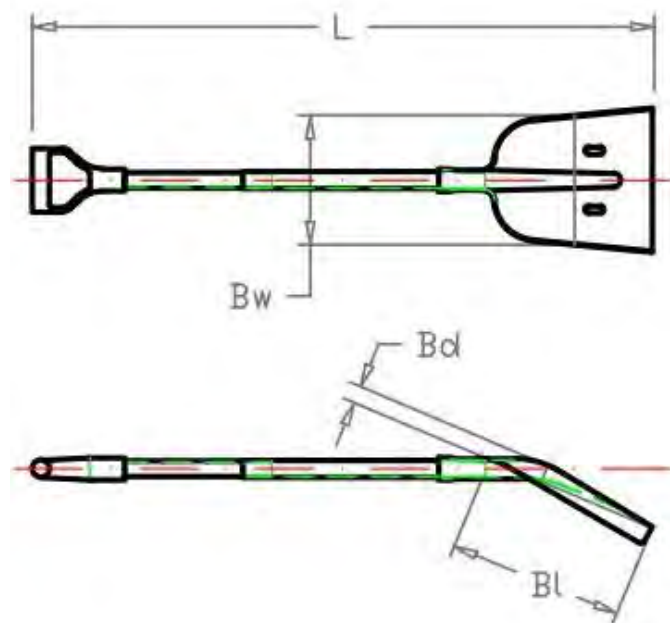
3.2.1 Shovel length (L): the overall tool length taken at its maximum shaft extension.

3.2.2 Blade length (B_l): the maximum length of the blade.

3.2.3 Blade width (B_w): the blade dimension taken perpendicular to the shovel axis, at 50% the blade length.

3.2.4 Blade depth (B_d): the maximum distance taken perpendicular to a straight line taken from blade tread and blade penetration tip, including serrations if any.

Figure 1 – Geometry



Safety Requirements

4.1 Construction

4.1.1 Tubular components, holes and gaps accessible during use shall be covered if a 7 mm or 12 mm test probe (EN 581-1:2006 clause 4) can be pushed into them in any direction with a maximum force of 30 N to a depth of more than 10 mm and cannot be pulled out again in the reverse direction by a maximum force of 30 N.

4.1.2 Bottom of tubular stems shall be capped or plugged.

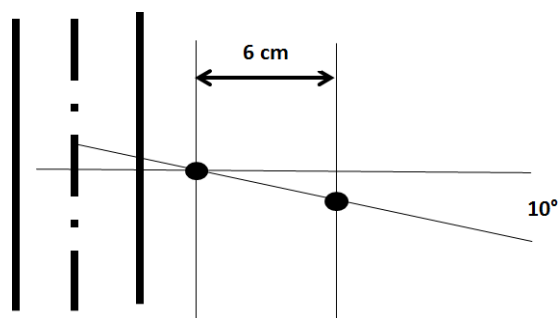
4.1.3 There shall be no accessible shear and squeeze points created by loads applied during normal use, that could harm the user.

4.1.4 As far as it is allowed by the intended use, sharp corners, edges and rough surfaces which can cause minor injuries shall be avoided. Make sure that edges are deburred, beaded, or framed. Functional cutting edges are not permitted.

4.1.5 Screw, bolt and rivet connections shall be permanently secured.

4.1.6 The tread of the blade shall contain a part, extending at least 6 cm, presenting a slope less than 10 degrees, and relative to a line perpendicular to the shaft axis, refer to Figure 2 – Tread.

Figure 2 – Tread



4.1.7 The handle shall be designed to suit a user wearing gloves. The shape may be symmetrical referred to the shaft axis: T, D or similar shapes are recommended.

4.1.8 The shovel length (L) shall be greater than 75 cm.

4.1.9 The blade surface area, evaluated in accordance with 0, shall be greater than 500 cm².

4.2 Strength

4.2.1 The shovel flexural permanent deformation, evaluated in accordance with the 5.2.3.1 Bending test procedure, shall be less than 5 % of its length dimension L as per 5.2.3.1.4 criterion when exposed to 300 Nm bending moment. No parts rupture nor any sort of material separation are permitted.

4.2.2 The shovel reverse flexural permanent deformation, evaluated in accordance 5.2.3.2 Reserve bending test procedure, shall be less than 5 % of its dimension L as per 5.2.3.2.4 criterion when exposed to 300 Nm bending moment. No parts rupture nor any sort of material separation are permitted.

4.2.3 The axial strength of all the shovel parts and their connections, evaluated in accordance with 5.2.3.3 Axial pull test procedure, shall withstand 1000 N. No parts rupture nor any sort of material separation are permitted.

4.3 Stiffness

4.3.1 The shovel stiffness compliance, evaluated in accordance with 5.2.3.1.5 and 5.2.3.2.5 test procedures, shall be less than 0.15 mm/mm.

5. Test Methods

5.1 Construction proof

5.1.1 Requirements in items 4.1.1 to 4.1.9 shall be verified by means of visual inspection, hands-on inspection, and dimensional measurements. Tolerances: ± 1 mm for lengths, ± 1 gram for weights and ± 1 Newton on forces.

5.1.2 Check compliance to item 0 computing a blade average surface according to Equation 1:

$$\text{Equation 1} \quad S_{ave} = B_w \cdot B_l$$

If $S_{ave} >$ then required value, test is passed, otherwise is failed. Small functional holes or slots are negligible.

5.2 Strength and Stiffness proof

5.2.1 Number of tests

Tests shall be carried on three (3) samples of each type/model.

5.2.2 Test Apparatus

The test apparatus consists of:

5.2.2.1 A pair of clamps, molded to suit the specific blade profile. Their span shall extend from Blade tip to 50% of Blade length. Adequate material maybe charged polyester or epoxy die cast type resins or any similar tough alternative material.

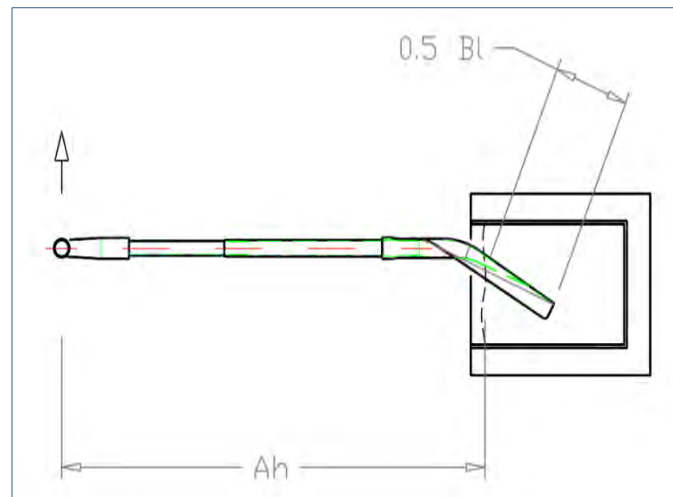
5.2.2.2 A stiff frame to firmly hold the clamps and the test item when subjected to mechanical loading.

5.2.3 Test procedures:

5.2.3.1 Bending test

Refer to Figure 3.

Figure 3 - Bending Test Set up



5.2.3.1.1 Set up:

clamp the Test Article so that the load applied on the handle lies perpendicular to the shaft. Measure and record A_h actual value

5.2.3.1.2 Loading:

increase the applied load at a constant rate ≤ 250 N/min while recording the paired cross beam stroke continuously up to load P_{05} determined to Equation 2, when A_h expressed in m.

Equation 2
$$P_{05} = \frac{300}{A_h} \text{ [N]}$$

Check the angle between the load-line, from shovel to actuator jack, and the shaft longitudinal axis remains perpendicular within ± 6 degrees.

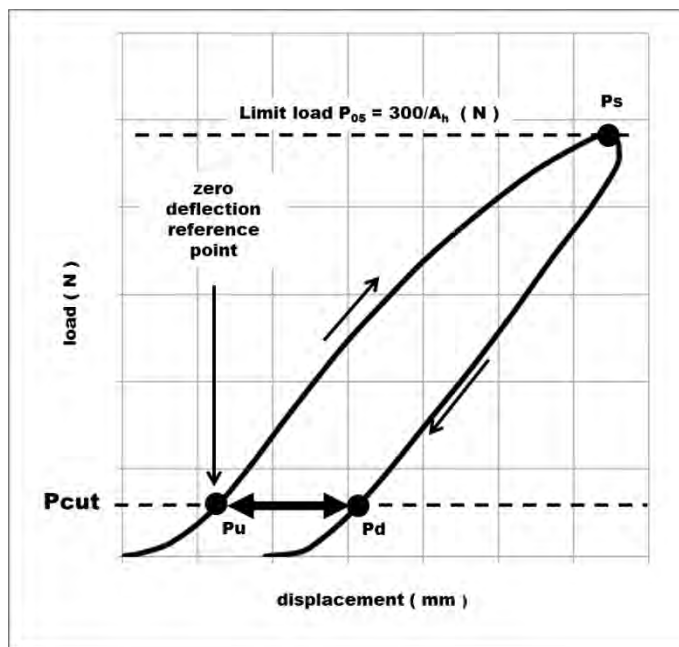
5.2.3.1.3 Unloading:

decrease the applied load up to zero while recording the paired cross beam stroke continuously.

5.2.3.1.4 Pass/fail criteria Strength:

Refer to Figure 4

Figure 4 - Typical Load/Deflection Curve



- i) plot the load-deflection curve according to Figure 4
- ii) draw a cut off line parallel to the abscissa axis at a force value P_{cut} given by Equation 3, when A_h expressed in m

Equation 3 $P_{cut} = \frac{60}{A_h} \text{ [N]}$

- iii) evaluate the intersection point P_u between the recorded loading curve and the cut off line: this point is assumed as zero deflection reference point
- iv) evaluate the intersection point P_d between the recorded unload curve and the cut off line
- v) evaluate the residual deflection DFL_{res} according to Equation 4

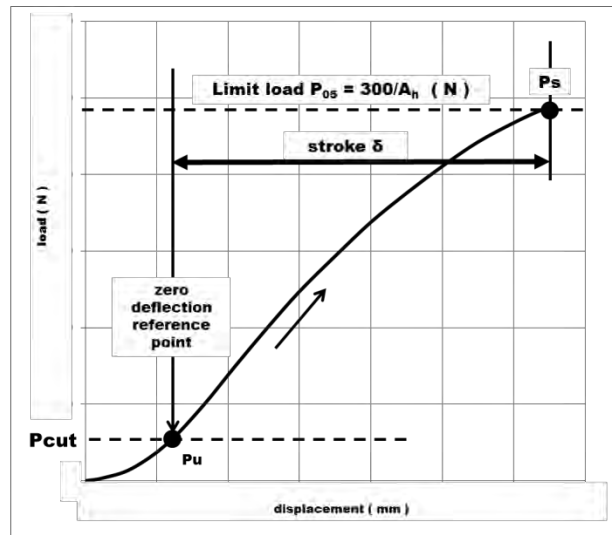
Equation 4 $DFL_{residual} = P_d - P_u \text{ [mm]}$

Test is passed if $DFL_{res} < 0.05 L$ (when L expressed in mm), otherwise it is failed. All Test Articles must pass.

5.2.3.1.5 Pass/fail criteria Stiffness:

Refer to Figure 5

Figure 5 - Stiffness Evaluation



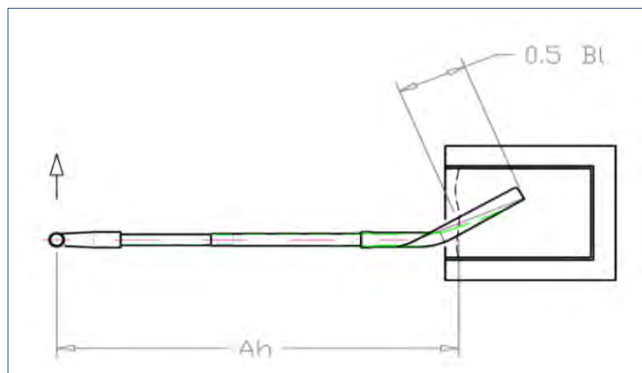
- i) consider the uploading part of the recorded load/deflection
- ii) draw a cut off line parallel to the abscissa axis at a force value P_{cut} given by Equation 3, when A_h expressed in cm
- iii) evaluate the intersection point P_u between the recorded loading curve and the cut off line: this point is assumed as zero deflection reference point.
- iv) evaluate the intersection point P_s between the recorded loading curve and the line parallel to abscissa axis at $300/A_h$ N load
- v) evaluate the stroke δ as the abscissa of point P_s referred to the assumed zero-deflection reference point

Test is passed if the ratio δ / A_h (i.e. stroke over span) < value specified in 4.3.1. All Test Articles must pass.

5.2.3.2 Reverse bending test

Refer to Figure 6

Figure 6 - Reverse Bending Set up



5.2.3.2.1 *Set up*: clamp the Test Article so that the load applied on the handle lies perpendicular to the shaft. Measure and record A_h actual value.

5.2.3.2.2 *Loading*: increase the applied load at a constant rate ≤ 250 N/min while recording the paired cross beam stroke continuously up to load P_{05} determined to Equation 2, when A_h expressed in cm. Check the angle between the load-line, from shovel to actuator jack, and the shaft longitudinal axis remains perpendicular within ± 6 degrees

5.2.3.2.3 *Unloading*: decrease the applied load up to zero while recording the paired cross beam stroke continuously.

5.2.3.2.4 *Pass/fail criteria Strength*:

apply same procedure as per item 5.2.3.1.4 while using the reverse bending load-deflection recorded curve.

5.2.3.2.5 *Pass/fail criteria Stiffness*:

apply same procedure as per item 5.2.3.1.5 while using the reverse bending load-deflection recorded curve.

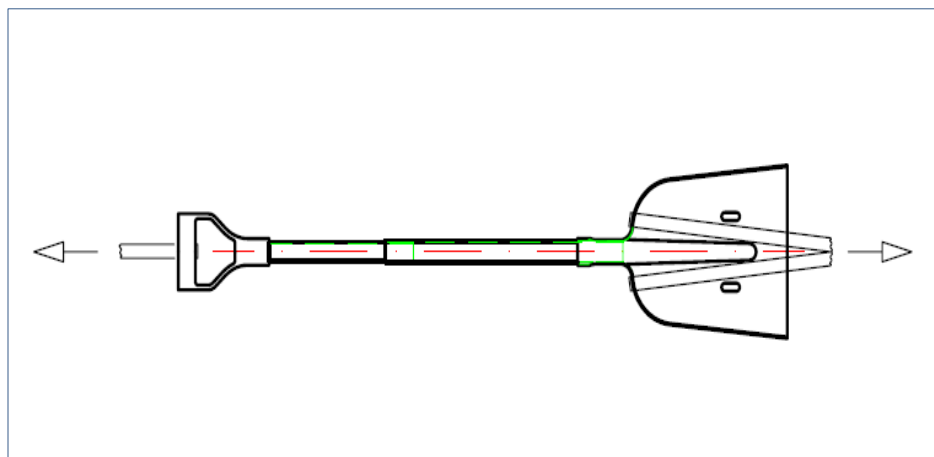
5.2.3.3 Axial pull test

5.2.3.3.1 *Set up*: pull the handle by means of a rigid sling; constrain the blade by means of a rigid sling as per Figure 7.

5.2.3.3.2 *Loading*: increase the applied load at a constant rate ≤ 250 N/min while recording the paired cross beam stroke continuously until the Test Article fails at P_{ax} N.

5.2.3.3.3 *Pass/fail criteria*: test is passed if $P_{ax} \geq$ value specified in 4.2.3 otherwise it is failed. All Test Articles must pass.

Figure 7 – Axial Pull Set up



5.3 Test temperature

All the bending and axial tests shall be run at room temperature, +23 °C.

When the test article or part of it is made by plastic material, either purely polymeric or fibre reinforced, the manufacturer shall certificate (directly or according to documents from the raw material supplier) that the brittle transition temperature t_b is lower than -20°C (see ASTM D746–14 for the evaluation) and furthermore that the glass transition temperature t_g is greater than room temperature +23 °C (see ASTM E1356–08 for the evaluation).

As alternative possibility, the test can be run at low temperature stating that the temperature in the shovel socket zone is ≤ -20 °C at the end of the complete data recording.

The temperature can be measured by an infrared thermometer or equivalent.

6. Information supplied by the manufacturer

The "information to be supplied" shall be given in Standard English and, if required, in the official language(s) of the country in which the product is made available on the market. As an alternative to a printed form, the information may be provided via an electronic or other data storage format link (e.g. a QR code) allowing the downloading of the information. The information link shall be preceded or surmounted by an icon showing an open booklet; the information link and icon may be directly printed on the product in a clearly visible and accessible place.

The avalanche shovel shall be supplied with the following information:

- Name of the manufacturer or its authorized representative;
- Identification of the model, if several models are marketed by the same manufacturer;
- Year of fabrication;
- Instruction about the use, storage and maintenance;
- Information about service life and disposal

7. Marking

The avalanche shovel shall be permanently marked at least with following data:

- Name of the manufacturer or its authorized representative and his address;
- Identification of the model, if several models are marketed by the same manufacturer;
- Year of fabrication;
- Graphical symbol (see Figure 8), which instructs the user to read the information supplied by the manufacturer.

Figure 8 — Operator's manual (according to ISO 7000, Symbol No. 1641)



8. Information to be supplied

The "information to be supplied" shall be given in Standard English and, if required, in the official language(s) of the country in which the product is made available on the market. As an alternative to a printed form, the information may be provided via an electronic or other data storage format link (e.g. a QR code) allowing the downloading of the information. The information link shall be preceded or surmounted by an icon showing an open booklet; the information link and icon may be directly printed on the product in a clearly visible and accessible place.

9. Attachment of the UIAA Label

- 9.1 For any model of mountaineering equipment, which has been awarded the UIAA Label, the UIAA recommends that the UIAA Trademark (see below) or the four letters "UIAA" be marked clearly and indelibly on each item sold in accordance with the branding guidelines specified in the "General regulations for UIAA Safety Label".



- 9.2 In addition, the UIAA Trademark or the four letters "UIAA" may be included in the instructions for use and/or on a swing ticket as well as in catalogues and other publications of the manufacturer. In the last case, the illustration and/or the text must clearly apply only to the equipment which has been awarded the UIAA Label.

Last Updated	Remarks
June 2018	<p>Corrections: Point 4.1.6 The tread of the blade shall contain a part, extending at least 6 cm, presenting a slope less than 10 degrees, and relative to a line perpendicular to the shaft axis, refer to Figure 2 – Tread. Point 4.2.1 The shovel flexural permanent deformation, evaluated in accordance with the 5.2.3.1 Bending test procedure, shall be less than 5 % of its blade length dimension B-L as per 5.2.3.1.4 criterion when exposed to 300 Nm bending moment. No parts rupture nor any sort of material separation are permitted.</p> <ul style="list-style-type: none"> - Point 4.2.2 The shovel reverse flexural permanent deformation, evaluated in accordance 5.2.3.2 Reserve bending test procedure, shall be less than 5 % of its dimension B-L as per 5.2.3.2.4 criterion when exposed to 300 Nm bending moment. No parts rupture nor any sort of material separation are permitted. - Equation 5 $DFL_{residual} = P_d - P_u [mm]$ <p>Test is passed if $DFL_{res} < 0.05 \text{ B-L}$ (when B-L expressed in mm), otherwise it is failed. All Test Articles must pass.</p> <ul style="list-style-type: none"> - Point 6: The avalanche shovel shall be supplied with the following information: Name of the manufacturer Type name Model number; Instruction about the use, storage and maintenance; Information about service life and disposal. Name of the manufacturer or its authorized representative; Identification of the model, if several models are marketed by the same manufacturer; Year of fabrication; Instruction about the use, storage and maintenance; Information about service life and disposal; - Point 7: Marking <p>The avalanche shovel shall be permanently marked at least with following data:</p> <ol style="list-style-type: none"> a) Name of the manufacturer or its authorized representative and his address; b) Type name Model number Identification of the model, if several models are marketed by the same manufacturer; c) Year of fabrication; d) graphical symbol (see Figure 8), which instructs the user to read the information supplied by the manufacturer.

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