



PNL TEST STANDARD

PNL-TS-001

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Standard Test Method for Measuring Broadhead Edge Sharpness Using Controlled Force Application

1. Scope

1.1 This standard establishes a repeatable method for measuring the edge sharpness of archery broadheads by determining the force required to sever a standardized test filament.

1.2 This method applies to
Fixed blade broadheads
Replaceable blade broadheads
Single-bevel and double-bevel edges

1.3 Results are reported in grams-force (gf).

1.4 This standard is intended to minimize operator influence and improve measurement repeatability through controlled force application and defined data acquisition requirements.

2. Purpose

2.1 The purpose of this standard is to:

Provide a consistent and repeatable method for sharpness testing

Reduce variability caused by manual testing methods

Improve accuracy through controlled loading and adequate sampling rates

Establish a consistent baseline for comparison across broadhead designs

3. Terminology

3.1 Sharpness (BESS Value): Force, in grams-force, required to sever a standardized filament.

3.2 Cut Event: The moment at which the test media is completely severed.

3.3 Peak Force: The maximum force recorded immediately prior to filament failure.

4. Significance and Use

4.1 This method provides a quantitative measurement of edge sharpness.

- 4.2 Results may be used to
 - Compare broadhead sharpness
 - Evaluate manufacturing consistency
 - Measure edge retention after use
- 4.3 This method emphasizes controlled conditions to ensure data reliability.
- 4.4 Sharpness is only one factor in broadhead cutting performance and should not be interpreted as a complete measure of penetration performance.

5. Apparatus

- 5.1 Force Measurement System
 - Load cell capable of measuring force in grams-force
 - Minimum resolution: 1 gf or better
- 5.2 Data Acquisition System
 - Sampling rate: 100 Hz to 200 Hz
 - Continuous force vs. time recording required
- 5.3 Blade Fixture
 - Rigid mounting system preventing movement of the blade during testing
- 5.4 Test Media
 - Standard BESS filament or equivalent documented material
- 5.5 Force Application System
 - Gravity-fed mass system
 - Linear actuator with controlled speed
 - Mechanical tester with controlled displacement

6. Sampling Rate Requirement

- 6.1 For Method B and Method C, force measurements shall be recorded at a sampling rate between 100 Hz and 200 Hz.
- 6.2 A sampling rate of 200 Hz is preferred when available for Method B and Method C.
- 6.3 Method A commercial tester results shall be reported using the sampling rate and display method provided by the manufacturer.
- 6.4 The filament severing event occurs rapidly and produces a short-duration peak force. For Methods B and C, lower sampling rates may fail to capture the true peak force, resulting in under-reported sharpness values.
- 6.5 Systems operating below 100 Hz shall not be used for Method B or Method C unless specifically documented as a deviation.

7. Test Specimen Preparation

- 7.1 Broadheads shall be clean and free of debris.
- 7.2 Blades shall be tested in as-received condition unless otherwise specified.
- 7.3 Each cutting edge shall be tested independently.
- 7.4 If a blade is sharpened prior to testing, the sharpening method shall be documented.

8. Test Methods

8.1 Method A — Commercial Tester (Baseline Comparison Method)

8.1.1 This method uses commercially available testers, such as the Edge-On-Up PT50A Sharpness Tester, for baseline comparison.

8.1.2 Procedure

Follow manufacturer instructions

Perform a minimum of three (3) trials per blade edge

Record displayed peak force

8.1.3 Limitations

Lower sampling rate, commonly reported at approximately 25 Hz

Potential for missed peak force during rapid cut events

Operator-dependent loading rate

Limited access to full force vs. time data

8.2 Method B — Load Cell Method (Controlled Force Method)

8.2.1

8.2.2 Setup:

Blade fixed rigidly

Filament attached to or positioned against the load cell fixture

Force applied using a gravity-fed or otherwise controlled system

8.2.3 Requirements:

Sampling rate: 100–200 Hz

Preferred sampling rate: 200 Hz

Force application rate: 5 g/sec \pm 10%

Full force vs. time curve required

8.2.4 Output:

Peak force from recorded dataset

Force vs. time curve

Trial-to-trial repeatability information

8.3 Method C — Linear Actuator Method (Advanced Controlled Method)

8.3.1 Setup:

Linear rail or guided actuator system

Controlled downward motion

Load cell integrated into the filament or blade fixture

8.3.2 Parameters:

Controlled actuator speed: 0.0625 in/sec (\pm 10%)

Sampling rate: 100–200 Hz

Full force vs. time curve required

8.3.3 Applications

High repeatability testing

Research-grade comparisons

Validation of loading-rate effects

9. Sharpness Classification (Archery Scale — Reference Only)

9.1 Background

9.1.1 The standard BESS classification system is commonly used for general-purpose cutting tools. However, general cutlery and utility-edge classifications do not directly reflect performance expectations for archery broadheads.

9.1.2 The following classification is intended for archery-specific interpretation of sharpness values.

9.1.3 This classification is informational and does not affect the validity of measured results.

9.2 Broadhead Sharpness Classification Scale

Sharpness (gf)	Classification	Performance Description
0–150	Extremely Sharp	Razor-level edge; shaves arm hair easily
150–250	High Performance	Excellent cutting ability; hunting ready
250–300	Acceptable	Functional edge; shaving ability begins to decline
300–400	Dull for Hunting	Sharpening recommended before use
>400	Very Dull	Sharpening required before use

9.3 Guidance

Broadheads measuring greater than 300 gf are recommended for sharpening prior to use.

Edges below 250 gf are considered high-performance broadhead edges.

In testing, shaving ability was observed to diminish near 300 gf.

9.4 Important Notes

This classification is intended for archery broadheads and does not apply to general-purpose cutting tools.

Sharpness does not account for blade geometry, edge angle, structural durability, or penetration mechanics.

Sharpness should be interpreted as one component of broadhead performance, not the only component.

10. Industry Reference Method (Contextual Comparison Only)

10.1 General

10.1.1 The Edge-On-Up PT50A Sharpness Tester is widely used as a commercial device for measuring edge sharpness using BESS methodology and is considered a common industry reference.

10.2 Purpose of Inclusion

10.2.1 The PT50A is included in this standard to:

Provide a baseline for comparison with commonly reported sharpness values
 Allow cross-reference with existing BESS-style sharpness data
 Establish context for interpreting results obtained using Methods B and C

10.3 Limitations of Reference Method

10.3.1 While widely used, the PT50A system has the following limitations:

Sampling rate commonly reported at approximately 25 Hz

Limited ability to capture short-duration peak force events

Potential variability due to manual force application

Limited visibility into the complete force vs. time curve

10.4 Method Characteristics

10.4.1 Method A commercial testers typically operate at lower sampling rates and use manufacturer-defined force application and display methods.

10.4.2 Methods B and C use higher sampling rates and controlled force or displacement application, allowing for continuous force measurement and capture of peak force during filament severance.

10.4.3 Differences in sampling rate and force application method may result in variation between results obtained using Method A and Methods B or C.

10.5 Data Comparison Statement

10.5.1 All methods described in this standard measure the force required to sever standardized test media.

10.5.2 Results obtained using different methods may be compared for general trend analysis, provided the method used is clearly identified.

10.5.3 Direct numerical equivalency between methods is not implied unless validated through controlled comparison testing.

11. Procedure

11.1 Secure the broadhead in the fixture.

11.2 Position the filament perpendicular to the cutting edge unless otherwise specified.

11.3 When using Method B, apply force at a controlled loading rate of 5 grams-force per second ($\pm 10\%$).

11.4 When using Method C, advance the linear actuator at a controlled displacement rate of 0.0625 in/sec ($\pm 10\%$) unless otherwise specified.

11.5 Each cutting edge shall be tested at normalized positions corresponding to 25%, 50%, and 75% of the usable cutting edge length, measured from the forward cutting tip toward the base of the cutting edge **as shown in Fig. 1**.

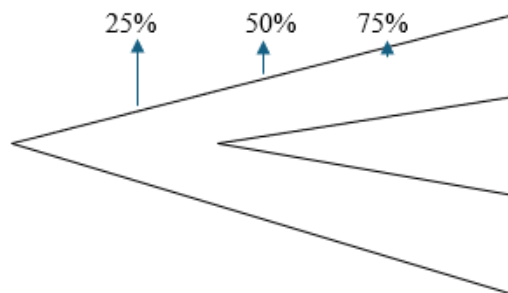


FIG. 1 — Broadhead Blade Showing Measurement Locations at 25%, 50%, and 75% of the Usable Cutting Edge (See 11.5)

11.6 One trial shall be performed at each location, for a minimum of three trials per cutting edge.

11.7 Replace or reposition test media as required to ensure each trial uses an undamaged test section.

11.8 Continue loading until the filament is severed and record the peak force at severance.

12. Data Collection

12.1 Record full force vs. time data for each trial.

12.2 Peak force shall be determined from the recorded dataset.

12.3 Do not rely on single-point or internally filtered values when using Method B or Method C.

12.4 The force-time curve shall be reviewed to confirm a single, clear peak associated with filament severance. Irregular or multi-peak curves shall be flagged and may require retesting.

12.5 Any trial with obvious filament slip, blade movement, fixture movement, or abnormal media failure shall be rejected and repeated.

13. Calculation

13.1 For each blade or edge, calculate:

Mean sharpness (gf)

Standard deviation

Minimum and maximum values

13.2 Individual trial values shall be retained and reported when practical.

14. Report

14.1 The report shall include:

Broadhead identification

Blade or edge identification

Test Method (A, B, or C)

Sampling rate (Hz)

Force application method

Test media type

Number of trials

Individual trial values when practical

Mean sharpness (gf)

Standard deviation

Minimum and maximum values

Condition of blade before testing, including whether it was as-received or sharpened

14.2 If the filament does not sever within system limits, report the result as “> Maximum measurable force.”

15. Limitations

15.1 Results are influenced by:

Test media consistency

Force application rate

Sampling rate

Blade geometry

Edge angle

Fixture rigidity

15.2 Systems operating below 100 Hz may not accurately capture peak force.

15.3 This method measures the force required to sever test media. It does not directly measure penetration depth, wound channel size, tissue damage, or edge durability.

16. Notes (Method Comparison Statement)

16.1 Industry tools such as the Edge-On-Up PT50A Sharpness Tester are commonly used for BESS-style sharpness measurements.

16.2 Methods B and C improve repeatability by:

Controlling force application

Increasing sampling resolution

Recording full force-time data

16.3 This standard prioritizes measurement consistency and data quality.

16.4 The broadhead sharpness classification scale defined in this standard is intended specifically for archery broadheads and should not be treated as a general-purpose knife or cutlery scale.

17. Keywords

Broadhead

Sharpness

BESS

Load cell

Edge retention

Force measurement

Peak force

Force-time curve