Quad X Fletching Performance Analysis – Part 2: Stabilization Study.

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Introduction

This paper analyzes the **stabilization performance** of **Flex Fletch Quad X vanes** in a **4-fletch right helical configuration**. The primary goal of this study is to evaluate the **stabilization behavior of different helical offsets (1°, 3°, and 5°)** and how they influence arrow flight characteristics.

The vanes were installed using a right helical offset. This analysis serves as **Part 2** of an ongoing study, with future parts expanding on these findings. (The tested arrows showed a natural left rotation with a bare shaft.)

Arrow Build

- **Shaft:** Black Eagle Carnivore 350/.003 (26.5" carbon to carbon)
- **Nock:** Black Eagle factory nock
- **Insert:** Ethics 25/50 aluminum insert (50gr)
- **Point:** Ethics 100gr bullet point
- **Vanes:** Flex Fletch QUAD X vanes F**letching Tool:** Vane Master Pro
- **Total Arrow Weight:** 380.5gr ± 0.9gr
- **Velocity at Launch:** 285.3 fps ± 0.5fps
- **Helical offset tested spin indexer:** 1° tested 1°.
- **Helical offset tested spin indexer:** 3° tested 3°.
- **Helical offset tested spin indexer:** 5° tested 4.75°.
- **Measurement from the pocket of the nock to back of fletching.** 1.125"
- **Forward Of Center (F.O.C.)** 16.5%

Test Methodology

Data was collected by shooting arrows through paper at incrementally increasing distances to see stabilization trends. Two **primary deviation peaks** were found at approximately **3 yards and 12 yards.**

Procedure:

1. Move the rest to induce a controlled **horizontal misalignment**.
2. Take the first shot at **1 yard** through paper and measure the **tear pattern**.
3. Continue shooting in **1-yard increments** to see the first peak deviation.
4. Find the second peak distance.
5. Ensure **measurement accuracy** with a ±0.06-yard and ±0.0625-inch margin of error.

Visual Representation of Data

To better illustrate the stabilization process, individual charts have been included for each helical offset configuration:

Figure X: Arrow Recovery at Different Distances (5° Helical Offset) – Displays the oscillation pattern for the 5° offset, showing faster stabilization, and reduced lateral deviation compared to lower offsets.

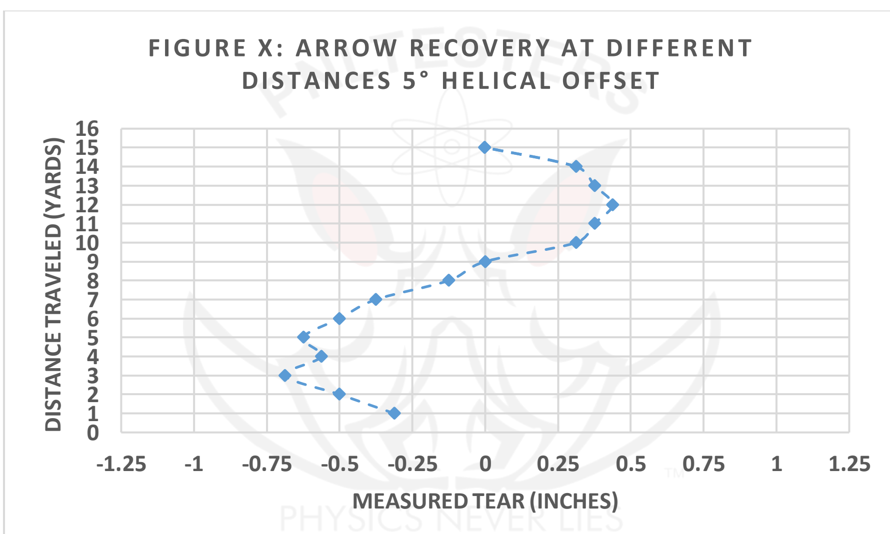


Figure Y: Arrow Recovery at Different Distances (3° Helical Offset) – Highlights the stabilization characteristics of the 3° offset, showing moderate recovery speed.

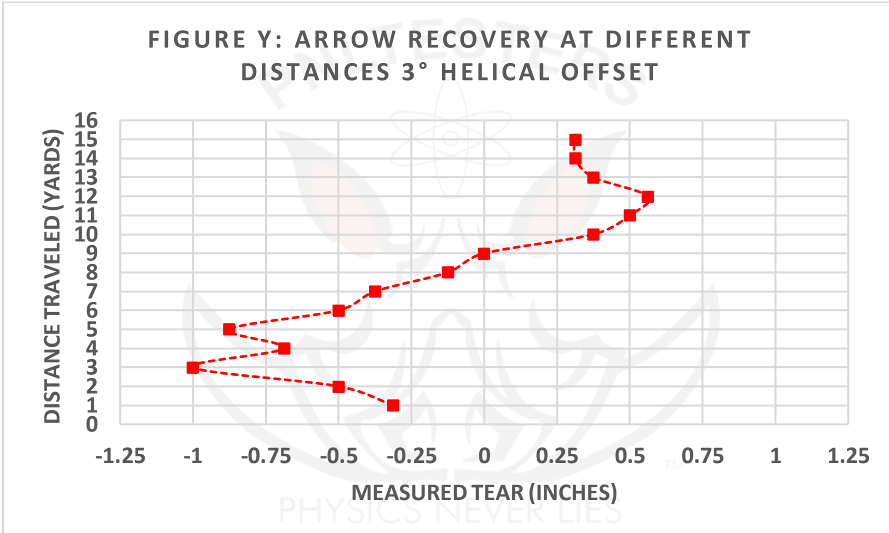
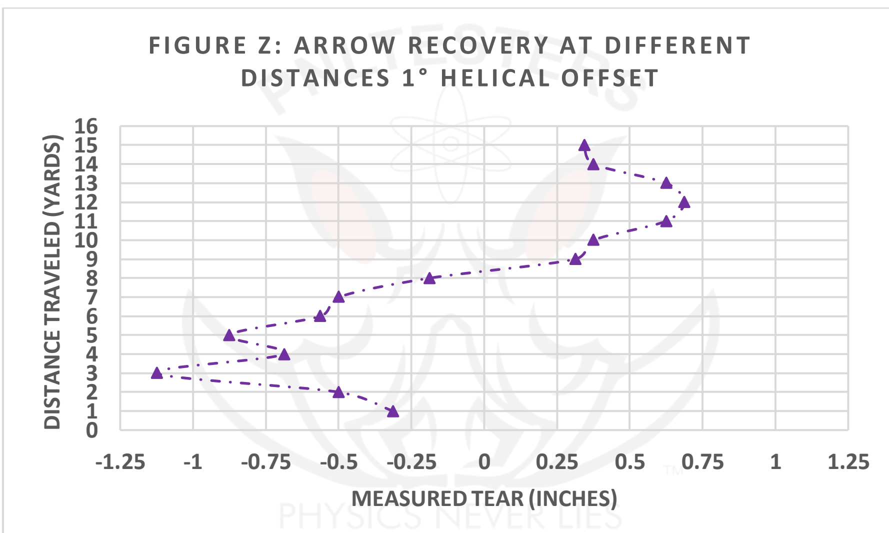


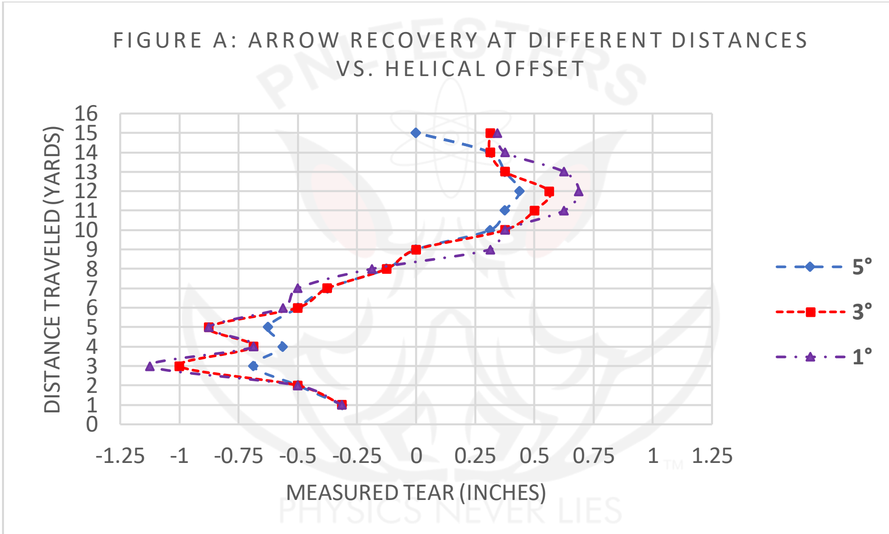
Figure Z: Arrow Recovery at Different Distances (1° Helical Offset)—This figure depicts the largest deviation and slowest recovery, illustrating how reduced spin affects stability.



With the individual and comparative data visualized, we now analyze how these trends impact arrow stabilization dynamics.

After analyzing individual charts, a **comparison chart** has been provided:

Figure A: Comparative Analysis of Helical Offsets – Combines data from all three helical offsets to highlight differences in stabilization rates and deviation recovery across different helical offset configurations.



These figures provide a structured, step-by-step analysis that clearly explains how helical offset influence arrow stability.

Analysis and Observations

When comparing the **three helical offsets**, the **5° helical offset** proved a **more controlled stabilization pattern** than the 3° and 1° configurations, as shown in **Figure A**. All three arrows showed **a primary deviation peak at 3 yards and a secondary shift at 5 yards**, showing a consistent stabilization trend across configurations.

The **1° helical offset showed the greatest lateral movement before stabilizing**, while the **3° and 5° offsets showed reduced deviation** throughout the recovery process. This suggests that **a higher helical offset contributes to a more predictable stabilization pattern rather than directly accelerating stabilization.**

Key Findings:

- The **3-yard and 5-yard deviations** show **critical phases** in the arrow's flight correction.
- Rather than **overshooting past true alignment**, the **secondary deviation at 5 yards** appears to be a **natural part of the stabilization process**, consistent across all helical offsets.
- Instead of reaching **full stabilization at 12–15 yards**, the data shows a **second peak in deviation**, showing that the arrow is **still actively correcting**.
- The **increased spin rate** from a **higher helical offset** plays a role in **reducing lateral deviation**, rather than directly affecting **recovery speed**.

Part 3 – Velocity Loss Over Distance and Roll Rate

Beyond stabilization, an important consideration is how **increased rotation affects velocity retention** over distance. A higher roll rate may introduce **added drag**, potentially slowing the arrow down to longer ranges.

Part 3 will compare **velocity retention** across different helical offsets, measuring whether **increased roll rate causes greater energy loss** or whether **its aerodynamic benefits outweigh added resistance**.

Part 4 – Helical Angle Effect on Accuracy

The final phase of this research will assess how **different helical offsets influence accuracy**. By measuring **dispersion patterns at varying distances**, this study will find whether a **specific helical offset provides a measurable accuracy advantage**.

Final Summary

These findings show that a higher helical offset results in a more controlled stabilization process, reducing lateral deviation while keeping a predictable flight trajectory.

Conclusion

This multi-part study aims to **comprehensively analyze** how **helical offset angles impact stabilization, velocity retention, and accuracy**. The results of **Part 2 show a clear relationship between helical offset and stabilization**, with the next phases investigating the **trade-offs between increased roll and aerodynamic performance**.

Future studies may explore how **arrow mass interacts with fletching offset**, considering the **moment of inertia's role** in spin-up time and steady-state roll rate.