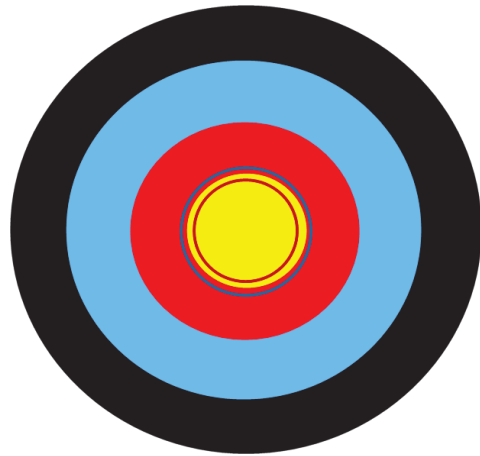


FIELD TEST RESULTS

We asked several high level shooters to compare our Impulse vane with the Mylar vane they typically use. Some adjusted their tuning while others kept everything the same. We then calculated the CEP : Circular Error Probable which is the radius of a circle statistically containing 50% of the shots. The smaller the CEP is, the tighter the grouping is.

The graph below represents the average difference between the **CEP of the Impulse 3"** (red—inside bull's eye) and the CEP of the competitive vane (blue—outside bull's eye). (all shootings at 70 m, on a variety of bows).



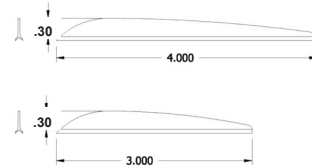
Recommended uses: Olympic style, outdoor, long distance recurve shooting, especially in high and changing wind conditions.

Fletching: using a traditional jig (like our Proclass Jig) and glue (Fletch-Tite Platinum or Quantum XT cyanoacrylate.)

Patent Pending.

WHAT DID THE TESTERS HAVE TO SAY ABOUT THE IMPULSE VANE?

"Despite rain and windy conditions, all my archers were happy with the groupings they could obtain with the Impulse, while their spin vanes diverged more. They said their sights did not drop and performed well without re-tuning. One had his spin vane arrows blown further to one side while the Impulse centered. Another one had pass throughs on a bad target butt. The impulse survived and regained its shape while his spin vanes, as expected, crumbled."



Profiles and item numbers:

	Impulse 3"	Impulse 4"
Length	3", 76 mm	4", 102 mm
Height	0.30", 7.6 mm	0.30", 7.6 mm
Weight	4 grains, 0.26 g	5 grains, 0.33 g
Item Number -40pk	101008	101011

Colors:

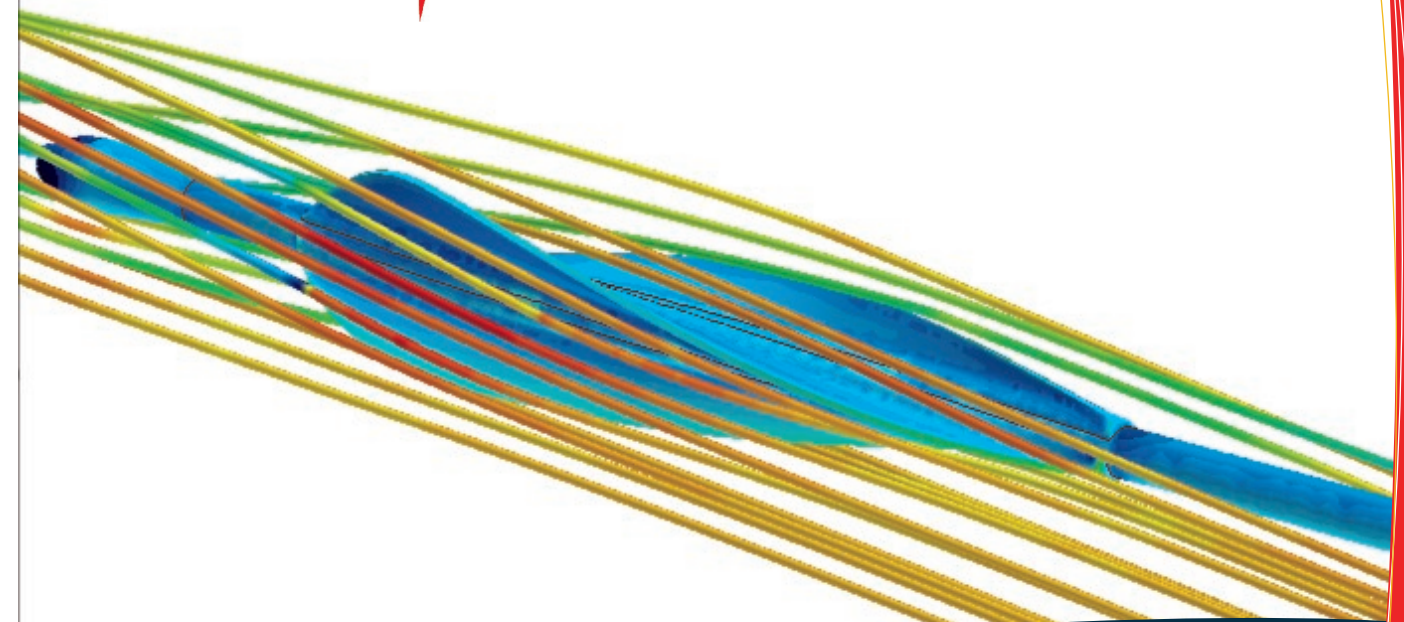
WHITE (WH)	BLACK (BK)
NEON YELLOW (NY)	LIGHT BLUE (LB)
NEON GREEN (NG)	JADE (JD)
HOT PINK (HP)	



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Boost your performance
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WHAT IS THE IMPULSE VANE?

The Impulse vane is a light weight, highly durable vane developed to compete with the Mylar curved vanes used in Olympic style archery.

WHY HELICAL?

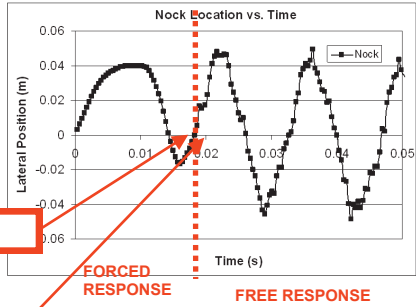
We recommend a helically fletched configuration with the Impulse vane, which makes the arrow spin and alleviates any imperfections in arrow.

WHY PARABOLIC?

Our tests have shown that changing the shape of the vane from a shield cut to a parabolic shape moved the Center of Pressure aft... a good thing.

ARROW REST IMPACT PROBABILITY

For this study, our engineers developed Structural Finite Element Models (FEMs) for our Impulse vane and a Mylar curved vane. A force was then applied to the nock to simulate the forces imparted by the bow string and the response of the arrow was computed. Draw length, bow poundage and lateral release distances (from rolling of fingers on the string) were varied. We then compounded all the results and calculated that the impulse vane was **14% less likely to impact** the arrow rest than the curved vane.



Science and Technology at work for archers

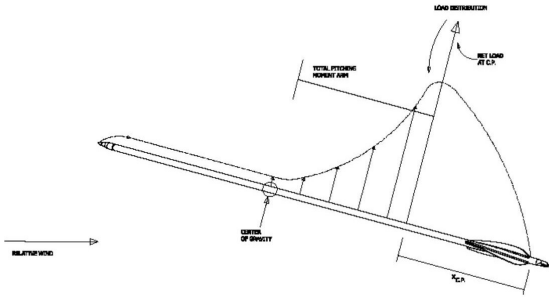
FINDING A VANE THAT MEETS TOUGH CRITERIA

The Impulse vane is the fruit of more than 2 years of research and development that started with tests and analysis from two teams of aerodynamic engineers in Boston and San Diego. We then went on to perform a battery of tests on innovative new polymers and composite materials to study their extrusion processability, physical and adhesive properties. Finally, we sent prototypes to some of the best archers in the world for field tests performed both indoor and outdoors.

A durable solution for your performance

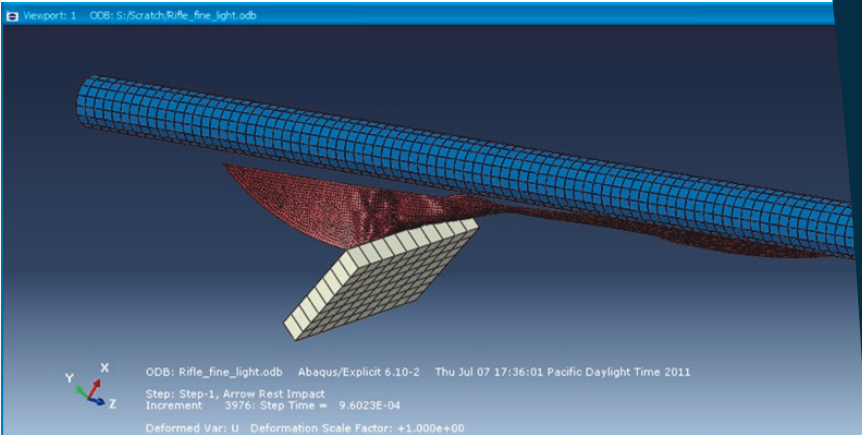
AERODYNAMIC STABILITY

You are already familiar with the F.O.C. of your arrow ("front-of-center"), which is related to the center of the gravity on the arrow. In order to maximize the flight stability of the arrow (i.e. its ability to resist gusts of wind or other instabilities), one also needs to look at the location of the Center of Pressure of the arrow. This point is the location where the distribution load of aerodynamic forces (lift, drag and side force) can be resolved into a single force starting at this location. **The bigger distance there is between the Center of Gravity and the Center of Pressure, the better flight stability.**



We performed CFD (Computational Fluid Dynamics) analysis to measure the forces and moments (torque) applied onto the Impulse vane and a competitive vane on arrows going at 170 ft/s (186 km/h). We then applied a 20ft/s (22 km/h) vertical and lateral force ("wind") and looked at how they changed. From this change, we derived the location of the Center of Pressure. We took into account the stiffness of the vanes tested and their shape in flight. Our results (table below) show that **the Impulse vane provide a more aerodynamically stable arrow.**

	Arrow Mass (g)	Center of Gravity from Nock (mm)	Center of Pressure from Nock (mm)	Distance between Cg and Cp (mm)
Mylar Vane	20.00	445.2	213.6	231.6
Impulse 3"	20.54	435.0	203.5	231.5
Impulse 4"	20.75	431.0	198.1	232.9



THE IMPULSE VANE PROVIDES A COMPLETE SOLUTION.

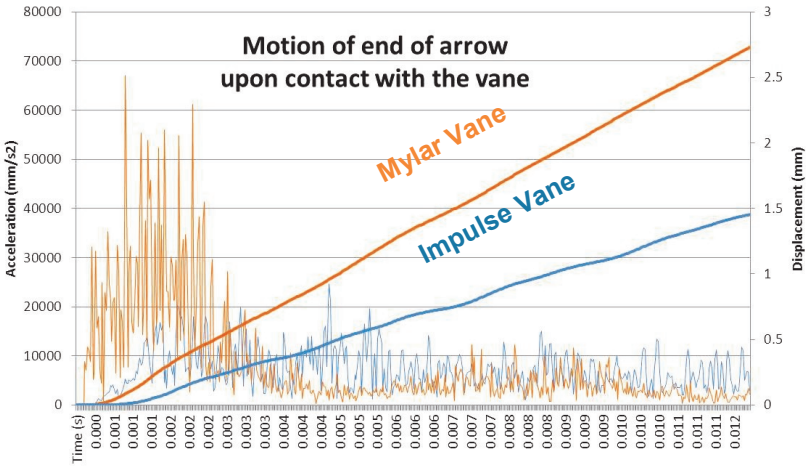
CONSEQUENCE OF IMPACT WITH THE VANES

Why does impact matter? Are all vanes equal in the way they react to an impact with the arrow rest—or anything else? How can we develop a vane that is not so much affected by such a contact?

To answer those questions, the engineers turned to ABAQUS, a software typically used in the automotive and aerospace industries to study crash tests.

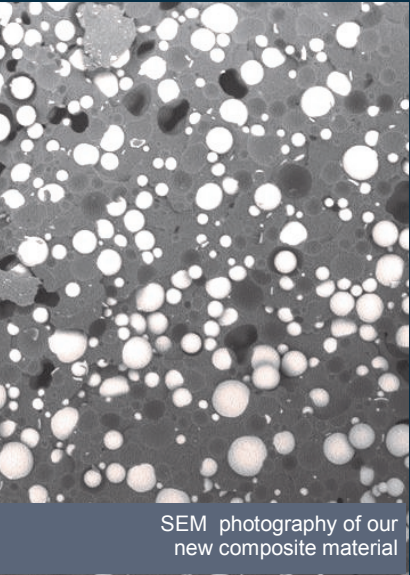
With this program, they measured the displacement of the arrow after an impact with the arrow rest. A higher displacement implies a greater perturbation from the impact. The graph below

shows that **the Impulse vane performed better than the spin vane.**



NEW MATERIALS

To achieve the performance of the Impulse, we have used novel composites typically used in the aero space industry. This enabled us to reduce the weight by 50% while maintaining the durability archers are accustomed to find with the Bohning products.



SEM photograph of our new composite material



COMPLETE TESTS AND ANALYSIS RESULTS ON THE IMPULSE VANE

Check out our website for full articles on the tests performed. <http://www.bohning.com/assets/news/pdfs/Questions--Answers-Impulse---December-15th-2011---PDF.pdf>