EXPANDABLE BROADHEAD

IRON WILL

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DESIGN CENTER COLORADO

Background

- Iron Will Outfitters specializes in fixed blade broadheads for hunting big game animals
- Fixed blade broadheads are simple, reliable, and durable, but are less aerodynamic with smaller cutting diameters

Objective

- Design and manufacture two types of expandable broadheads that improve upon existing products
- Test and analyze our broadhead designs against existing products through simulations and dynamic tests

Primary Requirements

- ✓ Must have a cut diameter over 1.75”
- ✓ Blades must not deploy in flight
- ✓ Blades must deploy upon contact with target
- ✓ Lower penetration force than competitors
- ✓ Must weigh 100 or 125 ± 3 grains
- ✓ Lower drag and lift forces than Iron Will fixed blade
- ✓ Blades must not collapse while cutting
- X Broadhead must be reusable up to 3 times

Design Process

1. Benchmarking
2. Ideation and design formation
3. Prototyping with Al 7075 ferrule and 4130 steel tips and blades
4. Fit check and performance evaluation
5. Final design updates
6. Final manufacturing with grade 5 titanium ferrules and A2 tool steel tips and blades
7. Assembly, testing and analysis

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Phantom Claw (PC)

Frontal pivot expandable broadhead with a spring-loaded blade retention and deployment mechanism

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Weight: 99.4 Grains
Length: 1.94”
Closed Diameter: 0.75”
Cutting Diameter: 1.75”
Interchangeable blades: 125-Gr with 2.0” cutting diameter

Iron Fang (IF)

Slip cam expandable broadhead with an integrated detent blade retention mechanism

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- Weight: 96.3 Grains
- Length: 1.99”
- Closed Diameter: 0.96”
- Cutting Diameter: 1.81”

Synthetic Test Stack

Designed to represent an elk shoulder, enabling data collection that is representative of a real hunt

Deer Hide	0.25”
Ballistics Gel	3.0”
Synbone	0.25”
Ballistics Gel	3.0”

Synbone mimics cortical bone, the hard exterior shell on bones

Low Speed Penetration Test

Performed to measure force to deploy blades and penetrate through stack

Results

- PC 125: Did not penetrate bone, tip bent. Blades partially deployed
- IF: Lowest force to penetrate Synbone (240 lbf). Blades partially deployed
- Competitors: Broadheads 1 and 3 did not penetrate bone, with only competitor 1 fully deploying

CFD

Performed to obtain drag and lift coefficients and visualize high pressure areas

Results

Broadhead	Coefficient of Drag	Coefficient of Lift
S 100	0.30	0.39
PC 100	0.36	0.37
IF	0.35	0.29

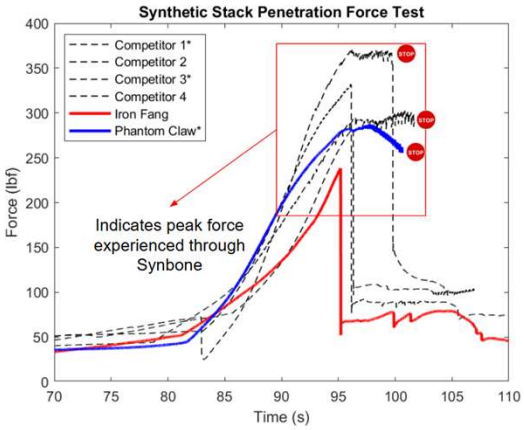
- Iron Will S100 has the lowest coefficient of drag
- IF has the lowest coefficient of lift
- Comparing all CFD results, the IF performs the best on average

Shooting Penetration Test

Performed to measure cutting diameter through stack and observe deployment and broadhead durability

Results

- PC 100: Successful flight and deployment with blade collapse after first layer of gel, no damage from test stack
- IF: Successful flight and deployment with no blade collapse, with the untreated blades fracturing at Synbone. Blades remained intact after heat treatment
- Competitors: Minor to no damage with some showing moderate blade collapse



Phantom Claw Fluid Analysis

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Next Steps

- Conduct a greater number of tests for each broadhead to obtain greater accuracy of data
- Iterate designs to eliminate failure points and further optimize retention and deployment
- Heat treat steel components to increase yield strength and hardness