

COMMERCIAL / TECHNICAL OVERVIEW

# Arrow Intelligence

*How BowPro+ combines continuous dynamic-fit modeling with exhaustive arrow auto-configuration.*

BowPro+ uses one physics-informed description of the complete arrow for two complementary jobs. It can evaluate an arrow the archer has already built, and it can search a component catalog to design arrows that satisfy the active bow, safety rules and performance objectives.

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| <p>01</p> <p><b>Dynamic Arrow Fit Modeling</b></p> <p>Evaluates a specific finished arrow against the active bow. It translates static spine into a continuous build-specific response and explains the direction and degree of mismatch.</p> | <p>02</p> <p><b>Arrow Auto-Configuration</b></p> <p>Searches compatible shafts, lengths and components, rejects impossible or unsafe combinations, and ranks a short list of complete arrows against the archer's objectives.</p> |
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## One mechanical model, two user workflows

The shared foundation is the finished arrow—not a catalog spine label. Shaft spine and GPI, actual cut length, point system, inserts or outserts, nock, wrap, vanes and count are assembled into an explicit mechanical build. BowPro+ derives total arrow weight, balance point, FOC and mass distribution, then compares the arrow with the way the active bow delivers energy.

- Dynamic Fit asks: How will this completed arrow respond when this bow launches it?
- Auto-Configuration asks: Which complete, buildable arrows best match this bow and the archer's stated priorities?
- Both workflows return continuous numerical results and a human-readable explanation rather than a single chart cell or unexplained recommendation.

**The central distinction**

Dynamic Fit evaluates one explicit build. Auto-Configuration constructs and evaluates many explicit builds. The same fit model therefore supports both diagnosis and design.

## Why a chart lookup is not enough

Traditional spine charts remain useful as a first screening step, but they group bows and shafts into broad bins. They cannot fully distinguish two arrows made from the same shaft when length, front assembly, rear components or mass distribution differ. They also cannot describe how a particular bow's power stroke and energy-delivery profile change the demand placed on the shaft.

BOWPRO+ MODEL FOUNDATION

# Build the Arrow That Actually Exists

*From static spine and component data to a continuous, bow-specific mechanical response.*

## The complete arrow is the unit of analysis

A shaft’s printed spine number is only a starting point. The arrow that leaves the bow is a complete mechanical system, and component changes can alter several outputs at once: compliance, total mass, grains per pound, balance point, FOC, launch speed and trajectory.

| Input or choice                  | Mechanical consequence                                                                          |
|----------------------------------|-------------------------------------------------------------------------------------------------|
| Cut length                       | Changes shaft compliance and the lever arm through which front mass acts.                       |
| Point, insert or outsert         | Changes front inertia and normally increases the bending demand near launch.                    |
| Nock, wrap and vanes             | Changes total mass, rear inertia and the finished balance relationship.                         |
| Vane count and package           | Changes the specific finished build rather than merely selecting a generic default.             |
| Draw weight and draw length      | Define part of the launch-side demand applied to the arrow.                                     |
| Power stroke and energy delivery | Distinguish a softer loading profile from a more aggressive system at similar peak draw weight. |

## Why weight distribution matters

Total arrow weight alone is not enough. Two arrows can share the same total mass while placing that mass differently. A front-heavy build concentrates more inertia ahead of the shaft’s working length; a shorter shaft may recover stiffness, while a longer shaft increases compliance. Rear components alter total mass and balance without producing the same launch-side effect as front weight.

### FOC is part of the model, not decoration

BowPro+ calculates finished balance from the component build and uses the front-loading relationship in the dynamic-fit assessment. This allows arrows with the same nominal spine—or similar total weight—to be compared on the basis of how they are expected to behave under acceleration.

## Continuous response instead of category jumps

BowPro+ normalizes nominal static spine for the selected length and completed build, producing a continuous estimated response. A finished arrow can therefore sit between commercial spine categories while the nearest catalog spine remains available as a purchasing reference.

## The bow is part of the equation

Dynamic fit is a relationship between bow and arrow. BowPro+ supplies bow-side loading from draw force, draw length, power-stroke behavior and energy delivery, then compares that demand with the completed arrow’s resistance to bending. Poundage alone does not define the result.

BOWPRO+ SEARCH PIPELINE

# From Requirements to Buildable Candidates

*A staged rules engine removes impossible arrows early and reserves detailed analysis for credible builds.*

## 1. Define the search space

The active bow and the archer’s objectives establish the valid boundaries. Inputs can include actual draw weight, draw length, power-stroke characteristics, safe minimum shaft length, intended use, preferred mass, FOC limits, point-weight range, shaft diameter, manufacturer preferences and permitted shaft families.

## 2. Construct complete candidates

For each compatible shaft and commercial spine, BowPro+ combines usable cut lengths with compatible inserts or outserts, points, nocks, vane packages, wraps and optional front or rear mass. Every permutation becomes an explicit finished-arrow candidate—not an abstract shaft recommendation.

## 3. Apply hard rejection rules

Invalid candidates are removed before detailed scoring. This prevents an attractive performance score from rescuing a build that is physically impossible, unsafe or incompatible.

| Hard constraints                                                 | Optimization targets                                            |
|------------------------------------------------------------------|-----------------------------------------------------------------|
| Required safe finished length cannot be achieved.                | Closest fit to the preferred dynamic-response region.           |
| Insert, outsert, point or nock is incompatible.                  | Desired total mass and front-of-center balance.                 |
| Mass or grains per pound is outside mandatory limits.            | Practical component choices and available commercial sizes.     |
| FOC or dynamic response is clearly outside the permitted window. | Speed, trajectory, momentum or retained-performance priorities. |

## 4. Calculate and score the survivors

Candidates that pass the rules receive the full mechanical assessment. BowPro+ derives finished mass, mass distribution, balance point, FOC and continuous dynamic response, then applies bow-side loading and any requested ballistic objectives. The score describes the quality of the complete solution rather than one isolated number.

### Why staged filtering matters

A broad component catalog can imply hundreds of thousands of theoretical combinations. Early compatibility, geometry, safety and mass checks keep detailed calculation focused on credible candidates without reducing the search to a handful of preselected chart answers.

## 5. Return a useful shortlist

The final output is normally a small set of technically defensible builds: the best overall match and meaningful alternatives, such as a lighter trajectory-oriented option, a balanced all-round configuration or a heavier momentum-focused build. Each recommendation can state why it ranks well and what trade-off it represents.

BOWPRO+ FIT MODEL

# How BowPro+ Determines Good Fit

*A continuous, multi-objective assessment of bow-to-arrow compatibility—not a single pass/fail chart cell.*

## Good fit is a preferred region

Real bows, arrows and shooters operate within tolerances. BowPro+ does not claim that one exact dynamic-spine value is perfect and every neighboring value is wrong. It evaluates a preferred fit window, grades how close the completed arrow is to its center and retains mandatory safety and use-case limits.

| Assessment area       | What a strong candidate demonstrates                                                                                    |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------|
| Dynamic compatibility | The completed arrow is close to the bow's preferred response, with no material weak- or stiff-side mismatch.            |
| Structural margin     | Safe finished length, mass and component configuration remain appropriate for the bow and intended use.                 |
| Total mass            | The build is near the selected grain, grains-per-pound or performance objective without artificial component choices.   |
| FOC and balance       | The center of mass remains in the chosen region and is achieved with a practical distribution of front and rear weight. |
| Build practicality    | Components are compatible, commercially available and reasonable to assemble, cut and maintain.                         |
| Ballistic suitability | Where requested, speed, trajectory, retained velocity, energy or momentum support the selected purpose.                 |

## Scoring separates acceptable from exceptional

After mandatory rules are satisfied, graded penalties describe deviation from preferred values. A build near the edge of an acceptable dynamic window may pass, but it ranks below a build near the preferred center. The same logic can be applied to total mass, FOC, shaft length, component extremes and ballistic objectives.

### Explainable recommendations

BowPro+ does not merely announce that one shaft is “correct.” It can show the estimated dynamic value, the reference or ideal value for the active bow, the percentage difference, the fit grade and the component changes most likely to move the build toward the preferred region.

## The result remains useful after the recommendation

- Compare point, insert, length, vane and rear-component choices before cutting or buying shafts.
- See how a heavy-front build changes dynamic fit without confusing total mass with mass position.
- Evaluate strong alternatives rather than forcing target, all-round and hunting priorities into one answer.
- Use numerical output and fit labels such as weak, slightly weak, good fit, slightly stiff or stiff to guide real-world tuning.

BOWPRO+ COMPUTATIONAL SCALE

# Thousands of Builds, One Shortlist

*The combinatorial work behind a recommendation that appears simple on screen.*

## How quickly the search space grows

A moderately broad search can include 30 shaft or spine variants, 7 usable lengths, 5 insert systems, 7 point weights, 3 nocks, 5 vane configurations and 3 wrap or rear-weight options:

$$30 \times 7 \times 5 \times 7 \times 3 \times 5 \times 3 = 330,750 \text{ possible combinations}$$

The number is illustrative rather than a fixed product limit. A focused search may be much smaller, while a broad manufacturer-independent search can exceed one million theoretical permutations.

| Search stage                    | Typical order of magnitude | What happens                                                                               |
|---------------------------------|----------------------------|--------------------------------------------------------------------------------------------|
| Theoretical permutations        | 50,000–300,000+            | All combinations implied by shafts, lengths and component choices.                         |
| Compatibility and geometry pass | 5,000–30,000               | Impossible parts, unsafe lengths and obviously invalid mass combinations are removed.      |
| Mechanical fit candidates       | 500–5,000                  | Finished mass, FOC and preliminary dynamic response are calculated.                        |
| Detailed scoring shortlist      | Tens to hundreds           | Full multi-objective scoring separates strong, marginal and purpose-specific alternatives. |
| User-facing recommendations     | Usually 3–10               | The best overall result and useful alternatives are presented with reasons.                |

## What the archer gains

- A better starting point before cutting, buying or rebuilding arrows.
- Exhaustive comparison without manually recalculating every component change.
- A short list of buildable choices supported by compatibility, safety, mechanical fit and optional ballistic objectives.
- A repeatable explanation of why one build ranks above another.

## Precision without pretending tuning is automatic

BowPro+ is an engineering decision tool, not a substitute for safe construction, shooting, paper tuning or broadhead validation. Its value is that those processes begin from a much more precise description of the equipment. Modeling the complete arrow and the way the bow loads it narrows the search space, exposes component effects and makes arrow selection repeatable and explainable.

### In a nutshell

BowPro+ does more than recommend a shaft. It evaluates the arrow the archer is actually shooting and designs complete arrows the archer can actually build—matched to the bow, constrained by real components and ranked against real objectives.