Christophe Roelofse

Ketty PhDee

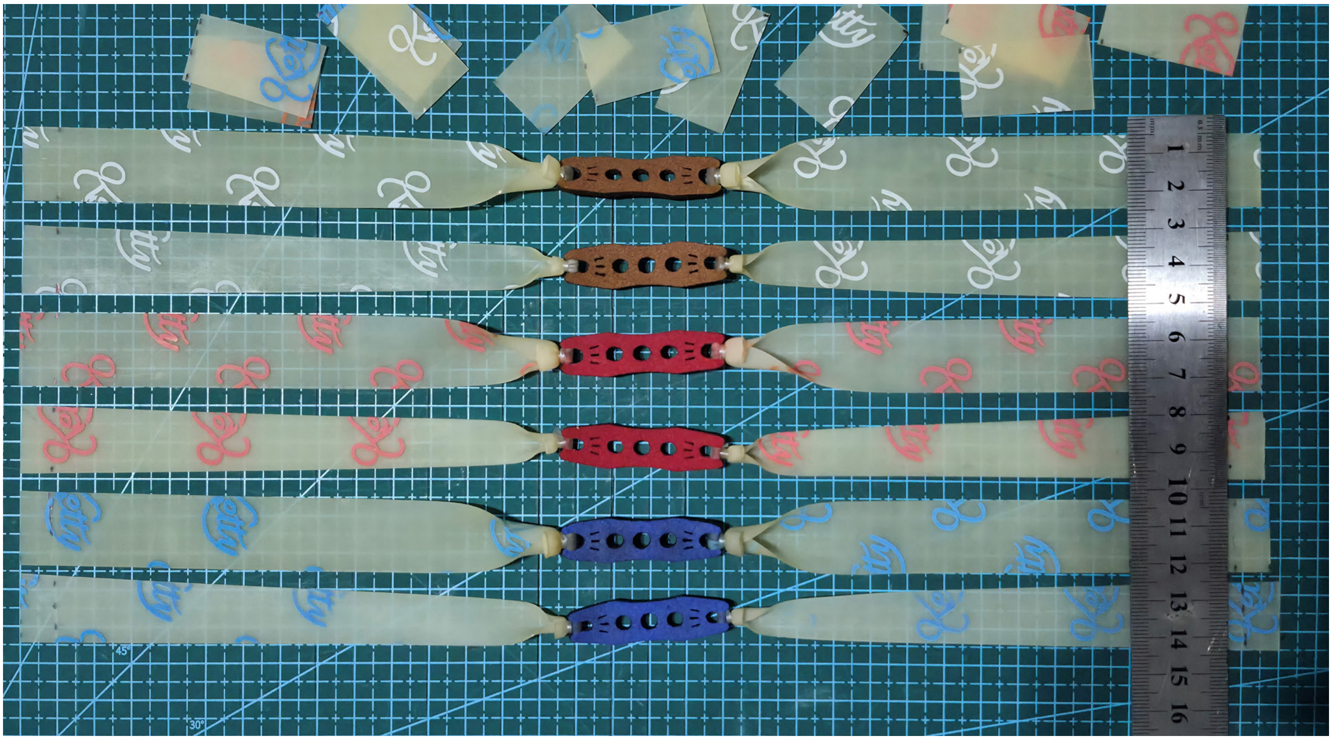
PART 9: *KETTIE* SHOOTING

Component metrics – Theoretical Band Physics, SC v. TC.

Welcome Forkers, we are now truly in the PHDee phase. In part 8, we looked at elastic band theory and physics and started a scientific field study on real-world flatband performance to understand the significance between straight-cut (SC) and taper-cut (TC) band geometry and performance. In this part, we continue the quest to truly understand: Your *kettie* and specifically the flatbands as a propulsion system for a projectile required to impact and eliminate (knock down) the target.

Memo – this is Ketty PHdee

We continue our deep dive into theory, focusing on specific metrics (elements) of the PAM (Precision and Accuracy Matrix) as a practical resolve, to "Achieve our objective in this series to get you, as a *kettie* athlete, to the 10 m standard discipline shooting range line." To make you a champion, we need to advance your (a) practical knowledge, (b) basic experience, and (c) critical equipment (such as "flatbands") to the next level. However, performance remains ultimately up to you – so keep an open mind and be prepared for an expedient (d) elective knowledge learning curve (self-discovery) to become a competitive athlete within one season. I will unequivocally not apologise for any incursion on industry prerogatives, the art, cultural, or historic beliefs regarding Slingshot shooting. This is my teaching: use it – or lose it, period!



The standard KETTY ELITE PRO Flatband Sets used in the tests. Top down: White - 0.6 SC & TC; Pink - 0.50 SC &TC and Blue 0.55 SC & TC. Note the unique refined Ketty wrap & tugg pouch binding.

Précis

"Taper-cut bands shoot faster (yield more velocity) than straight-cut bands". The basic hypotheses assume that a "tapered band" will yield more velocity (give more speed) – presumably based on the same draw length and the same geometric width, but tapered. It is said to have less "torque" (power to set in motion, to propel), as opposed to a straight cut band (with the reverse effect and benefit of relative longevity). In other words, take your ideal straight-cut band and just taper it. Part 8 suggested the performance yield model of the (i) straight-cut (disadvantage, if any?) versus (ii) taper-cut (advantage, if any?) answer is not as straightforward as it seems. The pragmatic resolve is finding the "tipping-point" between SC versus TC. It is generally believed that a taper-cut band could yield better (higher velocity) performance, only under two conditions: (A) if the elastic band has the same volume (mass), and (B) at the same draw strength (weight). I am of a different opinion. Remember not to confuse draw length with draw weight.

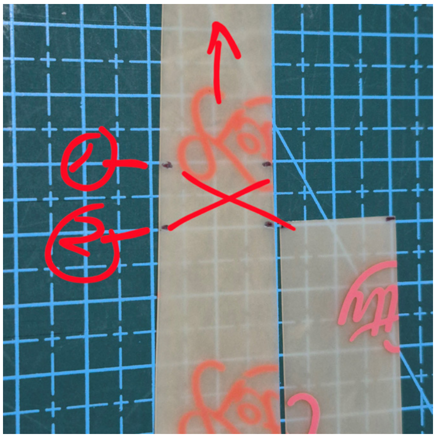
Trial

Doubt the supposition, caveat all – the pilot trial: Take two bands of equal geometrics, except for the taper and shorten the taper-cut band, in small increments, critically optimising the length to where the band has the same draw strength (strain/stress) as the straight-cut, and observe and compare velocity values against the straight-cut results. If the values are analogous to the straight band (but with less latex rubber material), it stands to reason that a taper-cut with the same material metric volume, wider at the forks and narrower at the pouch, should provide higher velocity. Of course, this method does not actually render a serviceable band solution because the band would be over-stressed and the improvement, if any, would be rather mediocre. But it does demonstrate the principle and warrants further investigation and experimentation.

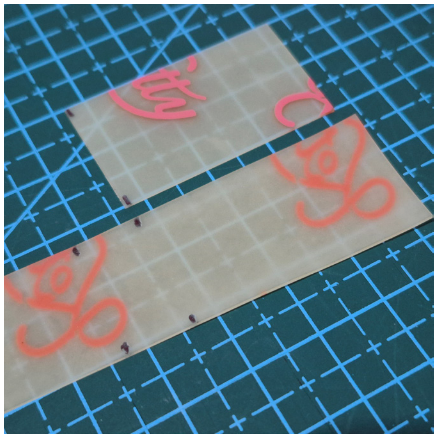
Experiment 1.4

The parameters for "bands to bands" assessment were set at band gauges from the same (A) the same gauges, (B) same production batches, (C) same pouches (from the same batches), (D) same steel pellets, and (E) a consistent environment (temperature and wind) – with a proper test bench set-up, to ensure (F) consistent angles, draw lengths, etc and (G) release unbiased, with a (H) valid statistical data set of 30 shots each. Notes: Velocity was measured 30 cm from the fork (bow). Each band was fitted and warmed up with three (3) draws at 0.25 cm/s (per second), same with each

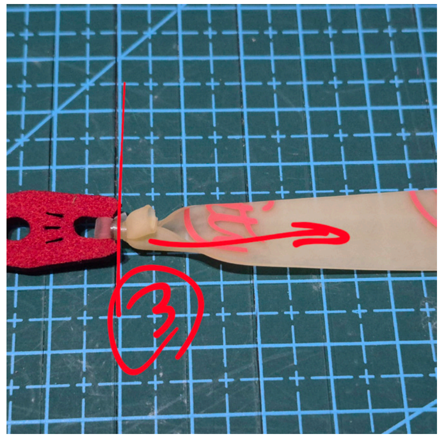
KETTY PROFESSIONAL ELITE - Flatbands Taper Cut V Straight Cut				
Stretch ratio 1:4 (manufacturer recommendation 1:5)				
Pro Elite	Pellet mm	Draw (Pull) length:	Velocity (Ave)	
		Temp:	Ve fs	+ > < - fps
0.45 YELLO	8	15 mm x 160 (160 active)	183.13	0.7
Ave draw weight: 4.9 ft-lb | Draw 670 mm | **Stretch ratio 1:4.**				
0.50 Pink	8	20 mm x 160 mm SC	211.74	0.8
Ave draw weight: 7.2 f ft-lb | Draw 670mm | **Stretch ratio 1:4**				
0.50 Pink	8	20 mm-12 mm x 160 mm TC	204.73	2
Ave draw weight: 5.4 f ft-lb | Draw 670 mm | **Stretch ratio 1:4**				
0.55 Blue	8	20 mm x 160 mm SC	209.85	1.4
Ave draw weight: 7.55 f ft-lb | Draw 670 mm | **Stretch ratio 1:4**				
0.55 Blue	8	20 mm-12 mm x 160 mm TC	212.15	2
Ave draw weight: 6.4 f ft-lb | Draw 670 mm | **Stretch ratio 1:4**				
0.55 Blue	8	20 mm-12 mm x **145 mm TC**	**231.73**	0.8
Ave draw weight: 7.55 ft-lb | Draw 670 mm | **Stretch ratio 1:5**				
0.60 White	8	20 mm x 160	227.04	1.9
Ave draw weight: 10.2 ft-lb | Draw 670 mm | **Stretch ratio 1:4**				
0.60 White	8	20 mm-12 mm x 160	223.74	1.7
Ave draw weight: 7.30 ft-lb | Draw 670 mm | **Stretch ratio 1:4**				
Note: Active / Passive band length is 160 mm, which ideally with the x 5 factor represent a draw of 800 mm. **Deviation:** The experiment used the 160 mm band at a draw length of only 670 mm, conversion ratio of x 4.18 (technically should be 136 mm band / 67 cm draw), to simulate a average "weak draw" (since most inexperienced users do not tune their bands to the correct optimal length).				



No 1 & 2 shows the cut position and seating depth (in this case 1 cm / 10 mm)



Band tuning, cutting the bans shorter, and marking the seating depth - for precise set-up



No 3 indicates the start point to measuring the flatband, in this case 13.6 cm + 1 cm for seating.

of the data point shot draws, 20-second delay between shot releases, with shot release in more or less two seconds on dead-stop draw. The draw length was set at 67 cm (670 mm). But the relaxed band measurement was 160 mm, measured from where the band protruded from the fork to the tie at the pouch.

I decided to use the 160 mm band at a draw length of only 670 mm instead, with a conversion ratio of 1:4 (instead of the manufacturer's recommendation of 1:5 – technically 136 mm band / 67 cm draw – see: Experiment 5.0). I wanted to simulate a typical average "poor set-up" (since most inexperienced users do not tune their bands to the correct optimal length). It will also exaggerate and highlight the band performance indifferences. The Bow (fork) – model: Ketty Phantom, prongs set at 90 mm, OTT (Over the Top) with the fork (bow) at 180 degrees (upright). The draw weight is measured with certified push-pull instrumentation.

Observations

Let's focus on the Ketty Elite Blue 0.55 mm natural latex flatband set. The Blue seems to be the ideal balance, if we consider that the data shows the Taper Cut (TC) outperformed the Straight Cut (SC) by a 2.3 fps average, at a marginal less draw weight (pull force) of only 6.40 ft-lb to the SC 7.55 ft-lb. But – would this be valid at full draw strength. The difference between the Blue 0.55 SC and TC is a marginal 1.15 ft-lb, as opposed to White 0.60 at 2.8 ft-lb and Pink 0.50 at 1.8 ft-lb. This revelation is very significant! We will circle back to this phenomenon later. Less effort for the same performance!

It is important to note the velocity extreme spread, thus the difference between the fastest and the slowest recorded velocity of 1.4 fps for the SC as opposed to the 2 fps of the TC band set.

At the same draw length, of 670 mm, at 6.4 ft-lb, if the TC flatband set draw release was increased to about one second, the average velocity increases 214.02 fps (as opposed to 212.15 at 2 seconds), and at more or less three seconds it decreased to 211.34 fps, and at seven seconds 209.60 fps. Interestingly, there seems to be a steady (linear?) increase in extreme spread – as the release period is extended (extended), 0.7 fps (1 sec), 0.8 fps (3 sec) and 1 fps (7 sec).

Furthermore, it is interesting to note that in relation to the Blue SC band set of 7.55 ft-lb, the TC performance in velocity increased considerably with an increase in draw weight: At 6.6 ft-lb draw weight, the average velocity was recorded as 224.33 fps, representing a 1 cm shorter band at 150 mm. At 6.90 ft-lb, average velocity 231.73 fps, and at 7.55 ft-lb, practically matching the TC draw weight, an average velocity of 234.96 at the standard dead-stop to release time of 0.75 – 1.0 seconds. However, at a release time of approximately two seconds, the recorded velocity dropped to 231.73 fps, which is an average of 3.69 fps.

The Blue TC band set, increased the velocity of 231.27 fps over the SC band set at 209.85 when measured at the same draw length and strengths (pull weight of 7.55 ft-lb), yielding 21.24 fps faster, representing a phenomenal 9.1% increase in velocity.

9 mm steel pellets: Just for interest sake, let's look at basic performance difference for the Blue 0.55 SC and TC band sets with using 9 mm steel pellets, with 160 mm bands at the same draw length of 670 mm, the SC (at 7.55 ft-lb) yielded average of 194.30 fps the TC (at 6.20 ft-lb) yielded and average velocity of 189.94 fps. If these figures are viewed in terms of the 8 mm results, where the TC outperformed the SC admirably, you can surmise my claim that taper cut bands have less torque to move heavier objects at the same draw length.

Experiment 5.0

The experiment followed the same methodology as experiment 1.4, including the short 67 cm (670 mm) draw length, only this time the formula ratio of 1:5 (136 mm / 13.6 cm) as prescribed by the manufacturer, Ketty (Pty) Ltd, was followed. The difference is remarkable. This is a real-world test – simulating actual shooting conditions.

Observations

It is clear from the results – that a more expected gradual (linear) pattern emerge, as appose to the very weak draw exercise. Obviously the draw weight of SC is heavier than TC bands. What is interesting is the draw weight curve (behaviour), and we will circle

KETTY PROFESSIONAL ELITE - Flatbands Taper Cut V Straight Cut								
Band type	Draw Avg	Max V	Min V	Avg V	X Sprd	Std Dev	Avg KE	Avg PF
Pink 0.50 SC	8.69	238.9	236.8	237.5	2.1	0.6	4.1	7.7
Pink 0.50 TC	6.42	227.2	223.0	225.0	4.2	1.1	3.7	7.3
Blue 0.55 SC	9.57	238.6	235.2	237.3	3.4	0.9	4.1	7.7
Blue 0.55 TC	7.10	237.7	233.8	235.2	3.9	1.3	4.0	7.6
White 0.6 SC	11.22	254.7	250.5	252.5	4.2	1.1	4.6	8.2
White 0.6 TC	8.44	254.6	250.2	252.4	4.4	1.3	4.6	8.2

Note: Band length: 13.6 cm (136mm) / Draw time (Speed) 2 seconds / Release time varied – 1-3 seconds. There was no pre-stretching; the data was recorded from the first draw (shot), which is very significant. SC (Straight Cut) Bands measured 20 mm at the prong (clip) and TC (taper cut) measured 18 mm (12 mm at the pouch).
Key: Draw Avg = Draw weight average (pull force) foot pounds (Fp), Max V = highest speed recorded, Min V = lowest speed recorded, AVG V = average speed recorded, X Sprd = extreme spread (difference between the highest and lowest speed), Std Dev = standard deviation speed, Avg Ke = average kinetic energy foot pounds, Avg PF = average Foot Pound energy (Fpe).

back to that in future. The difference in draw weight between SC and TC is clear: Pink 2.27, Blue 2.47, and White 2.78, representing an average of 2.50 ft-lb, which is a significant saving in energy with practically insignificant velocity performance. The standard deviation for SC seems significantly less, and this will translate into CEP (Circular Error Probable) performance, in other words, “group sizes” in practice - precision versus accuracy.

Summation

In the murky grey of assumptions and suppositions, the data sends the mind down the proverbial latex spiral rabbit hole. What is very important to me – and should actually be the only issue at stake – is the insignificant practical variation between my tests results in this real world test results (above) and a separate baseline test under perfect laboratory conditions, with controlled temperature, exact pull force and pull length, draw speed (time) and release time, the results are actually stunningly repeatable within 1 fps repeatability. There is no doubt that the KETTY PRO ELITE range is exactly what it claims to be: Dedicated slingshot bands for precision shooting, and it leaves little doubt that it is most likely the finest in the world.

Lesson

It is extremely important to understand that a very good latex rubber band is essential to the performance of your slingshot. There are so many variables that you can ill afford poor and inconsistent band performance. How you implement and extract the best performance is up to you.

Your mind should now be spinning with questions. Example: Is it better to rather use a narrower SC band (let’s say 17 mm) as opposed to 20 mm-12 mm TC? Since the Standard Deviation suggests inconsistent snap-back (compression) performance - but a better draw weight curve and lighter weight hold. This is the joy of slingshot technology and dynamics – it is extremely complicated. Now you know why there are so many very intelligent people who are totally fascinated and consumed by the science of slingshot shooting.

Thank you for participating in this exciting phase of the Ketty PHDee series. In the next part, we will continue to discuss band performance, touch on the significance of pouch metrics and circle back to pellet jump, leading on to shooting actual shooting techniques.

The image demonstrates - the marginal lengthening of the bands after 30 shots. It does not increase after 10 - 300 shots)