Scientific Crossbow Test

PSE has been in the crossbow market for years, and throughout that period, it has been producing various compound style crossbows. The most recent designs are far advanced from the older models. The PSE models of today are even superior to many of the competitors' products available this year. After quickly reviewing the performance information online for the 2010 PSE TAC 15i, I was somewhat in awe. The TAC 15i is producing speeds I have yet to see from a crossbow. With that in mind, I was very interested in performing a product evaluation.

The TAC 15i crossbow from PSE is a complete integrated unit. It is based on the Tac 15 which preceded it by an year and which was designed to mate to the receiver and stock of any rifle based on the popular AR 15 platform. PSE also sells more compact Tac 10 and Tac 10i models. Note the absence of a foot stirrup. This powerful crossbow has to be cocked by a crank.

The TAC 15i went through a standard and regimented performance test. The focus of these types of tests is to determine, for a specified product, the performance characteristics. Additionally, the goal is to provide those archers that enjoy shooting and/or hunting with appropriate objective information, as well as some subjective commentary, for aiding in the purchase process. With that said, this evaluation is by no means conclusive. Each archer should assess what is important to him or her and interpret the results within the context of this article. As always, I recommend that anyone who is considering a crossbow, shoot as many different makes and models as possible to determine what best suits their individual needs and desires.

Due to the lack of testing methods and procedures available publically for crossbows, testing guidelines were developed and published in 2009. These testing guidelines remain unchanged since 2009, and I continue to use these methods to evaluate crossbows.

Production Information and Testing

Introduction: PSE is an Arizona based company that has been designing archery products for many years. The company is recognized in the industry as being very innovative and extremely knowledgeable when it comes to developing new technologies. With that understood, it is no surprise that the TAC 15 crossbow was developed. The most recent version of the TAC 15, known as the TAC 15i, maintains that high level of performance as compared to its brother. The TAC 15 and TAC 15i stand together as products that are unique from others because of their tactical look.

During the 2010 Archery Trade Show, I was fortunate to get some time with the PSE engineering team that developed the TAC 15i. The distinctive look and matchless speeds of the TAC 15i suggest that this group of engineers is keen on thinking outside of the box. The PSE staff revealed many details of the trials and tribulations that went into this product. Their efforts and research have created a product that is more technologically advanced than some of the previous products that have gone through my tests.

The TAC 15i is slightly different from its brother the TAC 15 as the product has an integrated stock, while the original TAC 15 required the customer to use his own "lower" from an AR 15 rifle. The stock is fully adjustable,comes as a complete package and has the following components: TAC crank, Telescopic sight (Accushot 3-9X44 30MM tube) with mounting hardware, PSE TAC arrows, safety glasses, instructional DVD and manual.

Background on Testing: The TAC 15i is designed without a traditional stirrup and has an integrated drawing mechanism. These two unique features are something that I am not used to when testing crossbows. With that said, I was skeptical that my drawing/shooting fixture would even allow me to test the TAC 15i. Fortunately, with some slight modifications to my fixture I was able to control, draw and test the product. One other thing to mention, when I was testing the product in my fixture I was very impressed with the ease of drawing the crossbow with the crank mechanism (TAC crank). I will discuss the crank and other features later in this article.

So without further delay, here are the test results. The crossbow dimensions/weights measured out of the box:

Dimensions

Model	Axle to Axle	Axle to Axle (full draw)	Powerstroke	Overall Length	Mass Weight (including scope)	Mass Weight (without scope)
TAC 15i	17.0625"	12"	17.5"	41.25"	10 lbs	8.2 lbs

By Jon Teater

Peak Force		154.0	lbs
Stored Energy		191.3	lb-ft
Dynamic Efficiency	425 grains	79.9	percent

shot		Weight (grains)	Chrono 1	Chrono 2
	1	425	402.8	400
	2		402.4	399
	3		402.3	399
	4		402.2	399
	5		402.6	399
avg (fps)			402.5	399

	Weight	Speed Per Inch of PS	
Speed per inch of Powerstroke	425 grains	23.0	
	Powerstroke (inches)		17.5

Next, the crossbow went through a thorough inspection. The review focused on string and cables, eccentrics, limb and limb pockets, rail, stock, butt plate, trigger housing, trigger and trigger guard. After a thorough review of the TAC 15i, I was unable to find any blemishes. As you can guess, I was very impressed with PSE. I believe that PSE's focus on workmanship and all of their in-house capabilities results in products leaving their facility with a clean bill of health.

Thereafter, I put the product through a 100-150 shot cycling to verify functionality. Some minor testing is performed, but the focus is to detect any issues or concerns with the product before starting the actual performance testing. No different from the physical inspection, the product did not have any issues noted. The crossbow is next evaluated on the five criteria outlined below:

Test Category	Assessment
Dynamic Efficiency	Provides an indication of the amount of energy output by a crossbow relative to the energy expended through drawing the crossbow back. An assessment is made with multiple projectile weights.
Speed per inch of Powerstroke	Provides an indication of the amount of speed output by the crossbow over the distance from the full-draw position to the static brace height position. An assessment is made with multiple projectile weights.
Noise Output	Provides an indication of the noise output characteristics of a bow at the "point blank" range utilizing a series of shots with multiple projectile weights.
Trigger Force	Provides an indication of the amount of force required to discharge a given crossbow.
Precision Test	Provides an indication of how close groups are shot together by shooting from a bench rest or other supportive device.

Detailed Test Results

Dynamic Efficiency: The dynamic efficiency portion of the test utilizes a Revere Load-Cell controlled by a winch device; the load-cell connects to the crossbow with a cocking aid. The crossbow is mounted in a shooting platform that controls any movement that might be experienced as Force-Draw curves are taken. The stored energy obtained from the Force-Draw curve is used in conjunction with speed measurements to calculate dynamic efficiency shown in the chart at the top of this column.

Speed and Performance Measurements: Speed measurements were taken with one projectile. A 2009 Pact Chronograph XP and a Competition Electronics Pro-Chrono IR are set in tandem to record results. The average speed measurement is divided by the powerstroke to determine the speed per inch of powerstroke. See the twin charts above.

Noise Output: Sound measurements for the TAC 15i were recorded with one projectile. The measurements were averaged and the sound meter was set to A-weighted filter (a setting which mimics the human ear). A CEL-430 sound level meter is used for this test.

PSE TAC 15i

Contact Info PSE
www.pse-archery.com

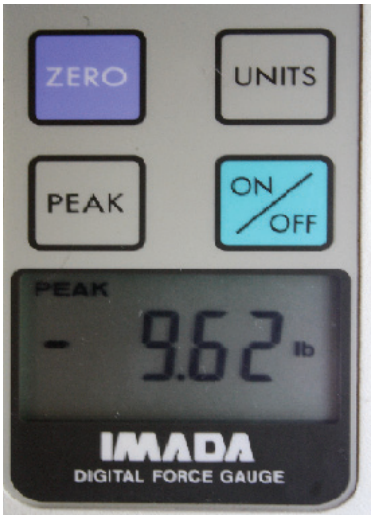
MSRP	$1,599.99	Finish	Hard anodized aluminum
String Material	BCY 452X with BCY Halo Serving	Stock	AR-15 compatible
		Limbs	XTech™

Performance at a Glance

Arrow	Speed	K.E.	Momentum
425 Grains	402.5	152.9	24.4

Sound Measurements	
Weight (grains)	425
Parameter	Peak A -Weighted Noise (dBA)
1	~~94.2~~
2	94.3
3	~~95.0~~
4	94.7
5	94.4
6	94.8
7	94.5
8	94.7
9	94.5
10	94.9
Average	94.6

Trigger Analysis	
	Trigger Pull (lbs)
1	9.55
2	9.75
3	~~10.21~~
4	10.10
5	9.72
6	9.64
7	9.67
8	~~9.52~~
9	9.52
10	9.62
11	9.71
12	9.67
13	9.62
Avg Trigger Pull	9.69
Distance Traveled	.3175"



This was the figure recorded on two of the trigger pull cycles.

Trigger Force: The Trigger Force measurements were recorded in pounds and averaged. An Imada Digital Force Gauge is used in determining the Trigger Force.

Precision Measurements: Provides an indication of how close groups were shot together when shooting by hand from a bench rest or other supportive device. Extreme spread is the method used to calculate group size.

The Initial Review

I was very eager to start testing after the PSE package arrived. The crossbow was well contained inside the package. Upon opening the package, I quickly looked at all the componentry and took note of the numerous accessories. The product required some minor assembly and mounting of the telescopic sight, which is detailed in the instructional manual. The total assembly took less than ten minutes.

Right after I completed the assembly, I read the remainder of the instructional manual and watched the DVD. The information provided in both documents adequately details the steps required to draw and fire the crossbow.

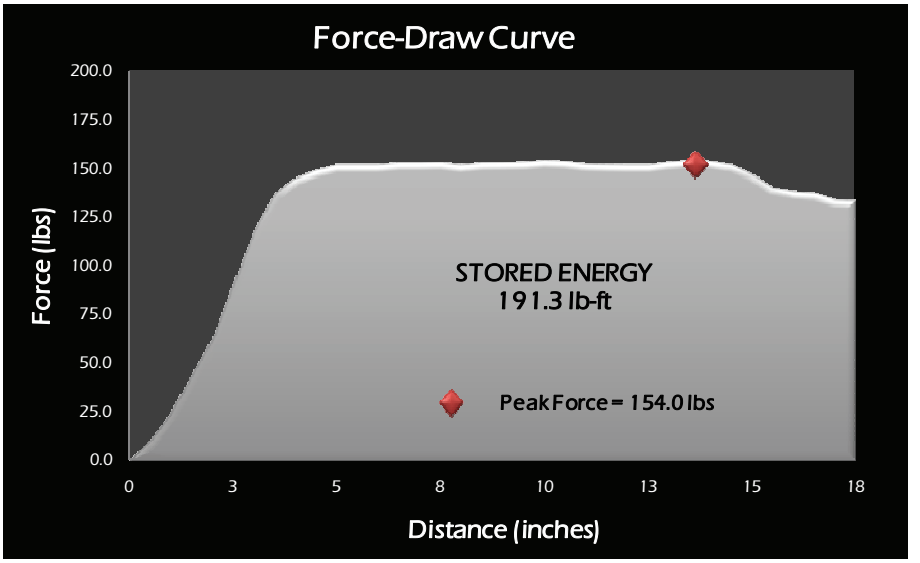
While shooting at the range it was not hard to notice the benefits of the cocking mechanism of the TAC 15i. A ratchet release mechanism needs to be pushed down to free the release assembly. Once released, the assembly can be pulled toward the string. The string has a special heavy duty "D" loop pre-installed, the loop connects to a hook on the release assembly. With an arrow placed on the string, the crossbow can be drawn with the crank mechanism. The crank takes approximately 11 full turns to reach the full draw position. The crank is a big relief when shooting. The device takes the pressure off the archer's muscles and ligaments while drawing. The crank should be a great advantage for archers that want to draw their crossbow in a treestand or ground blind. An archer can draw the TAC 15i without the need to stand up, which could reduce any risky maneuvers while up in a treestand. In addition, after the hunt is over the crossbow has the ability to be let down. The crank, in combination with the ratchet release mechanism, allows the crossbow to be un-cocked.

Precision: I did a lot of shooting with this product during the testing. While shooting, I was very pleased with the group size I was able to achieve at 40 yards. Moreover, my group size when shooting off sandbags is the smallest I have achieved thus far. It is always a great accomplishment to be shooting tight groups at any dis-

Digital calipers were used to measure the group size for the precision shooting test, using the extreme spread.

Projectile Precision						
	Model/ Brand	Arrow Weight	Distance (yards)	Spread 1 (inches)	Spread 2 (inches)	Average
Shooting by hand	PSE TAC	425 grains	40	0.561	0.599	0.580

tance over 30 yards. After thinking about how the TAC 15i functions, it seems that there are three distinct elements that contributed to my group size. PSE designs this crossbow to be rail-less, which means that the arrow will make no contact against a rail. The rail-less design is beneficial because it creates less disruption and allows the arrow to flex freely as the crossbow is fired. The second element is the nock, which plays a vital role in keeping the arrow in the same place each time the crossbow is shot. The third feature is the arrow rest, which allows for a multitude of adjustments and permits the archer to tune the crossbow. Being able to tweak the arrow rest ever so slightly to achieve optimal flight is a feature that most products do not offer. All these features combined to provide an excellent crossbow that supports accurate shooting.



PSE's Advertising: Marketing campaigns related to products typically include key performance specifications. These specifications are used to draw in consumers. Many feel that this information can be less that totally accurate, and that's why some of us are skeptical and unlikely to use this information when comparing products. The testing that I performed on the TAC 15i proved to me that PSE is focused on a very important element that I think sometimes is lacking in this industry — truth-in-advertising. The peak force and speed numbers that my equipment measured were almost identical to the information on PSE's website. PSE is undoubtedly paying attention to the information they are making available to consumers, which really makes a big impact on consumer confidence.

The Off-Shoot

The TAC 15i has some opportunity for improvement, as do most products I test. The crossbow weighs in at exactly 10 pounds with the telescopic sight. The crossbow by itself is a lot lighter than it looks, but the weight of the scope at just under 2 pounds seems a little heavy. The benefits of this scope with weight aside are the range of variable power adjustment and fine-tuning capabilities. However, those additional facets for some consumers may not offset the weight concern that I had.

The overall axle-to-axle length of the crossbow was very small and shorter than many products I have tested. However, the overall length of the TAC 15i compared to some of the recent products is longer. In comparison, the TAC 15i is approximately 2 to 3 inches longer than most other products. For that reason, users may feel the crossbow to be somewhat bulky because of this size. Still, I did see the benefits of the weight and length of this product while shooting. The product stabilized and balanced very well when I was shooting off the bench rest. Nevertheless, the archer needs to evaluate this aspect of the crossbow and decide on what weight and length is comfortable for them.

Another minor point, yet one that I think needs to be mentioned, concerns the trigger pull. The trigger has very little slack and hits peak weight rapidly. The peak weight recorded is just over 9. 5 pounds, which is higher than most of the products that have been tested in the past. I personally found that the trigger weight did not affect my group size. Nevertheless, archers should be aware of the difference as it may be noticeable to his or her shooting style.

The team of engineers at PSE has put a lot of time

into designing the arrows for this product. The TAC 15i only permits use of TAC arrows while shooting. The negative for the consumer is that we are not permitted to use other arrows. With that known, archers should have back-up TAC arrows available should something happen in the field or at the range.

Overview

The first thing to take note of is the speed of this crossbow. I have yet to test a crossbow with speeds over 400 fps. I have stated this before, but I am certainly not a speed freak. Nevertheless, people will be attracted to the speed numbers of the TAC 15i. The reason for such incredible speeds boils down to the crossbow's energy storage capabilities. The force-draw curve illustrates an immense amount of stored energy and also validates that the energy is stored over a rather long distance. The total distance that the crossbow stores energy is over 17 inches, and is 3 or more inches longer than most competitors. Because of these factors, more energy is available to be imparted on the arrow, and because the bow is designed efficiently, it produces very high speeds.

The crossbow has several key attributes that I felt to be important to the archer. The timing marks indicated on the cam provide a good reference point, and keeps the archer aware that the cams remain aligned with one another. Without such a feature, it is hard to know if something was bumped or changed over time. Another feature that stood out was the dual string stops. The string stops are critical to reducing vibration. The crossbow releases a significant amount of energy into the arrow, but some of the energy that does not escape remains within the crossbow. The string stop is a major contributor in reducing the forward "recoil" and works to dissipate the vibration from the propulsion of the arrow. In fact, while I was shooting the product I noticed that I had much less trigger flinching, which was attributed to the vibration levels or lack thereof after the shot. The final element that was enjoyable and benefited my shooting was the nylon stock. I am a fan of stocks that allow some adjustment for various shooting styles and situations. This product, which is no different from the AR 15 in regards to stock design, provides approximately 4 inches of length adjustment.

By and large, the TAC 15i is designed first and foremost for precision shooting—no pun intended. PSE's focus on being extremely accurate is tied directly to the design features of the crossbow. The attributes of this bow are numerous and are intended to be functional and supportive to productive shooting. Some of the additional attributes, like the picatinny rail, are accommodating and permit a multitude of additional components, which may create even better results when it comes to shooting. The most impressive features are the performance numbers, especially when it comes to speed. This type of performance seemed almost unachievable a few years ago. PSE has reached this feat with a crossbow that only reaches a peak weight of 155 lbs. In my opinion, this bow is very impressive in many areas and overall provides a good platform for accurate shooting.

Special Thanks: I would like to thank the manufacturer and sponsor who supported this event; without them and their support, this evaluation would never have been possible. Scorpion Venom Archery Lubricants provided wax, lubricants and crossbow rail lube. The rail lube is stated to have the ability to increase speeds upward to 1-2 fps.

About the Author: Jon Teater began archery product testing in 2005. His technical experience, hunting skills, and test equipment allow Jon to perform some of the most in-depth technical reviews of products in the industry. Jon has designed and built sophisticated test equipment, which enables compound bows and crossbows to be shot automatically, providing a top-notch test environment to base his conclusions. Jon provides readers with accurate product assessments that have been published in *Bow and Arrow, ArcheryTalk. com* and *ArrowTrade* Magazine. Jon and his wife Lisa live in Upstate New York. He can be reached at jon@archeryconsumer.com.