Bow Report

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Elite Z28

The Elite Z28 for 2009 is essentially the same bow as the 2008-1/2 model except for the cam system. The earlier model bow used the Revolution Cams while the 2009 model introduces the "Z" Cams. Since this is the first Elite bow that I have had to test, I cannot comment on the differences between the two cam systems except to say that I was told that that the "Z" cams were developed to offer a smoother draw cycle and were intended to be more friendly for bowhunters.

The Z28 has an axle-to-axle length of 32¼ inches with a brace height of 7¾ inches. It is built on a fully machined 6061-T6 aluminum alloy handle that has an overall length of 26 inches. The handle

TABLE 1: ELITE Z28

COMPARATIVE TEST DATA

Comparative data from the tests of the Elite Z28 set at 50, 55, and 60 pounds peak draw force and at 30" draw length.

RATING VELOCITY (Feet Per Second)	
(AMO) 60 LBS./30 IN./540 GR.:	235.2
(AMO) 60 LBS./30 IN./360 GR.:	283.7
(ATA) 60 LBS./30 IN./300 GR.:	308.1
(ATA) 50 LBS./30 IN./250 GR.:	306.5

PEAK DRAW FORCE Pounds:	50	55	60
DRAW LENGTH (AMO) Inches:	30	30	30
HOLDING FORCE AT DRAW LENGTH Pounds:	13.7	14.8	17.6
BRACE HEIGHT (Inches):	7.81	7.81	7.75
LETOFF PERCENT:	65.4	66.6	70.7
STORED ENERGY Foot-pounds:	66.16	74.28	79.52
STORED ENERGY/POUNDS OF DRAW FORCE Foot-pounds/pound:	1.323	1.351	1.325
STATIC HYSTERESIS Foot-pounds:	3.81	3.88	4.18
% STORED ENERGY:	5.76	5.19	5.26
AVG. VIRTUAL MASS in Grains:	92.5	101.0	99.1
CABLE CLEARANCE:	9⁄16	9⁄16	9⁄16

MASS WEIGHT: 4 LBS. 3¼ OZ.
CAM SYSTEM: NO. 7 "Z" CAM

Pictured is the new-for-2010 Z28; for this test Norb used a 2009 model that featured the "Z Cam" two-track cam system—the 2010 model, like all the bows in the Elite lineup, now makes use of the new, modular "Rev Cam" two-track system that is adjustable in half-inch increments. According to Elite, the new cam system's geometry and efficiency has not changed, so the enclosed test results accurately depict 2010 performance. (For more on the new cam system see page 58.)

is reflexed 3¼ inches measured from the pivot point of the grip to the centerline of the limb pocket pivots. The grip is positioned on the vertical centerline of the handle, and the 6-inch sight window is cut ⅞ inch past centerline. The shelf is slightly dished rather than flat, so there is a slight upsweep as it extends outward from the base of the window. The grip is formed from the base metal of the handle augmented by two laminated wooden side plates that are individually bolted in recessed pockets. It is a slender medium shape that I found quite comfortable.

The limb pockets are pivoted on the extreme ends of the risers, which are radiused to match the sockets machined into the pockets by cross-drilling through the flanges that extend over the riser ends. The flanges of the limb pockets are also

FIGURE 1:
ELITE Z28

Force-Draw Curves

Force-draw curves for the 60-, 55-, and 50-pound test bow at 30 inches draw length.

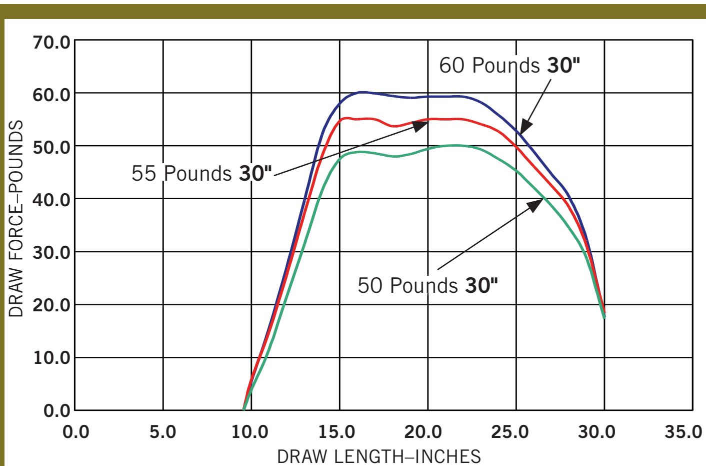


FIGURE 2:
ELITE Z28

Initial Arrow Velocity

Plots of initial arrow velocity versus arrow weight taken from the data given in Table 2.

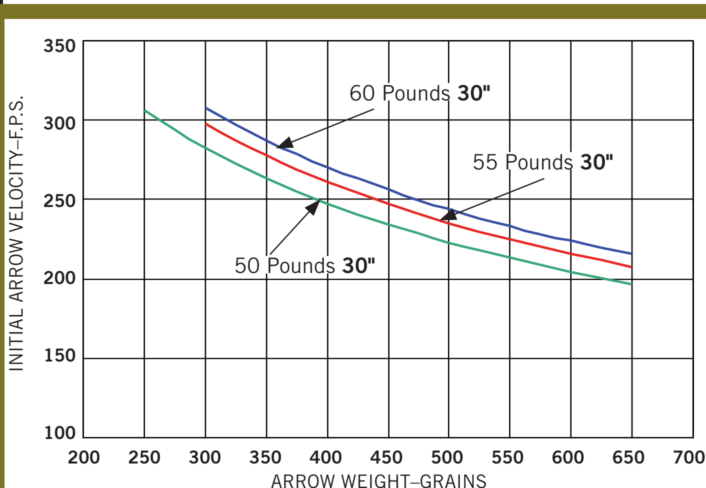
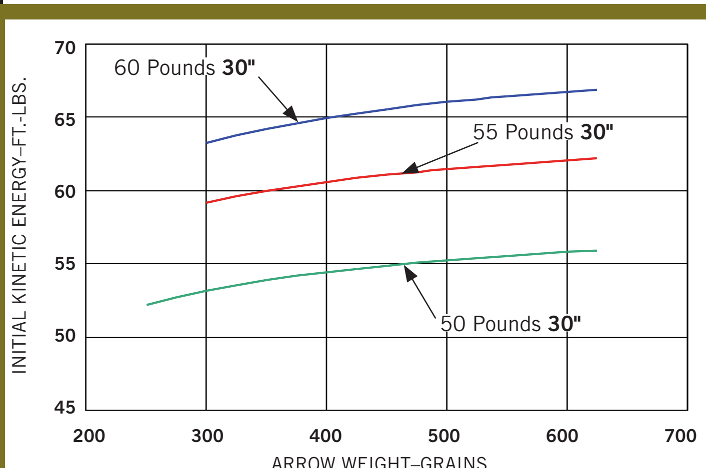


FIGURE 3:
ELITE Z28

Initial Kinetic Energy

Values of initial kinetic energy plotted versus arrow weight for the four test conditions.



drilled to accept four socket-head bolts that tap into the riser. These bolts are used the lock the limb pockets in position when adjusting draw weight. The limb adjustment bolts are threaded into steel cylinders that are set in lateral holes drilled into the riser ends. This arrangement allows the bolts to rotate with the limbs and maintain a perpendicular orientation with the backs of the limb butts as adjustment is made. This is not a new feature, but I feel that is always worth mentioning.

The string arrestor is a doglegged rod tipped with a cushioned bumper that is mounted in a socket that threads into the rear-facing accessory bushing just below the grip. The rod is anchored by means of two socket-head set screws that permit adjusting the positioning of the cushioned tip relative to the string. The dogleg allows alignment of the tip with the center of the string.

The usual assortment of tapped holes for mounting accessories—including an arrow rest, sight, quiver, and stabilizer—are all located on the handle. The machining on this handle is exceptionally well done. The corners are smoothly rounded and blended into the side surfaces with very little demarcation—a sign of careful processing.

The limb system for the Z28 consists of a pair of 13-inch-long units machined from Gordon's glass-reinforced epoxy matrix material. The width is constant at 1½ inches, with the tips thickened for reinforcement and to accept the axles. The tips have through fasteners to prevent splitting from the axle load. The limbs are set at an angle with the risers to assure that most limb deflection is vertical and opposed. Each limb has a BowJax limb dampener attached to the face just inboard of the slot.

Elite "Z" cams for 2009 are a two-track binary type that is draw length-specific. Seven distinct cams cover the draw length range from 27 to 30 inches in ½-inch increments. Both top and bottom cams are equipped with draw stops that offer a small adjustment in draw length. It is very important to remember that these stops must be left in place to prevent the bow from being overdrawn, which could result in serious injury to the operator.

The "Z" cam carries the shooting string (56¼ inches) on the main track, and the cable (36⅞ inches) on the second track. Timing is set at brace height by measuring from the 0.160 hole on the periphery of the main track of the cam to the face side of the limb. This gap is different for each cam size ranging from 0.925 inch on the #1 cam (30 inches) to 0.425 inch on the #7 cam (27 inches). A complete listing of these gaps can be found on the Elite Archery Web site.

The string carries special speed button units that are composed of five elements each. Attachment to the bowstring is specific at 4 inches from the axle measured on the angle.

The Tests

The bow I had to test was rated for 60 pounds peak draw force and was equipped with a #1 cam set. Without the rest it weighed 4 pounds, 3¼ ounces. I mounted an API Ultimate arrow rest in place and established a test format that incorporated tests at 50, 55, and 60 pounds draw weight with a common draw length of 30 inches (ATA).

In my last published Bow Report I commented on the new ATA Guideline (ATA/BOW-104-2008) and how it would affect the format of future Bow Reports that I prepare. In essence I have revised the minimum arrow weight used in the tests to conform to the 5-grains-per-pound peak draw force that the ATA Technical Committee has endorsed in the new Guideline. This means adding two more arrow weights to the array of test arrows to cover the spread from 250 to 650 grains for a test at 50 pounds peak draw force, and one more arrow weight to cover the 300- to 650-grain range for a test at 60 pounds peak draw force. This permits the determination of Rating Velocity at both 50 and 60 pounds as established by the Guideline, but will also include the Rating Velocity as prescribed by ASTM 1544-04, which is accomplished at two arrow weights: 360 and 540 grains.

Static testing is performed using a force-draw machine equipped with a Mark 10 digital force gauge capable of reading to the nearest 0.1 pound. This type of force gauge is necessary to obtain credible letoff characteristics for the high-performance bows of today, particularly when the letoff is precipitous. Spring gauges will not respond fast enough to monitor steep letoff, nor are they sufficiently accurate to adequately define the very short valleys that typically accompany the hard walls used for draw stops. Force readings are recorded at one-inch increments from brace height to just past full draw in order to define the force-draw characteristics of the bow and permit determination of the stored energy. The procedure includes recording forces during letdown as well. This allows calculation of the static hysteresis. Other static measurements taken include brace height, axle-to-axle distance, weight- in-hand, tiller, and cable clearance.

The first nine lines of **TABLE 1** list the data obtained from the static test. Figure 1 presents the force-draw curves obtained using the procedure outlined in the preceding paragraph. Observe that the curve for 60 pounds peak draw force reaches peak just past 16 inches draw length, drops slightly to about 59 pounds, and holds that level for about 6 inches of dwell and then eases into the letoff in a smooth rounded manner. This promotes the feeling of a smooth draw cycle that was designed into the “Z” cam. Elite purposely surrendered about 10 feet per second arrow velocity in order to achieve a smooth, pleasant draw cycle that would create a bow that would appeal to bowhunters. At 60 pounds, the Z28 stores 79.52 foot-pounds of energy for a S.E./P.D.F. (stored energy to peak draw force) ratio of 1.325 foot-pounds per pound. As draw weight is reduced to 55 and then to 50 pounds, the ratio changes very little although there is a dimple noticeable in the dwell area, and the acquisition of peak force moves later in the draw while the beginning of letoff is more gradual.

The figures given for percent of letoff are based on the peak draw force and the holding force read at the precise draw length stated. If the bow bottoms at some draw length other that the draw length listed, that value is ignored. Many bows bottom ⅛ to as much as ¾ inch beyond the test draw length. This makes a valid comparison of percent of letoff meaningless. The Z28 bottomed at exactly 30 inches draw length when set to 60 pounds peak draw force. It bottomed ¼ inch beyond 30 inches when set to 55 and 50 pounds peak draw force. However, the letoff was computed with the holding force at precisely 30 inches draw length.

Static hysteresis is at the low end of the normal range for this characteristic with values from 5.19 to 5.76 percent of stored energy. Static hysteresis is determined from the difference between stored energy measured during the draw and energy registered during the let-down. Since it is obtained under static conditions, it is not a true measurement of the friction that would be present under the dynamic conditions of the shot, but is a useful indicator of the mechanical efficiency of the bow. Early compounds had static hysteresis values as high as 12 percent of stored energy, but over the years designers and manufacturers have greatly improved this area of bow design.

Dynamic tests are conducted using a shooting machine and a double chronograph arrangement. The standard chronograph, a Custom Chronograph Model 1000, is positioned three feet down-range from the back of the bow at the arrow pass. The checking chronograph, a Custom SpeedTach, was located immediately adjacent (down-range) to the standard unit. Eight or nine test arrows, depending on draw weight, ranging in weight from 250 to approximately 650 grains in approximate 50-grain increments, are each shot and chronographed a minimum of five times to establish a credible value of average initial velocity for the individual arrows. Arrows weighing exactly 250, 300, 360, and 540 grains are included in the test arrows to insure that the conditions set forth in ATA/BOW-104-08 and ASTM Standard 1544-04 are met. The arrow weights and velocities are used to calculate experimental values of virtual mass. A curve of virtual mass is determined by linear regression from the experimental values. This permits the calculation of initial arrow velocity and dynamic efficiency for any desired arrow weight.

Bow or dynamic efficiency is the initial kinetic energy of the arrow expressed as a percentage of the stored energy of the bow. In other words, it is the energy obtained (initial arrow kinetic energy) expressed as a percentage of the energy or work applied to draw the bow (stored energy). Kinetic energy is the energy the arrow possesses as of result of its mass and velocity as obtained as the arrow passes through the standard chronograph. Table 2 presents values of initial arrow velocity and bow or dynamic efficiency for the Z28 for each of the test conditions. Values are given in 25-grain increments of arrow weight for the wide range of arrow weight tested. The curves of initial arrow velocity shown in Figure 2 were plotted from the data tabulated in **TABLE 2**. The values shown for dynamic efficiency indicate that this bow is quite efficient in converting its stored energy into kinetic energy in the arrows

The kinetic energy carried by an arrow is related to the penetration potential of that arrow when it strikes a target medium. For a given arrow the actual penetration is a function of the target medium as well as the kinetic energy. Of course, the form and flight characteristics of the specific arrow also affect the actual penetration. To properly evaluate the actual penetration effect as related to kinetic energy, the target medium must be consistent and the arrow must be identical. To recognize the effect of changing target medium, I use the term "penetration potential" rather than "penetration" because the target medium can be a highly variable factor, and it can be eliminated by using the term "penetration potential." The kinetic energy, which is a function of the mass of the arrow and its velocity, is the determinant that concerns us. The arrow is assumed constant in all cases. **FIGURE 3** presents curves of initial kinetic energy plotted versus arrow weight.

The Rating Velocity is a performance parameter developed by the technical committee of AMO/ATA to permit standardized comparison of the performance of various bows. The ASTM Standard F 1544-04 defines it as the initial velocity of an arrow of specific weight, shot from a bow set at 60 pounds peak draw force and 30 inches ATA draw length under precisely controlled conditions. ASTM standard F 1544-04 was created to detail and control the testing procedure necessary to determine the Rating Velocity. It establishes two different test arrow weights, 360 and 540 grains, because some bows that yield similar Rating Velocities with the 540-grain arrow demonstrate substantially different Rating Velocities when tested with the 360-grain arrow. In other words, some bows gain arrow velocity at a greater rate than other bows when arrow weight is reduced. The method for obtaining the Rating Velocity set forth in ASTM standard F 1544-04 uses the average of five shots of the specified arrows to establish the value.

The new ATA Guideline, ATA/BOW-104-2008 (for compound bows), introduces some changes to the method of determining the Rating Velocity. Under the revised test program, the Rating Velocity can be determined at any of three different peak draw weights using the 5-grains-per-pound of peak draw force to govern arrow weight. Determination is limited to the use of only one arrow and five shots to establish the average. This means: 70 pounds peak draw force with a 350-grain arrow; 60 pounds peak draw force with a 300-grain arrow; or 50 pounds peak draw force with a 250-grain arrow. All arrow weights must be held to a tolerance of plus or minus 0.05 grains. Draw weights must be held to a tolerance of plus or minus 0.1 pounds, and draw length is to be set to 30 inches (ATA) plus ¼ inch minus 0 inch. This summarizes the ATA Guideline in general. For other detail it is recommended that you refer to the booklet of ATA Technical Guidelines.

The tests I conducted on the Elite Z28 yielded sufficient data to provide Rating Velocities in accordance with ASTM Standards and also under ATA Guidelines at both 50 and 60 pounds peak draw force. The results are as follows:

ARROW WT.	RATING VELOCITY			
	ASTM F 1544-04	ATA/BOW 104-2008	ATA/BOW 104-2008	BOW REPORT
POUNDS:	60	60	50	60
250 grains	-	-	306.4	-
300 grains	-	308.6	-	308.1
360 grains	284.0	-	-	283.8
540 grains	234.4	-	-	235.2

If you are wondering what the ATA Rating Velocity at 70 pounds peak draw force using a 350-grain arrow will be, it should be about 3 to 5 feet per second faster than the figure given for 60 pounds using a 300-grain arrow.

I will continue to use the "performance profile" method for testing and rating bows even though the less-tedious ASTM method and new ATA method provide quite acceptable results for Rating Velocity evaluation. However, in my opinion, they do not provide a broad picture of a bow's performance like the "performance

TABLE 2: ELITE Z28

ARROW VELOCITY
Feet per second.

ARROW WEIGHT Grains:		250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650
PEAK DRAW FORCE (Lbs.)	DRAW LG. (Inches)																	
60	30	-	-	308.1	297.2	287.4	278.5	270.4	263.0	256.1	249.8	243.9	238.4	233.2	228.4	223.9	219.6	215.5
55	30	-	310.0	298.0	287.4	277.8	269.1	261.2	253.9	247.2	342.0	235.3	229.9	224.9	220.2	215.8	211.7	207.7
50	30	306.5	293.8	282.5	272.4	263.3	255.1	247.6	240.7	234.4	228.5	223.1	218.0	213.3	208.8	204.6	200.7	197.0

DYNAMIC EFFICIENCY %
Tabulations of initial arrow velocity and dynamic efficiency derived from the dynamic tests of the Elite Z28 for a wide range of arrow weight.

ARROW WEIGHT Grains:		250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650
PEAK DRAW FORCE (Lbs.)	DRAW LG. (Inches)																	
60	30	-	-	79.6	80.2	80.8	81.3	81.7	82.1	82.4	82.8	83.1	83.3	83.6	83.8	84.0	84.2	84.3
55	30	-	79.0	79.7	80.3	80.8	81.2	81.6	81.9	82.2	82.5	82.8	83.0	83.2	83.4	83.6	83.7	83.9
50	30	78.9	79.7	80.4	80.9	81.5	81.9	82.3	82.7	83.0	83.3	83.5	83.8	84.0	84.2	84.4	84.5	84.7

The new-for-2010 Z28 makes use of the new and improved Rev Cam (left) two-track system that is adjustable in half-inch increments, using patent-pending modules (above left) that, unlike most other designs, positively interlock with the base cams for a rock-solid fit. At upper right is the similar, previous "Z Cam" system tested by Norb.

profile" does. I feel that limiting test arrow weight to two values as stipulated by the ASTM standard, or to just one at the minimum arrow weight as the ATA Guideline recommends, fails to offer the same level of confidence as that afforded by using eight test arrows of graduated weight. In addition, having the data from eight test arrows offers other factors and trends to check that promote confidence in the results.

General Commentary

The included string angle on the Z28 is very close to 75 degrees when drawn to 30 inches. I doubt that will be of interest to many archers who purchase this bow because it is obviously intended to be shot with a release. However it is something I always measure, so it is included for general information.

I liked the slim appearance of this bow and the basic simplicity of the design, particularly in the grip area. I found it a very pleasant bow to shoot. The string stop and BowJax limb dampeners maintain a good level of noise reduction, and the parallel limb action keeps hand shock to a minimum.

The draw stops that are incorporated in both top and bottom cams are limited in adjustability because they only have to span the ½-inch draw length covered by the draw-length-specific cams. They contact the limb to arrest draw length, which provides the most positive type of draw stop. The resilient bumper that is used to protect the limb offers very little compression when this happens; hence the stop is quite positive. This is in contrast to those designs that bottom on the cable which deflects under load.

In my opinion, the Elite Z28 displays every evidence of quality design and construction. It has achieved the easy-drawing characteristic that the manufacturer sought while offering excellent performance. I believe that it will be a popular hunting bow. BW