Getting the Most Out of Your Laser Rangefinder

By

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It's hard to believe. Just twenty years ago laser rangefinders were an expensive curiosity; but today they're modestly priced and standard kit for most serious long-distance rifle shooters. The only problem is, once you start using one it seems a laser is as temperamental an instrument as ever devised by man. One day, you can range to 750 yards on a rangefinder rated to 600 yards, then the next day you can't range to 400 yards with the same laser!

For the past decade I've used eleven different laser rangefinders — owned six — from three different manufacturers, and field-tested them from the Arizona desert and northland snowfields, to the forested mountains of Eastern Europe and the rarified air of the Rockies — from dawn beyond dusk — and, at last, I think I've collected enough tips and lessons learned so you can get the most out of your laser.

How a Laser Rangefinder Works

To understand the fundamentals of a laser ranging device, I spoke with Bushnell's top laser engineer, Tim Carpenter, who explained that a rangefinder uses a laser diode similar to a pen pointer, except it emits pulses of non-visible wavelength light. (For those of you technically inclined, Bushnell lasers have a wavelength of 905 nanometers, in the infrared spectrum, while visible light wavelength is 400-700 nm.)

The laser diode emits light pulses of about 35-45 nanoseconds, which reflect off the target, and then the light is optically detected in the rangefinder. Next, this tiny reflected light is amplified enough to register in multiple circuits containing a high speed chronometer that measures the time it took for the light to return from the target — which, in turn, is translated into the distance to yield a range measurement. Bushnell rangefinders are calibrated to read +/- one yard of a lazed target.

Interestingly, Carpenter explained, a laser rangefinder's maximum range is not determined by the laser's output power. Indeed, all Bushnell lasers — whether 600-, 800-,1000- or 1600-yard versions — employ the same strength laser light emitter. No, the maximum potential range is determined by the quality of a laser's electronic receiver, and its ability to sense light and measure tiny fractions of seconds. The difference between low-cost and high-cost lasers largely reflects lens quality and the ruggedness of its construction. What about the effect of scratched or dirty lenses? Testing at Bushnell has found this only marginally affects the laser's range or ability to detect reflected light.

Perhaps the least understood aspect of laser ranging is properly matching the beam's size to the object you're ranging. Many shooters don't get near the maximum possible range out of their laser because they imagine it's the size of a laser pointer beam — WRONG! Bushnell laser beams, for example, are four mils high and two mils wide, which, at 1000 yards means a beam four yards high by two yards wide! First, understand that a mil is an angular measurement which equals approximately 3.6 inches at 100 yards, and steadily widens until it equals 36 inches at 1000 yards. Now, look in the accompanying data to see what the beam measures at various distances, along with common objects this size so you can visualize what's best to range upon at each indicated distance. Note that my examples use items which, like the beam, are approximately twice as high as they are wide.

To get the highest likelihood of ranging to a given distance, laze on an object of at least the indicated size — say, a 55-gallon barrel at 250 yards. This way your entire laser beam shines upon and reflects off the object.

Factors Affecting Laser Efficiency

Here are some tips for getting readings when initially it appears you can't, and how to stretch your range measurements to their maximum possible. As we already noted, the laser beam usually is much larger than an animal, so find a suitably sized object at the same distance, and laze to that instead.

I've listed the following factors in the order of how substantively they affect laser readings — the degree of ambient light present is crucial, but depending upon conditions, all these factors will vary in contribution.

— *AMBIENT LIGHT*: Bright sunlight or strong artificial light reduces your laser's maximum effective range because this extra, intense light overwhelms and somewhat confuses the laser's light sensor. Even waiting for clouds to block the sun can help, as can lazing from a shadow into a shadow, but only marginally. The very longest ranging can be achieved in overcast, or at dusk — that's when I've had some lasers range far beyond their official maximum.

— *DENSITY*: The thicker and more impervious your target, the better. If you must laze foliage, go for a thick clump of broad leaves rather than an equal area of pine needles which may diffuse laser light. A solid cliff face is better yet. If you're lazing in grassland, don't laze on the grass itself, but onto an exposed spot of earth. Think of your laser as a flashlight, and you prefer to shine it at something that will completely block its light beam.

— *REFLECTIVITY*: A shiny surface reflects laser light better than a dull surface. Look for wet leaves rather than dry ground — best of all is a license plate or corrugated aluminum, but these usually are only present in urban areas. (See my warning about lazing over or onto water, below.)

— *COLOR*: A bright color reflects laser light better than a dark color — at least usually. Black is the worst color to laze because it absorbs a high percentage of light. Alternatively, I've had difficulty lazing into fresh fallen snow mounds, I think because the snow's microscopic crystals scatter and diffuse the light. What to do? As I did a few months ago while winter hunting, find a rock or clump of exposed ground near the snow mound, and laze it instead.

— *SIZE*: The larger the lazed object, usually, the better. As explained already, the laser beam actually is quite large — as big as a car at 1000 yards — and it's twice as high as it is wide. For best results, try to laze on an object that's at least as big as the beam should be at the distance you're ranging.

— *SHAPE*: Lazing onto a flat surface usually generates better reflection than on a concave or convex surface. For example, a flat rock the same width as a tree trunk should reflect more readable light because light hitting the curved trunk will be somewhat deflected right or left while a flat surface bounces most light straight back.

— *ANGLE*: Related to a target object's shape is the angle of your laser beam upon it. For the best generation of reflected light, your beam should impact at 90 degrees, or perpendicular, to the object's surface. Not only will a flat surface bounce most light straight back, but by lazing perpendicular to its surface, just about all the light bounces back to you.

Other Tips and Observations

All of these factors contribute to laser effectiveness, with tradeoffs that can sometimes be dramatic. At Ft. Benning, using a 600-yard Bushnell laser on the Burroughs sniper range I happened to laze an old armored personnel carrier far downrange, well beyond that laser's maximum range — it was painted deep green so the color didn't suit a laser, and it was a bright, sunny, Georgia morning. Yet, it ranged instantly at almost 750 yards, 25 percent beyond the laser's rated maximum range. Why? The flat-sided vehicle presented an extremely dense, large aluminum hull, perfectly perpendicular to my beam, which more than compensated for the effect of dark color and bright ambient light conditions.

Lazing over water generates some unique considerations. Bushnell engineer Tim Carpenter has noticed that humid air absorbs laser wavelength light like a sponge, while I've noticed my laser beam can bounce invisibly off water, reflect off a distant obstacle, then bounce back off the water, yield an exaggerated range — although I was attempting to measure a spot near the water. Best advice: Be careful to keep your beam above water, even pot holes.

Carpenter agreed with me, that when lazing to a distant target, you should aim the laser as carefully and steadily as you'd aim your rifle. If you're shaking the laser, the beam's not reflecting efficiently, and either you won't get a reading, or it may mistakenly reflect off another object beyond or closer than your target.

Bushnell Laser Beam Dimensions
(*Beam height is twice its width*)

Distance	Height	Width	Visualize
100 Yards	14.4"	7.2"	Cornflakes Box

250 Yards	36" (1Yard)	18" (1/2 Yd)	55-Gallon Drum
500 Yards	2 Yards	1 Yard	Front Door
750 Yards	3 Yards	1-1/2 Yards	Plywood Panel (8' x 4')
1000 Yards	4 Yards	2 Yards	Midsize Car, overhead view

Comparing Laser Performance in Varying Conditions

As part of my research, I've recorded tables of laser performance at different temperatures, different humidity and varying ambient light conditions. Here are two tables, comparing the performance of 600-, 800-, and 1000-yard rangefinders against broadleaf bushes. Note the increased measurable distances under an overcast (Test Two), with the 600-yard laser ranging well beyond its rated maximum distance. Slight variations in distance reflect the normal accuracy of +/- one yard, and the irregularity of the target surface.

Laser Test One: Readings Off Broadleaf Bushes, 69 degrees F, Bright Sun to rear, Mid-day

	1000-Yard Laser	800-Yard Laser	600-Yard Laser
Target 1	186 Yards	188 Yards	188 Yards
Target 2	291 Yards	289 Yards	289 Yards
Target 3	406 Yards	406 Yards	407 Yards
Target 4	600 Yards	600 Yards	No Reading
Target 5	659 Yards	No Reading	No Reading

Laser Test Two: Readings Off Broadleaf Bushes, 49 degrees F, Overcast, Late Afternoon

	1000-Yard Laser	800-Yard Laser	600-Yard Laser
Target 1	200 Yards	200 Yards	201 Yards
Target 2	371 Yards	372 Yards	373 Yards
Target 3	513 Yards	514 Yards	514 Yards
Target 4	754 Yards	751 Yards	752 Yards*
Target 5	780 Yards	No Reading	No Reading

**Beyond this laser's rated maximum range*