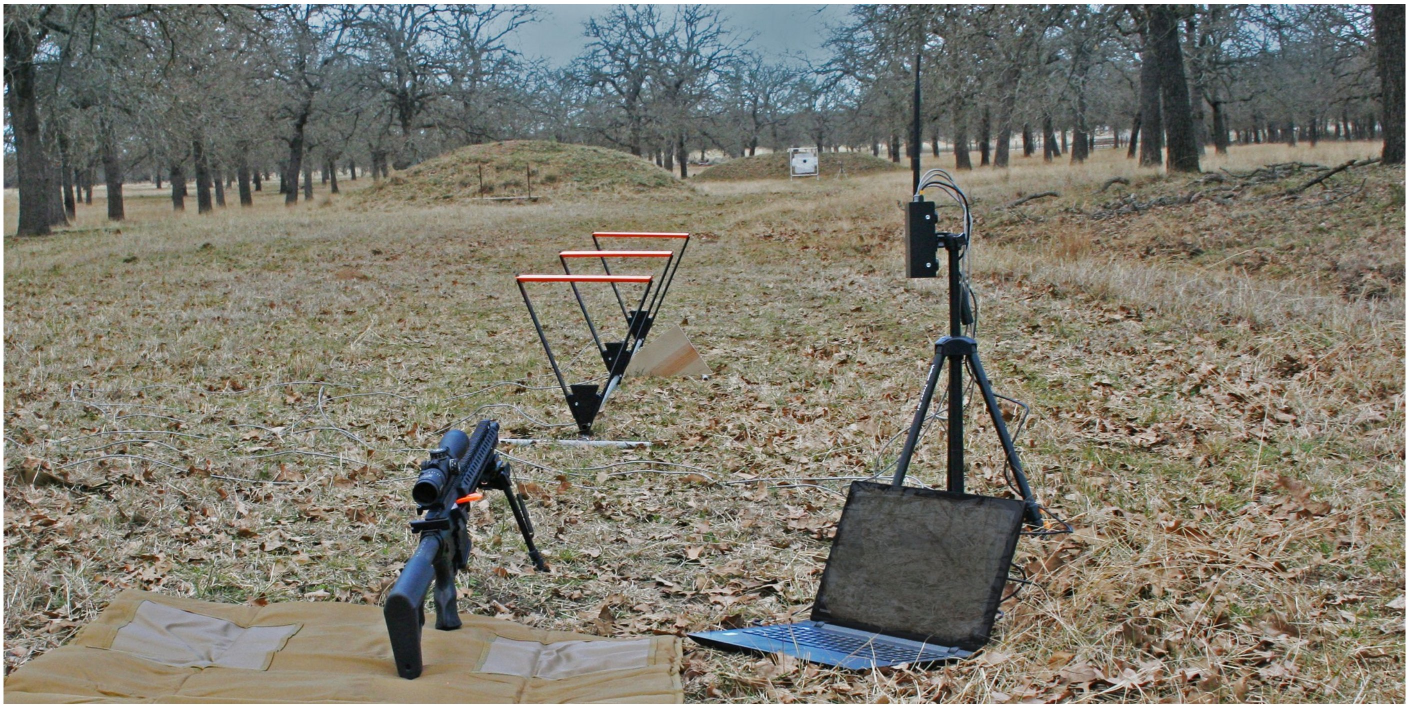
BC Chrono© System

System 89 Ballistic Coefficient Chronograph



A conventional chronograph measures velocity near the muzzle. The *BC Chrono*© System 89 measures both muzzle velocity **and** the time-of-flight from gun to target. An accurate ballistic coefficient requires both measurements using your ammo and your gun.

Predictions based on G1 or G7 with nominal ballistic coefficients often miss at long range. You don't trust book values for muzzle velocity; and you can't trust book values for ballistic coefficient! To get an accurate ballistic coefficient for your ammo and gun, you measure it over long distance. Just like muzzle velocity, ballistic coefficient depends on your rifle.

Standard G1 and G7 drag functions can provide accurate predictions if the ballistic coefficient is calibrated to your specific gun and ammo.

Custom drag functions for stock bullets must be verified to fit your load and the rifle. The Oehler *BC Chrono*© System 89 finds the precise ballistic coefficient required so that your predicted time-of-flight exactly matches the measured time-of-flight for your loads and gun. The *BC Chrono*© System 89 uses lessons learned from the pioneer Oehler System 88, but the '89 is simpler and more reliable. The troublesome GPS units are no longer needed.

The System 89 costs much less than radar, yet it accurately measures the drag of your bullets!

The *BC Chrono*© System 89 uses identical controller units at gun and target. Each includes a radio and rechargeable battery. The gun unit measures initial velocity using three proven Skyscreen IIIs. The skyscreens also signal the start of the time-of-flight. The target unit uses four microphones to triangulate apparent hit location and to signal the end of flight time. The system is controlled by the user's Windows® computer connected via USB cable. A single shooter can operate both gun and computer.

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The microphones of *fly-over* or *fly-thr*u targets require that the bullet be supersonic. The impact target works with both subsonic and supersonic bullets.

The *fly-over* array has the four microphones lined up on the ground perpendicular to the bullet's expected path. It is easy to deploy. An array 10 feet long will typically detect bullets passing within 10 feet above the array.

A square *fly-thru* array may be used. The square array provides more reliable scoring, but it is more trouble to set up. The maximum size is 10 feet. Either *fly-thru* or *fly-over* arrays provide excellent time-of-flight measurements.

You must provide an impact plane for subsonic bullets. The microphones must be clamped to a steel target or sheet of plywood, particle board, or even drywall. The microphones detect the impact of the bullet on the sheet. A large steel target is suggested for 22RF. Multiple plywood sheets can be joined to make a large target at long range.

You must select your favored drag model (G1, G7, or custom) from the library and enter atmospheric conditions. The computer uses the measured initial velocity and time-of-flight to compute the calibrated ballistic coefficient for each shot. The '89 makes and saves an Excel® file including the set-up and all raw data. It provides a complete report at the end of a test. Tests can be replayed to provide results for different drag functions.

Measurements with the target at the Mach 1.2 range provide the most valuable information. This single calibration yields accurate predictions down to sonic velocities. For improved predictions through the sonic range, you can fire a second test with a target located nearer the expected Mach 1.0 range. Software is provided to join results of this second test to the first by using the proven "stepped BC" method. An impact target may be used for accurate time-of-flight results extending down into the subsonic range.

The System 89 measures the calibrated ballistic coefficient for each bullet fired. At extreme ranges, the shot-to-shot uniformity of the ballistic coefficient becomes even more important than uniform muzzle velocity. At long range, the uniformity of ballistic coefficients and muzzle velocities is more important than just looking for high average values.

The recorded muzzle velocity and time-of-flight to the long range can be used to verify the accuracy of ballistic programs, including those using custom drag functions. After you have measured actual muzzle velocity and time-of-flight you must adjust the program until the predicted time-of-flight agrees with the measured time-of-flight. The Hornady 4DOF program anticipates this calibration by allowing adjustment of the Axial Form Factor.

The latest version of ***Ballistic Explorer***® Windows® software is included with each system. We find it invaluable for test interpretation and often use it to compare loads and to display behavior as a function of either distance or time.

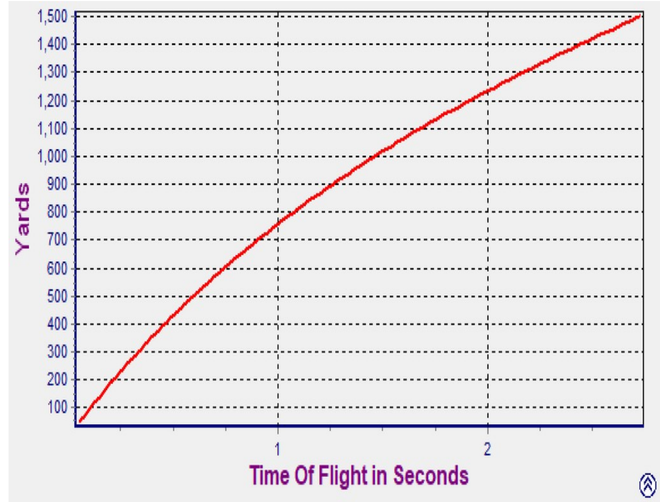
TOF and BC in more detail ...

Ballisticians write their equations in terms of time, but shooters think in terms of range. Flying bullets recognize time, but not range. Time and range are connected by the oft misunderstood drag function. We use standard G1 or G7 drag functions because custom drag functions are difficult to obtain. Custom drag functions are typically measured with Doppler radar systems. (If the radar can't track your bullet for a couple of miles, then you can't get a complete drag function.) Just as we know that we must measure the muzzle velocity of our ammo from our gun, we now learn that we must also measure drag from our ammo and our gun. We don't claim to measure the entire drag function, but with the Oehler *BC Chrono*© System 89 you can accurately determine points on the true curve of range versus time.

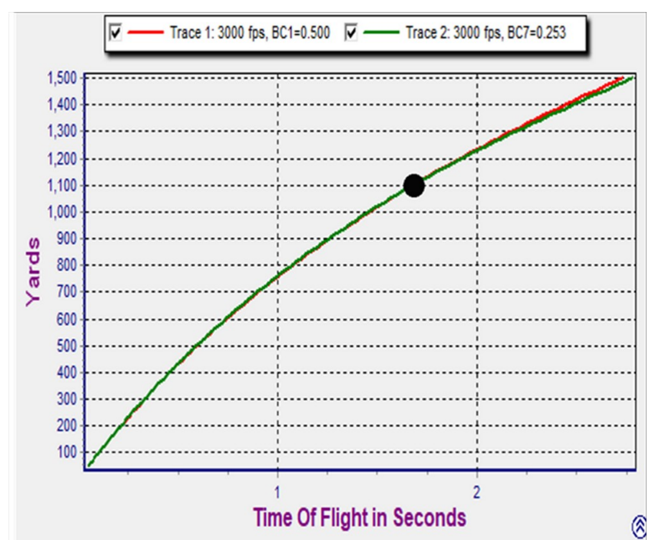
Engineers often make accurate measurements using imperfect instruments. The engineer *calibrates* his instrument by using it to measure a known exact value or calibration point. The instrument is then *calibrated* to force the observed reading to agree with the known exact value. The engineer's most valuable calibration point is at the high end of the meter scale. The shooter's most valuable calibration points are at long range. If you can reliably predict parameters at long range, then intermediate ranges take care of themselves.

If the measured time at a long distance doesn't match the predicted time, then your prediction does not properly account for drag. You must change the prediction until they agree.

Graphs or curves help us to visualize what happens. We expect to see graphs of drop, wind drift or remaining velocity plotted versus range. The bullet actually responds to flight time, not range. The curve of distance versus time is most useful. This curve is used to *calibrate* ballistic predictions.



Here the red curve shows the distance traveled versus time for a bullet having a G1 ballistic coefficient of 0.500 and launched at 3000 feet per second. It's simple, but shows much. Not only does it show time and distance, but the slope of the curve represents velocity. It starts with a steep slope at the muzzle and then flattens out as the bullet looses velocity. The curve shows the distance at a given time, or the expected time to your target. **The distance and time predicted at the target must match your measured time.**



Here are two distance versus time curves using G1 and G7 at the same muzzle velocity. The ballistic coefficients are chosen so that predicted times-of-flight match at 1100 yards (velocity near Mach 1.2). The difference in zero-adjust remains less than 0.1 mil out to 1350 yards where the bullet has fallen subsonic.

If you calibrate ballistic coefficient using time-of-flight to a long range, any reasonable drag function may be used.

We did not say that all drag functions are equal, but that you can use an approximate drag function if the ballistic coefficient is properly calibrated. You still want to use the drag function that best approximates the behavior of your bullet. We have followed the arguments for G1 vs G7 vs custom radar drag functions for many years . There are good arguments on all sides, but you cannot assume that any drag function will exactly fit your bullet from your gun. Before you can trust any drag function or ballistic coefficient for your ammo and gun, you must measure how your ammo and gun perform at long range.

Years ago we found that we could make very similar predictions for the same bullet using different drag functions. Just because the predictions are the same doesn't prove that either drag functions or ballistic coefficients are correct. Even if we force two drag functions to give the same predictions, they may both be wrong. If the first prediction misses the measured time, the second prediction will do the same. If the prediction method can't predict the time versus distance, it won't properly predict drop and wind deflection. The correct prediction must match reality. You must **measure** the time-of-flight to the long range and then force your prediction to match the measured time.

You **calibrate** your prediction by adjusting the ballistic coefficient or axial form factor so that the predicted time matches the measured time. The Oehler *BC Chrono*© System 89 calibrates your prediction with standard drag functions. You must adjust other programs to predict the proper time..

General Forrest allegedly said that to win a battle, *"Get there firstest with the mostest."* The long range shooter wants his bullets to be ***the firstest, the mostest, and the samest.***

- The bullet with the shortest time-of-flight will be the the *firstest.* It will have the least drop.
- The bullet retaining the *mostest* of its initial velocity all the way to the target shows the shortest lag time and least wind deflection.
- The *samest* bullets with the least variation in time-of-flight give the smallest vertical dispersion at the target and the best fit between prediction and shooting.

You can select your most uniform load by measuring both the muzzle velocity **and** long-range ballistic coefficient. The System 89 measures both. You can select 22RF ammo based on uniform time-of-flight for most uniform drop.

You can download a demo version of the system program. This includes simulated firing, and several videos. ______________________________.

Introductory price $2485 thru May 31, 2021,

Anticipated price $2995 after June 1, 2021.

First ordered; first shipped.
Domestic orders only.
Made in U.S.A.

Oehler Research, Inc.
Post Office Box 9135
Austin, TX 78766
Phone 512 327 6900
www.Oehler-Research.com
Sales@Oehler-Research.com
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