Oehler System 88

Extended Exterior Ballistic Data

Why ?

Because you want first-shot hits !

Before you can predict the hit point at long range, you must test your ammo from your gun at long range. You can't simply measure ballistic coefficient near the gun and know what happens downrange. When you compute a ballistic coefficient using muzzle velocity and time-of-flight over the maximum range, you get exact drop and wind drift predictions at the maximum range. Fit is forced at the long measurement distance. Fit is extremely close at all intermediate ranges and even beyond measurement distance.

Time-of-flight over extended range is just as important as is muzzle velocity. Oehler has been measuring flight times over long ranges for over thirty years. Oehler developed the System 86 to meet needs of military proving grounds. Extreme precision over long range were absolute needs. The '86 delivers microsecond time accuracy and centimeter target accuracy when used with up to ten targets spread over ranges of many miles. The successor System 88 delivers similar accuracy for three targets spread over a few kilometers. The '88 retains the precise GPS timing and the flexible radio network of the '86.

Data collected with the System 88 has validated several premises and has provided new insight into the exterior ballistics of small arms.

1. Exterior ballistic prediction models based on muzzle velocity are valid, **if and only if**, the predicted time-of-flight matches observed time-of-flight at long range.
2. Accurate long-range predictions must be based on accurate measurements of long-range time-of-flight. Long-range behavior is primarily governed by time-of-flight, not distance traveled
3. The combined barrel/bullet system must be considered. The ballistic coefficient and the drag function both depend on the bullet combined with a unique barrel.

Experience with the System 88 clearly demonstrates a total system for making long-range predictions. It accurately and reliably measures muzzle velocity and time-of-flight. These measurements are essential for accurate long-range predictions for the ammo and gun tested.

System 88 Controller

System Description

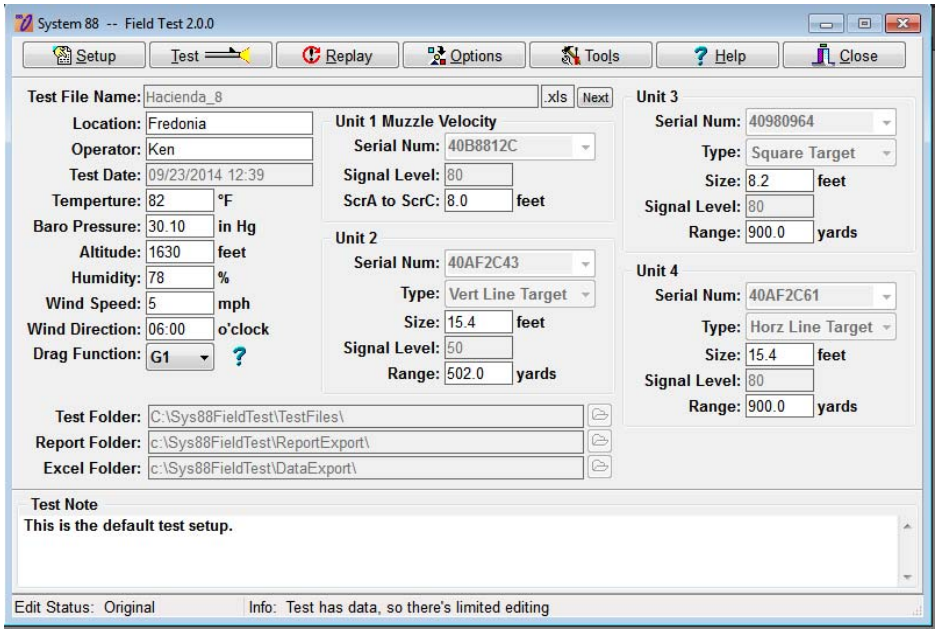
The Oehler System 88 is built to measure ballistic performance over extended ranges. It measures initial velocity, time-of-flight to target, and target impact point. It can use standard or custom drag functions and computes an appropriate long-range ballistic coefficient based on long range results

The system uses two, three, or four identical controller units connected in a radio network including a personal computer with Windows operating system. Each controller records the times of four events on each shot. At the gun, the events are signals from three Skyscreen III units. At the target, the events are signals from four microphones.

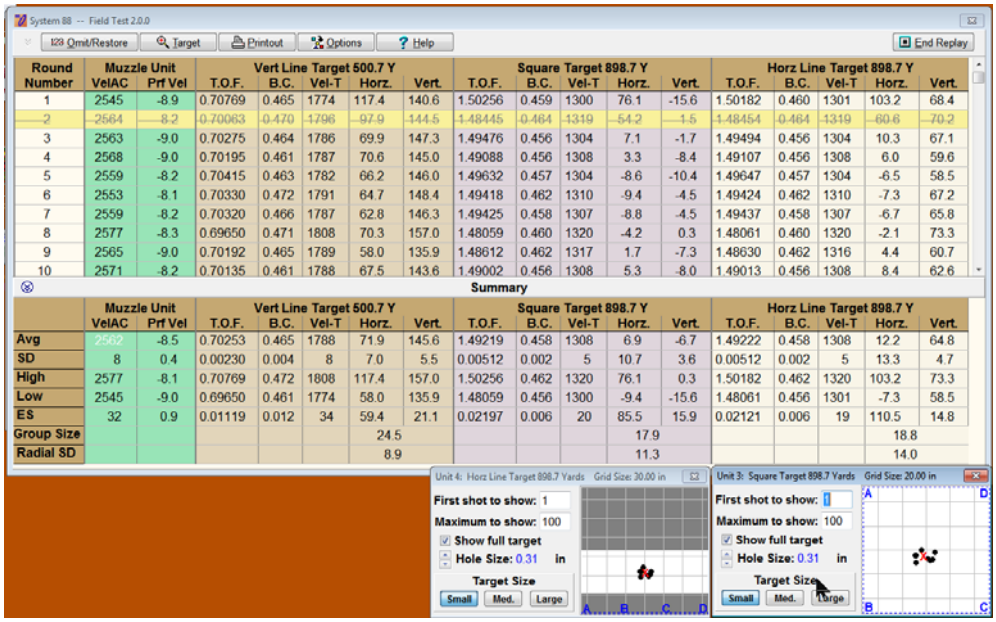
The operator works from a set-up screen similar to that shown. For each controller used, the operator selects the sensor type from a menu and enters the array size and the expected signal level. Sensor types include skyscreens for initial velocity measurement, the four-microphone square array acoustic target, and the four-microphone line array. Microphones can be clamped to a metal or plywood sheet to record arrival time of subsonic bullets.

The user must choose a unique test name and provide the information included in the test notes. The test name is automatically incremented for similar tests. The name is critical because it points to the data records contained in Excel files.

An informal test log book is provided for field use. This book should contain details of the gun and ammo. The unique test name ties these details to test results recorded by the System 88.



Setup Screen



Testing Screen

After a shot, the computer displays the initial velocity along with the *Proof* velocity difference. For each downrange target, the system displays time-of-flight, ballistic coefficient, estimated velocity at target, and the apparent impact location. A shot is recognized by the muzzle start screen; event times falling within appropriate time intervals after the start signal are processed. Downrange units report all events and automatically reset after collecting event times for a shot. The maximum firing rate is, "No more than one bullet in the air at one time."

System 88 Field Tests

Test File Name:	Hacienda_8.xls		Unit 1 Muzzle Velocity ----------			Unit 3 ----------		
Location:	Fredonia		Serial Num:	40B8812C		Serial Num:	40980964	
Operator:	Ken		Signal Level:	80		Type:	Square Target	
Test Date:	09/23/2014 12:39		ScrA to ScrC:	8.0	feet	Size:	8.2	feet
Temperture:	82	°F	Unit 2 ----------			Signal Level:	80	
Baro Pressure:	30.10	in Hg	Serial Num:	40AF2C43		Range:	900.0	yards
Altitude:	1630	feet	Type:	Vert Line Target		Unit 4 ----------		
Humidity:	78	%	Size:	15.4	feet	Serial Num:	40AF2C61	
Wind Speed:	5	mph	Signal Level:	50		Type:	Horz Line Target	
Wind Direction:	06:00	o'clock	Range:	502.0	yards	Size:	15.4	feet
Drag Function:	G1					Signal Level:	80	
Edit Status:	Original					Range:	900.0	yards
Test Folder:	C:\Sys88FieldTest\TestFiles\							
Report Folder:	c:\Sys88FieldTest\ReportExport\							
Excel Folder:	c:\Sys88FieldTest\DataExport\							
Test Note:	This is the default test setup.							

Round	Muzzle Unit		Vert Line Target 500.7 Y					Square Target 898.7 Y					Horz Line Target 898.7 Y				
Number	VelAC	Prf Vel	T.O.F.	B.C.	Vel-T	Horz.	Vert.	T.O.F.	B.C.	Vel-T	Horz.	Vert.	T.O.F.	B.C.	Vel-T	Horz.	Vert.
1	2701	1.8	0.67670	0.430	1828	105.1	154.8	1.48335	0.411	1265	31.7	7.3	1.48252	0.411	1266	46.6	102.8
2	2694	3.6	0.67946	0.428	1818	105.0	144.4	1.49359	0.407	1254	44.8	5.1	1.49295	0.407	1255	48.5	102.5
3	2698	2.7	0.67766	0.430	1825	98.8	150.7	1.48519	0.410	1264	22.1	5.8	1.48433	0.411	1265	33.9	103.7
4	2708	3.7	0.67525	0.429	1831	104.9	164.3	1.48515	0.407	1260	27.4	13.2	1.48444	0.407	1261	42.1	105.3
5	2686	1.8	0.68270	0.424	1806	103.7	151.7	1.50147	0.405	1246	22.9	-1.9	1.50041	0.406	1247	39.1	113.5
6	2701	3.7	0.67889	0.424	1816	100.9	165.9	1.49074	0.406	1255	22.2	18.6	1.48975	0.407	1257	36.9	120.8
7	2700	2.7	0.67735	0.429	1825	106.0	158.2	1.48163	0.412	1268	40.1	18.1	1.48091	0.412	1269	47.6	115.2
8	2683	1.8	0.68173	0.430	1814	113.0	153.7	1.49394	0.411	1257	31.2	2.9	1.49253	0.412	1259	56.8	119.4
9	2692	3.6	0.68003	0.428	1817	102.7	149.2	1.48721	0.412	1263	47.1	12.1	1.48683	0.412	1264	48.3	101.8
10	2695	2.7	0.67901	0.429	1820	116.8	158.3	1.49257	0.407	1255	36.4	2.6	1.49139	0.408	1256	62.7	111.6

---------- SUMMARY ----------

	Muzzle Unit		Vert Line Target 500.7 Y					Square Target 898.7 Y					Horz Line Target 898.7 Y				
	VelAC	Prf Vel	T.O.F.	B.C.	Vel-T	Horz.	Vert.	T.O.F.	B.C.	Vel-T	Horz.	Vert.	T.O.F.	B.C.	Vel-T	Horz.	Vert.
Avg:	2696	2.8	0.67888	0.428	1820	105.7	155.1	1.48948	0.409	1259	32.6	8.4	1.48861	0.409	1260	46.2	109.7
SD:	7	0.7	0.00214	0.002	7	5.4	6.7	0.00573	0.003	6	9.2	6.9	0.00559	0.003	6	8.8	7.0
High:	2708	3.7	0.68270	0.430	1831	116.8	165.9	1.50147	0.412	1268	47.1	18.6	1.50041	0.412	1269	62.7	120.8
Low:	2683	1.8	0.67525	0.424	1806	98.8	144.4	1.48163	0.405	1246	22.1	-1.9	1.48091	0.406	1247	33.9	101.8
ES:	25	1.9	0.00744	0.006	25	18.0	21.5	0.01984	0.007	22	25.0	20.5	0.01950	0.007	22	28.8	19.1
Group Size:						21.9					28.0					29.9	
Radial SD:						8.6					11.5					11.2	

Sample Test Report

Test Results Stored in Convenient Form

Each raw test data file is in Excel format and is stored in the Test Folder. Important fields are protected by check sums; any alterations will be reflected in the Edit Status. The test data file for each test includes setup information along with the raw times recorded by the system for each recognized event.

The Excel Folder contains similar files for each test. Each file contains the set-up information, the measured times referenced to the start screen, the computed outputs, and the statistical summary.

Each file stored in the Report Folder contains all the information from the test setup screen along with the shot-by-shot test results. Images of the target groups can be included. Reports are generated at the end of an actual test or after replay of a test and are saved in *pdf* format.

Software Included

Oehler's *Ballistic Explorer* and *Extended Range Truing* are included. These programs let you translate the data measured with your gun/load into accurate trajectory predictions. Our tests indicate that the G7 drag function TOF trued at approximate Mach 1.2 range provides the most significant data. It can be refined for extreme ranges by including tests at the Mach 0.9 range. The results of multiple tests at successive longer ranges can be consolidated into a single table of "stepped" ballistic coefficients with the *Extended Range Truing* program. You can specify the drag function. Tests need not be fired on the same day or even on the same range but muzzle velocities should be similar. The capabilities of *Ballistic Explorer* can be used to verify your choice of drag function. (When predictions are based on TOF truing at long range, the choice of drag function is not significant. All reasonable drag functions give essentially the same predictions out to the tested range.)

Practical Considerations

Oehler is well aware of the advantages and the problems of long-range testing. Long-range Doppler radar with bullets fired at a high angle for maximum range yields beautiful results. You see beautiful data, but the sample size is small. Firing rates are typically limited to a few dozen rounds per day. Doppler radar systems are very expensive and require trained operators.

The System 88 is affordable and can be easily used at an unimproved range. No electrical power or communications cables are required. Set-up for muzzle velocity is exactly the same as has been done by handloaders for many years. Set-up of a square acoustic target (up to ten feet square) at long range is less trouble than mounting a paper target of similar size. Set-up of a fly-over acoustic target is even easier. Terminal and intermediate locations can use a fly-over line target array placed directly on the ground. A fly-by vertical line target requires a "flagpole" for support. The vertical fly-by array is useful to time a bullet traveling tens of feet above the line-of-sight. All arrays use the rugged Model 8836 microphones. These microphones can also be used with a plywood or steel impact plate to sense the impact of subsonic bullets.

The system operates in metric units or can operate in yards, feet and inches. Tests conducted in one system of measure can be replayed in the other for automatic translation. Each System 88 controller is powered by a rechargeable 12-volt gel-cell battery. Batteries last for several days testing.

Oehler has tested the System 88 at one mile with provided antennae and without a radio repeater. Some locations may require a larger antenna. Any intermediate target unit automatically functions as a radio repeater.

The System 88 provides the muzzle velocity and verified ballistic coefficient unique to your gun and ammunition at long range. This provides precise downrange predictions. We accept that muzzle velocity varies from gun-to-gun and ammo lot-to-lot. We now recognize that ballistic coefficient also varies from gun-to-gun and lot-to-lot. The System 88 measures both muzzle velocity and ballistic coefficient.

Evolution

The ballistic testing community has never seen a system comparable to the System 88, but it is a natural evolution for Oehler Research. Oehler Research has built many systems involving the same technology used by the System 88. For almost thirty years, most of the industry has measured short-range ballistic coefficients using the Oehler four-microphone acoustic target. The regular four-mic square array provides an exact measure of the time of arrival at the plane of the target because it knows the path of the bullet. *You must know where the bullet passed relative to the mics, and how fast it was going, before you can tell exactly when it passed the target plane.* The line arrays are well suited for timing even though target accuracy is not up to the high standard of accuracy demonstrated by the square microphone array. Line arrays are much easier to deploy than the square array.

The System 88 uses convenient and reliable radio links between the distant targets and firing line. The use of wireless communication between units and use of GPS timing for synchronization between targets was previously reserved for the large Oehler target systems used on military proving grounds. The acoustic systems were initially developed for targeting, but precise timing over long distance can be even more valuable when used to correct those ballistic predictions we have used for years.

There have been many systems used to measure ballistic coefficients, but the System 88 allows you to measure them quickly and accurately, over a long range, and without wires.

System 88 units have been in the field since 2014.

System 88 units are not exported.