Oehler System 86 Acoustic Target

Acoustic Target Introduction

Oehler acoustic targets have been in use since 1982. Advances in available computation power, along with improved microphones, have allowed significant improvements over the years.

Newest Oehler acoustic targets (System 86) offers many advantages for testing direct-fire weapons and ammunition. These advantages include:

- Proven accuracy better than 0.2% of target size. This accuracy has been demonstrated in actual firing tests under field conditions.
- Targets up to 10 meters square are used routinely. Larger targets can be provided.
- Demonstrated high reliability. Systems have been in operation for many years.
- Wireless system with a range of over 10 kilometers from target to operator. This allows easy installation even in rough or contaminated terrain.
- Each set of target coordinates is time-stamped to an accuracy of a few microseconds using GPS. This time-stamping allows data to be interpreted using proven exterior ballistic models.
- No prior knowledge of projectile velocity, projectile arrival angle, or wind is required.
- The downrange portion of the system requires only 12-volt dc power at approximately 1 amp.
- Software automatically finds and rejects abnormal signals from microphones. A noisy microphone or random false signals during a burst will not prevent proper system function.
- Software provides a measure of quality or confidence on each shot to prevent acceptance of invalid scoring.
- The system has been proven using redundant acoustic targets along the projectile path and matching output with physical target and proven exterior ballistics models.

System 86 Downrange Controller

General System Description

The Oehler System 86 Acoustic Target consists of sixteen sensors (microphones) distributed around or adjacent to the target. Each sensor responds to the leading edge of the Mach cone associated with a passing projectile. The time of arrival of the Mach cone at each sensor is recorded with microsecond resolution by the System 86 Controller and is transmitted to the control room computer. These arrival times are subsequently processed to provide apparent hit location along with the computed arrival time at the apparent target plane.

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The control room computer is dedicated to one gun, but can simultaneously manage up to 10 System 86 Controllers. One controller is used at the gun to provide muzzle mark time to the system and one controller is required for each downrange acoustic target. Multiple targets (up to nine) can be used for one gun in either slow fire or burst fire tests.

The computation algorithm has been proven with several years of field tests. Use of sixteen sensors provides redundancy by which two microphones can be automatically excluded from the computations if their arrival times are not consistent with other arrival times for the shot. The computation also includes display of a residual time to provide a positive indication of system malfunction on any shot.

Communication between the control room computer and the downrange controllers is via radio. These radio links have a maximum range of well over 10 km with line-of-sight and proper antennae.

Each controller includes a GPS receiver and a stable time-of-day clock slaved to the received GPS timing signals. Thus all recorded times are absolutely referenced to the same base. This allows the output from the acoustic target system to be used with proven exterior ballistics models to provide a precise measurement of muzzle velocity.

Rate of Fire

The system will accommodate either single shot or burst firing. For single shot firing the target output is available immediately after a round is scored. For extended bursts at high rate, computations can be initiated with the first round, but scoring results may lag.

The maximum rate of fire that can be scored requires that the Mach cone of the first round be dissipated before the Mach cone of the second round arrives at the target. For a cubic array and typical outdoor conditions, the maximum rate of fire (rounds per minute) is estimated by

$$ROF \approx 10000 / L$$

where L is the length of cube edge in meters. The actual arrival time of each round is shown on the output. Rates of fire for any segments of the burst can be manually computed.

For practical purposes, the maximum number of rounds is unlimited. Unprocessed information is buffered at each target and is then transmitted to the firing line computer during the burst.

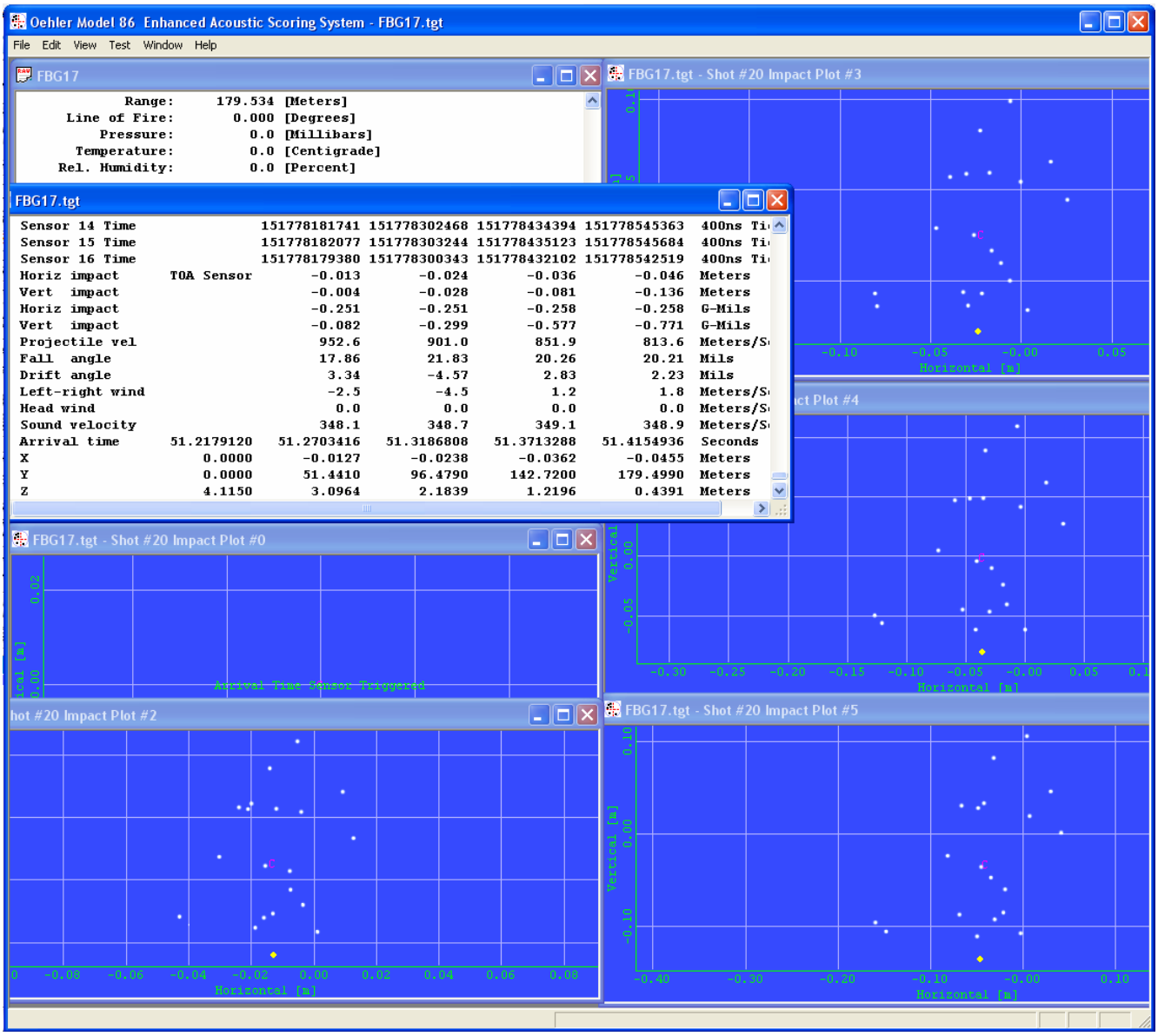
Target Microphones


Microphone for Oehler Acoustic Target

Each target is designed to use up to sixteen microphones. Full system capability requires use of all microphones. If the system need not solve for elevation and azimuth of incoming projectiles, local speed of sound or vector wind at the target, then the number of microphones can be reduced.

The microphone array can be hidden behind a berm to protect microphones. Accuracy is reduced if this configuration is used. Contact Oehler to discuss your specific applications.

Typical Operator's Display During Test



The test screen above shows the results of firing the same group through five acoustic targets using five System 86 Controllers feeding one computer. Plot #1 indicates that the controller near the muzzle was used to record muzzle exit time. Targets of Plot #2 thru #5 were located at approximately 51, 96, 142, and 196 yards. Note the similarity of the groups.

Shown on the next page are two sample report prints showing the target details for the target located at 196 meters along with the comparison of the groups at the four targets.

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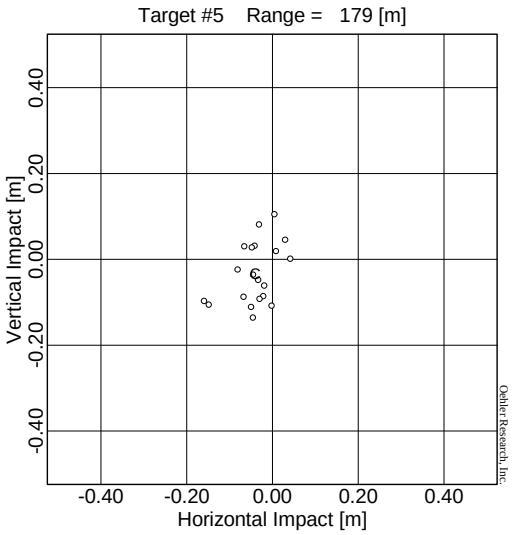
Virtual Vertical Target Accuracy Firing

Date/Time Fired: 06 Mar 2003 16:35:54
Weapon Type:
Ammunition S/N:
Test Director:
Gunner:
Temperature(degC): 0.0
Mode:
Note #1:
Note #2:

Vehicle Type:
Weapon S/N:
Ammo Lot No.:
Group No.:
Line of Fire(Deg): 0.0
Rel. Humidity(%): 0.0

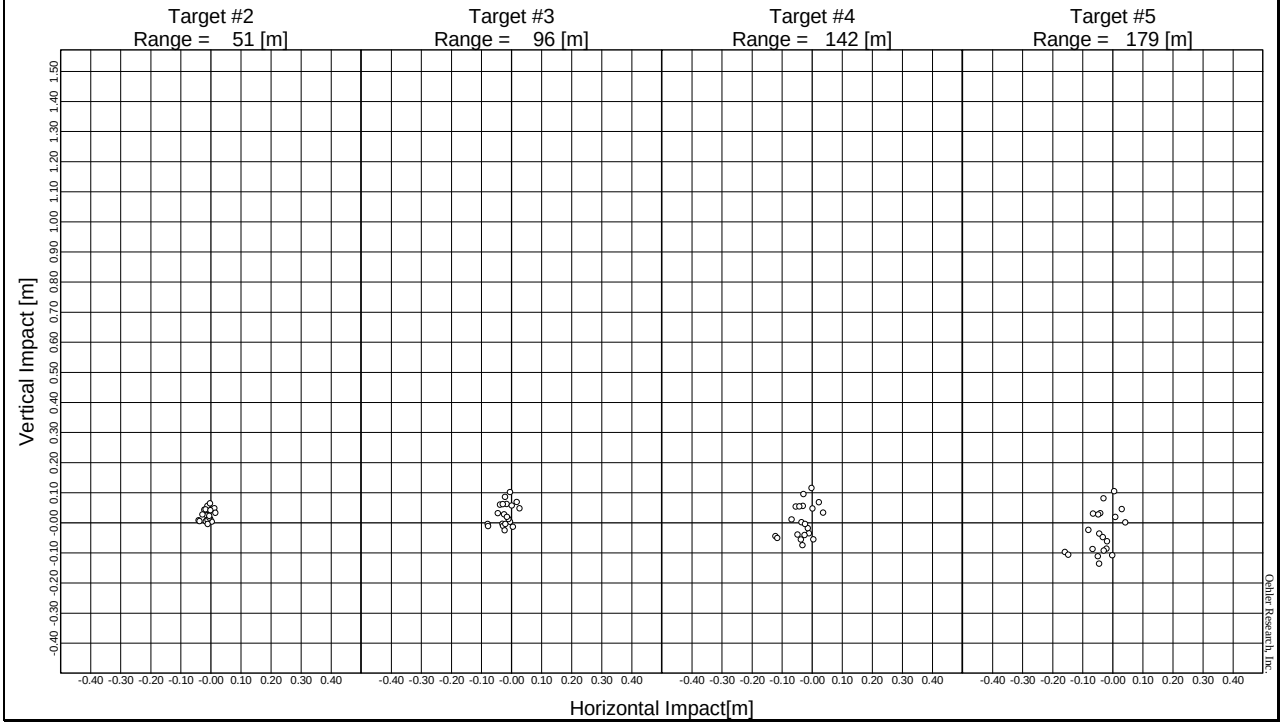
Vehicle S/N:
Ammunition Type: 5.56 Generic
Project No.:
Range(M): 179
Pressure(mb): 0.0



Round Number	Time hh:mm:ss.sss	Horiz X m	Vert Y m	Horiz X mil	Vert Y mil	Vel m/s	TOF sec
1	16:33:43.675	0.030	0.045	0.170	0.257	821.8	0.1948652
2	16:34:00.475	-0.041	0.032	-0.235	0.179	831.5	0.1932116
3	16:34:23.770	-0.067	-0.087	-0.381	-0.496	825.6	0.1938092
4	16:34:38.888	-0.021	-0.086	-0.120	-0.488	804.1	0.1992984
5	16:34:51.735	-0.159	-0.097	-0.904	-0.552	802.8	0.1998044
6	16:35:20.370	-0.002	-0.108	-0.011	-0.614	836.4	0.1920300
7	16:35:38.607	0.042	0.001	0.236	0.006	822.1	0.1946608
8	16:48:53.079	-0.031	0.081	-0.176	0.461	841.6	0.1907992
9	16:49:16.563	-0.066	0.030	-0.372	0.171	828.3	0.1936260
10	16:49:36.572	-0.050	-0.111	-0.282	-0.631	822.0	0.1948960
11	16:49:53.472	0.005	0.105	0.027	0.595	817.3	0.1960368
12	16:50:06.221	-0.045	-0.036	-0.256	-0.204	817.9	0.1961316
13	16:50:18.235	-0.048	0.028	-0.273	0.156	812.8	0.1970816
14	16:50:30.221	-0.081	-0.024	-0.460	-0.136	829.0	0.1938872
15	16:50:45.251	-0.030	-0.092	-0.170	-0.524	833.3	0.1930632
16	16:50:58.589	0.008	0.019	0.048	0.108	819.3	0.1955428
17	16:51:12.951	-0.019	-0.061	-0.108	-0.348	831.2	0.1936588
18	16:51:25.244	-0.033	-0.048	-0.188	-0.272	820.6	0.1947868
19	16:51:36.350	-0.148	-0.106	-0.841	-0.601	818.9	0.1958228
20	16:51:51.415	-0.046	-0.136	-0.258	-0.771	813.6	0.1975816
Avg	20 rounds	-0.040	-0.033	-0.228	-0.185	822.5	0.1950297
S.D.		0.050	0.071	0.284	0.404	10.0	0.0022456

Virtual Vertical Target Accuracy Firing

Date/Time Fired: 06 Mar 2003 16:35:54
Mode:
Note #1:
Note #2:



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