



TECHNICAL PAPER

# STANDARDIZED UXO DEMONSTRATION SITES

## PARSONS – MAGNETOMETER SCHONSTEDT HAND HELD

*BLIND GRID SCORING RECORD NO. 257*



The Magnetometer Schonstedt is shown being demonstrated by Parsons at Aberdeen Proving Ground, Maryland.

Technologies under development for the detection and discrimination of unexploded ordnance (UXO) require testing so that their performance can be characterized. To that end, Standardized Test Sites have been developed at Aberdeen Proving Ground (APG), Maryland and Yuma Proving Ground (YPG), Arizona. These test sites provide a diversity of geology, climate, terrain, and weather as well as diversity in ordnance and clutter. Testing at these sites is independently administered and analyzed by the government for the purposes of characterizing technologies, tracking performance with system development, comparing performance of different systems, and comparing performance in different environments.

The Standardized UXO Technology Demonstration Site Program is a multi-agency program spearheaded by the U.S. Army Environmental Center (USAEC). The U.S. Army Aberdeen Test Center (ATC) and the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) provide programmatic support. The program is being funded and supported by the Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP) and the Army Environmental Quality Technology Program (EQT).

## DEMONSTRATOR'S SYSTEM AND DATA PROCESSING DESCRIPTION

Parsons will safely locate and flag detectable magnetic anomalies using hand-held magnetometers (Schonstedt) within the Standardized UXO Technology Demonstration Site at APG, including the Blind Grid (.48 acres), Open Field (13.68 acres), Moguls (1.3 acres), and Wooded (1.35 acres), but not including performance the Active Response Area (3.5 acres). As each anomaly is detected, its location will be marked by a pin flag. This Technical Paper will provide performance summaries for the Blind Grid portion of these demonstrations only.

The process for detection of anomalies using a magnetometer, marking with pin flags, and surveying by real-time kinematic (RTK) Global Positioning System (GPS) is described as follows. At the outset, lanes will be set up to organize work activities. The lanes will be set up on a 100 x 100 meter grid basis and each grid will then be subdivided into lanes that are one meter wide. The lanes will be marked using ropes stretched between tape measures. The Ordnance and Explosives (OE) technician will proceed slowly along the lane while scanning with the magnetometer until the technician detects an anomaly. Once the position of the anomaly has been determined, a pin flag will be placed at the location. Once a lane has been completed the team will move to next lane in the grid. Once all the lanes in the grid have been traversed then the team will move on to the next grid.

The Magnetometer Schonstedt was demonstrated by Parsons at the Aberdeen Proving Ground Standardized Demonstration Site's Blind Grid Area. This technical paper contains the results of that demonstration. This is a reference document only and does not serve as an endorsement of the demonstrator's product by the US Army or the Standardized UXO Technology Sites Program.

### For more information

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Once a grid has been completed, then it will become available for surveying. The surveying team will use either a Trimble 5700 or equivalent RTK GPS system for areas where vegetation doesn't prevent the use of GPS, or a Trimble Total Station in areas of dense vegetation. When using the GPS, the instrument will be placed over each flag and location recorded in a digital data logger. After that, the flag will be removed. In the case of wooded areas, the assistant will place the rod over the flags in the wooded areas and once the operator of the total station indicates that a reading has been acquired, then the assistant will remove the flag and proceed to the next point.

## PERFORMANCE SUMMARY

Results for the Blind Grid test, broken out by size, depth and nonstandard ordnance, are presented in tables below. Results by size and depth include both standard and nonstandard ordnance. The results by size show how well the demonstrator did at detecting/discriminating ordnance of a certain caliber range. The results are relative to the number of ordnances emplaced. Depth is measured from the geometric center of anomalies.

The Response Stage results are derived from the list of anomalies above the demonstrator-provided noise level. The results for the Discrimination Stage are derived from the demonstrator's recommended threshold for optimizing UXO field cleanup by minimizing false digs and maximizing ordnance recovery. The lower 90-percent confidence limit on probability of detection and probability of false positive was calculated assuming that the number of detections and false positives are binomially distributed random variables. All have been rounded to protect the ground truth. However, lower confidence limits were calculated using actual results.

The overall ground truth is composed of ferrous and non-ferrous anomalies. Due to limitations of the magnetometer, the non-ferrous items cannot be detected. Therefore, the summary presented in the "Ferrous Only" table exhibits results based on the subset of the ground truth that is solely the ferrous anomalies. The second table exhibits results based on the full ground truth. The response stage noise level and recommended discrimination stage threshold values are provided by the demonstrator.

## SUMMARY OF BLIND GRID RESULTS (FERROUS ONLY)

Metric	Overall	Standard	Nonstandard	By Size			By Depth, m		
				Small	Medium	Large	< 0.3	0.3 to <1	>= 1
<b>RESPONSE STAGE</b>									
P <sub>d</sub>	0.60	0.60	0.60	0.50	0.70	0.80	0.65	0.60	0.55
P <sub>d</sub> Low 90% Conf	0.53	0.52	0.45	0.35	0.55	0.55	0.52	0.47	0.33
P <sub>d</sub> Upper 90% Conf	0.69	0.72	0.73	0.62	0.79	0.95	0.77	0.73	0.74
P <sub>fa</sub>	0.70	-	-	-	-	-	0.70	0.70	0.80
P <sub>fa</sub> Low 90% Conf	0.64	-	-	-	-	-	0.62	0.58	0.42
P <sub>fa</sub> Upper 90% Conf	0.77	-	-	-	-	-	0.81	0.78	0.98
P <sub>na</sub>	0.40	-	-	-	-	-	-	-	-
<b>DISCRIMINATION STAGE</b>									
P <sub>d</sub>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>d</sub> Low 90% Conf	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>d</sub> Upper 90% Conf	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>fa</sub>	N/A	-	-	-	-	-	N/A	N/A	N/A
P <sub>fa</sub> Low 90% Conf	N/A	-	-	-	-	-	N/A	N/A	N/A
P <sub>fa</sub> Upper 90% Conf	N/A	-	-	-	-	-	N/A	N/A	N/A
P <sub>na</sub>	N/A	-	-	-	-	-	-	-	-

Response Stage Noise Level: 0.50  
Recommended Discrimination Stage Threshold: 0.50

## SUMMARY OF BLIND GRID RESULTS (FULL GROUND TRUTH)

Metric	Overall	Standard	Nonstandard	By Size			By Depth, m		
				Small	Medium	Large	< 0.3	0.3 to <1	>= 1
<b>RESPONSE STAGE</b>									
P <sub>d</sub>	0.60	0.60	0.60	0.50	0.70	0.80	0.65	0.60	0.50
P <sub>d</sub> Low 90% Conf	0.53	0.51	0.47	0.39	0.55	0.55	0.51	0.48	0.30
P <sub>d</sub> Upper 90% Conf	0.67	0.70	0.71	0.61	0.79	0.95	0.73	0.74	0.70
P <sub>fa</sub>	0.70	-	-	-	-	-	0.70	0.70	0.80
P <sub>fa</sub> Low 90% Conf	0.64	-	-	-	-	-	0.62	0.58	0.42
P <sub>fa</sub> Upper 90% Conf	0.77	-	-	-	-	-	0.81	0.78	0.98
P <sub>na</sub>	0.40	-	-	-	-	-	-	-	-
<b>DISCRIMINATION STAGE</b>									
P <sub>d</sub>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>d</sub> Low 90% Conf	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>d</sub> Upper 90% Conf	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P <sub>fa</sub>	N/A	-	-	-	-	-	N/A	N/A	N/A
P <sub>fa</sub> Low 90% Conf	N/A	-	-	-	-	-	N/A	N/A	N/A
P <sub>fa</sub> Upper 90% Conf	N/A	-	-	-	-	-	N/A	N/A	N/A
P <sub>na</sub>	N/A	-	-	-	-	-	-	-	-

Response Stage Noise Level: 0.50  
Recommended Discrimination Stage Threshold: 0.50

*Note: The recommended discrimination stage threshold values are provided by the demonstrator. No discrimination algorithm was applied. Therefore, the discrimination stage results are not applicable.*

To view the full Scoring Record for this demonstration and for all other demonstrations conducted at the Aberdeen and Yuma Proving Grounds in support of the Standardized UXO Technology Demonstration Sites Program please visit our Web site at: [www.uxotestsites.org](http://www.uxotestsites.org).

