Lateral-approach Methodology and HSTAMIDS

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Sensitivity profile is influenced by many properties as theoretical works and experiments have exhibited, such as the coil and electronic design of the device, metal content and shape of the target, magnetic and electrical properties of the soil, etc. When clearance operations are planned at a site, the metal-detector model is the only choice users can make, and this determines the sensitivity profile and associated performance. Therefore, the choice is very important.

In the detection-performance analysis of blind tests, the concept of halo radius that sets a circular area around a target to define hit miss was commonly used. In the CEN Workshop Agreement, the halo radius is “half of the maximum horizontal extent of the metal detector's location error can be assessed, indicating a pinpoint error that frequently occurs and includes 95% of detections. Additionally, the percentage of detections with...

...the information may be used to establish an operating procedure for detection and safe excavation of landmines.

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Lateral-approach Methodology and HSTAMIDS

MAG Cambodia has used the Handheld Standoff Mine Detection System (HSTAMIDS) with lateral-approach methodology for three years within an operational field evaluation funded by the U.S. Department of Defense’s Night Vision and Electronic Sensors Directorate. MAG’s current research tested the productivity of two ways of using LAM combined with HSTAMIDS against the productivity of the traditional one-man one-lane drill methodology; this article presents the findings.

by Clifford Allen and Shathel Fahs

Lateral-approach methodology is the method by which a minefield is cleared along its linear boundaries rather than by breaching clearance lanes every 25m or 90 degrees to the linear boundary into a minefield. This is done by selecting the longest and most conveniently accessed boundary and advancing into the minefield laterally or in extended lane approach. LAM is broken down into phases that can differ in number depending upon the terrain encountered. LAM is not a new concept; The HALO Trust developed it about half a decade ago when the organization first began deploying the Handheld Standoff Mine Detection System (HSTAMIDS), a metal detector with ground-penetrating radar capabilities, in the field. MAG (Mines Advisory Group) adopted the methodology in November 2007 and has since altered it many times to improve productivity and ease the burden on deminers.

Procedure

Prior to Phase 1, the lane is marked using a red rope with white markers painted or taped onto the rope every meter. The operational field evaluation then begins the following phases for clearance:

1. Quick search
2. Vegetation cutting/muck removal
3. Raking and blowing
4. Marking
5. Detection
6. Manual excavation
7. Rapid-extraction drill

Quick search. In Cambodia, the tripwire threat is considered nonexistent; consequently, the first phase entails conducting what is known...
Detection. The next phase is detection or clearance, and it can be executed using either conventional metal detectors or HSTAMIDS. If the former is adopted, the deminer starts a systematic search, sweeping sideways on straight lines, placing red chips on all signals encountered. If HSTAMIDS is used as the primary search tool, the detector operator can immediately differentiate between metal clutter and possible mines, and the operator places blue and red chips (markers) accordingly.

If the area being detected has many signals per cell, then a magnet can be utilized to reduce surface clutter. A senior deminer or a superior, such as a supervisor in Cambodia or a deputy team leader in Angola, should supervise this activity to negate any missed signals. The procedure is to lift a chip and sweep the magnet over the area where the chip was placed, attracting metal fragments to the magnet. A detector is then placed over the area again, and if the signal has disappeared, the chip is removed. However, if the signal remains, the chip is again placed on the spot for further action. When the cell sweep is completed, the operator moves the sensor/search head forward and continues with the next sweep. The operator progresses to the blue-colored rope, thus creating overlap. Overlap should also be maintained at the front and ends of all cells.

If a conventional metal detector is used for detection and marking of the entire lane with red chips, the HSTAMIDS detector then verifies all red chips placed by conducting isolation and moving in a zigzag motion over each chip. Since HSTAMIDS costs upwards of US$41,000–26,000 and conventional metal detectors cost roughly $3,000, the use of a conventional metal detector is often used in place of HSTAMIDS. On the other hand, HSTAMIDS’ GPR sensors allow the operator to change up to 95% of the red chips to blue, which identifies the remaining 5% as being the only red chips necessary to manually excavate. If the HSTAMIDS is deployed as the primary clearance tool, then the blue and red chips are placed concurrently, depending on the signals HSTAMIDS gives.

Manual excavation. The next phase involves manual clearance with the help of a conventional metal detector. The deminer observes the lane for chips and moves to where the first red chip is placed. If this is, for example, in cell 4, then the excavation deminer will manually excavate that cell using conventional standard-operating procedures. Excavation drills, which is done by centralizing the chip using the metal detector. No sweeping toward the signal is required. If the chip is the correct position, as indicated by the detector, the operator will proceed to excavate the signal location, moving along the lane until all locations are excavated. Mines are not completely excavated; they are only partially excavated to allow a donor charge to be placed alongside unless they are to be neutralized or disarmed. QCSA is then conducted on the excavations, and any mines are destroyed in situ.

Rapid excavation drill. The final phase is to proceed to rapid excavation of all blue chips using mechanical means, which is carried out by an operator using a long-reach tool with a digging attachment. This procedure is known as a rapid-digging drill. The long-reach tool operator will excavate each blue chip by digging a trench to the rear or side of the blue chip as per manual drill, and will force its way forward with the long-reach tool until the operator is just behind or alongside the chip. At this point, the operator must stop the digging bit from revolving and brush the chip into the excavation behind or alongside the chip’s position before continuing excavating 5cm beyond the place where the chip was originally lying.

Bringing the chip aside to continue excavation 5cm beyond will ensure that all items will either be uncovered or thing to the side, and will enable the long-reach tool operator to determine the source of the signal. Once all the rapid excavations are completed in a given lane, the lane is designated as cleared, and the next lane can be prepared. The rapid excavation drill procedure achieves final quality assurance.

Modifications to LAM

Since the inception of LAM, a number of innovative ideas were adopted, and most of those have come from the deminers on the ground. For instance, since MAG first utilized LAM and the introduction of rapid-digging drill in November 2008, marking has seen substantial changes. This methodology was simplified and re-engineered to optimize productivity.

Two improvements in the process were made. First, the red rope with white markers has eliminated the need for conventional minefield pickets at every meter, thereby removing these obstacles for the deminers. Second, in the way in which these ropes are deployed, by means of polyvinyl chloride pipes and stakes, is also an improvement. MAG is continually rethinking marking to increase efficiency.

Even without HSTAMIDS, evidence suggests LAM is easier to control, has improved safety benefits, and is more cost efficient on marking materials than the one-man, one-lane drill methodology. LAM could better benefit mine/verge clearance than the current method of clearing with the one-man, one-lane drill methodology. Those productivity advantages can be seen in Figures 1 and 2 (previous page).

On the other hand, using HSTAMIDS in LAM is additionally advantageous in a number of ways:

• As shown in Figures 3 and 4 (above), substantial increases in productivity occur.

• The number of time-consuming and labor-intensive manual excavations are minimized.

• Using a blower is seen to have morale-boosting effects on deminers as it clears everything from the lane in a less labor-intensive way.

• Removing some surface metal and stones means the detector operators have an easier time sweeping the detector close to the ground for better detection.

• Using magnets before and after clipping, depending upon contamination levels, is a time-saver. If a lot of surface clutter is encountered, then the magnet can be swept over the cell before the detector is deployed. Correspondingly, after clipping, the magnet can be deployed on selected targets, particularly around red chips that can then be discounted if the magnet detects and lifts the offending signal from the surface.

In a conventional minefield, the standard operating procedure for MAG Cambodia states that the safety distance between any working deminers should not be less than 25m. However, this distance is largely because all deminers work independently, and 25m is the default distance that most demining organizations worldwide adopt in anti-personnel minefields. Due to the nature of the methodology covered above, not all activities are deemed equally hazardous or potentially so. Therefore, the authorities devised a system pertaining to the nature of the activity shown in Table 1 (next page) giving various distances that should not be exceeded.

Use of Enhancements to Long-Reach Tools

MAG used Honda long-reach tools for strimming before it began using LAM. However, since MAG began using LAM with HSTAMIDS, a range of tools designed for gardening produced by Stihl, a German manufacturer, were procured. These tools were modified in many ways to adapt them for the demining industry. For example, the shafts MAG uses are half shafts held together in the center by a coupling, which has also been modified. This facilitates quick tool change—a shaft change

Free minefield. Drive shafts were modified, and the locating pin was re-manner as strimming, bearing in mind MAG is not looking for a metal-
mizing the operator’s effort. The blowing is done in roughly the same
allows the debris to be more easily blown into the cleared area, mini-
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The basic design of the pineapple and the alignment of drive shafts maximizes the potential for digging. Sometimes overhanging trees and bamboo must be removed before clearance. Teams are supplied with chainsaw attachments to deal with the heavier branches and bamboo shoots. These saw attachments on the end of a half shaft are easier to transport and operate than a completely independent saw. Various digging devices were trialed and mostly discarded, although the cutting blades designed by engineers at NVESD have had some success in soil that is not densely compacted and is largely free of rocks and roots. The rapid-excavation drill uses the pineapple drill head, which is the mainstay of mechanical-extraction activity.

### Two Methods of Clearance Utilizing HSTAMIDS

The agreement between MAG and NVESD is that HSTAMIDS should be the primary clearance tool; therefore, the lateral approach methodology was largely developed with this in mind. More recently, the purchase of additional HSTAMIDS units, funded by the Office of Weapons Removal and Abatement in the U.S. Department of State’s Bureau of Political-Military Affairs (PMWRA), is allowing MAG to experiment with other approaches outside of the NVESD operational field evaluation.

The OFE methodology has evolved as three-by-three-person sub-teams, each with an HSTAMIDS detector and all the ancillary equipment needed to conduct operations. Each sub-team is allocated an area of the minefield and concentrates its efforts in this area only. Each member of the sub-team is multi-skilled in as many of the activities as possible needed to conduct operations, thus allowing for flexibility and continuity. These three individuals can operate the various phases independently and without strict supervision. Each team member knows what the next step is and equips themselves with the necessary equipment from a fixed point (rot area) close to their working lane, which has been found to work very well provided that the sub-team is continually allocated between five and seven lanes minimum to allow for observation of safety distances while conducting constant activity.

Teams outside the OFE are equipped with one HSTAMIDS detector and two operators and they support a number of metal detector operators. The team is roughly divided into two parts. On average, five or six conventional metal-detector operators are deployed, conducting quick search and marking all signals in lanes with red chips. This practice ensures that the HSTAMIDS has sufficient work to sustain it for an entire day. Later, these operators also manually excavate red chips that remain after HSTAMIDS has verified them.

The other team members (up to six in a standard MAG mine-action team configuration) perform the other activities, which revolve around the long-reach tools. These are strimming, cutting, sawing, blowing and rapid excavation. All of the operators are also involved in marking when the HSTAMIDS is being used as the verification detector. This methodology needs further study to ascertain whether this procedure should be altered to remain flexible in order to account for varying contamination levels. Metal contamination is the main factor governing the number of metal detectors deployed at any given time because this affects whether more than one HSTAMIDS detector is necessary.

**Productivity**

MAG continually strives to increase efficiency and effectiveness, and the introduction of HSTAMIDS has greatly enhanced its ability to do so, as illustrated in Figures 3 and 4 (page 47). Last year, MAG saw significantly improved with the introduction of HSTAMIDS to the toolbox.

The methods MAG Cambodia uses when deploying HSTAMIDS with the lateral-approach methodology exhibit certain advantages when compared with the traditional one-man, one-lane approach, particularly with regard to productivity. The analysis of HSTAMIDS and LAM is still an ongoing process within the program with further technological advances and improvements in productivity expected.

The various outlined approaches are open for improvement and adjustment, with expectations that as HSTAMIDS is introduced into other programs, the improvements in these methodologies will ensure that HSTAMIDS and LAM continue to give significant benefits over standard metal detectors and more conventional clearance methodology.

### Conclusion

The study presented here is one of MAG’s Technical Field Manager Leaders and is a former British Army Royal Engineers Bomb Disposal Warrant Officer who has worked in humanitarian mine action for MAG in various positions since 1993. Allen has run the HSTAMIDS OFE in Cambodia since July 2006, and is implementing a second MAG program in Angola, offering advice, support and training.

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**Table 1. LAM safety distances.**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hazardous</th>
<th>Non-Hazardous</th>
<th>Safe Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strimming</td>
<td>x</td>
<td>5m</td>
<td></td>
</tr>
<tr>
<td>Cutting</td>
<td>x</td>
<td>10m</td>
<td></td>
</tr>
<tr>
<td>Sawing</td>
<td>x</td>
<td>25m</td>
<td></td>
</tr>
<tr>
<td>Raking</td>
<td>x</td>
<td>25m</td>
<td></td>
</tr>
<tr>
<td>Blowing</td>
<td>x</td>
<td>40m</td>
<td></td>
</tr>
<tr>
<td>Lane preparation</td>
<td>x</td>
<td>10m</td>
<td></td>
</tr>
<tr>
<td>SCA/MATTE</td>
<td>x</td>
<td>10m</td>
<td></td>
</tr>
<tr>
<td>Data Collection</td>
<td>x</td>
<td>5m</td>
<td></td>
</tr>
<tr>
<td>Manual excavation</td>
<td>x</td>
<td>25m</td>
<td></td>
</tr>
<tr>
<td>Rugged excavation</td>
<td>x</td>
<td>25m</td>
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</tr>
<tr>
<td>QA</td>
<td>x</td>
<td>2m</td>
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</tbody>
</table>