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The Mine Action Technology Newsletter lets you know where to find more information and who to contact, where to go and what is going on in support of your work.

Issue No 9

Introduction

This is the ninth issue of the Mine Action Technology Newsletter, produced by UNMAS and GICHD, dedicated to the promotion and development of related mine action technology.

We welcome new ideas and would happily share them with others if sent for inclusion in the Newsletter. Feedback from the field, NGOs, manufacturers, donors or headquarter organizations helps to make the Newsletter more interesting.
This issue includes short articles on the following:

- Magnetism, magnetometers and mine action.
- Easy access to publicly available information on humanitarian demining equipment, ITEP Secretariat;
- CEN tests at Swedish EOD and Demining Centre (SWEDEC)
- ALIS - A Hand Held Dual-Sensor with Imaging Capability
- MineWolf workshop in Stockach, Germany;
- Vallon/Force Ware Workshop in Einingen/Riederich, Germany;

We hope that you find the articles above and the information provided through the " What's going on in Technology" and "Sound Bites" sections both interesting and informative.

We will continue to do everything we can to bring new technology to the field and information to you via this Newsletter and other means. In the meantime, we thank you for your contributions and interest and hope that you will continue to help us produce the Technology Newsletter by submitting information to be shared with others.

This newsletter is sent out via e-mail to people and organizations who have expressed an interest in mine action technology. Please pass to anyone else who may be interested and ask them to sign up for a copy of future editions. Those wishing to receive a copy as soon as it is available can simply click the sign-up link on the email accompanying this newsletter or subscribe at the following web page http://www.gichd.org/gichd-newsletters/mine-action-technology-newsletter/sign-up/
The newsletter is also available on the UN Mine Action Service website, **E-Mine** (www.mineaction.org).

Readers are once again invited to provide their own comment and to make constructive suggestions to the Editors, Noel Mulliner, Technology Coordinator at UNMAS, or Erik Tollefsen, Technology Officer at the GICHD.

Mine Action
TECHNOLOGY
NEWSLETTER

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WHAT'S GOING ON IN TECHNOLOGY ?

Conferences, Training and other Events

Editor's Note: *If readers have details of any forthcoming conferences, symposiums or training events please submit the information to one of the editors.*

ASEM Seminar on New Technology for Demining and Human Security, Taranto, Italy . 5 - 6 March 2009

ASEM Seminar on New Technology for Demining and Human Security was a direct response from the call made at the ASEM (Asia-Europe Meeting) Foreign Ministers' Meeting for furthering efforts to deal with the suffering and casualties caused by indiscriminate use of anti-personnel mines. The Italian Ministry of Foreign Affairs is organizing a conference, launched in the ASEM context on new technology in demining in Taranto in southern Italy 5 to 6 March 2009. The meeting is co-chaired by Italy and Cambodia and co-sponsored by Belgium. The meeting will discuss the following topics:

1. A review of demining lessons learned/success stories and relevant technological approaches (e.g. detection, clearance, etc) as well as their impact on community environment and economy.
2. The potential role of new integrated detection technologies.

For more information contact Paola Munzi at dgao4@esteri.it

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Workshop on Robotics and Mechanical Assistance in Humanitarian Demining and Similar Risky Interventions (HUDEM 2009), Florida, USA. 6 – 8 March 2009

The International Advanced Robotics Programme (IARP) HUDEM 2009 Workshop on Robotics and Mechanical Assistance in Humanitarian Demining and Similar Risky Interventions will be held at the Florida Institute for Technology (FIT), USA, from the 6th to the 8th of March 2009. The workshop will review and discuss the available technologies and development efforts to automate tasks in the area of environmental surveillance, risky interventions and humanitarian demining in particular. Specific topics include but are not limited to:

- Tele-operations,
- Mobile Robotics Systems (Design, Control, Command) for unstructured environments (UGV, UAV, multi-robotic cooperation),
- Modular Tool-Kit Solutions,
- Sensors and sensor fusion,
- Demonstrators – Tests Results,
- Human Machine Interface,
- Social aspects and education, and
- Crisis management tools

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UXO Countermine Range Forum™.. Orlando, Great Lakes, USA. 24 - 27 August 2009

Hosted by the Department of Defense Unexploded Ordnance (UXO) Center of Excellence – with support from other Federal organizations – the UXO/Countermine/Range Forum™ 2009 is the U.S. Department of Defense Preeminent Conference on Technology, Programs and Partnerships. The Forum 2009 will address 21st Century Explosive Hazard Challenges, Technology Solutions and Partnerships for Full Spectrum Operations. The program includes a general session and luncheon speakers, more than 150 technical presentations also covering humanitarian demining, as well as special sessions and exhibits dedicated to IED Defeat and exhibitors of a wide range of technologies.

The abstract submission begins on the 9th of January until the 2nd of March 2009. The Conference registration starts on the 2nd of February 2009. For more information, visit http://www.theforum2009.com/

Feature Article 1

Magnetism, Magnetometers and Mine Action

by

Marcel Durocher

Historical background

In the 1800's rudimentary compasses and dip needles were used in Europe to prospect for iron ore deposits. More sophisticated instruments to measure the earths magnetic field were not developed until WWII when the fluxgate magnetometer was developed as a search tool for submarine detection.

Since that time magnetometers have been used extensively by governments, resource development industries and the scientific community. Their use by the mine action community to search for buried UXO and landmines is a recent development.

Earth's Magnetic Field

Prior to discussing the pros and cons of using magnetometers in mine action programmes, some of the attributes of the earth's magnetic field and the terms used to describe them warrant a brief review.

Although not fully understood, the earth's magnetic field is believed to originate in the earth's molten outer core. The earth's magnetic field (magnetosphere) is tear drop shaped with the bulbous end facing the sun and the tail on the shadow side of the planet (Figure 1).

By convention the magnetic pole located near the geo-graphic north pole is referred to as the north magnetic pole. The magnetic lines of flux are vertical at the north and south magnetic poles and horizontal at the magnetic equator. Generally, their orientation is north-south. The intensity of the earth's field at the magnetic poles is roughly twice as high as that at the magnetic equator. The magnetic poles do not coincide with the geographic poles.

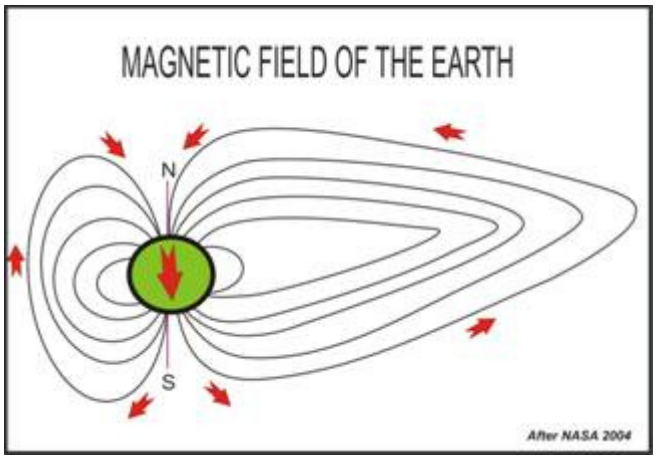

Figure 1: Schematic of the earth's magnetic field. Arrows indicate direction of magnetic flux.

The distribution of the total intensity of the earth's magnetic field in different parts of the world is shown in Figure 2. The numbers indicate the total field intensity in nanoTeslas (units of magnetic field intensity) at the location of some of the major intensity highs and lows.

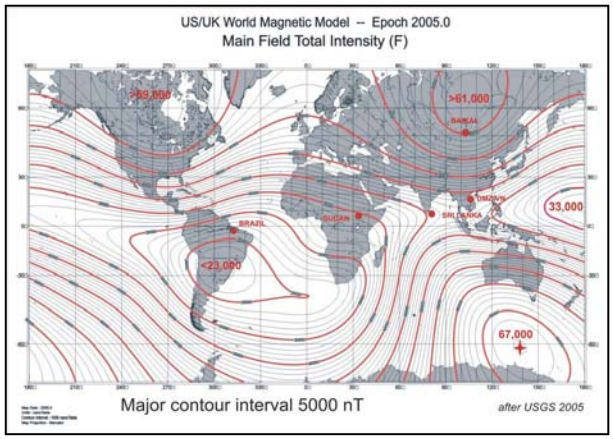

Figure 2: Map showing the distribution of the total magnetic field intensities.

The star in the SE corner of the map is the location of the south mag-netic pole. The north magnetic pole is off the northwest corner of the map in arctic Canada. The dots are loca-tions that will be referred to later. As can be seen from the map the total intensity of the field is higher in polar regions than in equatorial regions.

At any location, the earth's magnetic field can be viewed as being made up of vertical and horizontal components. The distribution of the intensity of the vertical compo-nent is shown in Figure 3. Major vertical intensity highs are located in polar regions.

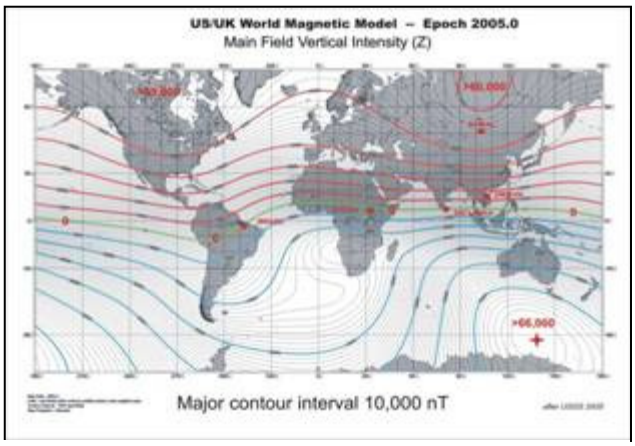

Figure 3: Map showing variations in the vertical intensity of the earths magnetic field.

Of special interest is the line marked with zeroes. It represents the magnetic equator. The vertical intensity of the earth's magnetic field at the magnetic equator is zero. Except for the dip over south America and the Western Pacific it is located approximately 10 degrees north of the geographic equator. In the northern hemisphere the orientation of the vertical component is downward into the ground, whereas in the southern hemisphere it is upward out of the ground.

The distribution of the horizontal component of the earth's magnetic field is shown in Figure 4. The horizontal intensity highs define a belt that is centered on the magnetic equator. Horizontal intensity lows are mainly in the polar regions. Several of the regions of interest to the mine action community are located within the equatorial belt of horizontal intensity highs.

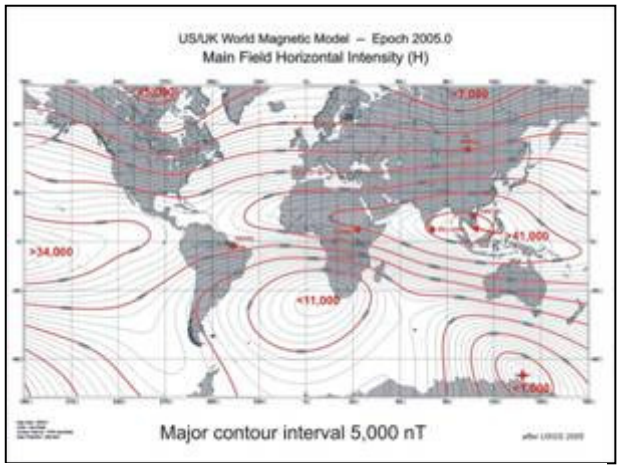

Figure 4: Map showing variations in the horizontal intensity of the earth's magnetic field.

The inclination of the earth's magnetic field in different parts of the planet is shown in Figure 5. The magnetic equator is again shown with zeroes. The earth's magnetic field at locations along this line is horizontal. The inclination increases away from the magnetic equator and at the magnetic poles it is vertical. North and south of the magnetic equator the inclination of the field is downward into the ground and upward out of the ground respectively.

The angle of inclination is the angle between the earth's field and a horizontal plane on the earth's surface. In the text, regions in which the inclinations are low (<30 degrees) are also referred to as low magnetic latitude or equatorial regions. Regions with >60 degrees field inclination are referred to as high magnetic latitude or polar regions. The magnetic equator does not coincide with the geographic equator (see Figures 3 and 5).

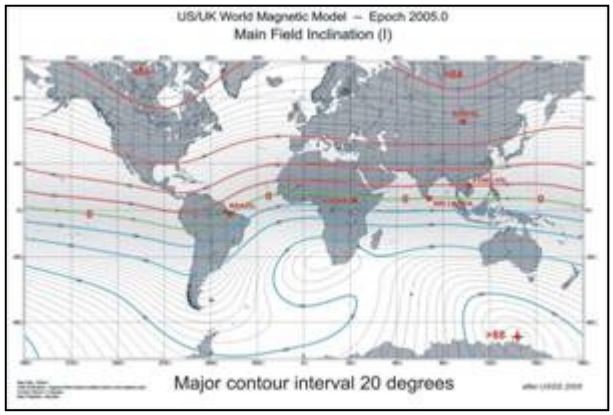

Figure 5: Map showing variations in the inclination of the earth's magnetic field.

Magnetic Anomalies

Magnetic anomalies are disturbances in the earth's magnetic field. They are caused by the interaction of the earth's magnetic field with magnetically susceptible objects such as iron and steel. The interaction sets up what is referred to as an induced magnetic dipole (similar to the magnetic field around a bar magnet) within a magnetically susceptible object such as a UXO. The nature of the interaction between the dipole's magnetic field and the earth's magnetic field is what a magnetometer measures.

At the magnetic poles the magnetic field associated with an induced dipole will be in the same direction as the earth's magnetic field and reinforce the earth's magnetic field causing a large positive peak or anomaly. At all mid-latitude locations there will be both reinforcement and cancellation over different parts of an object; giving rise to an anomaly that has both positive and negative components. At the equator they will be in the opposite direction and result in a large negative peak over the center of the UXO, and weak positive peaks along the northern and southern edges of the object. Idealized anomaly profiles over a vertical cylinder are presented in Figure 6.

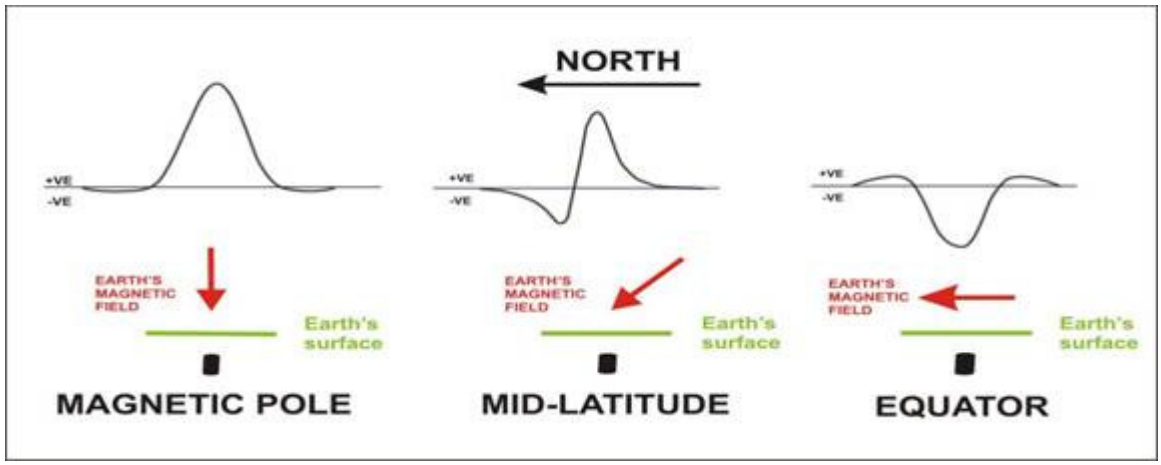

Figure 6: Schematic of magnetic anomaly profiles in polar, northern mid-latitude and equatorial regions and the inclination of earth's magnetic field (arrows) with respect to the earth's surface..

Five locations are indicated on each of the maps. They are (1) Brazil, (2) Sudan, (3) Sri Lanka, (4) DMZ-VN and (5) Baikal. The main characteristics of the earth's magnetic field at each of the above locations obtained from the above maps is of summarized in Table 1.

	Brazil Mouth of Amazon river	Southern Sudan	Sri Lanka	Vietnam (former DMZ)	Lake Baikal (southern Siberia)
Total Field Intensity	~26,000 nT	~35,000 nT	~40,500 nT	~43,000 nT	~60,000 nT
Vertical Component Intensity	0 nT	0 nT	0 nT	~16,000 nT	~55,000 nT
Horizontal Component Intensity	~26,000 nT	~35,000 nT	~40,500 nT	~40,000 nT	~19,500 nT
Field Inclination	0 degrees	0 degrees	0 degrees	~ 20 degrees	~ 70 degrees

Table 1: Main attributes of the earth's magnetic field at selected locations.

Calculated peak anomaly values over a vertical medium sized bomb (~30cm diameter x ~150cm length) using total field intensities at each of the above locations are tabulated in Table 2.

Depth to top of bomb	Brazil mouth of Amazon river	Southern Sudan	Sri Lanka	Vietnam (former DMZ)	Lake Baikal (southern Siberia)
1.0 meter depth	~ - 492 nt	~ - 662 nT	~ - 766 nT	~ 813 nT	~ 2268 nT
2.0 meters depth	~ - 127 nT	~ - 171 nT	~ - 197 nT	~ 209 nT	~ 585 nT
3.0 meters depth	~ - 50 nT	~ - 67 nT	~ - 78 nT	~ 83 nT	~ 231 nT

Table 2: Summary of peak anomaly values that would be obtained over a vertically oriented medium sized bomb at the locations referred to in text.

The two main factors affecting peak anomaly values for any given UXO at a given depth are location and UXO orientation. Brazil, Sudan, Sri Lanka and the former DMZ in Vietnam are all in magnetic equatorial regions. All other factors being equal and ignoring the peak polarities (+/-), the differences in peak anomaly values among these four locations are due solely to differences in the total field intensities at these locations.

In the Lake Baikal location (70 degrees north field inclination) peak anomaly values are much higher than at the other four locations. This is due to the fact that the intensity of earth's magnetic field is higher at that location and that the induced magnetic field in the bomb will be in the same direction and therefore will reinforce the earth's field.

For any given vertical UXO scenario, peak anomaly values at locations in equatorial regions will be roughly 3 to 5 times lower than in polar regions. UXO orientation with respect to the orientation of the earth's magnetic field is also important. For UXO scenarios where the orientation of the long axes of the UXO are parallel to the orientation of the earth's magnetic field lines peak anomaly values will be roughly twice as high as for other UXO orientations.

Detection Depths

It is clear from the above examples, that for any given magnetic background, detection depths for most UXO scenarios at locations along or near the magnetic equator will generally be significantly lower than at high magnetic latitude locations.

Magnetic Survey Parameters

Peak anomaly values will be obtained when surveying along lines parallel to the orientation of the earth's magnetic field. In most of the regions of interest to the mine action

community the magnetic declination is less than 10 degrees east or west of true north. Magnetic surveys should, as a general rule therefore, be conducted from south to north along survey lines in the northern hemisphere. In the southern hemisphere the survey direction should be from north to south. Conducting magnetic surveys along other orientations in equatorial regions will yield reduced peak anomaly values and possibly difficult to interpret data. These effects diminish away from the magnetic equator. In addition to the effects of location and UXO orientation, ferromagnetic (iron and steel) objects on the operator can interfere with proper functioning of the instrument. For optimum performance operator clothing should be free of all iron and steel objects.

Magnetometers and Gradiometers

The above discussion and examples were centered on total field magnetometers. They are instruments that measure the total intensity of the earth's magnetic field at any location. Because of more stringent operational and more complex computerized data processing requirements total field magnetometers are not in widespread use within the mine action community. Instead, magnetic gradiometers, also known as ferrous probes or bomb locators, are used more extensively because they are easier to use.

Most of the instruments being used in mine action projects are fluxgate gradiometers. These instruments are directional and maximum readings over UXO's will only be obtained when the long axes of the gradiometers are aligned parallel to the earth's magnetic field. Readings obtained when the long axes of the gradiometers are not parallel to the inclination and direction (north-south) of the earth's field will be greatly reduced.

All of the fluxgate gradiometers that are currently available were designed and built to measure gradients in the vertical intensity of the earth's magnetic field. Only a brief glance at the vertical field intensities in Table 1 and the distribution of vertical field intensities in Figure 3 is required to realize that these types of instruments will be of limited usefulness in the search for UXO in magnetic equatorial regions. The best that can be expected at these locations are severely reduced peak values. Horizontal field intensities on the other hand are much higher (see Figure 4). Fluxgate gradiometers should, therefore, be oriented horizontally with the long axes of the instruments aligned in a north-south direction in equatorial regions.

Conclusions

If magnetic surveys are being contemplated for UXO detection the first consideration should be location in relation to the magnetic equator. All other factors being equal, peak anomaly values and detection depths for any given UXO scenario will be significantly lower and operational constraints more severe in equatorial regions than in high magnetic latitude regions.

The second consideration is equipment. It is recommended that only instruments that are capable of measuring variations in the horizontal field intensities of the earth's magnetic field be used in equatorial regions. Total field magnetometer systems which are orientation independent will yield higher quality data than currently available fluxgate gradiometers The former however, are more demanding in terms of operator knowledge, training and experience.

Whether or not magnetometers or gradiometers should be used at all in mine action projects in equatorial regions is dependent on desired project search/clearance depths. For safety reasons, for anything smaller than aircraft bombs they should be regarded as shallow (<1.0 meter) search tools. For very large bombs 2-3 meter detection depths may be possible in some areas.

Note* The maps used in this article were downloaded free of charge from the following website. An interactive calculator for calculating magnetic field intensities at any location is also featured on this website.

NATIONAL GEOPHYSICAL DATA CENTER (NGDC)
NOAA Satellite and Information Service
http://www.ngdc.noaa.gov/geomag/

The author wishes to thank NVESD/US DoD and Golden West Humanitarian Foundation for their support during preparation of the manuscript.

Feature Article 2

Easy access to publicly available information on humanitarian demining equipment

by

ITEP Secretariat

This article describes a new feature that was recently introduced on the ITEP website: the humanitarian demining equipment database. The database provides a list of pointers to directly accessible/downloadable information, together with a summary description of the available information.

Appropriate application of demining equipment leads to cost-effective clearance and, as a result, to the safe return of land to communities. Appropriate application implies that the right equipment is used for the envisaged task. This means not only that the task and the conditions in which the task has to be fulfilled are well understood, but it also implies that the capabilities of the available demining equipment are known so that it is possible to match the equipment to the task.

To fully understand the capabilities of equipment for a specific task, the equipment has to be tested in the operational conditions where it is going to be used. However, prior to selecting equipment for field assessment and/or procurement, it might be useful to screen the range of equipment that is on the market to learn about the characteristics, to obtain data on the performance in standardised conditions, and to maybe find out what other users think of the particular equipment. Apart from the communication between field practitioners, several sources of information on humanitarian demining equipment are available nowadays which should allow potential buyers/users to make an informed decision:

- Most equipment manufacturers have a website on which they provide a basic description of their equipment, and the equipment specification.
- The GICHD equipment catalogues provide comprehensive overviews of mechanical demining equipment, detectors and personal protective equipment available on the market today (1, 2). Next to an equipment description, which is in many cases more exhaustive than on the equipment manufacturer website, these directories include additional information such as where the equipment is in use today, details on factory support and maintenance, information on reported limitations and strengths, and a list of references where test and evaluation information can be found.
- The ITEP website provides a list of directly downloadable test reports (3), as well as information on projects in which humanitarian demining equipment was tested (4).
- The Journal of Mine Action (5) and the UNMAS GICHD Mine Action Technology Newsletter (6) also publish articles on humanitarian demining equipment, equipment trials and operational applications.
- Workshop and conference articles may also include useful data.

This list suggests that in many cases the information is out there, publicly available. A series of internet searches will most likely provide what is needed to screen the available equipment and make a first assessment. However, some time might be necessary to search and some patience might be required to extract the useful data amongst the found information. The ITEP Secretariat has therefore made an attempt to centralise pointers to available information on a "webpage per equipment item" basis. Currently, the database can only be searched for mechanical demining equipment (7), but the search will be expanded to also include detection equipment, and in the long term personal protective equipment. Every equipment page includes:

- The equipment name, as listed in the GICHD mechanical demining equipment catalogue. If the equipment is not listed in the catalogue, the name given on the manufacturer website is used.
- The manufacturer name, with a link to the manufacturer's website. In most cases, the link points to the description of the selected equipment on the manufacturer's website. When this is not possible, it points to the manufacturer's website home page.
- A list of the GICHD mechanical demining equipment catalogues which contain the selected equipment, with a link to the catalogues followed by the machine category under which the equipment is listed in the GICHD catalogues.
- A list of publicly available test and evaluation reports, indicating if the described trials were carried out by ITEP Participants or by other testing entities. If the reports are the result of ITEP trials, links to the ITEP project descriptions provide summary information on the test projects (ITEP nations and/or other partners involved, trial period and place, etc.). For each trial report, a short description of the type of trial is given which should allow users to assess if this is the type of report they are looking for, without having to download the report. For instance, the trial description will show if it is a trial executed according to the CEN Workshop Agreement (CWA) on Test and Evaluation of Demining Machines (8) or not, if it concerns a performance trial or a survivability trial, and in the latter case if it was the survivability of the machine/tools that was tested or also of the operator, etc.
- A list of other documents, with links. These documents are publications and articles extracted from journals and conference proceedings which include additional information on the equipment.

Tables 1, 2 and 3 provide examples of the equipment webpage layout and content, as well as of the different information sources users are directed to. The examples have been selected in order to illustrate the type of information that can be found on the equipment page.

From Table 1 visitors can determine that:
- the Mini MineWolf was tested according to the CWA agreement by ITEP, and that information will be found on the CWA performance, as well as on the AP and AT survivability of the machine.
- the Mini MineWolf was tested by HCR-CTRO and that information will also be found on performance, AP survivability of the machine and ground processing depth, although the test was not a CWA test.
- there are several articles available which provide additional information

From Table 2 it can immediately be seen that the only publicly available test information available for the MANTIS is a 2005 report from an ITEP trial. The user is informed that it concerns a performance and AP survivability trial, not carried out according to the CWA guidelines, and that the test report also includes information on additional capabilities of the machine.

From Table 3 visitors will learn that a considerable amount of public test information is available for the Scanjack 3005, and that the test information is wide ranging. There are reports from trials executed by various test organisations and according to different test procedures. Furthermore, the equipment page shows that the visitor will find data on the CWA performance of the machine, the AT survivability of the machine, hammer-wear issues and other machine capabilities.

Table 1: result of a search on the equipment “Mini MineWolf”

Equipment: **Mini MineWolf** **Manufacturer:** *MineWolf Systems*	
GICHD catalogues: Mechanical Demining Equipment Catalogue 2008 Mine clearance machine - Medium Dual Capability (Flail or Tiller) Mechanical Demining Equipment Catalogue 2006 - Tiller	
Reports: **Tested by ITEP:** Project No.: 3.2.44 Report: Mini MineWolf Test and Evaluation - 2007 Trial type: CWA (CWA performance trial + CWA AP and AT survivability trial - machine) **Tested by another entity:** Report: Mini MineWolf demining machine testing report - 2006 Trial type: Non-CWA (CROMAC-CTRO performance, AP survivability trial - machine + Ground processing depth trial)	
Other documents: Remote Operation of the Mini MineWolf in High-Threat Mine Environments - 2008 - 'Article/Publication' Humanitarian Mine Clearance in the Balkans - 2007 - 'Article/Publication' Machine Demonstration Analysis and Preliminary Results - 2007 - 'Article/Publication'	

Table 2: result of a search on the equipment “Mantis”

Equipment: **MANTIS (Mine Clearing Survivable Vehicle - MCSV)** **Manufacturer:** *Pearson Engineering Ltd.*	
GICHD catalogues: Mechanical Demining Equipment Catalogue 2008 Ground preparation machine - Multi-Tool	

Mechanical Demining Equipment Catalogue 2006 - Multi-Tool
Reports: **Tested by ITEP:** Project No.: 3.2.5 Report: Proof of Performance Test Report on Mine Clearing/Survivable Vehicle (MANTIS) - 2005 Trial type: Non-CWA (Capabilities demonstration + Non CWA performance trial + non CWA AP survivability trial - machine) **Tested by another entity:** No report found
Other documents: No other document found

Table 3: result of a search on the equipment “Scanjack 3500”

Equipment: **Scanjack 3500** **Manufacturer:** *Scandinavian Demining group AB*	
GICHD catalogues: Mechanical Demining Equipment Catalogue 2008 Mine clearance machine - Heavy Flail Mechanical Demining Equipment Catalogue 2006 - Heavy Flail Mechanical Demining Equipment Catalogue 2004 - Heavy Flail Mechanical Demining Equipment Catalogue 2003 - Heavy Flail Mechanical Demining Equipment Catalogue 2002 - Heavy Flail	
Reports: **Tested by ITEP:** Project No.: 3.2.29 Report: Flail Hammer Head Test and Evaluation - 2005 Trial type: CWA (CWA performance trial + Hammer wear-out trial) Project No.: 3.2.30 Report: Scanjack 3500 System Technical Test Report - 2005 Trial type: Non-CWA (Capabilities demonstration) **Tested by another entity:** Report: Verification of Mine Clearance Vehicle 1/T Deep Mine Clearance Machine. - 2003 Trial type: Non-CWA (Non CWA AT survivability trial)	

Report: Area Mine Clearing System (AMCS), Study Report - 2002
Trial type: N/A

Report: Performance Test of Demining Machines Performed by SWEDEC - 2001
Trial type: Pre-CWA, CWA like (Pre CWA performance trial following closely the CWA guidelines)

Other documents:

Test Report after Trials with Mine Detection Dogs (MDD) and the Mechanical Mine Clearance System Scanjack - 2003 - 'Technical note'

References:

1. GICHD Mechanical Demining Catalogue 2008, http://www.gichd.org/gichd-publications/mde-catalogue/
2. GICHD Metal Detection and PPE Catalogue 2007, http://www.gichd.org/gichd-publications/metal-detectors-and-ppe-catalogue/
3. ITEP reports database, http://www.itep.ws/reports/search1.php
4. ITEP work Plan database, http://www.itep.ws/activities/itep_workplan/search_workplan.php
5. Journal of Mine Action, http://maic.jmu.edu/journal/index/
6. UNMAS GICHD Mine Action Technology Newsletter, http://www.gichd.org/gichd-newsletters/mine-action-technology-newsletter/current-edition/
7. Humanitarian demining equipment database for mechanical equipment: http://www.itep.ws/equipment/search_mech_equipment.php
8. EN Workshop Agreement on Test and Evaluation of Demining Machines, CWA 15044:2004, http://www.itep.ws/pdf/CWA_demining_machines.pdf

Feature Article 3

CEN tests at Swedish EOD and Demining Centre (SWEDEC)

by

Pehr Lodhammar

At the end of September 2008 GICHD participated in the CEN tests of the Swiss Digger D-2 flail/tiller at Swedish EOD and Demining Centre (SWEDEC) (www.swedec.mil.se).

The tests were conducted at the SWEDEC test facility between 22 September and 2 October 2008. SWEDEC tests are undertaken in accordance with CEN Workshop Agreement (CWA) 15044:2004 (available at www.mineactionstandards.org) and the subsequent test results are published on the International Test and Evaluation Programme's (ITEP) webpage (www.itep.ws).

Test lane being prepared

Test standardisation for demining machines supports the development of new demining tools and methods. Standardisation also

enables the comparison of available tools and products, and helps improve the efficiency of demining programmes. The CWA covers testing of performance, survivability, acceptance and test targets. The tests are coordinated through ITEP.

Test lane with sand at SWEDEC

The SWEDEC test facility is located at Norra Kulla, a 20 minutes drive from Eksjö. The purpose-built test facility has office facilities, a workshop and canteen, as well as three test lanes offering different soil conditions. One lane has top soil, another sand, the third, gravel. These lanes are used for testing tillers and flails, with targets buried between 0 and 15 centimetres deep. Each test involves 50 mines at varying depths, with a total of 450 mines per machine test.

Explosive-free test mines are used at SWEDEC, however fuses are live in order to determine whether the mine has detonated or not. If a mine has failed to detonated it will fall under one of the following three categories:

- triggered (detonated) - The firing chain or circuit has been completed;

- mechanically neutralised (untriggered, damaged, non-functional) - the target has been engaged by the tool, and the firing chain or circuit cannot be completed;
- live damaged (untriggered, damaged, still functional) - the tool has engaged the target, but the possibility of the firing chain being completed exists.

An alternative to using test mines with live fuses is to use the purpose-developed Wireless Operated Reproduction Mine (WORM) target (http://www.itep.ws/pdf/WORMBrochure_Low Resolution.pdf).

Live fuse with test mine

Pizza cutter being used to prepare for placement fibre boards

While the tillers and flails are being tested against mines the tool penetration profile is simultaneously evaluated. This is done with sections of 3mm thick fibre boards. The fibre board is buried in the ground across the clearance path/test lane of the machine, up to 15cm below the maximum depth.

The width of the fibre board is always at least 10 per cent wider than the width of the digging tool. A minimum of three fibre boards are used, one before engaging the targets, one within the targets, and one after the targets. SWEDEC use a so-called 'pizza slicer', mounted on an excavator, to cut the ground for the fibre boards.

Fiber board being buried

On the last day of the machine trial a survivability test is conducted. This measures blast effects on the tool under controlled conditions, using charges as specified in the CWA and with the tool in normal operation. The size and characteristics of the charges are also defined in the CWA. The target selection is based on the manufacturer's declaration of capacity, unless otherwise agreed in the test documentation.

Fibre board after test

As a minimum the machine will always be tested with an anti-personnel mine. At SWEDEC a high speed camera is used during the survivability test to document the test, picture by picture. The tests are carried out at a demolition training area with a shelter, to allow them to be observed at a close distance.

The full reports of the above tests will be made available on the ITEP webpage over the coming months. Full test reports from previous ITEP tests are also available on the ITEP webpage.

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Feature Article 4

ALIS – A Hand-Held Dual-Sensor with Imaging Capability
by
Dr. Motoyuki Sato

Kazunori Takahashi (Federal Institute for Materials Research and Testing, Germany)
Motoyuki Sato (Tohoku University, Japan)

Landmine or not? Deminers may seriously ask themselves this question every time a metal detector beeps in a minefield. Metal detectors can find landmines as well as metal pieces however they cannot discriminate between the two. Consequently, thousands of metal fragments and false alarms are found until one mine is found, making the clearance operation extremely slow. One of the ideas to improve the efficiency of clearance is the use of a dual-sensor, which has a metal detector and ground-penetrating radar (GPR), normally combined in one unit. GPR can sense the underground and it responds to contrasts of electromagnetic properties, for example the soil and air gap in a mine. On the other hand, small pieces of metal (e.g., bullets and screws) cannot be seen because they are too small. Therefore, it is possible to differentiate between a mine or just a piece of metal.

Since 2002, Advanced Landmine Imaging System (ALIS) has been developed by Tohoku University, Japan supported by the Japan Science and Technology Agency (JST). It is a hand-held dual sensor system and consists of three parts: search head, control unit, and display. The search head integrates the metal detector coils and the GPR antennas. The control unit is designed to be shouldered and weighs about 5 kg. The display is portrayed on an electronic screen. The system employs a commercial metal detector, MIL-D1 (CEIA S.p.A, Italy) and a rechargeable battery can drive the system for more than 3 hours.

The unique feature of ALIS is the imaging capability. Despite being a handheld system, the system can acquire the position of the search head by tracking with a CCD camera, and thus the survey results of both metal detector and GPR can be displayed as images. Furthermore, the metal detector response can be seen on the display being overlaid on a picture of the ground surface while scanning, i.e. in real time. Therefore, the deminer can check whether he has scanned every inch of the area to be cleared. Other hand-held dual-sensor systems can only output sound alerts and only ALIS can output images as well as the sound of the metal detector.
(Please refer to: Guidebook on Detection Technologies http://www.gichd.org/)

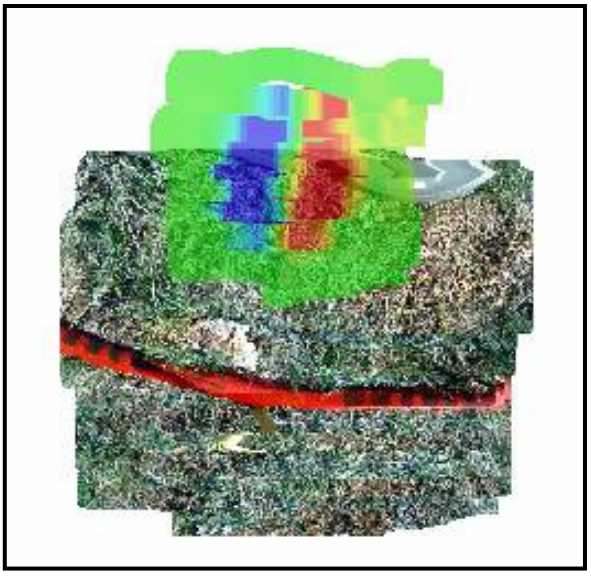
ALIS in its operation in Croatia by a local deminer

The detection scenario with ALIS is as follows:

1. The metal detector is used to find and locate a signal which could indicate either a piece of metal or a suspected mine containing metal. At this stage,

the GPR and imaging function is not turned on, i.e. there is only the sound alert of the metal detector as if the dual sensor is being used as a stand-alone metal detector in the conventional manner.

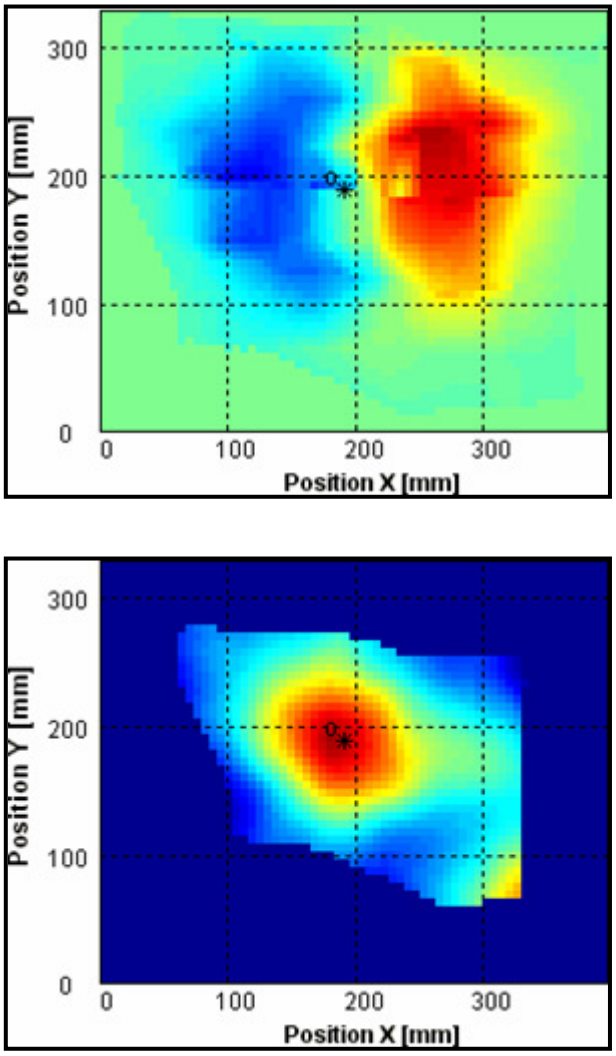
2. A marker is placed on the pinpointed location.
3. The GPR and imaging function is now turned on and the marked area is scanned. The display continues to show the metal detector response while scanning.
4. The signal processing starts after finishing the scanning. It takes a few seconds.
5. The display then shows two images; one from metal detector and the other from the GPR, both of which are showing horizontal slices.
6. From the information presented by the two systems, if the operator concludes that it is a mine, a marker with different color to the first one is put on the location. If the operator concludes that there is not a mine, he/she leaves the first marker and proceeds sweeping to next detection.



Metal detector response which deminer can see while the scanning in real time

The metal detector is used as the primary sensor and the GPR is the secondary sensor. Thus, the probability of detection (POD) is basically defined by the metal detector. The GPR is used in order to provide more information about the suspected object that has been located by the metal detector.

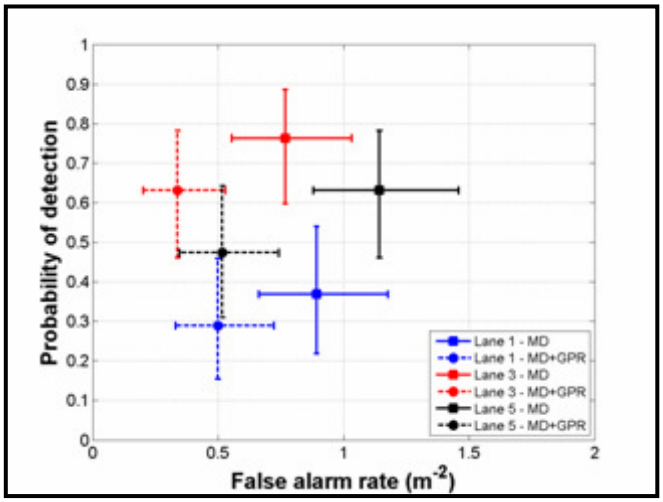
ALIS has been tested and demonstrated in various countries including Afghanistan, Cambodia, Croatia, and Egypt. In 2007, ALIS participated a trial organized by Croatian Mine Action Centre – Centre for Testing, Development and Training (HCR-CTRO). (Please refer to: Test and Evaluation of Japanese GPR-EMI Dual Sensor Systems at Benkobac Test Site in Croatia http://www.itep.ws/) Three local deminers were trained and operated the system in the trial. According to the report, ALIS reduced the false alarm rate (FAR) to about one-half (50% reduction with consequent increase in efficiency.)



Metal detector response (top) and GPR image (bottom) after processing for PMA-2.

As the report of the Croatian trial depicts, ALIS can improve the efficiency of the clearance operation by discriminating between detected objects. However, in practice, miss-discrimination can sometimes happen. To reduce this possibility is our future work. In addition,, the next model will be much more compact, lightweight and simple to operate.

ALIS is currently being evaluated by HCR-CTRO in the QC/QA operations on many sites in Croatia and the Japanese government is planning to donate a number of ALIS systems to Croatia. The experience, evaluation and feedback from real operations in Croatia will definitely improve the system.



ROC diagram (POD vs FAR) with 95 % confidence limits of using only the metal detector and both sensors from the trial in Croatia in 2007.

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MineWolf workshop in Stockach, Germany
by
Pehr Lodhammar

Between 23-25 September 2008 the MineWolf annual workshop was held at the MineWolf workshop facility in Stockach in Germany and was attended by more than 15 participants from commercial demining companies, Non Governmental Organisations and other organisations using the MineWolf products. Amongst the participants were also field operators from Sudan and Iraq.

The workshop was well organized and covered a range of interesting topics related to mechanical demining operations. The agenda included: project planning, design of contracts and responses to requests for proposals, operator and mechanics training, project planning and execution, examples from the field, logistics, management of mechanical assets and testing of demining machines. Good examples on how to overcome bottle necks during the initial stages of mechanical projects were provided and provided a base for interesting discussions.

The second day of the workshop was concluded outside Munich with an initial presentation how CEN tests are carried out following the CEN Workshop Agreement -CWA 15044:2004, Test and Evaluation - Demining Machines. The presentation covered performance testing, survivability testing, acceptance testing and test targets. This was followed by a live demonstration of testing of demining machines and an example of testing of the MineWolf in Afghanistan. This day also included a remote controlled detonation of a live Anti-Tank mine with 6.2 kilograms of TNT in front of a MineWolf tiller.

The workshop provided an important opportunity for mechanical demining operators to share experiences and knowledge. It was encouraging to note that CEN tests and standardized tests were seen, and promoted, as something positive for the mechanical demining industry by both the host, MineWolf, and the various organisations participating in the workshop.

More information about CEN tests, including CWA 15044:2004 and past tests of demining machines the can be found on the GICHD webpage. The main web resource for information on tests of demining machines is however the International Test and Evaluation Programme (ITEP) for Humanitarian Demining webpage (http://www.itep.ws) where you can find a wealth of information regarding mechanical demining machines.

Demonstration of survivability test

Witness boards after demonstration

Vallon/Force Ware Workshop in Einingen/Riederich, Germany

by

LTC Klaus Koppetsch

The biannual Vallon/Force Ware Workshop on Detectors, Systems and Tools for Demining, EOD and IED-D was held in Eningen, Germany during the period 29 of September through 1 October 2008.

Vallon GmbH is an internationally operating manufacturer of Metal Detectors and magnetometers for detection of landmines and Unexploded Ordnance (UXO). Their products are used in humanitarian demining as well as military operations. Vallon also offers a Dual Sensor Detector for detection of minimum-metal mines, the Minehound™ VMR2, comprising a metal detector and a ground penetration radar. The Dual sensor was developed in conjunction with ERA Technology Ltd. UK and has been on the market since 2005.

Force Ware GmbH is a supplier of security equipment such as demining equipment, EOD/IED equipment, personal protective equipment and metal detectors. Force Ware also provides EOD training.

The workshop was held at a hotel in Riederich, close to the Vallon facility in Eningen. The workshop was divided in two parts, with a one day meeting on detection technologies and half a day exhibition and presentation of the product range from the Vallon and Force Ware company. Following the exhibition, the participants had an opportunity to visit the headquarter and production facilities of the Vallon company. Approximately 70 participants, mainly from the UXO clearance sector, attended at the workshop. Amongst the participants were field operators from Denmark, Laos and the Netherlands who reported on their field experiences concerning detection technologies which led to fruitful discussions.

In particular the application of discretionary technology in UXO clearance as well of dual sensor systems was introduced and discussed.

The ERA Technology Ltd. company presented an eight channel GPR system for detection of anti-vehicle-mines. This GPR can be combined with the Vallon vehicle mounted metal and/or UXO detector (VMXV). This system has an application in road clearance operations in particular.

During the exhibition the Vallon/Force Ware product range was introduced and the participants were given the opportunity to test the detector fleet.

The workshop was well organized and provided an important opportunity for demining operators to share experiences and knowledge. It was encouraging to note new trends and developments concerning detection technologies. This will hopefully lead to the introduction of new products on the market for humanitarian demining.

In early February 2009 the GICHD will publish the next issue of the GICHD publication Detector and Personal Protective Equipment Catalogue. The products shown during the above mentioned workshop are all included in this catalogue.

More information about detection technologies and past tests of detectors can be found on the GICHD webpage. Another web resource for information on tests of detectors is the International Test and Evaluation Programme (ITEP) for Humanitarian Demining webpage (http://www.itep.ws) where you can find further information on metal detector tests.

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Mine Action Technology Information Resources

The following websites contain information on the latest technical mine action activities and organizations, as well as calendars showing forthcoming technology conferences.

E-Mine

The Official Website of the United Nations Mine Action Service (UNMAS) designed to support both the planning and coordination of global mine action efforts.
http://www.mineaction.org

Geneva International Centre for Humanitarian Demining

The Official Website of GICHD that provides regular updates on GICHD activities, studies and projects, including the Equipment Catalogues.
http://www.gichd.org

International Test and Evaluation Programme

Provides information, updates, current test and evaluation reports of demining machines and technologies.
http://www.itep.ws

Mine Action Information Center at James Madison University

Contains a good global mine action registry, the Journal of Mine Action, Lessons Learned database, and a Spatial Information Clearing House.

http://www.maic.jmu.edu

The International Mine Action Training Centre (IMATC)

The International Mine Action Training Centre (IMATC) is a joint British and Kenyan venture aimed at alleviating the suffering caused by landmines and Explosive Remnants of War by providing high quality Mine Action Training.

http://www.army.mod.uk/aroundtheworld/ken/imatc/

UXOInfo.com

Website devoted to information on Unexploded Ordinance (UXO). Latest news on UXO, photo galleries and technology information available.
http://www.uxoinfo.com

Canadian Forces National Defense Mine/Countermine Information Center

The NDMIC provides mine and countermine information for Canadian Forces in international operations.
http://ndmic-cidnm.forces.gc.ca

US Humanitarian Demining R & D Programme

This site provides an overview of the optional products and technologies that are available for use in global humanitarian demining and developed, or being developed, tested, and evaluated under the U.S. Department of Defense (DoD) Humanitarian Demining Research and Development Program.
http://www.humanitarian-demining.org/demining/default.asp

ORDATA Online

ORDATA Online supports the U.S. Department of Defense by providing information to facilitate international UXO training, awareness and clearance operations.
http://www.maic.jmu.edu/ordata

Mine Information and Training Centre (MITC)

Sponsored by the Battlefield Engineering Wing at Minley in Surrey, UK, MITC provides a gateway that facilitates the flow of information between military and civilian organisations.

http://www.army.mod.uk/royalengineers/org/mitc/index.htm

Nordic Demining Research Forum (NDRF)

Aims to stimulate research and development activities to support improvement in demining efficiency and safety through promotion of co-operation between the operator, research and development, and industrial environments; stimulation of information exchange; and initiation of cross border and cross sector research and development activities between companies and institutions in the Nordic countries.
http://www.ndrf.dk/

International Campaign to Ban Landmines

Provides information on the Ottawa Treaty, as well as general information on landmines, campaigns and calendar information on mine action activities.
http://www.icbl.org

Sound Bites

The following section contains snippets of information for general interest. They are collected from different communications in the course of the working day. They are offered for what they are worth but the accuracy of the information cannot be guaranteed. If you, too, have short interesting bits of information just send them to the Editors and we will pass them on, submit to the lessons learnt database or discard as appropriate!

Fire or blast?

In some country programmes security considerations demand a restriction on detonators and explosives – ideally there should be none! This demands alternatives to a slab of explosives for destruction of recovered devices. Development of a thermite system is underway in New Zealand and this will hopefully be tested in 2009 and may even be provided for operational use. Similarly a device similar to an oxy-acetyl in burner has been used in Bosnia-Herzegovina and proved successful enough that additional items have been purchased. Alternative neutralization techniques slowly progress.

New Face Protection

Further to the information provided in the last Newsletter, the full face protection device from a Norwegian manufacturer was tested in late 2008 in accordance with the new CEN Workshop Agreement which supposedly defined the level of testing required for PPE. Unfortunately the tests have highlighted a problem in the laboratory equivalent of 240gm of TNT. The CWA on PPE is therefore being held back from publication until additional tests can be conducted and a more accurate equivalent defined for use in test conditions. In the meantime, experience with the new face protection is being gained by several organizations who have purchased the new protection and further information can be obtained form the Editors if required.

Dual Sensors

It is now intended that the German army will conduct trials into the reliability of dual sensor systems in the autumn of 2009. Additionally, separated systems i.e. a ground penetrating radar and a metal detector will be tested alongside. Several NGOs have been approached in regard to these tests and have input questions to be considered. In the meantime, HSTAMID continues to be used by HALO and MAG and MineHound has been sold commercially. More details of the forthcoming tests can be obtained form the Editors.

Have you tried a treasure hunter?

While the mine action metal detector market has traditionally been dominated by a few manufacturers, the treasure hunting manufacturers have not really been accepted as practical alternatives – many times from a physically robust point of view. Details have recently been received from the US company Garrett who are well known in the treasure hunting world and now produce a countermine/ERW detector which claims to operate in all soils. It has a ground compensation capability and further details can be obtained from www.garrett.com. One thing about treasure hunting detectors is that they are made by companies with a much larger volume turnover of devices than the traditional mine action detection manufacturers and so should be much cheaper. However, they have seldom been tested in similar testing regimes and so full information is not easily available. Why not buy one and see how they compare?

Techniques or technology?

One of the more interesting realisations from the UNMAS/GICHD Mine Action Technology Workshop in Sep 08 was that Technology is as much about methodology as it is about physical hardware. Analysis of the processes and techniques we use in mine action can identify ways to save both time and money and yet not compromise safety in any way. Think not what technology can do for you, but think what you can do for technology!

One simple example to illustrate this could be the difference between issuing detectors each morning, conducting centralized testing and

preparations before work and retrieving the detectors in the evening, as opposed to issuing the detectors to the individuals and expecting them to arrive for work with their detector prepared for confirmatory testing. This could save 30 minutes every day which, when multiplied by the number of deminers at a site and the number of working days in a month, could translate into a considerable improvement in actual output i.e. available time on detecting. While this example may not be practical to all it illustrates how we should be continually examining what we do in order to improve our efficiency and output. This is time and motion analysis and can pay dividends.

LL needed

A Lesson Learnt data base is still maintained at the James Madison University Mine Action Information Centre website. Along with this Newsletter, this is an ideal way of sharing concepts, ideas, lessons and experience with others and you are strongly recommended to access this site and submit lessons as and when you experience them.

Accident reporting

Although we all hope for a zero report on accidents, accidents do happen among our deminers. The idea of analysing accidents and issuing lessons learnt to others so that they can avoid similar accidents is unquestioned. However, the act of submitting information of accidents when they have happened to you, or your organisation, is more difficult to do. There is a database of accidents that have occurred to deminers and it has a great deal of information available. All reports submitted to the database are cleansed of names of individuals as well as organisations before the information is made available. In the unfortunate event of an accident happening in your organisation, you are strongly requested to submit the information for analysis and onward anonymous dissemination. Please submit accident reports and Boards of Inquiry to Noel Mulliner, Technology Coordinator, at mulliner@un.org for entering into the database.

At the same time please note that most investigations into accidents analysed to date have concluded that a major contributory cause was a lack of adequate supervision and control. It is not necessarily the deminers who need to learn from accidents but the supervisors should look inwardly at how they could avoid the same thing happening. Boredom makes a deminer less alert but the need for supervision even greater.

Free Magnetic Locators

The management of Schonsdedt bomb locators initiated a project in 2007 whereby anyone buying one of their pipe and cable locators triggered a gift, from the company to a mine action programme, of a magnetic locator. This has proved to be very successful with locators now in Kenya, Laos,Tajikistan and Somalia.

The initiative is now attracting donors who want to simply pay for the deployment of a Schonsdedt magnetic locator to a mine action programme where it is needed. If your programme has a need for such a locator and you would be interested in receiving one or more, if they are available, please contact one of the editors and we will pass on your request to the company. Or, visit the web site http://www.schonstedt.com/ to learn more.

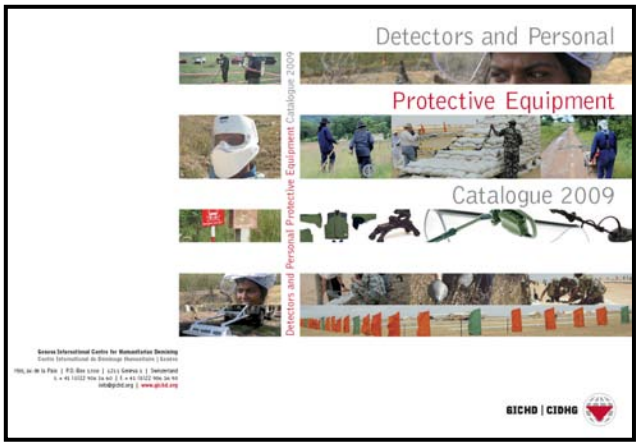
Transportable Incendiary Device

To ensure the safe and effective destruction of fuses from hundreds of AP mines that are being lifted and neutralised every day at Jordan's northern border, Norwegian People's Aid (NPA) has in co-operation with The

National Committee for Demining and Rehabilitation (NCDR) developed a transportable incendiary device. The burner is heated by propane gas and has a modular design. The heating chamber, which takes most of the beating during operation can easily be replaced by a new steel liner. Please contact the editors for more information on the Control And Safe Burning Devise (CASBUR-D) from Jordan.

New Detectors and Personal Protective Equipment Catalogue from GICHD

The GICHD Detectors and Personal Protective Equipment Catalogue 2009 provides a comprehensive directory of detector systems and personal protective equipment under one cover. The sub-categories in the detector systems chapter are: Metal Detectors, UXO Detectors, Vehicle Mounted Detectors and Dual Sensor - and Ground Penetrating Radar Systems. For PPE the sub-categories are: Protective Clothing, Helmets, Visors and Masks, and Mine Protective Boots.



The Catalogue will be available in hard copy, CD-ROM, or can be downloaded from the GICHD website at www.gichd.org. The catalogue will be released during the first week of February 2009.

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