The Landmine Menace: The Great Humanitarian Challenge

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**Protection**

The Mine resistant (Blast Protective) boot model ZEMAN AM offers a few levels of protection.

1st Level—Multi-Layer Armour In Sole

The sole contains a special multi-layer ballistic armour. When excessive pressure (energy of explosion) is exerted on the armour, part of the energy is reflected back from the armour, part is consumed by programmable destruction using layers, part flows across the boots to surrounding space and only a small part of the energy gets through the multi-layer armour and hits the inner armour.

2nd Level—Inner Armour

The inner armour is situated inside the boots, around the lower leg. This reduces an effect of overpressure entering through the multi-layer armour (from sole) as well as overpressure and fragments impacting from the surrounding area. Special attention was given to the development of a heel block and toe cap. Trials with charges exploded in front of the boots simulated a situation when a user kicks at unexploded ordnance. The human body received only a small part of the energy entering through the multi-layer armour because the inner armour reduces it.

3rd Level—Ballistic Protection

All-leather parts of the boots are reinforced by ballistic material. It ensures ballistic protection against fragments (mine bodies, soil, stones) accelerated by explosion or other flying particles.

Perforation Protection

Special construction of the sole ensures 250 percent anti-perforation according to the requirements of EU standards. It protects 2–5 times more than other special safety shoes containing usually steel anti-perforation inserts.

5th Level—Tread Energy Protection

Special construction of heel and anti-torsion replaceable inserts absorb tread energy in the heel seat.

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ZEMAN AM
Blast Protective Boots

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Himmler: The Landmine Menace: The Great Humanitarian Challenge

On the basis of the conflict scenarios and the resultant threat, it is necessary to develop methods and means to eliminate the threat. Simply using available tools is not always easy. What is necessary is to optimally combine existing detection and clearance methods and, if necessary, to develop new, promising technologies in a targeted manner.

**by Thomas Himmler, Institut Dr. Förster**

**Introduction**

Lien Ta had just started to repair the irrigation ditch in his field when an explosion shattered the tranquility of the early morning. One small step on the wrong spot wiped out the life of this farmer. A family lost a member of its community and children lost their father and the security of their existence.

Regardless of whether a farmerills his field in Vietnam, a woman in Afghanistan fetches drinking water from a well or children in Bosnia go to school, they should all be able to do this on safe ground and on safe footsteps. But this is far from the case. Even years after conflicts and wars have almost disappeared into oblivion, the menace from landmines and UXO in these areas is extreme.

The United Nations is aware of over 60 affected countries in which the civilian population is still constantly threatened by hidden mines. Estimates extend from 60 to over 100 million mines laid during times of war and conflict. In many areas, the number of items of UXO still substantially exceeds the number of mines.

Besides the resultant personal threat to the individual, this also blocks traffic routes on land and water. Urban areas are considered risky and unsafe, and valuable agricultural land necessarily lies fallow. But it is not only the kind and the number of vital structures are delayed or prevented from an unacceptable extent. It is only an immediate and targeted solution to the problem that can provide a quick remedy and make a contribution to the urgently required restoration of a situation in which the public can live their lives safely in former conflict areas.

**Detection**

We must first fundamentally differentiate between surface and near-surface threats and the threat posed by UXO, frequently at great depth. The criterion of clear and, thus, reliable signal indication has absolute priority. In addition, other essential deciding factors include how easy the method is to apply and its efficiency and economy in use.

**Near-Surface Detection**

In the majority of cases, metal detectors based on eddy-current technologies are used for near-surface detection today. Regardless of whether they are handheld, individual sensors or large-area systems, which are sometimes designed as continuous belts, are used to detect UXO with several channels in the form of sensor arrays, the technological fundamentals are very largely the same and have been tried and tested for many years now.

Attempts have been made to solve the problem of the high alarm rate and the non-detectability of non-metallic ordnance associated with this technique by opting for a combination with complementary sensor systems. Essential aspects in this case are the incorporation of "metal-independent" methods, such as ground penetrating radar (GPR), and infrared (IR) sensors. Material-analytical methods such as the Nuclear Quadrupole Resonance (NQR) method complement the range of methods that can be used.

On the one hand, all new methods must meet the extreme requirements of the task at hand; on the other, they must comply with the economy/efficiency aspects. Practical use frequently fails owing to the as yet inadequate case of handling of these methods, the technical complexity and expenditure involved, which are still too great and, in some cases, the extreme requirements applicable to any qualification. Ongoing development projects, such as the research activities launched within the framework of the European Union's European Strategic Programme for Research and Development in Information Technology (ESP2RIT), do indicate, however, that it is possible to reduce the existing handicaps. In small steps, we are approaching the target of practical suitability, a race against time that we must win. This is certainly no easy undertaking if we consider the stringent requirements placed on use in the field.

**Where are the Problems?**

Well, minefields may be laid anywhere; not only level and easily accessible areas may be mined, but also slopes, road embankments, wooded areas, desert areas, or beach areas, even front yards. One other factor is extreme infiltration with other objects which must be clearly detected. In addition, many of the areas are covered by vegetation that grows back constantly subject to constant change as the result of erosion or floods. The detection tasks required will largely be performed by metal detectors until the above-mentioned methods and method combinations are advanced enough to stage at which they can be introduced on a large scale. Here we all, further advances have been made in recent years.

The existing Continuous Wave (CW) and Pulse metal detectors in use worldwide have undergone substantial development. They are thus still the method that most widely covers the listed requirements of practical use.

In regard to the metal detectors, we shall explicitly illustrate further development by way of example of the Minex
This two-frequency CW unit has been meeting the requirements for ground adaptation for years now (i.e., the electronic circuitry adapts the unit automatically to change ground conditions). This means that optimum detectability is guaranteed even in areas with magnetic or conductive soils and in waterway and bricklay water areas. Integrated, selectable soil-adaptive functions that learn allow additional adaptation to extreme situations. When, in the 1950s and 1960s, the plastic age gained ground, mine manufacturers also developed so-called "plastic mines", which, in extreme cases, incorporate only a minimum metal share (e.g., the filling pin). Allowance has been made even for this development, a dramatic one for mine detection, by adapting the sensor performance. An adequately high transmit power and software-based, automatic evaluation of the in some cases minimal secondary signals of the metal object guarantee reliable detection capability. The appropriate arrangement of the receive elements, some of them as twin, identical modules, allows precise positioning (pointpining) of the object. One step further towards enhanced efficiency of detection is the design of large-area sensor systems, generally by maximising the above method. A maximum transmit power in conjunction with a large number of receive elements makes it possible to quickly scan large areas. Using a high-resolution position-finding system then makes it possible to plot the object on corresponding location maps or to precisely mark the position of the object with paint directly on site. However, the flow of so-called false alarms unnecessarily accompanying this method must be counteracted appreciably. One way of doing this is to use an appropriately adapted combination of sensors (e.g., by adding GPR technology). The illustration shows the test track plot results achieved in a first test step, initially exclusively with a metal detector that was later complemented by GPR.

**method**

**Detection at Depth**

As mentioned above, detection and clearance of the surfaces must also be followed by detection and clearance of the deeper-lying UXO. In this field as well, essential advances that have enhanced performance have been made in recent years. These include creating large-area sensors incorporating pulse technology and operating on the basis of the eddy current method and creating appropriate methods for editing and representing the measured signals. The magnetometric technology developed by Prof. Friedrich Železny is available for high-resolution detection of ferromagnetic objects at great depths. Having been further developed constantly over the years, it supplies the clearest results available today. Safety and efficiency/economy are of prime importance in the case of UXO detection as well. Here, as well, the method of choice is to add corresponding evaluation software and to set up large, full-cover-sensor arrays adaptively to the procedure used for surface detection. The related evaluation software supplies clear magnetic field charts and, on the basis of this, makes it possible to construct suitable object lines for informing the clearance team deployed subsequently. When using such systems, the quantity of data produced is very large, so it is practical to make a separation on the basis of data acquisition, data evaluation and clearance. Data acquisition and simultaneous evaluation of this data are already technically feasible today. This "division of labour" has proven ever more successful in recent years: site sounding and information editing by specially trained teams, followed by clearance and disposal by appropriately trained Explosive Ordnance Disposal (EOD) personnel. Similarly, the detection and evaluation method can be used as a subsequent method of quality inspection after clearance has been performed.

**Conclusion**

Mined areas can be used safely by the civilian population only if definitive clearance of all munitions and ordnance is carried out and completed and only when the cleared area has been certified and the areas released. Achieving this humanitarian goal in a very short time after the end of conflicts or wars still necessitates a great deal of commitment on the part of all concerned. It is the challenge to the men of landmines and UXO. All technologies already available today offer an extraordinarily good basis for developing more extensive and optimal methods for efficient economic and safe detection of the heritage of numerous crises. It is the joint task of all those involved — be they users or manufacturers — to continue this development process in a targeted manner. Regardless of this, however, it is absolutely essential to ensure appropriate support for this process at a political level, which requires elaborating corresponding fundamentals and standards and ensuring that they are introduced and applied worldwide.

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The University of Rhode Island may soon get to test a new minefield clearance vehicle. With its sturdy frame and versatile design, this machine may be suitable for areas like farmlands.

**The Versatile Tank-like Flail**

by Harry Einstein, PE NERETCO Engineering in Rhode Island has developed a new self-contained, affordable, rider-controlled machine for safely discharging land mines in farmlands and other accessible areas. The operator is well protected by heavy steel plates and sits ten feet behind the mine discharge, the force of which is confined and directed away from the operator. The heavy steel structure of this machine is designed to withstand the explosive force of an AP mine. Should AP mines be encountered, some damage to the machine could result, but the operator should be unharmed. The machine is designed to clear a four-foot wide path and to clear one acre in two to four hours depending upon the ground conditions. If desired, the described machine can be remotely operated. This operation would be desired in areas where AP or heavy concentrations of UXO are suspected.

When not needed for mine elimination, the machine can, with add-on accessories, serve as a shrub cutter, a tiller or cultivating machine, a small tractor, a portable hydraulic supply for other machinery or as a portable electric supply with the addition of a generator. Some of these operations can be performed at the same time as mine clearance.

The design features three wheels and a narrow track providing for operation on uneven ground. The machine is relatively simple and could be manufactured in countries with limited facilities. The machine can be driven on ramp boards up a trailer bed or a medium steel open or closed track. Most if not all countries would permit such mobile machines to be driven on paved or unpaved roads for short distances from one area to another.

The mine-discharging section shows a revolving square or round tube to which are affixed rows of flames hinged, flat pounding plates or heavy chain which fly outward by centrifugal force and repeatedly strike the earth. The hinged plates are shown flat, but contoured plates could be more effective. Additionally, spikes could be incorporated on the outer plate of the string that could help break up the soil. Rotation is provided by a hydraulic motor. The power source is an internal combustion engine driving a hydraulic pump. Hydraulic power is also supplied to the two hydraulic motor wheels that provide (motor) power. Individual valve control of each hydraulic motor wheel provides for speed and steering. The prepared wheels are pneumatic with heavy tires. Automotive type chains may be used to increase traction. A second driving arrangement is the use of tracks instead of wheels. An alternative to pneumatic wheels or tracks is all steel wheels with steel ears that were common on very early tractors.

The machine is supported by the two wheels, or tracks, and a single rear free swiveling wheel that is designed to be raised or lowered hydraulically as required by the operator for the desired depth of engagement with the earth. Several accessories could be used with the basic machine. It is also possible to have the machine pull a tiller or a cultivator while clearing minefields at the same time. A simple addition is the installation of a row of tines or a cultivator installed on the underside of the machine behind the driving wheel or tracks. If such operation is desired, a larger engine is probably required, depending upon the land conditions. The operation and depth of entry would be under the control of the operator.

Safety of the operator has been provided for. The revolving mine-discharging rotating mechanism is housed in heavy steel plates with openings in front for discharge of earth and exploded mine fragments. The small opening between the rotary mechanism and the wheel housing, which is also housed in heavy steel plates, is covered by a heavy steel woven-fiberglass blanket. In addition to the heavy steel plates indicated, the operator sits above a heavy steel floor. Additional protection can be provided by a heavy reinforced plastic enclosure as needed.

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