Quality Assurance for Mined and Survey Areas

Mechanical demining is an important and essential part of any demining process, and quality-assurance methods must constantly be revised to address the balance between safety and efficiency. Based on experience from the MineWolf mechanical demining experience, the tiller system would improve the demining process significantly, thereby increasing speed and reducing the costs of demining operations.

by Heinz Rath and Dieter Schröder [Safety Technology Systems]

It is common knowledge that mechanical demining has to be part of the complete demining process to improve the speed of operations, defeat major obstacles for manual deminers, reduce costs and simplify quality assurance. It is also common knowledge in the car and aircraft industry that quality must be continuous and cannot be guaranteed by inspection alone.

Modern quality-assurance programs (such as the Failure Mode and Effect Analysis) have to be used to ensure a capable process. The FMEA is a method for failure-prevention and should be used for the design, system, assembly, production and, of course, demining process. The FMEA for tiller operation must include clearing-depth control, vehicle-speed control, rate of revolution for tiller and flail, and engine-temperature control.

Based on our demining operations in Bosnia and Herzegovina with *Hilfe zur Selbsthilfe eV* (HELP) and Norwegian People's Aid, we reached the following conclusion: The flail process suffers from limited and uncontrolled demining depth and limitations imposed by soil, terrain and vegetation—meaning it can miss intact mines. These findings are confirmed in various other publications.[1] The flail process requires intensive follow-up verification of clearance—additional demining operation by hand and dog—which is time-consuming and costly.

Area with dense vegetation after demining.
ALL GRAPHICS COURTESY OF MINEWOLF SYSTEMS GMBH

Important Requirements

A Total Quality Control system—a management tool for improving performance that aggressively strives for a defect-free demining process—is required and includes the demining organizations, equipment choices, standard operating procedures, training programs and the following essential requirements:

1. Ground-penetration depth up to 30 centimeters (12 inches).
2. Multiple operations with the tiller, to break up partially detonated or remaining mines and explosive components not completely destroyed by the flail.
3. Effective depth-control for both the flail and tiller system. We recommend placing travel sensors on both sides of the vehicle so the movement on either side is independent from the movement of the opposite side (otherwise, effective depth of demining might be reduced due to topographical variants).
4. Monitoring of drive control to be displayed inside the cabin for all relevant technical data such as clearance depth, rate of revolution for tiller and flail, vehicle speed, engine temperature and vehicle positioning.
5. Global-positioning-system navigation for directional control.
6. Driver on board to intervene if needed with difficult topography and obstacles.
7. Quality track-record for all relevant data to be printed from data logger.

The tiller process has the potential to be capable of destroying all mines, provided the tiller rotates clockwise with a rotation speed of at least 300–400 revolutions per minute and is fitted with special cutting tools to destroy all mines, avoiding slipstreaming, burying and bow waves.[2] In general, a Total Quality Assurance program as used in the aircraft and car industry is required because it will analyze all aspects of quality on a continuous basis. In general, a TQA program provides a modern, overall quality concept of a company or system.

It is easy to see if the process is capable or not by looking at the area after the demining process. The area has to be homogeneous after a uniform process as this is the basis for a capable process.

The MineWolf toolbox system with tiller in operation.


Open tiller design details including depth control.

Foerster MultiCAT detector.


Ebinger large-loop detector.


Area with little vegetation after demining.

Proposed Quality-assurance Process for Mined and Survey Areas

While the MineWolf tiller system provides a capable process with control of demining depth, tiller rotation and vehicle speed, which is the basis for hitting every mine without fail, mines can be destroyed without being detonated. Consequently, mine pieces such as TNT, fuzes, or steel bodies of fragmentation mines will be left and might pose a limited risk. There is a capable technology to find the steel bodies using Foerster MultiCAT or the Ebinger large-loop detector UPEX 740. Experience has shown that most mine pieces are thrown onto the surface by the force of the tiller. Visible control of the cleared area would identify the areas requiring an additional quality measure.

There remains the risk that a small number of parts and fuzes located in the ground, either ferrous or non-ferrous, will not be detected. We believe that the limited risk has to be taken. If there are records or signs of fragmentation mines or items of unexploded ordnance, the Foerster MultiCAT or the Ebinger large-loop detector UPEX 740 is capable of finding them. It should be noted that small metal parts cannot be found with 100-percent certainty by manual methods.

If we take into account statistics published by the Geneva International Centre for Humanitarian Demining in *A Study of Mechanical Application in Demining*,[2] which indicates that only 2 percent of the demined areas worldwide are contaminated by mines, we do believe it is worth the risk.[3]

Proposed Quality-assurance Methods

Based on our experience, we recommend the following four methods for quality assurance:

- **Scheme 1.** Visual control of the cleared area by means of an armed tractor to identify and mark areas requiring additional quality measures. If no detonations are reported or mine residue found, the area can then be declared mine safe, meaning no further quality measures are required.
- **Scheme 2.** If detonations are reported or mine residue found, a complete search of the cleared area needs to take place, by means of establishing a grid of working lanes as given by the standard operating procedures, followed by a manual or explosives-detecting dog team. Residue must be removed. The area can then be declared mine safe.
- **Scheme 3.** If only a small number of detonations were reported or residue of mines found, a partial manual-demining operation is proposed to ensure that fuzes and explosives are found and excavated. The area can then be declared mine safe.
- **Scheme 4.** If there are records or signs of fragmentation mines or items of UXO, the Foerster MultiCAT or the Ebinger large-loop detector UPEX 740 can be used. The search is focused on steel bodies greater than 0.7 kilograms (1.5 pounds) because fragmentation mines have steel bodies that cannot be fully destroyed by mechanical demining (only the fuzes are cut). Foerster and Ebinger equipment is proposed to find the remaining bodies because they are specialized to locate steel objects within this range. The equipment can be fitted to an armed tractor to locate the steel bodies or items of UXO. Supplement the search for fuzes and explosives with a handheld detector around the steel bodies to excavate fuzes and explosives. The area can then be declared mine safe.

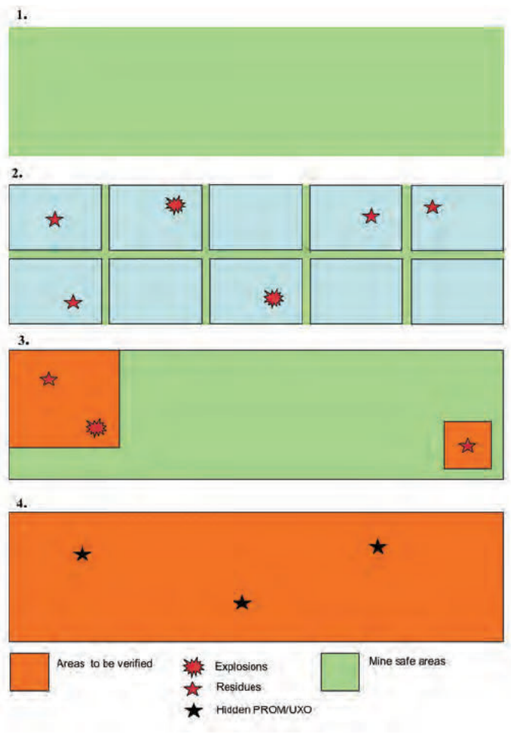

Figure 1: Proposed quality-assurance methods.

Summary

The tiller-demining process, combined with total quality-control methods, strives to move from the ground-preparation process currently used, to a "mine free"[4] process. By using the follow-up verification system, additional quality control after mechanical demining will be minimal, fast and more cost-effective without reducing aspects of safety.

For additional references for this article, please visit http://snipurl.com/15ixk.

See Endnotes, page109

Heinz Rath is Chairman of the Supervisory Board of MineWolf GmbH, inventor of the MineWolf Toolbox concept and founder of MineWolf Systems GmbH. In 1996, Rath retired as International Director for Research and Quality at TRW Automotive Holding Corporation. Rath is also the recipient of the *Bundesverdienstkreuz*, the highest award from the Federal Republic of Germany.

Heinz Rath
MineWolf Systems GmbH
Seb.-Kneipp-Str. 73a
D-Vallendar, Rhein / Germany
Tel: +49 261 667 9628
Fax: +49 261 667 9629
E-mail: h.rath@sts-engineering.de

Dieter Schröder is a former Engineering Manager at TRW Automotive Holding Corporation, having supported Heinz Rath in all aspects of engineering and quality. Schröder retired from TRW in 1995.

Dieter Schröder
Quality Manager
Minewolf Systems GmbH
Wolkener Weg 37
D-56220 Bassenheim / Germany
Tel: +49 2625 6619
Fax: +49 2625 7969