

Test and Evaluation Protocol

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QM for Mechanical Demining

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Contents		Page
Foreword		4
Intoduction		5
1 Scope		6
2 References		6
3 Quality management and the use of machines in mine action		6
4 Applying QA and QC to mechanical demining		8
5 Quality assurance at the site		9
6 Quality control at the site		10
7 Summary		12
8 Agreement statement		12
Bibliography		14

Foreword

This CEN Workshop Agreement has been drafted and approved by a Workshop of representatives of interested parties, the constitution of which was supported by CEN following the public call for participation made on 27 November 2006.

Participants in the process were drawn from the following sectors with interests in humanitarian demining: non governmental organisations, other international organisations, national mine action authorities and manufacturers and users of demining machines. The following organisations have been actively participating in the process: Geneva International Center for Humanitarian Demining (GICHD), Switzerland. Active contributions have also been received by representatives from ANAMA, CMAC, CTRO, INTERSOS, PNDHD, SWEDEC, UNMACA, UNMAS, Norwegian People's Aid, Idea Group, Cranfield, DOK-ING, MineWolf Systems AG and Scanjack AB.

The formal process followed by the Workshop in the development of the CEN Workshop Agreement has been endorsed by the National Members of CEN but neither the National Members of CEN nor the CEN Management Centre can be held accountable for the technical content of the CEN Workshop Agreement or possible conflict with standards or legislation. This CEN Workshop Agreement can in no way be held as being an official standard developed by CEN and its members.

The final review/endorsement round for this CWA was started on 2007-12-21 and was successfully closed on 2008-02-21. The final text of this CWA was submitted to CEN for publication on 2008-03-27.

This CEN Workshop Agreement is publicly available as a reference document from the National Members of CEN: AENOR, AFNOR, ASRO, BDS, BSI, CSNI, CYS, DIN, DS, ELOT, EVS, IBN, IPQ, IST, LVS, LST, MSA, MSZT, NEN, NSAI, ON, PKN, SEE, SIS, SIST, SFS, SN, SNV, SUTN and UNI.

Comments or suggestions from the users of the CEN Workshop Agreement are welcome and should be addressed to the CEN Management Centre.

The development of this CWA has benefited from an EC - EuropeAid Co-operation Office, financial contribution allocated in the context of the EC Mandate M/306.

Introduction

The following definitions and notes associated with quality are taken from the International Mine Action Standard IMAS 04.10 *Glossary of mine action terms, definitions and abbreviations*. The note under the Quality Assurance (QA) definition is critical to understanding that quality in mine action is about more than checking processes during demining operations. This might be obvious but there is sufficient anecdotal evidence to suggest that it is often forgotten.

NOTE The IMAS definitions reference an earlier version of EN ISO 9000. The present EN ISO 9000 is from 2005. The cited definitions are the same except for the NOTES which are IMAS additions.

Quality Assurance (QA)

part of QM [quality management] focused on providing confidence that quality requirements will be fulfilled. [EN ISO 9000:2000]

NOTE: The purpose of QA in humanitarian demining is to confirm that management practices and operational procedures for demining are appropriate, are being applied and will achieve the stated requirement in a safe, effective and efficient manner. Internal QA will be conducted by demining organisations themselves, but external inspections by an external monitoring body should also be conducted.

Quality Control (QC)

part of QM focused on fulfilling quality requirements. [EN ISO 9000:2000]

NOTE: QC relates to the inspection of a finished product. In the case of humanitarian demining, the "product" is safe cleared land.

The note under Quality Control suggests that, in humanitarian demining, QC relates only to the inspection of safe cleared land (which is also addressed in IMAS 09.20 *Post-clearance sampling and inspections*). In this agreement, this narrow interpretation of QC is broadened to include quality control checks at stages of the process when there is something to be checked. QA and QC can, therefore, be conducted during demining operations as well as at the end when we check the quality of the final product, i.e. safe land through post-clearance sampling.

Both QA and QC are thus intrinsic parts of quality management which is defined in IMAS as:

Quality Management (QM)

coordinated activities to direct and control an organisation with regard to quality. [EN ISO 9000:2000]

This agreement looks at quality from the perspective that:

- Quality assurance (QA), either internal or external, has a primary focus on *process*;
- Quality control (QC), either internal or external, is focused on a *product*.

The product, when referring to safe cleared land ready for release, is not produced on day one. It may take weeks to clear the whole area but quality processes can start immediately. This agreement takes the position that both internal and external QA and QC are required at all stages of the process if demining machines are to be used to best effect.

This CEN Workshop Agreement should be read in understanding with the terminology used in CWA XXXXX *Humanitarian mine action – Follow-on processes after the use of demining machines*.

1 Scope

This workshop agreement considers quality management in humanitarian demining in general as well as associated with demining machines. The agreement also focuses on specific actions for quality assurance (QA) and quality control (QC) in the use of demining machines at hazardous sites.

2 References

Users of this CEN Workshop Agreement should also refer, in particular but not only, to the following CEN Workshop agreement, International Mine Action Standards¹⁾ and standards from International Standards Organisation (ISO):

CEN/CWA 15044, *Testing and Evaluation of Demining Machines*;
IMAS 03.40, *Test and evaluation of mine action equipment*;
IMAS 04.10, *Glossary of mine action terms definitions and abbreviations*;
IMAS 07.10, *Guide for the management of demining operations*;
IMAS 07.30, *Accreditation of demining organisations and operations*;
IMAS 07.40, *Monitoring of demining organisations*;
IMAS 09.10, *Clearance requirements*;
IMAS 09.20, *Guidelines for sampling*;
IMAS 09.40, *Guide for the use of MDD (mine detection dogs)*;
IMAS 09.50, *Mechanical demining*;
IMAS 10.20, *Safety and occupational health (S&OH) demining worksite safety*;
EN ISO 9000, *Quality management systems – Fundamentals and vocabulary (ISO 9000:2005)*;
EN ISO 9001, *Quality management systems – Requirements (ISO 9001:2000)*;
EN ISO 9004, *Quality management systems – Guidelines for performance improvements (ISO 9004:2000)*.

Readers should also refer to the National Mine Action Standards (NMAS) and/or the National Standards and Technical Guidelines (NSTG) for mine action in their operating country, as well as any other relevant country-specific technical notes.

The guidance in this agreement should be used to supplement the guidance in the above documents. Note should also be taken of the CEN Workshop Agreement CWA xxxxx²⁾ *Follow-on processes after the use of demining machines*, and the 2004 Geneva International Centre for Humanitarian Demining (GICHD) publication, *A Study of Mechanical Application in Demining* is a useful reference.

3 Quality management and the use of machines in mine action

Demining machines are not used in isolation in a demining programme. They are either used in support of other assets or other assets are used in support of the machines. Therefore, a holistic approach to the management of machines and quality must be considered.

IMAS 07.10 *Guide for the management of demining operations* sets out guidance for the conduct of demining operations. For mine action to be effective, efficient and timely the overall process must be managed within the framework of a quality management system. It follows that, for demining machine use to be effective:

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- 1) IMAS can be accessed through www.mineactionstandards.org.
 - 2) Result from CEN/WS 28, under publication.

- all aspects of quality management must be addressed;
- QC should be seen as more than a post-clearance sampling process at a minefield site; and
- QA should be seen as more than assuring that the minefield processes are correct.

Figure 1 set out one model for a process-based quality management system.

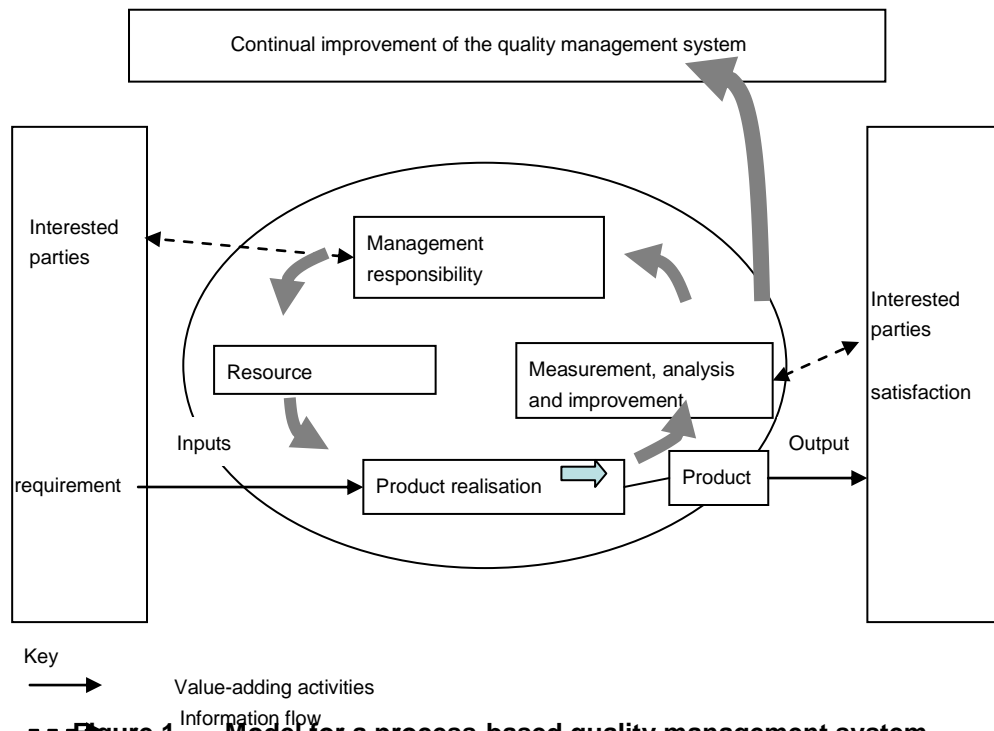


Figure 1 — Model for a process-based quality management system

The physical processes of operations in the suspected hazard areas are inside the box “Product realisation”. In the case of clearance operations, clearance and follow-on as appropriate lead to the product, which is safe cleared land. As a consequence, interested parties, in this case the users of the processed land are satisfied.

The diagram is intended to show that the product can only be produced efficiently if:

- management allocates the required resources and those resources are applied correctly when allocated;
- the process of demining is measured, analysed and improved – and management seeks to learn from mistakes and takes ownership and responsibility.

It should be noted that management responsibility rests with both the national authorities (and their equivalent) and the implementers of mine action.

The process, in the context of mechanical demining, is more simply shown in Figure 2.

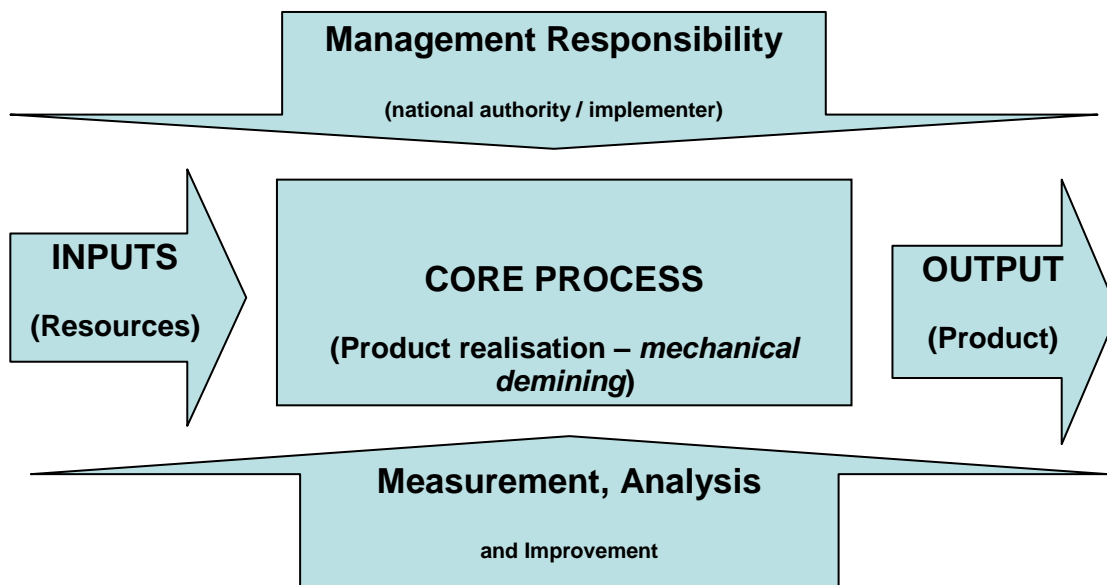


Figure 2 — The core process and influences.

4 Applying QA and QC to mechanical demining

Demining machines are essentially used for two functions, ground preparation or ground processing. However, to operate effectively in either role it is fundamental that the machine must be “fit for purpose”. For example, a vegetation cutter that does not engage the ground/soil cannot effectively be used to process ground if the intent of the operation is to disrupt the soil to a depth of 20cm.

The concept of “intent” is very important and, before the application of any machine, it must be agreed /decided exactly what is expected/anticipated of the machine in the specific operation, i.e. what is intended to be achieved?

In ground preparation operations, intent can be relatively straightforward: vegetation cutting and/or clearing; removal of tripwires, loosening of soil; removal of metal contamination; removal of building debris, boulders, rubble, defensive obstacles etc; and the sifting of soil and debris.

However, in ground processing the intent can be more complex. For example, demining machines can be used when the intention of the operation is one of the following:

- a) To find mines;
- b) To clear mines; or
- c) To prove there are no mines.

The role against which the performance of the machine is to be measured must be decided early in the planning stages.

QA is about process, thus actions to ensure quality should not exclusively focus on how the machine is being used at a particular site – and the starting point for QA is to understand machine use within the country/programme. Confidence that the machine is fit for purpose comes from:

- testing and evaluation of the demining machine;
- field analysis of results; and
- pre-testing before a site deployment.

In addition, and as part of the accreditation process, the experience of the operator must be known and the organisational SOPs fully understood. These aspects of QA – testing, analysis, pre-testing, operator experience and SOPs – are all off-site processes that will enable an on-site QA evaluation to take place against benchmarks other than pure observation and speculation.

In Figure 3 the steps of machine use at a suspected hazardous site are shown. The first step is establishing a clear understanding of the intended outcome. (What are we trying to achieve?) Next is the mechanical process. (What is going to be done?) Then comes establishing that the objective has been achieved – for example, that the depth required has been met. (What has been done?)

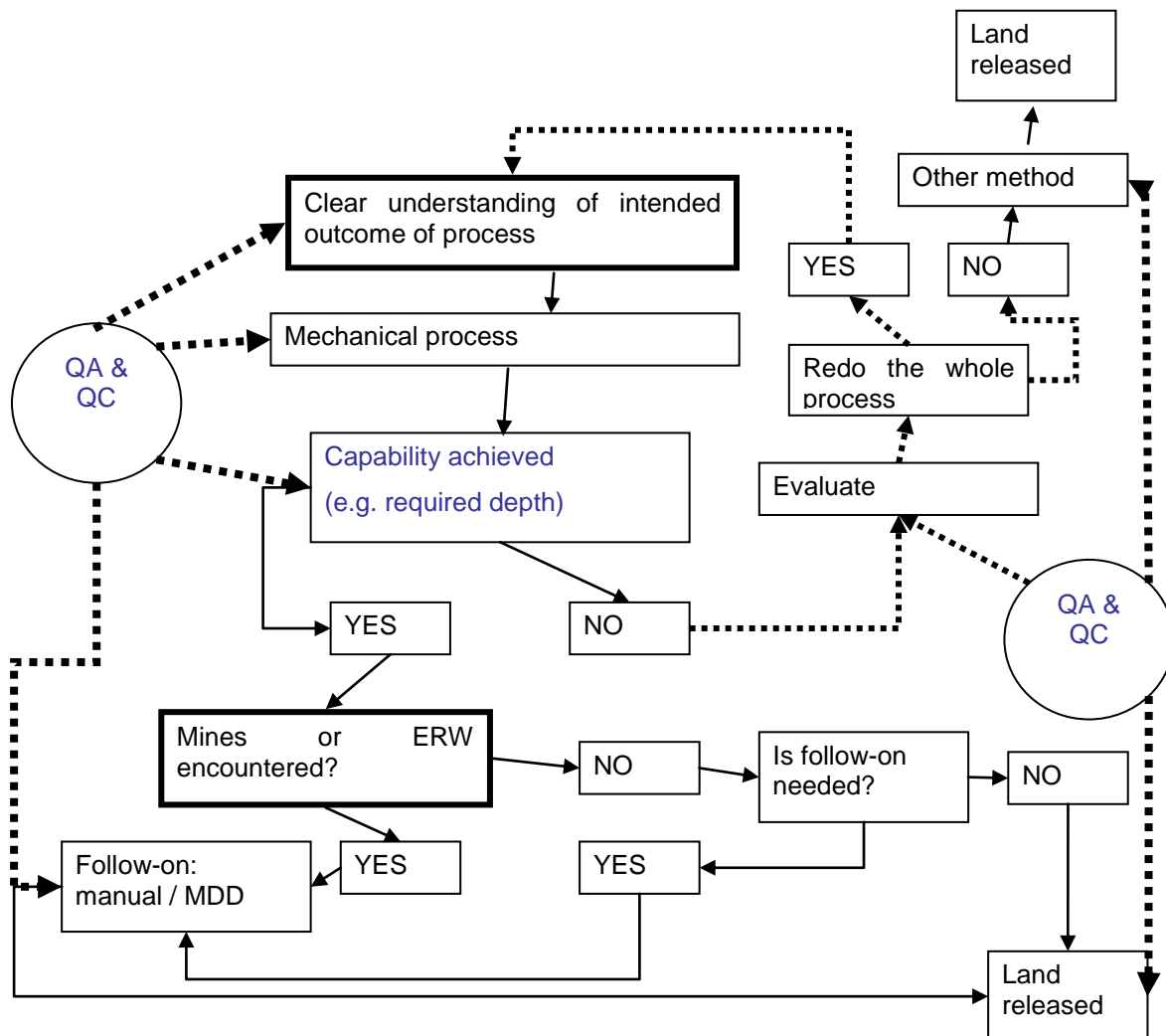


Figure 3 —The demining machine in the operational process.

Superimposed on the diagram are links shown to QA and QC. Thus it can be seen that quality is achieved by applying quality measures to understanding the intent, the process and the result. (Capability achieved)

5 Quality assurance at the site

On the demining site or suspected hazard area, quality can be directly assured by checking, among other things, records and planning: for example, by reviewing the operational site plan and by observing the work of the machine, i.e. observing the process (e.g. IMAS 09.50 Annex C).

If there are no records of hours worked, or no records of fuel use or maintenance, it becomes more difficult to make a judgement as to whether the process is going according to plan (the intent). Likewise, if there is no operational plan for the use of the machine, it is possible that the intended use of the machine is not clearly defined, therefore a judgement about whether the machine is working well becomes difficult. If vegetation is being cut, this is clear, but is it clear that the right vegetation is being cut?

Beyond records, plans and training, quality assurance of machine use is based on observation, often from a distance and is almost always conducted differently from QA of manual or dog demining. Traditionally, the QA process in manual demining has three stages – looking at the deminer, the section leader and the team leader – all of whom have a role in processing the ground in question. QA is sequential and deliberate. With a machine this process is more difficult to replicate.

Therefore, successful QA of machines relies on observation of the process but is also measured against facts established through:

- testing and evaluation of the demining machine;
- field analysis of results; and
- pre-testing before a site deployment.

Comprehensive testing and evaluation should include understanding the relationships between speed of movement and the effectiveness of the tool – for example, forward movement speed will have an effect on flails and tillers.

Pre-testing before deploying on a site can be done by simply engaging the machine and tool on an area in close proximity to, and similar to, the suspected hazard area – i.e. in similar ground conditions but in a safe area. At this “test ground” the capability of the machine is evaluated and recorded in the prevailing conditions. This gives you sufficient information against which to evaluate the actual work of the machine. A refinement in the case of tillers and flails – rather than simply engaging the tool in virgin ground – could be to introduce witness boards into the test area. Typically used witness boards are five mm wooden fibre boards that are dug into the ground prior to clearance to provide a profile of the cut achieved by the machine. (See CEN/CWA 15044 *Testing and evaluation of demining machines*). Note that one limitation of pre-testing in proximity to the site is that no live mines will be encountered. Dummy mines could, however, be introduced.

6 Quality control at the site

Normally both internal and external QC will be carried out at a given task to ensure the performance of the machine at the work site. The box “capability achieved” in Figure 3 describes where a QC check of the product can be carried out. For example, has the vegetation been cut to the quality expected, or has the depth required been achieved, or is the bucket separating material correctly?

Vegetation cutters and similar machines do not present a QC challenge as it is clear if the capability of the tool has been met when the process is paused or stopped – and it is also obvious from QA observation whether the active machine is working to standard. The same applies to any system where it is possible to inspect the working process visually from close proximity and to observe the quality of product in a pause in operations. For example, measuring the depth of cut when a front-end loader is used to excavate ground is a relatively simple process of walking onto the excavated area and establishing that soil to a specific depth has been removed. QC checks are more problematical when other ground processing operations are being conducted.

There are essentially only two ways of carrying out QC checks on the product of an intrusive demining machine.

The first method is to walk around the outside edge of the hazardous area, on known safe ground, and to take samples at the edge of the ground processed by the machine (see *Figure 4*).

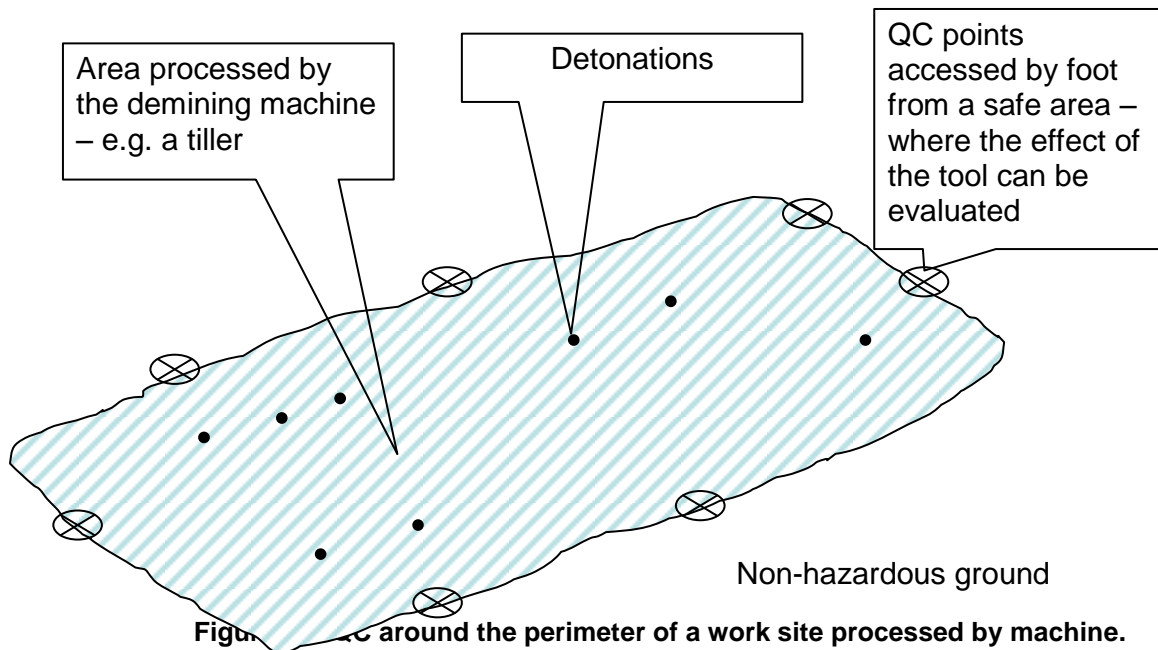


Figure 4 – QC around the perimeter of a work site processed by machine.

The second method is to run one or more deliberate QC lanes into the site. This will enable a QC monitor to evaluate the work of the machine inside the site. This process will clearly be more time consuming than the perimeter check. This is shown diagrammatically in Figure 5.

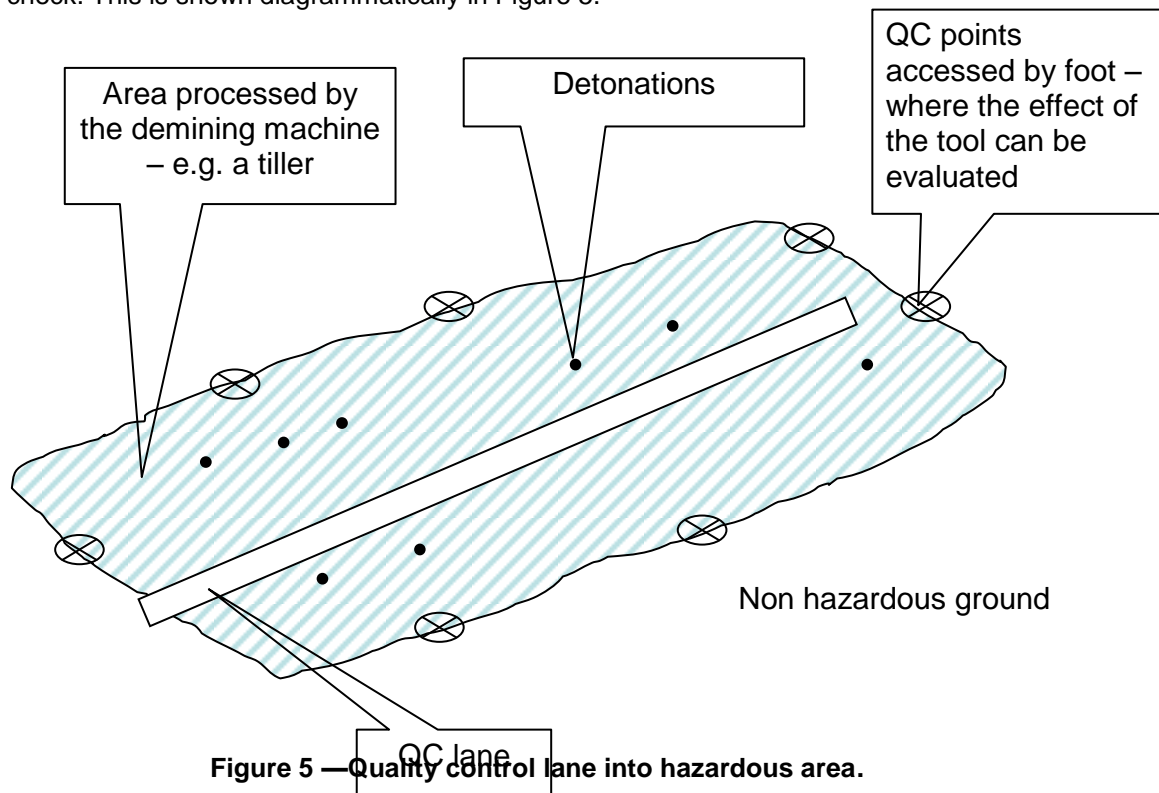


Figure 5 – Quality control lane into hazardous area.

The performance of a machine will vary over the area being worked on and achieved depths over the entire site will be different. The critical issue is to verify that the minimum intended depth is being achieved. Thereafter a view can be taken as to why a greater depth is being achieved and whether the operator is working the machine inefficiently.

As with QA, effective QC must be a check that is measurable against facts established through:

- testing and evaluation of the demining machine;
- field analysis of results; and
- pre-testing before a site deployment.

7 Summary

- a) For mine action to be effective, efficient and timely the overall process must be managed within the framework of a quality management system. This agreement recommends use of the EN ISO 9004 Model for a process-based quality management system.
- b) A quality product will only be produced efficiently if, for example:
- Management allocates the required resources;
 - Those resources are applied effectively when allocated;
 - The process of demining is measured, analysed, and improved; and,
 - Management seeks to learn and take ownership and responsibility.
- c) Management responsibility depends on both the national authorities (or equivalent) and the implementers of mine action.
- d) The “intent” is very important. Before the application of any machine, it must be agreed /decided exactly what is expected/anticipated of the machine in the specific operation, i.e. what is intended to be achieved. If the intent is not clear it will not be clear how to QA the process or QC the product.
- e) Therefore, successful QA and QC depends on making evaluations measured against facts established through:
- testing and evaluation of the demining machine;
 - field analysis of results; and
 - pre-testing before a site deployment.

8 Agreement statement

The agreement described in this document has been reached over three meetings. The workshop concluded that this agreement should be seen as an advisory document towards the development, or revision, of existing, International Mine Action Standards. The workshop members do not believe that this agreement should, in itself, be a stand-alone document defining specific actions within the complex considerations of the use of machines in humanitarian demining. The workshop also concluded that this agreement is of a significantly different character to those that have preceded it in the mine action sector, such as CWA 14747-1[1] CWA 15044[2] and CWA 15464[3].

Unlike the preceding CEN Workshop Agreements, this agreement does not set out a test nor does it set out any evaluation procedures or processes. Instead, this agreement is presented as a series of condition statements and a contribution to the wider consideration of the use of machines.

The workshop consensus was that the CEN workshop process was not ideally suited to the subject of quality management (quality assurance and quality control) for mechanical demining processes after the use of demining machines. This was not at first apparent but, by the second meeting, it was clear that, within the subject matter, there was little of real contention and little that was not already covered either directly or obliquely in many IMAS, national mine action standards (NMAS) or operator standard operating procedures (SOP). The utility of this agreement document is, however, that the various key factors are presented in one document.

Bibliography

- [1] CWA 14747-1 *Humanitarian Demining Actions – Test and Evaluation – Part 1 : Metal Detectors,*
- [2] CWA 15044 -2004 *Test and evaluation of demining machines,*
- [3] CWA 15464-2005 *Humanitarian Demining Action - EOD Competency Standards – Parts 1 to 5*