Minutes of the Mechanically-assisted Clearance Equipment Workshop on Test and Evaluation Standards

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Abstract

Mechanically-assisted clearance equipment is widely developed throughout the world for humanitarian demining, yet basic criteria for the test and evaluation of such equipment is still lacking. The rationale behind this workshop and the common goal of the participants was to identify criteria and recommend certain guidelines for test and evaluation of mechanical equipment. This information would feed into the upcoming work sponsored by the Swedish Explosive Ordnance Disposal and Demining Centre on standards for the type of test and evaluation.

Executive summary

A short term set of guidelines focusing on key issues relating to the test and evaluation of mechanically-assisted clearance equipment was achieved in a three day workshop at DRDC-Suffield in May 2002. Issues discussed included: Safety/Survivability, Logistics, Vehicle Systems and Effectiveness

Safety/Survivability was regarded as a machine's ability to withstand certain explosive hazards present in a demining region. A variety of mines (anti-personnel and antitank) were recommended for testing along with explosive content and range of burial depth for each mine.

Logistics discussions centred mainly on issues that would affect operating costs.

Also examined were issues of vehicle system performance with relevant parameters defined from end user, developer and donor perspectives. Numerous parameters were noted for test, all of which could be basically defined as either a mobility or transport concern.

Effectiveness was defined as the ability to accomplish stated task(s); most importantly, vegetation and mine processing. Various categories of vegetation, soil type, mine burial depth and target quantity were recommended for test. Collectable data from tests in this category would focus on description of processed ground in terms of resultant ground level, debris depth and size, and the degree to which complete clearance was achieved.

Carruthers, A. 2004. Minutes of the Mechanically-assisted Clearance Equipment Workshop on Test and Evaluation Standards. DRDC – Suffield.

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1. Aim of CCMAT MCE Workshop

This workshop was held at Defence R&D Canada Suffield (DRDC Suffield) and hosted by the Canadian Centre for Mine Action Technologies (CCMAT). There were a total of sixteen participants representing a wide range of functions concerned with humanitarian demining. A list of participants is included as Annex A to these Minutes. The workshops aim was to identify critical criteria for the test and evaluation (T&E) of Mechanically-assisted Clearance Equipment (MCE) and recommend guidelines or record a series of best practices for carrying out T&E activities. Its scope included equipment manufacturer/developer tests, trials by T&E agencies such as CCMAT, and trials conducted in mine-affected countries by Mine Action Centres, Non-Governmental Organizations, and commercial demining companies. The workshop was meant to provide the demining community with interim guidance on the conduct of T&E activities that would result in reports which could be used for comparative assessment of MCE available in the world today.

The three day workshop could not resolve all the issues but did produce some important guidelines which can be used until more formal standards are developed. This workshop will be followed by a European Committee for Standardization (CEN) Workshop Agreement (CWA) process sponsored by SWEDEC. This CWA will go into the development of formal standards for MCE in the longer term. The CCMAT workshop wanted to provide interim guidance for MCE T&E activities in the short term.

2. Introduction

There is a great deal of T&E activities taking place in the support of demining equipment development and procurement in the world today. It is being done primarily by three groups and generally for specific purposes. The T&E can be classified into three general groups and their outputs can be summarized as follows:

- Manufacturer/Developer Trials – Designed to determine basic performance, integration issues and suitability of components.

- T&E Agencies – (Such as SWEDEC, CCMAT, ITEP participants) – Test to a standard, validate manufacturers' claims, provide comparative data, and to assist development.

- User Trials – (MACs, NGOs, Commercial deminers) – Assist in development of equipment to their specific needs, introduce new technologies to users, develop SOPs, assure personal safety, and if they are the national authority, accredit equipment for operational use in their country.

- Similarly there are three groups within the demining community who will make use of the information derived from T&E. They also have specific needs and priorities for information.

- Donors – Need information on capital costs, cost-effectiveness, and performance.

- Manufacturers/Developers – Need to know performance against a standard, personnel safety, logistics concerns.

- Users – Want comparative data or performance, capabilities and limitations of the equipment in their area of operation, safety of personnel, logistics concerns, and cost-effectiveness.

3. General Factors

The T&E process for mechanical demining equipment is subject to a number of general factors and these must be taken into account during planning, execution, and reporting of T&E. These factors also impact upon the T&E requirements and methodologies proposed for use during testing. These factors include:

- Urgency. There is a need for a sense of urgency by all concerned because the need for T&E of MCE is **now**. That is not to say that T&E must be speedily completed to the extent that the results are flawed. Rather it means that T&E must be organized and conducted with a minimum of delay and that the results are made available to the community as expeditiously as possible.

- Developmental Versions. Often equipment will be tested when it is in an early stage of development and cannot be considered ready for the field. These results may not be released for general distribution if the developer is going to implement redesign or make substantial improvement to the item. Premature release of developmental trial information may create an unfavourable impression of equipment which would be difficult to overcome, even though the equipment was modified to correct the problems detected in the developmental T&E.

- Test Articles. Often the equipment provided for T&E is a single item or prototype. Tests involving destruction of the item may not be possible or recommended. Furthermore, the test of a single item limits the significance that may be placed on the data produced during a trial.

- Equipment Specifications. These documents are seldom available at the present time and development of a T&E plan is difficult without knowing to what standard or specification you are testing. Without the standards and/or specifications comparison of the tested items is difficult, emphasising the urgent need for guidelines and best practices as soon as possible. Some efforts have been made to produce some form of requirement documents but they are often geographically specific or very general in nature and lacking detail.

- Geographical Diversity. Demining takes place in virtually every geographical region and climatic condition in the world. The test scenarios are almost limitless and it is impossible to cover them all with a single T&E effort. In most cases T&E will be required at the user level in a mine-affected country as well as T&E agencies such as a government laboratory, or other arms length test agency.

- T&E Resources. Much of the T&E is conducted using very limited resources in terms of financing, time available, trained personnel, T&E facilities and equipment. Complex methodology and resource requirements must be kept to a minimum, particularly for trials conducted at the user level. Time likely to be available for a typical trial would be two weeks.

- Passage of Information. Exchange or distribution of T&E results has been haphazard and incomplete. Detailed T&E reports and information must be, to the greatest extent practical, made readily available throughout the demining community. This is particularly for Commercial off the Shelf (COTS) equipment being marketed for demining applications.

4. Approach Taken by the Workshop

Representatives for the UK, Sweden, US, and Canada gave presentations on T&E activities that they had recently conducted on MCE. (Copies of the presentations/papers are included in Annexes B to E). These set the stage for what other countries were doing and many lessons were learned from their experiences. Participants contributed throughout the workshop with their comments and additional information based on their background and experience.

There are many aspects involved in the T&E of MCE and the workshop could not possible address them all. Furthermore, it was difficult to get consensus on several issues or there could be two or more approaches to a particular T&E activity. If a solid majority opinion could not be achieved then the issue had to be deferred for later discussions. Where there were several approaches to a T&E activity and all had merit, then all of the methods were suggested as being practical approaches. From the start, it was necessary to limit the discussion to issues and guidelines that would cover essential aspects and those that would be the most beneficial to users of the T&E products. Guidelines for the discussion during the workshop included limiting discussion to essential T&E criteria, reducing duplication of tests, and a limitation on the time that would generally be available for T&E of an item of equipment.

Discussions during the workshop focused on aspects of T&E relating to:

- Safety/Survivability
- Logistics
- Vehicle Systems
- Effectiveness

Clearly there is a certain amount of overlap between these categories, and it may well be argued that certain topics would be better placed in one category than another. The issue of a machine's ability to deal with operations in hot climates without overheating might be considered part of testing the vehicle systems or as one of the logistics parameters. Such differences of opinion are not critical providing that the data is captured in some part of the T&E program.

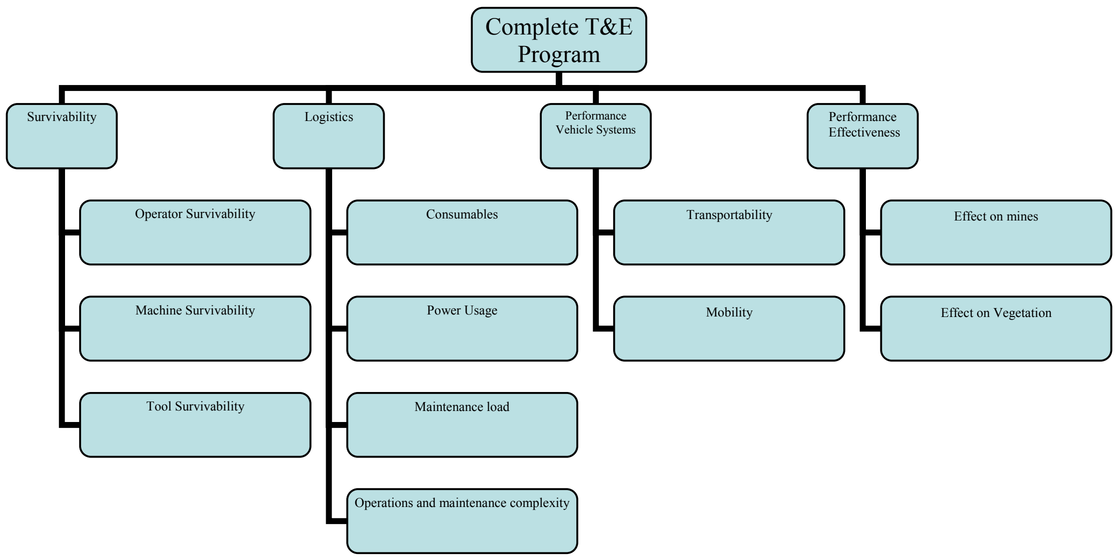

Figure 1. *T&E Program layout*

5. Discussion

5.1 Safety and Survivability

In the early part of this workshop the word safety was used but this was easily taken to mean, "Can the machine be operated safely?" The intent was to discuss the survivability of the working head or tool, the machine/vehicle that the system is mounted on, and the operator in the event of anti-tank or anti-personnel mine detonations. Thus the word survivability was substituted.

There is considerable discussion about what survivability tests should be applied to MCE. Some people believe that protection from anti-personnel mines is sufficient. They are confident that they can delineate those areas where only anti-personnel mines will be found and they would not use MCE in areas where there could be anti-tank mines. Others are not of the opinion that you must always test for the worst case scenario and that survivability testing must be done using the most powerful mines and UXO that could be encountered. It is this broad divergence of opinion that makes development of equipment requirements documents and T&E standards rather difficult. The participants of the workshop then took the approach that the equipment developer and users would define what survivability criteria they would design their equipment to, or the degree of protection required to work in a specific demining operation. The workshop should therefore provide guidelines on what methods would be used to prove the survivability of the MCE undergoing T&E.

The workshop sought to provide some guidance as to the representative types of mines and UXO that could be used for survivability T&E. The mines were selected as follows:

- Anti-personnel (AP) Blast Mines – Use of relatively large AP mines were recommended because there is a significant population of these mines throughout mine-affected countries. Small AP blast mines are quite common but normally do not represent a serious hazard to most MCE systems. An example of an AP blast mine that should be used in survivability T&E is the PMN mine. Mines with an explosive content of less than 100 grams should not be used.

- Fragmentation AP Mines – Mines that possess fairly large fragments and high velocity fragments should be used. Typical mines in this category are the M-16, and OZM series mines or directional fragmentation mines such as the MON series could also be used.

- Cased Anti-tank (AT) Mines – Mines that should be used are in the mid to high explosive weight category, i.e. 5.5 kg and higher. Examples include the TM 46, M-15 and MK 7 mines.

- Uncased AT Mines – These mines are simple to replicate in terms of explosive effects and bare explosive such as C-4 may be used. Ten KG weight of explosive was suggested.

Shaped charge, plate charge and explosively-formed projectile mines are not included in the list above.

UXO threats are an extremely difficult situation to define because of the extreme variety of the munitions that could be encountered, going from 1000 kg aircraft bombs to small arms ammunition. Consensus could not be achieved during the workshop on a typical UXO threat munition. Advice from the particular theatre of operations where the MCE would be used would have to be sought and T&E would have to take place using representative UXO found in the region.

5.2 Logistics

It was recognized that one of the key pieces of information needed be the end user is cost. This includes not only the acquisition cost but also the operating cost. Unfortunately, the evaluation of costs or cost effectiveness is virtually impossible without a specific context in which to make the evaluation. Fortunately, there are several parameters which can be measured and which can help an end user make cost effectiveness decisions in a specific context. The acquisition cost may be determined by a number of factors including whether the machine was donated or purchased, whether it was manufactured locally or in a highly industrialized (higher priced) location, or whether several machines were obtained at once to obtain volume discounts, etc. The size and weight of the machine may have an impact on shipping costs from the manufacturing location to the end user's location. It is therefore difficult for a T&E agency to firmly establish exactly what the acquisition cost might be, but this data can be very easily obtained by an end user or donor by contacting the manufacturer and shipping companies. Clearly, acquisition cost should not form part of a T&E activity.

Costs relating to the use of the system are less clear-cut. The rate at which a machine cuts brush or flails an area, the rate at which it uses fuel, the amount of fuel or air filters it consumes, and the number of maintenance hours (and the type of maintenance) required per operating hour all contribute to the operating cost. Similarly the skill level of the operator and the salary needed to obtain that skill level directly affect the operating cost. To complicate matter even more, all of these factors will change depending on the location of use. A dry, dusty environment will require more frequent air filter changes. An area with a poor supply of high quality fuel will require more fuel filters, and perhaps, more maintenance. An area without skilled machine operator might require the use of ex-patriot labour, resulting in higher costs. While these costs are difficult to quantify, and will vary with the local economy, there are many estimate operating costs. These are referred to here as logistics parameters which a T&E program should attempt to capture, and include at least the following:

Area covered per unit time (square meters per hour for example) in standard test conditions (probably ideal conditions for some machines).

Fuel consumption while operating in standard test conditions (and also under non-standard, field test conditions).

Recommended rate of replacement/maintenance of consumables, including fuel filters, oil filters, air filters, hydraulic filters, hydraulic oil, spark plugs, wear elements (flail chains/hammers), etc.

Observed replacement (if any) of filters, parts, etc., during T&E.

A record of the daily, regularly scheduled, and unscheduled maintenance required during the test program.

Recommended list of spares/replacement parts and repairs needed following mine detonations.

Utilization of a form such as that used by the US is included as Annex F could collect most of this data and information. The UK uses a similar form in their T&E. (Copy is attached as Annex G.)

In addition to the data collected above, there are a number of assessments that can be performed during the T&E of equipment. Many of these assessments tend to be subjective unless they are performed by highly qualified teams of personnel using sophisticated methods and instrumentation over a long period of time. Resource limitations will likely not permit detailed investigation of many factors but the informal assessment of operators, maintenance and other field personnel can provide valuable contributions to the overall T&E processes. Typical assessments that should be performed include:

Evaluation of the necessary operator and maintainer skill levels. This determination should be made by a person with extensive experience in machine operation and/or maintenance to ensure that the opinion is valid. It should not be made by the manufacturer since it will be in the manufacturer's interest to suggest that operation and maintenance are easy or that training for these tasks will be easily achieved.

A determination of the effect the machine has on the environment either due to pollution that must be remedied (hydraulic oil spillage, etc), or due to operational characteristics (destruction of topsoil for example). This may be a qualitative description rather than an objective, quantifiable data point.

Evaluation of the system's ability to operate in hot climates without overheating. This could easily be complicated by dusty conditions which clog radiators and inhibit normally sufficient cooling capacity.

An evaluation of the likelihood of overheating in normal operation. This might be the case, for example, in a system which must operate an engine or hydraulic system at close to 100% capacity on a continual basis. Again, degraded cooling capability due to dust or vegetation debris might exacerbate this problem but in ways that are difficult to quantify without a very intricate and expensive T&E program.

An evaluation of the reserve power available in the system to accommodate less than ideal conditions or to allow operation at less than peak capacity to prevent overheating problems.

General comments should be made of unusual occurrences or incidents which occur during the T&E such as unscheduled maintenance requirements and repairs, and tolerance to poor quality fuel.

It is possible that a performance test of a machine might be of too short a duration or in too benign a location to accurately measure some of these parameters. In this case, it may be possible to collect the information during a field test. Where actual measurements can be taken they should be recorded. These can include data such as coolant temperatures, operator's cabin temperature, and noise levels.

5.3 Vehicle Systems

As a matter of definition, Vehicle Performance was used to define the ability of the vehicle or the complete system to climb slopes, make turns, or perform other mobility functions, as separate from the system's ability to perform its intended task (vegetation cutting, soil grinding, etc.). Initially the discussions regarding the vehicle systems focussed on individual aspects of vehicle testing such as slope climbing ability, weight distribution, dimensions, centre of gravity, rollover angle, etc. We changed the approach and attempted to define which parameters were essential from the points of view of the end users, the equipment developers and the donors.

Starting with the end user's position we listed numerous specific aspects of vehicle performance/testing and identified the essential parameters. The developer's representative suggested that, as a starting point, any information that the end user deemed essential became essential for the developer to provide or find out. A few additional parameters were also identified as being important specifically for the developers. After some discussion we decided that the donor was effectively playing a purchasing agent role in which a decision was made about the amount of money available, and the available information (either manufacturers' claims or objective T&E reports) was compared with the end user's stated requirements. Again, the users' requirements became the driving factor.

At the end of this exercise only a small number of parameters were left which had not been defined as absolutely essential, although all agreed that they would provide useful information. As the test, evaluation, analysis and reporting on these few items represented only a tiny (relatively speaking) incremental cost; it was decided to include them in a list of essential elements.

By this point it had become clear that he information needed here could be broadly defined as basic mobility and basic transportability concerns. Effectively the mobility question addressed how the system would move from site to site under its own power, while transportability looked at how it would be moved using trailers, aircraft, etc. Examples of the type of information considered useful are listed below but this should be used as a guide rather than as a list of absolute requirements.

Table 1. Examples of Vehicle Performance Parameters	
PARAMETER	**COMMENTS**
Dimensions	In shipping configuration and operating configuration (if different).
Weights and Weight distribution	In shipping configuration and operating configuration (if different).
Centre of gravity or rollover angle	Most useful if there is some method of feedback to the operator showing an impending rollover possibility.
Turning circle	Useful for work planning (in operating configuration) and for transportability (in shipping configuration).
Ability to turn/manoeuvre without the tracks/wheels leaving the cleared path	Essential in ensuring the system can be manoeuvred safely during operations.
Field of vision	Identify blind spots.
Road speed and range	Especially for self-transportation from site to site.
Cresting, ground clearance, approach angles	Especially useful in determining loading ramp requirements.
Rough terrain capability	Particularly its ability to transport itself into difficult-to-access worksites.
Trafficability	Particularly the system's ability to deal with soft soils, VCI, ground pressure, etc.
Rescue/self-rescue capabilities	Identification of features that lend to rescue or self-rescue capabilities (onboard winched, towing eyes, etc). Actual testing is probably not useful since every rescue situation will be completely different.

5.4 Effectiveness

Effectiveness was defined as the ability of the system to accomplish its stated task(s). A conventional flail, for example, is (presumably) intended to use chains/hammers to impact the ground, break up the soil, and detonate or destroy mines. (It may also be used to cut and chop vegetation but for this illustration consider its mine-attack role). The stated task of the machine is not to climb slopes, make tight turns or have a clear field of vision, although these factors will clearly have an impact on how the machine can be applied to its stated task(s). The two main tasks that need to be addressed in this area are vegetation processing and mine processing. Some machines accomplish both tasks (in some cases at the same time), but the two tasks are addressed separately to be more general in their application.

5.4.1 Vegetation

Description of Vegetation: In testing the effectiveness against vegetation, there are the issues of vegetation type, size and density. This can be very difficult to quantify but certain categories have been defined which may lend use in T&E. The categories devised by Menschen gegan Minen (MgM) are a simple and effective method to categorize types of vegetation. Other descriptors size as thickness of stalks/trunks can be used but the four categories described give a general impression of the nature of the vegetation being encountered and must be considered the minimum of required detail when describing vegetation.

Table 2. *MgM Vegetation Categories*

CATEGORY	DESCRIPTION
A	Low grass, no rocks or rubble obstructions, good conditions (a backyard that hasn't been mown in three weeks).
B	Moderate grass and shrubs (good grazing land for cattle).
C	Heavy brush, saplings and obstructions 1-4m high, poor visibility (blackberry briers).
D	Basically impassable (heavy jungle brush).
Source: www.mgm.org – Mechanically-Assisted Demining Strategy Paper-Draft 8-2001	

Recording results of Vegetation Processing/Clearance: A description of the processed vegetation should be provided. Use of terms such as complete clearance to ground level, debris depth, and maximum size of processed debris should be used. After vegetation has been processed an assessment must be made as to what effect the processing has upon demining operations. For example, does the vegetation processing assist or inhibit follow-on demining work such as detection with metal detectors or dogs, did the processing result in any dangerous situations such as partial clearance of tripwires, etc.

5.4.2 Performance Against Mines

In trying to determine what parameters are essential in the T&E of a machine's performance against mines, several parameters were identified along with some guidance on proposed methodology.

Statistics and Number of Test Targets. There was considerable discussion over the number of target mines, both surrogate and live, used in the credibility of trial results if the sample size were too small. The general principle followed to give a high confidence level in the results is to use a high number of targets. Some estimates are that 34,000 targets would be required to adequately test one item of MCE. To emplace that number of targets, collect and analyze the data, would be impractical due to the resource and time requirements. Trials by the different participants displayed a range of approximately 30 to 1000 targets used for each trial. The number of test targets varied by test type, time available and the person conducting the test. The number of test targets used should be sufficient to show repeatability of performance, and not accept an anomaly in performance as actual performance. A general consensus was that the number of AP test targets used for test should be no less than 300 and the number of AT targets should be no less than 30. Some participants felt the number should be more and others felt number of test targets could be less. Participants were requested to review this requirement and provide any information on what the number of test targets should be for an acceptable level of confidence in the trial results. There was no response from any participants although some effort was made by several to contact national authorities for an opinion on the subject. As an interim measure, it is recommended that the suggested target numbers given below be used until a more definitive study can be made no the subject.

Table 3. *T&E of MCE Effectiveness Against Mines*

PARAMETER	DESCRIPTION	DETAIL
Soil Types	Sand and gravel	Sand and gravel are very easy to obtain almost anywhere in the world and are easy to prepare to standard specifications. Obviously these will not provide data relevant to all conditions but they will provide standardized, benchmark data against which different machines can be compared.
Soil Preparation	Soil description	Soil depth should be approximately 0.5 meters and the minimum soil description should include: a. Grain size and distribution (sieve analysis) b. Moisture content c. Degree of compaction (as measured by a cone penetrometer, nuclear densitometer, or other soil compaction measurement device/method.)
	Topsoil, clay, grassy, turf, etc.	Conditions, types of soil available, and types of vegetation, roots, etc. will vary tremendously from location to location even in relatively small areas. Additional data from these environments will be very useful in many cases, but being almost impossible to standardize, are not essential to all test programs.
Depth of Burial (DOB)	Surface (scattered) + 100mm DOB + 200mm DOB	Surface laid mines will test (i) a machine's tendency to fling mines away, and (ii) a brush-cutting-only machine's ability to deal with non-buried threats. The 200mm DOB mines will show the machine's ability to deal with threats at a nominally agreed limit of depth. The 100mm DOB mines will provide a reasonable mid-depth data set.
	Flush buried + other depths	It is assumed that any machine capable of dealing with 100mm burials will have no trouble with the 0mm burials (flush) or additional depths between 0mm and 100mm. Additional depths of burial will provide valuable additional data to improve the statistical relevance but are not specifically required.

	DOB definition	While the DOB for flat mines like the PMN are easy to define (to the top of the mine), irregular mines like the PMA-2 are more difficult. (Is DOB measured to the top of the mine body, the top of the fuse tower, or the top of the star shaped plunger? What about the PMN-2?) To alleviate this, the standard should have a diagram for each accepted type of mine target showing what is meant by DOB for that type of mine, even if it is obvious.
Types of Mines	Live/Surrogate	It was implicitly agreed that doing performance tests with live mines was not necessarily a requirement. The supply and use of real AP mines is a major problem for most nations, and the use of real AT mines might prove too expensive (in terms of machine damage) or risky (in terms of operator safety). As a result discussions tended to allow the use of surrogates. This does not in any way negate the use of live mines. In T&E conducted in mine-affected countries, live mines may be the preferred test item due to their availability and low cost.
Types of AP Mines	PMN and PMN-2	To represent large AP mines with large pressure plates, the PMN is selected. The PMN-2 represents a small bodied AP mine with a very small pressure plate. This is a target that is easy to miss (because it is so small) and easy to fail to trigger (because its pressure plate is so small).
	Other AP Mines	(i) Ideally all testing will be done with exactly the same targets regardless where the tests are conducted or by which agency. This may not be practical at this stage, although it should be pursued as the best practice in the future. (ii) Providing that it is similar in size, shape, and functionality, a substitute for the recommended mines (PMN and PMN-2) may be selected. (iii) Specifically discussed as possible T&E mine targets during the workshop were the Canadian Mechanical Reproduction Mine (MRM) and the Swedish test mine with live fuse and inert body. Both systems were recognized as having advantages and disadvantages. At present there was no direction given about which of these two methods (or other methods) should be used, although, as described above, the idea of identical targets in all tests should be pursued as the best practice. (iv) The UK peat mines were also discussed and were recognized as having potential as depth indicators or perhaps in other supplementary roles, but it was agreed that the peat mines were not the best targets for use in the statistical data collection needed in the performance trials. This is mainly due to the fact that the peat mines did not indicate whether a mine had functioned and if it were repositioned in the mechanical processing,

		there was no means of identifying where the mine was originally positioned.
Types of AT Mines	TM57 or similar	The TM57 was identified as an acceptable generic AT mine. Other AT mine types would also be acceptable on the same terms as the other AP mine types, i.e. similar in shape, size and weight.
Number of AP Targets	300	SWEDEC ended up using just under 1000 targets per mine. At the other end of the scale, some T&E has been conducted using only one or two dozen targets. Pending further information about the statistical nature of data gained in these tests, the following arrangement was agreed as the minimum number of targets: • 25 PMA-2 targets in sand (surface) • 25 PMA-2 targets in sand (100mm DOB) • 25 PMA-2 targets in sand (200mm DOB) • 25 PMA-2 targets in gravel (surface) • 25 PMA-2 targets in gravel (100mm DOB) • 25 PMA-2 targets in gravel (200mm DOB) • 25 PMN targets in sand (surface) • 25 PMN targets in sand (100mm DOB) • 25 PMN targets in sand (200mm DOB) • 25 PMN targets in gravel (surface) • 25 PMN targets in gravel (100mm DOB) • 25 PMN targets in gravel (200mm DOB)
	Additional AP targets	As above, additional targets (either in the same conditions or in additional soil types) provide welcome additional data to the above minimums.
Number of AT Targets	30	• 5 TM57 targets in sand (surface) • 5 TM57 targets in sand (100mm DOB) • 5 TM57 targets in sand (200mm DOB) • 5 TM57 targets in gravel (surface) • 5 TM57 targets in gravel (100mm DOB) • 5 TM57 targets in gravel (200mm DOB)
	Additional AT targets	As above, additional targets (either in the same conditions or in additional soil types) provide welcome additional

		data to the above minimums.
Data Reporting	Mine/Fuse damage assessment	A mine target left untouched is easily identified from a data analysis point of view. An obviously detonated mine target is also easily dealt with. Between these two extremes there are several possible conditions that must be explicitly identified in the reporting. Some organizations may have different requirements relating to these different conditions. Possible conditions include (but are not limited to): • triggered/detonated • live, intact, unaffected • live, damaged, still functional • main charge found, intact • main charge found, partial (indicate %) • fuse found, undamaged • fuse found, damaged/non-functional
	Statistical results	A kill rate of 95% over 1000 targets means something quite different from a kill rate of 95% over 20 targets. It is important that the data be presented in a clear manner that shows the number of targets used (established in the discussion above). A basic statistical analysis showing the relevance of the data adds immeasurably to the data and should be included.
Additional Information	Speed	The rate of clearance or machine operation should be quoted in square meters per hour or some similar, easily identified manner. (This data are actually included in the Logistics discussion, but must be collected during the Effectiveness testing activities.)
	Fuel Consumption	The rate of fuel consumption (litres per hour or (better) litres per square meter) should be recorded. (This data are actually included in the Logistics discussion, but must be collected during the Effectiveness testing activities.)
	Climate	Recording the temperature, wind speed and direction (relative to the vehicle's direction), and other ambient conditions was considered good practice.

5.5 Additional Information

Included as Annex H are copies of notes provided by Francois Littman and Mark Buswell regarding areas of importance discussed during the workshop.

List of symbols/abbreviations/acronyms/initialisms

DND	Department of National Defence
DRDC	Defence Research and Development Canada
CCMAT	Canadian Centre for Mine Action Technologies
T&E	Test and Evaluation
MCE	Mechanically-assisted Clearance Equipment
COTS	Commercial Off The Shelf
UXO	Un-exploded Ordnance
AP	Anti-Personnel
AT	Anti-Tank
US	United States
UK	United Kingdom
MgM	Menschen gegen Minen
DOB	Depth Of Burial
CEN	European Committee for Standardization

Annexes

A – List of Participants

B – Canadian Presentation

C – Swedish Presentation

D – United States Presentation

E – United Kingdom Presentation

F – Sample US Data Proforma

G– Sample UK Data Forms

H – Additional Information

WORKSHOP FOR TEST & EVALUATION (T&E) OF MECHANICALLY ASSISTED CLEARANCE EQUIPMENT (MCE) FOR DEMINING OPERATIONS
14,15,16 MAY 2002

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1/2

Annex A
MCE Workshop on T&E Standards
14-16 May 2002

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Bartley Smith	bartley.smith@nvl.army.mil USACECOM RDEC NVESD ATTN: AMSEL-RD-NV-CM-HD 10221 Burbeck Rd. Ste 430 Fort Belvoir, VA 22060 703-704-1180	
Robert Suart	robert.suart@drdc.rddc.gc.ca Director Canadian Centre for Mine Action Technologies Defence R&D Canada - Suffield PO Box 4000, Stn Main Medicine Hat Alberta T1A 8K6 Tel: 403-544-5332, Fax: 403-544-5324	

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A-2/2

The Canadian Centre For Mine Action Technologies | Le Centre canadien des technologies de déminage

Workshop Aim

Identify the CRITICAL criteria for T&E of Mechanically –Assisted Clearance Equipment (MCE) and recommend guidelines for the conduct of T&E activities

Canadä

The Canadian Centre For Mine Action Technologies | Le Centre canadien des technologies de déminage

Workshop OBJECTIVES

- Define essential parameters of T&E and to what accuracy
- Review existing T&E methods, recommend improvements or changes
- Provide interim guidelines/best practices until formal standards are developed
- Complement the efforts of others, e.g., SWEDEC, GICHD

Canadä

B-2/9

The Canadian Centre For Mine Action Technologies | Le Centre canadien des technologies de déminage

WHO is Doing T&E?

- Equipment Developers, Manufacturers
- Government Labs
- T&E Agencies – SWEDEC, QuintiQ, CCMAT, NVL, Others
- MACs – CROMAC
- NGOs

Canadä

Annex B
MCE Workshop on T&E Standards
14-16 May 2002

The Canadian Centre For Mine Action Technologies
Le Centre canadien des technologies de déminage

Types of T&E

- Developers/Manufacturers – basic performance, system integration, component selection
- T&E Agencies – Test to a standard, Validate manufacturers claims, Provide comparison data, Assist in development
- MACs/NGOs – Assist in development, Introduction to technology, Assure safety, Develop SOPS, Accreditation

Canada

B-4/9

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MCE Problems

- Need is NOW! Need a Sense of Urgency!
- Lack of Standards, SORs, SONs, Equipment Specifications
- Lack of T&E Standards-Poor planning, poor execution
- Some evidence of bias or perceived bias
- Poor sharing of information

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Economics of T&E

- Must concentrate on essential elements
- Must be practical for each stage of T&E
- Must minimize resource requirements, especially for in-theatre testing, and provide assistance
- Must take into account limited number of test items and state of development
- Must avoid duplication, non-essential testing

Canadä

Annex B
MCE Workshop on T&E Standards
14-16 May 2002

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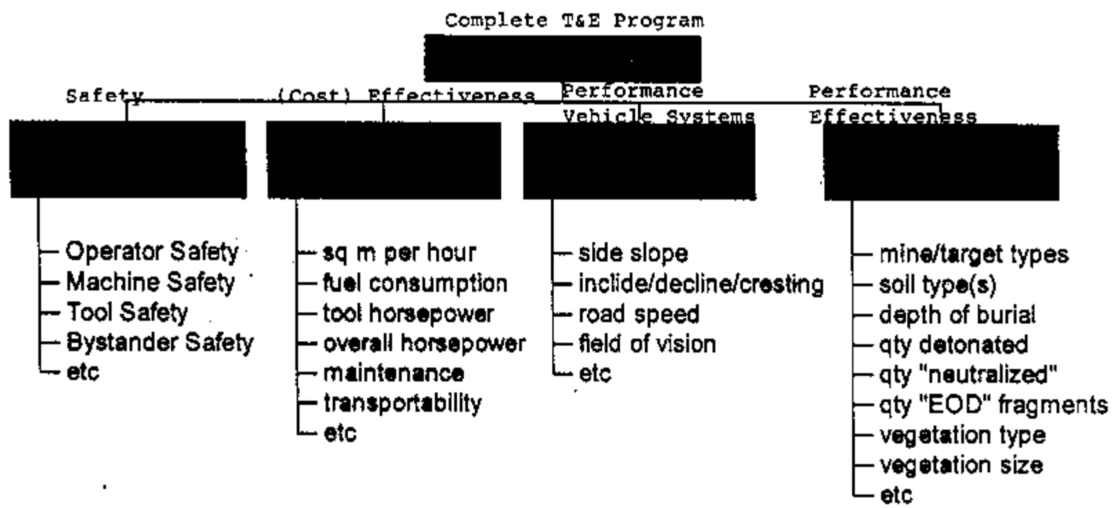
T&E Program Elements



Canada

B-7/9

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Tough Issues (2)

- Defining the Threat
  - **AP Mines**
  - **AT Mines**
  - **UXO**
  - **“Pathological Threats”**
    - **Area Defence Weapons**
    - **Stacked Mines**
    - **Off-route Mines**

Canadä

B-8/9

Annex B
MCE Workshop on T&E Standards
14-16 May 2002

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Tough Issues (1)

- How much is enough?
  - –Number of metres traversed
  - –Types of Soils
  - –Number of mines used

B-9/9

Canadä

Annex C
MCE Workshop on T&E Standards
14-16 May 2002

Test plan for trials with mechanical mineclearing systems

1. General details

Tests and trials are performed at the test range for mechanical mine clearance equipment and at the explosion test site in Eksjö, Sweden. The test range consists of three different ground types enabling repeatable tests. At the explosion test site 1, dynamic demolition tests are performed. The test performance will take approximately four weeks and the machine will be in service for 15 days.

Testing units, corresponding to anti personnel mine (PMA 2) and anti tank mine (TMM 1), are used for probability tests. The testing units are provided with live fuses. Dimensions and technical specifications according to 3.1.1.

A log-book will be kept in order to control the reliability et cetera of the machine.

The ergonomics of the machine will be evaluated with accent on the driver's environment.

Calculated running distance (clearing) of the machine during the tests will be approximately 10 km.

2. Extent

The trials include the following moments:

- Mine clearance probability tests, where the machine is tooling the testing units corresponding to anti personnel mine (AP) and anti tank mine (AT). The test is performed in different ground configurations at various depths down to 200 mm under the ground surface, measured from the upper surface of the testing mine unit.
- Mine clearance capacity in ground conditions with bushes and brush wood.
- Mine clearance capacity in inclined conditions.
- Manoeuvrability of vehicles.
- Dynamic blast tests.

3. Execution

3.1 Mine clearance probability test

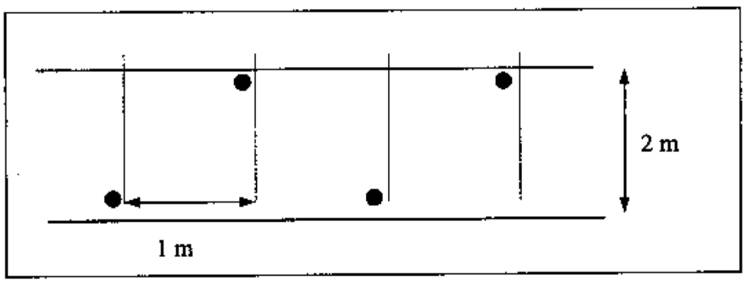
The tests will take place in the following ground conditions:

Sand	(according to 8)
Gravel	(according to 8)
Top soil	(according to 8)

C 1/5

The testing mine units with live fuses from anti personnel mine m/49B along with mine live fuse m/47 is used as mine detonation detector to see if the mine is influenced or detonating. The testing units are provided with a metal plate facilitating search afterwards. It is sufficient to find the metal plate in order to consider the mine as cleared.

- The mines are laid at a distance of 1 m and at various depths, i.e. 0 cm, 10 cm and 20 cm. Finally, they are being charged. See the sketch below (to be adapted to the machine concerned).



The machine is clearing the laid mines. The EOD-mine clearance leader is observing the detonating mine fuses, and the observations made are entered in the minutes. Thereafter the unexploded munition is located and neutralized by the EOD leader.

- The mine fuses tooled by the machine are subject to evaluation/estimation to what extent they have been influenced.
- The machine is subject to evaluation to what extent it has been influenced by the tooling of the ground.
- The procedure comprises approximately 300 anti personnel mines and approximately 30 anti tank mines in each type of ground.

3.1.1 Specifications and data for testmines

AT-test mine

AT –test mine consists of a sheet iron casting filled with plaster. AT-test mine is armed with Swedish mine fuse m/47 together with breaking trigger m/49.

Data

Casing:	sheet iron
Diameter:	180 mm
Height:	70 mm
Type of fuse:	Pressure activated
Trigger force:	2000 N
Explosive weight:	0,0023 kg RXD
UN NR:	0364
Explosive code:	1,2B

AP-test mine

AP-test mine consists of a plastic casing filled with plaster. AP-test mine is armed with Swedish mine fuse m/49B.

Data

Casing:	Plastic	
Diameter:	65 mm	
Height:	30 mm	
Type of fuse:	Pressure activated	
Trigger force:	50-100 N	
Explosive weight:	0,0012 kg	0,00025 kg detonating comp 19 0,00045 kg lead-acid 0,0005 kg RDX/TNT 60/40

3.2 Clearance capacity in vegetation and bushes

The clearance capacity in agricultural ground covered with brush wood having a tree diameter of 10 cm is examined. About 20 AP-mines and 5 AT testing units are being used for this purpose. The degree of flexibility to the ground of the clearing device is subject to evaluation.
DISTANCE CLEARED IS 25 METRES

3.3 Clearance capacity in inclined conditions.

The clearance capacity of such ground conditions as vertical inclinations, i e ascending and descending, as well as lateral inclinations in areas, that have not previously been tooled, are subject to evaluation. The inclination corresponds to 10 % in lateral conditions and 20 % in ascending and descending conditions. Approximately ~~50~~ 10 AP and ~~8~~ 2 AT are to be used.

3.4 Manoeuvrability/passability

The passability of the vehicle is examined in respect of its manoeuvrability.

During clearance:

- Turning radius during the clearance with retained security concerning tracks and wheels. - i.e. ABILITY TO FOLLOW IN OWN TRACK
- Turning of the machine in already cleared tracks.
- Flexibility to the ground of the clearing device.

During the driving of the vehicle:

- Capacity to reverse in cleared tracks.
- Driving in ditches, width 1,5 m and depth 50 cm.
- Traversing 30 cm high obstacles.

3.5 Dynamic blast test

The trial consist of an demolition test with live mines. The weight of the charged mine is 5,5 kg and 10 kg. Two trials will be performed and the trial will start with the charged weight of 5,5 kg. The machine is triggering and duly neutralizing the mine according to the principles of its effect. The supplier has the possibility to interrupt the trial after the first detonation.

4. Premises

Göta Engineers are keeping premises available for elementary maintenance, reparation welding etc, in direct connection with the testing range.

There are also premises for meetings and access to telephone, telefax and internet within the test area.

5. Security regulations

The Göta Engineers EOD leader is responsible for the security during the trials.
The EOD-leader is responsible for the security during the locating and neutralization of UXO.
Proper risk areas and restrictions of the machine are communicated by the supplier.
The supplier is responsible of the security during running and maintenance of their machine as well as possible damage coming up during running and maintenance.

6. Administrator and contact person

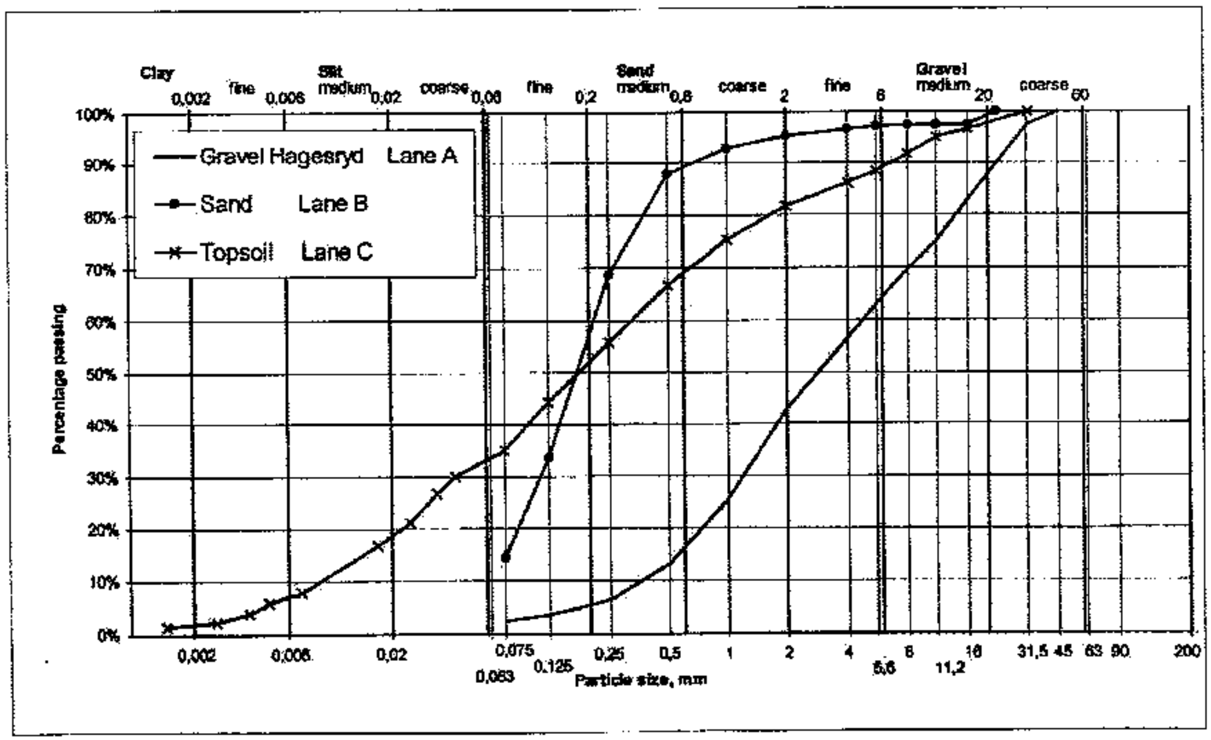
Trials and tests are performed at Göta Engineers testing unit.

Contact person: Maj Stephan Horste, +46 381-186 91
Fax +46 381-175 95

7. Surveillance

The test range is fenced.

Lane A-C



8. Test lanes

C-5/5

Annex D
MCE Workshop on T&E Standards
14-16 May 2002

US.

SYSTEM CONSIDERATIONS

- What does manufacturer say it will do?
- What type of mines is it designed to go up against?
- What are operating limitation?

D-1/8

TEST TARGETS

- Test targets should represent mines the system is designed for. Preference is for real mines, but surrogates okay.

NUMBER OF TEST TARGETS

- Varies by type of test and person conducting test.
- Number should be sufficient to show repeatability of performance, and not accept a fluke occurrence as actual performance.
- Given above and other considerations, US testing done with 5 to 30 test targets.

REAL vs SURROGATE

- Real Targets: Represent actual threat and are inexpensive to buy. BUT, sources are dwindling, quality is inconsistent, pose safety issues in use, hard to store/transport.
- Surrogates: Safe to use, easy to purchase, store/transport. BUT, do not actually represent threat, are very expensive compared to real mines, consumed at high rate.

TEST CONDITIONS

- Replicate actual operating conditions, terrain and environment as close as possible
- Bury test targets at depths anticipated in field
- Test to operating limits (e.g., cultivator, remove small mines, withstand blast of large mines)
- Test to manufacturers stated capabilities

D-5/8

Annex D
MCE Workshop on T&E Standards
14-16 May 2002

TEST LIMITATIONS

- Stuck with soil available at test site.
- Safety concerns require planting and removing of real mines on a daily basis. No weathering-in possible.
- Soil conditions affect blast tests. Limited replication of field conditions.

D-6/8

SOME LESSONS LEARNED

- Equipment design and operating characteristics can influence how test is run.
- Safety requirements can limit test procedures short of field use
- Maintain equipment log on all operations, failures, causes, repairs, length of time, parts, cost, special tools, downtime

LESSONS LEARNED

DESIGNATED TEST DIRECTOR:

RESPONSIBLE FOR SCHEDULING TEST, COORDINATION OF TEST ASSETS (MANPOWER & MINES) AND THE CONDUCTION OF TEST

DEDICATED DATA COLLECTORS:

ALLOWS THE PROJECT LEADER TO FOCUS ON TEST ISSUES AND OVERALL CONDUCTION OF TEST

DEDICATED DATA COLLECTORS:

ALLOWS THE PROJECT LEADER TO FOCUS ON TEST ISSUES AND OVERALL MANAGEMENT OF SYSTEM UNDER TEST

TASKED IDA (INDEPENDENT AGENCY) TO ASSIST IN TEST PLAN PREPARATION AND REPORT WRITING 1

Lessons Learnt during testing of Mechanical devices used in the demining process.

1 Aim

To outline a path to clear and concise evaluation of MACE through structured systematic testing although the same methodology could be used in testing any piece of demining equipment. This document is meant to be commented on and improved on.

2 Scope:

The scope of this document is to provide a guide to carrying out trials.

3 Overview of the testing process

There are four common stages of managing a trial: planning, preparation, execution, and reporting:

3.1 Planning

3.1.1 Setting the aim and scope of the trial.

It is vital to establish the aim of the testing process. Although the actual tests may not change too much for different aims, the end of project deliverable could.

3.1.2 Pretrial Assessment

The main aim of a pre trial assessment is to ascertain whether a piece of equipment has the potential to meet the criteria to be tested before a large amount of time and resources are allocated. A user requirement or similar document will have already defined the criteria. It is suggested that prior to a meeting with the manufacturer a questionnaire (similar to the GICHD questionnaire) should be completed by the manufacturer. This will allow the trials engineers to ascertain some of the characteristics of the equipment and will serve as a good basis for the subsequent meeting as well as the trial itself. Work is being carried out on the GICHD questionnaire to make it reflect the type and style of information required by the user community.

From the questionnaire and the meeting the Pre-trial assessment report can be compiled and if the equipment meets the criteria then preparations to trial it may begin. If the equipment shows potential as a mechanical demining machine the completed questionnaire can be also be sent to GICHD for updating or inclusion in the catalogue.

During the meeting it can be advantageous to explain to the manufacturer what type of tests you wish to carry out on the equipment. A compromise may have to be reached if, for instance, you intend on performing a survivability test with an AT mine but the manufacturer wishes to sell the equipment after the trial.

3.2 Preparation

Before preparation for the trial it is always worth going back and re-assessing the aim, scope and criteria for this specific project. The user requirement may have changed or the information gleaned from the pre-trial assessment may have brought up different ideas or concepts.

3.2.1 Trial preparation

The following points need consideration:

- Form the trials team:
  - From your own organisation
  - From external sources such as ITEP
- Test procedure sheets & data recording sheets (Examples in Annex A)
- Tool box
- First aid Kit
- Discuss trial plan with manufacturer
- Safety plan, to include:
  - Risk assessment
  - Emergency Telephone numbers and actions to take
- Assemble the correct basic equipment such as:
  - Surrogate mines
  - Mine marker tape & poles
  - Spades and pick axes
  - Metal detector
  - Measuring tape
  - Cans of marker paint
  - Cone Penetrometer
- Check availability of test sites and specialist equipment/services required

3.3 Execution

To allow the tests carried out to have the greatest use to the user community it is vital that a structured systematic testing regime is followed. If the same types of tests are carried out by the majority (preferably all) of the testing organisations then it will be easier to draw comparisons between different equipment.

The following are suggested categories and sub-categories for testing:

- **Safety**
  - Survivability
    - AP Blast
    - AP Fragmentation
    - AT Blast
  - Safety aspects for the operator
  - Safety aspects for persons working near the equipment
- **Performance**
  - Minefield clearance
  - Brush cutting/Vegetation clearance
- **Trafficability & Transportability**
  - Gross vehicle mass
  - Major dimensions
  - Approach & Departure Angles
  - Roll-over angles
  - Gradability
  - Ground Pressure
- **Logistics**
  - Maintenance
  - Fuel type and consumption
  - Lubrication and other consumables
  - Environmental limitations/considerations

An example of trials procedure and data sheets accompanies this report.

3.4 Compiling data and Report writing

The end product is the final trial report. This shall not only contain the information that the trial is intended to determine but shall also reach the Sponsor promptly. Arrangements shall be made for the communication of reports by telephone, fax or e-mail. Arrangements shall also be made for the Supervisor/Monitor at working level to be able to consult the Organiser and Sponsor as rapidly as possible, particularly on issues of safety. *(To quote the draft IMAS)*

3.5 Follow up monitoring and tests in mine affected countries

After the trial has been completed and the report written it is tempting to think that the objective of testing has been fulfilled. This is not necessarily true; the trial has answered a lot of questions about the equipment but certain questions about its ability to operate in certain environments and its long term reliability can only be answered when the equipment is used in a mine affected county.
For a fuller picture of the capabilities and limitations of the equipment information certain aspects of the day to day operations will need to be recorded and analysed over the life of the machine. Additional to this, a small-scale in-country trial to assess the above factors could be carried out before the equipment is committed fully to an operational status.

Annex A

DERA/QINETIQ Trial data & Procedure sheets.

Daily Trials Report - Counter Minewarfare Dept

Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A1 Weights, Dimensions and Approach Angle**		Location:
Time:	Weather:	

Equipment Data

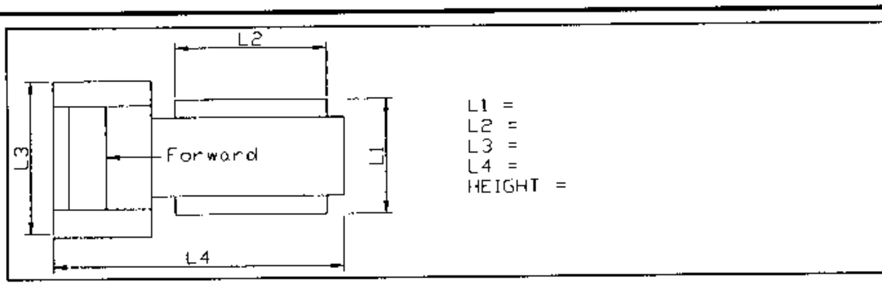
Description	Serial No + Calibration Date	Remarks

Weights and Dimensions: N.B. All figures given in kgs and metres

	Load	
Wheel Station (WS)1		
Wheel Station 2		
Wheel Station 3		
Wheel Station 4		
Gross Weight (W)		
Wheel Base Dimensions:	Length L1 =	Length L2 =
Centre of Gravity:	Lx = L2(WS2 + WS4) / W	Ly = L1(WS1 + WS2) / W
Distance from WS3:	Lx =	Ly =

Maximum Approach Angle

Trials Layout:



Comments & Observations:

Video No:	Stills No:
DERA Trials Officer:	Signature:

E-5/17

Daily Trials Report - Counter Minewarfare Dept

Time:	Weather:

Annex E
MCE Workshop on T&E Standards
14-16 May 2002

Equipment Data

Description	Serial No + Calibration Date	Remarks

Terrain

Comments & Observations

Depth after...	From top of Soil	From Datum Line
1m		
2m		
3m		
4m		
5m		
6m		
7m		
8m		
9m		
10m		

Video No:	Stills No:
DERA Trials Officer:	Signature::

Daily Trials Report - Counter Minewarfare Dept

Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A4: Logistics Daily Maintenance**		Location:
Time:	Weather:	

B-6/17

Start of Day Preparation

Unloading Time (Min) Start-up Time (Min) Oils & Lubs Req'd Top-up Y\N

Adjustments Needed/Faults Found:

End of Day Servicing N.B. All quantities given in litres or metres

Engine Hours Logged: Amount of Fuel Used:

Engine Oil Used: Transmission Oil Used: Hydraulic Oil Used:

Steering Oil Used: Coolant Used: Other:

Est'd Distance Travelled: Loading Time (Min):

Adjustments Needed/Faults Found:

Spares Used or Required:

Tests Completed:

Comments & Observations

Video No:	Stills No:
DERA Trials Officer:	Signature:

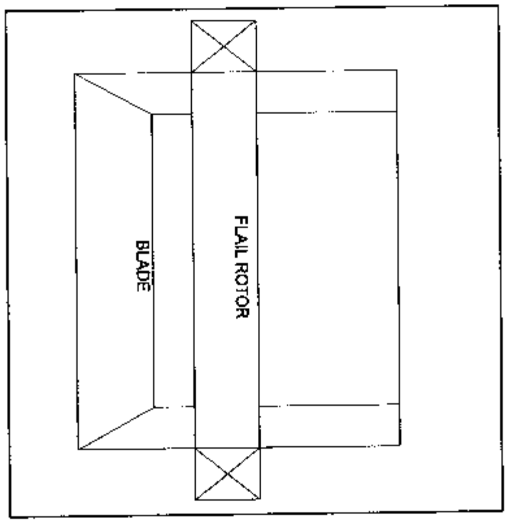
Daily Trials Report - Counter Minewarfare Dept

Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A6a: Static Live Ordnance Encounter**		Location:
Time:	Weather:	

Equipment Data E-7/16

Trial Layout: All measurements given in metres



Comments & Observations

Video No:	Stills No:
DERA Trials Officer:	Signature:

E-8/17

Daily Trials Report - Counter Minewarfare Dept

Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A2a Handling and Mobility - Turning Circle**		Location:
Time:	Weather:	

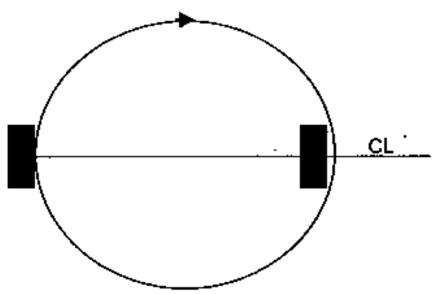
Equipment Data

Description	Serial No + Calibration Date	Remarks

Turning Circle: All dimensions given in metres

Direction	Test1	Test 2	Test 3	Average
Forward Left Hand Lock				
Reverse Left Hand Lock				
Forward Right Hand Lock				
Reverse Right Hand Lock				

Trial Layout



Comments & Observations

Video No:	Stills No:
DERA Trials Officer:	Signature:

E-9/17 **Daily Trials Report - Counter Minewarfare Dept**

Time:	Weather:	

Annex E
MCE Workshop on T&E Standards
14-16 May 2002

Equipment Data

Description	Serial No + Calibration Date	Remarks

Terrain

Comments & Observations

Video No:	Stills No:
DERA Trials Officer:	Signature:

Daily Trials Report - Counter Minewarfare Dept

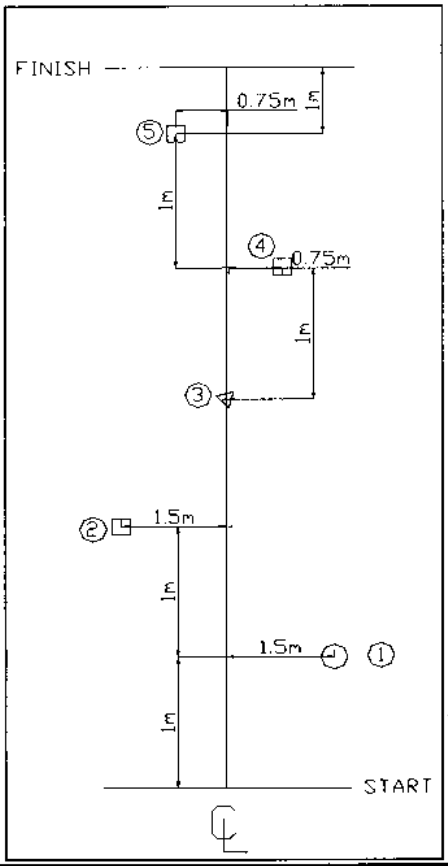
Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A5: Inert Minefield Encounter**		Location:
Time:	Weather:	

E-10/17

Equipment Data

Trial Layout



△ - FLUSH

○ - BURIED

□ - SURFACE LAID

Comments & Observations

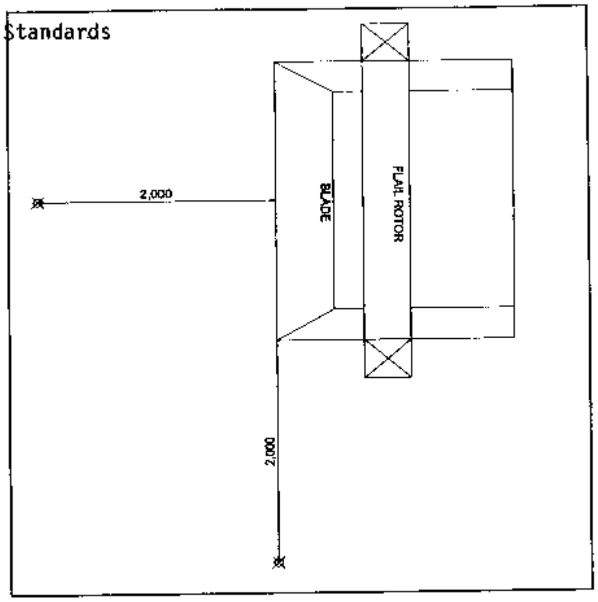
Video No:	Stills No:
DERA Trials Officer:	Signature:

Daily Trials Report - Counter Minewarfare Dept

Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A6b: Attack from Off Route Mine**		Location:
Time:	Weather:	
Equipment Data	E-11/17	

Trial Layout: Mine situated 2m in front and to the side.



Comments & Observations	
Video No:	Stills No:
DERA Trials Officer:	Signature:

Annex F
MCE Workshop on T&E Standards
14-16 May 2002

Daily Trials Report - Counter Minewarfare Dept

Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A2b Handling and Mobility - Slopes**		Location:
Time:	Weather:	

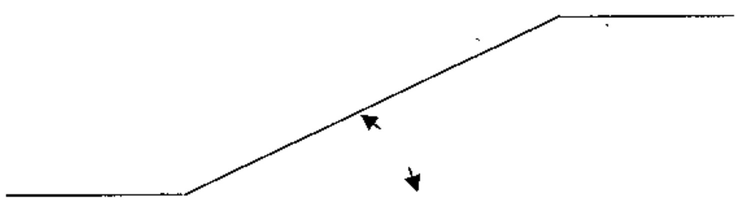
Equipment Data

Description	Serial No + Calibration Date	Remarks

Gradient of Slope: N.B. All dimensions given in metres

Direction	Gradient	
Fwd		
Rev		

Trials Layout



Comments & Observations

Video No:	Stills No:
DERA Trials Officer:	Signature:

E-13/17 **Daily Trials Report - Counter Minewarfare Dept**

Test: As Field of Vision

Time:	Weather:	

Equipment Data Annex E
MCE Workshop on T&E Standards
14-16 May 2002

Description	Serial No + Calibration Date	Remarks

Terrain

Comments & Observations

See attached sheet

Video No:	Stills No:

DERA Trials Officer:	Signature:

Daily Trials Report - Counter Minewarfare Dept

Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test:		Location:
Time:	Weather:	

E-14/17

Equipment Data

Description	Serial No + Calibration Date	Remarks

Terrain

Comments & Observations

Video No:	Stills No:
DERA Trials Officer:	Signature:

Daily Trials Report - Counter Minewarfare Dept

Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test:		Location:
Time:	Weather:	

Equipment Data E-15/17

Terrain	
Comments & Observations	
Video No:	Stills No:
DERA Trials Officer:	Signature:

E-16/17

Carruthers, Al

From: Chris Leach [chris.leach@jrc.it]
Sent: Tuesday, September 17, 2002 3:55 AM
To: LITTMANN FRANCOIS; Bartley Smith; Hal Bertrand; Chris Leach; Pete Blatchford; hakan.jacobsson@srv.se; bo.malmberg@swedec.mil.se; Goran Danielsson; stgpwts.dm@mla.mindef.nl; Dieter. Guelle@Jrc. It; Geoff Coley; eric.colon@rma.ac.be
Cc: Secretariat Itep; LITTMANN FRANCOIS; Bert Garcia; Lewis David W; Curt Larsson; J. Koster; manfredmerk@bwb.org; Al Carruthers; Jean-Paul Salmon
Subject: Lessons Learnt

Lessons learnt.doc   Armtrac 100 Procedure sheets.x..

Dear ITEP Working Group for Mechanically Assisted Clearance Equipment,

Attached is a base document for lessons learnt. Can I ask you to spare 10 or 20 minutes of your time to comment on it. The aim is to provoke discussion and comment in ITEP and the wider demining community and is most definitely not a finished document.
The idea is that from your comments we will be able to get that little bit closer to a common testing methodology.
Comments can be on all aspects of the document and testing methodology from specific tests to the general approach.

We look forward to your comments.

Chris

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Annex F
MCE Workshop on T&E Standards
14-16 May 2002

System Specifications

		Implement(s)	
Tool System	Purpose:		
Total/Shipping Length	Total/Shipping Width	Total/Shipping Height	Total/Shipping Weight
Outward Reach	Lift Capacity	# Tiedown Rings	Type of Attachment (3-pt hitch, front)
Other:			
Tool	Purpose:		
Total/Shipping Length	Total/Shipping Width	Total/Shipping Height	Total/Shipping Weight
Outward Reach	Lift Capacity	# Tiedown Rings	Type of Attachment (3-pt hitch, front)
Other:			
Tool	Purpose:		
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Tool	Purpose:		
Total/Shipping Length	Total/Shipping Width	Total/Shipping Height	Total/Shipping Weight
Outward Reach	Lift Capacity	# Tiedown Rings	Type of Attachment (3-pt hitch, front)
Other:			
Comments			

F-1/11

1. Transportation and Transportability

System ______________

a. Review and assess the initial load up of equipment (contractor), arrival and off load at Fort A.P. Hill, and load up and transport from A.P. Hill.
b. Review and assess capabilities for rail, surface, water or air transport.
c. Review and assess weight and cube limits and lenght/width/height constraints.
d. Review any customs issues or requirements.
e. Review hazardous materials constraints.
f. Review system containerization capabilities.
g. Document the tie-down/lift point provisions for all equipment comprising the system.
h. Review and assess potential/ required breakdown of the system prior to load up and transport (ie modular (?); electronics packages transportation, etc.)
Comments:

F-2/11

2a. Operations

System:	Date:	
Temperature:	Vegetation and Terrain Cat 1 2 3 4	
Ground Condition/Site Description:	Weather Condition:	
Type of Operations:		
Implement(s):	Remote Control Mode? Yes ___ No	Max Effective Operating Distance:
	Radio/Video Frequency: ___ / ___	
	Power Output:	

Results:

Start Time: ___	Stop Time: ___	Area Operated (LxW) ___ Rate (m2/hr): ___
Area Operated (L x W):	Ground Depth Penetration:	Safe Distance Trng ___, Ops ___, Maint. ___
Description of Site after Operation. (Graphic and written).		
Performance Limitations:		

System Effectiveness: U E O 1 2 3 4 5	Comments:(U-unexceptible, E-exceptible, O-outstanding)
Operator Skill Level Needed: US S HS 1 2 3 4 5	Comments:(US-unskill, S-skill, HS-highly skill)
Additional Comments:	

F-3/11

2b. Operational Mobility

System_______________

(1) Review and assess the type of terrain the system can operate in (ie slopes, rocky, hilly, rugged, etc.)
(2) Review and assess the turning radius, ground clearance and speed at which the system operates. Left/Right Turning Radius_____/_____, Ground Clearance_______, Speed_______
(3) Review and assess the ability of the system to maneuver through a designated course/mobility lane. Start/Stop Time:_____/_____
(4) Review and assess the distance (not to exceed 30km) the system (with/without its implements) can travel without transportation assistance.
(5) Review and assess the speed and abilityof the system to travel over roads without damage to the road surface.
Comments:

3. Maintenance, Support and Test Equipment and Supply

System_______________

a. Maintenance
(1) Review of overall maintenance concept. What items/equipment are considered repairable and which are consumable. For non-consumables, what level of effort and expertise is required to repair them and can they be repaired in the field or at original manufacturer. For consumables, show ease of replacement in a field environment(i.e filters, chains of flails, etc.)
(2) Performance (in a field environment) and assessment of Preventive Maintenance Checks and Services; daily, monthly, quarterly, and other.
(3) Assess the capability to remove and replace tires and/or tracks in a field environment.
b. Support and Test Equipment:
(1) Support and Test equipment requirements review; tools and tool kits, test equipment, calibration equipment, materials handling equipment, electrical generation equipment, and recovery equipment.
(2) Review for quatinties, cost, size, support requirements, etc.
(3) Facilities:
(a) What training facilities are required?
(b) Are there any fixed maintenance facility requirements? Any special maintenance/repair facility requirements?
(c) What are the storage facility requirements?
(d) What are the physical security requirements?

3. Maintenance, Support and Test Equipment and Supply

System__________

(e) What are the recommended facility utilities requirements (commercial power and type, etc.)
(f) Any other special facility requirements (clean room for electronics repair, etc.)
c. Supply Support (to include packaging, handling and storage)
(1) Review of contractor recommended initial support package:
(a) Have the contractor recommend a list of initial support items required.
(b) Which items are repairable and which items are consumable. Petroleum, oil and lubricants (POL) estimates based upon a 40-hour per week operational tempo. Track POL usage during operations.
(c) Review of supplies storage (facility requirements.) Review of physical dimensions of the support package. Can the support package fit into a 20 foot ISO container?
(d) Any large items requiring handling equipment.
(2) Review and assessment of follow-on support of consumables, repairable items and above field level repair capabilities.
Comments:

Daily Maintenance Log

System:

Main Engine

Date	Fuel	Eng Oil	Hyd Oil	ETM Hr	Run Time	Remarks

Auxiliary Power Unit (APU)

Date	Fuel	Eng Oil	Hyd Oil	ETM Hr	Run Time	Remarks

Comments:

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4. Technical Data

System_______________

a. Review and assessment of operator and maintenance technical documentation.
b. Review and assessment of training documentation.
c. Review and assessment of parts lists.
d. Review and assessment of transportation documentation, to include packaging.
e. Review and assessment of previous test results documentation.
f. Review and assessment of any lubrication or calibration documentation.

5. Manpower and Personnel

System________________

a. Review recommendations on numbers of personnel required to operate the system.
b. Review recommendations on numbers of personnel required to maintain the system (daily, weekly, monthly, other.)
c. Special or recommended skills required to operate or maintain the system.
d. Review and assess any perceived human factors considerations (i.e. color recognition, lift weight, manual operations and size/stature of operator, air conditioning, etc.)
f. Look at complexity of technical documnetation in reference to host nationals being able to understand and comprehend (in English or national language?).
Comments:

6. Training and Training Equipment

System ______________

a. Can all training take place in a field environment?
b. What is the recommended training time for operator and maintenance training?
c. Can we be trained to provide training to host nationals, or will it have to be a contractor representative?
d. Review the recommended training team make up (how many and skills required, etc.)
e. Review and assess the recommended and/or required training materials, aids and/or devices.
f. Review training facility requirements.

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7. System Safety

a. Has a system safety assessment and documentation been completed by the manufacturer?
b. Review and assess the amount of safety the system provides the operator.
c. Review and assess the feasibility of protecting the system and operator with armor to withstand a blast equivalent to a .56kg (TNT) bounding fragmentation mine at 2 meters.
d. Comments:

Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A4: Logistics Daily Maintenance**		Location:
Time:	Weather:	

Start of Day Preparation

Unloading Time (Min) Start-up Time (Min) Oils & Lubs Req'd Top-up Y\N

Adjustments Needed/Faults Found:

End of Day Servicing N.B. All quantities given in litres or metres

Engine Hours Logged: Amount of Fuel Used:

Engine Oil Used: Transmission Oil Used: Hydraulic Oil Used:

Steering Oil Used: Coolant Used: Other:

Est'd Distance Travelled: Loading Time (Min):

Adjustments Needed/Faults Found:

Spares Used or Required:

Tests Completed:

Comments & Observations

Video No:	Stills No:
DERA Trials Officer:	Signature:

Daily Trials Report - Counter Minewarfare Dept

Q

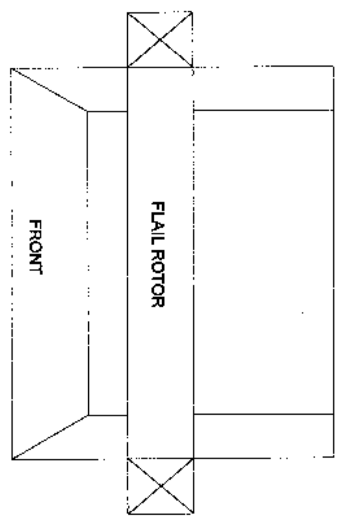
Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A6a: Static Live Ordnance Encounter**		Location:
Time:	Weather:	

Equipment Data

Description	Serial No + Calibration Date	Remarks

Trial Layout: All measurements given in metres



Comments & Observations

Video No:	Stills No:
DERA Trials Officer:	Signature:

G-2/22

Annex G
MCE Workshop on T&E Standards
14-16 May 2002

Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A2a Handling and Mobility - Turning Circle**		Location:
Time:	Weather:	

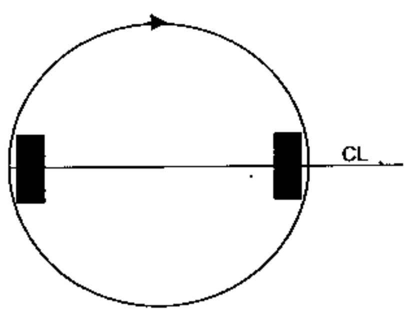
Equipment Data

Description	Serial No + Calibration Date	Remarks

Turning Circle: All dimensions given in metres

Direction	Test1	Test 2	Test 3	Average
Forward Left Hand Lock				
Forward Right Hand Lock				

Trial Layout



Comments & Observations

Video No:	Stills No:
DERA Trials Officer:	Signature:

G-3/22

Daily Trials Report - Counter Minewarfare Dept

Performance Sheet for Armtrac Assessment Trial

Q

Project No:	Date:	Trial/Sheet No:
Test: **A2d Handling and Mobility - Obstacles**		Location:
Time:	Weather:	

Equipment Data

Description	Serial No + Calibration Date	Remarks

Terrain

Comments & Observations

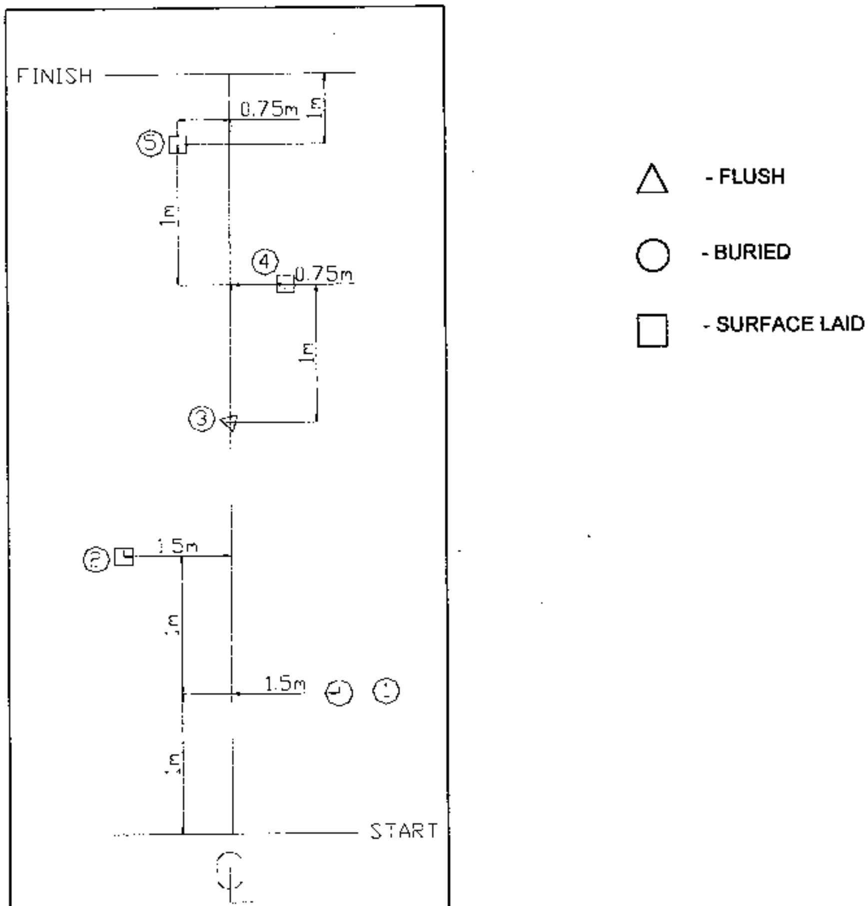
Video No:	Stills No:	
DERA Trials Officer:		Signature:

Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A5: Inert Minefield Encounter**		Location:
Time:	Weather:	

Equipment Data

Trial Layout



Comments & Observations

Video No:	Stills No:
DERA Trials Officer:	Signature:

G-5/22

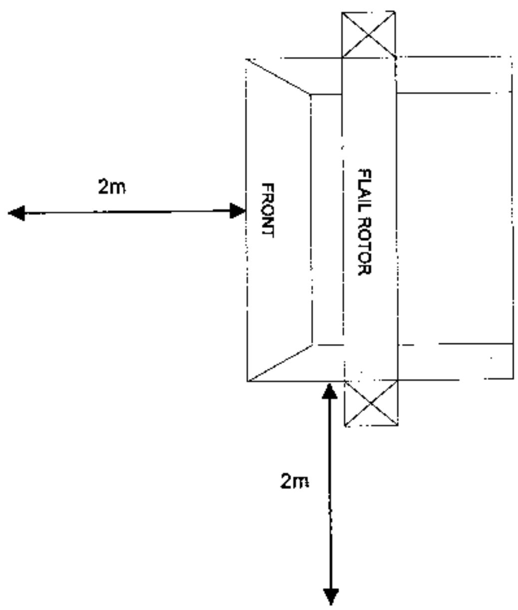
Performance Sheet for Armtrac Assessment Trial

Project No:	Date:	Trial/Sheet No:
Test: **A6b: Attack from Off Route Mine**		Location:
Time:	Weather:	

Equipment Data

Description	Serial No + Calibration Date	Remarks

Trial Layout: Mine situated 2m in front and to the side.



Comments & Observations

Video No:	Stills No:
DERA Trials Officer:	Signature: