



TIRAMISU

Toolbox Implementation for Removal
of Anti-personnel Mines, Submunitions and Uxo

Proposal for a New Framework for the Acceptance Test and Comparative Evaluation of Demining Machines not designed to detonate hazards

26/04/2016

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14th IARP Workshop on Humanitarian Demining and Similar Risky
Interventions, Biograd, Croatia

- What if? - vision
- Background: existing standards
- scope
- steps of the test
- conclusions

The Government of Ukraine:

- has chosen 3 mixed teams of:
 - students of the National Technical University of Ukraine+
 - military personnel+
 - blacksmith workshops
- Provided limited funding for the design and development of new demining machines for ground processing
- All machines received a very good feedback from the Ministry of Defence of Ukraine
- How to see if and where these machines could be used at best?
- HOW to test them, WHERE and by WHO?

IMAS 09.50, mechanical demining:

- General scopes of T&E of machines:
 - each machine should be T&E to determine its suitability for the task it is expected to carry out in the conditions in which it will work
 - identify optimal operating conditions
 - identify the residual risk remaining from each potential hazard
 - identify environment damages caused by the machine
 - ...

- Responsibility of the NMAA:
 - The NMAA should operationally accredit demining machines in accordance with the requirements of this standard
 - The NMAA should establish reporting systems and procedures for the gathering of data on mechanical and follow-up demining operations. Such data should be made available to all stakeholders
 - the NMAA should require demining organisations to maintain detailed records of their mechanical and follow-up operations to establish a statistical database of information that can be used for operational decision making

Background: existing standards

T&E 15044, T&E of demining machines:

- Accreditation

The process, **including the acceptance test**, by which a mechanical equipment is allowed to be used in humanitarian demining in a specific mine affected country

IMAS 03.40, T&E of mine action equipment:

- Acceptance trial:

- o **establish that the performance of the equipment in the hands of the user meets the characteristics specified in the SOR in field conditions**
- o give the user early experience of the equipment to develop operational procedures, drills and training programmes
- o confirm logistic implications...

Background: existing standards

T&E Protocol 15044:2009 (previously known as CWA 15044:2009):

*“For the purposes of this document, demining machines are defined as those machines whose stated purpose is the detonation, destruction or removal of landmines. This does not necessarily imply a fully demined area following passage of the machine. **Ground preparation machines are those, which are primarily intended to improve the efficiency of subsequent demining activities such as manual demining. This may include breaking of hard ground, vegetation cutting, fragment removal, or rubble removal. It may or may not involve the detonation, destruction or removal of landmines. It is recognised that this CWA concentrates on the testing of machines employed to clear mines, and there is a need to expand future work to address a number of issues, including: Appropriate testing for ground preparation devices, including test of.....”***

- lack of a specific T&E protocol specifically targeting ground preparing machines
- lack of a specific T&E protocol for the Acceptance test of these machines

In summary:

- There are no guidelines for testing and evaluating demining machines NOT designed to detonate hazards (ground processing machines)
- There are no guidelines for carrying out the Acceptance test and evaluation of demining machines in a systematic manner

→ Proposal for a New Framework for the Acceptance Test and Comparative Evaluation of Demining Machines not designed to detonate hazards

The framework proposed here is meant to guide NMAAs through a test and evaluation process aimed at:

- assessing the performance of machines not designed to detonate hazards in terms of mobility, vegetation cutting, ground treating and obstacle removal in field conditions, typically found in their country
- identifying the residual risk, in terms of hazardous items, remaining from the employment of mechanical assets in a ground processing role and operational procedures for integrating the mechanical assets with other demining assets, i.e. their follow-up (such as manual deminers, mine detection animals..), for countering this residual threat.
- assessing the capacity of machines not designed to detonate hazards to withstand explosions from live mines typically found in the country
- comparing machines not designed to detonate hazards on the basis of their Cost-Efficiency Ratio (CER)

$$\text{CER} = (\text{CE of full manual demining process } [€/\text{m}^2]) / (\text{CE of machine+follow-up } [€/\text{m}^2])$$

Scope - Cost Efficiency Ratio

$$\text{CER} = \frac{\text{(CE of full manual demining process [€/m}^2 \text{])}}{\text{(CE of machine+follow-up [€/m}^2 \text{])}}$$

The CER value becomes an intrinsic property of every different machine in a certain scenario and represents a means by which to quantitatively compare different machines in the same environment.

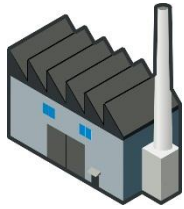
The CER value can also be used as an absolute indicator of the economic advantage a certain machine in a specific environment brings with respect to a full manual demining approach.

If $\text{CER} > 1$, the mechanical equipment brings economic benefits
If $\text{CER} \leq 1$, manual demining is more convenient.

Scope – def. of scenario

Data to be recorded before the machine processes the area		Reasons for collecting the data
Vegetation type	Qualitative description	Affecting machine vegetation cutting performance
	Mean diameter of plants (in a randomly chosen patch of 1m by 1m) [mm]	Affecting machine vegetation cutting performance
	Spatial density of plants (n. of plants in a randomly chosen patch of 1m by 1m)	Affecting machine vegetation cutting performance
	Mean height of plants (in a randomly chosen patch of 1m by 1m) [mm]	Affecting machine vegetation cutting performance
	Volume of vegetation (volume of 500g of bushes cut manually) [m3]	To be compared with the volume of vegetation left over by the machine, when not removed by the machine; an advantage of using a machine could be in the reduction of volume of the vegetation to carry away
Soil	Mean Cone Index value at three depths (0mm = flash with surface, 76mm, 152mm) (over 5 measurements in randomly chosen points) [psi]	Affecting soil trafficability and therefore machine performance
	Density (weight of a soil sample dug out from the soil /its volume)[kg/m3]	Affecting soil trafficability and therefore machine performance
	Moisture content (measured as ratio of the weight a soil sample dug out from the soil dried up, after 5 days, over the same sample of soil wet (just collected) multiplied by 100) [%]	Affecting soil trafficability and therefore machine performance
	Root presence (measured with the time taken by digging manually 0.25m2 of soil) [min]	To be compared with the root presence after the machine has processed the ground; an advantage of using a machine could be in the reduction of root presence
	False alarm rate before (n. of metal fragments in a randomly chosen patch of 0.25m2, found by metal detector at the national required clearance depth)	To be compared with the number of false alarm rate after the machine has processed the ground; an advantage of using a machine could be in the reduction of false alarm rate
	Other obstacle presence, over the soil (measured with the time taken by collecting manually 0,5m3 of it) [m3/min]	To be compared with the removal of other obstacles after the machine has processed the ground; an advantage of using a machine could be in the reduction of obstacles to be removed
Orography	Slope [°]	Affecting machine performance
Atmospheric conditions	Temperature [°C]	Affecting machine performance
	Relative humidity [%]	Affecting machine performance

Steps



Classification, threat,
Technical parameters and cost

time

pre-test

COUNTRY SPECIFIC data

Key staff salaries, fuel cost, other
Equipment cost

BASELINE data

Document checking

test

VEGETATION CUTTING data

Test in a safe area with surrogate,
non-explosive targets

GROUND TREATING and
OBSTACLE REMOVING data

MOBLITYdata

SURVIVABILITY data

Test in a safe area with live mines
and UXOs

PRODUCTIVITY data

Test in a SHA, with follow-up after

Residual risk and suggested
Follow-up
Benefits for follow-up in terms
Of safety

Cost-Efficiency Ratio (CER)



Baseline data

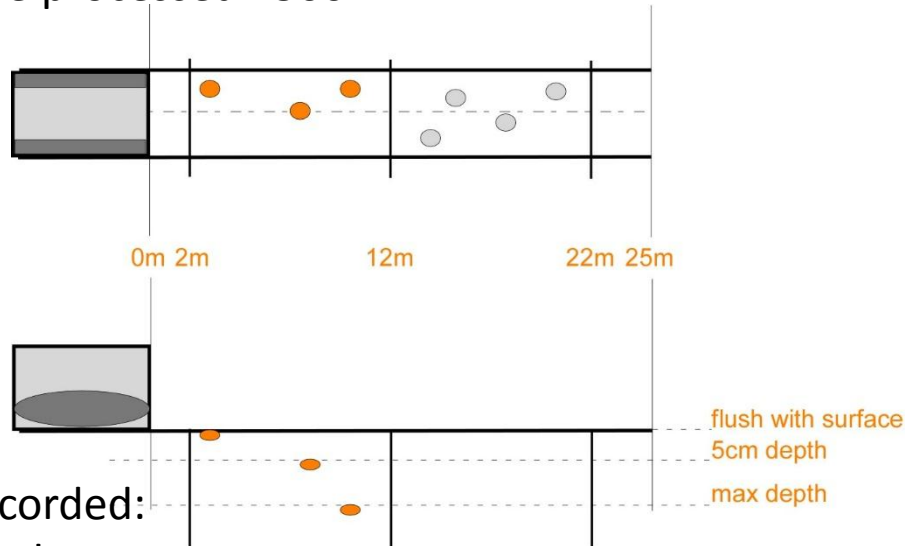
Example of data to be provided (by manufacturer):

A.1. CLASSIFICATION							
origin			Claimed				
			value	1° output	2° output	3° output	notes
MANUFACTURE	OUTPUT in terms of	vegetation cutting [tripwire removal, vegetation cutting, vegetation removal]		na	na	na	
		ground treating [breaking hard ground, mine obstacle removal [metal fragments removal, rubble removal, barber wire removal,...]		na	na	na	
		other		na	na	na	
		POST CLEARANCE USE					
mode of USE	intrusive						
	non intrusive						
type of LOCOMOTION	wheels						
	tracks						
mode of OPERATION	direct operation from the cabin of the machine						
	operation by remote control						
	operation by remote control and video monitoring						
			Claimed		Pre-test assessment		
			value	notes	verified by test? [y/n]	by which test centre?	referece report/notes
THREAT it can withstand and keep on working after in terms of	highest content of explosive in blast explosion [g]						
	highest content of explosive in fragmentation explosion [g]						

Performance data

Safe area with characteristics similar to typical SHAs

Min area to be processed: 500m²



Data to be recorded:

- area cleared,
- time taken, including time for manoeuvring
- fuel used.
- +
- effects of the machine on the vegetation and the soil
- qualitative evaluation of benefits for the follow up in terms of safety and residual threat
- indication of the best follow-up asset to counter it...

mine (target) treating	0 depth		no movement	below	up >=1m	up >1m
		no damage				
		>=1 piece				
		signs				
	10cm depth		no movement	below	up >=1m	up >1m
		no damage				
		>=1 piece				
		signs				
	max depth		no movement	below	up >=1m	up >1m
		no damage				
		>=1 piece				
		signs				

Field integrated data

Typical SHAs

Min area to be processed: five days of work

Machine + follow up as suggested by the Performance test

Data to be recorded:

- area cleared,
- time taken, including time for manoeuvring
- fuel used
- downtimes, problem, time to solve it, cost of spare parts and labour to fix them, ...

→ After Integrated Field Performance test, to each piece of mechanical equipment plus its follow-up is associated the Cost Efficiency Ratio, an intrinsic property of every different machine in a certain scenario, allowing a quantitative comparison of different machines in the same environment, regardless of their nature or their Output



THANK YOU

ANY QUESTIONS?

