

## CATEGORISATION OF MECHANICAL DEMINING MACHINES AND A BUYER'S CHECKLIST

This chapter describes the categorisation of mechanical demining machines, and concludes with a “buyer’s checklist” intended to help people considering the purchase or leasing of specific machines. The checklist is not exhaustive.

### Categorisation of Mechanical Demining Machines

The International Mine Action Standards on Mechanical Demining 09.50 are available at the website: [www.mineactionstandards.org](http://www.mineactionstandards.org).

The IMAS divide mechanical demining machines into three categories: mine clearance machines, ground preparation machines and mine protected vehicles. This categorisation is used as the structure for this edition of the Catalogue. Where a single machine could be assigned to either “mine clearance” or “ground preparation”, it has been allocated to the “mine clearance machines” category. This category is further differentiated by type of machine (flails, tillers, flail and tiller combined, sifters, rollers) as well by weight in each category.

The GICHD *Mechanical Demining Handbook* (2008), clarifies the categorisation of demining machines described above, as well as showing the variety of applications in the field.

Demining machines in mine action are broadly used to do three things:

- > destroy mines
- > prepare ground<sup>1</sup> (and destroy mines but not in all cases)
- > act as a platform for another application

Often an individual demining machine can be used to do all three things. For example, a consequence of using a ground engaging tool such as a flail may be the destruction of mines, the removal of vegetation and the loosening of soil. Also, if the prime mover is fitted with a magnet it would also be the platform for an additional application. More commonly when a machine is used as a platform it is understood that arrays of detectors or sensors are mounted.

Following these three broad purposes for use, demining machines are divided into three general design categories:

- > mine clearance machines (light, medium and heavy systems)
- > ground preparation machines (light, medium and heavy systems) including vegetation cutters (attachments to a tractor or excavator)
- > mine protected vehicles (which are commonly adapted ex-military personnel carriers, but the category includes vehicles such as tractors with added armour)

The categories are thus derived from the design intent or use intent.

Machines can be further sub-categorised into:

- > intrusive to the mined area – designed to work inside the mined area
- > non-intrusive – designed to work from a safe area “reaching into” the mined area
- > remote operated – designed to work remotely from the driver/operator position either intrusively or non-intrusively
- > driver operated – designed to be controlled by a driver/operator in a cab either intrusively or non-intrusively

Machines in all categories are normally designed with armoured protection for both the operator and component parts/areas of the machine.

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### Common tasks

The table overleaf provides a general, non-definitive summary of the tasks normally associated with the three machine categories. There is a lot of task crossover, particularly between mine clearance and ground preparation machines.

Tasks slide into one another and the operator will know that area reduction, technical survey, verification, vegetation cutting, ground preparation and land release can be occurring concurrently when a machine is used in a specific area.

The table is presented to help thinking about what task or tasks a machine could or should be doing at a site.

### Mine clearance machines (light, medium and heavy systems)

Mine clearance machines are those machines whose stated purpose is the detonation, destruction or removal of landmines.<sup>2</sup> For example, a front-end loader, armoured and adapted to excavate mined ground, can be designated as a mine clearance machine because the definition includes the removal of mines.

The use of a mine clearance machine may mean that follow-on processes can be reduced or eliminated. Not following up a mine clearance machine with a secondary process to finish the removal and destruction of all targets is unusual, but circumstances do exist where the machine used will have cleared all mines.

What these circumstances are will be derived from rigorous testing against target mine types in specific conditions. It may be established that a machine, for example a flail, engaging a specific mine type will detonate all functioning mines of this type without the machine being damaged or its capability degraded. If it is known that the contaminated site contains only the specific mine type which the machine is known to detonate, a case could be made for there being no requirement to follow on with a secondary clearance process. A simple visual inspection of the area may be sufficient.

The main mine clearance machine designs are:

- > flails
- > tillers
- > combined tiller & flail systems
- > dual capability of either a tiller or a flail
- > rollers
- > civil or military plant machinery that has been adapted for mine clearance or removal

### Ground preparation machines (light, medium and heavy systems)

Ground preparation machines are primarily designed to improve the efficiency of demining operations by reducing or removing obstacles.

Ground preparation may or may not involve the detonation, destruction or removal of landmines. Ground preparation machine tasks include:

- > vegetation cutting and clearing
- > removal of tripwires
- > loosening the soil
- > removal of metal contamination
- > removal of building debris, boulders, rubble, defensive wire obstacles
- > sifting soil and debris

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## MECHANICAL DEMINING

Machine category	Common machine tasks
<p>Mine clearance machines (light, medium and heavy systems) Specifically designed</p> <ul style="list-style-type: none"> <li>&gt; Flails</li> <li>&gt; Tillers</li> <li>&gt; Combined systems flail &amp; tiller</li> <li>&gt; Dual capability flail or tiller</li> <li>&gt; Rollers</li> </ul> <p>Adapted</p> <ul style="list-style-type: none"> <li>&gt; Earth movers/front-end loaders</li> <li>&gt; Rotary sifter systems</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Area reduction</li> <li>&gt; Cancellation</li> <li>&gt; Inspection</li> <li>&gt; Land release</li> <li>&gt; Mechanical mine clearance</li> <li>&gt; Quality control procedures</li> <li>&gt; Removal of metal contamination</li> <li>&gt; Removal of buildings debris, boulders, rubble, defensive wire obstacles, etc.</li> <li>&gt; Risk reduction</li> <li>&gt; Road clearance</li> <li>&gt; Road hazard (threat) reduction</li> <li>&gt; Sifting of soil and debris</li> <li>&gt; Soil loosening</li> <li>&gt; Tripwire removal</li> <li>&gt; Technical survey</li> <li>&gt; Vegetation cutting</li> <li>&gt; Vegetation clearance</li> <li>&gt; Vegetation removal</li> <li>&gt; Verification<sup>3</sup></li> </ul>
<p>Ground preparation machines (light, medium and heavy systems) Multi-tools (attachments to a tractor or excavator):</p> <ul style="list-style-type: none"> <li>&gt; Flail head</li> <li>&gt; Tiller head</li> <li>&gt; Magnet</li> <li>&gt; Tree excavator</li> <li>&gt; Soil disrupter</li> <li>&gt; Rotary mine comb</li> <li>&gt; Lift and grab</li> <li>&gt; Rotary systems</li> <li>&gt; Constructional engineering equipment tools</li> <li>&gt; Adapted farming implements</li> </ul>	
<p>Ground preparation machines (light, medium and heavy systems) Vegetation cutters (attachments on a tractor or excavator):</p> <ul style="list-style-type: none"> <li>&gt; Mower</li> <li>&gt; Rotary mower</li> <li>&gt; Reach mower</li> <li>&gt; Brush cutter</li> <li>&gt; Mulcher</li> <li>&gt; Slasher</li> <li>&gt; Flail</li> <li>&gt; Tiller</li> <li>&gt; Rock crushers</li> <li>&gt; Sifters</li> </ul>	
<p>Mine protected vehicles</p>	<ul style="list-style-type: none"> <li>&gt; Inspection</li> <li>&gt; Mine clearance</li> <li>&gt; Risk reduction</li> <li>&gt; Road hazard (threat) reduction</li> <li>&gt; Road clearance</li> </ul>

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### Mine protected vehicles (MPV)

MPV are vehicles specifically designed to protect the occupants and equipment from the effects of a mine detonation.

In mine action, the designation MPV is associated with vehicles that may have been originally designed as armoured military personnel carriers.

MPV are commonly used during survey and detection operations (often on roads), where they may carry equipment such as detector arrays or vapour sampling devices, or they may push or pull a roller.

MPV equipped with steel wheels can be used for hazard reduction, technical survey and area reduction. MPV with steel wheels have also been used in the process of inspecting excavated soil.<sup>4</sup>

Further reading on the subject of armouring can be found in the GICHD 2004 study, *Mechanical Application in Mine Clearance*, Chapter 5: The protection of vehicles and plant equipment against mines and UXO.

### A checklist for buying a demining machine

This checklist has been assembled from several sources, including the experiences of the GICHD mechanical demining team, and is offered to help those thinking about buying or leasing a demining machine.

#### Need

- > What is the identified need for a machine?
- > Is there a large number of potential target sites for the machine?
- > Will the machine speed the achievement of national objectives?
- > What difference will a machine make?

#### Capabilities

- > Is there an existing machine (or several variations of type) in the market with the right capabilities for the task required?
- > What is the productivity of the machine?
- > Will the machine be used in support of manual deminers or mine detection dogs (MDD), or will manual deminers and MDD be in support of the machine?
- > What are the differences between the various manual, animal and mechanical capabilities?
- > How many personnel will be needed to support/follow-on the work of the machine?
- > What are the annual costs of balanced supporting/follow-on assets – manual deminers, MDD or other?
- > What is the working life of the machine – five years, ten years?
- > What climatic factors will impact on the machine – heat, dust, rain, etc?

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### Capital cost

- > What is the purchase cost of the machine(s)?
- > Will the machine need to be armoured?
- > What are the costs of armouring the machine?
- > Does the machine need to be adapted?
- > Has the adaptation been done before?
- > What is the cost of the adaptation?

### Establishment and running costs

- > Will a specialised operator be required?
- > How much operator training will be required?
- > What is the cost of operator training?
- > What is the maintenance regime for the machine?
- > Will an internationally qualified mechanic be required?
- > What is the annual cost of a qualified mechanic?
- > How many other supporting mechanics will be needed?
- > What is the training requirement?
- > What will be the annual salary costs for mechanics?
- > What are the annual costs of maintenance and spares parts?
- > How easily are spares sourced – is the machine built with common parts?
- > Are there parts suppliers or maintenance facilities in the country?
- > What spares package and support is the machine supplier offering?
- > What is the warranty period for the machine?
- > What are the annual fuel costs?
- > Will machine maintenance schedules need to be adjusted because of climatic factors?
- > What will be the annual costs of maintenance adjustments?
- > Does the frequency range of remote controlled units interfere with other operators (eg military forces) in the area?

### Further support costs

- > Can fuel be purchased easily in the country or region?
- > Will a fuel truck need to be purchased to support the machine in some parts of the country?
- > Will a low-loader or lorry be required to transport the machine between sites?
- > What are the maintenance and running costs of the fuel truck and low-loader?
- > Will a mobile workshop be required?
- > What is the cost of a mobile workshop vehicle and tools?
- > What are the main maintenance and running costs of the workshop?
- > What maintenance and training package does the manufacturer provide?
- > Is the infrastructure (rail, road and bridges) of the country good enough to enable the machine to be transported between sites?
- > Will additional operations planners be required?
- > Will additional operations planning vehicles be required?
- > What are the costs of additional operational planning?

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### Importation

- > What rules govern importation of the machine or in-country purchase? (For example, can a machine be imported if it is second hand?)
- > What will be the costs of shipping the machine to the operational theatre?
- > What country of origin/manufacture rules govern the export of the machine?
- > What is the manufacture and delivery timeline?
- > Will the delivery date coincide with the optimal season for machine use?



### Quantity

- > Will one machine be sufficient?
- > Will two or more machines give measurable advantages and cost savings over the medium term?

### Quality

- > What test and evaluation needs to be done?<sup>5</sup>
- > How much will the evaluation process cost?
- > Can it be done safely in-country?
- > Has it been done before?

### Funding

- > Are funds available to purchase the machine(s)?
- > Are funds available for the running and support costs associated with the machine?
- > Is funding likely to be sustainable for a number of years?
- > When does the break-even point occur between machine use and the alternative of continued operations without a machine?

### Other

- > Is there a potential other use for the machine after its use in mine action?

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If it is decided to obtain a machine, the following should be considered when negotiating the contract.

- > What are the warranty conditions – and when does the period start?
- > Can the machine be commissioned and delivered in-country (thus providing a guarantee from the manufacturer that the machine is working) and does the commissioning include a field trial?
- > What spare parts package is included in the contract?
- > Is delivery insurance for the machine included in the contract?
- > Can the contract payment be in instalments (eg 30% on contract signature, 30% when the machine leaves the factory and 40% when commissioning/acceptance is completed)?
- > Are technical manuals and operators handbook available in the desired language?
- > Can a penalty agreement for late delivery of the machine be included?
- > What factory/manufacturer support will be available?
- > What service agreement on major services is available?
- > Can a training package for both mechanics and operators be provided by the manufacturer?
- > What are the competency standards of manufacturer's personnel giving support in-country?

### ENDNOTES

<sup>1</sup> Preparing ground includes vegetation cutting.

<sup>2</sup> IMAS 09.50 First Edition, 12 October 2006.

<sup>3</sup> Verification is the act of establishing that a suspected hazardous area is mined, thus this could also be described as technical survey.

<sup>4</sup> RONCO Bagram Airfield, Afghanistan 2005.

<sup>5</sup> The European Committee for Standardization (CEN) Workshop Agreement 15044 on "Test and evaluation of demining machines" sets out a mine action industry agreement on how machines could be tested and evaluated.