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Mechanical Demining

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Foreword

The National Mine Action Standards (NMAS) of Lebanon were first developed in the form of Technical Standards and Guidelines (TSG). These TSG were edited into the first edition of the NMAS in 2010 and were written to comply with the first edition of the International Mine Action Standards (IMAS). Since then, the scope of the IMAS has been expanded to include more components of mine action and amended to mirror the most recent changes to standards as required in today's operations. These changes, as well as changes in the local context of Lebanon, have necessitated a review and update of the NMAS.

As detailed in the National Mine Action Policy of 2007, the Lebanon Mine Action Center (LMAC) has the responsibility to execute and coordinate the Lebanon Mine Action Program (LMAP) on behalf of the Lebanon Mine Action Authority (LMAA), including the development and amendment of standards. Such standards shall be developed in a participatory approach that shall involve international, governmental, and nongovernmental organizations.

The NMAS are reviewed as needed to reflect amendments in the IMAS as well as incorporate changes to international obligations and local requirements. Such revisions are made available on the LMAC's website www.lebmac.org or can be obtained through contacting the LMAC via the email info@lebmac.org.

Acronyms

AP	Anti-Personnel
APM	Anti-Personnel Mine
AT	Anti-Tank
BAC	Battle Area Clearance
CASEVAC	Casualty Evacuation
CHA	Confirmed Hazardous Area
EO	Explosive Ordnance (all explosive mines and munitions)
EOD	Explosive Ordnance Disposal
ERW	Explosive Remnants of War
HMA	Humanitarian Mine Action
HTHA	High Threat Hazard Area
IA	Implementing Agency
IED	Improvised Explosive Device
IMAS	International Mine Action Standards
LMAA	Lebanon Mine Action Authority
LMAC	Lebanon Mine Action Center
LMAP	Lebanon Mine Action Programme
LTHA	Low Threat Hazardous Areas
MDT	Mechanical Demining Team
MDD	Mine Detection Dogs
MFA	Minefield Area
NMAS	National Mine Action Standards
PPE	Personal Protective Equipment
QA	Quality Assurance
SHA	Suspected Hazard Area
SOP	Standard Operating Procedures
TSG	Technical Standards and Guidelines
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance

Introduction

Mechanically assisted demining is an asset for use during Land Release operations in Lebanon. When appropriately integrated into the demining process, the use of mechanical assets often significantly reduces the time spent on tasks and therefore increases production rates and diminishes the overall cost of releasing contaminated areas. To achieve this without a reduction in safety for the people of Lebanon or damaging the environment unnecessarily, the use of mechanical assets during the overall Land Release process must be controlled and restricted. Respecting the principle of continuous assessment embedded in any Quality Management system, the performance of machines in terms of reliable output shall be subject to objective assessment and, when necessary, improvements made to ensure that the assets are always being used safely and appropriately.

In Lebanon, mechanically assisted demining is primarily used for the removal of vegetation and for the preparation of ground in order to accelerate manual or Mine Detection Dog (MDD) search and clearance operations. Appropriate mechanical assets may also be used as tools to rapidly determine the extent of a suspected hazardous area (SHA) when conducting area reduction in low threat hazardous areas as long as the mechanical asset is proven capable of reliably achieving the required processing depth of 15 cm and follow-up search and clearance is conducted to give full confidence that no hazards are left behind. Machines designed to detonate pressure activated mines rarely achieve this reliably and very rarely detonate other munitions that may be present, so when any explosive hazards are anticipated, follow-up search shall always be conducted before land is declared “cleared”.

LMAC approved mechanical assets may also be deployed to raise confidence that manually cleared areas have been searched appropriately as part of the Quality Control (QC) process.

Mechanical Demining

1. Scope

This NMAS provides standard principles and guidance for the implementation of mechanical demining operations in Lebanon. It shall apply to all implementing agencies (IAs) that intend to conduct mechanically assisted demining.

2. References

A list of normative and informative references is provided in Annex A.

Normative references provide cross-referencing to other standards referred to in this NMAS, and which form an integral part of the provisions of this standard.

Informative references provide a list of documents that may be consulted for a clearer understanding of this standard.

3. Key Terms and Definitions

The following terms and definitions are used in this NMAS:

- *High Threat Hazardous Area (HTHA):* an area with a confirmed presence of an EO contamination hazard. All areas contained within minefield fencing are generally deemed to be HTHAs. In minefields where the positions and pattern of mine-lines can be confidently identified, the area inside the fencing of the minefield may be divided into HTHA (location of mines) and LTHA. A HTHA is a Confirmed Hazardous Area (CHA).
- *Low Threat Hazardous Area (LTHA):* an area of land suspected to contain explosive hazards and requiring non-technical survey (NTS) or technical survey (TS). An LTHA is a Suspected Hazardous Area (SHA).
- *Mechanically Assisted Demining:* the use of appropriate mechanical equipment to complement other procedures in humanitarian mine action operations, such as manual or MDD search and clearance, by preparing the areas for them.
- *Minefield Area (MFA):* a defined area containing mines as well as the specified area surrounding the mine rows within a military laid pattern minefield. A MFA may also be a specified area around non-military laid pattern minefields. This area shall be subject to a minimum 10% confirmation search and clearance after all anticipated hazards have been found.

In addition to the above terms, NMAS 04.10 provides a glossary of terms and definitions used across all standards.

As in the IMAS, the terms 'shall', 'should' and 'may' are used across all standards to indicate the required degree of compliance. For any organization working in Lebanon, the use of 'shall' indicates a compulsory requirement. The term 'should' indicates the national preference which may be varied with LMAC approval. The term 'may' indicates a suggestion that is not obligatory.

4. General Principles of Mechanical Demining Operations

The general principle of operations adopted in Lebanon when clearing known recorded military laid pattern minefields permits the use of approved mechanical and/or Mine Detection Dog (MDD) assets for area reduction and to search and clear access routes to the minefield perimeter (which are usually visible minefield fences).

Manual search and clearance shall be used thereafter to clear into the minefield and locate the mine rows. When the mine rows are located and the mine orientation and patterns are confirmed, manual search and clearance procedures are used to clear the known mine rows.

Following the manual mine row clearance, i.e. clearance of the area known as the Minefield Area (MFA), confirmation search shall be conducted by a second asset for a minimum of 10% over the MFA (mine rows). Mechanical and MDD assets may then be used to prepare and search the peripheral areas outside the MFA, both inside and outside the minefield fence.

Mechanical flail/rotary tiller assets shall never be used as a sole clearance tool in a CHA or HTHA; rather, such assets shall always be followed by systematically applied manual or MDD search and clearance.

Mechanical demining that causes avoidable damage to the environment or risks damaging cultural/heritage sites shall not be permitted. See NMAS 10.70 Safety - Protection of the Environment.

5. Systems Approach to Mechanical Demining

Mechanical demining is conducted in Lebanon using a systems approach in which a combination of machines, tools, and procedures are deployed throughout the demining process.

The parameters for each mechanical system will vary, but in general, each system must:

- be safe for the system operator and be adaptable in order to cater to the specific explosive hazards present and specific ground conditions;
- have an internal organizational structure enabling the system to integrate fully with other demining assets as required; and

- be designed and structured in such a way that it accelerates Land Release operations in a safe, cost effective, and productive manner.

The development and employment of mechanical assets must take into account the following factors:

- the specific mine/EO threat;
- the simplicity of design and operation;
- the maintainability and sustainability of the equipment in the area of operations;
- the ability to deploy itself, or be deployed, to the worksite;
- the adaptability of the mechanical asset in differing terrain conditions;
- the availability of detailed and accredited SOPs;
- when ground processing, the ability to achieve a reliable processing depth;
- any training requirements of national operators in order to maintain a national capacity.

6. Limitations

The use of mechanical flails as a primary demining tool over the known mine rows when assisting clearance of "military laid pattern minefields" such as those laid by the Israelis and their Militia Forces is prohibited in Lebanon.

Due to the increased risk, mechanical flailing/rotary tillers should not be used to process the ground in areas known to contain mines fitted with a cocked-striker mechanism that incorporates a spring assisted striker retained by a recessed firing pin or collar such as the Israeli No.4 anti-personnel mine or the GYATA 64 anti-personnel mine.

Mechanical flails/rotary tillers shall not be used as a primary demining tool in any minefield where a pattern can be determined. Manual clearance shall always be the preferred method of clearing "patterned minefields", which may be followed by a mechanical flail and MDD assets as a means of 'confirmation' or confidence building, when that use is approved. Manual search and clearance of patterned minefields allows for the accurate recording of the size, shape, pattern and exact quantities of mines located in the area for future reference. The primary use of a mechanical asset would normally destroy the pattern and any useful information about the minefield. Evidence around the world has shown that demining machines cannot reliably detonate *all* hazards present. When these minefields are being cleared as part of humanitarian mine action and so fall under the LMAC's jurisdiction, the standards of clearance required in NMAS 09.10 Clearance Requirements shall be maintained.

Mechanical flail/rotary tiller assets shall never be used as a sole clearance tool in a CHA or HTHA; rather, such assets shall always be followed by a systematic full search and clearance of the area. However, in a Low Threat Hazard Area (LTHA), or a Suspected Hazard Area

(SHA) where there is no prior history or evidence of mines/EO, mechanical flailing may be conducted as a verification or community confidence building operation. Recognizing that the use of the machine does not guarantee that the land is safe unless it was already safe before the machine was used, the LMAC Operations Section may authorize mechanical flailing without follow-up search and clearance other than visual BAC on a site-by-site basis depending on the community's needs, but the land so processed shall not be recorded as having been 'cleared'.

A second search and clearance asset shall follow any mechanical ground processing conducted in any LTHA that has a previous history or evidence of the presence of mines/EO.

Mechanical flail/ rotary tillers may be used as a primary demining tool in Anti-Tank (AT) Minefields with the LMAC's formal approval. However, given the cumulative shock-wave damage that such machines are known to sustain after multiple detonations of large mines, it is unlikely that their deliberate use to detonate AT mines would be cost-effective, or as efficient as the use of manual demining assets.

Mechanical assets, such as the excavator/sifter, may be used for primary search of contaminated earth spoil and rubbish piles as long as any such sifted spoil/rubbish is searched by a second asset after the machine. Even if the machine sifts all intact targets effectively, the secondary search will check for fuses or EO parts that have passed through the sifter. Manual or MDD search and clearance assets may be employed for this purpose.

7. Mechanical System Test and Evaluation

Mechanical System Test and Evaluation shall be used to assess the limitations of any mechanical asset before it is approved for operational deployment.

The LMAC requires the following to be included in the evaluation of any demining machine deployed in Lebanon:

- a set test and evaluation time period: the test shall be designed to determine the machine's abilities AND its limitations;
- LMAC desk approval of mechanical SOPs detailing the mechanical asset procedures, safety precautions, and the planned way to integrate the asset's work into the IA's other search and clearance procedures;
- when a machine processes the ground or contaminated spoil, there is thorough follow-up manual search and clearance to provide reliable data about the machine's limitations; and
- QA results of the mechanically worked area.

A written evaluation report shall be produced specifying the following operational statistical data:

- ground processing capacity (square meters/hour);

- mechanical mobility in different terrain and soil types;
- mines or EO discovered by type, surface laid or buried, destroyed;
- mines or EO discovered by type, surface laid or buried, partially destroyed;
- Mines or EO discovered by type not partially damaged or destroyed;
- Mines or EO, or parts thereof, moved more than a meter from their place of origin;
- reliable depth of processing in different terrain and soil types, variations of processing depth shall be accurately recorded;
- command, control and communications procedures; and
- test and evaluation conclusions and recommendations.

Data collected over the trial period shall include information and performance data on deeply buried mines as well as surface irregularities produced by rocks or ditches and maneuverability problems encountered in different ground. Data should be comprehensive enough to give the conclusions a high degree of reliability and support the recommended working parameters for the machine.

All mechanical trial and evaluation results must be submitted to the LMAC Operations Section to be evaluated during the accreditation process.

8. Working Plan

Prior to any mechanical work being carried out, a mechanical work plan shall be drafted by the IA as part of the task Clearance Plan that is agreed with the LMAC. The mechanical work plan shall be located on site for both internal and external QA evaluations. All mechanical work plans should include the following:

- full details of the defined mechanical area parameters (to include a schematic diagram);
- full details of the mechanical work to be completed; and
- full details of all follow up search and clearance required.

Any amendments to an approved mechanical work plan should be submitted for prior approval from the LMAC Operations Section before being implemented.

9. General Safety Precautions

The following safety precautions shall be adhered to at all times.

a) A thorough investigation of the mine/ERW threat in the area should always be conducted before the deployment of a mechanical asset.

b) The minimum working distances shown in Table 1 should be observed at all times. When necessary, safety distances should be applied instead.

c) Strict command/control and appropriate working distances shall be enforced when a worksite uses combined mechanical, manual, and/or MDD assets.

d) All worksites operating mechanical assets should have a designated machine Control Point established at a distance of 250 meters, which may be reduced on a site-by-site basis with the approval of the LMAC Operations Section, depending on ground conditions, geographical layout of the site, and the mine/EO threat.

e) When conducting follow-up search of a mechanically processed area, all found mines or mine parts that include a fuse component should be destroyed in-situ. Hazardous EO and their components should not be neutralized or moved except when mechanical sifters are employed (refer to mechanical sifting for further clarification).

f) The *minimum* safety distance from any working machine for persons not wearing Personal Protective Equipment (PPE) or behind other protection should be 250 meters.

g) A safe minimum working distance from the machine should be observed by persons operating remote controlled demining machines. When the operator is behind an approved protective control cabin or enclosure, this distance may be reduced. In areas where only an anti-personnel blast mine threat is anticipated, the wearing of demining PPE may be considered adequate protection.

h) Each mechanically worked lane should have at least 0.5 m overlap. The worked lanes should be as straight as possible to ensure easier overlapping of lanes. If the machine cannot work in straight lines, the overlap area should be increased to ensure that a minimum of 0.5 m is maintained throughout.

i) Ground processing machines should be backed up at least 10 meters before starting work to ensure a proper overlap of the area where the flail had previously stopped.

j) An external controller should carefully record any detonations and visible throw-outs of possible mines/EO to assist the QA checks and follow-up search and clearance. If the machine has been used for area reduction or area confirmation, this information is vital to determining the extent of the newly identified hazardous area.

k) When conducting mechanically assisted demining, all minefield markings that are moved, damaged or destroyed by the mechanical asset should be replaced as soon as the mechanical demining is completed and before any follow-up demining teams move into the area.

l) Areas worked by mechanical assets shall be marked at all times to prevent people moving into the area before follow-up search and clearance has been conducted.

m) When conducting mechanical ground processing or vegetation cutting in a CHA or HTHA, the area shall not be entered by anyone until after follow-up search and clearance has been conducted.

n) If the machine is being used for QC confirmation on previously manually cleared areas, then the confirmation processing depth should be the depth of search required of the IA conducting manual search and clearance at that task. When a machine cannot reliably process the ground to the required search depth at the task, it should not be used as the sole means of QA/QC.

o) If a mechanical asset is used for verification in a SHA or LTHA, a minimum processing depth of 15 cm should be applied. This processing depth may be increased if required by the LMAC Operations Section when required.

p) When a machine is used to raise end-user confidence in an area where there is no evidence of there being any explosive hazards, the minimum ground processing depth should be sufficient to give the end-users confidence but may be less than 15 cm. The are processed shall not be recorded as having been 'cleared'.

q) Access routes should be established for all mechanical demining tasks. The width of the routes should be a minimum of 1.5 times the width of the machine being used. Mechanical assets should always enter any hazardous areas through a designated access route.

r) All other safety precautions as detailed in IA's Mechanical SOPs and this NMAS shall also be observed.

Minimum Working Distances to be Observed when Operating Mechanical Assets					
Mechanical Asset	**Activity**	**Machine Operator in Cabin or PPE**	**Staff on site in PPE**	**Staff on site without PPE**	**General Public**
BOZENA 3	Flailing (in cabin)	25m	100m	250m	250m
	Flailing (out of cabin in PPE)	50m	100m	250m	250m
MINI MINEWOLF Flail/Rotary Tiller	Flailing/Tiller (out of cabin in PPE)	50m	125m	250m	250m
ARMTRAC 100	Flailing	N/A	125m	250m	250m
Bulldozer	Access Tracks	N/A	25m	100m	100m
	Clearing Wire	N/A	25m	100m	100m
	Clearing Debris/Earth	N/A	25m	100m	100m
	Spreading sifted soil	N/A	25m	100m	100m
Excavator	Clearing Vegetation (Strimmer)	N/A	100m	250m	250m
	Access Tracks	N/A	25m	250m	250m
	Clearing Wire	N/A	25m	250m	250m
	Clearing Debris/Earth	N/A	25m	250m	250m
	Flailing	N/A	150m	250m	250m
Excavator Bucket Sifter or Table Sifter	Sifting spoil with AP Blast Mines	N/A	25m with no shield 5m with shield	250m	250m
Excavator Bucket Sifter or Table Sifter	Sifting spoil with Fragmentation Mines	N/A	50m with no shield 10m with	250m	250m

			shield		
MINECAT 230	Flailing (in cabin)	25m	150m	250m	250m
	Flailing (Out of cabin in PPE)	50m	150m	250m	250m

Table 1: Recommended Minimum Working Distances during Mechanical Assets Operations

The IA may submit variations to the above recommended working distances to the LMAC in their mechanical SOPs and, if the LMAC approves the variation(s), they may be used.

Some machines are designed to detonate hazards, others to locate and expose them. When a machine is designed to detonate hazards, safety distances shall apply. When a machine is not intended to detonate hazards and tests confirm that this is unlikely to happen, working distances may be applied. For the distinction between safety distances and working distances, see NMAS 10.20 Demining Worksite Safety.

9.1 Vehicle EO Checks

When conducting any mechanical operation that involves processing the ground or striking the ground surface, the following requirements apply.

Before using the machine, a designated EO inspection area which should be situated at least 100 meters from the machine Control Point shall be clearly marked. This area should be searched and cleared using other assets when required.

The Site Supervisor/Mechanical Operator shall ensure that on completion of all ground engaging mechanical operations, the vehicle is checked and cleared of all EO or parts of EO by positioning the vehicle within the designated EO inspection area and having it inspected by a suitably trained deminer wearing full PPE.

When the machine has an on-board operator, the operator should drive the vehicle into the EO inspection area and shut down the engine, remaining in the vehicle until the machine has been inspected and the “all clear” signal has been given. The on-board operator can disembark from the vehicle after the EO inspection has been completed.

When the machine is remotely controlled, the vehicle should be driven into the designated EO inspection area and the engine switched off. The machine should then be inspected by a suitably trained deminer wearing full PPE before the operator or any others approach.

The machine should only be brought closer to the Control Point after the EO inspection has shown it to be “clear” of explosive hazards.

In the event of an explosive hazard being located within the working parts of the machine, the inspector should immediately inform the Site Supervisor/Mechanical Operator. Only a suitably trained and experienced EOD operator shall be permitted deal with the hazard.

All mechanical assets and attachments used for mechanically assisted demining should be cleaned of accumulated debris and an EO check conducted before the machine is moved between worksites. Cleaning thick mud and vegetation or other debris from the machine should be conducted slowly and carefully as a precaution against any hazardous components that may be concealed in the debris.

9.2 Machine Recovery Procedures

Machine recovery procedures should be practiced on a monthly basis, or more frequently, for each individual mechanical asset. These exercises should be logged in the Daily Work Diary of the Mechanical Demining Team (MDT) and in the machine's log.

Practicing machine recovery need not be conducted during live operations. It may be conducted during stand-down or training days, at the start of the worksite set up or on a monthly basis. Recovery exercises do not have to be conducted on every new worksite although, as part of the worksite preparation, planning for machine recovery shall be carried out.

A damaged or unserviceable demining machine should be approached over routes that are searched and cleared using reliable assets. All MDTs should have at least one support deminer available included to expedite its safe recovery.

If another machine is to be used as a towing recovery vehicle, then its operator should be adequately protected against the hazards anticipated in the area. Generally, it is preferable for any recovery vehicle to remain outside the hazardous area whenever possible.

9.3 Casualty Evacuation (CASEVAC) Drills

In the event of injury to persons other than the operator, the machine shall stop work and return to a designated safe area. Standard demining accident CASEVAC procedures as described in NMAS 10.40 should be conducted unless other procedures detailed in the IA's mechanical demining SOPs have been approved by the LMAC.

Mechanical demining operations shall not be conducted unless there is a qualified medic and ambulance at the worksite or within 5 minutes of the worksite. Medical support may be shared with another MDT operating nearby if required. Similarly, medical support may also be shared with manual demining teams working in the same area when appropriate.

CASEVAC drills involving the machine operator should be conducted on a regular basis in the same way as CASEVAC exercises are conducted during manual demining. Each operational mechanical asset should have documented operator CASEVAC procedures that are practiced monthly, or more regularly.

CASEVAC exercises should also be practiced whenever there are changes to staff within the Mechanical Demining Team, such as medics, deminers, or operators to ensure that the new

staff on site are familiar with the CASEVAC procedures for that asset. These exercises should be logged in the MDT's reports, the worksite supervisor's reports and in the machine's log.

9.4 The Mechanical Demining Team (MDT)

Disciplines command and control of mechanical demining operations is imperative. At no time shall mechanical demining start unless the following requirements are satisfied.

- All mechanical operations shall fall under the control of a suitably qualified and LMAC accredited supervisor. This may be the MDT Supervisor, the MDT Team Leader of a demining worksite supervisor.
- Any change to the level of supervision detailed in the task Clearance Plan should be requested in writing by the IA and requires prior authorization from the LMAC.
- When worksite supervisors are shared between worksites, the supervisor should never be more than five minutes travel time from any worksite they control. Under no circumstances shall mechanical operations start without qualified and LMAC accredited supervision.
- All mechanical assets shall be operated by a qualified and LMAC accredited/licensed operator.
- All mechanical assets shall have manual support to conduct EO check drills and CASEVAC operations. This support may be in varied capacities depending on the asset but at least one accredited deminer should be present with the MDT. This deminer must have fully knowledge of the machine's EO check procedures. A second deminer or a suitably qualified worksite supervisor should be within 5 minutes travel time from the worksite. In the event of two machines and two MDTs working in the same task area, the demines in each MDT may support each other.
- Sufficient trained staff shall be present to carry an injured person from the scene of the accident to the ambulance, taking into account the possibility of a deminer being injured while en-route to a stricken machine.
- Staff shall not approach working machines and should remain outside the working area at all times. They should remain alert and maintain approved distances when operating around working machines.
- Staff shall not ride on the outside of machines inside a task area, except in a casualty evacuation situation.
- Machine Operators should stop the machine immediately if unauthorized people, vehicles, or animals enter the working area.

10. Mechanical Assets in Lebanon

There are various mechanical assets used within Lebanon. This section explains when and where certain assets may be used.

10.1 BOZENA 3 Flail and MINECAT 230 FLAIL

The MINECAT 230 flail is a remotely operated mechanical asset that is accredited and licensed by the LMAC to process suitable ground to a depth of 10 cm, subject to soil, root and rock conditions.

The same standards applicable to the BOZENA 3 below apply to the MINECAT 230 flail.

10.1.1 BOZENA 3 Flail

The standards described below apply to the BOZENA 3 flail's deployment.

10.1.2 Area Reduction / Verification

When working on patterned minefields, the BOZENA 3 flail may be used to raise confidence that no mines have been placed outside the minefield fence as long as all mines in the minefield have been removed and none were located at a greater depth than 10 cm. If any detonations occur during the flailing, the machine shall be extracted and a 10 m x 10 m box shall be manually searched and cleared to a depth of 15 cm, with the box centered around the seat of detonation.

The area processed by the flail may be recorded as 'reduced' but shall not be recorded as 'cleared'.

The BOZENA 3 may be used to process access lanes up to the minefield fence or up to the edge of the HTHA if the area is without a fence. In the event of processing an access lane to the Universal Transverse Mercator (UTM) of a Booby Trap or IED, flailing should cease approximately 35 m from the UTM where the LTHA becomes a HTHA. Access lanes shall be searched using demining assets able to reliably search to depths of 15 cm if there is any evidence that explosive hazards may be present. The access lanes shall always be searched using reliable demining assets able to reach a depth of 15 cm if the area processed is to be recorded as "cleared".

Under no circumstances shall the BOZENA 3 be used as a primary demining asset in a CHA, HTHA over mine rows, or in any part of the MFA as defined in this NMAS. However, the BOZENA 3 may be used in CHA and HTHA in a vegetation cutting mode as detailed below.

10.1.3 Vegetation Cutting

The BOZENA 3 may be used to cut vegetation and prepare the ground for manual or MDD assets inside CHA and HTHA only after the manual clearance of the known mine-lines or mine patterns has been completed.

When conducting vegetation cutting, the BOZENA 3 should have all the flail hammers removed from its chains with no more than 9-chain links on each flail chain to ensure that it is used purely for vegetation cutting and not flailing the ground.

If the machine has disturbed the soil, MDD assets shall not be used for follow-up search until a suitable time has elapsed. See NMAS 09.40 Guide for the use of MDD.

Mechanical vegetation cutting shall only permitted within the CHA or HTHA by machines following an in-country test and evaluation conducted with the approval of the LMAC.

10.1.4 Area Confirmation

The BOZENA 3 shall not be used as a confirmation asset for areas manually cleared because it is not accredited to flail deeper than 10 cm, so does not meet the minimum search and clearance depth of 15 cm.

10.1.5 Summary of Restrictions for BOZENA 3 Flail:

The following constraints to the use of the BOZENA 3 apply:

- The BOZENA 3 shall not be used as a primary demining tool in areas where rows of mines are anticipated.
- The BOZENA 3 shall not be used as a ground processing tool without follow-up by reliable search and clearance assets in areas that will be released as “cleared”.
- The BOZENA 3 should not be used in known minefields where there is a threat of cocked-striker mechanism that incorporates a spring-assisted striker retained by a recessed firing pin or collar, such as the Israeli No. 4 APM or the GYATA 64 APM.
- The BOZENA 3 shall not be used as the confirmation asset on manually cleared areas.
- The BOZENA 3 should not be used to cut vegetation inside a CHA or HTHA before the mine-lines patterns have been manually searched and cleared.
- The BOZENA 3 should not be used to process the ground directly up to the UTM of a Booby Trap or IED.
- Only a qualified and experienced operator who has been accredited and licensed by the LMAC shall operate the BOZENA 3.

The BOZENA 3 should not be deployed in areas where there is a threat of directional fragmentation mines. Subject to the LMAC’s approval on a case-by-case basis, the BOZENA 3 may be deployed in vegetation removal mode to disrupt suspected IEDs when the IED is believed to have a small explosive content.

When anticipated large EO is reliably known to be non-functional and/or unlikely to be initiated using the machine, this shall be reflected in the task risk assessment and, when appropriate, the LMAC may permit the use of the machine.

10.2 ARMTRAC 100

The ARMTRAC 100 with flail unit is controlled by an on-board operator. It has an accredited and licensed ground processing depth of 15 cm in suitable ground, subject to soil, root and rock conditions. This machine should not be used as a tool for area reduction or confidence building in areas where Anti-Tank mines or large IEDs are anticipated.

The ARMTRAC 100 should not be operated in a CHA or HTHA which contains mines fitted with a cocked-striker mechanism that incorporates a spring assisted striker retained by a recessed firing pin or collar.

The standards described below apply to the employment of ARMTRAC 100 Flail.

10.2.1 Area Reduction/Verification

The ARMTRAC 100 may be used for area reduction of SHA or LTHA outside the minefield fence when it can be shown to be reliably processing the entire ground surface to a depth of 15 cm or greater. In the event of a detonation during the flailing, the machine shall be withdrawn and a 10 m x 10 m box shall be manually searched to a depth of 15 cm centered over the seat of detonation. If any evidence of mine rows or patterns is discovered, the area shall be reassessed and the task Clearance Plan suitably revised. The flailing of SHA or LTHA shall be followed up with systematic and reliable search and clearance assets before any ground can be declared “cleared”. At the discretion of the LMAC, follow-up search and clearance may not be required in some areas that are to be reduced. When an area processed by the machine is to be recorded as “reduced” there must be no evidence of the area containing explosive hazards and the mechanical processing should be followed-up with visual surface BAC procedures. If any evidence of explosive hazards is found during BAC, the task Clearance Plan shall be revised to require clearance using manual search and clearance assets over an appropriate area.

The ARMTRAC machine may be used to process access lanes up to the minefield fence or up to the edge of a CHA/HTHA when the area is not fenced. In the event of processing an access lane to the Universal Transverse Mercator (UTM) of a Booby Trap or IED, flailing should cease approximately 35 m from the UTM where the LTHA becomes a HTHA. The access lane should be searched using demining assets able to reliably search to depths of 15 cm if there is any evidence that explosive hazards may be present. The access lane(s) mechanically processed shall be searched using reliable demining assets able to reach a depth of 15 cm when the ground processed is to be recorded as “cleared”.

Under no circumstances shall the ARMTRAC be used as a primary demining asset in a CHA, HTHA, over mine rows/patterns, or in any part of the MFA as defined in this NMAS.

After search and clearance of the CHA/HTHA or MFA has been completed, the ARMTRAC may be deployed to flail a percentage of the CHA/HTHA/MFA to provide a measure of assurance that the work was conducted adequately and that no mine rows remain. If during

this “confirmation” flailing the machine detonates a hazard, it shall be immediately withdrawn and the LMAC informed. If there are no detonations during this kind of “confirmation” flailing, the area flailed shall be subject to visual surface BAC and if evidence of explosive hazards is found, the LMAC shall be informed. In both cases, the task Clearance Plan for the area shall be reassessed. The ARMTRAC may only be used for assurance/confirmation in this manner after discussions between the LMAC Quality Management Officer and the Site Supervisor to establish whether the ground is suitable for mechanical confirmation.

10.2.2 Summary of Restrictions for ARMTRAC Flails

The following constraints on the use of the ARMTRAC flails apply:

- The ARMTRAC should not be used to cut vegetation within a CHA or HTHA.
- The ARMTRAC shall not be used as a primary demining tool in CHA, HTHA or any areas where rows or patterns of mines are anticipated.
- The ARMTRAC shall not be used as a primary demining tool without full follow-up search and clearance by manual assets on areas that will be released as “cleared”.
- The ARMTRAC should not be used in known minefields where there is a threat of cocked-striker mechanisms that incorporate a spring-assisted striker retained by a recessed firing pin or collar.
- The ARMTRAC should not be used to process the ground directly up to the UTM of a Booby Trap or IED.
- A qualified and experienced operator who has been accredited/ licensed by the LMAC shall operate the ARMTRAC.
- The ARMTRAC should not be deployed in areas where there is a threat of large EO, Booby Traps, large IEDs or directional fragmentation mines.

When the anticipated EO is reliably known to be non-functional and/or not liable to be initiated using the machine, this shall be reflected in the task risk assessment and, when appropriate, the LMAC may permit the use of the machine.

10.3 Armored Excavators

The Armored Excavators (Caterpillar 215 / 225) are a multi-role manually driven mechanical asset that may be used for vegetation cutting and for the excavation of anti-personnel mines from bunds and previously bulldozed mined areas. It may also be used to help excavate deeply buried explosive hazards. The machines can also be fitted with a flail attachment and work in a similar way to the ARMTRAC 100, subject to the same constraints.

The following restrictions shall apply to the use of excavators:

- Excavators shall be suitably armored to protect the operator from the anticipated threat. They should not be used for the excavation of Anti-Tank mines.

- Excavators should be operated while the machine is standing in a cleared or designated safe area unless the excavator is using an approved ground engaging attachment.
- Excavators should not be driven over CHA, SHA, LTHA or HTHA unless such areas have been previously searched and cleared using manual demining assets.
- Only a qualified and experienced operator accredited/ licensed by the LMAC shall operate the Excavator.
- Excavators should not be deployed in areas where there is a threat of large Booby Traps, IEDs or directional fragmentation mines. They shall not be used with any ground engaging tool in areas where AT mines or other large EO are anticipated.

When anticipated large EO is reliably known to be non-functional and/or not liable to be initiated using the machine, this shall be reflected in the task risk assessment and, when appropriate, the LMAC may permit the use of the machine.

10.5 Armored Bulldozer

Armored Bulldozers may be used as a preparation mechanical asset in the construction of access routes outside any designated SHA, CHA, LTHA or HTHA. They may also be used in the removal of debris and large rocks from the worksite after the area has been cleared of explosive hazards.

Armored Bulldozers may be used in the removal of earth spoil containing AP mines only in conjunction with an excavator that is conducting sifting operations.

The following restrictions shall be applied to the use of Armored Bulldozers:

- armored bulldozers should not be used in areas where AT mines, IEDs, directional fragmentation mines, or large munitions are anticipated.
- armored bulldozers should not be driven over SHA, CHA, LTHA or HTHA unless they have been previously searched and cleared. However, they may be driven into SHA, CHA, LTHA or HTHA when using a bucket to remove and stockpile soil for sifting or crushing operations. In this case, the machine should remove the soil to the required clearance depth before driving onto the area from which it has removed the ground; and
- only a qualified and experienced operator accredited/ licensed by the LMAC shall operate the Armored Bulldozer.

When anticipated large EO is reliably known to be non-functional and/or not liable to be initiated using the machine, this shall be reflected in the task risk assessment and, when appropriate, the LMAC may permit the use of the machine.

10.6 Mechanical Sifting

Mechanical sifting is used to sift contaminated earthen spoil and rubbish, separating larger objects. The use of mechanical assets in this type of clearance can reduce the risk to manual deminers who are required to search and clear areas where mines have been disturbed from their original position. Mines that have been moved by previous mechanical disturbance or by natural forces may be more sensitive and therefore more hazardous.

Mechanical sifting methods should only be used to process ground from areas where the anticipated hazards are limited to AP blast mines. Mechanical sifting should not be used when the material may contain AT mines or large EO.

All mechanical sifting, whether by mechanical attachments or independent table sifts, shall undergo an in-country test and evaluation before use. If successful, they shall be accredited and licensed by the LMAC.

Whenever conducting mechanical sifting operations, the following factors shall be considered.

- An assessment of the extent of the area to be sifted shall be conducted and procedures implemented specific to each site. The exact requirements of any sifting operation shall be stated in a written task Clearance Plan submitted for the LMAC's approval.
- When incorporating manual or MDD assets into the sifting process, these assets shall be fully conversant with all safety procedures associated with that machine.
- Mechanical assets conducting sifting operations should not travel over un-cleared land that has not been excavated to the required depth.
- If an AT mine or large EO threat exists, then mechanical sifting should not be used.

When anticipated hazards are reliably known to be non-functional and/or not liable to be initiated using the machine, this shall be reflected in the task risk assessment and, when appropriate, the LMAC may permit the use of the machine.

10.6.1 Actions on Detonation during Sifting Operations

If a detonation occurs during any sifting operation, the machine should stop immediately and the machine or sifting table should be inspected. If the machine or table is damaged, then sifting operations shall stop until the damage is repaired.

If the machine or sifting table is not damaged, then the supervisor may continue operations.

All such detonations shall be recorded and the LMAC notified as required.

10.6.2 Manual Search of Sifted Material

In addition to the regular demining safety standards, the following standards shall apply when manually searching sifted material.

- Only appropriately trained and accredited deminers/searchers shall be employed when searching for explosive hazards in mechanically sifted material.
- Sifted material shall be spread out in a previously cleared area in layers no deeper than 15 cm and checked by deminers either using metal detectors or by raking.
- Deminers searching sifted material shall wear PPE in compliance with NMAS 10.30, PPE. The handling of all located items shoud be kept to a minimum due to the possible increased sensitivity of the hazards, and the use of remote handling devices should be considered.
- Wherever possible, hazards and potential hazards should be moved by remote means to a demolitions pit to reduce the risk to manual deminers.
- Protective shields may be employed by deminers observing sifting operations as long as these shields are approved and certified by the LMAC. If protective shields are used, then working distances may be reduced.

10.6.3 MDD Search of Sifted Material

In addition to the regular MDD safety standards, the following standards shall apply when MDD are searching sifted material:

- MDD assets used for searching sifted material shall be suitably trained and accredited by the LMAC to conduct the search. All searches shall be conducted by at least two MDD.
- MDD search of sifted material should not be conducted before seven days after the sifted material has been laid out.
- Sifted material to be searched by MDD should be no deeper than 15 cm in one layer and then to a maximum of two layers (30 cm).
- All MDD indications shall be investigated by manual deminers prior to the next sifted layer being applied.
- When using MDD, all sifted spoil should be laid out over areas previously searched by MDD without indications. If the MDD indicate at all, a second layer shall not be applied to that layer of sifted material.

10.7 Mechanical Crushers

Mechanical crushers have been successfully used for the crushing of contaminated soil collected from areas where only AP blast mines are anticipated. The following rules apply for the use of mechanical crushers.

- Any mechanical crusher shall have detailed written SOPS that are approved by the LMAC prior to use.

- Any mechanical crusher used in Lebanon should be capable of crushing contaminated material down to a finished size of 38 mm or smaller, 38 mm being smaller than the smallest known AP mine found in the country (US M14 AP mine).
- All crushers shall have sufficient armored protection to withstand blast and fragmentation from AP blast mines.
- Ordnance over 60 mm in diameter should not be processed through any crusher systems in Lebanon.
- Metallic encased AT mines shall not to be processed through any crusher system. Unfuzed plastic cased AT mines may be crushed when approved by the LMAC.
- All crushed material shall be searched by a manual search and clearance assets to ensure full clearance.
- Only appropriately trained and experienced deminers shall be employed when dealing with explosive hazards located during or after mechanical crushing operations.
- Deminers searching crushed material shall wear PPE in compliance with NMAS 10.30, PPE. The handling of all located items shall be kept to a minimum due to the possible increased sensitivity of the hazards, and the use of remote handling devices should be considered.
- Wherever possible, hazards and potential hazards should be moved by remote means to a demolitions pit to reduce the risk to manual deminers.
- Protective shields may be employed by deminers observing crushing operations as long as these shields are approved and certified by the LMAC. If protective shields are used, then working distances may be reduced.

10.8 Mini MINEWOLF - Flail/Rotary Tiller

The Mini MINEWOLF - Flail/Rotary Tiller is a remotely operated mechanical asset that is accredited and licensed by the LMAC to process the ground to a depth of 15 cm, subject to soil, root and rock conditions.

As with other ground processing machines, this machine should not be used in areas where Anti-Tank mines or large IEDs are anticipated.

The standards described below apply to the deployment of the Mini MINEWOLF.

10.8.1 Area Reduction / Verification

The Mini MINEWOLF - Flail/Rotary Tiller may be used for area reduction of SHA or LTHA outside the minefield fence when it can be shown to be reliably processing the entire ground surface to a depth of 15 cm or greater. If any detonations occur during the flailing, the machine shall be withdrawn and a 10 m x 10 m box searched to a depth of 15 cm centered over the seat of detonation. If any evidence of a mine row or pattern is found, the

task Clearance Plan shall be reviewed and revised. The ground processing of SHA/LTHA shall be followed up with full search and clearance assets before any ground can be released as "cleared". At the discretion of the LMAC, follow-up search and clearance may not be required in some areas that are to be "reduced". When an area processed by the machine is to be released as "reduced", not as "cleared", there must be no evidence of the area containing explosive hazards and the mechanical processing should be followed-up with visual surface BAC procedures. If any evidence of explosive hazards is found during BAC, the task Clearance Plan shall be revised to require appropriate search and clearance in the area.

The Mini MINEWOLF - Flail/Rotary Tiller may also be used to process access lanes up to the minefield fence or up to the edge of the CTA/HTHA if the area is without a fence. The access lane should be searched using demining assets able to reliably search to depths of 15 cm if there is any evidence that explosive hazards may be present. The access lane(s) processed shall be searched using reliable demining assets able to reach a depth of 15 cm if the area processed is to be recorded as "cleared".

When processing an access lane to the UTM of a Booby Trap or IED, ground processing shall cease approximately 35 m from the UTM where the LTHA becomes HTHA.

Under no circumstances shall the Mini MINEWOLF be used as a primary demining asset in a CHA, HTHA, over mine rows, or in any part of the MFA as defined in this NMAS.

After search and clearance of the CHA or MFA has been completed, the Mini MINEWOLF may be deployed to process a percentage of the CHA/ HTHA/ MFA to provide a measure of assurance that the work was conducted adequately and that no mine rows or patterns remain. If during this 'confirmation' processing the machine detonates a mine, it shall be immediately withdrawn and the LMAC informed. If there are no detonations during this kind of 'confirmation' ground processing, the area processed shall be subject to visual surface BAC and if evidence of explosive hazards is found, the LMAC shall be informed. In both cases, the task Clearance Plan for the area shall be reassessed. The Mini MINEWOLF may only be used for assurance/confirmation in this manner after discussions between the LMAC and the Site Supervisor to establish whether the ground is suitable for mechanical confirmation.

The Mini MINEWOLF - Flail/Rotary Tiller may be used in some CHA or HTHA in a vegetation cutting mode as detailed below.

10.8.2 Vegetation Cutting

The Mini MINEWOLF with flail may be used to cut vegetation or process the ground inside CHA or HTHA only after manual search and clearance of the MFA has been completed.

When conducting vegetation cutting, the Mini MINEWOLF with flail should have all the flail hammers removed from its chains and no more than 9-chain links on each flail chain to ensure that it is used purely for vegetation cutting and not flailing the ground.

Mechanical vegetation cutting shall only permitted within the CHA or HTHA following an in-country test and evaluation conducted with the approval of the LMAC.

10.8.3 Area Confirmation

When the ground conditions ensure that a reliable processing depth can be achieved, the Mini MINEWOLF - Flail/Rotary Tiller may be used as a confirmation asset over areas that have been manually searched, cleared and declared ready for release because the machine has been accredited to flail/tiller to a depth of 15 cm in suitable ground conditions. Where there are significant rocks, root systems or areas of wet ground, this method of seeking 'confirmation' would be unreliable, so should not be used.

10.8.4 Summary of Restrictions for the Mini MINEWOLF

The following constraints on the use of the Mini MINEWOLF with Flail or Rotary Tiller apply:

- The machine shall not be used as a primary demining tool without full follow-up clearance by reliable search and clearance assets on any areas that will be released as "cleared".
- The Mini MINEWOLF - Flail/Rotary Tiller should not be used when there is an anticipated threat with a cocked-striker mechanism that incorporates a spring-assisted striker retained by a recessed firing pin or collar.
- The Mini MINEWOLF - Flail/Rotary Tiller should not be used to process ground directly up to the UTM of a Booby Trap or IED.
- Only a qualified and experienced operator accredited by the LMAC shall operate the Mini MINEWOLF - Flail/Rotary Tiller.
- The Mini MINEWOLF - Flail/Rotary Tiller should not be deployed in areas where the presence of AT mines, large EO, Booby Traps, large IEDs or directional fragmentation mines is anticipated.

When anticipated large EO is reliably known to be non-functional and/or not liable to be initiated using the machine, this shall be reflected in the task risk assessment and, when appropriate, the LMAC may permit the use of the machine.

11. Communications

All MDTs shall have appropriate means of communication to ensure that immediate communication between the Operator, team members and the Site Supervisor is available in the event of an accident, intrusion into the machine's operating area, or other need.

Vehicle communications shall be such that the Operator is able to hear over the machine's operating noise.

All communications shall be tested at the Control Point before any machine moves into the task area.

When ground processing machines raise significant dust and have an on-board operator, the MDT shall include sufficient spotters to provide guidance to the operator who will be unable to see obstructions and will require guidance.

12. Mechanically Assisted Demining Worksite Layout

When opening a new worksite, and in circumstances where the first asset to start operations is a demining machine, the worksite layout shall be as that of any other demining worksite.

A machine Control Point shall be prepared and set up in the same manner as the Control point at any other worksite. When other assets arrive, they may establish a worksite Control Point that is separate from the machine Control Point.

All marking shall be in compliance with the demining organization's LMAC approved SOPs and the NMAS.

A designated EO check area shall be established approximately 100 meters from the machine Control Point where the machine can be safely inspected after each use.

Designated machine parking areas should be prepared and marked when appropriate.

13. Roles and Responsibilities

14.1 Role of the LMAC

The LMAC shall:

- operationally accredit demining machines in accordance with the requirements of this NMAS;
- assess the IA's mechanical demining SOPs and, when appropriate, approve their use;
- assess and accredit IA staff for the use of mechanically assisted demining operations;
- implement a Quality Management system to ensure the safe, effective, and efficient use of machines in demining operations;
- conduct a mechanical system test and evaluation to assess mechanical assets prior to deployment;
- ensure that the use of mechanical demining is only permitted after due attention to environmental damage/degradation has been paid;
- assess and, when appropriate, approve mechanical working plans presented by IAs; and
- monitor adherence to safety precautions and other provisions of this NMAS.

14.2 Responsibilities of Implementing Agencies (IAs)

When conducting mechanical demining operations, IAs shall:

- submit relevant mechanical demining SOPs to the LMAC for their approval before deploying any machine;
- obtain accreditation from the LMAC for each demining machine to be used;
- obtain LMAC accreditation for staff conducting mechanical demining operations;
- submit appropriately detailed mechanical working plans for each task and obtain the LMAC's approval to implement them;
- conduct internal QA/QC to ensure the safe, effective, and efficient use of the machines they use; and
- adhere to the provisions of this NMAS at all times.

The documents listed below constitute normative references which form an integral part of the provisions of this standard.

- Current LMAC and IMSMA reporting formats (request copies from the LMAC);
- NMAS 04.10 Glossary of Mine Action Terms, Definitions, & Abbreviations;
- NMAS 05.11 Communications;
- NMAS 07.11 Guide for Land release;
- NMAS 07.12 Guide for the Inspection of Cleared Land;
- NMAS 07.30 Guide for the Accreditation of IAs;
- NMAS 07.20 Guide for Land release;
- NMAS 09.40 Guide for the use of MDD;
- NMAS 09.10 Clearance Requirements;
- NMAS 10.20 Demining Worksite Safety;
- NMAS 10.30 Safety - PPE; and
- NMAS 10.70 Safety - Protection of the Environment.

In addition to the normative references listed above, the following informative references may be consulted:

- Lebanon National Mine Action Policy.

NMAS 09.50, Edition 2.1: Amendment Record

The NMAS are subject to a comprehensive or partial review by the Review Board periodically. Changes in the context as well as safety requirements and efficiency considerations may necessitate amendments to individual NMAS standards more frequently. If this occurs, such amendments shall be given a number, dated, and detailed in the table below. The amendment should also be indicated on the header under the NMAS edition number.

Whenever the formal review of the NMAS is completed, a new edition shall be issued. Amendments that have taken place before the review date shall be incorporated in the new edition and the amendment record table cleared. Consequently, the recording of amendments shall start again until the next review.

The most recent revisions of the NMAS shall be posted on the Lebanon Mine Action Center (LMAC) website on www.lebmac.org.

Number	Date	Amendment Details
1	March 2020	Minor revisions throughout to improve consistency with other NMAS.