

Sudan National Mine Action Standards – SNMAS 06.04

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Mechanical Demining

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1. Introduction

The safety and efficiency are common consents in demining operations and continually improving them especially as part of the land release operations is the permanent objective of Sudan Mine Action Programme (SMAP). Efforts shall be made by NMAC and all accredited mine action

organizations in Sudan to seek and adopt the methods, tools, equipment and procedures that enhance safety of demining staff, beneficiaries, communities and other stakeholders as well as ensure operational efficiency. Demining machines have been used in demining operations for many years in Sudan with increasing output especially in road and route verification and clearance, and the clearance of vast flat areas safely. This SNMAS covers the requirements of mechanical demining operations in Sudan and provides guidelines and specifications that promote the safe, efficient and effective use of machines in demining operations.

2. Scope

This SNMAS covers the standard guidelines and specifications for mechanical demining operations in Sudan.

3. References

The main references for this standard are IMAS 09.50, IMAS 07.11 and IMAS 08 and 09 series.

4. Terms and Definitions

A complete glossary of all mine action terms and definitions is given in IMAS 04.10, which should be referred to, IMAS 04.10 is inclusive and broader in principle, covering all mine action terms and definition that are used globally including Sudan. However, the terms related to mechanical operations are covered in this SNMAS and those used in Land Release operations, are covered in SNMAS 05.01.

The term ‘mechanical demining operations’ refers to the use of demining machines on demining operations and may involve a single demining machine employing one mechanical tool or ancillary, a demining machine employing a variety of tools or ancillaries, or a number of machines employing a variety of tools and ancillaries.

The term ‘demining machine’ refers to a unit of mechanical equipment used on demining operations.

The term ‘mechanical tool’ refers to the working component(s) attached to a demining machine, such as flails, tillers, sifters, rollers, excavators, ploughs, magnets and cultivator. A single demining machine may utilize several different tools, which may be fixed or interchangeable.

The term ‘residual risk’ as part mechanical demining operations relates to the hazard remaining from landmines or ERW following mechanical demining in a hazardous area.

5. Use of Demining Machines in Demining Operations

5.1 General

Demining machines used in demining operations are generally classified in following categories:

- 1) Demining machines used for ground preparations;
- 2) Demining machines used for ground verification; and
- 3) Demining machines used ground processing.

Some machines may be designed to fulfil more than one of these purposes. Many of these machines are also designed to be Mine Protected Vehicles (MPV) and so protect the occupants and equipment from the effects of a mine detonation. Such machines are mainly used in survey operations.

5.1.1 Machines Designed to Detonate Hazards

Machines designed to detonate or otherwise destroy hazards may be meeting their design aims under different conditions. Their use may reduce or, in some cases, eliminate the need for follow up operations especially where the perceived hazard was non-existent. Such machines are mainly used in technical survey and hazardous area verification purposes.

5.1.2 Machines Designed for Ground Preparation

Ground preparation machines are primarily designed to improve the safety and efficiency of demining operations by reducing and or removing obstacles mainly for manual demining operations.

Ground preparation includes:

- 1) Vegetation cutting and clearing;
- 2) Removal of tripwires;
- 3) Loosening the soil through ploughing and ripping;
- 4) Removal of metal contamination;
- 5) Removal of building debris, boulders, rubble, defensive wire obstacles; and
- 6) Softening the ground for follow up operations.

Ground preparation may or may not involve the detonation, destruction or removal of landmines.

5.1.3 Machines Designed to Detect Hazard

Machines designed to detect hazards can include variety of detecting tools and ancillaries such as sifting, rollers, machine mounted metal-detectors array or vapor sampling devices. Some physical detection methods may involve detonating some hazards during the detection process. Such machines are mainly used in mine and ERW survey role.

5.1.4 Machines Designed for Ground Processing

Machines designed for ground processing can be the same machines designed for preparations but with specific ancillaries for ground and soil processing including buckets such as Gill Buckets and Star Buckets and sifting system.

5.2 Follow up Requirements

The following follow up requirements shall be considered as part of mechanical demining operations in Sudan:

- 1) When demining machine is used to detonate mines in a hazardous area; it may leave the mines or parts of them behind within the required clearance depth. The follow up operations shall be carried out before the area is released as cleared.
- 2) When demining machines are used for ground preparation in a Hazardous Area, such areas shall be followed up by other demining operations.
- 3) When demining machines are used for detection or in technical survey operations, the information that they provide shall be followed up as appropriate and determined by an

information management process, leading to a decision to clear the area, mark the area or release the land as verified of having “no evidence of hazards”.

- 4) When a demining machine is used in a technical survey role aiming to detonate mines to define the boundaries of hazards, follow up after the use of demining machine in those areas where no detonation occurred, may not be required as the aim is to search for evidence of hazards, rather such area should be released as reduced area without follow up operations.

5.3 Land Release with Mechanical Demining Operations

The main requirement for land release as a result of mechanical demining operations shall be the application of “All Reasonable Effort”. All mine action organizations working in Sudan shall apply and consider “All Reasonable Effort” covered in SNMAS 05.01, 05.02 and 05.03 when undertaking land release operations using mechanical demining machines.

Hazardous areas can be released as a result of mechanical demining operations either in technical survey and or clearance roles. Land release involves a machine being used to indicate or confirm the presence or absence of explosive ordnance within a suspected or confirmed hazardous area. This will support the demining team in fact-based decision making; either to continue demining operations in case of identifying evidence of EO or cease operations as soon as “no evidence of” EO is proved by mechanical demining operations. Use of mechanical demining aims to enable the deployment of other demining assets only in areas that are proven to contain EO.

The scope and extent of mechanical land release operations depends on factors such as the accuracy and completeness of existing information, terrain and ground profile, vegetation, type of machine and their attachments and type of EO and area reduction requirements as covered in SNMAS 05.03 and tolerable risk. Generally, the less information available about a hazardous area, the more investigation is required by a machine in order to be able to confirm the location of EO and define hazardous areas. Application of the requirements of SNMAS 05.02 shall be considered when collecting information about hazardous areas.

5.4 Facilitating Demining Operations

Demining machines may also be used for other functions in support of technical survey and clearance operations. Such functions may include:

- 1) Preparing tracks to permit access into areas for demining operations;
- 2) Excavation in support of deep search operations;
- 3) Removal of debris to enable access to suspected hazards.

There may situation where the machines are used in leveling the roads after being cleared; to verify the clearance and facilitate use of released road and routes by the beneficiaries and public transport.

6. Systems Approach to Mechanical Demining

The important aspect in mechanical demining operations is the selection and use of the most suitable machines and appropriate ancillaries to achieve optimum results and ensure safety and operational efficiency. There are varieties of demining machines and related ancillaries and tools designed for different purposes including detonation of EO, however, there is possibility that machines will leave some EO undetonated. It is, therefore, important to consider a ‘**systems approach**’ whereby machines with a combination of tools, a combination of machines with different

tools, or non-mechanical demining methodologies are applied at different stages during the demining process.

The systems approach is about the use of demining machines being integrated with other demining assets (manual or MDD) to ensure that the most effective outcome is achieved.

Below are the steps involved in a systems approach leading to the selection of appropriate demining machines to use in a hazardous area.

- 1) STEP 1: Identify what mechanical demining systems **can** consistently, safely and efficiently achieve the optimum results when used in the hazardous area.
- 2) STEP 2: Identify what mechanical demining systems **cannot** achieve the optimum results when used in the hazardous area.
- 3) STEP 3: Identify the further work that will need to be completed before the land can be released after mechanical demining operations completed.

The main consideration as part of the system approach to mechanical demining shall be the application of “all reasonable effort”.

6.1 Tolerable risk

The identification of tolerable risk to the end user is an important component of any demining operation including mechanical demining, as it determines how thorough the demining process shall be, to reach the required level of tolerance. After mechanical demining has been completed, an assessment of the residual risk posed by remaining hazards may show that the risk is already tolerable and no further demining is required. See SNMAS 05.01 of land release operations.

7. Mechanical Demining Operations Requirements

Demining machines used in demining operations in Sudan shall conform to below requirements:

- 1) Each demining machine and mechanical tool shall be Tested and Evaluated by NMAC to determine their suitability for the operations they are expected to carry out in the worksite conditions in which they will be used;
- 2) NMAC shall ensure that the operation of each demining machine is assessed and confirmed to be safe for the operator, demining staff and beneficiaries. The protection level for machines shall be established through a risk assessment; and
- 3) Mine action organizations shall develop Standard Operating Procedures (SOPs) for each type of demining machine and their ancillaries that are used in a hazardous area. The SOPs should include general mechanical demining procedures, procedures specific to the machine, and procedures for the integration of the machine with other machines or demining operations
- 4) Demining machines, their ancillaries and teams relating to any mine action organizations shall be tested, evaluated and licensed/accredited by NMAC, prior to deployment and starting any mechanical demining operations in Sudan.

Prior to the procurement and purchase of any demining machines by any mine action organizations, NMAC shall be consulted to properly assess that the machine is suitable to be used in Sudan and also to assess the in-country infrastructure and technical support facilities to ensure that a demining machine can be operationally maintained in the areas where it will be used.

8. Testing and Evaluation (T&E) of Demining Machines

T&E of demining machines is carried out to ensure that a machine is suitable for its intended use in the environment in which it will operate.

8.1 Scope of T&E

T&E for demining machines shall be designed to:

- 1) Identify the operational capability and limitations of the machine;
- 2) Identify the optimal operating conditions for the machine in its intended operating environments;
- 3) Identify the effectiveness in disrupting, destroying, detonating or otherwise removing different types of landmines or ERW from hazardous areas in different operating environments. This should only occur for landmines or ERW that a machine has been designed and developed to combat in accordance with the manufacturer's specifications;
- 4) Identify the residual risk remaining from each potential hazard to be targeted in the operating environments in which the machine(s) will work. (for individual demining machines, or a number of machines or tools to be used as part of a systems approach);
- 5) Identify any limitations in the employment of a machine (environmental conditions such as inclines, wet soil, hard ground, temperatures, or certain explosive hazards);
- 6) Assess and confirm the safety of the machine for the operator and any other person on a mechanical demining worksite;
- 7) Identify the operating procedures required to ensure that a machine is able to achieve the specified standards; and
- 8) Identify any potential environmental damage caused through the use of demining machines, such as soil erosion.

Where a demining machine has been through T&E or has proven to be effective in other comparable locations, additional formal T&E may not be necessary. This shall only be permitted if continued performance monitoring is carried out by NMAC and the demining organization using them, and that the operating procedures for the machine are such that the NMAC is confident that the standards required of the machine, and any required follow-up demining, will be achieved.

Where such operational performance monitoring is undertaken, records shall be maintained by NMAC and the demining organizations. The records shall be sufficient to justify any changes to the operating procedures of the machine.

8.2 CWA 15044:2009 for T&E of Demining Machines

The European Committee for Standardization (CEN) has developed a CEN Workshop Agreement (CWA) for the T&E of demining machines (CWA 15044:2009). This CWA provides standardized methodology for T&E of demining machines. It gives technical criteria for the following:

1) PERFORMANCE TEST:

A test to establish whether the machine and its tool(s) is capable of performing the role for which it is intended under comparable and repeatable conditions and to evaluate the manufacturer's specifications;

2) SURVIVABILITY TEST:

A test to verify that the demining machine survives the explosive forces used as design criteria; and

3) ACCEPTANCE TEST:

A test to ensure that a demining machine is able to work in the environment where it is intended to be used.

The CWA also establishes the requirements for the test targets to be used in the performance and acceptance tests. Further information can be found at <https://www.mineactionstandards.org/standards/te-protocols/te-protocols-in-english/>

8.3 Mechanical Records

All mine action organizations conducting mechanical demining operations in Sudan shall maintain detailed records of their mechanical operations including the records of follow-up demining activities and submit them to NMAC Information Management section for entry to IMSMS database; after being checked and verified by NMAC sub-office. Such documented information will support the Sudan Mine Action Programme in operational decision making; including decisions to release land after mechanical demining operations without follow-up activities, if statistical data proves sufficiently that the residual risk posed by remaining hazards is tolerable.

Reporting on operational performance indicators, such as:

- a) Hours worked in the worksite;
- b) The size of hazardous area covered and processed;
- c) The landmines and ERW found and discovered.

Are essential in order to maintain sufficient statistical records. However, reporting on non-operational time, such as:

- a) Mechanical breakdowns;
- b) Transport between sites and base camp or machine parking facility;
- c) Logistical delays including provision of required fuel, lubrications and spare parts;
- d) Downtime due to the environmental limitations.

Are essential to help SMAP in understanding the operational constraints and or visualizing performance trends of demining machines, which subsequently can help the programme to improve the efficiency and reduce adverse effects of mechanical operations in Sudan. See Annex A for an example of a weekly report format for a mechanical demining unit.

9. Requirements of Mechanical Procedures

All mine action organizations working in Sudan and intend to carry out mechanical demining operations shall develop operating procedures for mechanical operations that at minimum include the following main requirements.

9.1 General

The following main requirements shall be considered:

- 1) Demining machines are only employed within the limits of their operational accreditation as established during T&E undertaken by NMAC and documented in organizations SOPs.
- 2) Follow up of soil expansion as a result of ground processing.
- 3) Depth of processing shall be referenced to the original undisturbed ground surface, not from the surface loosen soil.

9.2 Landmines, ERW and other Hazards

The following requirements shall be covered in organizations SOPs:

- 1) The use of demining machines on the area containing explosive hazards that the machine is designed for, tested and approved. If during operations, such a hazard is identified, the mechanical demining operation shall be stopped, and a review of the task shall be carried out involving NMAC operations and sub office.
- 2) Checking demining machines prior to operations and after daily operations before moving from hazardous to safe areas, in order to ensure that no EO or their components including remain in the working or moving parts of the demining machine or are attached to the machine.

9.3 Management of Mechanical Demining Operations

The SOPs shall cover a detailed procedure for the management of mechanical demining operations that ensures that adequate control over the operation and that it is possible to provide emergency support in accordance with accident response and equipment recovery plans.

9.4 Medical Support

Based on the requirements of SNMAS 08.03 the mechanical demining SOPs shall cover the detailed procedure and requirements for medical supports including accident response plans, emergency response plan, evacuation plan and the requirements of CASEVA. The SOPs shall also include procedures for the extraction of a casualty from the inside of any machine used inside a hazardous area.

9.5 Communications

Communications between the site supervisor and the mechanical operator shall be in place at all times while a demining machine is working in a hazardous area.

9.6 Personnel

The requirements of qualified staff including if practical female staff, in a mechanical demining worksite shall be covered in SOPs, this will ensure that the followings are achieved:

- 1) Standards for operations are maintained;
- 2) Where applicable, the effective integration with other demining operations is achieved; and
- 3) The necessary support is provided in an emergency.

9.7 Maintenance and Servicing

The SOPs shall include provisions for the maintenance and servicing of demining machines and mechanical tools, including but not limited to:

- 1) Demining machines and tools are maintained and serviced in accordance with the manufacturers' recommendations;
- 2) Maintenance and servicing are carried out by qualified staff and authorized agencies;
- 3) Routine checks are made on the working components of demining machines, as working components crucial to the effective operation of a demining machine. If damaged or lost, the components shall be repaired or replaced before further work continues;

- 4) Routine inspections of safety features on demining machines shall be carried out and where damage is identified, the damage is repaired before further work continues; and
- 5) Whenever a demining machine is subject to a detonation that may have affected the safety of the operation, the demining machine is immediately withdrawn from the hazardous area and inspected.
- 6) Where damage to a demining machine may place staff in danger from subsequent detonations, the demining machine should not return to work until the damage is repaired.

The key aspect of proper maintenance of demining machine maintenance is the way that a machine is effectively operated without downtime or cease of operations for repair. The SOPs shall also include provisions regarding the qualification and skills of operators to be experienced in operating and in maintenance of their machines.

9.8 Recovery Requirements

Mechanical demining SOPs shall include provisions for the recovery of:

- 1) The demining machine becoming stranded in hazardous area;
- 2) The machine operator onboard the machine in such an event.

The provisions shall ensure the safe extraction of the operator as quickly as possible, and the safe recovery of the demining machine in a reasonable time.

9.9 Fire Precautions and Drills

The SOPs shall include provisions to be followed in the event of a fire on a demining machine when employed in hazardous areas, in parking, on the way moving to/from the working site and when refueling the machine. On no account shall any person be permitted to enter a confirmed hazardous area to fight a fire on a burning demining machine without first clearing the access routes.

Demining machine shall always be fitted with fire extinguisher or fire suppressing system especially when the operator is present on-board and working inside the hazardous area.

10. Environmental Considerations

10.1 General

The ground over which mechanical operations are carried out shall be left in a state whereby the land is suitable for its intended use when handed over to the beneficiaries.

Where mechanical operations involve the removal of vegetation or occur on ground that may be subject to erosion, demining organizations shall ensure that measures are taken to limit such erosion.

The operation, repair, maintenance and servicing of demining machines shall be carried out in an environmentally acceptable manner preventing ground or watercourse contamination from fuel, oil and lubricants. SNMAS 07.04 provides further details on environmental protection.

10.2 Protection of Property and Infrastructure

Planning for mechanical operations shall take into account any possible damage to property or infrastructure. Where damage to property or infrastructure is possible, the property owners or local authorities should be consulted prior to the operations.

When machines are used in clearance of residential areas or agriculture land, they may remove boundaries of the land and this may create a potential land right dispute. Measures shall be taken to ensure property ownership prior to the operation.

11. Responsibilities

11.1 Sudan National Mine Action Centre (NMAC)

The NMAC shall:

- 1) Operationally accredit demining machines in accordance with the requirements of this standard and SNMAS 07.02;
- 2) Ensure and oversee the implementation of this standard for the employment of demining machines on demining operations;
- 3) Implement QM systems to ensure the safe, effective and efficient use of machines on demining operations based on the requirements of SNMAS 07.01 and 07.02;
- 4) Develop an environmental policy for the use and maintenance of demining operations including use of machines; and
- 5) Provide advice to prospective demining machine users.
- 6) Establish, maintain and implement procedures to ensure the proper T&E of demining machines and their teams are undertaken prior to their deployment on demining operations;
- 7) Establish and maintain 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; and
- 8) Provide advice and assistance to demining organizations in establishing tolerable risk for demining operations based on the NMAC risk management framework.

11.2 Mine Action Organizations

All mine action organizations working in Sudan and intend to undertake mechanical demining operations, shall:

- 1) Obtain (from the NMAC) the operational accreditation for each different demining machine (model, make, type) to be used in demining operations;
- 2) Comply with Sudan National Mine Action Standards and contractual obligations for the employment of demining machines and undertaking demining operations.
- 3) Apply management practices and operational procedures which aim to clear land to the requirements specified in SNMAS, contracts and agreements as agreed with NMAC and UNMAS;
- 4) Establish and maintain reporting systems and make the information available on mechanical and follow-up demining operations as specified by the NMAC; and
- 5) Establish systems and procedures to ensure that demining machines used on mechanical demining operations operate effectively, are properly maintained and serviced and remain safe for the operator and support staff.
- 6) Ensure capacity building of their staff in mechanical demining operations.