

LAO PDR NATIONAL UXO/MINE ACTION STANDARDS (NS)



Chapter Ten Mechanical Operations

National Regulatory Authority for
the UXO/Mine Action Sector in Lao PDR

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Mechanical Operations

1. Introduction

The use of machines on UXO clearance operations can greatly increase production rates, reduce the time spent on tasks and may reduce the overall costs of clearing contaminated areas. However, the use of machines must be carefully managed to ensure that the right machine and tools are used, their use is carefully controlled and they are properly employed so that clearance is able to proceed safely, efficiently and effectively.

The Lao PDR National Regulatory Authority (NRA) is the authority responsible for the regulation and control of UXO/mine action within Lao PDR. This responsibility includes establishing procedures for mechanical operations and ensuring that clearance requirements are met.

2. Scope

This chapter covers the minimum requirements for the conduct of mechanical operations within Lao PDR.

The requirements included in this chapter of NS apply to mechanical operations in support of UXO clearance operations; they do not apply to mechanical operations as part of mine clearance.

3. Scope of Mechanical Operations in Lao PDR

Mechanical operations may involve individual machines employing one mechanical tool, individual machines employing a variety of tools or a number of machines employing a variety of tools. Where a variety of tools is used, it is called a mechanical system.

The term machine refers to a unit of mechanical equipment used on UXO clearance operations.

Note: Where the term machine(s) is used in this standard it is to be taken as also referring to a mechanical system.

Machines involved in mechanical operations in Lao PDR may perform two principal roles:

- a. Ground preparation. Machines are used to reduce or remove the obstacles to clearance in a contaminated area in order to speed up the UXO clearance process and to make it safer. Ground preparation tasks may include:
 - (1) Vegetation cutting and clearing.
 - (2) Removal of metal contamination.
 - (3) Removal of obstacles such as wire, boulders, rubble etc.
- b. Mechanical UXO clearance. Machines are used to destroy or disrupt UXO in a contaminated area or to remove them from the contaminated area. The aim of mechanical UXO clearance is to clear as many UXO as possible in order to reduce any follow-up action to a minimum. Follow-up action may be required to remove any remaining UXO.

Machines may also be used for other functions in support of UXO clearance operations. Such functions may include preparing tracks to permit access into areas for UXO clearance operations, assisting with the excavation of suspected UXO or excavation of pits in support of Explosive Ordnance Disposal (EOD).

4. General Requirements

The following general requirements are applicable to all mechanical operations conducted in Lao PDR.

Each machine is to be Tested and Evaluated (T&E) to determine its suitability for the task(s) it is expected to carry out in the conditions in which it will work. Machines are not to be employed on tasks or in conditions for which they have not been T&E for.

Note: The results of T&E carried out in other programmes, or in T&E establishments may satisfy the requirements for T&E in Lao PDR.

Operating procedures are to be developed for each machine and are to be approved by the NRA before implementation. These procedures are to cover general mechanical operating procedures, procedures specific to each machine and where necessary, procedures for the integration of the machine with other UXO clearance methodologies.

No machine is to be employed on mechanical operations in Lao PDR unless the requirements of this section have been complied with and the NRA has given approval for the use of the machine. When appropriate, the NRA may require restrictions or limitations on the use of the machine.

4.1. Testing and Evaluation (T&E)

Where a machine has been T&E in other locations, or where confirmatory or initial T&E show that the machine has utility in the programme concerned, in the interests of operational efficiency, formal T&E should cease and a machine should be permitted to be deployed operationally.

This should only be permitted provided that continued performance monitoring is carried out by the clearance organisation concerned, and that initial operating procedures for the machine are such that the NRA has confidence that the standards required of the machine, and any required follow-up UXO clearance, are achievable.

Where such operational performance monitoring is permitted, comprehensive records shall be maintained by the clearance organisations, with the records being required to justify any changes to the operating procedures of the machine.

4.2. Design, Development and Conduct of T&E

T&E regimes for machines should be designed, developed and conducted in order to:

- a. Identify the parameters within which a machine is able to be employed in its intended operating environments.
- b. Identify the optimal operating conditions for the machine in its intended operating environments.

- c. For machines to be employed on mechanical UXO clearance, identify the effectiveness in disrupting, destroying, detonating or otherwise removing different types of UXO from contaminated areas in different operating environments. This should only occur for UXO that a machine has been designed and developed to combat in accordance with the manufacturers specifications.
- d. For individual machines to be employed on mechanical UXO clearance, or a number of machines or tools to be used as part of a mechanical system, identify the residual risk remaining from each UXO type to be targeted in the operating environments in which the machine(s) will work and the means and manner of countering this residual risk
- e. Identify any limitations in the employment of a machine (for example; environmental conditions such as inclines, wet soil, hard ground, temperatures etc, or certain explosive hazards).
- f. Assess and confirm the safety of the machine for the operator and any other person on a clearance worksite where machines are employed. Protection for these personnel is to be provided against the worst-case risk to the particular machine.
- g. Identify the operating procedures required to ensure that a machine is capable of achieving specified standards.

5. Clearance Requirements

The clearance requirements referred to in this chapter of NS only concern UXO area clearance operations. They do not concern EOD roving tasks.

Clearance requirements include specifications as to the depth of clearance, the area to be cleared and the quality of clearance.

Clearance requirements should be specified by the tasking authority based on the intended land use; however when the tasking authority does not specify clearance requirements, the default depth of clearance and quality of clearance included in this chapter of NS are to apply.

Clearance organisations carrying out mechanical UXO clearance, whether as a stand-alone operation or supported by other UXO clearance methodologies, are to develop clearance drills and procedures to ensure that the specified area to be cleared is cleared to the specified depth and to the required quality.

In situations where clearance organisations are unable to achieve the clearance requirements, they are to cease operations and immediately report the matter to the tasking authority.

5.1. Depth of Clearance

Depth of clearance is to be determined based on the intended land use and the types of UXO likely to be encountered. Different depths of clearance may be specified for different areas on a clearance site.

When depth of clearance is not specified, the default depth of clearance is to be applied. **In Lao PDR the default depth of clearance is 25 cm.**

Note: The default depth is based on the most common use of cleared land, rice farming. The depth is based on an estimated maximum penetration depth of digging or ploughing implements into the ground.

5.2. Area to be Cleared

UXO area clearance operations in Lao PDR should only be considered when land is to be used within 6 months. If the land use is known then the area to be cleared should be able to be specified. Specification of the area to be cleared should occur during the task allocation process.

5.3. Quality of Clearance

The minimum quality requirements for mechanical UXO clearance, on completion of any necessary follow-up action, are:

- a. All UXOs equal to or greater in size than a half BLU 26 with a fuze are removed from the ground to the required depth of clearance within the area to be cleared.
- b. All other UXOs smaller than a half BLU 26 with a fuze, including hazardous components of UXOs, located during the UXO area clearance operations are removed from the ground.

Tasking authorities may specify clearance quality requirements that are more stringent than those stated above.

Note: For the purposes of these NS the half BLU 26 with a fuze is deemed to be the minimum target UXO that poses an intolerable risk to personnel in Lao PDR.

6. Safety

6.1. Safety Distances

During the T&E of machines, clearance organisations are to determine the minimum safety distances for each machine based on the maximum danger area for the hazards associated with the operation of the machine. Safety distances are to take into account detonations from UXO, the throwing of rocks and other objects by a machine and the loss of working components from a machine. Where remote controlled machines that employ protective cabins are used, the safety distances are to be determined for situations in which the protective cabin is used and for situations in which it is not.

Minimum safety distances are to be included in the operating procedures for the machine.

Where mechanical operations are integrated with other UXO clearance methodologies, the greater applicable safety distances are to be applied.

No personnel are to move within the minimum safety distance for a machine while the machine is working, irrespective of whether or not a person is wearing Personal Protective Equipment (PPE).

6.2. Medical

Accident response plans for mechanical operations are to include drills for the extraction of a casualty from the inside of a machine. Different drills are required for each type of machine and additional equipment may be necessary on site.

All clearance worksites where machines are employed are to have at least two qualified clearance technicians (in addition to the clearance supervisor and the medic) on site at all times while a machine is working. In an emergency these clearance technicians will be required to assist with the extraction of the operator.

Note: These clearance technicians should also have other duties such as checking machines for UXO and for watching for throw outs.

6.3. Communications

At all times when a crewed machine is working on mechanical operations, the machine operator is to have radio communications with the clearance supervisor.

6.4. Unforeseen Hazards

If at any time during the conduct of mechanical UXO clearance, a hazard for which the machine was not designed or approved to deal with is identified or suspected, the matter is to be reported to the clearance supervisor, the machine is to be withdrawn to a safe area and the tasking authority is to be informed. This requirement applies even if the hazard is not within the immediate working area of the machine.

6.5. General Safety Precautions

The general safety precautions to be complied with by all clearance organisations carrying out mechanical operations are:

- a. Unless a machine is specifically designed for a crew of two, only the machine operator is permitted to be in the machine while it is working. The only time when two people are permitted in a single-crewed working machine is if an operator is under training. This is only to be done in non-contaminated areas.
- b. The protective cabins on machines are to be properly closed at all times when machines are working.
- c. Seat belts, where fitted on machines, are to be worn by the machine operator at all times while the machine is being operated. This includes moving the machine around the worksite.
- d. No loose articles such as tools, bolts, machine parts etc. are to be stored in the cabin of a machine. If tools or accessories are required to be kept in the cabin of a machine, they are to be secured to the inside of the cabin.
- e. Prior to any mechanical UXO clearance commencing, the danger area for the machine being used is to be checked and confirmed as being clear of personnel.
- f. Where machines are fitted with audible warnings, these warnings are to be sounded before any work with that machine commences.
- g. Where fitted, visual warnings such as flashing lights are to be shown on working machines at all times.

7. Mechanical Procedures

Clearance organisations carrying out mechanical operations are to develop drills and procedures that ensure that the provisions in this section are complied with.

7.1. General Provisions

When machines are employed on mechanical UXO clearance, and the machine has been assessed as leaving a residual risk, follow-up UXO clearance operations are to be carried out to remove the residual risk before the area is to be considered cleared.

When mechanical operations are carried out, the ground over which the operations were carried out is to be left in a state whereby it is suitable for its intended use. For example:

- a. Ground that is to be used for growing crops is to have the topsoil in place on the top of the ground after mechanical operations are complete.
- b. Cleared ground is not to be left with excavation holes as a result of mechanical operations.
- c. Where vegetation is removed from ground that is subject to erosion, measures are to be taken to stabilise the ground on completion of mechanical operations.

When mechanical operations involve excavation either to locate UXO, or in support of EOD, excavation is to be carried out in layers and the ground checked by metal detection equipment and confirmed clear before further excavation takes place. The depth of layer is not to exceed the detection depth of the metal detection equipment. Where indications are received using the detection equipment, excavation is to be carried out manually until the source of the indication is removed. When magnetometers are used, and it is possible to estimate the depth of the item being investigated, mechanical excavation is to be no deeper than 1 metre above the item.

Any movement of contaminated spoil or materials during mechanical operations is to be carried out in a manner that prevents contaminated materials being spilled on access routes.

7.2. Preliminary Requirements

During clearance worksite preparation for mechanical operations there are some specific to mechanical requirements that should be complied with. These are included in **Chapter 5 of NS Worksite Preparation**.

Prior to any mechanical UXO clearance taking place, the boundaries of the areas to be worked in are to be identified and marked in accordance with the requirement included in **Chapter 4 of NS, Marking Systems**. When the mechanical UXO clearance involves a crewed machine, the machine operator must be able to clearly see the clearance marking systems from within the machine.

When mechanical UXO clearance involves the pushing, raking, collection or movement of UXO contaminated material, safe areas are to be established for the placement of this material. These areas are to be easily accessible, large enough for the material to be placed in a manner where it can be checked, large enough to permit machines to manoeuvre without moving over contaminated material and located with consideration to safety distances.

For mechanical UXO clearance, areas should be established adjacent exit routes out of the clearance area for machines to be checked to ensure that there are no UXO attached to the machine. These areas must be sited with consideration to safety distances and the need to dispose of any UXO that may be found.

7.3. Command and Control

Mechanical operations are to be planned and executed to ensure that adequate command and control is exercised over the operation and that it is possible to provide emergency support in accordance with accident response and equipment recovery plans. This may mean limiting the size of working areas.

Procedures must ensure the safety of any personnel required to control or assist with mechanical operations.

7.4. UXO and Other Hazards

The following provisions apply in relation to UXO and other hazards during mechanical operations:

- a. Procedures are to detail the action to be taken by the mechanical operator and the clearance supervisor when a UXO is located; either by detonation or by observation.
- b. The location of all UXO detonations during mechanical UXO clearance are to be identified and recorded.
- c. All UXO thrown out during mechanical UXO clearance are to have the location where they landed marked and recorded.
- d. All machines carrying out mechanical UXO clearance are to be checked prior to moving from the working area to an administration areas to ensure that no UXO remain in the working or moving parts of the machine or are attached to the machine. When such checks are carried out:
 - (1) Excavation drills are to be used for checking dirt and mud on the machines.
 - (2) Safety distances for the assessed UXO hazards on the site are to be applied. These are to be determined by the clearance supervisor.
 - (3) When suspected hazardous items are found, they are to be pulled from the machine and dealt with in situ. If necessary, EOD support is to be obtained.
- e. During mechanical UXO clearance any contaminated areas within the area to be cleared that are unable to be cleared mechanically are to be cleared manually. Other contaminated areas that have been created by the mechanical UXO clearance, such as areas where contaminated spoil may have been spread, pushed or raked, including those outside of the area being cleared, are also to be cleared manually.
- f. During mechanical UXO clearance, items collected by sifting, use of magnets or other mechanical processes are to be placed in a predetermined area and inspected for hazardous components. Hazardous components are to be disposed of in accordance with **Chapter 8 of NS, Explosive Ordnance Disposal (EOD)**.
- g. The placing of contaminated spoil in predefined areas is to be carried out safely and in a manner that permits the subsequent inspection or processing of the contaminated material by other assets. In placing material in a collection area, the mechanical operator is to allow sufficient space for the machine to move without having to manoeuvre over contaminated material.
- h. Visual checks are to be made on material such as entangled wire after it has been removed from the contaminated area and before it is placed in a collection area to ensure there are no UXO entangled in it. When such checks are being carried out, the machine is to be stationery.

7.5. Ground Preparation

When mechanical ground preparation is carried out it is always to be followed up with manual, MDD or mechanical UXO clearance to achieve the clearance requirements.

7.6. Mechanical UXO Clearance

When mechanical UXO clearance is carried out, the following rules apply:

- a. Only those machines assessed as being capable against the likely UXO hazards are to be used for mechanical UXO clearance.
- b. Mechanical UXO clearance is to continue a minimum of 5 m beyond the extent of the contaminated area unless ground conditions make this impossible.
- c. Where subsequent passes over ground are required, these passes are to be at 90 degrees to the previous passes.
- d. There is to be a minimum overlap of 0.5 m between adjacent lanes.

7.7. Action on Mechanical Failure

Specific procedures are to be developed for equipment recovery in the case of mechanical failure in a contaminated area. Separate procedures may be necessary for different machine types. All are to include the requirements to:

- a. Safely extract the machine operator as quickly as possible.
- b. Safely recover the machine in a reasonable time.
- c. Conduct a risk assessment prior to recovery operations commencing.

8. Sentries

Sentries are to be used if control of the danger area during mechanical operations cannot be maintained by other means. Sentries are to be positioned to cover all possible approaches into the danger area. They are to stop people entering or are to warn the clearance supervisor if people approach.

Sentry points are to be outside the danger area of the mechanical operation or under suitable cover. If sentry points are inside the danger area under cover, the position must have good visibility of the approaches into the danger area. Sentries are to have communications with the clearance supervisor.

9. Protection of Property and Infrastructure

Planning for mechanical operations is to take into account any possible damage to property or infrastructure. Where damage to property or infrastructure is possible, the property owners or local authorities are to be consulted about the operations. If necessary, advice to minimise damage is to be given to property owners adjacent to clearance worksites.

10. Disposal of UXO

All UXO located during mechanical operations are to be disposed of in accordance with the requirements of **Chapter 8 of NS, Explosive Ordnance Disposal (EOD)**. Whenever possible, this should occur on a daily basis. On no account are UXOs located during mechanical operations to be left without being disposed of.

All UXO, or parts thereof, thrown out from mechanical UXO clearance operations are to be destroyed in-situ.

When UXO that exceed the authority limitations of a clearance supervisor are located, the tasking authority is to be notified and EOD support obtained.

11. Fire Precautions and Fire Drills

Some machines are fitted with automatic fire fighting equipment. However, in addition to any such equipment, each machine is to have, as a minimum, a serviceable 2kg CO² fire extinguisher available as follows:

- a. For remotely operated machines, the extinguisher is to be held by the remote operator.
- b. For operator crewed machines with a protective cabin, the fire extinguisher is to be securely fitted in the operators cabin.

On no account is a fire extinguisher to be bolted or padlocked onto the outside of a machine.

Clearance organisations employing machines are to develop procedures to be followed in the event of a fire on a machine. These procedures are to cover:

- a. The immediate action to be taken by the operator. This will depend on whether the machine is remotely controlled.
- b. The actions of other personnel on the clearance worksite.
- c. Fire fighting equipment is to be available at all places where refuelling of machines is carried out.

12. Maintenance and Servicing

Clearance organisations employing machines in Lao PDR are to ensure that:

- a. Machines are maintained and serviced in accordance with the manufacturers recommendations. Maintenance and servicing is only to be carried out by qualified and authorised agencies or personnel.
- b. Routine checks are made on machines such as rollers, flails and rakes. Where working components critical to the effective operation of the machine are damaged or lost, these components are to be repaired or replaced before further work continues.
- c. Routine inspections of safety features on machines are carried out and where damage is identified, the damage is repaired before further work continues. Such damage may include ruptures or breaks in armoured plating or armoured glass or the loosening of fittings in the cab.
- d. Whenever a machine is subject to a detonation that may have caused structural damage or significant damage to a key component, the machine is to be immediately withdrawn from the contaminated area and inspected. When damage to a machine may place an operator in danger from subsequent detonations, the machine is not to return to work until the damage is repaired.

Repair, maintenance and servicing of machines are to be carried out in an environmentally acceptable manner in accordance with **Chapter 21 of NS, Environmental Management**.

Machines are only to be operated within the designated clearance worksite, within the boundaries of any temporary accommodation facilities or any other areas approved by the NRA for training or testing purposes.

Tracked machines are not to be driven on sealed roads unless absolutely necessary. If tracked machines have to cross sealed roads, timber is to be laid down to protect the road surface from damage.

13. Mechanical Records

Clearance organisations employing machines on UXO clearance operations should maintain detailed records of their mechanical and follow-up operations in order to build up a statistical database of information that can be used for operational decision making. Such information should include operational and non-operational information:

Operational information should include such things as:

- a. Type of operation carried out.
- b. Ground conditions, soil, vegetation, slopes, moisture content etc.
- c. Weather conditions.
- d. Hours worked.
- e. Areas prepared or cleared.
- f. UXO encountered.
- g. Effect of the machine on UXO, if applicable.
- h. Effect of UXO on the machine, if applicable.
- i. Follow-up UXO clearance carried out.
- j. Quality of ground preparation work in preparing for follow-up clearance.
- k. Residual hazards remaining as determined through follow-up clearance.
- l. Depth of clearance achieved, if applicable.

Non-operational information should include details of operational time lost through such things as mechanical breakdown, transport between sites, logistical delays, poor coordination etc.

14. Miscellaneous Provisions

Where applicable, the requirements for progress reporting, completion surveys, clearance worksite documentation, visitors and community liaison as described in **Chapter 7 of NS, UXO Clearance Operations** also apply to mechanical operations.