MECHANICAL CLEARANCE

Standard Operating Procedures (SOPs)

AMMENDMENTS

This amendment record is to be completed for each formal amendment to these SOPs. Formal amendments can only be authorised and implemented by the Operations Manager (with advice from the Capability Group as required)

Version	Amendment	Date	Amended By
v.3	Version produced following external review by Artois ltd. Various changes, for detail see report (available from Capability Group)	3 Aug 18	NT
v.3	Standardised safety distances (from 100m to 200m) in Annexes	24 Sep 18	NT
v.3	Minor edits to Section 3 (inspection process) and Annex C	31 Oct 18	NT
v.3	Removal of 'or multiple teams may work under a single Team Leader with permission from the Operations Manager' from end of section 1.2.	24 Nov 18	AB
v.3	Addition to overview in 2.1. Additional information on loader use in 2.2. Additional information on bulldozer use in 2.3.	24 Nov 18	AB
v.3	Annex C. removed.	24 Nov 18	AB
v.3	Addition of actions on breakdown/recovery of vehicle from un-cleared area 4.5.	24 Nov 18	AB
v.3	Amendment of Annex D to be commensurate with global clearance SOPs for excavation and back-blading.	24 Nov 18	AB
V.3	Deletion: "In AT mine/IED fields with suspected main charges of more than 10kgs and/or metal casing fragmentation hazard the minimum distance between armoured vehicles is 100m. All personnel and unarmoured vehicles must be 300m away from a working machine."	09 Jan 19	JV
V.3	Deletion of the reference to AP mines	09 Jan 19	AB
V.3	Deletion "After levelling and compacting the inspection area, any large items of metal shall be removed. This will prevent continual false signals during the inspection process. Metal removal will be done manually with detectors. During operations the inspection area shall be marked with one red flag placed at each corner."	09 Jan 19	AB

V.3	Change of minimum distance for the TL to be observing behind a blast shield	09 Jan 19	AB
V.3	Removal of - Once all of the first mechanical rake has been visually inspected and cleared the team leader shall place a marker 1m inside the forward edge of the inspected soil. This marks the start of the next inspection line and will create a 1m overlap between mechanical rakes. The inspection team shall work in pairs – one with a long-handled detector, one with a long rake	09 Jan 19	AB
V.3	Changes in the inspection process Section 3.4 Manual Clearance Team	09 Jan 19	AB
V.3	Edits on Quality Control Procedure . Section Five "this check is to include raking at least 20% of each inspection pit with a long rake".	09 Jan 19	AB
V.3	Edits to safety distances in Task Set up - Annex B and Annex C	09 Jan 19	AB
V.3	Introduction of Technical Survey Section incl. use of Cultivator and Gill. Addition of Technical Survey section and Annex E – Technical Survey using Cultivator or Gill Bucket	April 19	AB
V.3	Revision of Annex B – removing obligation for second mechanical process and allowing raking towards cab on second pass.	April 19	AB
V.31	Update of SOP following review in Iraq	April 19	NT

Contents

SECTION ONE – Introduction

1.1 Introduction

The HALO Trust has used machines in the clearance process since 1995 and leads the world in the development of cost-effective and sustainable mechanical clearance solutions. The philosophy is one very much based on simplicity and the use of existing commercial platforms that are modified for the task of removing explosive devices. In this way, the costs can be kept to a fraction of those associated with specialist one-off clearance machines. Furthermore, local staff can be easily trained in the operation of the machines and reliability in harsh and remote environments tends to be far higher. HALO has developed a wide range of machines and processes over the years; these are covered in the relevant sections of this SOP

1.2 Mechanical Clearance Specific Definitions

Excavation: The complete removal of all spoil that might be contaminated by Improvised Explosive Devices (IEDs), mines or UXO.

Processing: Filtering and preparation of spoil prior to inspection, to filter, screen and/or condition spoil to reduce the requirement/difficulty of inspection.

Inspection: A variety of manual and mechanical processes used to ensure that excavated spoil is free from explosive devices, either by isolating them from the spoil so that they can be removed or destroyed in situ, or by crushing them.

Ground preparation/risk reduction: Processes which make subsequent manual (or mechanical) clearance quicker, easier, and/or safer. Preparation can include breaking up hard ground; bringing explosive devices to the surface; clearing wire or vegetation; disrupting devices by severing of wires; reducing the threat by removing or dispersing main charges; or detonating a majority of the devices in dense minefields/defensive barriers, thereby saving on explosives. Risk reduction may also be used in areas where subsequent full clearance may be necessary but not currently viable.

Area Reduction: The process through which the initial area indicated by general survey as contaminated or suspect is reduced to a smaller area. This allows full clearance assets to be concentrated onto the real threat. Mechanical area reduction may be carried out using rollers to define patterns or limits of AP mined areas.

Team Structure

The minimum structure of a mechanical clearance team is to be as follows[1]:

TEAM MEMBER	QTY	QUALIFICATIONS
Mechanical Team Leader	1	EOD Level 3, Mechanical TL Course, HALO Paramedic
Machine Operator	2	Mechanical Clearance Course, IED Awareness
Medic/Deminer	2	HALO Paramedic IED Awareness

[1] In order to increase outputs Mechanical teams may be supplemented by additional manual deminers (or entire teams) who have received the appropriate training.

Mechanic/Driver	1	Driving Assessment / IED Awareness

Depending on specific operations, the personnel in the team may be supported by specialist EOD/IEDD teams.

1.3 Safety Distances

During the pre-clearance assessment, the Operations Manager shall assess the hazard and designate the appropriate safety distances and record these in the task book. See SOP 1, safety distance annex for guidance. If in doubt, the largest of the distances.

For some mechanical operations, the team leader and/or deminers will need to stay within the minimum 50 m safety distance whilst the machine is working. In this case a suitable shelter must be created. The shelter entrance may be left open, but it shall always face away from direction of the inspection area. Team leaders and deminers on the ground are to wear personal protective equipment (PPE) when they are working with contaminated spoil. Operators working in armoured cabs do not generally need to wear PPE, but consideration should be given to helmets and hearing protection etc.

1.4 Medical

A dedicated ambulance with communications must be at the site or, with the Operations Manager permission within reasonable proximity (maximum 15 minutes away). A minimum of one trained paramedic shall be at the site. Each mechanical team is to be equipped with one major trauma bag and one minor injury kit CASEVAC drills will be as per HALO medical SOP.

1.5 Servicing and Maintenance

The correct and timely maintenance/servicing of all heavy machinery used by HALO is absolutely critical in order to ensure the minimum of downtime as well as safety in operations. All machines should have a servicing schedule as laid down by the original equipment manufacturer, which is the responsibility of the heavy plant workshop. On top of this, all machines are to undergo regular and thorough checks undertaken by the operators (daily/weekly parades) that will not only ensure that all necessary actions (such as cleaning out of air filters, checking of oil levels) have been taken, but should also identify any problems before they become serious.

Every machine that HALO operates is to have a daily service, before and after working hours, and weekly service. Any operator/team leader found to be neglecting daily and weekly services will face severe disciplinary action. The HALO country mechanical officer will ensure that all teams are provided with service schedules for the relevant machine. The daily service should include the following checks as a minimum: Engine oil check / Hydraulic oil check / Gearbox oil check / Air filter check and clean (after work) / Fuel filter check / General machine check for obvious faults/leaks.

Any equipment faults or defects that cannot be repaired in the field should be formally reported and prompt action taken to ensure that the fault is repaired with any necessary spare parts supplied. The Team Leader and operator should be able to clearly identify what kind of repair/spare parts different faults will be required and should report this to the Supervisor or to the heavy plant workshops directly.

1.6 Initial Set Up and Task Layout

The set up and task layout should follow the procedures outlined in HALO Global IED SOP - Part 3 - Manual Clearance and Technical Survey. If any specific variations are needed these should be approved by the Operations Manager and recorded in the task log book.

1.7 Armouring

All mechanical assets are to be protected in accordance with the appropriate hazards. This should include (but not necessarily limited to) armoured glass, steel plating and covered hoses. The level of armouring (e.g. metal and glass thickness) should be sufficient to protect against both planned and unplanned detonations of ERW. Armouring should consider not just the likely size of hazard, but also potential direction of blast, fragmentation type, secondary hazards etc.

All mechanical assets are to be certified by the Global Mechanical Officer to a specific degree of threat (e.g. by device type/size) and that it meets all relevant national and international standards for both mine action and armouring where necessary.

SECTION TWO – Clearance Methods

2.1 Overview

HALO clearance operations use a variety of machines for excavating contaminated soil, the most common being the front-end bucket loader. This section covers the excavation process for loaders, Gill buckets, bulldozers, backhoes, and excavators. Excavated soil, once inspected, shall be returned to the minefield - either in stages or on completion of the task. As far as possible the soil should be levelled.

All plant outlined in this SOP can be used for clearance of soil and rubble clearance i.e. rural and urban clearance. Their suitability for any given task will be dependent on: the threat; level of armouring; specific ancillary attachment(s) available; size, power and manoeuvrability of the specific machine; and weather/ground conditions. As deployment options/combinations are numerous and context driven, it is the responsibility of the operations manager and/or mechanical supervisor to make decisions on appropriate machine deployment (considering all of the points outlined above).

2.2 Loader Standard Bucket

Bucket Loaders are HALO's main mechanical clearance asset. They work in two main ways: excavating into virgin ground, and working in stockpiles. The method of operation is largely the same in both cases. Their use is generally most suited to relatively flat, open areas with a reasonable bearing capacity (can be prone sinking in wet soil). However, they can be used in more restricted space if needed.

The bucket loader is generally classified as a medium wheeled tractor which is fitted with a standard or 4 in 1 bucket on the front; some also have a winch, and/or a ripper.

2.2.1 Operating Principles. Excavation must be from the top surface of the hazardous area, or from the bottom of a spoil pile. The depth of excavation shall be determined by the information gathered by general survey. However, a minimum excavation depth of 15 cm shall always be observed. If the machine is fitted with self-levelling devices it should be operated in its automatic modes during excavation, to ensure the maximum level of accuracy. The loader shall start its excavation a minimum of one machine's

length back from the start point. This will ensure that the excavation lane is of the correct depth before the machine enters the danger area. This makes it easier for the operator to maintain the set depth. The soil removed from behind the start point does not require inspection and shall be placed to one side for later replacement.

During excavation of the lane it is important that the correct direction is maintained. Excavation should be in a straight line, except where the mine/IED pattern changes, or obstacles or operational instructions dictate. The width of the lane should be no less than one and a half of the width of the bucket. If working in an open and flat area, surrounded by cleared ground, a maximum of three lengths of the bucket (the distance between the front of the tyres and the tips of the bucket teeth) should be excavated forward from the front edge of the cleared area into uncleared ground, before the cleared area is expanded left and/or right. This ensures the loader tyres do not enter uncleared ground. To prevent loose items and soil falling from the bucket during manoeuvring, the bucket is to be a maximum of ¾ full.

Contaminated soil excavated from the un-cleared area shall be removed to a designated tipping area. The operator shall ensure that whilst manoeuvring within the lane that the machine wheels do not leave safety of the excavated area. Excavation lanes shall run parallel to each other with a minimum side overlap of 50 cm. This will ensure that material from subsequent lanes is not pushed to the side of the bucket into cleared ground. All cleared areas shall be marked at the end of each working day, as well as uncleared ground and stockpiles

2.3 Gill Bucket

The Gill system is made up of uprights of 15 - 25 mm steel plate and cross members of 10 -15 mm steel plate. These make up a grid system that fits inside the bucket. The Gill system can be either welded or bolted in place; bolting allows the bucket to be used for other purposes. The Gill system separates AT mines/IEDs from the soil as it enters the bucket, and holds these items at the front of the bucket. This ensures that in the event of a detonation during excavation, the bucket and machine are protected by the stand-off produced by the Gill; the detonation of an AT mine/IED in the rear of the loader bucket would cause considerable damage to the bucket and machine. The forward cutting edge and lip of the bucket are protected by 14mm armour plate.

2.3.1 Operating Principles. The loader shall excavate to the depth indicated by general survey, or a minimum of 20 cm. Excavating to an excessive depth will only slow down clearance. The loader shall start its excavation a minimum of one machine's length back from the start point if possible. This will ensure the excavation lane is of the correct depth before the machine enters the danger area. It also makes the maintaining of the depth easier for the operator. The soil removed from behind the start point does not require inspection and can be placed into a cleared tipping area

The operator shall keep the bucket to ¾ full so that there is an even flow of soil through the Gill System. If the soil is light and sandy then more soil can be excavated each cut than if it is heavy, stony and full of vegetation. The condition of the soil is also a factor, as dry soil will flow through the Gill System more easily than wet soil.

The operator shall ensure that whilst manoeuvring within the lane that the wheels do not leave the safety of the excavated area. The team leader should try to position themself in a safe area, at the appropriate safety distance from the loader and watch the excavation through binoculars. Alternatively the team leader may position himself/herself a minimum of 50m from the gill as long as he/she has full PPE and is behind a safety bund or blast shield at least 1m high. If this too is not possible then the operator will need to manoeuvre from the lane to an area where the team leader can safely observe the Gill. The bucket is raised to force soil to pass through the Gill and into the bucket, and then the operator shall position the bucket so that they and the team leader can check the Gill for AT mines/IEDs. Should a mine/IED be spotted forward of the Gill then the team leader shall instruct the operator to move to a safe area where the mine/IED can be destroyed in situ or removed to a demolition pit for disposal.

It may be necessary that the soil that has passed through the Gill requires inspection. In this case, the soil shall be moved to a tipping area for further inspection.

2.4 Bulldozers

Bulldozers can be used for area reduction or to move soil/rubble in order to prepare large areas of land and to stockpile soil for inspection. They are more suited to relatively flat and open working areas, pushing granular soils and/or rubble. However, they can be used on cohesive soils if ground conditions are appropriate. Bulldozers may be classified as a heavy crawler tractor or as a medium crawler tractor.

2.4.1 Operating Principles. Bulldozers are used primarily for open area clearance. The operation consists of bulldozing contaminated earth to a minimum depth of 20 cm into stockpiles which are then inspected by the appropriate method. Bulldozers can also be fitted with a roller and be used in area and/or risk reduction.

The excavation start point will be positioned in a cleared area. The machine must start excavation one machine's length from the uncleared area (if possible) in order to ensure that the correct depth is reached and that there is a steady cut throughout. The cut should be no longer than 20 metres from the start of the un-cleared area to the beginning of the stockpile. The stockpile should be 3 metres wide at the base and 2 metres high (if possible) When moving to the next lane whether during the working day or starting work the following day, the operator shall overlap from the previous cut by ¾ of the width of the blade to avoid any material spillage onto an already cleared area. At the end of each working day the stockpiles should be marked as un-cleared.

2.5 Backhoe

The Backhoe is an ancillary which is fitted to the rear of a light tractor and is ideal for excavating inside collapsed buildings and other confined spaces. It is used for clearance of dwellings, culverts and other

areas that are inaccessible for bigger machines and are too contaminated or too deep for manual deminers.

2.5.1 Operating Principles. Once an excavation start point has been established, the machine will reverse into position straight on with clear vision of un-cleared area and the inspection area. The operator must make sure that there is at least 2m safety margin from start of contaminated area to the slew motor, so that the digging angle does not become congested and the stabilisers can go down in a cleared area. In addition, any contaminated spoil excavated must not be placed any closer than 0,5m from the boundary of cleared/ uncleared area. Ideally it should not be closer than 4m.

When starting work in the morning the operator will take an initial half a cut overlap to prevent contaminated material falling into cleared areas. If the planned excavation area is deeper than the reach of the backhoe then the machine must be positioned 2m from the uncleared area and excavation conducted from the closest boundary working away from the machine, ensuring that the cabin door opens onto a safe area and that the other side has at least 2m of cleared area.

If the area to be cleared is within the backhoe's digging length then excavation will start at the furthest point and work towards the machine, again making sure that there is a safety margin either side of the machine. Wherever possible the operator must keep the cutting edge at 45°-75° to reduce the risk of detonating a mine. If a banks-deminer is required to watch for falling material, they/she must either be in an armoured vehicle at a minimum distance of 25m or must wait for the operator to stop before inspecting the material on the ground.

To prevent loose items and soil falling from the bucket, the bucket should be filled to a maximum of 75%.

The bucket must be tipped into the inspection area, slowly pushing the bucket outwards and dropping the soil to the right or left making sure the soil is spread evenly so that the operator can see any mines or IEDs. The material can then be manually checked.

When working on collapsed walls the operator will carry out the same operating technique. The only time this will change is when the backhoe is shifted on the frame to bring it in line with the outside of the

vehicle, therefore allowing the operator to work parallel with the wall. The ground underneath the collapsed wall must be cleared as well once all the debris has been removed.

2.6 Excavator

Excavators may be used for clearing road verges, bridge abutments, culverts, river and canal banks, and for clearance in shallow water. They may also be used as primary clearance tools for larger area clearance of mine/IED fields if fitted with the appropriate ancillaries, particularly in areas of hard ground.

2.6.1 Operating Principles. The machine should be positioned in a safe area so as to excavate over the front or rear of the tracks. Excavation over the side of the tracks is not recommended as it can cause the machine to overturn. It should only be done under strict control and where there is no steep embankment and the depth of excavation is not excessive. An inspection area measuring 10 m² must be cleared and marked a minimum of 3 metres from the machine but within reach of the boom. If the area to be cleared is longer than the reach of the machine then the excavator will work forward into the un-cleared area; if the area is within the machine's reach then the machine will work backwards. The team leader and operator must ensure that machine is a minimum of 2m from the edge of the uncleared area.

Wherever possible the operator must keep the cutting edge at 45°-75° to reduce the chance of detonating any UXO or mine/IED. The bucket must be filled to a maximum of 75% to prevent material spilling from the bucket. The operator must ensure that there is an overlap when digging so as not to spill any contaminated material into the cleared area.

When tipping the material into the area marked off for inspection the operator shall make sure that it is released evenly and slowly so they can watch for any IEDs or mines falling. After the visual check the operator will scarify the material; it is then checked visually and by detector for mines/IEDs. Before the machine moves to the next excavation the Team Leader or a deminer will check the material. After moving, if the former inspection area is out of the machines reach then the team leader should select another inspection area. Ideally the new inspection area should be in the area that has already been excavated, as this will avoid the need to replace spoil after clearance is complete. When working with a

screening unit, the excavator should place the material into the hopper gradually and not in one dump so as to reduce the risk of a detonation and also to avoid choking the unit.

SECTION THREE – Technical Survey

2.1 Overview

HALO has introduced ancillaries to be used in a Technical Survey (TS) approach. These ancillaries will be used according to conventional TS clearance methodology whereby the extent of contamination will be established, and then clearance teams will be able to establish a baseline closer to the Defined Hazardous Area (DHA).

2.2 Cultivator

The cultivator is derived from an existing agricultural platform readily available in most countries. It can be deployed to aid with the following activities:

1. Technical survey of low risk areas of Suspected and Confirmed Hazardous Areas (SHA and CHA)
2. Preparation of ground in advance of manual deminers to improve efficiency and safety
3. Post-clearance verification of cleared ground

The cultivator may be followed up with detector assisted or visual search. This will be decided by the Operations Manager and recorded in the task book. In the case of detector assisted follow up, detectors will need to be calibrated according to the instructions of the Operations Manager (informed by the threat assessment). During this follow up detector verification of cultivated ground, all manual deminers will need to undergo training and will only be deployed following an internal assessment from the Operations Manager.

The cultivator shall only be deployed in low risk areas of SHAs and CHAs, and never directly on to confirmed belts of IEDs (DHAs). Additionally, the cultivator shall only be used in those hazardous areas where just an IED threat has been identified; not conventional landmines. The use of the cultivator on a given task must also be approved by the Operations Manager.

See Annex E for details on the procedure to be used.

2.3 Gill Bucket

This drill will only be employed in low threat areas of tasks where assessment has indicated a possible IED threat. For QC, the team leader will perform a visual check of the *prepared* ground to ensure that the ground has been excavated down to a minimum of 20 cm. No metal detectors will be required as part of the follow-up verification of this drill.

The procedure to be used here is the standard Gill bucket procedure described in 2.3.1, also outlined in Annex E.

SECTION FOUR – Task Layout and the Inspection Process

Optimising task layout is a fundamental part of ensuring that mechanical clearance procedures are executed safely and efficiently. It is the responsibility of the Team Leader, Mechanical Supervisor and Operations Manager to ensure that mechanical assets are being used in the most effective way possible.

In general, it is to be the aim of the operations team to ensure that the site layout is such that, primarily, it is in agreement with the SOPs and that the site is safe for work. Any decision to deviate from the SOPs should be agreed by the Operations Manager and recorded in the task book.

The secondary consideration should be that the site is set up in such a way as to allow the mechanical asset to maximise time carrying out its productive function i.e. excavating soil or processing soil.

4.1 Task Set Up

Task set up shall include the following (each clearance annex identifies any specific additions to this list):

- Non-hazardous component pit. A pit in a cleared area for depositing non-hazardous components (such as pressure plates, or battery packs). At least 50cm deep, or walled with double width sandbags to a height of 50cm. To be marked with black/red markers in each corner. This pit is to be inspected at the end of each shift by the Team Leader to ensure that no hazardous components have been deposited within it.
- Main charge pit. A pit in a cleared area for depositing main charges for subsequent destruction by HALO. At least 50cm deep, or walled with double width sandbags to a height of 50cm. To be marked with yellow top sticks. No detonators or other components are to be stored in this pit. Any detonators still fixed to main charges are to be removed by the IEDD Operator, in accordance with the drills in HALO Global IED SOP 5, prior to the main charge being placed in the pit.
- Team Leader observation/control area. An area for the Team Leader to observe and control the task shall be established at least 50m from the working area. The area shall have adequate overhead and front/side protection facing the direction of the hazard; either 6mm hardened steel or two sandbags thick, and any armoured glass shall be at least 60mm. The Team Leader shall have communications with the plant operator, the control point, team medic, plus any cordon locations. If required, the Team Leader should be equipped with binoculars or remote camera equipment to help view the working area. The Team Leader shall not leave the protected area while the machine is actively clearing. If the Team Leader wishes to move forward they shall communicate to the plant operator to stop, await confirmation and then leave the protected area.
- Unidentifiable item/small hazardous component burning area (only required if specified by the Operations Manager/Mechanical Officer). A HALO incinerator to be placed in a cleared area for depositing small components/debris which cannot easily be identified or confirmed as safe (such as a bundle of wires and small earth clods). The incinerator shall be constructed in accordance with HALO Global EOD SOPs. Items shall be deposited by mechanical or semi-remote means (never by hand) and should be no larger than a fist. Any items in the incinerator should be destroyed at the end of each shift under the supervision of the Team Leader in accordance with global EOD SOPs. **Main charges or other identifiable ordnance shall never be placed in the incinerator.**

4.2 Mechanical Inspection

The mechanical inspection process is the follow-up process to excavation and/or ground preparation. In simple terms, the hazardous area has been removed and/or prepared down to a specified depth by the relevant mechanical process, and the spoil requires inspection for mines, UXO or IEDs, prior to being considered cleared. There are different methods for inspection and each is outlined in the relevant clearance annex to this SOP. In general, the methods of soil inspection are as follows:

1. Visual inspection following ground preparation or soil processing (Gill bucket, Allu bucket or wet soil bucket, for example).
2. Manual inspection (by raking or detector assisted).

Manual and visual inspection processes may require the use of dedicated inspection areas. This will be determined by the clearance methodology chosen. Prior to starting work, a location for the inspection area shall be selected. The following points shall be taken into consideration:

- Inspection areas should be sited as close to the hazardous area as is possible, without encroaching on any safety distances, so as to minimise travelling time and maximise productivity.
- The ground shall be as level as possible.
- Heavy vegetation, trees and large rocks should be avoided where possible.
- Areas which may be prone to flooding in the event of heavy rain should be avoided.
- The area selected shall be suitably sized and oriented so as to account for vehicle manoeuvring.

It will often be necessary to remove the topsoil from an area, in order to use the harder subsoil as an inspection surface. The amount of topsoil to be removed will depend on the hardness of the ground. In urban areas carparks and other hard surface may make excellent inspection areas. If topsoil has been removed to create an inspection area, the machine operator shall level and compact the soil using the base of the bucket and reversing in straight lines along the length of the inspection area.

The inspection team shelter shall be positioned as close to the inspection area as safety distances allow, in order to reduce time wasted travelling too and from the inspection area. This will likely mean creation of an area with protection from the assessed blast/fragmentation hazards (e.g. earth bund or sandbag wall). The protective bunker and inspection area are to be maintained and repaired regularly. It may be necessary, during the period of clearance, to reposition protective bunkers and inspection areas.

At the end of the working day, inspection areas are to be cleared of all contaminated spoil. If the inspection areas are left uncleared, the perimeter shall be marked with red/white painted rocks placed at 1m intervals with the red facing inwards.

SECTION FIVE – Actions On

4.1 Introduction

This section covers those actions which are the same regardless of the drill being used. Each annex details any specific additions.

4.2 Improvised device or component part

In general:

- As soon as a suspected device is uncovered the Deminer or mechanical operator stops work.
- The Deminer/mechanical operator then calls the Team Leader/EOD operator to verify the item.
- If the item is considered safe to move it will be moved to a location for later disposal.
- If the item is considered unsafe to move it will either be rendered safe using the procedures outlined in part 5 of this SOP or marked and handed over in situ to local security forces.

In addition:

a) Debris. Items of debris that hinder progress, but can be mechanically lifted, shall be mechanically lifted to the safe area and placed in the debris pit. Items of debris that cannot be lifted shall be recorded by the Team Leader and the area marked as uncleared during the QC and marking phase. Further guidance from the Operations Manager shall then be sought.

b) Unidentifiable item. In the case of an item that cannot be identified by the plant operator, the operator shall cease machine operations and the item visually inspected by the Team Leader (using optics, cameras or direct line of sight). If the item can still not be identified the Team Leader shall refer to the Operations manager for further guidance.

c) Hazardous item caught on machinery. If a hazardous component or complete device is caught on the machines working parts, the plant operator is to inform the Team Leader and move the machine to an accessible area if safe to do so. The Team Leader (or EOD operator) is to carry out any required EOD action (in accordance with HALO Global IED SOP 5). The plant operator is to remain in the armoured vehicle until told to move by the Team Leader or EOD operator.

d) Machine break down in hazardous area. The plant operator is to inform the Team Leader and attempt to restart/rectify the machine from within the armoured cab. If unable to do so, they are to exit the vehicle via a safe route. The task is to cease and the Operations Manage/Mechanical Officer asked for further guidance. The machine will then be recovered in accordance with Section 4.5 of this SOP.

e) Rubble piles/collapsed buildings. These are to be recorded and marked as uncleared. The Operations Manager/Mechanical Officer is then to assess the buildings/rubble and designated the appropriate clearance method to use (see separate annexes)

f) Unplanned Explosion. In the event of any unplanned explosion the Team Leader is to confirm the status of the plant operators and all other team personnel. Operations are to cease and the Operations Manager informed. Any machine involved in an explosion is to be inspected by the Mechanical Officer before operations resume.

4.3 UXO/ERW

For UXO the procedure is the same, except that the Team Leader must decide, in accordance with part 6 of this SOP, on one of the following actions:

- Destroy in situ.
- Pull and remove to store for later destruction
- Render safe and remove to store, for later destruction

4.4 People or Animals that are Close or Enter the Working Area

It is necessary to take all precautions to prevent the entry of people or animals into a clearance area. If nevertheless animals or people enter the uncleared area, then the Team Leader should blow his whistle once and call stop over the radio. The Team Leader should attempt to move the animal or person into a safe area, without putting any HALO staff at risk.

4.5 Breakdown/recovery of a vehicle from an un-cleared area.

It may be necessary to recover a vehicle from an un-cleared area. This may be necessary following a breakdown or a mine/IED/UXO incident.

In the event of this happening, the team leader shall immediately inform the Operations Manager and/or Mechanical Supervisor. The recovery method to be adopted will then be decided by the Operations Manager and/or Mechanical Supervisor and will be dependent upon the reason for recovery, the nature of the threat and the terrain from which the vehicle is being recovered.

The overriding principle that must be adhered to is that the safety of the person undertaking the recovery shall take precedence over the welfare of the machine and must be taken into account whatever methodology is decided upon.

Possible Methods:

- If possible the vehicle should be approached along its tracks to gain entry through the door or hatch and drive the vehicle back to the cleared area.
- If it is not possible to identify the vehicle tracks (or if the nature of the breakdown/threat determines that this area is not safe), a mine proof vehicle may be driven up to the vehicle and chains attached to the vehicle to tow it to a cleared area.
- In the event of an accident, if it is not possible to approach the vehicle by foot and there is no mine proof vehicle available, an emergency breach lane shall be established by other mechanical assets (preferable), or manual Deminers, to the damaged vehicle in order to evacuate the injured person and remove the vehicle with recovery assets.

SECTION SIX – Quality Control

All manual inspection pits are to be visually inspected by the Team Leader following the deminers check before any spoil is removed from the inspection pit. If any mines, IEDs or UXO is discovered at this stage then all work on the task is to stop, the supervisor informed and the task site reviewed by the Operations Manager.

The task site should be inspected weekly by the Operations Manager and/or supervisor. They are to check the following on each visit, and record it in the task book:

The layout and marking of the task is in accordance with SOPs

The task book is complete and up to date

The task map accurately reflects the situation on the ground

Medical equipment is present and in-date

Vehicle service log books are correct and up to date

Any other checks as required or directed by senior operations management

Annex A – Mechanical Clearance of IED Pre-Clearance Assessment.

1. **Introduction.** Prior to conducting any mechanical clearance task of IED, the Operations Manager and Mechanical Officer are to conduct a pre-clearance assessment in order to decide which is the most appropriate clearance method to use and what risk mitigation measures are required. This should be conducted no earlier than two weeks before the start of clearance and wherever possible should be conducted with the mechanical Team Leader who will conduct the clearance and the survey Team Leader who completed the original survey. The Operations Manager should complete the pre-clearance assessment form (attached) which should be included in the task book. At all times the categorization of the task should be determined by the type of hazard, environment and technical challenge- not the availability of mechanical clearance resources. The current categories are:

- Mechanical Clearance of Improvised Devices in a Rural Environment: Long Armed Excavator with Rake (Annex B) along with inspection/deminer support to mechanical clearance operations in a rural environment (Annex D).
- Mechanical Clearance of Improvised Devices from Light Rubble: Long Armed Excavator with Grapple/claw and Rake (Annex C).
- Technical Survey using Cultivator or Gill bucket (Annex E).
- Mechanical Clearance of Buildings and Urban Environments. **This will require in-depth technical assessments of individual buildings that will be detailed in an additional annex/SOP or bespoke task plan**

In some cases, it may be required that multiple techniques are required for a single task (e.g. the presence of light rubble in an otherwise rural environment). In this case the Operations Manager is to note this on the assessment form and mark the task map accordingly. If none of the above procedures are suitable for the task, the Operations Manager is to seek guidance from the Capability Group via the Global Chief Technical Adviser.

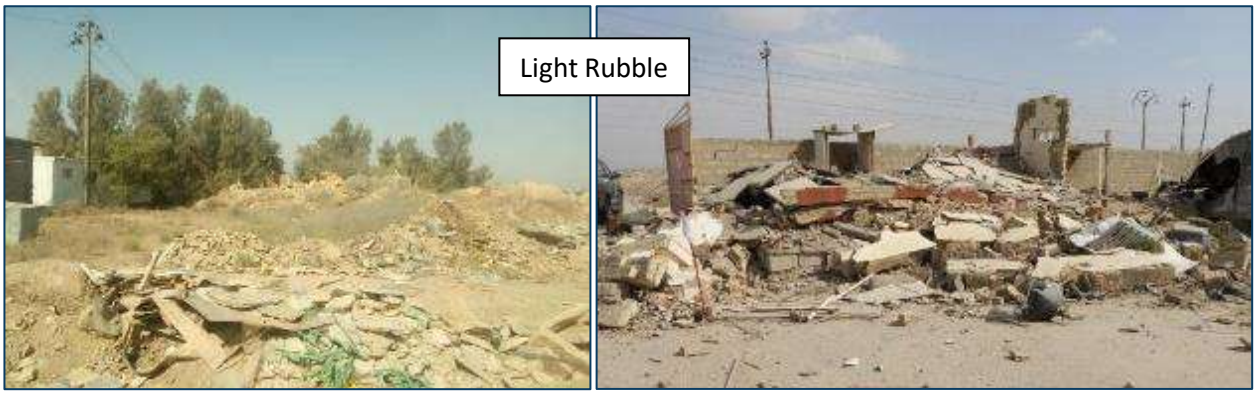
2. **Task Assessment**. The pre-clearance assessment should be equipped and adopt the safety principles as described in SOP 2 (NTS) section 2, including considerations for access routes, CASEVAC, communications with HQ etc. Desk assessments should only be used as a last resort (e.g. the Operations Manager cannot deploy to the task site for security reasons), in most cases a site visit and meetings with key informants will be required. The Operations Manager or Mechanical Officer should:

- Confirm the most likely and possible device types that will be encountered on the task
- Classify the terrain (open area, road etc.)
- Confirm if there any mechanical access issues.
- Identify any areas that cannot be cleared by mechanical means and/or that may require support from a manual clearance team.
- Identify suitable areas for plant storage during the task, if required.
- Draft a clearance plan to include baseline, CP, medical point and break-in locations etc.

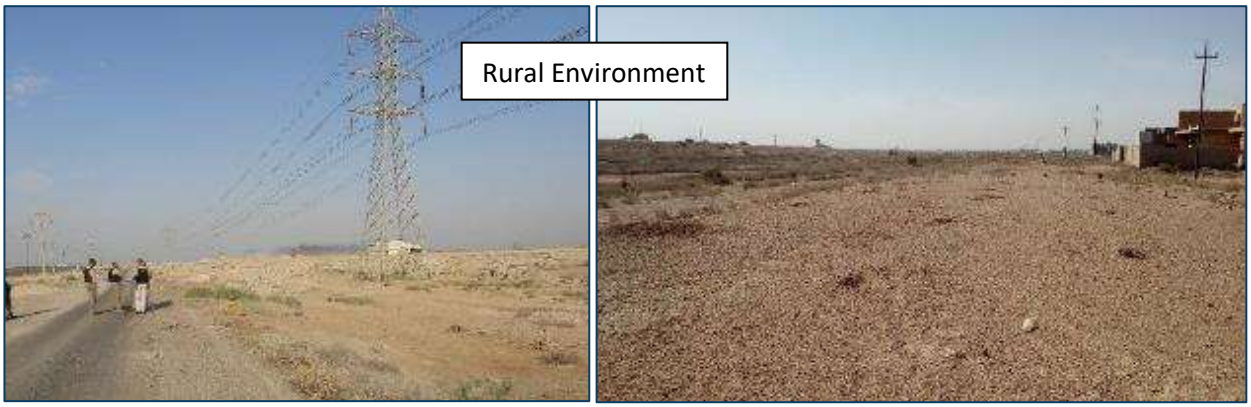
- Secondary hazards, infrastructure or areas where detonation of devices during clearance is undesirable/unacceptable
- Type and size of any rubble. Details should be taken about the maximum and minimum size of rubble, and the types of material- particularly if there is reinforced concrete. There is no specific maximum size of "light rubble", if there are large concrete slabs present that cannot be lifted with a grapple or claw without being broken up then in most cases this should be considered as urban clearance **(this will likely require a bespoke solution, seek guidance from the Operations Manager)**.

3. **Device Types**. In particular, the likely size of the main charge should be assessed and whether or not there is a fragmentation hazard, as this will determine the safety distances that will be used on the task. Categorisation for the purposes of a mechanical pre-clearance assessment can be distinct from other forms of classification (programme or national authority databases etc.) but should seek to match these wherever practical (see 1.3 Safety Distances).

4. **Terrain**. The terrain will be the key determining factor in assigning a clearance method. In particular, whether or not annex D should be applied, and/or whether the task should be considered an urban/building clearance task (annex pending). Examples are below:


Light Rubble


Urban/building Clearance


Rural Environment

General Information

Pre-Clearance Report ID:		IMSMA ID:	
Survey Report ID:		Task Name:	
Report by:		Date of Report:	
Region:		District:	
Community:		Settlement Code:	
Locality name:			

Assessed Device Type

Most Likely			
	Present		**Other/remark**
HME main charge	<10kg ☐[1]	>10kg ☐[1]	☐ Conventional HE (NEQ: _____)
Fragmentation hazard	☐[1]		
Victim operated devices	☐[1]		
Command devices	☐		
Time devices	☐		Unlikely. HALO should not be involved in clearance of active time devices – refer to security forces
Anti-lift/pressure release[2]	☐[1]		
Conventional AP mines	☐[1]		Type: _____ NEQ: _____
Conventional AT mines	☐[1]		Type: _____ NEQ: _____
UXO	☐[1]		Type: _____ NEQ: _____
Worst case			
	Present		**Other/remark**
HME Main charge	<10kg ☐	>10kg ☐	☐ Conventional HE (NEQ: _____)
Fragmentation hazard	☐		
Victim operated devices	☐		
Command devices	☐		
Time devices	☐		Unlikely. HALO should not be involved in clearance of active time devices – refer to security forces
Anti-lift/pressure release	☐		

[1] If these devices are "Most Likely" present: The threat when choosing Clearance Methods is High (see below)

Conventional AP mines	☐	Type: _____ NEQ: _____
Conventional AT mines	☐	Type: _____ NEQ: _____
UXO	☐	Type: _____ NEQ: _____
General description of devices:		

Terrain Type

Type	Present	Description/remark
Rural (fields, open area etc.)	☐	
Rubble	☐	
Urban/buildings	☐	
Infrastructure	☐	
Roads	☐	
General description of terrain (presence of re-enforced concrete, power lines etc.):		
Description of any mechanical access issues:		

Recommended SOP

Mechanical Clearance of Improvised Devices in a Rural Environment: Long Armed Excavator with Rake	☐
Mechanical Clearance of Improvised Devices from Light Rubble: Long Armed Excavator with Grapple/claw and Rake	☐
Mechanical Clearance of Buildings and Urban Environments	☐
Combination (detail below)	☐

Clearance plan description:

Sketch Map/Imagery/photos

Sketch Map/Imagery:

Photos:			
Report Approved By:			
Date:		Signature:	

Selecting the Mechanical Clearance Method

Once the assessment has been conducted the Operation Manager must prescribe the mechanical clearance method(s) that are permissible for use at the site. The following matrix provides example direction to Mechanical Team Leaders along with guidance from Operations Managers.

*May be used as follow up to other equipment, e.g. long armed excavator

MECH ASSET	Mechanical Asset Usage Guide: Defined Hazardous Area (DHA) or High Risk Area			
	IED NEQ > 10kg but < 20kg	IED NEQ < 10kg	AT + Higher Calibre UXO	AP + Lower Calibre UXO
Excavator w/ long reach boom + Rake - Tracked	Is the preferred primary search asset for IED search in rural environments or when searching through soils. Required tine spacing to be assessed by Operations Manager Tracked vehicles preferable for use in undulating, rocky and soft ground conditions but trade off for lower mobility.	Is the preferred primary search asset for IED search in rural environments or when searching through soils. Required tine spacing to be assessed by Operations Manager Tracked vehicles preferable for use in undulating, rocky and soft ground conditions but trade off for lower mobility.	*NOT TO BE USED*	*NOT TO BE USED*
Excavator w/ long reach boom + Rake - Wheeled	Is the preferred primary search asset for IED search in rural environments or when searching through soils. Required tine spacing to be assessed by Operations Manager Wheeled vehicles preferable where ground is relatively even and hard and where greater mobility is required i.e. movement around or between task sites.	Is the preferred primary search asset for IED search in rural environments or when searching through soils. Required tine spacing to be assessed by Operations Manager Wheeled vehicles preferable where ground is relatively even and hard and where greater mobility is required i.e. movement around or between task sites.	*NOT TO BE USED*	*NOT TO BE USED*
Front End Loader w/ standard bucket	*MAY BE USED AS A SECONDARY CLEARANCE ASSET, AT THE DISCRETION OF THE OPERATIONS MANAGER*	*MAY BE USED AS A SECONDARY CLEARANCE ASSET, AT THE DISCRETION OF THE OPERATIONS MANAGER*	*MAY BE USED AS A SECONDARY CLEARANCE ASSET, AT THE DISCRETION OF THE OPERATIONS MANAGER*	Can be used as a primary clearance asset for back-blading and raking of spoil to search for smaller items. It will not be possible to back-blade spoil if it is rocky or bound by vegetation. NB: Gill bucket should be used if available.
Front End Loader w/ Gill bucket	*MAY BE USED AS A SECONDARY CLEARANCE ASSET, AT THE DISCRETION OF THE OPERATIONS MANAGER*	*MAY BE USED AS A SECONDARY CLEARANCE ASSET, AT THE DISCRETION OF THE OPERATIONS MANAGER*	Can be used as a primary clearance asset for sifting AT and higher calibre UXO. Operations Manager to specify required Gill spacing.	Can be used as a primary clearance asset for back-blading and raking of spoil to search for smaller items (e.g. lower calibre UXO).
Front End Loader w/ Cultivator	*NOT TO BE USED*	*NOT TO BE USED*	*NOT TO BE USED*	*NOT TO BE USED*

This document is intended to provide a guide for asset deployment. Many different combinations of mechanical assets may be possible and will be task dependant. The suitability of assets and suitable combinations of assets is the ultimate decision of the Global Mechanical Officer and Operations Manager.

Mechanical Asset Usage Guide: Low Risk Area of a Confirmed or Suspected Hazardous Area (CHA or SHA)

MECH ASSET	IED NEQ > 10kg but < 20kg	IED NEQ < 10kg	AT + Higher Calibre UXO	AP + Lower Calibre UXO
Excavator w/ long reach boom + Rake - Tracked	Can be used as a primary Technical Survey asset. Required tine spacing to be assessed by Operations Manager Tracked vehicles preferable for use in undulating, rocky and soft ground conditions but trade off for lower mobility.	Can be used as a primary Technical Survey asset. Required tine spacing to be assessed by Operations Manager Tracked vehicles preferable for use in undulating and soft ground conditions but trade off for lower mobility.	*NOT TO BE USED*	*NOT TO BE USED*
Excavator w/ long reach boom + Rake – Wheeled	Can be used as a primary Technical Survey asset. Required tine spacing to be assessed by Operations Manager Wheeled vehicles preferable where ground is relatively even and hard and where greater mobility is required i.e. movement around or between task sites.	Can be used as a primary Technical Survey asset. Required tine spacing to be assessed by Operations Manager Wheeled vehicles preferable where ground is relatively even and hard and where greater mobility is required i.e. movement around or between task sites.	*NOT TO BE USED*	*NOT TO BE USED*
Front End Loader w/ standard bucket	*MAY BE USED AS A SECONDARY TECHNICAL SURVEY ASSET, AT THE DISCRETION OF THE OPERATIONS MANAGER*	*MAY BE USED AS A SECONDARY TECHNICAL SURVEY ASSET, AT THE DISCRETION OF THE OPERATIONS MANAGER*	*MAY BE USED AS A SECONDARY TECHNICAL SURVEY ASSET, AT THE DISCRETION OF THE OPERATIONS MANAGER*	Can be used as Technical Survey asset for back-blading and raking of spoil to search for smaller items (e.g. lower calibre UXO). It will not be possible to back-blade spoil if it is rocky or bound by vegetation. NB: Gill bucket should be used if available.
Front End Loader w/ Gill bucket	Can be used as a primary Technical Survey asset. Operations Manager to specify required Gill spacing. TS MUST STOP IF AN ITEM IS FOUND. OM MUST BE INFORMED AND WILL DECIDE ON FURTHER USE OF THE ASSET/METHOD ON TASK	Can be used as a primary Technical Survey asset. Operations Manager to specify required Gill spacing. TS MUST STOP IF AN ITEM IS FOUND. OM MUST BE INFORMED AND WILL DECIDE ON FURTHER USE OF THE ASSET/METHOD ON TASK	Can be used as a primary clearance asset for sifting AT and higher calibre UXO. Operations Manager to specify required Gill spacing.	Can be used as a primary clearance asset for back-blading and raking of spoil to search for smaller items (e.g. lower calibre UXO).
Front End Loader w/ Cultivator	Can be used as a primary Technical Survey asset. Operations Manager to specify required cultivator tine spacing. TS MUST STOP IF AN ITEM IS FOUND. OM MUST BE INFORMED AND WILL DECIDE ON FURTHER USE OF THE ASSET/METHOD ON TASK	Can be used as a primary Technical Survey asset. Operations Manager to specify required cultivator tine spacing. TS MUST STOP IF AN ITEM IS FOUND. OM MUST BE INFORMED AND WILL DECIDE ON FURTHER USE OF THE ASSET/METHOD ON TASK	*NOT TO BE USED*	*NOT TO BE USED*

This document is intended to provide a guide for asset deployment. Many different combinations of mechanical assets may be possible and will be task dependant. The suitability of assets and suitable combinations of assets is the ultimate decision of the Global Mechanical Officer and Operations Manager.

Annex B – Mechanical Clearance of Improvised Devices in a Rural Environment: Long Armed Excavator with Rake

1. **Introduction.** This annex covers the technical procedures to be used when conducting clearance of hazardous areas in a rural environment using mechanical demining equipment. The Operations Manager/Mechanical Officer is to decide whether or not this procedure is appropriate for the task (if not a separate procedure/annex is to be used) and make an assessment as to the likely device types and sizes.

Raking alone may be sufficient to consider the ground cleared of a specified threat. Alternatively, a second manual or mechanical process may be required to eliminate any residual hazard following the raking (surface or sub-surface BAC, for example). This assessment needs to be made during the task planning stage and re-assessed as more evidence is presented.

2. **Task Set up**. All aspects of task set up detailed in HALO Global IED SOPs 1 and 3 are to be adhered to. This includes establishment of a control point, medical point, setting out of the baseline etc. In addition, the following are required:

- General inspection area. A cleared area of ground approximately 10m^2 within boom reach of the excavator's working area, not closer than 5m to the machine body. To be marked by red markers in each corner. The general inspection area will need to be moved as clearance progresses.

3. **Mechanical Plant**. The main platform for this SOP is an armoured excavator fitted with a long boom arm. See annex A for guidance on HALO assets suitable for this clearance method.

- **Boom**. A boom arm of at least 8m should be used (dipper arm length may vary and should be approved by the Global Mechanical Officer). Shorter or longer booms may only be used if appropriate to the expected hazard and approved by the Global Mechanical Officer.
- **Rake**. The only rakes to be used are to be from designs approved by the Global Mechanical Officer. It shall be designed in order to allow forward-raking (away from the cab) to a depth of at least 15cm, and the teeth shall be sufficiently spaced to allow devices to be lifted from the ground. Where possible it should incorporate sacrificial components that can be easily replaced in the event of damage, and/or incorporate a grabber/cutter.

4. **Safety Distances**. During the pre-clearance assessment, the Operations Manager shall assess the hazard and designate the appropriate safety distances and record these in the task book. If in doubt, the largest of the distances should be used (see SOP 1 for full safety distance table).

5. **Process**. The ground is to be cleared to a minimum depth of 15cm or any relevant national standards (whichever is the greater). Clearance is to constitute at least one mechanical processes as well as Quality Control by the Team Leader. The following procedure is to be adhered to:

a. Rake phase. The rake head is to pass through the un-cleared ground to a minimum depth of at least 15cm (although 20-30cm is desirable). A minimum of two sweeps are to be conducted. The rake is to move away from the cab during the first sweep and be lifted at the end of the sweep to collect any debris or device components. The second is to be conducted towards the cab and again, to be lifted at

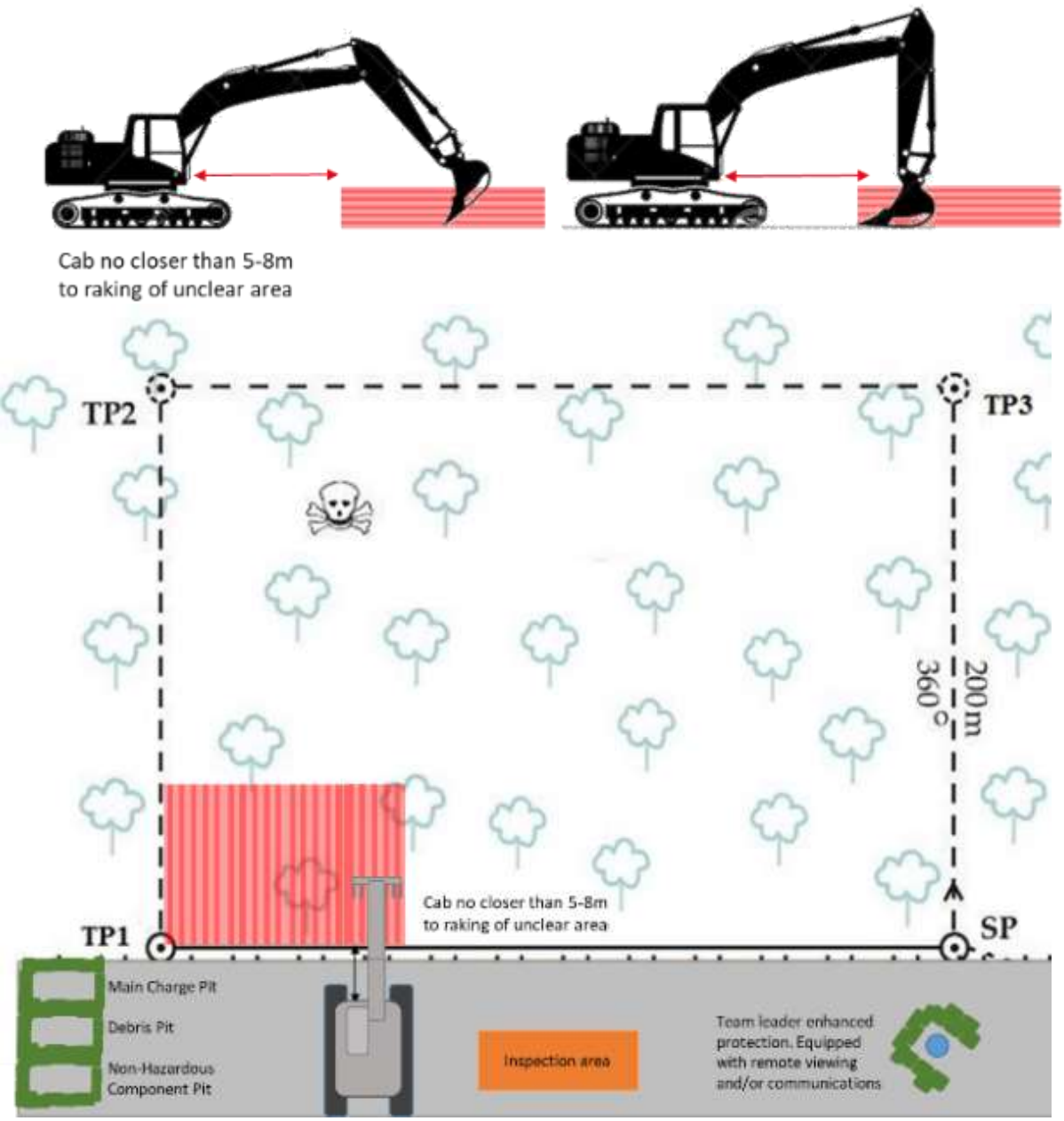
the end of the sweep to collect and debris or device components. Adjacent sweeps shall overlap by a minimum of two tines. The vehicle cab is to remain 5-8m away (as per SOP 1, safety distance annex) from the un-cleared area during the sweep.

b. Team Leader inspection and marking. The Team Leader is to watch the raking process and ensure that adequate depth is being achieved. Following this, the Team Leader is to conduct a visual inspection of the raked area. The Team Leader is then to move the marking stones forward, leaving 0.5m of raked soil as a buffer to both sides and to the front. While moving the marking, he/she is to conduct depth checks to ensure adequate depth has been achieved. In the event that the depth is deemed insufficient, the Team Leader must immediately retreat and inform the machine operator to rake again.

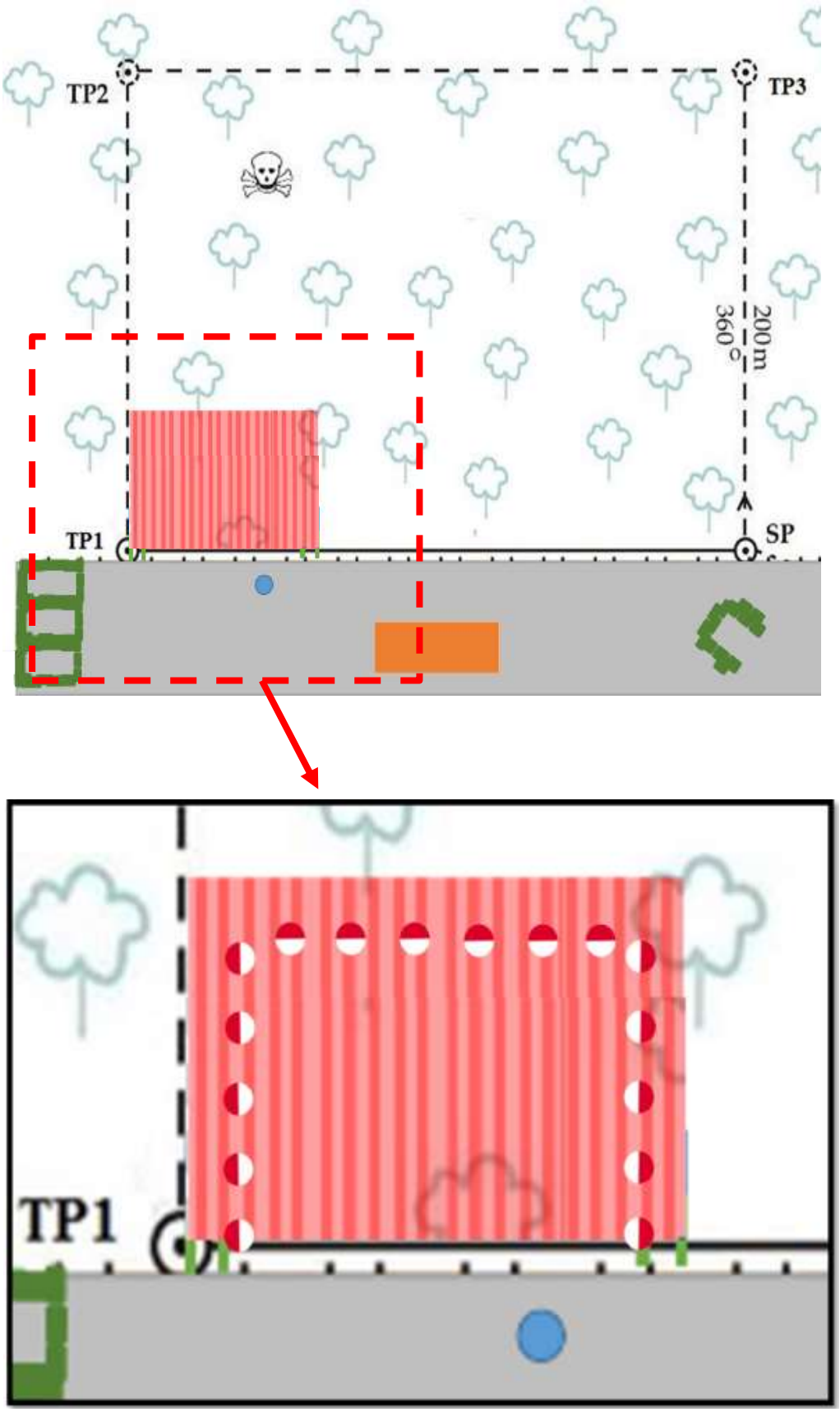
c. Progressing to next bound. Once the raked area has been visually checked, depth QC'd and marking moved, the Team Leader may instruct the operator to progress forward and rake the next bound.

c. Second mechanical process. If a second mechanical process is to be used, the operator is to clear the raked area leaving a 0.5m buffer to the left and right side and 0.5-1m to the front. In this case, blue and yellow marking sticks shall be placed by the Team Leader to indicate the area to be worked on by the second mechanical process. Any inspection of soil should be done in the inspection area as outlined in section Annex D.

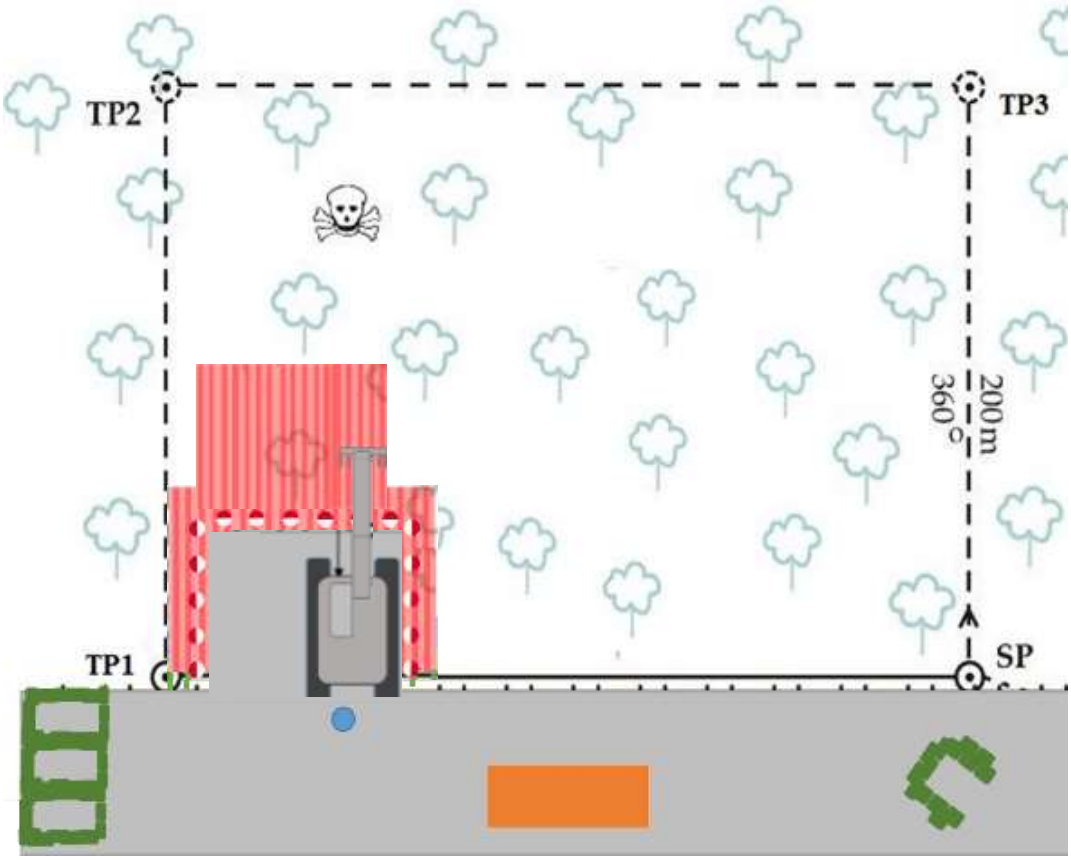
d. Quality control and marking. Prior to any soil being returned from the inspection area the Team Leader is to conduct a quality control check and mark the area. They are to conduct a physical inspection to ensure that the ground has been cleared to at least 15cm and mark the edges of clearance with red/white markers leaving a 0.5m buffer. They are then to brief the plant operator on the next area to be raked.



a. Rake Phase (note distance of cab from uncleared area while raking



b. Team Leader Inspection and Marking (note 1m buffer to left, right and front)



c. Progressing to Next Bound (note the need to rake to left and right sides as you progress, in order to maintain lane width)

6. **Actions on**.

a. Improvised device component part (non-hazardous). In the event of a component which is deemed to be non-hazardous being removed from the ground the plant operator is to stop machine operations. The Team Leader is to visually confirm the device (using optics, cameras or direct line of sight), return to the protected area and instruct the plant operator to place the items in the non-hazardous component pit. They should then direct the operator to the likely locations of other components and/or direct him to continue his raking pattern. The components are to be visually checked again by the Team Leader at the end of the shift.

b. Improvised device component part (hazardous). The plant operator is to place small hazardous components (such as det-cord, detonators in wire bundles etc.) in the incinerator or in the inspection area for further EOD action, main charges (not attached to any circuitry) are to be placed in the inspection area for further EOD action. The plant operator should then cease machine operations and the Team Leader (or EOD operator) is to carry out any required EOD action (in accordance with HALO Global IED SOP 5). Main charges should then be placed in the main charge pit for collection and/or subsequent destruction. The plant operator is to remain in the armoured vehicle until informed the device has been made safe by the Team Leader.

c. Complete/partial device. The plant operator is to stop machine operations, and the Team Leader is to visually confirm the device from the protected area (using optics or cameras). The plant operator is then to attempt to separate the components mechanically, beginning with the main charge. They should then place non-hazardous components in the relevant pit and the main charge in the inspection area for confirmation and detonator removal (if required) by the Team Leader (or EOD operator)

7. **Quality Control**. Quality Control is to be conducted in accordance with HALO Global IED SOP 4. In addition, the following checks are to be completed by the Team Leader:

- Daily inspection of mechanical plant including rake and other attachments
- Visual inspection of the raking process while it is being conducted, as well as visual inspection of raked areas, prior to moving of marking. The Team Leader shall look for areas that have been missed by the machine or do not appear to be sufficiently investigated. They are to record these and instruct the plant operator to re-rake.
- Physical inspection following second mechanical process. The depth of clearance should be checked and areas to be left un-cleared marked.
- Physical depth checking of raked area, before bounding forward
- Visual inspection of all pits at the end of each shift.

The Mechanical Officer is to conduct the following checks:

- Detailed inspection of any machine involved in an explosion, before it continues with operations
- Visual inspection of at least 10% of each task area
- Inspection of all pits at least once during any site visit
- Inspection of all machines at least once during any site visit

Annex C – Mechanical Clearance of Improvised Devices from Light Rubble: Long Armed Excavator with Grapple/claw and Rake

1. **Introduction.** This annex covers the technical procedures to be used when conducting clearance of light rubble in hazardous areas using mechanical demining equipment. Following non-technical survey, the Operations Manager/Mechanical Officer is to decide whether or not this procedure is appropriate for the task (if not a separate procedure/annex is to be used) and make an assessment as to the likely device types and sizes.

It is likely that in many cases this SOP will need to be combined with annex B (rural/rake) where rubble sits on soft ground or within a rural environment. In this case a layered approach will be required with rubble is removed in accordance with the below, and then the ground is subject to the rural drill before any people or vehicles can enter the area.

2. **Task Set up**. All aspects of task set up detailed in HALO Global IED SOPs 1 and 3 are to be adhered to. This includes establishment of a control point, medical point, setting out of the baseline etc. In addition, the following are required:

- General inspection area. A cleared area of ground at least 10m^2 within boom reach of the excavator's working area, not closer than 5m to the machine body. To be marked by red markers in each corner. The general inspection will need to be moved as clearance progresses
- Rubble area. A marked location in a cleared area for depositing innocuous debris/rubble. It will need to be large enough to accommodate all the anticipated rubble form a working area, at least 3m x 3m but possibly much larger. To be marked with black markers in each corner.

3. **Mechanical Plant**. The main platform for this SOP is an armoured excavator fitted with a long boom arm. It is to have the minimum below specifications:

- **Boom**. A boom arm of at least 8m should be used (dipper arm length may vary but shall be approved by Global Mechanical Officer). Shorter or longer booms may only be used if appropriate to the expected hazard and approved by the Global Mechanical Officer.
- **Grapple**. The only rakes to be used are to be from designs approved by the Global Mechanical Officer.

4. **Safety Distances**. During the pre-clearance assessment, the Operations Manager shall assess the hazard, and safety distances shall be applied according to SOP 1, safety distance annex. However, given the increase risk of secondary fragmentation, safety distances may need to be increased.

5. **Process**. As well as the removal of light rubble the ground beneath it is to be cleared to a depth of 15cm or any relevant national standards (whichever is the greater). This can be waived with permission

from the Operations Manager only if the ground is assessed as being impossible for devices to be seeded in- solid concrete with no signs of tampering for example[3]. The following procedure is to be adhered to:

a. Observation and planning phase. The Team Leader and plant operator are to visual inspect the area of rubble from a safe, cleared area. Using binoculars or other optics they are to look for signs of explosive ordnance and plan where the grapple will be used and/or where subsequent clearance will be needed. Particularly large or challenging pieces of rubble should be highlighted and the Team Leader should explain the order in which the rubble is to be cleared.

b. Rubble removal. Once the Team Leader is in his protective shelter and has confirmed no one is within the safety distances then the plant operator may begin removing the rubble. Large chunks of rubble are to be place in the rubble area with any smaller debris placed in the inspection area for sifting/sorting by supporting EOD personnel.

c. Sub-surface clearance. Unless a waiver has been specifically granted the ground beneath the rubble is to be cleared. **The ground is not considered to be cleared until the rubble has been removed and the ground has been subject to at least a primary search.**

d. Quality control and marking. Prior to any soil being returned from the inspection area the Team Leader is to conduct a quality control check and mark the area. They are to conduct a physical inspection to ensure that the ground has been cleared to at least 15cm and mark the edges of clearance with red/white markers leaving a 0.5m buffer. They are then to brief the plant operator on the next area of work.

Example of rubble grapple/claw

[3] The Operations Manager should consider that in many cases seemingly solid surfaces were modified, lifted and re-laid in order to disguise devices in many areas.

6. **Actions on**.

a. Improvised device component part (non-hazardous). In the event of a component which is deemed to be non-hazardous being uncovered the plant operator is to stop machine operations, the Team Leader is to visually confirm the device (using optics, cameras or direct line of sight), return to the protected area and instruct the plant operator to place the items in the non-hazardous component pit. They are then to direct the operator to the likely locations of other components and/or direct him to continue rubble removal. The components are to be visually checked again by the Team Leader at the end of the shift.

b. Improvised device component part (hazardous). The plant operator is to place small hazardous components (such as det-cord, detonators in wire bundles etc.) in the incinerator or in the inspection area for further EOD action, main charges (not attached to any circuitry) are to be placed in the inspection area for further EOD action. The plant operator should then cease machine operations and the Team Leader (or EOD operator) is to carry out any required EOD action (in accordance with HALO Global IED SOP 5). Main charges should then be placed in the main charge pit for destruction and/or collection. The plant operator is to remain in the armoured vehicle until informed the device has been made safe by the Team Leader.

c. Complete/partial device. The plant operator is to stop machine operations, and the Team Leader is to visually confirm the device from the protected area (using optics or cameras). The plant operator is then to attempt to separate the components mechanically, beginning with the main charge. They are then to place non-hazardous components in the relevant pit and the main charge in the inspection area for confirmation and detonator removal (if required) by the Team Leader (or EOD operator).

7. **Quality Control**. Quality Control is to be conducted in accordance with HALO Global IED SOP 4. In addition, the following checks are to be completed by the Team Leader:

- Daily inspection of mechanical plant including rake and other attachments
- Visual inspection of the clearance area (see relevant annex for QC of any second mechanical process applied).
- Physical inspection following any second mechanical process. The depth of clearance should be checked and areas to be left uncleared marked.
- Visual inspection of all pits at the end of each shift.

The Mechanical Officer is to conduct the following checks:

- Detailed inspection of any machine involved in an explosion, before it continues with operations
- Visual inspection of at least 10% of each task area
- Inspection of all pits at least once during any site visit
- Inspection of all machines at least once during any site visit

Annex D – Inspection/deminer support to mechanical clearance operations in a rural environment

1. **Introduction.** This annex covers the technical procedures to be used when deminers are used to support mechanical clearance operations in a rural environment (Annex B). In order to ensure adequate assurance that the ground has been cleared a second mechanical process may be required after a primary search (e.g. Rake or Cultivator), this will normally be a front loader moving the soil to an inspection area, for inspection by support deminers (but could also be conducted by an excavator with standard bucket).

   In this case, the ground has already received a primary search and hence the threat of IED main charges and higher calibre UXO has been discounted, resulting in a lower level of risk during inspection. The exact level of risk should be recorded following a task specific threat assessment. In addition, deminers may be required to conduct normal manual clearance drills (in accordance with HALO Global IED SOP 3) to assist with vehicle recovery, CASEVACs, or clear areas of the task that are inaccessible to mechanical plant (as outlined in section 4.5).

2. **Task Set up**. All aspects of task set up detailed in HALO Global IED SOPs 1 and 3 are to be adhered to, and the requirements in HALO Global IED SOP 4, Annex B. This includes establishment of a control point, medical point, setting out of the baseline etc. In addition, the following is required:

- Manual inspection area. The exact size of inspection areas will vary depending on the space available, number of bucket loads planned for each inspection lane and the machine/bucket being used. In any case, it should be sufficiently sized so that there is enough space around deposited spoil for deminers to work and conduct a casualty evacuation (as indicated in the image below). Inspection areas should be as close to the excavation face as possible so as to reduce machine travel time.

3. **Equipment and personnel**. This procedure will require an armoured excavator or front loader plus at least two support deminers who should be equipped as follows:

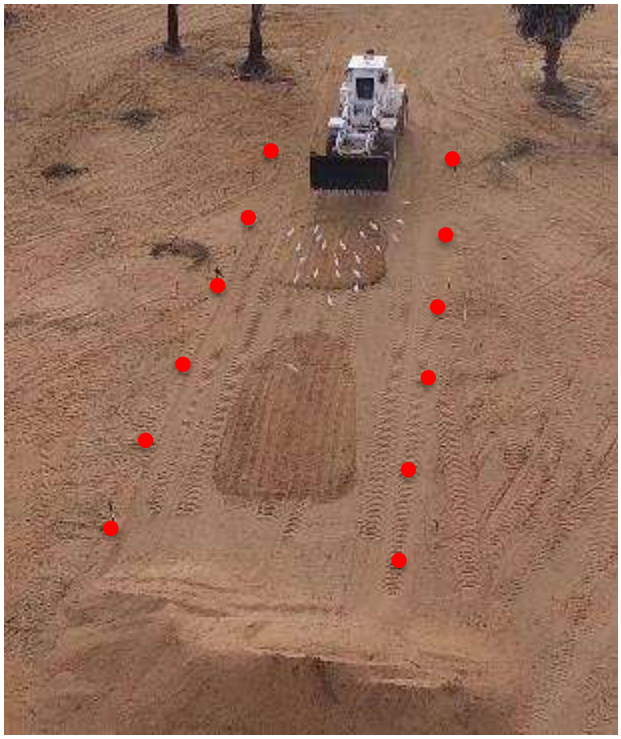
- PPE
- Hard hat mounted visor (minimum of 6mm thick, preferably 8mm).
- 2.5m wooden handled rake with rake head approved by the Operations Manager

- Hand held detector, in configuration approved by the Operations Manager
- Long sleeves and heavy work/gardening gloves.
- Deminer's tool bag
- Marking rope, chips and sticks to meet the requirements below

4. **Safety Distances**. During the pre-clearance assessment, the Operations Manager shall assess the hazard and designate the appropriate safety distances and record these in the task book. See SOP 1, safety distance annex for guidance. If in doubt, the largest of the distances.

5. **Process**. The ground is to be raked under the procedures in annex B. The second mechanical process/inspection should be conducted as follows:

a. Preparation of inspection area - The loader or excavator use the bucket to create a clean and flat base for the inspection lane, at the appropriate width for the bucket. The lane should be marked along each side with red stones or marking sticks at 1m intervals, in order to guide the operator (see indicative image to the right).



b. Lifting and depositing of soil – The clearance lane should be a minimum of 5m wide. Excavation should be done to a minimum depth of 20cm (in practice 25cm+ will be preferable), unless stated otherwise in the clearance plan. The Inspection Team (Team Leader and Deminers) should remain behind shelter whilst the Loader collects un-cleared soil and completes Back-Blading.

Loader collects one ¾ full bucket of contaminated soil from the excavation face/spoil pile and drives to the Inspection Area. The loader drives to one end of the inspection area and deposits the soil onto the ground from as low a height as possible (this is to prevent soil spreading over a large area). If a Gill has been fitted then the operator will empty any vegetation or other items caught in the Gill into a marked area next to back blading area, where it will be inspected for any mines or UXO under the direction of the Team Leader.

The loader then moves forward until the front wheels are close to, but not touching the soil. With the bucket positioned at a shallow angle the Operator lowers the bucket to the ground to the far side of the soil. Upon reversing the soil should flow under the bucket and through the small spaces between the cutting teeth on the bucket lip. This action should cause shallow furrows of soil to form straight lines the length of the Inspection Area.

Where back blading by excavator this shall be conducted by preparing and selecting an inspection area as described above. The excavator will place the uncleared soil into the inspection area and then use the teeth of the excavation bucket to spread the soil and create furrows for the raking deminers as described above.

The number of back-bladed piles shall be determined by the Operations Manager and shall be determined based on the space available and the most efficient use of the team members.

c. Soil inspection - The Operator shall signal to the Team Leader that the inspection areas are full and ready for inspection. This signal can be made by use of the horn or by radio communication. The inspection team shall now leave the shelter wearing their full PPE. Approach into the inspection area shall be made along the outside edge of the back-bladed soil.

Each back-bladed bucket of soil may have two Deminers raking it at any one time. They should work facing each other, to provide maximum protection from their PPE and be a minimum of 25m from any other inspection lane. Where the threat assessment deems this to be inappropriate, the Operations Manager will write a bespoke safety distance requirement, recorded in the task dossier (potentially the use of only one Deminer per bucket of spoil).

Starting at one end of the furrows, the Deminers initially carry out a visual inspection. If a suspicious item is identified, the Team Leader is immediately informed.

If no suspicious items are identified during the visual inspection, the Deminers rake the soil towards them looking for any suspicious items amongst the soil. The Deminer work one furrow at a time and continues like this until the furrow is completed, at which point they start raking the next furrow. Two Deminers work their way towards each other from opposite sides of the back-bladed soil until all of the soil has been inspected. On finding a hazardous, suspicious or unknown item, the Deminer shall stop work and inform the Team Leader.

Large lumps of soil may contain mines/UXO and require inspection. They should not be broken up manually by the Deminers but shall be left in situ while the remaining soil is raked. Once this is done the Loader shall back blade them for a second time, after which it shall be inspected by raking again. The Team Leader shall then inspect this soil to ensure it is free from mines/UXO.

While the machine is stood down (during manual raking), the team leader should periodically conduct a physical inspection of the excavation face, measuring that the minimum depth has been achieved.

Once the Team Leader is happy that all soil has been inspected, and any items have been dealt with, the loader may remove the cleared soil from the inspection area. This should be done by pushing the cleared soil into a spoil pile at the end of the inspection area, or loading it directly into a tipper truck for return to its original location.

Once the inspection area is cleared, the Operator may return the Loader to the un-cleared soil (pile or excavation face) to collect contaminated soil for the next back-blade inspection

d. Multiple inspection pits - It will usually be more efficient to have multiple pits running simultaneously. However, this will require additional supervision and maintenance of safety distances. Inspection pits must be at least 25m from each other.

6. **Actions On.** Actions on are to be the same as those laid out in HALO Global IED SOP 4 and Annex B to HALO Global IED SOP 4. In addition, the following are to be adhered to:

a. IED component part or ERW identified during mechanical lifting of soil. The plant operator is to stop work and inform the Team Leader. If safe to do so the machine is to move away from the item to allow the EOD operator access to the item. If the item is in the bucket the Team Leader may instruct the operator to lower the bucket to ground level and carefully deposit the item in safe area.

b. IED component part or ERW identified during excavation. The plant operator should attempt to place the item in a clear area in or near the inspection area. They are then to cease operations and inform the Team Leader. The EOD operator should then render safe the item in accordance with HALO Global IED SOP 5.

c. IED component part or ERW identified during visual manual inspection or manual raking. The deminer is to stop searching and inform the Team Leader. The EOD operator will then need to render the item safe in accordance with HALO Global IED SOP 5. It can be agreed beforehand by the Operations Manager that the Mechanical team, under the instruction of the EOD operator may move certain hazardous item from the inspection area to a marked collection area using the loader. Before moving a hazardous item from an inspection area to the collection area, all personnel other than the Operator should be at the appropriate safety distance and/or behind hard cover. The Operator should gently lift the item along with soil inside the bucket and deposit inside the relevant storage pit.

d. Spoil not suitable for back-blading with a standard bucket. Spoil contaminated with vegetation and /or rocks may not be suitable for back blading as lumps can become stuck behind the bucket, dragging the contents along the inspection lane and not spreading adequately for raking. Where this is the case, a gill bucket should be used in order to separate fines and larger items. These larger items must then be tipped into a separate inspection area for spreading and visual inspection.

7. **Quality Control**. Quality Control is to be conducted in accordance with HALO Global IED SOP 4. In addition, the following checks are to be completed by the Team Leader:
   - Daily inspection of mechanical plant including rake and other attachments
   - Visual inspection of the manual raking process while it is being conducted, as well as visual inspection of raked areas prior to clearing of inspection lane. The Team Leader shall look for areas that have been missed by Deminers or do not appear to be sufficiently investigated. They are to record these and instruct the Deminers to re-rake.
   - Visual inspection of all pits at the end of each shift.

The Mechanical Officer is to conduct the following checks:

- Detailed inspection of any machine involved in an explosion, before it continues with operations
- Visual inspection of at least 10% of each task area
- Inspection of all pits at least once during any site visit
- Inspection of all machines at least once during any site visit

Annex E – Technical Survey using Cultivator or Gill Bucket

Introduction. This annex covers the technical procedures to be used when conducting Technical Survey (TS) of tasks using mechanical demining equipment. Following non-technical survey, the Operations Manager/Mechanical Officer is to decide whether or not this procedure is appropriate for the task (if not a separate procedure/annex is to be used) and make an assessment as to the likely device types and sizes.

Mechanical technical survey should always be conducted in a systematic manner (as with manual TS) and the task layout will have been established in the pre-clearance plan. All TS lanes should be as straight as possible and parallel to any adjacent lanes.

If, during this TS survey process, devices are encountered, the Operations Manager must assess if the use of the methods outlined in the annex are still suitable for the task.

Cultivator and Gill bucket procedures are outlined in this annex. Both methods are intended to provide safe access lanes to Defined Hazardous Areas (DHA), so that other clearance assets can be deployed to clear the confirmed line of IEDs. Once the threat has been confirmed, these assets will be withdrawn as primary search tools.

8. **Task Set up**. All aspects of task set up detailed in HALO Global IED SOPs 1 and 3 are to be adhered to. This includes establishment of a control point, medical point, setting out of the baseline etc. In addition, the following are required:
   - A protective viewing screen is to set up such that the Team Leader is able to clearly observe the working machine.
   - <u>For use of a cultivator</u>
     - Depending on the pre-clearance threat assessment, the Operations Manager will be responsible for ensuring that there is the correct spacing between the tines prior to operations commencing. If the cultivator being used has adjustable tines, the spacing may be changed during clearance as a result of other findings.

3. **Mechanical Plant**. The main platform for this SOP is an armoured front loader fitted with either a Gill bucket or front mounted cultivator. See Annex A for guidance on HALO assets suitable for this clearance method.

The only ancillaries to be used are to be from designs approved by the Global Mechanical Officer.

- **Cultivator**. The working face of the cultivator shall be at a 5m stand of from the cab.
- **Gill Bucket**. The gill spacing must be suitably sized so as not to allow the target device to pass through and into the back of the bucket.

4. **Safety Distances**. During the pre-clearance assessment, the Operations Manager shall assess the hazard and designate the appropriate safety distances and record these in the task book. If in doubt, the largest of the distances should be used (see SOP 1 for full safety distance table).

5. **Process**.

Cultivator:

a. Engaging the Ground

Depth of Penetration - The operator should aim to achieve a target depth of 25 cm from original ground level. As per HALO global SOPs the minimum acceptable depth of clearance is 15 cm. Any deviation from this standard will first need to be authorised by the Operations Manager following a detailed risk assessment.

Start Point - The operator will engage the ground as far as is required before the start of suspect area to ensure the cultivator has reached the target depth prior to entering the suspect area. Likewise, after any planned or un-planned stops of the vehicle, they should reverse a suitable distance (this will be specific to the ground conditions and will be the ultimate responsibility of the Team Leader) to ensure correct depth of clearance before continuing.

Width of lane - The operator shall maintain a lane of at least five meters (incl. 50cm overlap). If the cultivator being used is the same width as the vehicle width (incl. tyres) then the machine must never progress so far, in any one run, that both front wheels are bounded by un-cleared soil. This helps ensure that the loader tyres do not enter the un-cleared ground.

Overlap - An overlap of 50 cm between cultivator widening passes must be strictly adhered to.

b. Processing

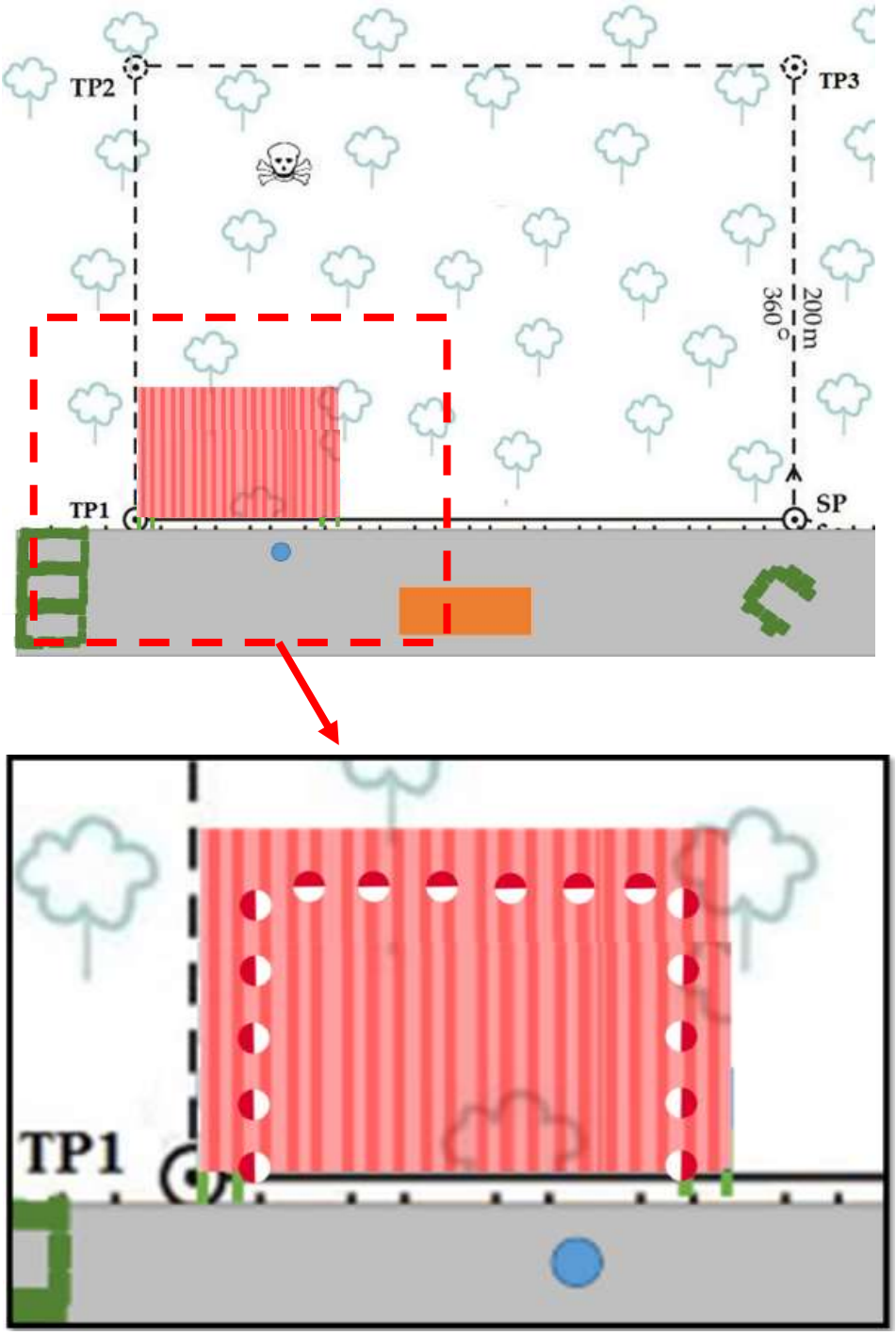
1. Once the cultivator has been engaged in the ground to the correct depth, the operator will drive forward progressively, at the appropriate speed that allows the operator to maintain the correct depth, safely observe the process and prevent excessive build-up of soil at the cultivator face. He/she will stop at a maximum of 20 linear meters, or before the tyres are bounded on both sides by un-cleared soil (depending on the cultivator being used – see section a) above).
2. The operator will then lift the cultivator from the ground and reverse back. If the required depth has not been achieved, the operator must repeat the process in the same area until it has been.
3. When the correct depth has been achieved, if the cultivator being used is the same width as the vehicle width (incl. tyres), the operator will then move to the left or right (under the instruction of the Team Leader) to widen the lane, using the same process outlined in point 1.
4. Once the bound is complete, the operator will stop work and inform the Team Leader. A bound will be a maximum of 20 linear meters.

If during the process excessive amounts of soil build up in front of the cultivator, the operator must:

- Stop
- Carefully back blade the built up soil over as short a distance as possible, in order to level it
- Continue cultivating the now level ground, starting from the rear of the back bladed soil

Excessive soil must not be allowed to build up in front of the cultivator. If soil is allowed to build up, there is a risk of burying items in the built up spoil and losing sight of the original ground level – both increasing the likelihood of missing items.

c. Team Leader inspection and marking. The Team Leader is to watch the process and ensure that adequate depth is being achieved. Following this, the Team Leader is to conduct a visual inspection of the cultivated area. The Team Leader is then to move the marking stones forward, leaving 0.5m of processed soil as a buffer to both sides and to the front. While moving the marking, he/she is to conduct depth checks to ensure adequate depth has been achieved. In the event that the depth is deemed insufficient, the Team Leader must immediately retreat and inform the machine operator to cultivate again.



c) Team Leader Inspection and Marking (note 0.5m buffer to left, right and front)

d. Progressing to next bound. Once the cultivated area has been visually checked, depth QC'd and marking moved, the Team Leader may instruct the operator to progress forward and work the next bound.

Gill Bucket:

a. Excavation

Start Point - Once an excavation start point has been decided the Loader shall start its excavation a minimum of one machines length back from the start point. This will ensure that the excavation lane is of the correct depth before the machine enters the danger area. It also makes the maintaining of the depth easier for the Operator. The soil removed from behind the start point does not require inspection and can be placed to one side for later replacement.

Depth of Cut - The Operator shall excavate to a minimum depth of 20cm, and should attempt to keep the cut not more than 30cm to prevent the removal of excessive amounts of soil.

Width of lane - The operator shall maintain a lane of at least one and a half buckets (incl. 50cm overlap). The machine should never progress so far, in any one run, that its wheels are bounded on both sides by un-cleared soil. This ensures that the loader tyres do not enter the uncleared ground.

Bucket Load - The Operator shall remove no more soil on each cut than can flow through the Gill. The amount of soil removed during the cut is dependent of the type of soil being removed. If the soil is light and sandy then more soil can be excavated each cut, than if it is heavy and stony. The condition of the soil is also a factor as dry soil will flow through the Gill easier than wet soil.

Loader control - The Operator shall ensure that whilst manoeuvring within the lane, the wheels do not leave the safety of the excavated area.

b. Inspection

Initial Check - The Team Leader should, if possible, position themselves in a safe area with good view of the working bucket. On excavation of the soil, the Operator is to tilt the bucket to encourage the flow of soil through the gill. On lowering the bucket the Team Leader should be able to see any items forward of the Gill. If it is not possible for the Team Leader to be safely forward of the Loader then the Operator will need to manoeuvre from the lane to an area where the Section Commander can safely observe the Gill. The only exception to this is where a camera is fitted to the machine so that the operator has full view of the gill from inside the cab. Even in this case, the view of the Team Leader is preferable.

Soil Placement - If the presence of items in the back of the bucket is not suspected (e.g. AP mines), then the soil in the bucket can be dumped or returned directly to the mine field. If the area is thought to hold an explosive hazard, then the soil shall be removed to a marked tipping area for subsequent inspection or processing (see Annex D).

6. **Actions on**.

If during this TS process devices are encountered, work in the given lane must be stopped and the Operations Manager informed. The Operations Manager must then assess if the use of the methods outlined in this annex are still suitable for the task.

Cultivator:

a. Improvised device component part (non-hazardous), Improvised device component part (hazardous) or Complete/partial device. In the event of a component which is deemed to be non-hazardous, hazardous or complete being removed from the ground the plant operator is to stop machine operations. The Team Leader is to visually confirm the device (using optics, cameras or direct line of sight). They should then close off that lane and report the finding to the operations manager. A secondary asset will then be required to deal with the finding.

Gill Bucket:

a. Improvised device component part (non-hazardous). In the event of a component which is deemed to be non-hazardous being removed from the ground the plant operator is to stop machine operations. The Team Leader is to visually confirm the device (using optics, cameras or direct line of sight), and place the items in the non-hazardous component pit. The components are to be visually checked again by the Team Leader at the end of the shift.

b. Improvised device component part (hazardous). In the event of a component which is deemed to be hazardous being found in the bucket, the plant operator is to stop machine operations. The Team Leader is to visually confirm the device (using optics, cameras or direct line of sight). The plant operator is to place small hazardous components (such as det-cord, detonators in wire bundles etc.) or Main charges (not attached to any circuitry) into an inspection area for further EOD action (in accordance with HALO Global IED SOP 5). The plant operator is to remain in the armoured vehicle until otherwise informed by the Team Leader.

c. Complete/partial device. The plant operator is to stop machine operations, and the Team Leader is to visually confirm the device from the protected area (using optics or cameras). The plant operator is then to lower the bucket to the ground in the cleared area and carefully deposit the item on the ground.

See section 4.2 of this SOP for actions on hazardous items caught on machinery.

7. **Quality Control**. Quality Control is to be conducted in accordance with HALO Global IED SOP 4. In addition, the following checks are to be completed by the Team Leader:

- Daily inspection of mechanical plant including any attachments
- Visual inspection of the working process while it is being conducted, as well as visual inspection of working areas, prior to moving of marking. The Team Leader shall look for areas that have been

missed by the machine or do not appear to be sufficiently investigated. They are to record these and instruct the plant operator to re-processed.

- Physical inspection of excavated areas. The depth of clearance should be checked and areas to be left uncleared marked.
- Physical depth checking of cultivated areas, before bounding forward
- Visual inspection of all pits at the end of each shift.

The Mechanical Officer is to conduct the following checks:

- Detailed inspection of any machine involved in an explosion, before it continues with operations
- Visual inspection of at least 10% of each task area
- Inspection of all pits at least once during any site visit
- Inspection of all machines at least once during any site visit

END