

Excavating indications during mine clearance

Two proven systems are explained here, one method using hand-tools and the other using rakes. Both have safely exposed many thousands of mines and explosive devices.

Excavating a metal-detector signal using hand-tools

When a metal-detector signal has been pinpointed and a signal marker placed at the nearest part of the reading, the deminer can begin a signal-investigation procedure. If at any point during the procedure the source of the metal-detector indication is found and it was not a mine or ERW, the deminer should stop the investigation and return to the metal-detector search procedure, checking the area where the metal was found to see if there are other indications.

If a mine or ERW is located, the deminer should expose the closest side of the device.

Hand-tools used during signal excavation should be blast resistant and keep the user's hand as far from the device as is practicable. 30cm has been proven effective in maintaining control of the tool while putting enough distance between the hand and an anti-personnel blast mine to prevent severe injury in most cases.



The picture above shows some blast resistant hand-tools. Any tool that is used in the ground during signal excavation should be blast-resistant to prevent them separating or fragmenting in an anti-personnel mine blast. Tools designed for gardeners may only be used for vegetation cutting.

Magnets

Strong magnets can be very useful in areas where metal-detector search is used and there is a lot of metal contamination in the ground. Magnets may be attached to tools or can be held in the hand. They should be brushed lightly over the ground surface without downward pressure.

The photograph below shows typical minefield scrap metal. Most of the metal has a ferrous content, so it is magnetic. The only item that is not magnetic is the ring-pull from a drink can.



Special tools for hard ground

When ground is exceptionally hard, a signal investigation may be started using a two-handed digging tool to break up the ground surface at least 20cm from the nearest part of the indication (the distance from the indication must be more than half the diameter of the largest anticipated target at the task). Digging down to the Clearance depth in a safe place gives the deminer a point from which to work forward towards the indication using other tools.



The deminer in the photograph above is using a two-handed tool to start the excavation well away from the metal-detector reading. The tool is made using blast-resistant material and its design includes a guard for the hand that would be closest to any blast.

Slicing tools

When investigating a metal-detector investigation or conduction area-excitation, there are times when the use of a tool that slices away the face of the excavation can be efficient and safe. Slicing tools can only be used when none of the anticipated targets are movement sensitive and none have pressure plates extending to the edge of the mine.

Movement sensitive ERW includes some submunitions that must be excavated with the greatest caution.

AP blast mines have pressure plates of various sizes. Pressure plates that are small make the mine less likely to be stepped on – but they also make the mine less likely to be detonated by the pressure wave associated with an air-blast nearby.



The GYATA-64 and PMN mines shown above have pressure plates extending to the edge of the top of the mine. When these mines are anticipated, signal investigation using a slicing procedure must NOT be conducted.



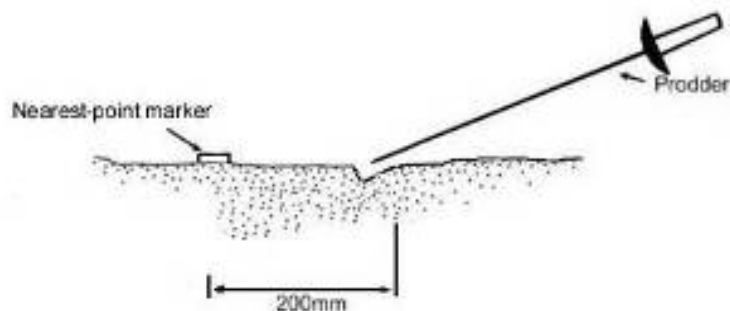
The AP mines shown above are the MAI-75, PMN-2 and Type-72. In each case the pressure plate is smaller than the top of the mine and excavation using a cautious slicing procedure may be permitted.

Procedure

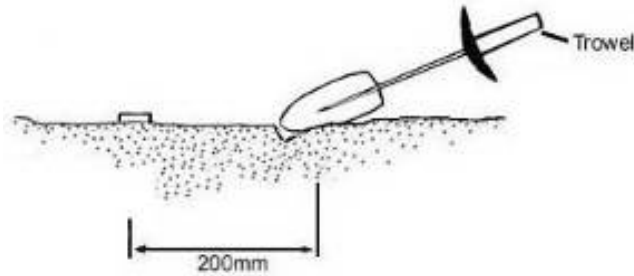
The following procedure should be followed to investigate a metal-detector signal:

- 1) The deminer must begin by looking closely at the ground surface for sources of the metal-indication. If any metal is found, the deminer should remove the metal and check the position with the metal-detector. Throughout the investigation, the deminer should be constantly searching the ground by eye, looking for the source of the metal-detector signal.
- 2) When magnets are available, the deminer should pass a magnet over the ground surface where the detector indicated. The signal marker may be temporarily removed for this. The 'Light rake' with a magnet may also be used for this. After a magnet is used, the deminer should check the area with the metal-detector again.
- 3) An investigation should be started by prodding the ground at least 20cm back from the signal marker. In most ground, the prod will not penetrate more than a few centimetres. The deminer must not apply excessive pressure to make the prodder go more deeply into the ground. If the prodder will not penetrate 3cm, the deminer should use another approved tool to break the ground surface. Sometimes the ground has a crust with softer spoil underneath. Frequently the ground becomes harder as the investigation gets deeper, and the use of other tools may be required.

The ground should be prodded or broken-up over a width of excavation equal to the width of the anticipated threats at the site. If anti-personnel mines are expected, a width of at least 15cm is required. If anti-tank mines are expected, a width of at least 30cm is required.

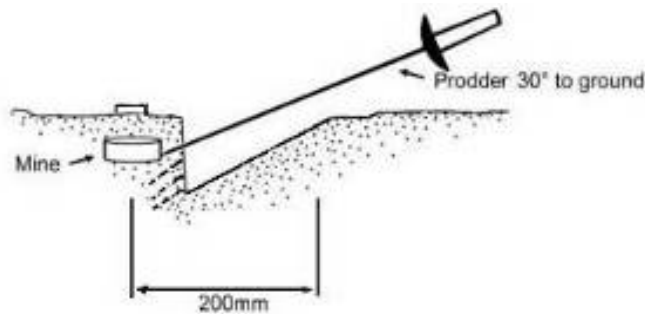


- 4) The ground that has been loosened with the prodder should then be removed with a trowel.



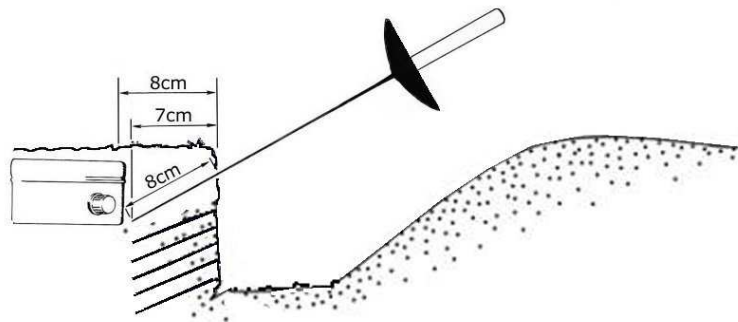
Whenever metal is found during the excavation, with the magnet or by eye, the deminer should check the position of the original indication with the metal-detector.

- 5) Steps 3 and 4 should be repeated as many times as necessary to create a sloping hole advancing towards the signal-marker. The depth of the hole should reach the required Clearance depth at the site BEFORE the marker is reached.



The side of the excavation closest to the marker is approximately vertical. This must be prodded from the bottom upward at a spacing of 2cm. The prodded earth can then be removed with the trowel. When the prodder meets an obstruction, the prodder should be used to feel for the sides of the obstruction and so estimate its size. The trowel should then be used with extreme caution to expose the obstruction.

In soft ground, it may be possible to insert the prodder as much as 8cm into the ground. The prodded ground can then be cut away with the trowel in complete confidence that there is nothing concealed within it. The ground cut away must never be more than the ground searched with the prodder.



For safety and to ensure an overlap, the deminer must never cut more away than 75% of the soil that has been prodded. The length prodded is NOT the distance ahead of the excavation face that can be safely removed with a trowel. The picture above shows a prodder inserted 8cms into the ground. Because of the angle of the prodder, the prodder has only reached 7cms into the unknown ground. In this

example, if a deminer were to cut 8cm of soil away with the trowel he/she would press on the edge of a concealed PMN mine.

After prodding (bottom upwards) the face of the signal-investigation, the deminer should insert the prod a final time and grip the blade to record the depth before withdrawing it. He/she should then estimate three-quarters of the length and mark the ground ahead of the hole lightly with the prodder tip. The ground up to that mark can then be removed with the trowel safely.

Lightly tapping an obstruction with the prodder may provide feedback to confirm that the object is likely to be a mine. However, the deminer must expose any obstruction with extreme caution, regardless of the “feedback” from the prodder.

- 6) If no obstruction is found at the signal-marker, the deminer should check the position of the indication with the metal-detector. When the metal-detector continues to signal over the area, it may be appropriate to dig more deeply. The deminer’s controller should decide this based on the Task Risk Assessment and any pattern of mines that may be known. Generally, when a mine is missing from an anticipated pattern and there is a metal-detector signal near where the mine was expected, the depth of excavation should be increased until the source of the signal is found.

When searching more deeply, the deminer should start excavating again, beginning further away from the indication and extending the slope of the hole so that any hidden device will still be approached from the side.

When a mine/device has been found and the parts facing the deminer have been gently exposed, appropriate procedures for recovering/disarming/moving or destroying the device in-situ must be applied. These will depend on the device, its condition and the approved procedures of the demining group. In general, any device that appears to be damaged or may be movement sensitive should be destroyed in-situ.

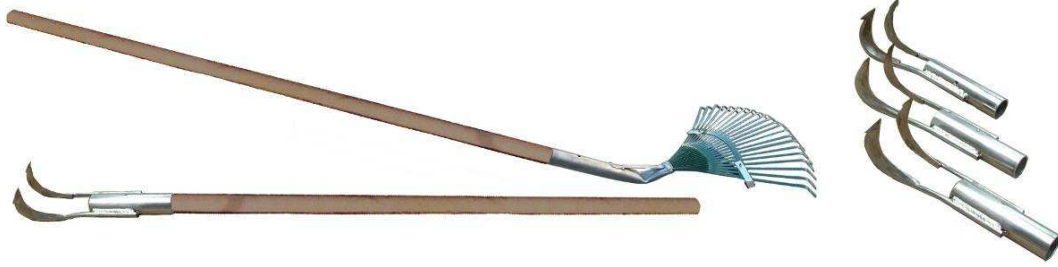
Investigating a metal-detector indication using long-handled rakes

Suitable long-handled rakes can be used for signal investigation. The hand-tools approved for signal investigation should also be available, along with a plastic bucket in which to place metal contaminated ground.

The light rake can be fitted with a magnet to help remove metal-clutter. The scratching action of the rake loosens fragments in the soil surface and often means that the deminer finds the metal that made the metal-detector signal.

NOTE: *The light rake must be tested against the AP blast mines that may be present. Testing the light rake involves using the rake to expose a rendered-safe test-mine. The initiation mechanism of the test-mine must be intact and the High Explosive removed. If the light rake initiates the fuze mechanism in the test-mine, it fails the test and cannot be used at Tasks where that mine is anticipated. Anti-personnel mines that have passed previous tests include the PkMk2/4, Type 72, PMA-3, M14 and PRB M35.*

The use of REDS rakes to investigate metal-detector signals can be very fast when mines are relatively close to the surface or when the source of a detector reading was a ferrous fragment close to the surface. In soft ground, the time saving over using other hand-tools to make the investigation can be significant.



Variations in REDS rake design should be tested. Heavy rake heads should be made using E304 Stainless Steel. Light rake heads may be made from plastic or sprung steel.

The REDS light rake (with or without a magnetic attachment) and the REDS heavy rake can be used to investigate metal-detector readings or for area-excavation.

Before starting the REDS detector investigation procedure, an area behind the deminer must be prepared to place the rakes and the metal-detector so that the deminer can change tool quickly.

Procedure

When a detector signal has been pinpointed, the deminer can begin a signal-investigation procedure with rakes. The following procedure should be followed:

1. Remove the signal marker and make a mental note of its position.
2. In a standing position, and holding the handle well back from the rake-head, use the light rake over the area where the metal-detector signalled. The rake tines scratch the ground surface and can expose metal fragments just below the ground surface. Soil collected by the brushing of the rake should be moved back to the base-stick with the rake.
The area raked will usually extend from 20cm beyond the metal-detector reading to the base-stick and be the width of the light rake head.
3. Look closely for exposed metal. When the magnetic light rake is used, the magnet may have picked up the metal. Use a hand-held magnet if necessary. If metal is found, the deminer should use the metal-detector to check the position of the indication. If the indication has gone, the investigation has been completed and the deminer should return to the metal-detector search procedure.
4. The area must be searched with the metal-detector again. This must be done whether or not metal fragments have been found because the action of the rake may have moved any non-magnetic metal.
5. Use the light rake to move soil from the area of the indication back to the base-stick. Continue until the light rake becomes ineffective. When roots are uncovered, they should be cut with pruners.
6. Check with the metal-detector to find out whether the signal has moved.
7. If the signal has moved, move the earth with metal in it into the plastic bucket and check with the metal-detector again.
8. If the metal-detector signal has not moved, use the heavy rake. Hold the rake handle as far as possible from the rake head. Place the heavy rake on the ground surface beyond the metal-detector reading in a place where the metal-detector did not signal when the area was searched.

NOTE: *The metal-detector search procedure usually means that an area beyond a signal position has been searched with the detector. When it has not, the deminer should ensure that the area closest is clear, then advance the base-stick so that he/she can safely sweep the metal-detector search-head beyond the area under investigation before using the heavy rake. The head of the heavy rake must not be placed on the ground directly above a metal-detector indication or on ground that has not been searched using the metal-detector.*

9. Drag the heavy rake towards the base-stick without downward pressure. Repeat this across the area where the metal-detector signalled until the soil is loose, then place the heavy rake in the safe-area.
10. Use the light rake to move the loosened soil back to the base-stick.
11. Return to Step 3 and check with the metal-detector to find out whether the metal has moved. Repeat Steps 3 to 10 until the detection depth has been reached or until the reason for the metal-detector signal has been found.

When a device is close to the surface or in loose soil, the light rake will expose the top of it. When this happens, the movement of the rake tines over the device can make an obvious scratching noise. In soft ground the heavy rake may expose or lift a mine or ERW to the surface.

When a device is found, the deminer should expose the parts facing the base-stick using approved hand-tools.

If the ground becomes harder at increased depth, the deminer should use the metal-detector to reposition the signal-marker and continue the investigation using approved hand-tools.

When a mine/device has been found, appropriate procedures for recovering, disarming, moving or destroying the device in-situ must be applied. These will depend on the device, its condition and the approved procedures of the demining group. In general, any device that appears to be damaged or may be movement sensitive should be destroyed in-situ.