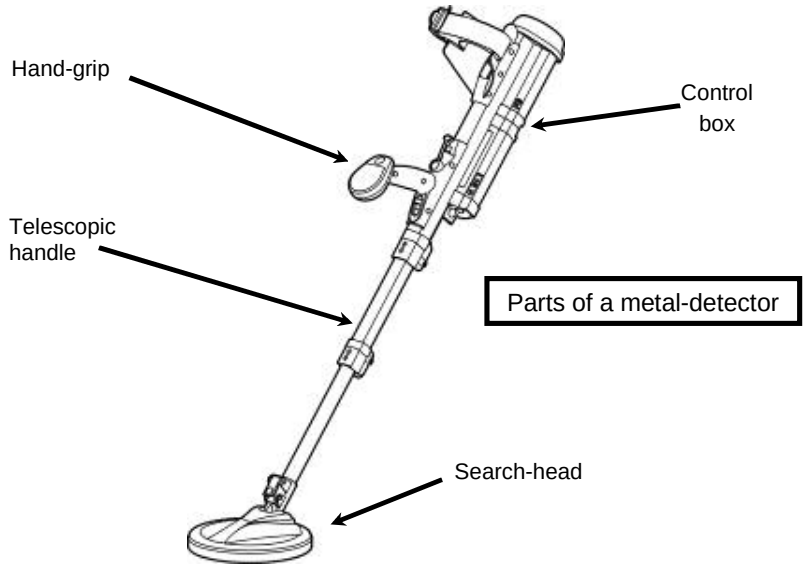
Using a metal-detector to locate explosive hazards

There must always be absolute confidence in the metal-detector's ability to locate the target device at the required depth before metal-detector Clearance procedures are used. Because equipment and deminers can both be at fault, it is essential to confirm that the metal-detector and its operator can locate the anticipated target. To determine whether the detectors can be used, metal-detector Test and Calibration areas must be established.

At the start of the working period, or after any period when the detector has been turned off, the detector must be switched on and set-up. The deminers must follow metal-detector turning-on and set-up procedures as outlined in the manufacturer's instructions.

NOTE: *The manufacturer's instructions determine whether the detector is working as designed, NOT whether it can locate the threats at a particular Task.*



Parts of a metal-detector

Detector calibration area

The Calibration area is needed for carrying out Ground Compensation (GC). This is the same thing as the "Ground Learning Function" referred to in the some metal-detector manuals.

The GC must be set-up as described in the manufacturers' documentation. To do this, a metal-free Calibration area of one metre square should be prepared close to where the deminer will work. The area should be moved forward as work progresses so that it is always within 100 metres of the place where the deminer will work. Usually the Calibration area will be close to the detector Test-area.

When a metal-detector cannot compensate for the electromagnetic properties of the ground and continues to signal or signal erratically where there is no metal, it must not be used at that Task (or that part of the Task).

Detector test area

The metal-detector Test area is used to ensure that the detector can reliably signal on a Target mine at the required depth. After the detector has been set-up with appropriate Ground Compensation, its ability to detect a Target mine must be checked. Each detector's ability to signal the presence of a Target mine at the Clearance depth must be confirmed.

The deminer must NOT use a metal-detector manufacturer's test piece as a reliable simulation of a real mine target. Target mines that accurately reflect the electromagnetic signature of the mine that is most difficult to locate at the Task must be used. This is usually a real mine that has been rendered safe. T

NOTE: *A minimum-metal mine that has been rendered safe for use as a metal-detector target is NOT Free From Explosive (FFE) because the detonator is generally present. They must not be marked as FFE but as "Detector Targets". They should be transported and stored as "detonators". They should be clearly marked (painted red) to avoid any confusion.*

The target mines must be buried in metal-free Detector test areas close to where the deminers will work (usually within 100 metres). Each target mine should be concealed in a marked area measuring at least 0.5 metres on each side. The target mine must be buried so that the top of the mine is at the required Clearance depth at the Task. The photograph alongside shows the depth of a test mine being measured.

Using the detector Test and Calibration areas

The deminer must set-up the detector in the Calibration area and then use it over the detector Test area to check that the detector signals on the test mine. If the metal-detector does not give a distinct signal over the test mine, the detector should be set-up (with GC) again and a second attempt made. If there is any ambiguity about the signal, other detectors should be used in the test area. If they can find the target, the first detector is faulty and must be removed from service. If other detectors cannot reliably detect the target, clearing the area with metal-detectors is not appropriate and the Task Release Plan should be adjusted appropriately.

If the supervisor can detect the test mine but the deminer cannot, the deminer must not be allowed to work with a metal-detector until he/she has been trained to use the detector again.

Every time that a deminer leaves the working area (for rest breaks etc) the ability of the detector to signal in the Test area should be confirmed. Detector performance can change while it is being used. This may happen, for example, as a result of temperature variations, battery condition or general malfunction. If the detector does not signal on the target concealed in the Test area when the deminer leaves the working area, the area searched since the last check must be searched again. The second search can be conducted using a detector that does signal reliably in the Test area, or using other procedures.

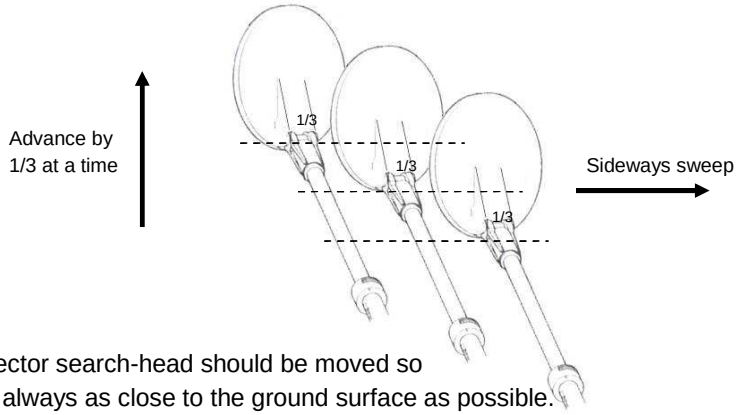
Search-head movement

The sideways movement of the search-head depends on its operating principle ("static" or "dynamic"). The search-head of a dynamic detector must be constantly moved over a target in order to signal. The search-head of a static detector will continue to signal when held still over a target. Some models of detector can be switched between static and dynamic operation.

Whichever model of detector is used, the required rate of advance is one third (or less) of the search-head width when searching for minimum metal mines or one half of a search-head width when looking for mines with more metal inside. The search procedure may be varied in BACS processes, but not in full Clearance processes.

Metal-detector search procedure

The following procedure achieves a one third overlap of a detector search-head.

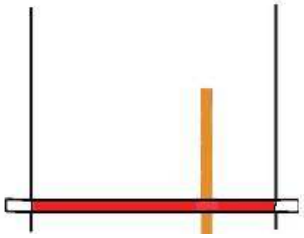


The detector search-head should be moved so that it is always as close to the ground surface as possible.

NOTE: *The detector search-head may be brushed lightly over ground that has been visually inspected but must not be used to "pat" the ground with an up-and-down movement.*

The ground in front of the deminer should be prepared using vegetation cutting techniques, and surface rocks should be removed. Cuttings and rocks must be placed behind the deminer and behind the last QA marker to ensure that they are in a safe-area.

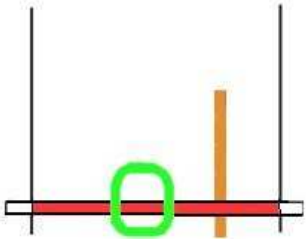
The deminer works forward from a base-stick. After cutting the vegetation, a 50cm long flat wooden "Guide-stick" may be laid so that is extends forward of the base-stick. The Guide-stick should be marked along its length to guide appropriate search-head overlap. The Guide-stick is optional.



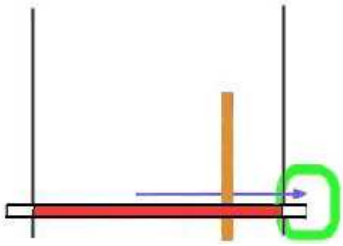
The preferred base-stick has 5 metre tapes attached to each end. The tapes are rolled out as work progresses. They are marked at every metre, providing a reminder to the deminer about placing side-marking.

The same search pattern must be used whether the deminer is standing or kneeling. The telescopic handle should be adjusted to an appropriate length before the detector is used in the detector calibration and test areas because changing the length of the telescopic handle can change the detector's sensitivity.

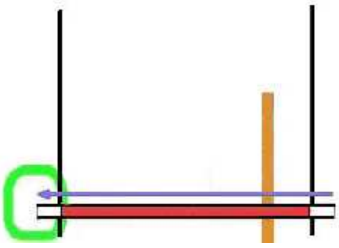
1. The search-head is placed in the middle of the base-stick, with at least one third of the search-head behind the base-stick. When using a raised base-stick, the search-head is placed under the base-stick.



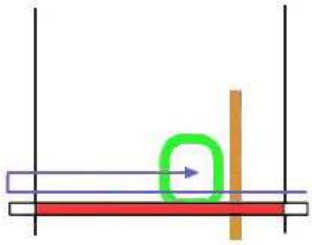
2. The search-head is moved to the right and beyond the end of the base-stick. The overlap outside the lane must be at least 10cm. The search-head is constantly kept as close to the ground as possible without applying pressure to the ground.



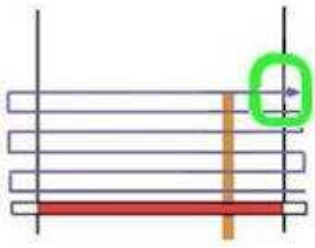
3. The search-head is moved all the way to the left without advancing it and beyond the end of the base-stick. The overlap outside the lane must be at least 10cm.



4. The search-head is moved forward by a third of the search-head length or less, and swept to the right. If the detector signals, the sweeps are not interrupted.

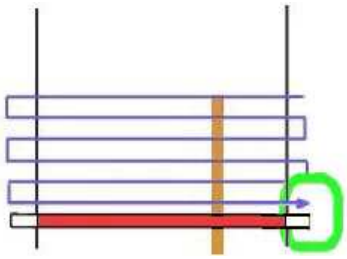


5. Advancing by one third of a search-head length or less, the head is advanced until it is at least one-third over the end of the guide-stick (or 40cm in front of the deminer) and over the nominal side of the search area (overlap). If the detector signals, the deminer must remember the approximate position and keep searching.



6. The detector head is moved *back* over the search area in a reverse action. If the detector signals, the sweeps are not interrupted, but a mental map of the search area is made.

   The deminer now knows how many signals are in the area and their approximate position. If two signals are close together, or are in a linear pattern (as is common with lengths of wire), the deminer knows this and so can pinpoint the closest signal (or the part of a signal that is closest).



7. **I**f there are no signals in an area, the base-stick is moved forward to 10cm closer than the extent of the search. The deminer then removes the vegetation and rocks in front of the stick and starts the search process again.

   If there are signals in the area, the deminer should first inspect the ground visually for surface metal and carefully remove any obvious metal by hand. Exposed wire or other items must not be pulled if parts are under the ground. After a visual inspection, the deminer should use a magnetic tool to try to remove metal that cannot be easily seen. The magnet should be brushed lightly over the ground surface to attract magnetic material on the surface.

If any metal is located the area must be searched with the detector again as described in Steps 1-6 above.

8. After the area has been searched with the metal-detector, surface fragments removed and the search repeated, the deminer must pinpoint the closest signal to the base-stick and place a marker at that place.

   If there are no metal readings, the deminer should move the base-stick forward to 10cm closer than the extent of the search. To ensure overlap, the base-stick should never be moved all the way to end of the area searched.

Pinpointing a detector reading

The method of pinpointing varies with the metal-detector but will either involve using the search-head to approach the signal from all sides ("a" below as with the MineLab F3) or moving the search-head across the signal in "cross-hairs" ("b" below). When a small target is deeply buried, it may not be possible to pinpoint accurately, so the deminer should be cautious and place the marker slightly closer to the base-stick than the signal.

The marker must be placed at the nearest part of the signal to the deminer's base-stick.

NOTE: *When marking mines with a central fuze mechanism, the marker often indicates the centre of the mine. When marking metal-cased hazards, the marker indicates the side of the hazard nearest to the base-stick.*

When the nearest signal has been pinpointed, the signal investigation procedure must be started.