

## **Metal-detector setup - general**



### **Section 2: Metal-detector set-up**

#### **2.1 General**

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 drills are applied. It is important to set-up the metal-detector appropriately for two main reasons. First it gives the Supervisors confidence that the ground can be cleared to the required depth. Second, it gives the deminers confidence that they can *and will* find every mine.

What follows is a basic procedure for use with all the current models of metal-detector that I know. It is intended to provide a basis that you can edit and refine to suit your equipment and working preferences.

The metal-detector set-up procedure leads directly on to the [Metal-detector search](#) drills and signal-investigation procedures.

#### **2.2 Switching on the metal-detector**

Only deminers internally trained and certificated in using the specific model of detector can be used to perform metal-detector procedures with that detector.

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 checked. The deminers should follow metal-detector starting 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. Deminers shall **NOT** follow the manufacturer's instructions for *USING* the detector unless those instructions coincide with the content of the procedures described here.



## 2.3 Determining whether the metal-detector is appropriate to use

When working in known areas and searching for known threats, past experience may make it obvious whether the metal-detector can or cannot be used to interrogate the ground thoroughly and reliably to the required depth. Even in these cases, it is essential to confirm that the metal-detector and its operator can locate the anticipated target to the required depth because equipment and deminers can both be at fault. To determine whether the detectors can be used, detector "Calibration" and "Test area" areas must be established.

The Calibration area is needed for carrying out Ground Compensation procedures. It can also be used to adjust some non-GC detectors so that they are "tuned-down" to exclude the signal from the ground itself. When searching for mines with a large metal signature that are concealed at shallow depths, this can be an appropriate procedure. What matters is that the detector can reliably signal on the target at the required depth. If there are no threats with a small metal content, small bits of metal can be safely left behind. When external QA with a metal-detector will take place, the QA personnel must use the same detector that has been set-up in the same way. To facilitate this, when a detector is deliberately adjusted to miss small metal signals, the detector set-up routine must be documented (usually in the Site Log).

### 2.3.1 Ground-compensation (GC)

When GC metal-detectors are used and the ground has an electromagnetic signature of its own, the GC capability should be set-up as described in the manufacturers' documentation. To do this, a metal-free "Calibration area" of 1 metre square should be prepared and marked close to where the deminer is working. The area should be moved forward as work progresses so that it is always within 30 metres of the place

where the deminer will work. Usually the Calibration area will be close to the detector Test-area. Both areas can be inside access lanes as long as those lanes are at least two metres wide.

It is the Supervisor's responsibility to ensure that Calibration areas are metal-free and that appropriate calibration and GC procedures are followed.

When the detector has been set-up with appropriate Ground Compensation, the detectability of targets must be checked at all Tasks where the Threat assessment identifies the presence of minimum-metal mines. It will usually be checked at ALL Task sites but this is not essential when the targets are known to be easy to locate with a correctly set-up detector and this has been checked during preliminary survey and recorded (usually in the Site Log) by a Supervisor.

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 should not be used at that Task (or that part of the Task).

### **2.3.2 Checking the detectability of targets**

It is the responsibility of every team Supervisor to ensure that the ability of each deminer and his/her metal-detector is checked at the start of each working shift. Usually they will follow the metal-detector set-up and Ground-Compensating procedure described in the manufacturer's documentation and appended as an Annex to these SOPs.

Each detector's ability to signal the presence of a target at the clearance depth must be confirmed. The deminer must NOT use a metal-detector manufacturer's test piece as a reliable target simulant. Despite any claim to the contrary, these test-pieces do not reliably simulate any mine in all ground conditions. Targets that accurately reflect the electromagnetic signature of the mine that is most difficult to locate at the Task must be used.

When the anticipated mines/devices have a large metal content, surrogates that have been proven to have the same or a smaller metal-signature may be used.

When the anticipated mines have a "minimal" metal content in which the detonator shell is a significant part, it can be appropriate to use real mines as targets. These must have been rendered "safe" by having their High Explosive content removed and their firing train blocked so that the detonator cannot be initiated by the inadvertent application of pressure. The render-safe procedure must be conducted by suitably experienced personnel, and shall never be attempted with mines in poor condition or without full knowledge of the mechanism(s) within the mine.

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

The target mines must be buried in metal-free "test-areas" close to where the deminers

will work (usually within 20 metres). When a site has varied ground conditions and the targets are minimum-metal mines, a target should be buried at the start of each working lane. Each target mine must be placed in the centre of four lane-markers which make a square at least 0.5 metres on each side. The marker posts will usually be linked with tape at ground level. The target mine must be covered with soil so that the TOP of the device is at the required clearance depth at the task. When burying the targets in dry conditions, water may be used to soften the infill and consolidate the covering soil. In dry ground, the water will usually be drawn sideways into the drier ground very quickly. When water is used, targets should be laid several hours before they are used (often at the end of the previous day's work when a "test-area" is moved forward so that it will be close to the next working area).

**Note:** The use of water may change the electromagnetic properties of the ground. To determine whether this is so, the detector should be set-up for use using a metal-free Calibration area. Then water should be applied to that area and allowed to soak in before the detector set-up is repeated to check whether the detector settings need to be changed. If the settings do have to be changed, either avoid using water when concealing target mines, or wait two days after concealing them before using the Test areas.



An adjustable set-square like the one shown above can be used to ensure that the target depth is reliably achieved. It is the Task Supervisor's responsibility to ensure that Test areas are metal free before target placement and that target mines are placed at the required depth.

A detector "Test-area" is often positioned alongside a marked and metal-free detector "Calibration area".

The deminer must set-up his/her detector for use in the "Calibration area", then (when minimum-metal mines may be present) must sweep over the "Test-area" to check that the detector signals on the concealed device. This gives the deminer confidence in his/her ability to detect the device. It also gives experience of the sound to anticipate when the device is deeply concealed. If appropriate, a second test-mine may be concealed at the depth at which most are actually found - so that the deminer is also

familiar with that sound (which may be very different).

If the metal-detector does not give a clear signal over the target mine, the detector should be set-up (with GC) again and a second attempt made by a Supervisor. If there is any ambiguity about the signal, the Supervisor must report that clearing the area with metal-detectors is not appropriate and ensure that the Clearance Plan is 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 remedial measures have been successfully taken.

It is not essential for each lane to have a Detector Test-area unless minimum-metal mines are anticipated in the area. When targets with a large metal signature are anticipated and the clearance is metal-free, the Site Supervisor may decide that one or two Test-areas can be shared by an entire team.

## **2.4 Determining the rate of search-head advance**

Using a metal-detector, the ground is swept from one side of the lane to the other then moved forward and swept back across the lane. The search-head advance rate is the distance that the search-head is moved forward into the suspect area before each new side-to-side sweep.

**NOTE:** Detectors with a "double-D" search-head shall never be swept with a forward and back motion, even when negotiating around obstacles (such as trees). This design of detector has lower sensitivity directly in front of (and behind) the dividing bar of the search head. Also, the detector signals when there is a variation in the electromagnetic signals coming from the two halves of the search-head. Moving the head forward and back, it is possible that a metal indication would be directly in front of and/or below the bar that divides the search-head into two. When this happens, the detector can fail to signal because the same disturbance affects both halves of the search-head. These search-heads must always be swept with a side-to-side movement.

The area beneath a detector search-head that is interrogated for metal depends on the size of the metal being sought. The area can be wider than the search-head when the metal is large or near the surface, so that the detector starts to signal before the side of the search-head passes over the metal (this feature can be useful when pinpointing). As depth is increased the area interrogated gets narrower. When a target is very small, it gets narrower very quickly. Generally, the deeper the target, the narrower the area interrogated. With a minimum-metal mine concealed at 10cm, the area beneath a detector search-head that is interrogated is never equal to the size of the search-head. This is why search-head passes have to be overlapped to ensure coverage of the entire ground to the required depth.

The required rate of search-head advance varies with the metal-detector, the target, its depth and the electromagnetic properties of the ground itself.

Manufacturers often recommend one rate of search-head advance. Whatever the manufacturer's recommendation, ***the rate of search-head advance shall not be more than one third of the search-head's back-to-front length*** unless the required advance rate has been determined for the anticipated target at the specific task.

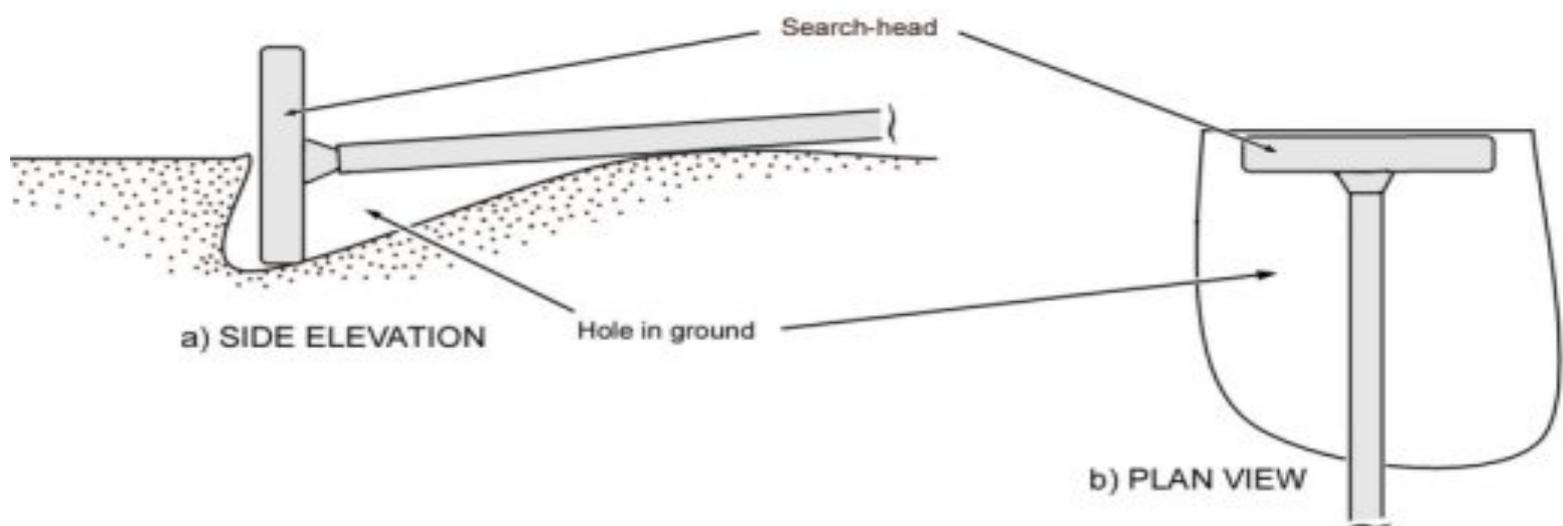
At the discretion of the Site Supervisor after due consideration of the Task and Threat assessment, the detector search-head can be advanced following A or B below.

**A:** As a maximum permissible advance rate the detector search-head can be advanced by half of its back-to-front length before each overlapping sweep (I prefer the advance to be one third of its back-to-front length).

**B:** The area interrogated beneath the search-head can be measured using an anticipated target in the ground at the site, as described in section 2.4.1.

### 2.4.1 Determining the area interrogated under a search-head

To find out how wide and deep the area interrogated beneath a particular search-head is, first dig a hole in the ground where the detector will be used. The hole should be big enough to bury half of the detector search-head when it is on its side. Then set the detector up for use, including following the Ground Compensation routine in a metal-free Calibration area. Place the detector on/in the ground as shown below.

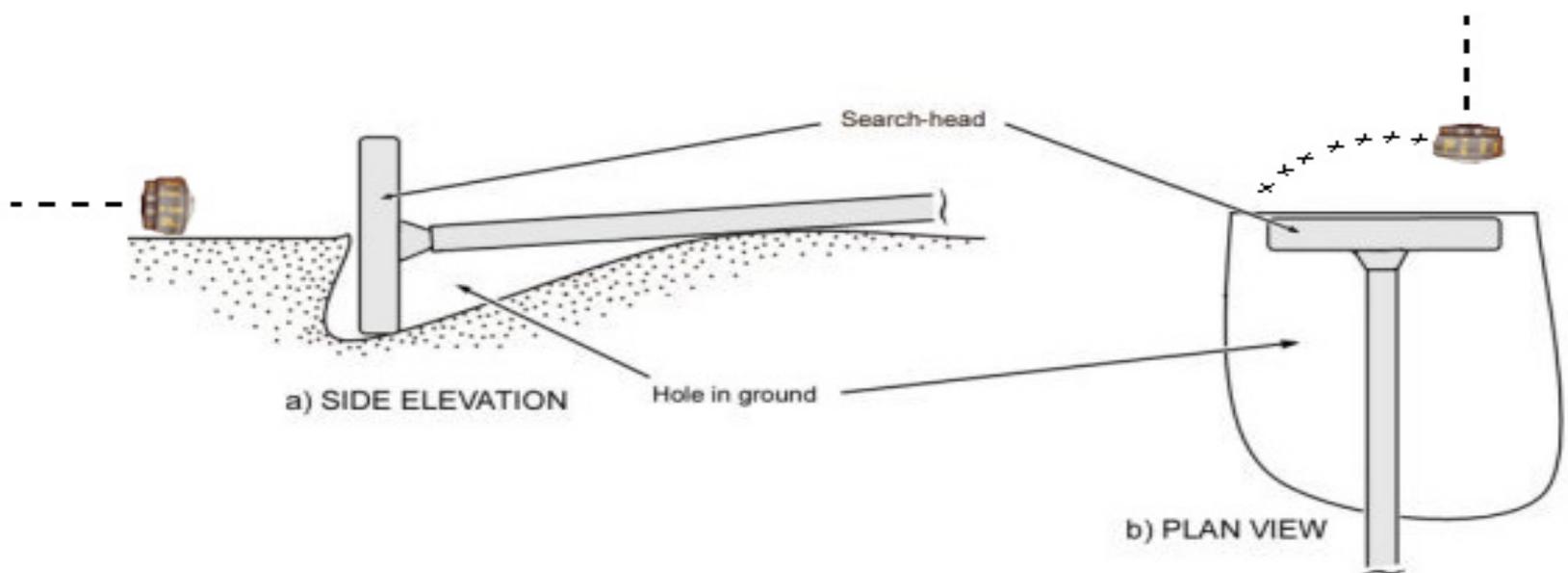


A Ground-Compensating detector should make no noise or other disturbance when placed as shown above. When the detector has a "double D" search-head, the centre line of the search-head should be vertical with equal parts of both sides below the ground surface.

The picture below shows a double D search-head that has been half buried and made ready to use in this routine.

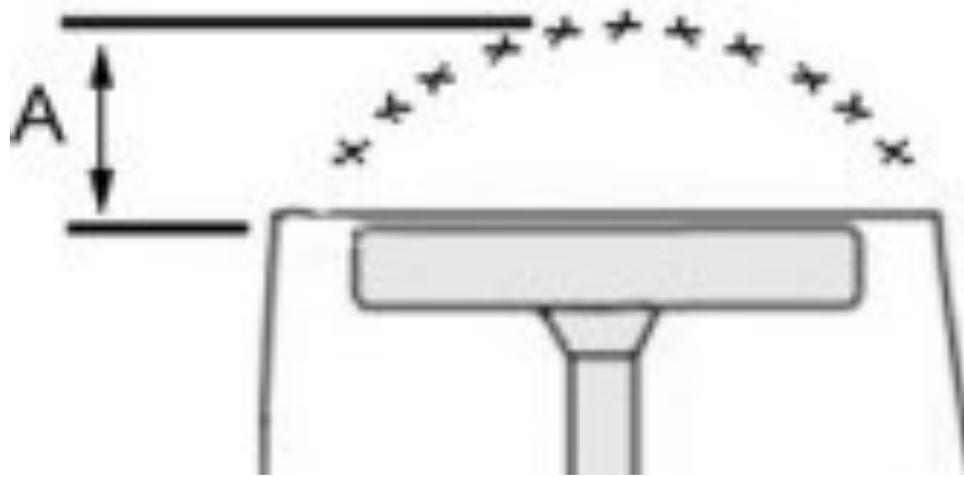


Then take a test-mine (holding it with its top facing the underside of the Search-head) and move it towards the search-head. The person doing this must not wear a wristwatch or metal rings. When the detector starts to signal, make a mark on the ground. Bring it forward again and again making many marks to trace an outline of the area inside which the mine would be found. To get an accurate shape, a mark should be made every two centimetres.

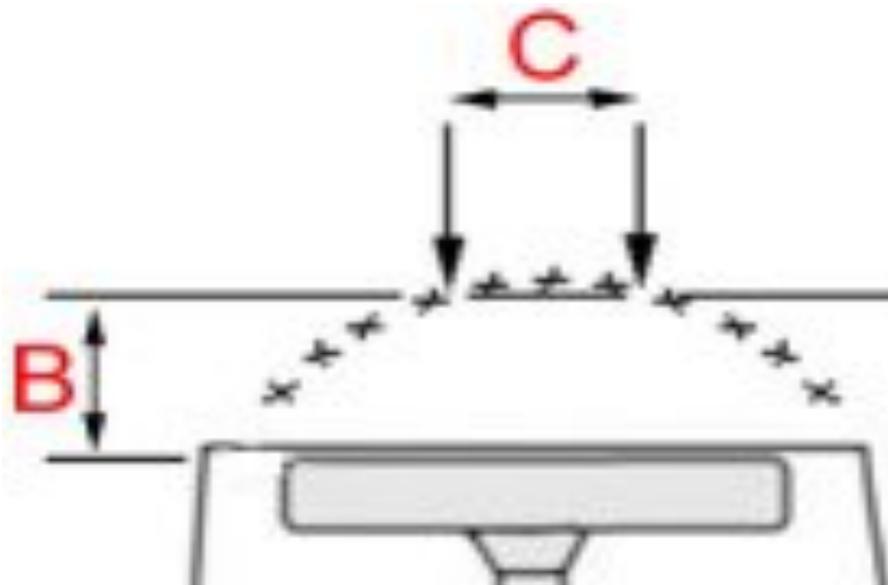


When the detector head is not a "double D" design and the search-head is not round, turn the detector search-head 90° and repeat to find the shape in another plane. To compensate for the element of judgment involved when making marks, the exercise can be repeated several times by different deminers to derive an average result.

In most cases, the outline you have marked on the ground will be a shape like a blunt cone, but its size and shape will be specific to the detector, the ground and to the target, which is why the target should always be an appropriate target mine (rendered safe).

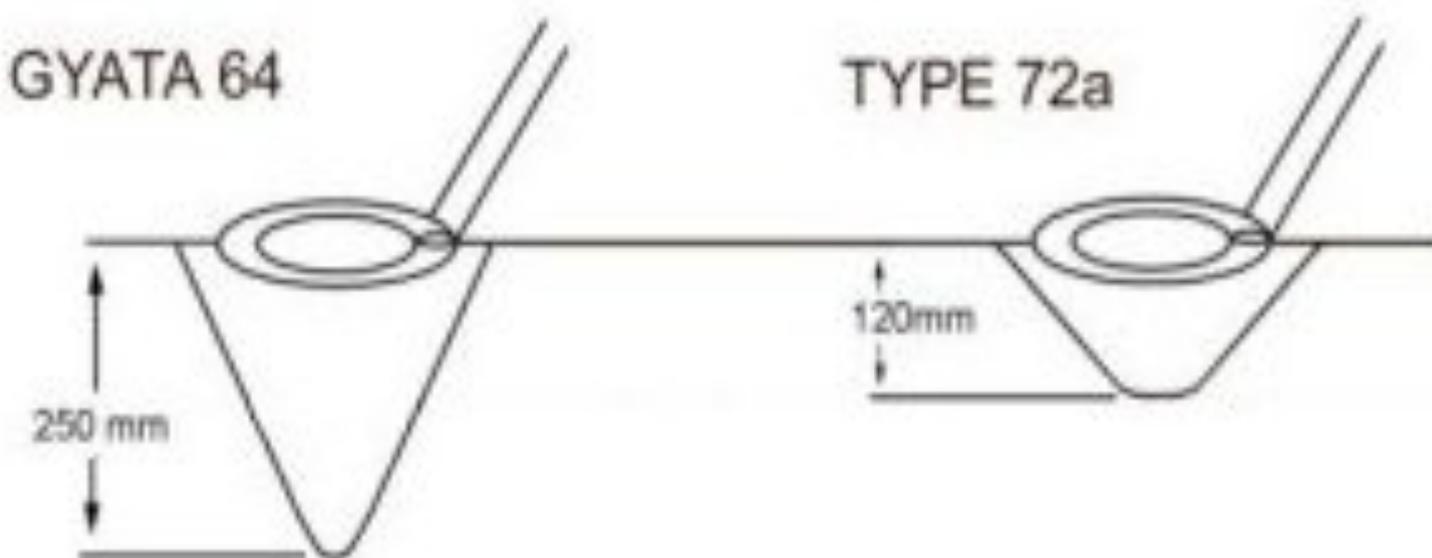


The distance "A" is the maximum clearance depth for that target in that ground.



If the distance **B** is the required clearance depth at a Task, then the length **C** is the maximum amount that the search-head could be advanced at each pass. To ensure an overlap, it should be a third less than the length **C**.

For any one model of detector, the shape of the cone will depend on the detector-settings, the target and its depth in the ground. The picture below shows the way that the shape changes for two different targets using the same detector in the same ground. The GYATA-64 has a significantly higher metal content than the TYPE 72.



The picture below shows a search-head with the resulting domes from the above test

cut out of plastic and attached to the bottom of the search-head. The smaller dome shows the area searched for a small target (the Type 72a AP mine). The larger dome shows the area interrogated for a larger target (a PMN AP mine). The detector settings were the same and the ground was the same, only the target varied.



**Note:** when the target is big, the search area may extend over an area significantly wider than the search-head. When the target is small, the search area near the edges of the search-head will be very shallow indeed.

## 2.5 Maintaining confidence

During use, the detector's ability to locate the target must be checked every time the detector is switched on, or every hour of continuous use, or more frequently. [This is required because metal-detector settings may "drift" over time.] This check must be made by the deminer using the detector, so checking his/her continued ability to use the detector as well as the performance of the detector itself.

Conditions at a Task may change and if the target does not give a clear and unambiguous signal when the search-head is swept over it (without touching the ground), the deminer must inform his/her Supervisor. The Supervisor should set-up and check the detector before deciding whether the equipment or the deminer is at fault. When the detector cannot detect the target, another clearance method shall be adopted in the affected area.

[NEXT: Metal-detector search](#) procedures.

Your comment, additions or corrections would be appreciated. [email me](#).