

**SUMMARY OF METAL DETECTOR TRIAL REPORT
UN MINE ACTION PROGRAMME AFGHANISTAN
February - March 2002**

The SPD-Mine Action Unit of UNOPS conducted a tender for metal detectors in February 2002 for the procurement of 1,700 detectors for use in Afghanistan under Project No. AFG/02/R51 and for a non-exclusive stand-by long-term arrangement for the purchase of metal detectors for other UN-supported mine action projects in the following two years.

Seven international firms, recognized as the leading manufacturers of metal detectors appropriate for humanitarian mine clearance, which had participated in the UN supported Afghan Detector Trial of 1999/2000 and in the International Pilot Project for Technology Cooperation in December 1998, were invited to participate. All seven submitted proposals.

The seven firms and the detectors that were tested were:

➤ Ceia / Italy	Model MIL-D1 (version 3.30)
➤ Ebinger / Germany	Model 420 GC
➤ Foerster / Germany	Model MINEX 2FD 4.500
➤ Guartel / United Kingdom	Model MD-8
➤ Minelab / Australia	Model F1A4
➤ Schiebel / Austria	Model ATMID
➤ Vallon / Germany	Model VMH2.1

The tender request spelled out the minimum technical specifications and requirements and indicated that detectors meeting these minimum specifications would undergo two field trials. The first would be held at the Defence Research Establishment Suffield (DRES) in Canada from 17-22 February 2002; the second in Jalalabad and Kabul, Afghanistan from 6-18 March 2002. Each manufacturer had to provide two of the same production model detectors for the trials so that in the event that one detector broke down, the other detector could continue to be tested. (See Annex for description of methodology utilized for each of the tests.)

The first trial in DRES, Canada served two purposes. The first one was to establish baseline tests to compare the detector performance in the air and controlled soil pits with known and repeatable targets. The second was to bring all the participating manufacturers' representatives in one place to train the international consultants who would in turn train the Afghan de-miners who would operate the detectors in the second trial in Afghanistan.

The second trial was conducted by experienced Afghan de-miners in Afghanistan. These deminers represented the users of the equipment. UN representatives oversaw the process while a representative from the European Commission - Joint Research Centre attended as observer.

The technical performance of the detectors were evaluated in nine tests: four in Jalalabad and five in Kabul. Six were "pass" or "fail" test and three were for information/confirmation purposes only. The tests were not conducted sequentially but rather in parallel. Thus, a complete picture was only available at the end of all the individual tests. A total of 36 de-miners conducted the tests.

Pass or fail test considered independently critical by itself:

- Test No. 2: Compacted Soil Depth Test (Jalalabad)

This was the most critical of all tests because the detectors had to locate a combination of real mines found in Afghanistan and international standard mine targets (ITOP) in natural Afghan soil. To pass the test, a detector had to locate the buried mines at a depth of 110 mm or more. Detection at less than 110 mm was recorded as 0 mm. Any detector which failed this test was considered technically unacceptable.

Pass or fail tests considered critical as a group:

- Test No. 5: Uncontaminated Soil Test Lanes (Kabul-Qargha)
- Test No. 6: Heavily Contaminated Soil Test Lanes (Kabul-Qargha)
- Test No. 7: Wet Soil Test Lanes (Kabul Reservoir)

A detector had to pass at least two of the three tests in the group to be considered technically acceptable.

Pass or fail tests considered non-critical:

- Test No. 3: Electro-Magnetic Sensitivity Test (META Jalalabad)
- Test No. 9: Electro-Magnetic Sensitivity Test (UNOCHA Kabul)

Tests for information purposes only:

- Test No. 1: Air Test (META Jalalabad)
- Test No. 4: Proximity Test between Small Target near Small Target (Jalalabad)
- Test No. 8: Proximity Test between Large Target near Small Target (Kabul Reservoir)

In addition to the technical qualification, the Request for Proposal (RFP) provided merit points for superior performance (up to a maximum of 10 points per detector), ease of operation (up to a maximum of 7 points per detector) and ease of maintenance (up to a maximum of 3 points per detector).

Following is a table illustrating how the seven firms fared in the nine tests.

	Pass or fail test critical by itself	Pass or fail tests critical as a group			Non-critical pass or fail tests		Tests for information purposes only		
	Test 2	Test 5	Test 6	Test 7	Test 3	Test 9	Test 1	Test 4	Test 8
Ceia	Pass	Pass	Pass	Pass	Pass	Pass	Data recorded	Data recorded	Data recorded
Minelab	Pass	Fail	Pass	Pass	Pass	Pass	Data recorded	Data recorded	Data recorded
Vallon	Pass	Pass	Pass	Pass	Pass	Pass	Data recorded	Data recorded	Data recorded
Schiebel	Pass	Fail	Fail	Fail	Pass	Pass	Data recorded	Data recorded	Data recorded
Foerster	Fail	Pass	Fail	Pass	Pass	Pass	Data recorded	Data recorded	Data recorded
Guartel	Fail	Fail	Fail	Fail	Pass	Pass	Data recorded	Data recorded	Data recorded
Ebinger	Fail	Fail	Fail	Fail	Pass	Pass	Data	Data	Data

							recorded	recorded	recorded
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Four firms passed Test No. 2. They were:

- Ceia - both Ceia detectors located all of the actual mines and all of the ITOP targets
- Minelab - both Minelab detectors located all of the actual mines and all of the ITOP targets
- Vallon - one detector located all of the actual mines and all of the ITOP targets; the other located all except 1 mine and 1 ITOP
- Schiebel - one detector located all actual mines but missed 1 ITOP target; the other missed 1 mine and 1 ITOP targets.

The other three firms' detectors missed over half of the mines and/or ITOP targets. These detectors were considered technically unacceptable.

The four detectors, which passed Test No. 2, were then evaluated on their respective performance on the "pass or fail tests considered critical as a group". The results were:

- Ceia and Vallon passed all three tests.
- Minelab passed the required two out of three.
- Schiebel did not pass any of the three tests and was, therefore, evaluated as technically not acceptable and disqualified.

This left Ceia, Minelab and Vallon as the only technically qualified detectors.

All detectors passed the ease of operation test and ease of maintenance test.

The merit points for superior performance were assigned, as follows:

- For detection: Ceia 7, Minelab 4, Vallon 1. The rest did not get any merit points.
- For ease of operation: Ceia 4, Foerster 4, and Guartel 2. The rest did not get any extra points.
- For ease of maintenance: Ceia 3, Minelab 3, Foerster 3, Guartel 3, Schiebel 1, Vallon 1, Ebinger 1.

The total extra merit points received by the three detectors which were found to be technically acceptable were: Ceia 14, Minelab 7 and Vallon 2.

In conclusion, UNOPS is pleased to report that it achieved the two objectives set for this trial. First, we have been able to determine what metal detector would be most appropriate to procure for detection of mines in Afghan soil – three detectors were found qualified in this case, in comparison with only a single detector in the trials conducted two years earlier – and have placed a purchase order for a large quantity of Ceia detectors to be used by the UN Mine Action Programme in Afghanistan. Second, we have entered into non-exclusive long-term standing agreements with the suppliers of the three technically qualified detectors for other UN mine action programmes around the world, although we may still procure other detectors where specific circumstances warrant.

ANNEX

A – TESTS CARRIED OUT IN DRES - CANADA

TEST 1

The first test was a free air test. The purpose was to establish a baseline detection capability using repeatable known targets. The detectors were attached to a non-metallic test jig that supported the inverted detector head at least one meter from any metal components. The jig allowed for a target to be passed over the head at a preset distance. The target was then moved further away from the head at 1mm increments until the target could no longer be heard when passed from left to right and then right to left. Once the target was no longer heard, it was moved closer to the head until the target could be confirmed in both directions. This distance was then confirmed and recorded. (This same test was performed with the same targets in Afghanistan for comparison purposes.)

TEST 2

The second test was to determine the detecting capabilities of known targets in inert soil (sand). Targets were buried in the soil at an increasing depth until the target could no longer be heard in both directions. Once the maximum detectable depth was determined, it was confirmed and recorded.

TEST 3

The third test was to determine the detecting capabilities of known targets in Cambodian Laterite soil. Targets were buried in the soil at an increasing depth until the target could no longer be heard in both directions. Once the maximum detectable depth was determined, it was confirmed and recorded. The Cambodian soil is very mineral rich causing ground interference with all the detectors.

TEST 4

The fourth and final test was to determine the detecting capabilities to detect a known target in a close proximity of a metal rail. In this test the smallest number is the best performer. This meant the target was detectable while working close to a larger metal rail, pipe or bar.

B - TESTS CARRIED OUT IN AFGHANISTAN

TEST 1 - Air Test (META Jalalabad)

The purpose of this test was to determine the maximum detection capability of the seven different mine detectors against ITOP I, G and M targets in air. This test provided baseline information only, against known and repeatable targets. No scoring was based on air tests, as results change considerably once targets have been placed in the ground. A completely non-metallic test jig was attached to the detector head to provide a calibrated slider to be passed over the head in a left to right and right to left configuration. The jig was made from hardwood and nylon. All movement areas were waxed to prevent static charges or interference. The detector head was suspended over the ground with a minimum 1-meter metal free area from the head. Targets were attached to the slider and passed by the head. The target tone had to be clearly heard when the target was passed in both directions. The target was moved further from the head until it was no longer detected in both directions. It was then brought closer until it was once again confirmed in both directions and the distance was then recorded.

TEST 2 - Compacted Afghanistan Soil Depth Test (Jalalabad)

The purpose of this test was to determine the maximum detection capability of the seven different mine detectors against ITOP and inert mine targets. The test was performed near the META facility to the east of Jalalabad. The soil was a natural local soil. The soil was fairly mineralized and therefore all detectors had to be ground compensated for the test. Maximum allowable sensitivity was used for all detectors. In a compacted section of metal free ground a trench was cut and a sloped section of ground was removed. The downward sloping cavity allowed the evaluators to hold targets under the compacted ground and increase the depth of the target to the point that the operator could no longer hear clear target indications in both left and right directions. The maximum depth was then measured and recorded.

All targets were opened and checked to verify they contained inert fuses and all other metal components normally contained in each mine type. The only exception was the PMN and PMN-2 mines. Both contained enough metal in their activation systems that it was not necessary to try to inert the detonators for these mines.

A OZM 72 all metal bounding mine was also included in the test. This target should be easily seen at 400 mm by all detectors due to the large mass of metal. This mine was placed only at this depth and recorded as pass or fail. The reason for introducing a large target to this test was due to concern that some detectors can detect small targets well, yet miss larger ones.

TEST 3 - E/M Sensitivity Test (META Jalalabad)

The purpose of this test was to determine the capability of each detector to eliminate electro-magnetic interference while searching for minimum metal mines. Outside the META facility near Jalalabad a site was found that had high voltage lines about 6 meters above the ground. A TS-50 mine was buried at this site 40mm in the ground. All units tested had some built in method to address E/M interference. Some units automatically eliminated interference while others have manual procedures to address the problem. These power lines did not interfere with the detection capabilities of the detectors and as such all detectors passed at this site and it was decided to find a higher source of interference in Kabul.

TEST 4 - Proximity Test / Small Target near Small Target (Jalalabad)

The purpose of test number four was to simulate two low-metal content mines in close proximity of each other. Often mine detectors have difficulties distinguishing between two targets in close proximity. This test aimed to see how close the mines could be from each other, while the detector can still distinguish clearly between the two separate targets. Targets used were TS-50 and P4 AP mines. The TS-50 was buried at approximately 1 cm and the P4 was placed in a small trench leading away from the first target. Approaching the two targets at a right angle, the detector had to clearly indicate separate targets both in both a left to right and right to left movement. Some detectors mask the second target when moving from a larger to smaller target, due to the ramping down or ringing of the detection tone. The best performance is the detector that can indicate separate targets at the closest distance. Starting with the mines separated by approximately 500mm the detector was passed over and the two tones were heard. The P-4 mine was then moved closer to the TS-50 and the detector was passed over them again. This continued until the two targets were no longer heard as separate tones. The P-4 was then moved out until the separation could be heard in both directions and then the distance between the targets was measured and recorded.

TEST 5 - Uncontaminated Soil Test Lanes (Kabul- Qargha)

The purpose of test number five was to determine the capability of the various mine detectors to find buried targets in the hands of experienced deminers. A test grid consisting of fifteen

1m x 1m boxes was staked out in an area just north of Kabul. Soil in this area is fairly mineralized therefore requiring all detectors to use ground compensation. The ground was cleared and confirmed free of targets before burying our targets. A target plan was determined based on information received during an interview with the deminers in Jalalabad. Twenty-two targets were buried in the 15 boxes at various depths; as per the target plan sheets. Location, depth and mine type were recorded on the sheets and used for scoring. As each user approached the target lanes he was advised to start up and balance the detector, and then located all targets placing a plastic marker over the center. As the deminer was proceeding he was monitored and the results were recorded on an evaluation form. Hits are indicated as a 'Y' for pass and 'N' for fail. After completion the number of false targets is counted and recorded.

TEST 6 - Heavily Contaminated Soil Test Lanes (Kabul- Qargha)

The purpose of test number six was to determine the capability of the various mine detectors to find buried targets in the hands of experienced deminers working in a contaminated soil environment. A test grid consisting of fifteen 1m x 1m boxes was staked out in an area just north of Kabul. The soil in this area is fairly mineralized therefore requiring all detectors to use ground compensation. The ground was cleared and confirmed free of targets before burying our targets and placing mineralized bricks and rubble throughout the test area. A target plan was determined based on information received during an interview with the deminers in Jalalabad. Twenty targets were buried in the 15 boxes at various depths, as per the target plan sheets. Location, depth and mine type are recorded on the sheets and used for scoring.

As each user approached the target lanes he was advised to start up and balance the detector, and then located all targets placing a plastic marker over the center. Deminers carrying out the tests were monitored and the results were recorded on an evaluation form. Hits are indicated as a 'Y' for pass and 'N' for fail. After completion the number of false targets were counted and recorded.

TEST 7 - Wet Soil Test Lanes (Kabul- Reservoir)

The purpose of test number seven was to determine the capability of the various mine detectors in the hands of experienced deminers to find buried targets in a wet soil environment. A test grid consisting of fifteen 1m x 1m boxes was staked out in the wet soil at the Kabul reservoir. Soil in this area was fairly benign enabling the detectors to operate without too much ground compensation. Additionally the detectors were sprayed with water from a spray bottle to keep them wet during the test. The ground was cleared and confirmed free of targets before burying our targets.

A target plan was determined based on information received during an interview with the deminers in Jalalabad. Twenty-one targets were buried in the 15 boxes at various depths, as per the target plan sheets. Location, depth and mine type are recorded on the sheets and used for scoring. As each user approached the target lanes he was advised to start up and balance the detector, and then to locate the targets by placing a plastic marker over the center. Deminers were monitored and the progress was recorded on an evaluation form. Hits are indicated as a 'Y' for pass and 'N' for fail. After completion the number of false targets were counted and recorded.

TEST 8 - Proximity Test, Large Target and Small Target (Kabul Reservoir)

The purpose of test number eight was to simulate a low metal content mine in close proximity to a large all metal AT mine. Often mine detectors have difficulties distinguishing between two targets in close proximity. This test was to see how close the two mines could be while clearly indicating the presence of two separate targets. Targets used were a TM57 metal AT mine and a TS-50 AP mine. The TM57 was buried at approximately 1 cm below the surface and

the TM-57 was placed in a small trench leading away from the first target. Approaching the two targets at a right angle, the detector had to clearly indicate two separate targets in both a left to right and right to left movement. Some detectors mask the second target when moving from a larger to smaller target, due to the ramping down or ringing of the detection tone. The best performance is the detector that can indicate separate targets at the closest distance to each other. Starting with the mines separated by approximately 1500mm the detector were passed over and the two tones were heard. The TS-50 mine was then moved closer to the TM57 and the detector was passed over them again. This continues until the two targets are no longer heard as separate tones. The TS-50 was then moved out until the separate tones can again be heard in both directions, and then the distance was measured between the targets and recorded.

TEST 9 - E/M Sensitivity Test (UNOCHA Kabul)

The purpose of this test is to determine the capability of each detector to eliminate electromagnetic interference while searching for minimum metal mines. At the UHOCHA facility in Kabul we found a 30,000 kw diesel powered generator. A Type 72 mine was buried at this site 60mm in the ground, about 8 meters from the generator. All units tested had some method to address E/M interference. Some units automatically eliminated interference while others have procedures to address the problem. At this test location, with the generator running we were able to create a small amount of interference that was easily addressed by all the detectors tested.

Operator Questionnaire Summary

The twenty questions listed below made up the questionnaire that was provided to the Afghan operators to complete. Those indicated with an asterisk were considered key in the evaluation.

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| Question 1 | Is the soft case acceptable? |
| Question 2 | Is the detector easy to assemble? |
| Question 3 | Is it possible to incorrectly assemble the detector? |
| Question 4 | Is it easy to change the batteries? |
| Question 5 | *Is the start up procedure simple? |
| Question 6 | *Is the ground compensating procedure easy to understand? |
| Question 7 | Are there any external components of the detector that could easily be damaged? |
| Question 8 | *Is the detector usable both standing and kneeling? |
| Question 9 | Is it easy to put the detector away while investigating a target? |
| Question 10 | Is the field-operating guide easy to understand? |
| Question 11 | *Are the controls easy to understand? |
| Question 12 | Is it easy to pin point the target? |
| Question 13 | *Are the alarm tones easy to distinguish and understand? |
| Question 14 | Is the confidence tone easy to understand? |
| Question 15 | Are you confident that the ground compensation works? |
| Question 16 | *After complete training would you feel confident with this detector in a live minefield? |
| Question 17 | Is it easy to break down and pack the detector after use? |
| Question 18 | Is the detector easy to adjust for comfort? |
| Question 19 | Is the earpiece comfortable |
| Question 20 | What is your overall impression of this detector? |