TESTING OF THE «MVR-1» - ROLLER TOOL ATTACHMENT

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Content

1. «MVR-1» TOOL ATTACHMENT – TECHNICAL SPECIFICATIONS..........................................................3

1.1. Description of «MVR-1» tool attachment...........................................................3

2. «MVR-1» TOOL ATTACHMENT – TESTING PLAN...........4

3. «MVR-1» TOOL ATTACHMENT – COURSE OF TESTING.9

3.1. «MVR-1» tool attachment – Course of testing with antipersonnel mines.........................................................................................................................9

4. COURSE OF TESTING – ACHIEVED RESULTS

4.1. «MVR-1» tool attachment test results on antipersonnel mines............14
1. “MVR-1” TOOL ATTACHMENT – TECHNICAL SPECIFICATIONS

Description of “MVR-1” tool attachment

“MVR-1” tool attachment is based in the “DOK-ING” d.o.o. demining company—Zagreb, which is the designer and producer of the machine. Above mentioned machine is the result of previous experience in design, manufacture and use of the “MV” type light machines on which the following core changes have been made:

- Pushing prime mover represents the classical “MV-4” machine (which has till now been tested and verified during tests in Croatia, Sweden and USA, on test sites for testing of demining machines and on demining projects)
- Working tool attachment is the “MVR-1” ROLLER, with following technical specifications:
  - Width of the Roller attachment is 71.42 inches
  - Total width of the Roller attachment is 78.74 inches
  - Number of Roller attachment segments is 10 pieces
  - Width of segment is 6.65 inches
  - Distance between each segment is 0.20 inches
  - Weight of each segment is currently not known (needs to be measured)
  - Total Roller attachment weight is currently not known (needs to be measured)

Testing Plan and Program for the “MVR-1” tool attachment is based on the “Testing and Evaluation Program for use of machines which are used for humanitarian demining activities” (Official Gazette – Nr. 138 from September 02, 2003).

![Picture No. 1 – “MVR-1” Transport](image-url)
2. «MVR-1» TOOL ATTACHMENT – TESTING PLAN

a) Aim and Task of the «MVR-1» tool attachment testing

Aim of "MVR-1" tool attachment testing is to obtain knowledge and results on working capability, resistance and quality on destruction of antipersonnel mines in polygon conditions.

During testing it is necessary to achieve the following tasks:

- To identify general technical characteristics of working tool
- To identify effective depth of antipersonnel mines destruction in various soil types and machine movement speed
- To identify resistance of working tool on antipersonnel mine activation
- To identify efficiency and effectiveness of machine’s remote control device
- To identify level and scope of need for the second method of pyrotechnical survey and demining of mined areas
- To identify needed machine logistics, service and regular maintenance

b) CRITERIA FOR «MVR-1» TOOL ATTACHMENT VALIDITY TESTING

The criteria for evaluation of tested «MVR-1» tool attachment are setup in accordance with the proposed Testing and Evaluation Program for use of machines which are used for humanitarian demining activities and Standard Operating Procedures for humanitarian demining in the Republic of Croatia, and Rules on execution of humanitarian demining activities.
c) LOCATION AND TIMEFRAME OF «MVR-1» TOOL ATTACHMENT TEST

«MVR-1» Tool Attachment test location is the Cerovac polygon for testing of demining machines.

Testing timeframe – July 2005, divided into phases with respect to set up criteria:
1. phase: – Preparation of Cerovac polygon for testing the tool attachment and machine
2. phase: – Testing of tool attachment on test lanes with different soil types and antipersonnel pressure activated mines
3. phase: – Testing of machine on antipersonnel fragmentation mines
4. phase: - Pyrotechnical survey of test lanes

After preparation of polygon, machine and tool attachment, testing of working tool attachment on test lanes with different types of soil with live antipersonnel pressure activated mines is executed, and possible depth of mine activation and machine movement speed is measured. After that, testing of working tool attachment on antipersonnel fragmentation mines (PROM-1) is executed.

Picture No. 3 – Layout of «MVR-1» demining machine

d) ORGANIZATION OF «MVR-1» TOOL ATTACHMENT TEST

a) First phase – PREPARATION OF POLYGON AND MACHINE
   ▪ Preparation of Cerovac polygon for testing of demining machines
     - Preparation of soil test lanes
     - Placement of live antipersonnel pressure activated mines in earth and sand test lanes on anticipated depths (2, 3.9 and 5.9 inches)
     - Preparation of site for tool attachment test on antipersonnel fragmentation mines
   ▪ Preparation of machine and «MVR-1» working tool attachment
     - Transport of machine to Cerovac polygon
     - Inspection and preparation of machine
b) Second Phase – TESTING OF TOOL ATTACHMENT ON TEST LANES WITH DIFFERENT SOIL TYPES AND ANTIPERSONNEL PRESSURE ACTIVATED MINES

- Testing of tool attachment on earth soil test lane
  - Measurement of soil treatment depth
  - Measurement of machine movement speed during work
  - Monitoring of activation of laid antipersonnel pressure activated mines on different depths

- Testing on sand soil test lane
  - Measurement of soil treatment depth
  - Measurement of machine movement speed during work
  - Monitoring of activation of laid antipersonnel pressure activated mines on different depths

- Formation of mines
  - The same pattern of mines is in earth soil test lane and sand soil test lane
  - 9 pieces of live AP pressure activated mines on 4 m distance between each mine are on one test lane:
    - PMA-1A, on depth of 2, 3.9 and 5.9 inches
    - PMA-2, on depth of 2, 3.9 and 5.9 inches
    - PMA-3, on depth of 2, 3.9 and 5.9 inches
    - TOTAL: 9 + 9 = 18 mines

c) Third Phase – TESTING OF WORKING TOOL ATTACHMENT ON ANTIPERSONNEL FRAGMENTATION MINES

- 2 PROM-1 mines are placed as follows:
  - First PROM-1 mine is placed in front of working tool attachment at distance of 5.5 yards, armed with related fuse, and prepared for pressure activation
  - Second PROM-1 mine is placed in front of working tool at distance of 5.5 yards, armed with related fuse, and prepared for pressure activation

d) Fourth Phase – PYROTECHNICAL SURVEY OF TEST LANES

Pyrotechnical survey of test lanes is accomplished with manual demining method by using metal detector and prodder with involvement of manual deminers. All remaining parts of placed antipersonnel mines must be found and removed.

e) LIST OF TEST TEAM PERSONNEL

Following personnel will be involved in preparation, organization, and execution of «MVR-1» tool attachment test:

a) First Phase – Preparation of Cerovac polygon and machine preparation
b) **Second Phase** – Testing of tool attachment on test lanes with different soil types and live antipersonnel pressure activated mines

- Head of Testing
- «MVR-1» Machine Operator
- «DOK-ING» company representatives
- 3 deminers from «DOK-ING» company
- Personnel for security of Operational Area, «DOK-ING» company
- Medical Support Team, «DOK-ING» company

c) **Third phase** - Testing of tool attachment on antipersonnel fragmentation mines

- Head of Testing
- «MVR-1» Machine Operator
- «DOK-ING» company representatives
- 3 deminers from «DOK-ING» company
- Personnel for security of Operational Area, «DOK-ING» company
- Medical Support Team, «DOK-ING» company

d) **Fourth Phase** – Pyrotechnical survey of test lanes

- Head of Testing
- 3 deminers from «DOK-ING» company
- Personnel for security of Operational Area, «DOK-ING» company
- Medical Support Team, «DOK-ING» company

f) **List of assets and equipment**

- **7.1.** «MVR-1» working tool attachment…………………………………………………………1 piece
- **7.2.** Set for machine and working tool attachment maintenance…………………………1 set
- **7.3.** Set of spare parts for machine and working tool attachment…………………………1 set
- **7.4.** Ambulance vehicle with all related equipment………………………………………1 piece
- **7.5.** Personal Protective Equipment (PPE) for deminers, machine operator and auxiliary workers……………………………………………………………1 set
- **7.6.** Metal Detectors……………………………………………………………………3 pieces
- **7.7.** Set of demining tools……………………………………………………………………3 sets
- **7.8.** Set of tools for destruction of mines and unexploded ordnance……………………1 set
- **7.9.** Set of tools and materials for temporary marking……………………………………1 set
- **7.10.** Equipment for short range contact (Motorola)………………………………………6 pieces
- **7.11.** Explosive (TNT or plastic)…………………………………………………………2.2 lbs
- **7.12.** Electric Detonator Cap……………………………………………………………………5 pieces
- **7.13.** Miners Cable……………………………………………………………………………0.75 miles
- **7.14.** Insulating tape………………………………………………………………………………1 piece
- **7.15.** Slowburning Pin…………………………………………………………………………..11 yards
- **7.16.** Detonator Cap No. 8………………………………………………………………………5 pieces
- **7.17.** Metal plates for mines………………………………………………………………………20 pieces
7.18. 4WD vehicle........................................................................................................1 piece
7.19. Head of Testing Personal Protective Equipment..............................................1 set
7.20. Digital camera....................................................................................................1 piece
7.21. Stop-watch.........................................................................................................1 piece
7.22. Binoculars...........................................................................................................1 piece
7.23. Cell phone (098 call number)...........................................................................1 piece
7.24. Short measuring band........................................................................................1 piece
7.25. Long measuring band (50 m)............................................................................1 piece
7.26. PMA-1A antipersonnel mine............................................................................6 pieces
7.27. PMA-2 antipersonnel mine...............................................................................6 pieces
7.28. PMA-3 antipersonnel mine...............................................................................6 pieces
7.29. PROM-1 antipersonnel mine...........................................................................2 pieces

NOTE:

- Material assets from No. 7.1. till No. 7.17 will be provided by «DOK-ING» company - Zagreb
- Material assets from No. 7.18. till No. 7.28. will be provided by CROMAC-CTDT
- Mines will be provided and transported to the test site by CROMAC-CTDT

Picture No. 4 – Detail of working tool - ROLLER

**g) SECURITY AND SAFETY MEASURES**

Deminer’s security measures

- Compulsory regulated Personal Protective Equipment on project site (protective helmet with visor, bulletproof vest)
- During execution of activities – minimum distance between each deminer must be at least 27.34 yards, and 328 yards from the machine
- It is necessary to test and inspect metal detector before use, and only proper metal detectors can be used
• It is allowed only to use proper and complete assets and equipment
• It is necessary to comply with safety measures during placing and arming antipersonnel and antitank mines with regard to types of mines
• It is necessary to comply with prescribed safety methods and measures during destruction of remaining mines

Safety measures during work with "MVR-1" tool attachment

• Machine Operator is due to check machine and working tool attachment before use, to eliminate identified defects, and to report to Head of Testing
• During movement of tool attachment towards mines, after detonation on test lane, it is necessary to move the machine according to the provisions of Head of Testing. Do not undertake any activities on the machine and tool attachment without prior approval by Head of Testing.
• Machine Operator is always situated in armored supporting vehicle, from which he is operating the machine by means of remote control device. Armored supporting vehicle is placed outside of test lanes.
• During break, machine needs to be returned to the safe area, machine needs to be inspected, identified defects need to be eliminated, and report must be given to the Head of Testing
• After completion of all daily activities, machine needs to be returned to the safe area, machine needs to be inspected, identified defects need to be eliminated, and report must be given to the Head of Testing
• Any kind of operation or activity is forbidden without prior approval from the Head of Testing.
• Personnel must be at distance of at least 328 yards from machine during work, and all visitors can monitor the work of machine from the WOLF armored vehicle.
• 5 working hours with 30 minutes break is the daily working time for all deminers.

3. COURSE OF TEST OF THE «MVR-1» TOOL ATTACHMENT

Course of test of the «MVR-1» tool attachment against antipersonnel mines

«MVR-1 ROLLER» tool attachment was tested on Cerovac polygon for testing of demining machines on July 19, 2005. Test is executed as follows:

a) Earth soil test lane

On previously impacted earth soil test lane, 9 antipersonnel pressure activated mines were placed and armed with related fuses at distance of 5.5 yards between each mine and placed on different depths namely:
- PMA-3, on depth of 0 inches (soil surface is aligned with operational surface of mine)
- PMA-3, on depth of 2 inches
- PMA-3, on depth of 3.9 inches
- PMA-2, on depth of 0 inches
- PMA-2, on depth of 2 inches
- PMA-2, on depth of 3.9 inches
- PMA-1A, on depth of 0 inches
- PMA-1A, on depth of 2 inches
- PMA-1A, on depth of 3.9 inches

Altogether 9 mines were placed, namely:
- 3 mines on depth of 0 inches
- 3 mines on depth of 2 inches
- 3 mines on depth of 3.9 inches

After machine and «MVR-1 ROLLER» tool attachment have passed the test lane, conditions of mines were as follows:

<table>
<thead>
<tr>
<th>MINE TYPE</th>
<th>DEPTH OF BURIED MINE (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 inches</td>
</tr>
<tr>
<td>PMA-1A</td>
<td>A</td>
</tr>
<tr>
<td>PMA-2</td>
<td>U</td>
</tr>
<tr>
<td>PMA-3</td>
<td>A</td>
</tr>
</tbody>
</table>

Table No. 1 – Overview of the «MVR-1» tool attachment performance results on earth soil test lane with antipersonnel pressure activated mines

A = Activated mine
N = Shattered mine, shattered fuse, neutralized mine
U = Undamaged mine

Activated mine (A) and shattered fuse (N) are considered as neutralized mine and its estimated effect.

There was no damage on the tool attachment (roller) or the machine (MV-4) itself.

b) Sand soil test lane

On previously impacted sand soil test lane, 9 antipersonnel pressure activated mines were placed and armed with related fuses (types of mines, distance, formation and burial depths were the same as in the earth test lane).

After machine and «MVR-1 ROLLER» tool attachment have passed the test lane, conditions of mines were as follows:

<table>
<thead>
<tr>
<th>MINE TYPE</th>
<th>DEPTH OF BURIED MINE (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 inches</td>
</tr>
<tr>
<td>PMA-1A</td>
<td>A</td>
</tr>
<tr>
<td>PMA-2</td>
<td>U</td>
</tr>
<tr>
<td>PMA-3</td>
<td>U</td>
</tr>
</tbody>
</table>
Table No. 2 – Overview of the «MVR-1» tool attachment performance results on sand soil test lane with antipersonnel pressure activated mines

There was no damage on the tool attachment (roller) or the machine (MV-4) itself.

![Performance of machine and «MVR-1» tool attachment on earth test lane](image)

Picture No. 5 – Performance of machine and «MVR-1» tool attachment on earth test lane

![Roller is «following» soil configuration](image)

Picture No. 6 – Roller is «following» soil configuration

c) Local soil test lane

Undamaged mines are extracted from test lanes (earth and sand) and are placed in local soil, regularly impacted, in line formation of 3.3 yards distance and 0 inches buried depth. 3 PMA-3 mines and 6 PMA-2 mines were placed and armed.
After machine passed the mine, situation was as follows:

<table>
<thead>
<tr>
<th>MINE TYPE</th>
<th>DEPTH OF BURIED MINE (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 inches</td>
</tr>
<tr>
<td>PMA-3</td>
<td>A</td>
</tr>
<tr>
<td>PMA-2</td>
<td>N</td>
</tr>
<tr>
<td>PMA-2</td>
<td>N</td>
</tr>
</tbody>
</table>

Table No. 3 – Overview of the «MVR-1» tool attachment performance results on local soil test lane with antipersonnel pressure activated mines

At all 6 PMA-2 mines, the pressure star was totally squeezed in the mine body, but the mines were not activated.

Picture No. 7 – Performance of machine on local soil

Picture No. 8 – Shattered fuse on PMA-1A antipersonnel mine
d) «MVR-1» ROLLER tool attachment test on PROM-1

Two PROM-1 antipersonnel mines were placed and armed with appropriate fuses on special area, and were prepared for pressure activation.

- One PROM-1 mine was placed in the soil under 90° angle and prepared for pressure activation. During passing of the machine and «MVR-1 ROLLER» tool attachment the mine was activated. Around 40 shrapnel blasts have resulted on the roller lining, the roller was not damaged, and the tool attachment and machine could continue with work.
Second PROM-1 mine was placed under 60° angle in relation to the soil area and was prepared for pressure activation. During passing of the tool attachment across mine, the mine was pressure activated by roller attachment. There were 2 shrapnel blasts on roller attachment itself, and a number of smaller damages on roller attachment lining. Roller tool attachment and machine still remained in functional condition.

e) Residual mines were gathered and destroyed.

4. COURSE OF TESTING – ACHIEVED RESULTS

4.1. «MVR-1» tool attachment test results in earth soil test lane

From the specified Table No. 1, the following things are noted:

a) Pressure activated mines were placed at 0 inches depth (it means that the pressure surface of mine was in line with the soil surface), 2 mines (PMA-1A and PMA-3) were activated, or 66%.

b) Pressure activated mines were placed at 2 inches depth, the fuse was shattered on PMA-1A mine, and other mines (PMA-2 and PMA-3) were undamaged.

c) Pressure activated mines were placed at 3.9 inches depth, the fuse was shattered on PMA-1A mine, and other mines (PMA-2 and PMA-3) were undamaged.

d) In total number of 9 mines, 4 mines (44.44 %) were neutralized, and 5 mines (55.55 %) remained undamaged.

4.2. «MVR-1» tool attachment test results in sand soil test lane

From the specified Table No. 2, the following things are noted:
a) Pressure activated mines were placed at 0 inches depth, 1 mine (PMA-1A) was activated, and 2 mines (PMA-2 and PMA-3) remained undamaged.
b) Pressure activated mines were placed at 2 inches depth, 2 mines (PMA-1A and PMA-3) were activated, and one mine (PMA-2) remained undamaged.
c) Pressure activated mines were placed at 3.9 inches depth, the fuse was shattered on one mine (PMA-1A), and 2 mines (PMA-2 and PMA-3) remained undamaged.
d) In total number of 9 mines, 4 mines (44.44 %) were neutralized.

4.3. «MVR-1» tool attachment test results in local soil test lane

From the specified Table No. 3, the following things are noted:

a) PMA-3 antipersonnel mines, placed at 0 inches depth, all three mines were activated
b) PMA-2 antipersonnel mines, the fuse was squeezed in body till the end on all 6 mines
c) All 9 mines, or 100%, were neutralized.

4.4. «MVR-1» tool attachment test results with PROM-1

By pressure of the roller attachment on PROM-1 antipersonnel mine under 90° and 60° angles, both mines (100 %) were activated, shrapnel blast damage resulted on the roller tool attachment and machine. Machine and tool attachment have retained all functional abilities.

4.5. Results analysis

If we analyze the total condition, having in mind all mines, the condition is as follows:

4.5.1. In relation to the mine placement depth

a) 15 mines were placed at depth of 0 inches, result is:
   - Activated . . . . 6 pieces (40 %)
   - Neutralized . . 6 pieces (40 %)
   - Undamaged . . . 3 pieces (20 %)

b) 6 mines were placed at depth of 2 inches, result is:
   - Activated . . . . 2 pieces (33.33 %)
   - Neutralized . . . 1 piece (16.67 %)
   - Undamaged . . . 3 pieces (50 %)

c) 6 mines were placed at depth of 3.9 inches, result is:
   - Activated . . . . 0 pieces (0 %)
   - Neutralized . . . 2 pieces (33.33 %)
   - Undamaged . . . 4 pieces (66.67 %)

d) It can be concluded, from the given figures, that the «MVR-1» roller tool attachment was activating and neutralizing antipersonnel pressure activated mines
at depth of 0 inches up to 80%, and the possibility of mine destruction is reduced with the increase of the mine placement depth. There was no functional damage on the roller tool attachment or the machine itself after activation of antipersonnel pressure activated mines.

4.5.2. In relation to the soil type

a) 18 mines was placed in earth soil and thereof:
   • Activated . . . 6 pieces (33.33 %)
   • Neutralized . . . 8 pieces (44.44 %)
   • Undamaged . . . 4 pieces (22.22 %)
   Sum of activated and neutralized mines is 14 pieces (77.77 %).

b) 9 mines was placed in sand soil and thereof:
   • Activated . . . . 3 pieces (33.33 %)
   • Neutralized . . . . 1 piece (11.11 %)
   • Undamaged . . . . 5 pieces (55.55 %)
   Sum of activated and neutralized mines is 4 pieces (44.44 %).

4.6. RECOMMENDATION

Achieved results during testing of «MVR-1» tool attachment are indicating that it is possible to achieve the neutralization of antipersonnel pressure activated mines on certain depths with high efficiency percentage. On the other hand, to achieve safe and quality indicators, we suggest testing of the specified «MVR-1» tool attachment for demining with larger number of mines, in different formation in relation to the placement depth and soil type. Reliable statistical data cannot be obtained from this small number of test mines.

Head of Testing:
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