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Aardvark Mark IV Joint Services Flail Unit Capabilities Demonstration

U.S. Humanitarian Demining Research and Development

U.S. HD R&D

Aardvark Mark IV Joint Services Flail Unit (MKIV)

Capabilities Demonstration

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United States Army
Communications-Electronic Command
Research, Development & Engineering Center
Fort Belvoir, Virginia 22060-5806

Night Vision & Electronic Sensors Directorate (NVESD)
DoD Humanitarian Demining Research & Development Program

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DISCLAIMER

The technology in this report was evaluated under the Department of Defense Humanitarian Demining Research and Development Program. The information contained in this document is strictly based on the capabilities demonstration and not a technical evaluation of this technology. The purpose of this report is to provide an overview of the capabilities of this system to organizations involved in humanitarian demining activities. DoD does not endorse this technology or company and makes no warranties or representations concerning the use of this product. Interested agencies are encouraged to contact the contractor directly for equipment availability and current pricing. The Department of Defense points of contact, however, would appreciate any and all feedback on equipment use and suitability.

INTRODUCTION

Background

The United States Department of State estimates that 80-110 million mines litter the world, the majority of which were deployed during the last 15 years. Many people are killed or wounded annually, mostly innocent civilians. Mines prevent growth and development in emerging or rebuilding countries, impede repairs to infrastructure, disrupt humanitarian aid shipments, and destroy the morale of civilians living close to the minefields.

Several efforts are underway that address the current landmine problem. The United States established the Demining Assistance Program to initiate research and development into cost-effective demining techniques. The Department of Defense (DoD) Humanitarian Demining Research and Development Program at Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA is tasked with executing this program.

In one response to this tasking, commercial companies were invited to provide a capabilities demonstration of their mechanical equipment that can suitably address either one or both of the mine and/or the vegetation problems in Humanitarian demining operations. The purpose of this system capabilities demonstration was to obtain information on non-developmental Mechanical Mine and/or Vegetation Clearing Systems that can demonstrate some or all of the following capabilities. 1) Support a variety of interchangeable tools capable of performing the diverse tasks involved with working in landmine suspect areas, i.e., mulchers, sifters, grinders, rakes, etc. 2) Clear a minimum of 200m2/hour of light to medium vegetation and cut 10cm diameter trees and brush. 3) Be capable of on-road and off-road operations in all types of weather and terrain. 4) Be capable of self-transport (less attachment) for distances less than 30km without destroying roads or bridges. 5) Be capable of destroying or removing landmines by grinding, sifting, raking, flailing, etc. 6) The system must be transportable, reliable, maintainable, and logistically supportable in third world mine affected countries. 7) Demonstrate the feasibility of protecting the system and operator, if applicable, with appliqué armor to withstand a blast equivalent to a .56kg (TNT) bounding fragmentation mine at 2 meters.

The Aardvark Clear Mine, Limited of Scotland responded by providing a capabilities demonstration of the Mark IV Joint Service Flail Unit. **The information in this report is strictly based on the capabilities demonstration and not on a technical evaluation of this technology.**

System Description

The Aardvark Clear Mine, Limited (a private British company) of Scotland has been designing and producing a variety of mechanical minefield clearance machines for seventeen (17) years. The Mark IV Joint Services Flail Unit (MKIV, see picture 1 on the next page) has been in production since 1999, and it is the product of years of improvement to the Aardvark Flail System basic design. Improvements affect engine performance, flail depth, flail control, steering control, operator safety, operator comfort, navigation and maintenance. The steering control (dual steering) can be switched from the operator (in the left seat) to the operator (in the right seat) and vice versa. Because the MKIV creates dust and works in many hostile environments, dual steering is fitted as an aid the operators. The dual steering limits wind direction problems and downtime. During mine clearing operations, the MKIV can clear heavy brush and trees with a diameter of up to 15cm. The MKIV has been purchased by the countries of Canada, Jordan and South Korea.

The MKIV system consists of an armored New Holland tractor and a specialized flail assembly. The tractor has a 160hp 6-cylinder in-line turbo charged diesel engine and a 3-speed power take off (PTO). The flail assembly is mechanically driven via a heavy-duty gearbox. The flail can clear a path 3m wide and consists of 72 chains with striker tips.

Picture 1 – Mark IV Joint Service Flail Unit

Demonstration Site Description

The MKIV capabilities demonstration was conducted at NVESD/CM (countermine) test site, during 1-10 Oct 2001. In an effort to minimize the variety of conditions found at the test site, the vegetation and terrain have been characterized into four categories. The categories range from easy (1) to very difficult (4) as listed below:

Category 1 (Easy)	**Category 2** (Moderate)	**Category 3** (Difficult)	**Category 4** (Very Difficult)
Light vegetation with minimal saplings up to 3cm diameter	Moderate vegetation with sparse brush and saplings up to 6cm diameters	Moderate vegetation with brush, saplings and trees up to 10cm diameter	Heavy vegetation with dense brush, saplings and trees greater than 10cm diameter
Fairly level terrain with minimal ruts	Level to light rolling terrain with some ruts	Rolling terrain with lots of ruts	Steep hills with lots of ruts, very rugged terrain
Minimal debris and obstacles	Some debris and obstacles	Moderate debris and obstacles	Heavy debris and obstacles

Table 1 – Four categories of vegetation and terrain

.

Picture 2 - Category 1 (easy)

Picture 3 - Category 2 (moderate)

Picture 4 - Category 3 (difficult)

Picture 5 – Category 4 (very difficult)

SYSTEM DEMONSTRATION

The Aardvark Clear Mine, Limited provided documentation of and/or demonstrated capability of MKIV Joint Service Flail Unit in the following areas: transportation and transportability; operations and operational mobility; maintenance and maintainability; technical data; manpower and personnel; training and training equipment; and system safety. Each capability of the system presented was reviewed, documented and assessed. The system demonstration began with the arrival of the MKIV to the test site and ended with the departure of the MKIV from the test site.

Transportation and Transportability

The system was transported by a sea vessel, then by a commercial truck and finally by a government truck to the NVESD/CM test site. Picture 6, below, shows the MKIV on a trailer. The system is transportable by truck, rail, vessel and C-130 aircraft (or other larger aircraft). Due to the width of the flail unit, over road transport restrictions are imposed, and some restrictions may be imposed for rail as well. For transport via a C-130 aircraft, the system must be broken down somewhat (the flail removed from the tractor and the cab roof filter removed, etc.). These procedures are documented in the system technical manual. The system has NATO standard tie down and lift points. The system can maneuver via track or tire configuration and can be changed from one configuration to another within a couple of hours. The tire configuration is better suited for long distance travel as compared to the track configuration for short distances. During mobility and maneuverability tests, the system performed very well. The MKIV system demonstrated the capability to be transportable by truck, sea vessel and aircrafts.

Specifications and Dimensions

The dimensions for the MKIV are:

1. Height (with air filter): 3.20m
2. Width (outer edge of flail): 3.56m
3. Length (flail unit extended): 8.4m
4. Shipping length (flail unit retracted): 7.75m
5. Weight (prime mover and flail): 15,328kg.

Picture 6 – MKIV on trailer

Operations and Operational Mobility

The MKIV demonstrated its cutting ability against category 1-4 types of vegetation, its mine neutralization ability against selected antipersonnel and antitank mines and its mobility on a designated course. The system can be driven in either the reverse or forward direction depending on the mode of operation. During vegetation and mine clearance operations, the tractor was driven in the reverse direction with the flail first. The operator also has many choices of gear selections. The gear selected was based on the types and depths of the targets and the ground conditions the MKIV was up against. Table 2 lists the only gear ranges used when flailing. The automatic depth control of the flail was dependent upon the speed, the slower the speed, the deeper the flail excavated the ground. Prior to entering the work site, the MKIV requires ~20m of area to acclimate its flail assembly to the terrain condition. For both the vegetation and mine clearance operations, the MKIV left a berm of soil at the leading edge of the lane and a ditch at the end of the lane for each pass conducted. The MKIV was driven in the forward direction for the operational mobility demonstration.

Reverse Speed		Reverse Crawler Speed	
Gear	**Pace (m/hr)**	**Gear**	**Pace (m/hr)**
A1	300	A1	64
A2	600	A2	92
A3	900	A3	138
A4	1200	A4	191

Table 2 – Gear Selection

Vegetation Clearance

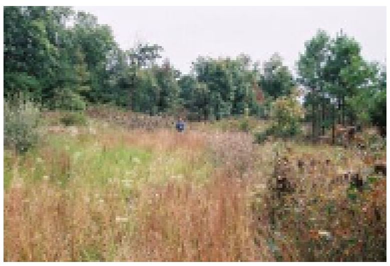
Category 1

This site consisted of hard, dry, fairly level ground with tall grass up to 1m in height. See picture 7, the area before flailing. The MKIV traversed the site at a pace of 1200 meters per hour. The MKIV cut a total of 1080m² in 45 minutes, achieving a cutting rate of 24m² per minute. While flailing, the MKIV threw heavy debris of dust, rocks, grass and whatever else was in the ground ~15-18 meters into the air as shown in picture 8. Visibility was a problem for the operators during this run due to a lack of wind. The windless condition made the cloud of debris linger over the tractor longer than when windy conditions exist. The MKIV pulverized the ground and left a bumpy blanket of dust ranging in thickness, from 5 to 15 centimeters, with the average approximately 10cm thick. See picture 9, below, for the flailed area. The ground was denuded of vegetation except for a few clumps of grass in the flailed area. The MKIV penetrated the ground at depths ranging from 5 to 15cm. The MKIV cut the vegetation with ease and did not lose any flail chains, heads or weights while cutting category 1 vegetation. The MKIV demonstrated the capability of cutting category 1 vegetation.

Picture 7 – Cat. 1 site before flailing   Picture 8 – Cat. 1 site during flailing   Picture 9 – Cat. 1 site after flailing

__Category2__

This site consisted of moderate vegetation with brush and saplings (up to 6cm in diameter and ~2.5m in height) on light rolling hard ground. See picture 10, below. The Aardvark MKIV operated at two different speeds while cutting category 2 vegetation. For the first two passes, the MKIV traversed the site at a 1200m per hour and the last pass was traversed at a 191m per hour. At 1200m/hr, the ground penetration depth was ~14cm and at 191m/hr, the ground penetration depth was ~20cm. Picture 11 shows the MKIV cutting category 2 vegetation. The ground was completely mulched and powdery with occasional stubbles ranging from 5cm to 7.5cm in height. Picture 12 below shows the site after the MKIV cut the vegetation. The MKIV cut 479.7m² in 26 minutes with a cutting rate of 18.45m² per minute. The MKIV lost two chains and one flail head while cutting category 2 vegetation. The MKIV demonstrated the capability of clearing category 2 vegetation.



Picture 10 – Cat. 2 prior to flailing

Picture 11 – Initial flailing of category 2

Picture 12 – Cat.2 after flailing

Picture 13 – Cat. 3, prior to cut

__Category 3__

Category 3 consisted of moderate vegetation and brush with saplings and trees up to 10cm on a slightly sloped terrain with lots of ruts. See picture 13. Category 3 was cut at A4 crawler gear, at which the MKIV traveled at 191m/hr. See picture 14. In a 30-minute time frame, the MKIV cut an area of 80m x 6m, with a cutting rate of 16m² per minute. The ground was turned into powdery mulch, see picture 15. Ground penetration was between 20cm to 30cm. The MKIV left occasional tree trunks and scattered pieces of trees in the lane. The tree trunks were ~7.5cm in height. During this vegetation clearance operation, the MKIV lost one chain, seven chain links and two cutting heads. The MKIV demonstrated the capability of clearing category 3 vegetation.

Picture 14 – MKIV cutting Category 3 vegetation

Picture 15 – Category 3, after flailed

Category 4

Although this site was considered to be category 4, the terrain was fairly level and the majority of the vegetation was considered category 3 and below, which is 10cm in diameter or less. See picture 16. This site contained some trees that were larger than 10cm diameter and the largest tree was 23cm in diameter. The operator used A2 crawler gear to cut this vegetation. The system traversed the site at 92m per hour. The flailing depth of the MKIV for this operation ranged from 20cm to 30cm with the average at 27cm. During a 30-minute time frame, the MKIV cut an area of 22m x 8m, with a cutting rate of 5.87m per minute. See pictures 17, 18 and 19. The ground was turned into a bumpy powdery field, see picture 20. The MKIV shredded and left most stumps in the ground, but one stump (1.3m long) was dug out of the ground. Even though the system was designed to tackle 15cm diameter trees or less, the MKIV demonstrated the capability to clear a 23cm diameter tree. During this operation, the MKIV lost two chains, seven links, two flail heads, and one weight. The MKIV demonstrated the capability of cutting category 4 vegetation.


Picture 16 – Category 4


Picture 17 – MKIV cutting category 4


Picture 18 – MKIV's second pass of cat.4


Picture 19 – MKIV throwing debris


Picture 20 – Category 4, after flailing

Vegetation Clearance Summary

Overall, the MKIV demonstrated the capability to clear category 1 – 4 vegetation. The MKIV cut a 23cm diameter tree with no difficulty during category 4 operations. This is 8cm larger than what the MKIV is designed to clear. Ground penetration is an integral part of the MKIV's vegetation clearance results and is dependent upon the speed at which the MKIV traverses the ground. Considering this, it is noted that the MKIV, in this configuration, is not capable of skimming the ground and in order to cut the vegetation, the MKIV must impact the ground. The MKIV left all sites with a bumpy layer of powdery dust ranging in thickness from 5cm to 30cm.

Mine Neutralization Operation

Three trials were conducted to demonstrate the MKIV mine neutralization ability. For each trial a lane, 50m long by 3m wide, was setup with various inert targets buried in the ground. The targets used during this demonstration are listed below in table 3 and shown in picture 21. All mines were inert mines and only the antitank (AT) mines had smoke fuzes. For the first two trials, the MKIV demonstrated its mine neutralization ability against AT mines and then against antipersonnel (AP) mines for the third trial.

Number	Target	Description
1	AT Mine	AT mine with smoke fuze
2	pAP	Plastic AP blast mine
3	MK2	Italian AP blast mine
4	VS50	Italian AP blast mine
5	TS50	Italian AP blast mine
6	PMD6	Russian box mine
7	Load Cell	Measures time and force

Table 3 – Inert Targets

Picture 21 - Demonstration targets

Trial One

The ground condition was hard and dry with category 1 vegetation covered. Five AT mines with smoke fuzes and one load cell were buried 15cm. The depth of the targets was measured from the top of the targets to the surface of the ground. See placement of the targets in diagram 1. The result of this trial is listed on the next page in table 4.

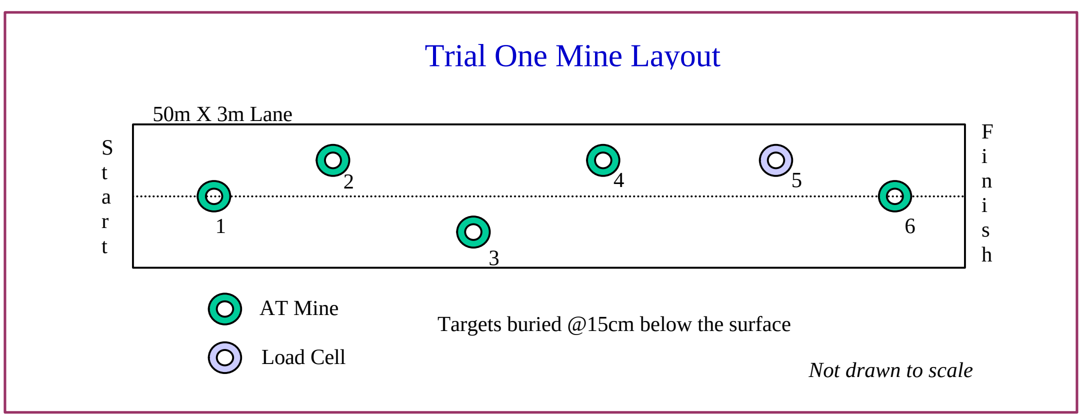
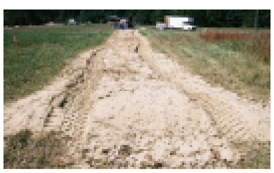


Diagram 1 – Mine Neutralization, Trial One

Target	Location	Target Result	MKIV Run Result
1 (AT mine)	Center	Multiple hits, detonated	The MKIV lost one flail chain and one flail head during this operation.
2 (AT mine)	1m left of center	Multiple hits, no detonation	
3 (AT mine)	1m right of center	Missed	
4 (AT mine)	1m left of center	Multiple hits, detonated	
5 (load cell)	1m left of center	Multiple hits (see diagram 2)	
6 (AT mine)	Center	Multiple hits, detonation	

Table 4 – Trial One Data

The MKIV traversed the lane at a pace of 138m per hour and completed the run in 22 minutes. The MKIV left the lane with a bumpy layer (15-20cm thick) of fluffy dust, a spoil (~20cm tall) at the beginning of the lane and a ditch (~20cm deep) at the end of the lane. Picture 22 below shows the lane after the MKIV completed a pass. The MKIV hit all targets except for the third one, an AT mine, and activated three of the four AT mines that were hit. The MKIV missed the third target because it strayed from the centerline due to the operator's limited visibility of the lane from the MKIV's dust cloud. The mine that was not activated by the flail received two or three strikes but the MKIV did not apply enough force to activate the smoke fuze. See picture 23. Most of the targets received multiple strikes by the flail as shown in pictures 24 and 25 below. In a six second duration, the load cell was struck six times by the flail, as shown by the peaks in diagram 2. The MKIV struck the load cell with forces ranging from ~1000lbs to ~3500lbs (~454kg to ~1,587kg). Recovery of the load cell was difficult because the load cell was displaced from its original position and was reburied deeper in the flailed ground as shown in picture 26. During this run, the MKIV lost one chain, and one flail head.



Picture 22 – Flailed lane

Picture 23 - AT mine with fuze not activated

Picture 24 – AT mine with multiple dents

Picture 25 – Load cell with multiple dents

Picture 26 – Digging for the the load cell in fluffy dust

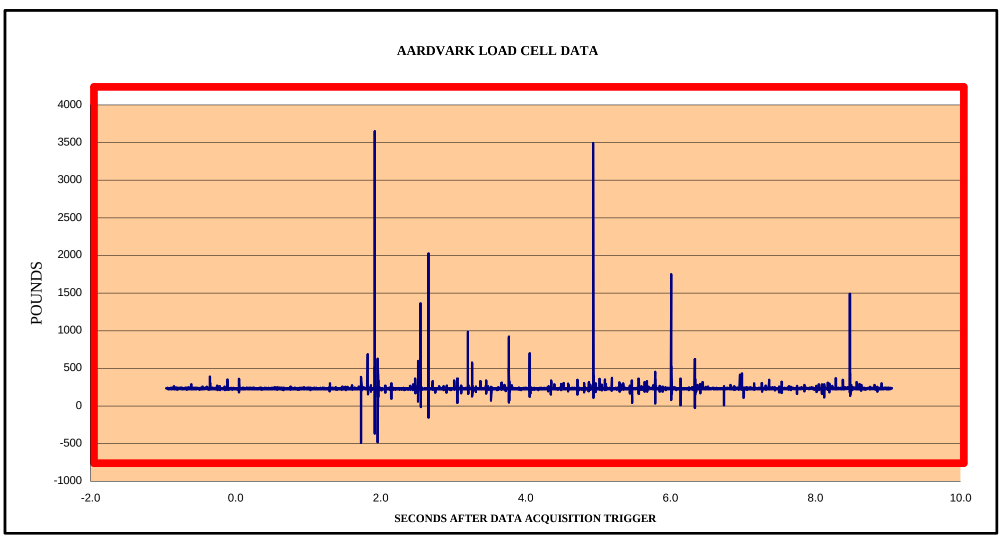


Diagram 2 – Load Cell Data

Trial Two

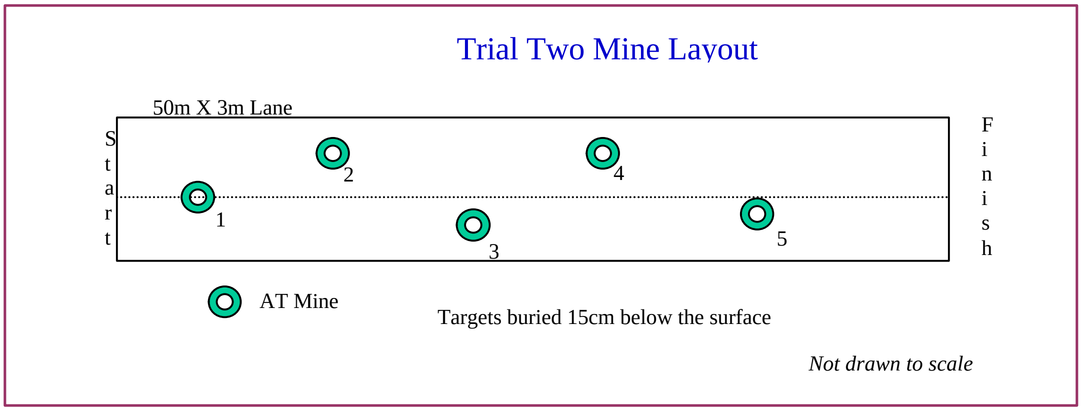
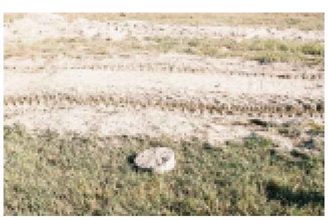


Diagram 3 – Mine Neutralization, Trial Two

Target	Location	Target Result	MKIV Run Result
1 (AT mine)	Center	Detonation	The MKIV lost 2 weights, 3 heads and 1 interlink during this run.
2 (AT mine)	1m left of center	Detonation	
3 (AT mine)	1m right of center	Detonation	
4 (AT mine)	1m left of center	Detonation	
5 (AT mine)	.5m right of center	Detonation	

Table 5 – Trial Two Data

Five AT mines with smoke fuzes were buried at 15cm depth for this trial, as shown above in diagram 3. The MKIV traversed the lane at 92m per hour and completed this run in 33 minutes. The MKIV struck all five mines and activated all five smoke fuzes, as annotated above in table 5. The MKIV threw some of the mines in the air along with other debris. Picture 27 shows an AT mine that landed about a meter outside of the lane. The MKIV left a 20-25cm berm at the beginning of the lane, a 20-25cm powdery layer of dust in the lane and a 20-25cm deep ditch at the end of the lane. Picture 28 shows the ditch and picture 29 shows the condition of the lane after the MKIV completed the pass. The MKIV lost two weights, three flail heads and one interlink. See pictures 30-32.



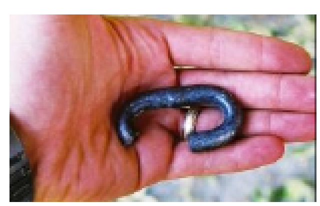
Picture 27 – Displaced AT mine

Picture 28 – Ditch dug by the flail

Picture 29 – Lane flailed by MKIV

Picture 30 – Flail weight lost during run

Picture 31 – A worn flail head (left, lost during run) and a new flail head (right)



Picture 32 – Broken interlink

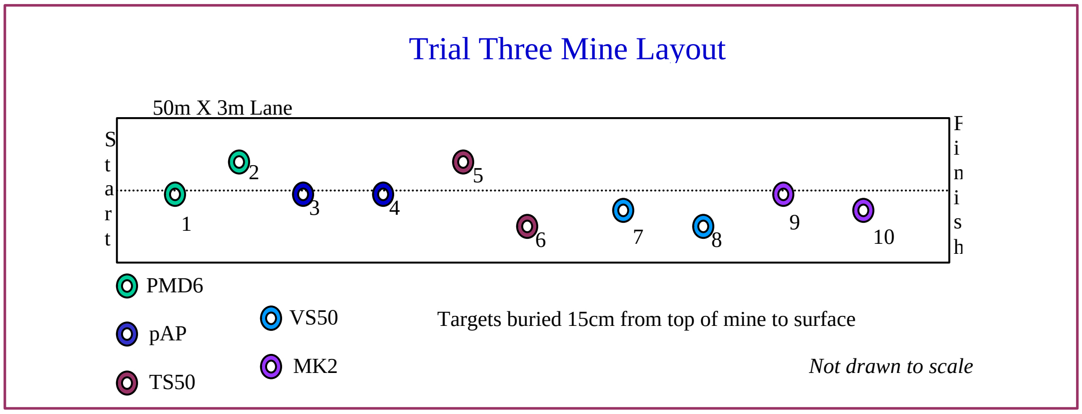


Diagram 4– Mine Neutralization, Trial Three

Target	#/Location	Target Result	MKIV Run Result
PMD6	1 / Center 2 / 0.5m left of center	Destroyed	The MKIV did not lose any flail parts during this run.
pAP	3 / Center 4 / Center	Detonated	
TS50	5 / 0.15m left of center 6 / 0.30m right of center	Found mine pieces	
VS50	7 / 0.15m right of center 8 / 0.30m right of center	Found pieces of one and one intact not detonated	
MK2	9 / Center 10 / 0.15m right of center	One detonated and one not found	

Table 6 – Trial Three Data

For this trial ten inert antipersonnel mines were buried at 15cm depth, see diagram 4 and table 6. Each antipersonnel mine contained a mechanism, which indicates activation when appropriate amount of force is applied to the mine. The MKIV traversed the lane at a pace of 64m per hour and completed this run in 48 minutes. The MKIV left the lane with a layer of dust (up to 50cm deep), a berm at the beginning of the lane and a ditch at the end of the lane, see picture 33. The ground was pulverized and the mines were thrown, reburied or relocated by the flail. Some of the mines/parts were thrown outside of the lane, as shown by pictures 34-36. One MK2 mine was not recovered. Out of the nine mines recovered, one VS50 was not activated, two PMD6 mines were smashed into pieces (these mines were presumed to be neutralized), two pAP mines were activated, and only pieces of one VS50, two TS50, and one MK2 mines were found (these mines were presumed to be neutralized). The recovery of these mines was made difficult due to the thick layer of dust and the small amount of metal content in the mines. Proofing a minefield with manual deminers (with handheld detectors) after the MKIV would also be very difficult for the same reasons. Other mechanical quality assurance methods would be more suitable for following the MKIV.


Picture 33 – Flailed lane


Picture 34 – PMD6 mine piece


Picture 35 – AP mine bottom


Picture 36 – AP pressure plate

Operational Mobility

A course was set up to evaluate the mobility of the MKIV. The course consisted of rugged dirt trail and gravel road with hills (some were 30-40 degree inclines), lots of ruts (some were 30-60cm deep), and over hanging branches. Two trials were conducted, one with the MKIV on tracks and the other on tires.

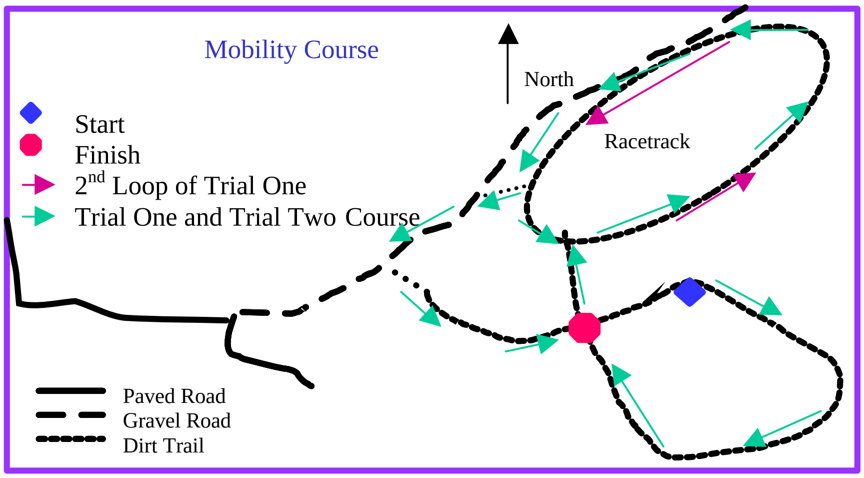


Diagram 5 – Mobility Course

Trial One

The first course was 5km long, consisting of the green arrow route plus the pink arrow route (second loop of the racetrack), see diagram 5. The MKIV traveled a 5km mobility course on its tracks. The MKIV completed the course in 22 minutes with no difficulty. The steep inclines were not a problem for the MKIV. However, the operator was required to down shift to a lower gear range so that the MKIV can continue up the hill with ease. The MKIV did not cause any damage to the road surface.

Trial Two

The same mobility course was used, except the MKIV did not make a second loop around the racetrack. The second course was 3km long and the MKIV completed the course in 12 minutes. The MKIV with tires mounted had no difficulty with turns, inclines or declines.

Operational Mobility Summary

The MKIV had no difficulty in traversing over paved, improved or unimproved roads on either tracks or tires. The only difference was the ride was a little rougher on the air filled tires than on the tracks. The MKIV demonstrated a slightly quicker pace on rubber tires than on tracks over the mobility course. Although paved road was not part of the mobility course, the MKIV demonstrated its mobility on asphalt with both tracks and tires. Upon its arrival, the MKIV (with tracks) was off loaded slowly onto an asphalt road. The tracks did not cause any damage to the road. However at a faster pace, the potential for the tracks to damage the road exists due to the cleats impacting the asphalt and the weight of the vehicle. If track pads were installed, the MKIV could travel over asphalt surfaces without afflicting damages to the road. The MKIV with tires achieved its maximum speed of 35 km/hr on paved road while traveling from the demonstration site to the load up site. The MKIV with tires could travel at a faster pace over paved roads than the MKIV with tracks. The MKIV with tires mounted would be the recommended mode for long distance travels.

Maintenance and Maintainability

The prime mover is a New Holland (Ford tractor with) 6-cylinder engine, which should be supportable worldwide. The Aardvark unique portions of the system are supportable as evidenced by the extensive documentation of support requirements (tools, parts, support equipment, etc.) Most items should be repairable in the field, and if not, Original Equipment Manufacturer (OEM) support should be available. The technical manual presents extensive Preventive Maintenance Checks and Services (PMCS) with both narrative and color pictures. The system also has built in capability for operating air tools during maintenance and servicing. Plus, the flail is mechanically driven, which should be easy to maintain and sustain for longer duration between downtime. A complete support package should fit in a standard 20 foot ISO container. A complete system with support package should cost about £400,000 British Pounds Sterling or approximately $598,000 U.S. dollars.

During the demonstration, the daily PMCS on the MKIV took approximately 30-45 minutes to complete with two people. And, only three operational repairs were needed. One repair was replacing worn outboard chains after each run because the chains hit the outer left and right shields of the flail assembly. The second repair was replacing missing chain parts or worn out heads. The third repair completed was changing out fuel filters prior to the actual demonstration. To limit the outboard chains from hitting the outer shields, the manufacturer recommended that the outer chains be removed, which would not affect the flail coverage of the vehicle's track.

Technical Data

The manufacturer provided several technical documents including the operator's manual, the spares list, the training outlines and the Defence Evaluation and Research Agency (DERA) report ("An Assessment of the "Aardvark" Mk 3 and 4 Joint Services Flail Unit by Collation of Existing Test Reports", dated March 2001). The operator's manual is very detailed and available in several languages. Illustrations of the system components and functions were very well documented with color pictures. The operator's manual includes a comprehensive maintenance chart with maintenance requirements and schedules. The MKIV is a product of years of improvement to the basic Aardvark system. One improvement is the new cyclonic panels in the filtration system. After one week of operation in extremely dusty environment, the filtration system limited the amount of dust accumulation in the engine and cab compartments to an insignificant level.

Manpower and Personnel

Operation of this system is not difficult for someone familiar with using heavy equipment. The MKIV required two operators, a driver and a co-driver or an assistant for safety measure. Two operators are needed for a continuous workday, where one person would operate the system for a short duration and then the other person would take over. This swapping would continue throughout the day. Also, if the wind changes direction, the steering control console can be rotated to the other operator for continuous operation of the MKIV.

Training and Training Equipment

The contractor has completed training to both host nationals through interpreters, as well as English speaking militaries. This training was conducted following the standard training outlines (developed by the manufacturer) for both operator and maintenance courses. There is a standard 4-week operators course, a 2-week driver course and a 2-week mechanics course. These training courses are flexible depending on the expertise of the trainees and whether interpretation is required. The manufacturer recommends a minimum of two operator and two mechanic trainees be provided for instruction and that the trainees have skills in track vehicle operation and maintenance. Some training documentation and technical manuals have been translated into other languages (Dutch, French and Arabic). A facility for classroom lecture and VHS VCR capability is required. For maintenance training, a workshop facility should be made available due to the extensive breakdown of the system. A large area for hands-on-operation training is required prior to actual operations in a minefield.

System Safety

The system appears to provide adequate protection to the operators, even though no blast testing was conducted during the demonstration. The manufacturer claimed that the system can be remote control (for greater operator safety), as was done with the MK III version. The MKIV creates huge dust clouds during operations and at times, poor visibility becomes an issue for the operators. To overcome this issue, the operator would either slow down the speed of the MKIV or stop the MKIV until visibility improves.

AARDVARK MKIV JSFU SUMMARY

The MKIV system is a 6-cylinder New Holland base engine with specialized cab and flail assembly designed by Aardvark Clear Mine Limited. This system is manually operated and capable of clearing vegetation ranging from light grasses to 15cm diameter trees. In demining operations, the MKIV can perform area reduction, landmine neutralization and quality assurance.

The MKIV is capable of clearing all vegetation types, however the MKIV is not designed to tackle the larger diameter trees in category 4 vegetation. Even though the system is designed to tackle 15cm diameter trees, the MKIV cleared a 23cm tree. The MKIV demonstrated a clearance rate of approximately $960m^2$/hour of the category 3 vegetation (10cm diameter or less). The MKIV is not capable of skimming the ground and must impact the ground while cutting vegetation. The ground penetration depth is dependent on the speed and it can be as deep as 50cm.

The MKIV was designed to neutralize mines by activating or destroying the mines. The MKIV activated 8 of 10 AT targets with one being missed due to poor visibility. It neutralized 8 of 9 AP mines. The one mine that was not neutralized was a blast hardened mine (VS50). One of the 10 AP mines was not recovered due to target displacement and the limited metal content. The MKIV throws mines and displaced them from their original locations. Quality assurance of the minefield after the MKIV with manual deminers with hand held detectors proved to be difficult. Quality assurance would be easier by other mechanical systems such as a sifter. The manufacturer recommends that the MKIV conduct overlapping passes in the same direction in order to assure maximum performance in clearing an area.

Although neither survivability nor blast test was conducted on the MKIV, it seems to provide adequate protection to the operators from AP mine blast fragments. The system is armored and can be remote controlled for added protection.

The MKIV with either the tracks or the tires can traverse most terrain with slopes less than 40 degrees. The MKIV demonstrated that it is capable of traveling at a slightly quicker pace with rubber tires than with tracks. The MKIV with tires can achieve speeds of up to 35km/hr on paved roads.

The MKIV performed satisfactory and was reliable and maintainable during the demonstration period.