

DOK-ING d.o.o. | Croatia

GENERAL DESCRIPTION

The DOK-ING *MV-4* is a remotely-controlled, tracked mine clearance system designed for the destruction of AP mines and unexploded ordnance. It is produced by DOK-ING in Croatia, a company with extensive humanitarian mine clearance field experience.

The *MV-4* is remotely controlled within a range of 3,000 m and has a standard working width of 1,725 mm. The machine can be controlled by an operator using a portable control panel, or from a second armour-protected tracked vehicle. The machine is small and light, suited for mine clearance and vegetation cutting in built-up areas, forests or in other areas unsuitable for larger machines such as domestic gardens or woodland. The low ground pressure makes the machine suitable for operations on wet ground. The driving engine and other vital parts of the machine are protected by Swedish Hardox 400 armoured plates 8-10 mm thick.

The light weight of the machine ensures rapid deployment. The machine can be loaded onto an ordinary truck or trailer. For transport over large distances, the machine and all necessary spare parts and accessories can be packed into a standard 20 ft ISO shipping container. The *MV-4* is fitted with four “eye-hook” lifting points for helicopter transport, and is certified for the Helicopter Sling Load (HSL) and for the Fixed Wing Airlift.



MV-4 | In action

CLEARANCE METHODOLOGY

The standard tool for clearance tasks is the flail unit. On request, the *MV-4* can be also equipped with the tiller unit, roller unit, blade unit or the special gripper unit. The *MV-4* flail unit rotates at up to 900 rpm, achieving a ground penetration depth from 240 mm to 320 mm, depending on soil conditions. Ground penetration is based on the impact force of the 34 flail hammers. The chains and hammers can quickly be replaced in case of damage or wear and tear. According to the manufacturer, a specially designed system keeps the clearing depth constant. The system is effective against vegetation and trees up to 50 mm in diameter. The action of the flail is intended to detonate or break up AP mines. A 10 mm steel shield hoods the flail unit to protect the chassis.

The flail unit can be rotated both clockwise and anti-clockwise. The machine can pass over ditches 0.5 m wide and 0.3 m deep. The MV-4 can operate in steeply inclined terrain both transversely and longitudinally. Flailing can be done on transverse slopes of 35° up and down, driving on transversal slopes of 45° up and down, flailing longitudinal slopes of 20°, and driving on longitudinal slopes of 35°.

The MV-4 tiller unit can be used as an alternative to the flail, depending on project requirements. The tiller has 52 specially designed steel teeth which can break up or detonate AP mines up to a depth of 25 cm.

The MV-4 blade unit is an exchangeable tool attachment that can be used for specific clearance-related tasks, such as: working soil containing explosives, removal or destruction of improvised explosive devices, clearing hazardous roadblocks, removal of vehicles.

The MV-4 roller unit provides less disturbance to soil and can be used for different mine-related tasks and missions, such as mine proofing, fast area reduction, and area or route clearance. The roller unit is mounted on the front of the MV-4 prime mover and is pushed through and over the designated area. It consists of a series of roller segments that individually “float” on uneven ground.

The MV-4 gripper unit is a special additional tool for the MV-4 designed to: penetrate walls and vehicles; cut barbed wire; move small devices, UXO, vehicles, fuel drums. It is especially designed for clearance of improvised explosive devices.

MACHINES IN USE TO DATE

To date, 92 MV-4 Mine Clearance Systems have been purchased by various organisations/demining companies, including:

Armed Forces

- > US Army - 38 units operating in the USA, Afghanistan and Iraq
- > Swedish Army – five units operating in Sweden
- > Croatian Army – two units operating in Croatia
- > Irish Army – two units operating in Ireland
- > Sri Lankan Army – four units operating in Sri Lanka
- > Greek Army – one unit operating in Greece
- > Colombian Navy Marines - one unit operating in Colombia

National Mine Action Authorities

- > Croatian Mine Action Centre (CROMAC) – four units operating in Croatia
- > Iraqi National Mine Action Authority (NMAA) – four units operating in Iraq
- > Azerbaijan National Agency for Mine Action (ANAMA) – one unit operating in Azerbaijan

Humanitarian Non-Governmental Organisations

- > Norwegian People’s Aid (NPA) – two units operating in Croatia and Sri Lanka
- > Swiss Foundation for Mine Action (FSD) – one unit operating in Sri Lanka
- > United Nations World Food Programme (UNWFP) – four units operating in Sudan

Commercial Demining Companies

- > Mechem Consultants – four units operating in the Democratic Republic of Congo and South Korea
- > REASeuro Worldwide – one unit operating in Croatia
- > DIZ-EKO – two units operating in Croatia
- > DOK-ING Demining – six units operating in Croatia and Bosnia and Herzegovina
- > AVANGARD – one unit operating in Croatia
- > ENIGMA – two units operating in Croatia and Bosnia and Herzegovina
- > RGComercial – one unit operating in Colombia
- > SEDITA – one unit operating in Angola
- > TITAN – one unit operating in Croatia
- > ISTRAŽIVA – two units operating in Croatia

ENGINE, FUEL AND OIL

The MV-4 can be equipped with the Perkins 1106 C-E60 TA modified diesel engine (129 kw/175 hp) or with the Perkins 1106D-E66 TA (186 kw/250 hp). No special fuel or oil is required. The fuel tank capacity is 70 litres, and the hydraulic oil capacity is 300 litres. Fuel consumption is from 15 to 25 litres per hour (depending on soil conditions and operating scenario).

FACTORY SUPPORT

The major components not produced by DOK-ING – such as the engine (Perkins) and hydraulics (Rexroth Bosch) – are from major international manufacturers and spare parts can be easily obtained worldwide.

DOK-ING has its own in-house service capabilities and can send a team at short notice to any location in the world.

DOK-ING maintains adequate stocks of spare parts – both those produced by DOK-ING and outsourced components.

Instruction manuals are available in Croatian, English and Spanish, and translation into the customer's language is possible. Manuals and documentation are part of the purchase package. Basic training of operators and mechanics is provided by the manufacturer and is free of charge. The warranty is provided for 12 months. General support service is provided by the manufacturer.

Additional equipment available includes additional tool attachments, up-armour kit, and video system.

MAINTENANCE AND SUPPORT

The manufacturer recommends daily inspections, monthly maintenance and a major annual inspection. One operator/mechanic is required for operation and maintenance.

TESTS AND EVALUATIONS

Croatian Mine Action Centre, *Testing of MV-4 Mine Clearing Machine*, Sisak, Croatia, May 2002.

Swedish Armed Forces, Swedish EOD and Demining Centre (SWEDEC), Defense Forces, Göta Engineer Regiment, *Final Report – Machine for removal of anti-personnel mines MV-4*, Eksjö, Sweden, November 2002.

Swedish Defence Materiel Administration (FMV), Combat Vehicles and Mobility Directorate, Test Centre, *Testing of the cooling capacity of the light vehicle for clearance of antipersonnel mines*, Skövde, Sweden, August 2003.

JämtTeknik, *System Safety Work for MV-4 MAPMCS*, Sweden, October 2003.

U.S. Army Aberdeen Proving Ground, *Detailed Test Report for the Production Qualification Test (PQT) for Electromagnetic Environmental Effects, Safety Release on the MV-4 Mini Flail*, Aberdeen, MD, USA, March 2004.

U.S. Army Yuma Proving Ground, *Final Test Report for the DOK-ING MV-4 Mechanical Anti-Personnel Mine Clearing System Assessment Test*, Yuma, Arizona, USA, April 2004.

Swedish Armed Forces, Swedish EOD and Demining Centre (SWEDEC), *MV-4 Test and Evaluation – Survivability Test*, Eksjö, Sweden, July 2004.

Department of the Air Force, Headquarters Aeronautical Systems Center (AFMC), Wright-Patterson Air Force Base, *Airlift Certification of the MV-4 Mine Clearing System (MAPMCS)*, Wright Patterson AFB, Ohio, USA, October 2004.

Department of the Army, US Army Research, Development and Engineering Command, Natick Soldier Center, *Helicopter Sling Load (HSL) Certification for the MV-4 Robotic Mine Flail*, Natick, MA, USA, June 2005.

Croatian Mine Action Centre, Centre for Testing, Development & Training (CROMAC-CTDT), *Testing of the MVR-1 – Roller Tool Attachment*, Sisak, Croatia, July 2005.

Department of the Army, Headquarters, US Army Developmental Test Command, *Safety Confirmation for DOK-ING MV-4 Mechanical Anti-Personnel Mine Clearing System (MAPMCS) in Support of Field Use*, Aberdeen Proving Ground, MD, USA, August 2005.

Croatian Mine Action Centre (CROMAC), Demining Machine Testing Committee: *Possible Effects of Tested Demining Machines, Appendix to CROMAC SOP 05.01: Efficiency Assessment of Technical Survey and Demining*, 2007.

Test reports are available at the websites:

www.itep.ws or www.hcr.hr or www.ctro.hr, or directly from the producer.



MV- 4

The following test reports are available at the ITEP website:

1. G. C. Coley, D. J. Roseveare, P.G. Danielsson, T.T. Karlsson, S. M. Bowen, L. M. Wye, F. C. A. Borry, *Demonstration Trial of Bozena-4 and MV-4 Flails*, by Defence Research and Development Canada (DRDC), 2007: www.itep.ws/pdf/NairobiFinal.pdf
2. C. Coley, F. Borry, *In-country trial of the Bozena-4 and MV-4 mini-flails*, by ITEP, 2007: www.itep.ws/pdf/NairobiTrialArticle.pdf
3. Geoff Coley, *Machine Demonstration Analysis and Preliminary Results*, International Symposium "Humanitarian Demining 2007" 24 - 27 April 2007, Šibenik, Croatia, 2007: www.itep.ws/pdf/MachineDemoSibenik2007_Coley.pdf
4. G. Danielsson, *Flail Hammer Head Test and Evaluation*, by SWEDEC, 2005: www.itep.ws/pdf/Flail_hammerhead_testreport.pdf
5. I. Steker, *Testing of the MVR-1 Roller Tool Attachment*, by Croatian Mine Action Centre - Centre for Testing, Development and Training (CTDT/CTRO), 2005: www.ctro.hr/eng/MVR-1%20Roller%20Tool%20Attachment%20Test%20Report.pdf
6. I. McLean, R. Sargisson, J. Dirscherl, H. Bach, *Throwing out mines: effects of a flail*, by GICHD, 2005: www.gichd.org/fileadmin/pdf/publications/Throwing_Out_Mines_Nov2005.pdf
7. Armed Forces Gota Engineer Regiment, *Final Report - Test and Evaluation of Machine for Removal of Anti-personnel Mines MV-4*, by SWEDEC, 2002: www.itep.ws/pdf/GotaEngineerALL.pdf



MV- 4 | With flail unit

REPORTED LIMITATIONS AND STRENGTHS

Limitations

- > Difficult to operate with precision from long distance. (This applies to all remotely controlled machines.)
- > System with attached flail creates huge dust clouds, as occurs with all flail systems in dry environments.

Strengths

- > Easy to transport on a light trailer.
- > The small size of the machine allows for flexible deployment.
- > Maintenance and repair can easily be made in field conditions.
- > Remote controls are simple to use.
- > Powerful engine.
- > Well-designed engine cooling system.
- > High quality armour for vital parts of the machine.
- > High quality steel for chains and hammers.



MV- 4

DIMENSIONAL DATA

1. Length without attachment	3,005 mm
2. Length total	4,455 mm
3. Width without attachment	1,530 mm
4. Width total	2,015 mm
5. Clearing Working width	1,725 mm
6. Height Overall	1,470 mm
7. Mass Basic vehicle	4,110 kg
8. Mass Detachable unit(s)	flail attachment: 1,200 kg gripper attachment: 900 kg roller attachment: 2,200 kg tiller attachment: 1,500 kg blade attachment: 500 kg
9. Mass Overall	5,310 kg

OPERATIONAL DATA

10. Wheels Tracks (description)	Metal tracks, 300 mm width
11. Ground Bearing Pressure (kPa)	0.43 kg/cm ²
12. Hill climbing ability (in degree)	
> Longitudinal Clearing	20°
> Longitudinal Driving	35°
> Transversal Clearing	35°
> Transversal Driving	45°
13. Number of Chains Chisels Tools	34 chains; 10 or 12 roller segments; 58 tiller teeth
14. Beat Pattern (hits per m ²) at different operating speeds	Not given
15. Length of Chains Tools	330 mm
16. Diameter of drum	900 mm
17. Rotation Speed	0 - 900 rpm
18. Clearance Working depth in varying terrain	Up to 320 mm
19. Working Speed (m ² /h)	
> Light Soil Medium Vegetation	2,184 m ²
> Medium Soil Medium Vegetation	1,896 m ²
> Heavy Soil Dense Vegetation	944 m ²
20. Control of Clearance Working depth	Automatically adjusted
21. Additional attachable working tools	Roller, blade, gripper
22. Armour	8, 10, 15 HARDOX 400 armour plates
23. Remote controlled	Yes
> greatest distance	3,000 m
24. Transportation	
> short distances	Road speed of 5 km/h
> long distances	6 t truck, 6 t trailer,
> sea transport	20 ft container,
> air transport	CH47 Helicopter

SYSTEM STATUS AND DEPLOYMENT

25. Machines in use	92
26. Other types	MV-4 MVR, MV-4 MVB, MV-4 MVG, MV-4 MVT
27. Location of use	Afghanistan, Angola, Azerbaijan, Bosnia and Herzegovina, Colombia, Croatia, DR Congo, Ireland, Iraq, Liberia, Serbia, Sri Lanka, Sudan, Sweden, USA
28. Totally cleared so far (m ²)	Approx. 40,000,000 m ²

ENGINE | FUEL | OIL

29. Engine	Perkins 1106C-E60 TA modified Optional: Perkins 1106D-E60 TA- 186 kw (250 hp)
30. Engine power at the flywheel	129 kw (175 hp)
31. Sufficient power supplied to working tool	140 hp
32. Fuel capacity	70 l
33. Fuel consumption	15 - 25 l per hour
34. Separate engine for working unit	No
35. Cooling system	Water cooled
36. Oil capacity of engine	15 l
37. Hydraulic oil capacity (both engines)	200 l

COSTS

38. Cost of system	On request
39. Other costs	
> training	
> spare part set chains belts	
> repair costs for one year	
40. Availability for hire	Yes

OTHER

41. Operator comfort	N/A
42. Air conditioning	N/A

Digger DTR Demining Technologies | Switzerland

GENERAL DESCRIPTION

The *Digger D-2* is a light-weight, remotely-controlled multi-tool mine clearance vehicle developed by the Swiss NGO, Digger DTR. This organisation has 11 years of technical background in mechanical demining, acquired through the development of a vegetation cutter for mine clearance, (Digger D-1) and a multi-tool machine for mine clearance (Digger D-2). Digger DTR has five years of field experience, mainly acquired during tests and operational engagement in North and South Sudan and in Macedonia.

The vehicle consists of an armoured, V-shaped hull made of 10 mm hardened steel which minimises the damage caused by AP mines or UXO detonations. Both the tracks and all air intake latticing around the Digger D-2 are armoured, to make operation possible in vegetation clearance tasks where the ground was not previously touched by the flail. The flail can be used for both AP and tripwire mine clearance and vegetation cutting.

Through a Caterpillar Quick Coupler, every standard Caterpillar tool (such as a shovel) can be attached to the front of the D-2. This makes the vehicle highly versatile.

The system is remotely controlled from 50 m to 500 m range by an operator placed behind a shield in the line of sight. The remote control system is shock-, slash- and dust-proofed and displays data from the vehicle.

Despite its rugged design the machine should not operate in areas where many AV mines are expected.



DIGGER 2 | Operating along runway

CLEARANCE AND CUTTING METHODOLOGY

The rotor on the flail unit operates at approximately 800 rpm, using 26 chains with hardened steel hammers to remove AP mines and vegetation. Clearance depth can be mechanically adjusted from 0 to 200 mm. Depth control is achieved mechanically and hydraulically through an arms pressure regulation system, which guarantees the flail skids at a constant light pressure on the ground, which can be adjusted by the operator according to soil conditions.

Digger D-2 arms can be raised up to 4 m from the ground, allowing the flail to cut any kind of high and dense vegetation.

The Digger's forward speed can be adjusted between 0.03 km/h and 5 km/h, allowing working speeds from 300 to 2,000 m² per hour. A forward speed regulation allows the machine to work always at the most suitable speed.

MACHINES IN USE TO DATE

The Digger D-1 has been used in Switzerland by the Swiss Army to cut vegetation on a military training field with UXO contamination.

One Digger D-2 has been in use in Sudan since early 2006. After six months of testing in September the machine was integrated into a Swiss Foundation for Mine Clearance (FSD) demining team, which was accredited by the UN in October 2006. After accreditation, the Digger D-2 was operated in different areas in Northern Sudan, until the FSD programme ended in June 2007. Despite some unavoidable breakdowns due to extreme working conditions (dust, hard soil, heat), the prototype was never blocked for more than three days. After these tests, the machine was recommended by the UN in Sudan for other mine clearance programmes in Sudan.

This prototype continues to work with Mines Advisory Group in Northern Sudan in 2008.

Series production of the machine began in 2006. The first serial production unit was sold in summer 2007 to The Development Initiative (TDI), which works for the UN around Juba, South Sudan. The unit began working in October 2007 and stopped one year later after the unexpected termination of TDI's contract with the UN.

ENGINE, FUEL AND OIL

The Digger D-2 is equipped with a 4.5 litre, 140 hp John Deere turbo-diesel engine which is cooled by a double heat exchanger and uses a three-stage air filtration system. Fuel capacity is 115 litres with a maximal fuel consumption of 22 litres per hour. The engine oil capacity is 17 litres. Hydraulic fluid capacity is 160 litres. All lubricants can be changed easily through openings in the hull and quick-coupler connections, in order to simplify maintenance.

FACTORY SUPPORT

The Digger D-2 can be delivered with an initial spare parts kit, containing all most-used parts. The manufacturer also offers a "wearing parts kit", which is specifically adapted to each place of operation. Engine parts can also be provided through the international John Deere retailer network. If desired by the customer, Digger DTR provides basic drawings of some parts, such as track links, thus allowing the operator to make field repairs which can reduce breakdown time when supplies are restricted.

Initial training can be provided at the Digger DTR facility in Switzerland or at the client's operation base.

All technical manuals and training material are available in English and are included in the D-2 package.

Digger DTR's experienced technicians provide technical support throughout the world. If available, a Digger technician can be hired by the customer, paid by the user at standard international staff conditions.