
Section 1

Flail systems

Mini flail

Armtrac 75 mini flail

Armtrac Ltd., United Kingdom



General description

The latest Armtrac development is a lightweight system which can be used as a flail or a tiller. It has left the prototype stage and according to the manufacturer is ready to be fielded. The machine aims to overcome the acknowledged limitations of tillers (weight, size, cost and mobility) while enjoying the advantages of flail systems (vegetation cutting, ability to withstand anti-tank mine blasts). The **Armtrac 75** is designed for the destruction of anti-personnel and anti-tank mines.

This lightweight, multi-purpose tracked vehicle has a capability of clearing up to 1,800m²/h in light soil.¹ It is particularly suitable for work in boggy conditions and restricted and difficult sites as it can turn 360 degrees without moving off its position.

The machine can be operator driven or remotely controlled.

Vital parts of the machine such as the cabin and engine are well protected by 10mm armour.

A fork-lift bucket and a sifting bucket can easily be fixed to the telescopic boom of the machine making it useful for a variety of demining applications.

Working methodology

54 chains or chisels (optional) rotate at a speed of 350rpm achieving a clearance depth of 300mm,¹ depending on soil conditions.

Of a much lighter design than other tillers, this attachment is preferred when operating in pure anti-personnel minefields.

The flail attachment is supposed to be used in mined areas which are likely to contain anti-tank mines.

No further information is available.

Machines in use to date

Machine is not yet fielded.

Engine, fuel and oil

- The machine is equipped with a 159hp diesel engine. No special fuel or oil is required.
- According to the manufacturer the fuel consumption is 35l/h during operations (depending on soil conditions).

Factory support

- The manufacturer/supplier provides spare parts during the first 12-month period.

- Most components of the machine are provided by worldwide operating companies, which ensure the availability of spare parts.
- The manufacturer recommends a four-week training course consisting of mechanical and driver instruction.
- Manuals and documentation are part of the purchase package and available in Arabic, English, French, German and Spanish.
- The system is covered by a 12 month warranty and factory follow-up.

Maintenance and support

- Service is recommended every 250 hours.
- A 3m shipping container can be supplied as a workshop.
- Armtrac recommends that the system be run by one person, serving as operator and mechanic.

Test and evaluation

The system has only recently left the prototype stage and therefore has not yet been tested independently.

Reported limitations and strengths

Due to a lack of independent test reports no detailed information can be provided.

Limitation

- Difficult to operate with precision from a long distance (this applies to all remotely controlled machines).

Strengths

- High manoeuvrability.
- Combines flail and tiller system.
- The machine is lightweight.
- Versatility.

1. According to the manufacturer.

Bozena 4

WAY Industry a.s., Slovak Republic



Bozena 4 system

General description

The **Bozena 4** is a remotely controlled mini flail designed to destroy anti-personnel and anti-tank mines containing up to 8.9kg of explosives and to cut low vegetation and remove tripwires. The vehicle is remotely controlled up to a range of 5,000m either by an operator in an air-conditioned cabin placed within line of sight or in the open using a control panel of 7kg weight. The truck-mounted, air-conditioned cabin is part of the purchase package. An armoured shield is attached behind the flail to protect the machine from blast and flying debris. An armoured hood protects the vehicle against explosive blast. The Bozena has been designed with versatility beyond demining. Nineteen other tool attachments can be fitted to the machine for a variety of engineering tasks and humanitarian support, such as a hydraulic hammer, drilling machine or concrete mixer. Detachment of the flail and attachment of another tool takes approximately 20 minutes.

The dimensions of the machine make it suitable for difficult-to-access areas.

The machine is protected by 4mm ARMOX steel. Vital parts such as engine or hydraulic system are covered by LEXAN armour.

Clearance methodology

36 chains rotate clockwise at 350-400rpm. The average clearance depth is approximately 200mm.¹ As the hardness of the soil increases, the clearance depth decreases. The speed of the machine depends on the clearance depth selected. The design of the flail helix configuration ensures overlap of the hammers. Operator safety is ensured due to remote control of the system. However, the problems associated with operating remotely controlled machines with precision from a distance of more than 200m must be taken into account.

Machines in use to date

- Albania: 1 x Bozena 1
- Bosnia and Herzegovina: 6 x Bozena (Bozena 1 and 2) purchased by NATO SFOR (1998, 2000) and used by local entity armies.
- Croatia: 13 x Bozena (Bozena 1, 2, 3 and 4), with Croatian Mine Action Centre (CROMAC) and various local and international private demining companies working on World Bank projects.
- Eritrea: 9 x Bozena 2 and 4 with Slovak Army units.
- Kosovo: 4 x Bozena 1 — 2 with Slovakian Army KFOR units, and 2 with UNMACC mine action projects.
- Lebanon: 4 x Bozena 3 operated in Operation Emirates Solidarity project.
- Iraq: 2 x Bozena (model 4) with Slovakian military engineering units.
- Northern Iraq: 9 x Bozena 2 with UN mine action projects as a part of the "Oil for Food" programme
- So far, more than 50 machines have been sold worldwide.

Engine, fuel and oil

- The vehicle is equipped with a Deutz diesel engine (106hp) with direct fuel injection and air-cooling system.
- Fuel consumption under working conditions is approx. 13.5l/h². Fuel tank capacity is 105l.
- 130l hydraulic oil capacity (standard type used in agricultural and construction machines).



Bozena in operation

Factory support

- Basic spare parts set included as part of purchase package.
- Extended spare parts kit for six months operation is offered by WAY Industry, based on manufacturer's experience of commonly required items, including losses.
- Six-month warranty. Engine (Deutz) and hydraulic system (Rexroth) are produced by well-known manufacturers with a worldwide servicing network. Spare spares can be obtained by local sources.
- Two-phase training course as part of purchase package: phase 1 approximately five days in Slovakia regarding maintenance and troubleshooting; phase 2, also approximately five days, practical training on-site. Three instructors are provided, one of whom acts as interpreter.
- Trainees receive instruction manual and technical notes (spare parts catalogue, etc.) in the relevant language. Also part of purchase package.
- A basic spare parts kit and a basic set of tools are included. Additional options can be negotiated with the manufacturer.

Maintenance and support

- WAY Industry recommends a two-man crew: one operator and one mechanic.
- Depending on the number of machines in use for a particular project, WAY Industries recommends/offers different levels of maintenance (to be negotiated).

Tests and evaluations

- The Croatian Mine Action Centre (CROMAC) tested a Bozena 4 machine in September to November 2002. Tests included PROM-1, PMR 2A, PMA 1A, PMA 2, PMA 3. During this test, 33,745m² of ground was flailed and the average productivity was stated as 826.41m²/h.³
- Polish Armed Forces, 5 December 2002. Tests included the detonation of a TM-62P (7kg of TNT).
- Military Technical and Testing Institute (VTSU, Záhorie, Slovakia). Blast protection of the operator's cabin was tested against the following mine types: PP Mi-SrII (fragmentation and bounding mine) and PT Mi- Ba III (AT mine, 9kg of TNT)
- Ethiopian Mine Action Office, 6 May 2003.
- Test reports can be provided by the manufacturer on request.

Reported limitations and strengths (Bozena 3)

Limitations

- Difficult to operate with precision from distances over 200m.³ (This applies to all remotely controlled machines.)
- Weight of the control panel (7kg).

Strengths

- Well-designed cooling system (no breakdown due to overheating).³
- Well-designed armoured plating ensures a good protection of vital parts, even against anti-tank mine blasts.
- Winch for self recovery is fitted.
- Transportation of the machine is simple. Easy to handle with a light low-bed trailer.
- Good results achieved in forest areas due to small size.

1. Republic of Croatia, Croatian Mine Action Centre, *Testing of Bozena-4 Demining Machine (test report)*, p. 4.
 2. *Testing of Bozena-4 Demining Machine (test report)*. *op. cit.*, p. 2.
 3. *Testing of Bozena-4 Demining Machine (test report)*, *op. cit.*

Columbia Research Corporation “Mini-Flail”

Columbia Research Corporation, U.S.



Prototype of the “Mini-Flail” in operation

General description and history

The **Mini-Flail** is a remotely controlled, diesel-powered vehicle with a hydraulic drive rotating chain flail to neutralise anti-personnel mines. The design is based on a commercial skid steer front-end loader and a radio-controlled unit. This mini flail integrates commercially available non-developmental items into a cost-effective vehicle. The vehicle is protected with armour in critical areas to provide survivability from multiple anti-personnel mine explosions. The system has four lift points for delivery by a helicopter capable of handling the 1,061kg (2,340lb) system weight. Two prototype vehicles were manufactured, field tested and delivered to the U.S. Army. The Army has used these mini flails in overseas clearing operations.

Due to its size and low weight it will be suitable for mine clearance in built-up areas, forests, house yards or difficult-to-access areas.

As there are no independent test results available, working performance of the machine including clearance depth under certain soil conditions and working speed cannot be evaluated.

Working methodology

The Mini-Flail’s principal of operation uses chains rotating on a drum in front of a remotely controlled vehicle. The chains beat the ground with sufficient force to detonate or break up anti-personnel mines.¹

Machines in use

Two prototype machines were manufactured by Columbia Research Corporation (CRC) for the U.S. Army and delivered in 1991. The machines have been used by the Army in mine clearing operations.

Engine fuel and oil

- The vehicle uses standard diesel fuel (DF-2).
- The hydraulic pump that drives the flail motor is integral with the commercial vehicle and uses standard hydraulic fluid.

Factory support

- The vehicle platform is a commercial skid steer front-end loader.
- The flail attachment uses standard commercial components that can be readily replaced in the field and is fully supported by CRC.

Maintenance and support

- The vehicle is designed to be field supportable.
- Personnel familiar with small diesel engines should be able to provide the routine field maintenance required.
- A minimum of two people are required for operation of the system. One person operates the hand-held remote control unit and another functions as an observer.
- Operational procedures dictate the use of actual personnel required in field operations.
- Workshop facilities would be a standard garage set-up for vehicle maintenance.

Test and evaluation

- The Mini-Flail was tested by the Army and according to the manufacturer it can be easily controlled after less than an hour of practice. It was tested against live mines and improvised explosives typical of a limited intensity conflict.
- Test reports displaying trial results are not available.
- The Mini-Flail was certified by the U.S. Army for air transportability by the UH-1H helicopter at speeds of up to 60 knots and the UH-60 helicopter up to 100 knots.



Reported limitations and strengths

Due to the lack of independent test reports detailed evaluation of the system is not possible.

Limitations

- For anti-personnel mine clearance only.
- Difficult to operate with precision from a long distance (this applies to all remotely controlled machines).
- Range of remote control panel.

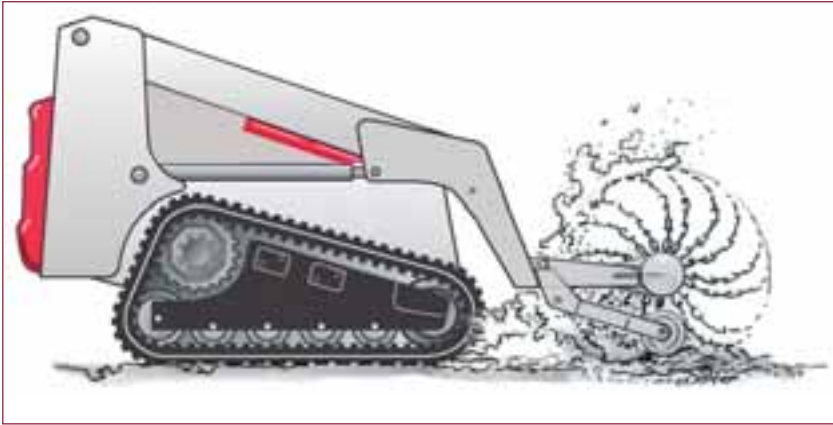
Strengths

- The Mini-Flail is designed to serve as a low-cost, light weight, anti-personnel mine clearance machine.
- High manoeuvrability and ease of transport.

1. According to the manufacturer.

Columbia Research Corporation “Small-Flail”

Columbia Research Corporation, U.S.



General description and history

The **Small-Flail** is planned to be a remotely controlled, diesel-powered vehicle with a hydraulic drive rotating a chain flail to neutralise anti-personnel mines. The design is based on a commercial compact track front-end loader equipped with radio controls and a flail attachment. The flail device is attached to the lift arms of the front-end loader and powered by a hydraulic motor operating off the vehicle's hydraulic system. The Small-Flail integrates commercially available non-developmental items into a cost-effective vehicle and will operate similar to the proven smaller Mini-Flail designed by Columbia Research Corporation. The vehicle will be protected with armour in critical areas to provide survivability from multiple anti-personnel mine explosions. The design uses components that have been fully tested, such as the flail attachment that has been tested on the Mini-Flail designed and manufactured by CRC. It is planned that the new attachment will be larger and will have a more powerful drive mechanism. The Bobcat compact track front-end loader is a well-proven vehicle in the construction environment.

Due to its low weight it will be likely to be suitable for mine clearance in built-up areas, forests, house yards or difficult-to-access areas. As the Small Flail is in the design phase no information about clearance depth, depth control or working performance is available.

Working methodology

The Small-Flail's principal of operation uses chains rotating on a drum in front of a remotely controlled vehicle. The chains are planned to beat the ground with sufficient force to detonate anti-personnel mines.

Machines in use

The Small-Flail is in the design phase.

Engine fuel and oil

- The vehicle uses standard diesel fuel (DF-2).
- The hydraulic pump that drives the flail motor is integral with the commercial vehicle and uses standard hydraulic fluid.

Factory support

- The vehicle platform is a Bobcat compact track front-end loader. This unit is fully supported by the manufacturer.
- The flail attachment uses standard commercial components that can be readily replaced in the field and fully supported by CRC.

Maintenance and support

- The vehicle is designed to be field supportable. Personnel familiar with small diesel engines should be able to provide the routine field maintenance required.
- A minimum of two people would be required for operation of the system. One person would operate the hand-held remote control unit and another would function as an observer.
- Operational procedures would dictate the use of actual personnel required in field operations.
- Workshop facilities would be a standard garage set-up for vehicle maintenance.

Test and evaluation

- The Small-Flail is in the design phase and therefore actual test data does not exist.

Reported limitations and strengths

Limitations

- For anti-personnel mine clearance only.
- Difficult to operate with precision from a long distance (this applies to all remotely controlled machines).
- Range of remote control panel.

Strengths

- The Small-Flail is designed to serve the function of a low cost, lightweight, anti-personnel mine clearing machine.
- The flail attachment can be replaced with standard construction attachments for other uses.
- High manoeuvrability and ease of transport.

Diana 40T

Hontstav S.R.O., Slovak Republic



The flail unit of the Diana 40T

General description

The newly developed **Diana** mini flail is based on experiences since 1993 in developing demining machines. The system is remotely controlled up to a range of 5,000m and designed to destroy anti-personnel and anti-tank mines containing up to 8.6 kg¹ of TNT. Due to its low weight the machine can easily be airlifted or transported by low-loader or trailer. An armoured shield is attached behind the flail to protect vital parts of the machine from blast effects and flying debris. Its dimensions make the Diana suitable for operations in wooded and built-up areas. Rapidly mountable metal tracks enhance operability on moist ground and hard-to-access areas. Ten additional attachments, such as an excavator, hydraulic hammer or cultivator can be fitted to the machine for a variety of construction tasks. A winch for recovery is attached to the machine and part of the purchase package.

Clearance methodology

According to the manufacturer the flail unit rotates at up to 600rpm achieving a clearance depth of up to 200mm, depending on soil conditions. Vegetation up to a height of 3m can be effectively treated by the machine. The action of the flail creates a ground-strike energy of 4,000N which is considered to be sufficient for detonating or breaking up buried mines. The control system, based on a 16-bit chip can be programmed to perform all functions automatically.²

Machines in use to date

The machine is new on the open market and has not yet been fielded.

Factory support

- A ready-to-use spare part package is offered for the first six months' operation after purchase.
- Instruction manuals are part of the purchase package and can be provided in English or Spanish, or other languages on request.
- Training for operators and mechanics is provided at additional cost. The duration of training depends on the operator's skills and customer requirements.
- The warranty for the machine is 12 months. Servicing has to be carried out by authorised staff.

Maintenance and support

- The core parts (engine and hydraulic system) of the Diana flail system are based on commercially available components provided by world-renowned manufacturers (Perkins and Rexroth-Bosch).
- Servicing details have to be negotiated between the customer and the manufacturer.

- The team running the system is recommended to consist of two operators and one mechanic.

Test and evaluations

- The machine was tested by SWEDEC in September 2003. Test reports were not provided by the manufacturer.



Reported limitations and strengths

Due to a lack of independent test reports, no detailed evaluation of the system's abilities can be provided.

Limitation

- Difficult to operate with precision from a long distance (this applies to all remotely controlled machines).

Strengths

- Ease of transportation by a light low-bed trailer.
- Dimensions make it suitable for wooded areas.
- Winch for self recovery is fitted.

1. According to the manufacturer
2. All the information contained in this paragraph has been provided by the manufacturer.

Compact 140 Minecat

Norwegian Demining Consortium AS (NoDeCo), Norway



General description

Based on the experiences gained from many years in humanitarian demining NoDeCo designed a new mini flail system which was close to being ready for the field (as of December 2003).

The **Compact 140 Minecat** mini flail is remotely controlled and weighs only 2.5 tonnes, making it easy to transport. The clearance width of 1.4m and the small size enable the machine to work well in urban or difficult-to-access areas where larger systems cannot be operated.

The Minecat has a rugged design and should be highly cost-effective as running costs for the system are likely to be low.

The machine is equipped with three different contouring systems (free float, automatic and front ski) and the cruise control system installed is said to ensure the consistent speed even when dust reduces operator's visibility.

A GPS system is available as an option to ensure the necessary overlap of the machine passes.

The Minecat is equipped with two diesel engines— one for the prime mover (18hp) and one for the flail unit (105hp).

The machine is designed for clearance of anti-personnel mines only and according to the manufacturer it can easily be repaired, even after having activated an anti-vehicle mine.

Clearance methodology

The flail unit attached to the system is powered by a 105hp engine and rotates its 48 chains at speeds of up to 800rpm. According to the manufacturer clearance depth of 500mm can be achieved, depending on soil conditions. The system is operated from an armoured mobile tower up to a range of 1,000m in line of sight.

Machines in use to date

The machine was tested by SWEDEC in 2003 and has not yet been used in live minefields.

Engine, fuel and oil

The system is equipped with two separate engines. The flail unit is powered by a 105hp Perkins engine with a claimed fuel consumption of 4l/h. Fuel capacity is sufficient for two working shifts.

Factory support

No information provided by the manufacturer.

Maintenance and support

Design features and machine components used are likely to ensure the availability of spares worldwide and ease of maintenance. No detailed information is provided by the manufacturer.

Tests and evaluation

The machine was tested by SWEDEC in 2003. Reports are available on request from SWEDEC or the manufacturer.



The Minecat remote control.



The Minecat armoured mobile tower

Reported limitations and strengths

Due to lack of test reports no information on clearance performance can be provided.

Limitations

- For anti-personnel mine clearance only.
- Difficult to operate with precision from a long distance (this applies to all remotely controlled machines).

Strengths

- High manoeuvrability and ease of transport.
- Designed to serve as a low cost, lightweight, anti-personnel mine clearance machine.

MV-4

DOK-ING d.o.o., Croatia



MV-4 with the attached roller

General description

The DOK-ING **MV-4** is a mini flail designed for the destruction of anti-personnel mines. It consists of a rotating flail followed by a roller. Depending on the customer's requirements, the roller can be replaced by two large supporting wheels. Skis are an extra option for operations on extremely muddy ground. The MV-4 is produced by DOK-ING in Croatia, a company which has earned its reputation from extensive field experience.

The first model of its mini flail, the MV-1, was produced in 1996. DOK-ING mini flails were originally designed as mine clearance machines. The MV-4 is remotely controlled, tracked and has a working width of 1,725mm. The machine can be controlled by an operator using a portable control panel, or from a second tracked vehicle protected by armour. The machine is small and light and is suited to mine clearance in built-up areas, forests or in other areas unsuitable for larger flails such as house yards or wood paths. Low ground pressure makes the machine suitable for operations on wet ground. The light weight of the vehicle allows for transport by small trailer. The driving engine and other vital parts of the machine are protected by armour plating.

The MV series have seen service in mine clearance programmes with DOK-ING, Mechem, Gerbera, CROMAC and AKD Mungos. According to the manufacturer, the MV series have cleared 12.5 million square metres during various projects between 1997 and 2003.

Clearance methodology

The flail unit of the MV-4 rotates at up to 900rpm, achieving a ground penetration depth of up to 20cm, depending on soil conditions. According to the manufacturer a specially designed system keeps the clearing depth constant. The system is effective against vegetation and trees up to 5cm in diameter. The action of the flail is intended to detonate or break up anti-personnel mines. A 10mm steel shield hoods the flail unit to protect the chassis. A roller is mounted behind the flail system in order to reduce the risk of missed ordnance.

The flail unit can be rotated both forward and reverse. The machine has the ability to pass over ditches 0.5m wide and 0.3m deep.

Machines in use to date

25 mini flails of the MV- family have been produced since 1996. As of October 2003, 19 machines were in service with various demining organisations and five systems were under construction, due for completion in early 2004.

Engine, fuel and oil

- MV-4 is equipped with a six-cylinder Perkins turbocharged, direct injection, water-cooled diesel engine (165hp). No special fuel or oil is required.
- Fuel consumption: 8-15l/h (depending on soil conditions).



Roller behind the flail unit.

Factory support

- All spare parts are stocked and available on client's request.
- Instruction manuals available in Serbo/Croat and English.
- Manuals and documentation are part of the purchase package.
- Training of operators and mechanics is provided by manufacturer at extra cost.
- Warranty and factory follow-up for 12 months in Croatia and the Balkans region. The same warranty applies outside Europe. Additional assistance must be negotiated with DOK-ING.
- General support service provided by the manufacturer.
- Additional equipment is available: skid for muddy terrain, electric winch, protected remote camera, and front loading bucket.

Maintenance and support

- Recommended level of maintenance:
 - First maintenance check after 50 working hours;
 - Second maintenance check after 200 working hours;
 - Regular maintenance and repair after 200 working hours.
- The company recommends a two-man crew: one operator and one mechanic.

Tests and evaluations

- The MV-4 was tested by CROMAC in May 2002. CROMAC test reports are available.
- The Swedish military conducted comprehensive tests in Eksjö, Sweden in 2002.

Reported limitations and strengths

Limitations

- Difficult to operate with precision from a long distance (this applies to all remotely controlled machines).

Strengths

- Easy to transport on a simple trailer.¹
- The small dimensions of the machine allow for flexible deployment.¹
- Maintenance and repair not difficult in field conditions.¹
- Remote control 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.

1. Republic of Croatia, Croatian Mine Action Centre (CROMAC) - Testing of MV-4 mine clearing machine, Sisak, May 2002.

Technical data sheet Armtrac 75 mini flail

a. Dimensional data

1.	Length without attachment:	3,380mm
2.	Length total:	4,700mm
3.	Width without attachment:	1,560mm
4.	Width total:	2,560mm
5.	Clearing width:	1,800mm
6.	Height, overall:	1,970mm
7.	Mass, total:	Not given

b. Driving specifications

8.	Wheels/ tracks:	Wheels and tyre chains
9.	Ground pressure, max. weight:	Not given
10.	Hill climbing ability:	45°

c. Clearance performance

11.	Number of chains/chisels:	54 chains or 54 chisels
	• length of chains/chisels:	chains 1m, chisels 30cm
12.	Gap between chains/chisels:	10mm
13.	Diameter of drum:	150mm
14.	Rotation speed:	350rpm
15.	Clearance depth, max:	350mm
16.	Working speed ^{o)} (depending on type and density of vegetation)	
	• light soil/small vegetation:	1,000m/h
	• medium soil/medium vegetation:	700m/h
	• heavy soil/dense vegetation:	500m/h
17.	Control of clearing depth:	Engine rpm
18.	Machines in use:	2
19.	Other types:	Armtrac 100, Armtrac 325, Armtrac sifter, Armtrac slash buster
20.	Location of use:	UK MOD
21.	Total area cleared so far:	60,000m ²

d. System specifications

22.	Engine:	Deutz 159hp
23.	Fuel capacity:	400l
24.	Fuel consumption:	At full load 35l/h
25.	Separate engine for working unit:	No
26.	Cooling system:	Water
27.	Oil capacity:	7l
28.	Hydraulic oil capacity (both engines):	300l

e. Comfort and security

29.	Air conditioning:	Yes
30.	Operator comfort:	Coil sprung suspension seat with 4 point harness
31.	Armour:	10mm steel and 45mm glass to 7.6 at point blank range
32.	Remote control:	Yes
	• greatest distance:	7,000m

f. Costs

33.	Cost of system:	£110,000
	• training:	driver: 2 weeks at £2,800, mechanical training £2,800
	• spare parts:	Spare part set chains/belts spares for 3 months period £2,500
34.	Transport limitation:	Road speed of 30kph or truck that will carry 6 tonnes
35.	Availability for hire:	Yes

Technical data sheet Bozena 4^{a)}

a. Dimensional data

1.	Length without attachment:	3,857mm
2.	Length total:	6,052mm
3.	Width without attachment:	1,960mm
4.	Width total:	2,746mm
5.	Clearing width:	2,000mm
6.	Height, minimum:	2,145mm
7.	Height, overall:	2,145mm
8.	Mass, total:	5,800kg

b. Driving specifications

9.	Wheels/ tracks:	Foam-filled tyres/metal tracks
10.	Ground pressure, max. weight:	Tracks: 0.66 kg/cm ² Front wheels: 2.82kg/cm ² Rear wheels: 1.45kg/cm ²
11.	Hill climbing ability:	Up to 35°

c. Clearance performance

12.	Number of chains:	36
	• length of chains:	470mm
13.	Gap between chains:	55mm (dynamically 20mm overlap)
14.	Rotation speed:	Up to 400rpm
15.	Clearance depth, max:	Up to 250mm
16.	Working speed ^{b)} (depending on type and density of vegetation)	
	• light soil/ small vegetation:	Approx. 1,800m ² /h
	• heavy soil/ dense vegetation:	Approx. 520m ² /h
17.	Control of clearing depth:	Automatic
18.	Machines in use:	More than 50
19.	Other types:	Bozena 1, Bozena 2, Bozena 3
20.	Location of use:	Albania, Bosnia and Herzegovina, Croatia, Eritrea, Iraq, Kosovo, Lebanon and Sri Lanka
21.	Total area cleared so far:	More than 15,000,000m ²

d. System specifications

22.	Engine:	Deutz BF4L913, 106hp, turbocharged diesel with direct injection, air cooled
23.	Fuel capacity:	100l
24.	Fuel consumption:	Approx. 13.5l/h ^{b)}
25.	Separate engine for tilling unit:	No
26.	Cooling system engine:	Air cooled
27.	Oil capacity:	14.5l
28.	Hydraulic oil capacity:	130l

e. Comfort and security

29.	Air conditioning:	In the cabin
30.	Operator comfort:	Armoured, air-conditioned cabin
31.	Armour:	4mm ARMOS steel. Vital parts are additionally protected by LEXAN
32.	Remote control:	Yes
	• greatest distance:	5,000m (with optical visibility only)

f. Costs

33.	Cost of system:	Subject to negotiation
	• machine	On customer request
	• training	Included in the purchase package
	• spare parts	Set chain/belts included
34.	Transport limitation:	The whole Bozena system can be packed in one 40ft and one 20ft container. The customer has to provide the truck for transportation
35.	Availability for hire:	Yes

a) All information according to the manufacturer.

b) Republic of Croatia, Croatian Mine Action Centre, *Testing of Bozena-4 Demining Machine (test report)*, p. 2.

Technical data sheet Columbia Mini-Flail

a. Dimensional data

1.	Length without attachment:	2,350mm
2.	Length total:	3,073mm
3.	Width without attachment:	1,067mm
4.	Width total:	1,295mm
5.	Clearing width:	1,067mm
6.	Height, overall:	1,143mm
7.	Mass, total:	1,063kg

b. Driving specifications

8.	Wheels/ tracks:	23 x 8.50 cleat tyres, foam-filled
9.	Ground pressure, max. weight:	6 PSI
10.	Hill climbing ability:	22°

c. Clearance performance

11.	Number of chains:	72
	• length of chains:	14.2 in. (361mm)
12.	Gap between chains:	152mm
13.	Rotation speed:	Not given
14.	Clearance depth, max:	Not given
15.	Working speed	
	• light soil/ medium vegetation:	3.2km/h
	• medium soil/medium vegetation	2.4km/h
	• heavy soil/ dense vegetation:	2.4km/h
16.	Control of clearing depth:	Not given
17.	Machines in use:	2
18.	Other types:	—
19.	Location of use:	Bosnia and Herzegovina, Kuwait
20.	Total area cleared so far:	Unknown

d. System specifications

21.	Engine:	17hp diesel
22.	Fuel capacity:	22.7l
23.	Fuel consumption:	3.9l/h (estimate)
24.	Separate engine for tilling unit:	No
25.	Cooling system engine:	Liquid
26.	Oil capacity	2.4l
27.	Hydraulic oil capacity:	34l

e. Comfort and security

28.	Air conditioning:	No
29.	Operator comfort:	N/A
30.	Armour:	SPECTRA
31.	Remote control:	Yes
	• greatest distance:	91m

f. Costs

32.	Cost of system:	U.S.\$110,000 (estimated)
	• spare parts	Set chains/belt U.S.\$8,500 including remote control spares
33.	Transport:	Self-propelled and trailer deployed
34.	Availability for hire:	No

Technical data sheet Columbia Small-Flail

a. Dimensional data

1.	Length without attachment:	2,717mm
2.	Length total:	3,759mm
3.	Width without attachment:	1,955mm
4.	Width total:	1,955mm
5.	Clearing width:	1,524mm
6.	Height, overall:	2,082mm
7.	Mass , total:	4,037kg

b. Driving specifications

8.	Wheels/ tracks:	Tracks (449mm width)
9.	Ground pressure, max weight:	4.2 PSI
10.	Hill climbing ability:	22°

c. Clearance performance

11.	Number of chains:	108
	• length of chains:	361mm
12.	Gap between chains:	152mm
13.	Rotation speed:	Not given
14.	Clearance depth, max. (planned):	203.2mm
15.	Working speed (planned):	
	• light soil/medium vegetation:	3.2km/h
	• medium soil/medium vegetation:	2.4km/h
	• heavy soil/ dense vegetation:	2.4km/h
16.	Control of clearing depth:	Not given
17.	Machines in use:	Developmental
18.	Other types:	—
19.	Location of use:	—
20.	Totally area cleared so far:	—

d. System specifications

21.	Engine:	73hp diesel
22.	Fuel capacity:	17.3l
23.	Fuel consumption:	17.3l/h (estimate)
24.	Separate engine for working unit:	No
25.	Cooling system engine:	Oil
26.	Oil capacity (both engines):	16.3l
27.	Hydraulic oil capacity (both engines):	49.2l

e. Comfort and security

28.	Air conditioning:	No
29.	Operator confort:	—
30.	Armour:	SPECTRA/steel
31.	Remote control:	Yes
	• greatest distance:	91m

f. Costs

32.	Cost of system:	U.S.\$200,000 (estimated)
33.	Other costs:	
	• training	—
	• spare parts	Set chains/belt U.S.\$12,500, including remote control spares
34.	Transport:	Self-propelled and trailer or flat bed truck
35.	Availability for hire:	No

Technical data sheet Diana 40T

a. Dimensional data

1.	Length without attachment:	3,370mm
2.	Length total:	5,370mm
3.	Width without attachment:	2,050mm
4.	Width total:	2,500mm
5.	Clearing width:	2,100mm
6.	Height, overall:	Not given
7.	Mass , total:	5,150kg

b. Driving specifications

8.	Wheels/ tracks:	400mm
9.	Ground pressure, max weight:	0.32kg/cm ²
10.	Hill climbing ability:	30°

c. Clearance performance

11.	Number of chains:	40
	• length of chains:	570mm
12.	Gap between chains:	60mm
13.	Rotation speed:	Up to 600rpm
14.	Clearance depth, max.:	200mm
15.	Working speed:	
	• light soil/medium vegetation:	4km/h
	• medium soil/medium vegetation:	2km/h
	• heavy soil/ dense vegetation:	0.8km/h
16.	Control of clearing depth:	Mechanically
17.	Machines in use:	Machine is not yet fielded
18.	Other types:	—
19.	Location of use:	—
20.	Totally area cleared so far:	—

d. System specifications

21.	Engine:	Perkins 1104C-E44T
22.	Fuel capacity:	70l
23.	Fuel consumption:	6l/h (estimated)
24.	Separate engine for working unit:	Not given
25.	Cooling system engine:	Water cooled
26.	Oil capacity:	8l
27.	Hydraulic oil capacity:	67l

e. Comfort and security

28.	Air conditioning:	In the control vehicle
29.	Operator confort:	After set-up the system works in semi-automatic mode
30.	Armour:	Not given
31.	Remote control:	CSD T2 type
	• greatest distance:	5,000m (with optical visibility only)

f. Costs

32.	Cost of system:	€150,000
33.	Other costs:	
	• training	€2,500
	• spare parts	€5,560/year
34.	Transport:	On a special trailer, air transportable
35.	Availability for hire:	Yes

Technical data sheet Compact 140 Minecat

a. Dimensional data

1.	Length without attachment:	2,400mm
2.	Length total:	3,600mm
3.	Width without attachment:	1,060mm
4.	Width total:	1,770mm
5.	Clearing width:	1,400mm
6.	Height, overall:	1,480mm
7.	Mass, basic vehicle:	1,700kg
8.	Mass, detachable unit(s):	800kg
9.	Mass, overall:	2,500kg

b. Driving specifications

10.	Wheels/ tracks:	Rubber tracks
11.	Ground pressure:	0.38kg/cm ²
12.	Hill climbing ability:	25° transport, 20° operational

c. Clearance performance

13.	Number of chains:	48
	• Length of chains:	520mm
14.	Diameter of drum:	1,300mm incl. chains
15.	Rotation speed:	350-800rpm
16.	Clearance depth, max.:	500mm
17.	Working speed:	0.2-2.5km/h
	• light soil/ meidumvegetation:	0.5-2.5km/h
	• medium soil/medium vegetation:	0.2-1.5km/h
	• heavy soil/ dense vegetation:	0.2-1.0km/h
18.	Control of clearing depth:	Manual/automatic
19.	Machines in use:	1 prototype completed all tests
20.	Other types:	—
21.	Location of use:	Norway, Sweden
22.	Totally area cleared so far:	Approximately 50,000m ²

d. System specifications

23.	Engine:	2 (104hp + 18hp)
24.	Fuel capacity:	70l
25.	Fuel consumption:	4l/h
26.	Separate engine for tilling unit:	Yes, Perkins (104hp)
27.	Cooling system engine:	Fluid-cooled via radiator and fan
28.	Oil capacity (both engines):	5 + 11l
29.	Hydraulic oil capacity (both engines):	24 + 40l

e. Comfort and security

30.	Air conditioning:	Yes, in mobile tower (armoured)
31.	Operator confort:	Very good - mobile tower (armoured)
32.	Armour:	Yes, variable in thickness
33.	Remote control:	Yes, two-way radio
	• greatest distance:	1,000m

f. Costs

34.	Cost of system:	
	• machine	—
	• training	—
	• spare parts	—
35.	Transport:	Helicopter (inside/under), any suitable trailer, truck, container
36.	Availability for hire:	To be discussed

Technical data sheet MV-4

a. Dimensional data

1.	Length without attachment:	2,950mm
2.	Length total:	4,6110-5,360mm
3.	Width without attachment:	1,540mm
4.	Width total:	2,080mm
5.	Clearing width:	1,725mm
6.	Height, minimum:	Not given
7.	Height, overall:	1,400mm
8.	Mass , total:	5,150kg (without fuel and lubricants)

b. Driving specifications

9.	Wheels/ tracks:	Tracks (300mm width)
10.	Ground pressure, max weight:	Between 0.41-0.43kg/cm ² , depending on terrain configuration
11.	Hill climbing ability:	Clearance of transverse slopes of 35° up and down; clearance of longitudinal slopes of 20°; driving on longitudinal slopes of 35°

c. Clearance performance

12.	Number of chains:	32
	• Length of chains:	320mm - chains with hammer; 115mm - single hammer
13.	Gap between chains:	45/15mm (static/dynamic)
14.	Rotation speed:	Up to 900rpm
15.	Clearance depth, max.:	Up to 200mm
16.	Working speed:	
	• light soil/ small vegetation:	1,500-2,000m ² /h
	• medium soil/medium vegetation:	1,000-1,200m ² /h
	• heavy soil/ dense vegetation:	500-800m ² /h
17.	Control of clearing depth:	Automatic (electronic)
18.	Machines in use:	16
19.	Other types:	6 (MV-1; MV-2; MV-3)
20.	Location of use:	Albania (planned) Bosnia and Herzegovina, Croatia, Democratic Republic of Congo, Iraq, and Sweden
21.	Totally area cleared so far:	Approximately 12,000,000m ²

d. System specifications

22.	Engine:	Perkins 1066-60TW; 6 cylinder in line; turbocharged diesel; 4-stroke; direct injection; water cooled; 199.5kw or 123.5kw
23.	Fuel capacity:	70l
24.	Fuel consumption:	10-15l/h
25.	Separate engine for tilling unit:	No
26.	Cooling system engine:	Water
27.	Oil capacity:	15l
28.	Hydraulic oil capacity:	178l

e. Comfort and security

29.	Air conditioning:	No
30.	Operator confort:	Remote control
31.	Armour:	8-10mm steel armour plates
32.	Remote control:	Yes
	• greatest distance:	1,500m

f. Costs

33.	Cost of system:	
	• machine	€250,000
	• training	Training course takes one week both for operators and mechanics
	• spare parts	Basic spare parts set •5,684. Other options available on customer's request.
34.	Transport limitation:	No . Air transportable on a C-130, IL-76 or similar cargo aircraft. MV-4 can be transported on a low-bed vehicle or an ordinary truck.

COMPARATIVE ANALYSIS

	Armtrac 75 mini flail	Bozena
a. Dimensional data		
1. Length without attachment:	3,380mm	3,857mm
2. Length total:	4,700mm	6,052mm
3. Width without attachment:	1,560mm	1,960mm
4. Width total:	2,560mm	2,746mm
5. Clearing width:	1,800mm	2,000mm
6. Height, minimum:		2,145mm
7. Height, overall:	1,970mm	2,145mm
8. Mass, total:	Not given	5,800kg
b. Driving specifications		
9. Wheels/ tracks:	Wheels and tyre chains	Foam filled tyres/ metal tracks
10. Ground pressure, max. weight:	Not given	Tracks 0.66 kg/cm ² Front wheels: 2.82kg/cm ² Rear wheels: 1.46kg/cm ²
11. Hill climbing ability:	45°	Up to 35°
c. Clearance performance		
12. Number of chains:	54 chains or 54 chisels	36
• length of chains:	chains 1m; chisels 30cm	470mm
13. Gap between chains:	10mm	55mm (dynamically 20mm overlap)
14. Rotation speed:	350rpm	Up to 400rpm
15. Clearance depth, max:	350mm	Up to 250mm
16. Working speed		
• light soil/small vegetation:	1,000m/h	Approx. 1,800m ² /h
• medium soil/medium vegetation:	700m/h	—
• heavy soil/ dense vegetation:	500m/h	Approx. 520m ² /h
17. Control of clearing depth:	Engine rpm	Automatic
18. Machines in use:	2	More than 50
19. Other types:	Armtrac 100, 325, sifter, slash buster	Bozena 1, Bozena 2, Bozena 3
20. Location of use:	UK MOD	Albania, Bosnia and Herzegovina, Croatia, Eritrea, Iraq, Kosovo, Lebanon, and Sri Lanka
21. Total area cleared so far:	60,000m ²	More than 15,000,000m ²
d. System specifications		
22. Engine:	Deutz 159hp	Deutz BF4L913, 106hp
23. Fuel capacity:	400l	100l
24. Fuel consumption:	At full load 35l/h	Max. 8.2l/h
25. Separate engine for tilling unit:	No	No
26. Cooling system engine:	Water	Air cooled
27. Oil capacity	7l	14.5l
28. Hydraulic oil capacity:	300l	130l
e. Comfort and security		
29. Air conditioning:	Yes	In the cabin
30. Operator comfort:	Coil sprung suspension seat	Armoured, air-conditioned cabin
31. Armour:	10mm steel and 45mm glass to 7.6 at point blank range	4mm ARMOX steel. Vial parts are protected by LEXAN
32. Remote control:	Yes	Yes
• greatest distance:	7,000m	5,000m (with optical visibility only)
f. Costs		
33. Cost of system:		Subject to negotiation
• machine	£110,000	On customer request
• training	driver: 2 weeks at £2,800, mechanical training £2,800	Included in the purchase package
• spare parts	For 3 months period £2,500	Set chain/belts included
34. Transport limitation:	Road speed of 30kph or truck that will carry 6 tonnes	Can be packed in one 40ft and and one 20ft container. The customer has to provide the truck for transportation.
35. Availability for hire:	Yes	Yes

Flail systems

Columbia Mini-Flail	Columbia Small-Flail	Diana T40
2,350mm	2,717mm	3,370mm
3,073mm	3,759mm	5,370mm
1,067mm	1,955mm	2,050mm
1,295mm	1,52mm	2,500mm
1,067mm	2,000mm	2,100mm
Not given	—	Not given
1,143mm	2,082mm	—
1,063kg	4,037kg	5,150kg
23 x 8.50 cleat tyres, foam-filled 6PSI	Tracks, 499mm in width 4.2 PSI	400mm 0.32kg/cm ²
22°	22°	30°
72	108	40
361mm	361mm	570mm
152mm	152mm	60mm
Not given	Not given	Up to 600rpm
Not given	203.2mm	200mm
3.2km/h	3.2km/h	4km/h
2.4km/h	2.4km/h	2km/h
2.4km/h	2.4km/h	0.8km/h
Not given	Not given	Mechanically
2	—	Machine is not yet fielded
—	—	—
Bosnia and Herzegovina, Kuwait	—	—
Unknown	—	—
17hp diesel	73hp diesel	Perkins 1104C-E44T
22.7l	17.3l	70l
3.9l/h (estimated)	17.3l/h (estimate)	6l/h
No	No	Not given
Liquid	Oil	Water cooled
2.4l (both engines)	16.3l (both engines)	8l
34l (both engines)	49.2l (both engines)	67l
No	No	In the control vehicle
—	—	After set up the system works in semi-automatic mode
SPECTRA	SPECTRA steel	Not given
Yes	Yes	Yes, CSD T2 type
91m	91m	5,000m (with optical visibility only)
U.S.\$110,000	U.S.\$200,000 (estimated)	€150,000
Training course takes one week both for operators and mechanics	Included in the purchase package	€2,500
Set chains/belt U.S.\$8,500, incl. remote control	set chains/belts U.S.\$12,500 incl. remote control spares	€5,560/year
Self-propelled and trailer deployed	Self-propelled and trailer or flat bed truck	On a special trailer, air transportable
No	Availability for hire:	No Yes

COMPARATIVE ANALYSIS

	Compact 140 Minecat	MV-4
a. Dimensional data		
1. Length without attachment:	2,400mm	2,950mm
2. Length total:	3,600mm	4,610-5,300mm
3. Width without attachment:	1,060mm	1,540mm
4. Width total:	1,770mm	2,000mm
5. Clearing width:	1,400mm	1,725mm
6. Height, minimum:	—	Not given
7. Height, overall:	1,480mm	1,400
8. Mass, total:	2,500kg	5,150kg (without fuel and lub.)
b. Driving specifications		
9. Wheels/ tracks:	Rubber tracks	Tracks 300mm
10. Ground pressure, max. weight:	0.38kg/cm ²	Between 0.41-0.43kg/cm ²
11. Hill climbing ability:	25° transport, 20° operational	Clearance of transverse slopes of 35°, driving on transverse slopes of 50-80 up and down, clearance of longitudinal slopes of 20°; driving on longitudinal slopes of 35°
c. Clearance performance		
12. Number of chains:	48	32
• length of chains:	520mm	300mm with hammer, 155mm with single hammer
13. Gap between chains:	diam. of drum 1,300mm <i>incl. chains</i>	45/15mm
14. Rotation speed:	350-800rpm	Up to 900rpm
15. Clearance depth, max:	500mm	Up to 200mm
16. Working speed	0.2-2.5km/h	
• light soil/ small vegetation:	0.5-2.5m/h	1,500-2,000m ² /h
• medium soil/medium vegetation:	0.2-1.5km/h	1,000-1,200m ² /h
• heavy soil/ dense vegetation:	0.2-1.0km/h	500-800m ² /h
17. Control of clearing depth:	Manual/automatic	Automatic (electronic)
18. Machines in use:	1 prototype	16
19. Other types:	—	6 (MV-1, MV-2, MV-3)
20. Location of use:	Norway, Sweden	Albania (planned), Bosnia and Herzegovina, Croatia, DRC, Iraq
21. Total area cleared so far:	approx. 50,000m ²	approx. 12,000,000m ²
d. System specifications		
22. Engine:	2 (105hp + 18hp)	Perkins 1006-60TW, 6 cylinder in line, turbocharged diesel, 4-stroke, direct injection, water cooled
23. Fuel capacity:	70l	70l
24. Fuel consumption:	4l/h	10-15l/h
25. Separate engine for tilling unit:	Yes, Perkins (104hp)	No
26. Cooling system engine:	Fluid cooled via radiator and fan	Water cooled
27. Oil capacity	5 + 11l	15l
28. Hydraulic oil capacity:	24 + 40l	178l
e. Comfort and security		
29. Air conditioning:	Yes, in mobile tower	No
30. Operator comfort:	Not given	Remote control
31. Armour:	Yes, variable in thickness	8mm steel armour plates
32. Remote control:	Yes, two-way radio	Yes
• greatest distance:	1,000m	1,500m
f. Costs		
33. Cost of system:		
• machine	—	€250,000
• training	—	Training course takes one week
• spare parts	—	basic set •5,864. Other options on customer's request
34. Transport limitation:	Helicopter, truck, trailer, container	Transportable by air, transportable on low-bed vehicle or truck
35. Availability for hire:	To be discussed	Yes