

WAY Industry J-s Co. | Slovak Republic

GENERAL DESCRIPTION

The *Bozena 4* is a remotely controlled mine clearance system using a light flail machine. It is manufactured by Way Industry which has invested significantly in R & D of the system since the Bozena 1 was introduced in 1995. (The company's Bozena 5 medium flail machine is described in the next sub-section.)

The Bozena 4 is designed for clearance of both AP and AT mines with up to 9 kg of TNT. It is also capable of removing tripwires, and vegetation up to about 4 m high.

The vehicle is controlled by an operator from either an air-conditioned cabin placed in line of sight or in the open air by means of a transmitter with a range of up to 5,000 m.

The chassis is primarily constructed as wheel-type, but manoeuvrability can be enhanced by easily mountable tyre tracks which can be supplied with each machine. Recent developments include a solution of fixed-track system (similar to dozer under-carriages).

The main protection against blast and flying debris is the armoured shield, attached behind the flail shaft. The hood (see picture) serves as the "dust cover" for the prime mover. The prime mover's internal parts are further protected by 4 mm ARMOX steel, additionally supported by LEXAN polycarbonate glass on the most vital parts.

The machine can process up to 2,500 m²/h, depending on the ground and terrain conditions. Internal fire safety is improved with an automatic fire-extinguisher system.

The Bozena 4's versatile design allows it to go beyond mechanical demining for various engineering tasks and humanitarian support. A total of 19 various tool attachments – including blades, shovels, buckets, drilling machine, hydraulic hammer, concrete mixer, excavator – can be fitted to the prime mover. Detachment of the flail and attachment of another tool takes approximately five minutes.



BOZENA 4

CLEARANCE METHODOLOGY

Hammers at the end of 38 chains rotate clockwise at around 400 rpm and penetrate the ground down to 250 mm, depending on soil and terrain. The flail design ensures a dynamical overlap of the hammers. AP and AV mines may be destroyed either by their activation, or by direct mechanical destruction. The machine is capable of destroying dense vegetation, including tree trunks up to 20 cm diameter.

A hydraulic winch helps recovery when stuck in field situations.

MACHINES IN USE TO DATE

There are more than 80 units of the Bozena 4 and together more than 160 Bozena systems in service with humanitarian and military customers. The machine is integrated into the armed forces of several countries (including NATO) and is in use in following countries: Afghanistan, Albania, Angola, Azerbaijan, Bangladesh, Bosnia and Herzegovina, Cambodia, Canada, Colombia, Croatia, Czech Republic, Eritrea, Ethiopia, Iraq, Kenya, Kosovo, Lebanon, the Netherlands, Niger, Poland, Slovakia, Sri Lanka, Sudan and Thailand.

ENGINE, FUEL AND OIL

The latest version of the Bozena 4 contains the 157 hp Deutz diesel engine with direct fuel injection and air-cooling. The engine serves for both the prime mover and the flail unit and its energy is transferred hydrostatically. Fuel consumption is estimated at 13.1 litres per hour. Fuel tank capacity is 140 litres, which is enough for one full-working day of operation.

FACTORY SUPPORT

The Deutz engine and the Bosch-Rexroth hydraulic components are well-known brands with worldwide servicing networks so spares can be easily obtained.

In addition, Way Industry offers to supply customers with any kind of spare part, service or logistic support.

The following training packages are offered:

- > initial operator's training (two weeks)
- > initial mechanic's training (one to two weeks)
- > advanced electrician's training (one to two weeks)
- > on-the-job training/support (for desired period, usually four to 12 months)

Each machine is delivered with a full set of technical documentation, including the spare parts catalogue, operation/maintenance/diagnostic manuals.

Prices of particular support and spare parts packages depend on selected composition and location and can be obtained on request to the manufacturer.

MAINTENANCE AND SUPPORT

The producer recommends at least a two-man crew: ideally an operator and mechanic trained by the manufacturer. Procedures for preventive and corrective maintenance (daily, weekly, monthly) are fully covered in supplied documentation and can be easily done by trained crew. Any set of spare parts for any project type and duration can be supplied on request. The manufacturer can also provide specialised staff (from operators and mechanics to mechanical demining team leaders) with many years of mechanical demining experience worldwide.

On-site technical and logistic support, 24-hour call-out or e-mail support can be ordered.

TESTS AND EVALUATIONS

The Bozena 4 has passed many survivability and performance tests which have proved its capabilities to effectively detonate or destroy all types of AP and AV mines up to 9 kg TNT charged in various types of soil and terrain conditions. See: www.way-industry.sk/eng/index.php?b=bozena4&c=test_reports

The following test reports are available at the ITEP website:

- > 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
- > 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
- > 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
- > G.G. Coley and R.W. Fall Defence R&D Canada – Suffield, Maj P.G. Danielsson SWEDEC, P.W. Blatchford and L.M. Wye QinetiQ, *Way Industries Bozena-4 Flail Test and Evaluation*, Defence Research and Development Canada, Canada, 2005; www.suffield.drdc-rddc.gc.ca/reports/English/DRDC_Suffield_TR_2005-138.pdf
- > C. Leach, *BOZENA 4 Mini Mineclearance System Assessment Phase 1*, by QinetiQ, 2004; www.itep.ws/pdf/Bozena_4_Phase1_Report.pdf



REPORTED LIMITATIONS AND STRENGTHS

Limitations

- > Difficult to operate with precision from distances over 200 m. (This applies to all remotely controlled machines.)
- > System creates huge dust clouds, as occurs with all flail systems in dry environments.

Strengths

- > Resistance to AV mines (up to 9 kg TNT) without significant damage (20 min repair time)
- > There is a variety of engineering working tools available.
- > It has a well-designed cooling system (reducing breakdowns due to overheating).
- > Well-designed armoured coating ensures good protection of vital parts, even against AV mine blasts.
- > Winch for self recovery fitted.
- > Transportation of the machine is simple. It is easy to handle with a light low-bed trailer.
- > Good results are achieved in forested and space-limited areas due to small size.



BOZENA 4

DIMENSIONAL DATA

1. Length without attachment	3,305 mm
2. Length total	5,280 mm
3. Width without attachment	1,985 mm
4. Width total	2,840 mm
5. Clearing Working width	2,225 mm
6. Height Overall	2,270 mm
7. Mass Basic vehicle	4,890 kg (with no tracks; with standard tyres)
8. Mass Detachable unit(s)	1,407 kg
9. Mass Overall	6,983 kg (with tracks, tyres and flail unit)

OPERATIONAL DATA

10. Wheels Tracks (description)	Wheeled tracked (tracks easily detachable by the crew, mounted on foam-filled tyres)
11. Ground Bearing Pressure (kPa)	
> Tracks	0.66 kg/cm ²
> Front Wheels	2.82 kg/cm ²
> Rear Wheels	1.46 kg/cm ²
12. Hill climbing ability (in degrees)	25°
13. Number of Chains Chisels Tools	38 hammers
14. Beat Pattern (hits per m ²) at different operating speeds	Not given
15. Length of Chains Tools	Chain 400 mm; chain with hammer 470 mm
16. Diameter of drum	1,400 mm
17. Rotation Speed	300 - 400 rpm
18. Clearance Working depth in varying terrain	Up to 25 cm, depending on speed and terrain
19. Working Speed (m ² /h)	
> Light Soil Medium Vegetation	2,500 m ²
> Medium Soil Medium Vegetation	1,100 m ²
> Heavy Soil Dense Vegetation	520 m ²
20. Control of Clearance Working depth	a. adjustable height of flail skids b. boom hydraulic control
21. Additional attachable working tools	Blades, shovels, buckets, drilling machine, hydraulic hammer, concrete mixer, excavator etc
22. Armour	a. 4 mm / 6 mm ARMOX steel plates strengthened by b. LEXAN polycarbonate plates (engine, remote control, hydraulic system)
23. Remote controlled	Yes
> +greatest distance	5,000 m
24. Transportation	
> Short distances	Self transportable (up to 9 km/h; harmless to tarmac surface)
> Long distances	Recommended to use the special BOZENA 4 trailer
> Sea transport	Whole BOZENA 4 system can be packed in one 40 ft container,
> Air transport	Transportable by cargo aircrafts (C130 or similar) transportable by helicopter (hooked up on steel ropes)

SYSTEM STATUS AND DEPLOYMENT

25. Machines in use	80 (over 160 of all models in use)
26. Other types	Bozena 1, Bozena 2, Bozena 3, Bozena 5
27. Location of use	Afghanistan, Albania, Angola, Azerbaijan, Bangladesh, Bosnia and Herzegovina, Cambodia, Canada, Colombia, Croatia, Czech Republic, Chile, Eritrea, Ethiopia, Iraq, Kenya, Kosovo, Lebanon, Niger, Poland, Slovakia, Sri Lanka, Sudan, Thailand, The Netherlands
28. Totally cleared so far (m ²)	More than 100,000,000 m ²

ENGINE | FUEL | OIL

29. Engine	DEUTZ, 4-Stroke, turbocharged diesel with direct fuel injection, air cooled, 6 cylinders
30. Engine power at the flywheel	110 kw (157 hp) at 2,500 rpm
31. Sufficient power supplied to working tool	Not given
32. Fuel capacity	140 l
33. Fuel consumption	13.1 l/h
34. Separate engine for working unit	No
35. Cooling system	Air cooled
36. Oil capacity of engine	18.0 l
37. Hydraulic oil capacity (both engines)	165 l

COSTS

38. Cost of system	On request
39. Other costs	On request
> training	(possible in country of operation or in Slovenia)
> spare part set chains belts	a. basic set of spares included b. various sets of spare parts available - tailored for specific projects and environment
> repair costs for one year	Not given
40. Availability for hire	Yes

OTHER

41. Operator comfort	Protective, air-conditioned cabin with power generator provides safety and high comfort for the operator during demining operation
42. Air conditioning	Yes, (separated mine-protected monitoring cabin)