

## MULTI-TOOL SYSTEMS | PEARSON MINEFIELD TRACTOR

Pearson Engineering Ltd. | United Kingdom

### GENERAL DESCRIPTION

The *Pearson Minefield Tractor* is a medium-sized, armoured, mine-protected tractor designed to operate with a wide range of tools (described below). The Minefield Tractor is based on a 110 kw (150 hp) John Deere 6920 tractor with continuously variable transmission (CVT) providing a stepless speed range from 0.05 to 40 km/h. It is fitted with an armoured cab, fuel tank and body panels. It also has “blast-off wheels” on the rear axle, which detach in the event of a mine strike, protecting the driver from life-threatening accelerations. Pearson say the Tractor has been successfully tested against a 10 kg TNT equivalent mine detonation.

The two-door cab is reversible, allowing bidirectional operation. The Tractor has a 8,500 kg lift capacity rear category II/III three-point hitch, three-speed mechanical power take off and up to four double-acting hydraulic power take offs. A 3,500 kg front three-point linkage and 2,000 kg front loader are available. A wide range of commercial attachments, such as buckets and forks, are available for the loader. The Tractor is supplied with pneumatic tyres and with solid tyres capable of withstanding multiple AP mine blasts.



THE PEARSON MINEFIELD TRACTOR | Mine comb in heavy vegetation | Area reduction roller

### WORKING METHODOLOGY

The Minefield Tractor is the prime mover and can carry tools on the front or rear for a wide variety of tasks. Most tools can be attached and removed in less than five minutes. Depending on the task, the CVT transmission can operate manually at constant engine speed (for power-take-off work) or work automatically in draft mode to provide maximum fuel economy.

### ATTACHMENTS

The following tools are available. All carry a one-year warranty from date of delivery and are supplied with operation, maintenance and parts books in English, with other languages available to order. Spare parts are available from Pearson Engineering.

#### Mine Comb

The *Mine Comb* is a vehicle-mounted AV mine clearing tool designed for unearthing AV mines in a wide range of ground conditions, including sand, clay and non-metallic roads and dense vegetation. The Mine Comb has a low power requirement and handles the mines gently. Clearing depth is up to 40 cm and width is 3.3 m, and clearing speed ranges from 0.1 to 0.5 km/h, depending on ground conditions. In trials in sand, heavy clay and non-metallic quarry roads, the power requirement never exceeded 80 kw. The Mine Comb is designed to be mounted on the Minefield Tractor or any other suitable prime mover of at least 100 kw and with sufficient hydraulic lift and a mechanical power take off.

---

The Mine Comb can be used for both route clearance and area clearance and clears all types of AV mines. The manufacturer says that in tests with more than 400 AV mines, the unearthing rate exceeded 99.5%. Tests also showed good results against large (greater than 100 mm diameter) AP mines. The Mine Comb has been blast tested with charges of 10 kg TNT equivalent in various locations. The main structure and drive train was undamaged. Damage was limited to field-replaceable parts.

The Mine Comb is pushed by the prime mover and operates by combing large objects including mines gently to the ground surface from where they can then be disposed of in an appropriate manner. It can be lowered to full working depth and lifted up while stationary and requires a forward travel of less than 2 m from encountering a mine to bringing it to the surface, therefore requiring a very small space envelope around the suspected area. It causes negligible soil displacement, creates very little dust and does not pulverise the soil. The tines move through the soil at a maximum speed of only 1.8 m/s.

The Mine Comb is simple to operate, requiring only one day of training. Routine maintenance can be done by the operator and requires no special tools or skills. There are no consumables.

- > Four units have been supplied to the US Department of Defense Humanitarian Demining Program.

### **Area Reduction Ruler**

The *area reduction roller* is a vehicle-mounted roller for rapid identification of the presence of AP mines in suspect areas and for area reduction. The roller is normally mounted on the front of a minefield-intrusive prime mover such as the Minefield Tractor or an armoured loading shovel. It is then pushed through the minefield. Operation methodologies are discussed in UNMAS Technical Notes For Mine Action (TNMA) 09.50/01 and in *A study of Mechanical Applications in Demining* (GICHD, May 2004).

The roller works by detonating any near-surface or surface pressure-activated mines. It is designed to withstand AP mine blasts only. The roller consists of a series of individually “floating” steel discs, each exerting a load of 50 kg on the ground. This feature ensures that the roller is effective on uneven ground.

The roller weight is approximately 1,000 kg per metre width. It is not only manufactured for the Minefield Tractor but is also available in any width up to 3.5 m for other prime movers.

No special training, few spares and no routine maintenance required.

- > The HALO Trust has approximately ten rollers in service in Abkhazia, Afghanistan, Cambodia, Georgia, Kosovo, Mozambique and Somaliland and confirms their robust construction and versatility.
- > The US Department of Defense owns three rollers, two with the Thailand Mine Action Centre and one in Nicaragua.



HEAVY ROTARY MOWER | MINE TRACTOR AND COMB | MEDIUM ROTARY MOWER

### Magnet

The *magnet* is a vehicle-mounted system for removing metal fragmentations from the ground to reduce the number of false signals encountered by manual deminers. It consists of two large permanent magnets mounted on a frame for attachment to vehicles with a hydraulic lift. Each magnet is fitted with a hydraulically operated ejector plate for dumping the collected fragments. The magnet has a 2.7 m operating width with a 0.8 m uncleared gap in the middle to provide the necessary separation between the two magnets. The uncleared gap can be cleared on the next pass.

The magnet may be pushed or pulled through the minefield by a minefield-intrusive prime mover such as the Minefield Tractor or an armoured wheeled loader. At suitable intervals the material collected is taken to a suitable dumping point and ejected by the operator from inside the cab. The magnet is most effective when used in conjunction with the Pearson Area Reduction Roller and ground preparation tools. It is recommended that the minefield is rolled with the Area Reduction Roller before using the magnet, as the magnet is susceptible to damage from the blast of an AP mine. The magnet is not intended for use where there is an AV mine threat. Further information on working methodologies can be found in *A study of Mechanical Applications in Demining* (GICHD, May 2004). No special training required for operation or maintenance.

- > The US Department of Defense has bought two magnets: one unit has been operational in Thailand with TMAC since 2001, the other in Nicaragua since 2005.

### Sifter

The *sifter* is pulled by the Minefield Tractor or other suitable prime mover. The sifter is designed for sifting soil in areas with an AP mine threat. It is mounted to a prime mover fitted with an agricultural three-point linkage, power take-off shaft and hydraulic outlets. The mine sifter is based on a commercial agricultural de-stoner. It is capable of sifting to a depth of 300 mm in prepared ground and can operate at speeds up to 4 km/h, with a working width of 1.6 m. The sifter uses plastic star wheels arranged in a double helix to sift the soil. Operating depth is controlled by manually-adjustable depth rollers. This ensures the soil flows side to side as it progresses up the sifter bed, ensuring maximum performance. For maximum durability the sifter is fitted with a one-piece share and automatic drawbar overload protection.

---

Before using the sifter, the ground needs to be prepared by removing vegetation followed by cultivation and rolling to break up clods. The sifter cuts the soil at the selected depth with a set of horizontal shares. These lift the soil on to a slatted vibrating conveyor. The soil falls through the slats leaving mines, stones and large clods deposited in a windrow behind or to one side of the sifter for manual removal.

The sifter is only suitable for use in areas where there are few trees and shrub roots. The soil needs to be in a friable condition. To ensure uniform clearing depth, the ground surface should be even before cultivation. Blast tests with a 100 g AP mine on the conveyor caused bending of the conveyor bar. No further damage was recorded.

No special skill required to operate or maintain/repair the sifter. The only routine maintenance is greasing surface-bearing areas and checking gearbox oil level.

- > One machine is in operation with the US Department of Defense Humanitarian Demining Program and the Nicaraguan army in Nicaragua.

### **Vegetation Cutting Tools**

The *vegetation cutting tools* are mounted to the Minefield Tractor or other suitable prime mover with agricultural three-point linkage. A range of vegetation cutting tools are available:

**Rotary mower** the medium rotary mower has a working width of 2.9 m and can cut material up to 50 – 60 mm diameter. The heavy rotary mower has a working width of 1.8 m and can cut material up to 150 mm diameter.

**Reach mower** the reach mower is fitted with a 1.2 m flail head and can be used to reach into a minefield from a safe area and to cut banks and ditches and around obstacles. It is capable of cutting material up to 75 mm diameter.

Routine maintenance can be carried out by the operator. The only consumables are the blades which require periodic replacement.

- > Units belonging to US DoD are in use in mine clearance in Thailand with TMAC and in Nicaragua.

### **Tree Extractor**

The *tree extractor* is designed for extracting trees complete with roots. The extractor fits on to standard loader lift arms. It consists of a pair of hydraulic jaws that are clamped firmly onto a tree trunk. The tree is lifted out of the ground by raising the loader arms. A pair of lifting legs provides extra force to pull the tree out of the ground. There are two tree extractor models. The *light tree extractor* for use on agricultural loaders has a maximum force of 14 tons; the *heavy tree extractor* is for use on loading shovels of the 12 - 18 tons class such as the Volvo BM 4400. The lifting legs have a tear-out force of up to 25 tons.

No special skill is required to operate or maintain and repair the tree extractors. Tests by both MAG and TMAC have proven the effectiveness of the tree extractors. The only routine maintenance required is the greasing of bearing surfaces. No special skills are required. The length for both extractors is 1.1 m. The width of the light extractor is 3 m, while the heavy extractor is 2.7 m wide. The light extractor weighs 520 kg. The heavy extractor weighs 1,100 kg.

- > Units belonging to US DoD are operational in Thailand with TMAC and in Nicaragua.

### Ground Preparation Tools

The *ground preparation tools* consist of a heavy soil loosener capable of working to a depth of 400 mm in undisturbed soil and a lighter spring tine cultivator for breaking up previously loosened soil. These tools fit on the Minefield Tractor or any other suitable prime mover with an agricultural category two- or three-point linkage.

The tools are pulled through the minefield and can be used to prepare ground for other mechanical clearing processes or as an aid to manual deminers where ground conditions are tough. They are particularly useful in enhancing the effectiveness of the Pearson Magnet and Area Reduction Roller. Further information on working methodologies can be found in *A study of Mechanical Applications in Demining* (GICHD, May 2004).

No specific operator training is required and there is no routine maintenance. The tine tips require periodic replacement. The soil loosener is fitted with shear bolt protection to each leg.

- > Units are operational with the US Department of Defense in Thailand and Nicaragua.



THE PEARSON MINEFIELD Reach Mower | TREE EXTRACTOR in operation | Mine Sifter

### MACHINE IN USE TO DATE

One Minefield Tractor supplied to the US Department of Defense has been operational in Nicaragua since early 2005, with operator training and maintenance provided by the local John Deere dealer. Two other machines have been operational in Thailand since 2001.

### ENGINE, FUEL AND OIL

The tractor is driven by a 110 kw turbocharged John Deere diesel engine. Fuel capacity is 180 litres and fuel consumption is approximately 5 – 20 litres per hour depending on conditions.

### FACTORY SUPPORT

Full operation, maintenance, repair and spares manuals are available in English, with other languages available to order. Full spares backup is provided by Pearson Engineering. Operator training, tractor spares and service available from the worldwide John Deere dealer network. John Deere manuals available in major European languages. One-year warranty by Pearson and John Deere.

---

## **MAINTENANCE AND SUPPORT**

Daily maintenance consists of checking fluid levels and greasing bearing surfaces. Engine oil change interval 500 hours. All filters and top-up points easily accessible without tools. The operator can undertake these tasks. No special workshop facilities are required. The tractor requires one operator. An assistant is required to attach and remove tools.

## **TESTS AND EVALUATIONS**

Field testing of the old version of the Pearson Minefield Tractor was done in Thailand in 2001. For the report see:

[www.humanitarian-demining.org/demining/pubs/catalog/contents/clearn40.htm](http://www.humanitarian-demining.org/demining/pubs/catalog/contents/clearn40.htm)

One test report on the new version is available at [www.itep.ws](http://www.itep.ws)

- > Institute for Defense Analyses, *Proof of Performance Test Report on Mine Clearing/Survivable Vehicle (MANTIS)*, by Humanitarian Demining Research and Development Program, Night Vision and Electronic Sensors Directorate – Office of the Assistant Secretary of Defense Special Operations and Low-Intensity Conflict, 2005.

## **REPORTED LIMITATIONS AND STRENGTHS**

No information provided.

## DIMENSIONAL DATA

1. Length without attachment	5,200 mm
2. Length total	Depending on the attachment
3. Width without attachment	2,300 mm (standard wheels) 2,800 mm (blast off wheels)
4. Width total	Depending on the attachment
5. Clearing   Working width	Depending on the attachment
6. Height   Overall	2,900 mm
7. Mass   Basic vehicle	9,600 kg with solid tyres
8. Mass   Detachable unit(s)	Varies
9. Mass   Overall	Depending on the attachment

## OPERATIONAL DATA

10. Wheels   Tracks (description)	4wd with pneumatic and solid tyres
11. Ground Bearing Pressure (kPa)	Not given
12. Hill climbing ability (in degrees)	30° depending on ground condition
13. Number of Chains   Chisels   Tools	N/A
14. Beat Pattern (hits per m <sup>2</sup> ) at different operating speeds	N/A
15. Length of Chains   Tools	N/A
16. Diameter of drum	N/A
17. Rotation Speed	N/A
18. Clearance   Working depth in varying terrain	
19. Working Speed (m <sup>2</sup> /h)	Not given
> Light Soil   Medium Vegetation	Not given
> Medium Soil   Medium Vegetation	Not given
> Heavy Soil   Dense Vegetation	Not given
20. Control of Clearance   Working depth	Not given
21. Additional attachable working tools	
22. Armour	8 mm high tensiled steel cab
23. Remote controlled	Available See <a href="http://www.pearson-eng.com">www.pearson-eng.com</a> for more details
> greatest distance	Not given
24. Transportation	
> short distances	Can road on pneumatic tyres max 40 km/h
> long distances	
> sea transport	
> air transport	

## SYSTEM STATUS AND DEPLOYMENT

25. Machines in use	3
26. Other types	Not given
27. Location of use	Nicaragua
28. Totally cleared so far (m <sup>2</sup> )	Not given

## ENGINE | FUEL | OIL

29. Engine	6 cylinder turbo diesel
30. Engine power at the flywheel	110 kw (150 hp)
31. Power at the working tool	Not given
32. Fuel capacity	180 l
33. Fuel consumption	5 - 20 l/h
34. Separate engine for working unit	No
35. Cooling system	Not given
36. Oil capacity (both engine)	Not given
37. Hydraulic oil capacity (both engine)	Not given

## COSTS

38. Cost of system	Not given
39. Other costs	Not given
> training	Available
> spare part set chains   belts	
> repair costs for one year	
40. Availability for hire	Not given

## OTHER

41. Operator comfort	Air suspension seat
42. Air conditioning	Yes