

Development Technology Workshop | Cambodia

GENERAL DESCRIPTION

The *Tempest MK VII* is a remotely-controlled, lightweight machine with proven vegetation cutting and tripwire clearing capabilities. It is manufactured by Development Technology Workshop (DTW), a non-profit organisation, which has been producing demining machines since 1998.

The *Tempest MK VII* is an upgraded version of the *MK VI* incorporating several innovations. It is now a multi-tool system. A range of attachments – such as a ground-engaging flail head, large and small magnets for the removal of metal fragmentations, a horizontal cutter – can easily be fixed to the basic vehicle. The *MK VII* has double-acting rams to allow the use of dozer attachments and to assist in recovery of the vehicle when stuck. The machine is fitted with a standard bobcat attachment plate so any bobcat tool can be used.



TEMPEST MK VII | In operation with HALO

This latest *Tempest* also has an intelligent flail head, a unique feedback system which can sense the load on the flail. If the load becomes too great, the system automatically reduces the forward speed which in turn reduces the load on the flail head. The intelligent flail head enables an operator to set the speed control to maximum; the *Tempest* will then adjust automatically to control its cutting rate and drive speed. The result is quicker land clearance coverage since the operator no longer has to back the machine off when encountering more dense vegetation.

The new *MK VII* with improved software control, affording greater flexibility in the automatic control of the machine, allows the operator to adjust the machine to minefield conditions through a user-friendly joystick system. Software parameters can be set by end users using a laptop and free software available from the internet. Vegetation cutting to ground engaging parameters can be changed at a flick of a switch.

Improved software has allowed the electrical system to be simplified. The electrical modular system also improves troubleshooting in case of problems. The automatic fan reversal helps clear blockages of the hydraulic cooler. All pumps are now piston type for greater system efficiency. A flail stall alarm system is fitted as well as an improved track running gear to reduce tracks coming off.

DTW has enhanced the Tempest's engine combustion and cooling air filtration to cope better with dust problems. A new hydraulic filling system ensures hydraulic oil cleanliness. Improvements have also been made to the flail head float system and to internal and external hose layouts. Deutz supplies an improved diesel engine.

Like its predecessor, the MK VII chassis is V-shaped with an 8 mm steel plate to minimise damage from AP mine or UXO detonation. It can operate on most soil conditions and terrains, especially since DTW has now adopted a rubber track which has been successfully blast tested against 250 g TNT mines.

The manufacturer points out that the Tempest was specifically designed for demining operations. Its mechanics are simplified. It is user friendly and versatile. It enjoys low operational costs. Its small size and light weight make for ease of transport and agility over difficult terrain.

OPERATING METHODOLOGY

The Tempest was originally purely a vegetation cutting device, clearing down to 25 mm above the ground. DTW has since developed an alternative flail head (Ground Engaging Flail - GEF) designed to dig into the soil in order to destroy or expose mines. The GEF can clear down to 100 - 150 mm; it can clear deeper if the forward speed is sufficiently slow. Spring steel GEF hammer heads significantly improve the machine's ground speed.

Both the vegetation cutting and the GEF heads have a mini flail head containing 36 chains and 40 chains respectively with either a cutter for vegetation or a specially designed hammer for impacting the ground. The rotor can work at up to 1,300 rpm. A magnet can be fixed to the machine to pick up ferrous fragments and debris, which can help speed up the demining process by reducing the false alarm rate of metal detectors.

MACHINES IN USE TO DATE

Seven demining organisations are now deploying 26 Tempest machines in Angola, BiH, Cambodia, DR Congo, Ecuador, Mozambique and Thailand. Many of the machines have been operating in the field continuously for more than six years.

ENGINE, FUEL AND OIL

The Tempest MK VII is fitted with a newer, turbo-charged Deutz diesel engine. Fuel capacity is 30 litres with a fuel consumption of approximately 9 litres per hour. Hydraulic tank capacity is 130 litres. The fuel tank is protected by 8 mm steel plate.

FACTORY SUPPORT

The Tempest is manufactured in Cambodia. Repairs and maintenance are relatively easy and inexpensive. According to the manufacturer, spares are supplied with the unit and are thereafter available worldwide or are easily fabricated.

As part of the purchase, DTW offers a full spare parts package, all manuals and documentation, warranty and factory follow-up for 12 months. DTW also offers a number of other packages relating to parts, maintenance and training – all tailored to meet the needs of the user organisation. Packages take into account the number of machines, the destination country, local skill levels as well as the level of support required. Another useful option is a custom-modified 20 ft enclosed container complete with all relevant tools. It is designed to be used as a field workshop.

MAINTENANCE AND SUPPORT

Daily, weekly and monthly routine check lists must be followed. Daily checks take one man-hour, weekly checks three man-hours and monthly servicing five man-hours.

DTW offers a full-service maintenance programme for the Tempest. They can also set up provincial workshops and offices, where DTW maintains a constant presence with a fully trained staff.

The Tempest was designed to be easily repairable without factory support and has tried to incorporate materials that are locally available. No special workshop equipment is needed to carry out maintenance or more substantial repairs.



TEMPEST MK VII | Vegetation cutting task

TESTS AND EVALUATIONS

The Tempest has undergone extensive tests in Cambodia for AP and AV mines. The US Army has tested Tempest in the United States and abroad. Full test reports and photographs are available from the manufacturer.

In April 2005, a Tempest MK V was tested by QinetiQ. During the trial the standard vegetation flail head, the PROMAC Slasher and the large magnet were assessed. "The machine has the ability to clear both mines and vegetation." (Leach Chris, Blatchford Pete, Coley Geoff (CCMAT), Mah Jennifer (CCMAT). Tempest V System with Ground Engaging Flail Cambodia Trials Report. Farnborough: QINETIQ/FST/LDS/TRD052379, 2005. p. 3, available at www.itep.ws/pdf/Tempest_V_GEF.pdf)

A 2007 test and evaluation of the Tempest's Ground Engaging Flail by W.C. Roberts and D.J. Roseveare at the Defence Research and Development Canada is available at: www.itep.ws/pdf/DRDC_Suffield_Tempest2007.pdf

REPORTED LIMITATIONS AND STRENGTHS

The Tempest VII with the ground engaging flail or the vegetation head is able to withstand blasts from AP as well as fragmentation attacks. The machine is not intended to be used against AV mines.

Limitations

- > The flail creates huge dust clouds, as with all flail systems in dry environments.
- > Difficult to operate with precision from greater distances (as with all remotely controlled machines).

Strengths

- > Removes vegetation to greatly increase the speed of subsequent clearance, either manually or with dog teams.
- > Removes the tripwire threat.
- > Transports easily. Can be moved with a 4 x 4 with trailer or 5 t flatbed truck.
- > Resilient: the blast of AP mines under the flail, skids and wheels did not affect the operational capability of the system; repairs took only minutes to perform.
- > Versatile.
- > Easy-to-use.
- > Low maintenance.
- > Light weight which facilitates access to difficult areas and improves manoeuvrability.
- > Tailor-made packages geared to user needs in terms of parts, maintenance and training.

| | Basic Machine | Veg Flail | GEFH |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|-----------|----------|
| DIMENSIONAL DATA | | | |
| 1. Length without attachment | 3,000 mm | | |
| 2. Length total | | 3,900 mm | 4,100 mm |
| 3. Width without attachment | 1,550 mm | | |
| 4. Width total | | 1,600 mm | 2,350 mm |
| 5. Clearing Working width | | 1,200 mm | 1,500 mm |
| 6. Height Overall | 1,600 mm | | |
| 7. Mass Basic vehicle | 2,400 kg | | |
| 8. Mass Detachable unit(s) | | 500 kg | 700 kg |
| 9. Mass Overall | | 3,300 kg | 3,500 kg |
| OPERATIONAL DATA | | | |
| 10. Wheels Tracks (description) | Blast tested rubber tracks as standard, steel wheels as optional | | |
| 11. Ground Bearing Pressure (kPa) | 33 kPa | | |
| 12. Hill climbing ability (in degrees) | 30° | | |
| 13. Number of Chains Chisels Tools | | 36 | 40 |
| 14. Beat Pattern (hits per m ²) at different operating speeds | | | |
| 15. Length of Chains Tools | | 280 mm | 380 mm |
| 16. Diameter of drum | | 140 mm | 180 mm |
| 17. Rotation Speed | | 1,300 rpm | 500 rpm |
| 18. Clearance Working depth in varying terrain | | | |
| 19. Working Speed (m ² /h) | | | |
| > Light Soil Medium Vegetation | 1,800 m ² /h | | |
| > Medium Soil Medium Vegetation | 1,300 m ² /h | | |
| > Heavy Soil Dense Vegetation | 1,000 m ² /h | | |
| 20. Control of Clearance Working depth | Manual float | | |
| 21. Additional attachable working tools | Fitted with a standard bobcat attachment plate so any bobcat tool can be used | | |
| 22. Armour | 8 mm steel plated | | |
| 23. Remote controlled | Yes | | |
| > greatest distance | Over 250 m | | |
| 24. Transportation | | | |
| > short distances | Standard 4 t truck with crane | | |
| > long distances | | | |
| > sea transport | | | |
| > air transport | | | |

SYSTEM STATUS AND DEPLOYMENT

| | |
|----------------------------------------------|------------------------------------------------------------------------|
| 25. Machines in use | 26 in 8 countries with 7 different organisations |
| 26. Other types | Previous versions of the machine |
| 27. Location of use | Angola, BiH, Cambodia, Congo DR, Ecuador, Lao, Mozambique and Thailand |
| 28. Totally cleared so far (m ²) | Over 5,000,000 m ² |

ENGINE | FUEL | OIL

| | |
|------------------------------------------|--------------------------------------|
| 29. Engine | DEUTZ diesel 4 cylinder turbocharged |
| 30. Engine power at the flywheel | 55 kw |
| 31. Power at the working tool | 30 kw |
| 32. Fuel capacity | 30 l |
| 33. Fuel consumption | 8 l |
| 34. Separate engine for working unit | N/A |
| 35. Cooling system | Oil/air |
| 36. Oil capacity (both engine) | 10.5 l |
| 37. Hydraulic oil capacity (both engine) | 130 l |

COSTS

| | |
|--------------------------------------------|------------------------------------------|
| 38. Cost of system | 120,000 US\$ |
| 39. Other costs | |
| > extra flail head | 11,000 US\$ |
| > large attachable magnet | 9,000 US\$ |
| > pro-mac slasher | 12,000 US\$ |
| > workshop container (including all tools) | 40,000 US\$ |
| > training | 11,000 US\$ plus trainer's expenses |
| > spare part set chains belts | 20,000 US\$ |
| > repair costs for one year | Minimal |
| 40. Availability for hire | Lease and lease to buy options available |

OTHER

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