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## Performance Report -The Minebreaker 2000

**By Thorsten Peter, Flensburger Fahrzeugbau Gesellschaft mbH**

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At the end of 1995 a decision was taken within the Diehl Group to create technologies for humanitarian demining. A starting point for these considerations was the German government's firm political intention to make a significant contribution to combating the landmine plague and in particular - as one of the world's leading industrialized countries - to provide technology on an industrial scale for this purpose.

The company Flensburger Fahrzeugbau Gesellschaft mbH (FFG) was commissioned to implement the project.

For this reason, since the summer of 1996, FFG has developed - at its own expense - a prototype for mechanical humanitarian demining applications. It presented the prototype to an international public in April 1997 at the Baumholder military training area. It was then submitted to a series of successful explosive tests until October 1997; subsequently, a successful field test was carried out in Bosnia and Herzegovina in the period from November 1997 to June 1998.

The findings gained from the trial and field test have been incorporated in a series produced model which was manufactured at the end of September 1998 - again at the company's own expense. This results in technology that is ready for series-production at low cost for mechanical humanitarian mine clearance.

This report summarizes:

- The basic considerations underlying a mechanical mine clearance system;
- The basic conditions for the use of the Minebreaker 2000;
- The findings of the field test;
- Conclusions for mechanically-assisted humanitarian demining

### **The basic considerations underlying a mechanical mine clearance system**

It has only been possible to develop and test a system in such a very short time because all the necessary development and production capacities are already available within the Diehl Group. The backing provided within the group limits the financial risk involved. What was decisive, however, was the availability of the group's test facilities and laboratories, with the corresponding expert personnel for handling explosives.

The binding

development target was to reach the mine clearance standard of 99.6% of all mines contained in the earth as determined by the United Nations for the



removal of mines. We are interpreting this as "a cleared area that is free of mines to the best of human judgment." The (improved) series model meets this requirement. In addition, it was also self-evident that the complete safety of the operating personnel is ensured. A further basis for the successful provision of the technology within a short time was the view that the danger-free handling of explosives is only possible using purpose-built machines; the conversion of machines originally built for other purposes does not ensure the 100% safety required for the operating personnel.

### **Three basic considerations proved to be crucial for the system:**

The reliable mechanical destruction of mines is only possible using a highly robust and sturdy drum fitted with chisels and which can easily mill the ground to a depth of 50 cm. The loosening of the soil and the turning under of the surface vegetation (mulching) that is involved is a welcome side effect. When handling explosives the protection of the personnel deployed is the top priority; armoring can only provide protection. For this reason a tank chassis was chosen as the carrier-vehicle as this is the only type of chassis that provides the necessary protection. The retrospective armoring of a commercially available chassis does not provide adequate protection or it is too costly. For this reason it was abandoned in accordance with our pertinent experience. In addition, as a rule, a tank chassis also has the very high engine output that is required (approx. 625 kW) to drive the vehicle and roller simultaneously; moreover, its low specific ground pressure (approx. 9.8 Newton / cm<sup>2</sup>) ensures the required cross-country capability accompanied by gentle treatment of the soil.

### **Basically, any tank chassis can be used as the carrier system. However, the following points favored the selection of the Leopard I for the chassis:**

- A tried -and -tested system, which is highly fail-safe.
- Technically well documented and catalogued.
- A reliable supply of spare parts with original parts is available even after many years.
- Well documented knowledge regarding maintenance and repair costs
- Inexpensive procurement and economical use during deployment.

### **Basic conditions for the use of the Minebreaker 2000**

The Minebreaker 2000 can be used in practically any type of terrain, with only swamp areas excluded from the outset. In addition, it can be used at all times of the year. Only deep snow makes the use of the



machine impractical. Indeed, it has been demonstrated that the Minebreaker 2000 can also be used under conditions where manual demining is no longer possible; the machine needs no winter or bad weather break!

The machine can be transported easily by road or deployed within the area of operations with commercially available trailers as normal heavy equipment

transportation (weight approx. 48 t). Thanks to its rubber-pad track, the vehicle can also drive on or cross over roads or other sensitive infrastructure components without causing damage - unlike commercially available caterpillar-track vehicles.

For technical reasons, the vehicle has a low cruising speed (4 km/h) and thus frequent changes of the place of deployment are impractical; for this reason, large, self-contained areas should be selected for demining.

No special technical knowledge or skills are required for the operation of the Minebreaker 2000. Anyone to whom one would otherwise entrust the operation of a machine can be trained as an operator in a very short time. This training is provided by FFG and is included in the system price.

A specially equipped "service mobile" can also be provided; this contains all the tools and materials needed to allow the Minebreaker 2000 to work independently and without interruption over a period of several months. One mechanic is sufficient for this; he is trained by FFG in a period of two to three weeks. This is also included in the system price.

In addition, it has also proved meaningful prior to deployment of the Minebreaker 2000 to carry out a detailed reconnaissance and to inform and involve all national and international authorities/organizations responsible for demining activities.

The Minebreaker 2000 needs a follow-up component if destroyed mines and/or parts of mines are to/must be removed from the ground, since many mine-types don't detonate through milling but are destroyed mechanically. (The testing of the Minebreaker 2000 with respect to the technical aspects of explosives in summer 1997 confirmed this beyond a doubt). A mechanical follow-up search device (Mineclearer 2000) was used in the field test. However, such a follow-up search device does not represent any particular technical challenge. For this reason, FFG dispensed with developing such a device itself and used a British company with the corresponding equipment as a sub-contractor here.

### **Findings of the Field Test**

The field test was planned in consultation with the German Foreign Office, which also provided support for it. The main objective was to gain knowledge of the system's continuous operating capability under difficult conditions. A prerequisite for such a field test was the evidence of efficacy against mines. This was provided by the explosive

tests conducted on the Baumholder military training area from April to October 1997.

The machine was then transported to an area in the Canton of Tuzla in the Federation of Bosnia and Herzegovina that had been selected in the meantime. This area is located around the former main battle line on both sides of the trenches that existed at that time and which were also leveled and thus eliminated as part of the clearance operation. The detailed reconnaissance of the terrain, the establishment of contacts with all parties involved and support from the Second Bosnian Corps proved particularly helpful for the smooth execution of the project.



The deployment of the Minebreaker 2000 began on November 17, 1997, and lasted initially until December 15, 1997. Following a break for the Christmas and New Year holiday period, the deployment was resumed on February 2, 1998, and completed on schedule on May 4, 1998. Subsequently, a further deployment was carried out in cooperation with the German NGO, HELP, in the greater-Sarajevo area in the period from May 18 to June 12, 1998.

In the Canton of Tuzla, 252,000 M<sup>2</sup> of mined terrain were cleared, followed by another 80,000 m<sup>2</sup> of mined terrain in the greater-Sarajevo area. A total of 595 antipersonnel mines and 9 anti-tank mines were found and rendered harmless. In addition, 22 unexploded ordnance devices (UXO) were also destroyed. Clearance performances of more than 1,000 m<sup>2</sup> per hour were achieved and produced top performances of over 7,000 m<sup>2</sup> per day with a fuel consumption of 90 to 100 litres per operating hour.

The Minebreaker 2000 was in use from November 1997 to June 1998 for a total of 680 operating hours without suffering any technical failures; no particular maintenance or inspection work was necessary during this 8-month period. The subsequent technical examination of the machine at the Flensburg plant revealed no particular signs of wear.

To check whether the desired clearance standard of 99.6% had been achieved, all areas were searched with manual deminers and mine dogs; *no more mines were found*. If this project had been carried out without the machine using traditional methods and a comparable personnel-base, the operation would have taken approximately ten times as long and entailed a statistically defined number of injured personnel and deaths.

A mechanical follow-up search is basically possible. The Mineclearer 2000, a modified field tractor, failed, however, to bring the desired performance; it was too weakly motorized and had too high a specific ground pressure so that it was only possible to use it as a "fair-weather" device.

### **Conclusions for mechanically-assisted humanitarian demining**

The Minebreaker 2000 proved itself excellently in the field test; large areas can be cleared fast, even anti-tank mines are eliminated without danger. The knowledge gained from the deployment of the prototype was immediately incorporated in current production so that as of the end of September 1998 a technologically state-of-the-art

version will be available for future use. (Delivery time approximately 6 months).

The system price of the series model will be approximately DM 2.1 m.



The series model Minebreaker 2000 incorporates significant improvements in its hydraulic system so that simpler handling is now possible and maintenance work will be reduced even further in the future. The number of drum revolutions has been increased to 100 revolutions per minute; this means that in the future more mines will detonate on the drum and that mines that cannot detonate and/or parts of mines can be broken up into even smaller parts. Stable side-aprons on the rotator ensure that no

mine parts can fall to the side; the removal of mine-remains is thus simplified further. Unnecessary armored steel plating on the top of the vehicle front has been replaced by simple steel plating and - by optimizing the design - the total weight of the series vehicle has been reduced by 5 t, which further increases off-road performance and mobility.

The field test has demonstrated that it is basically possible to carry out humanitarian demining completely mechanically. A mechanical follow-up search proved to be feasible, although the Mineclearer 2000 failed to fulfil the necessary conditions (too weakly motorized, too high a ground pressure, thus only capable of "fair-weather" deployment). There are no problems standing in the way of the construction of a suitable vehicle, but this will not be pursued further by FFG in the absence of a contractor. It would appear to be less costly to carry out the follow-up search with mine dogs and manual deminers.

There remains one major finding demonstrating that *mechanically assisted humanitarian demining* is significantly safer and, in particular, far faster than the traditional manual methods; an average daily clearance performance of 10,000 m<sup>2</sup> and more can be achieved by one Minebreaker 2000 and the necessary back-up. This entails significant overall cost reductions.

The necessary contribution to be made by the politicians consists of changing a "business-as-usual" way of thinking so that the new technology is in fact used. Technology that is not used becomes obsolete very fast - due to the lack of practice-oriented further development, and then no longer fulfils its purpose.

In addition, a change of approach to the award of demining contracts is perhaps also necessary. Machines that are capable of clearing over 200,000 m<sup>2</sup> of mined terrain and unexploded ordnance in one month call for solutions that are tailored to suit the machine, i.e. avoidance of a multiplicity of small projects and the arrangement of longer-term projects that are to be carried out on large areas.