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Success of Multi-tools in Mine Action: The Survivable Demining Tractor and Tools and the Mine-Clearing Survivable Vehicle

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The Survivable Demining Tractor and Tools and the Mine-Clearing Survivable Vehicle

The authors examine the various equipment and technologies that allow further effectiveness in demining achievements. Recent developments in demining tools allow for greater protection of deminers, in addition to improved search results. With technological advancements such as the Survivable Demining Tractor and Tools and the Mine-Clearing Survivable Vehicle, the authors express hope for demining centers worldwide.

by Tinh Nguyen and Charles Chichester [U.S. Humanitarian Demining Research and Development Program]

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Mine Survivable Tractor

Grab

The international demining community continues to seek reliable, efficient, and cost-effective mine- and vegetation-clearance equipment to assist in demining operations. The U.S. Humanitarian Demining Research and Development Program is responding to this need by focusing much of its effort on developing, demonstrating and validating technologies that help the demining community clear mines and vegetation faster, safer and more efficiently.

One of the ways in which the Humanitarian Demining R&D Program brings effective, reliable, yet affordable technologies to the field is through the adaptation of commercial off-the-shelf (COTS) equipment. In particular, one of its most successful strategies is using a COTS platform and adding tool attachments to create a multi-functioning vehicle. Through past efforts, the HD R&D Program has proven the concept that using a single prime mover with a toolkit comprising a well-thought-out selection of tools can reliably and rapidly perform the demining tasks of land preparation, mine removal, and area reduction and reclamation, leaving an area ready for quality-assurance proofing. Two such systems currently in use by demining programs are the Survivable Demining Tractor and Tools and the Mine Clearing Survivable Vehicle (aka Mantis). Both systems use COTS platforms and a variety of attachment tools to perform multiple demining tasks.

The Survivable Demining Tractor and Tools

The SDTT was first developed in 1997 and is one of the earliest successes of the HD R&D Program. The system uses a modified commercial New Holland 160-90 farm tractor fitted with armor plating, optional steel wheels and a variety of specialized implements used to clear heavily vegetated areas and support various demining operations from area preparation to quality assurance. Attachments include rollers, magnets, slashers, forestry toppers, rakes, hedge trimmers, sifters, light and heavy cultivators, large and small buckets, large and small grabs, pallet forks, and light and heavy tree-pullers. The system mechanically assists the manual demining process by providing deminers numerous tools and an armored platform from which to perform the most hazardous tasks. The versatility of the system allows deminers to work more efficiently.

The SDTT is currently in use by the Thailand Mine Action Center to clear vegetation and prepare the land for manual demining. From 2001 through 2005, the SDTT cleared over 3,862,310 square meters (954 acres) of land in Thailand and continues to be an integral part of TMAC's demining program.

Mine Clearing Survivable Vehicle

Based on the success of the multi-tool-attachments concept used in the SDTT, the HD R&D Program invested in the Mantis mine- and vegetation-clearance system. As its platform, the Mantis uses a modified and armored John Deere 6920 farm tractor capable of operating a number of specialized and commercial off-the-shelf implements to address some of the vegetation clearing, soil preparation, area reduction, quality assurance, and mine removal and neutralization problems in humanitarian-demining operations. The system is equipped with front and rear power take-offs, standard three-point hitches in the front and rear, and a loader frame. The tractor was modified, armored and reassembled under contract to the HD R&D Program by Pearson Engineering Ltd.

The purpose of developing a system such as the Mantis is to provide deminers with a mine-survivable vehicle that has multiple functions and is based on a COTS technology (i.e., John Deere farm tractor). The tractor has been armored, fitted with a 180-degree rotating driver's cab and anti-personnel-mine-survivable SETCO wheels with an innovative wheel-hub interface incorporating a dowel and plate design. This design allows the wheel to separate from the axle in the event of an anti-tank mine detonation, thus reducing the shock effect through the axle. The tractor acts as the prime mover for a toolbox of COTS and specialized implements generally used by the construction and earth-moving industries but also applicable to demining operations. Along with the mine-resistant John Deere tractor, this toolbox currently consists of a rotary mower, area-reduction roller, rotary mine comb, grab, four-in-one bucket, heavy cultivator, spring-tine cultivator, bed formers, mine sifter, tree extractor, magnet and hedge cutter. Together with the prime-mover tractor, these 12 tools provide deminers with capabilities to perform their work effectively and efficiently.

In August 2004, the Mantis and its complementary tools underwent a thorough performance evaluation conducted by HD R&D Program staff members and supported by engineers from the United Kingdom under the auspices of the International Test and Evaluation Program for Humanitarian Demining. For the soil and vegetation within the environment where the testing occurred, the results of the performance-demonstration assessment show the Mantis and its demining and area-preparation tools can prepare an area for demining, remove anti-personnel mines and leave an area ready for quality-assurance proofing and subsequent use.

Based on the positive results from the evaluation, the HD R&D Program deployed the Mantis to Nicaragua in spring 2005 for an operational field evaluation. Under the direction of the Nicaraguan Army Demining Units, the Mantis is currently performing in a minefield 6 kilometers (4 miles) long with Class II (medium to severe) vegetation and terrain near the town of Jinotega. In the first four months of operation in Nicaragua, the Mantis removed 9,600 kilograms (11 tons) of metal with the magnet attachment and cleared 64,050 square meters (16 acres) of land (clearing vegetation, and cultivating and sifting soil). NADU members also reported the blast-resistant SETCO tires were extremely effective in encounters with PMN mines,[1] not incurring any damage to the wheel when hit. In addition, the roller attachment has encountered and detonated 10 PMN mines and the cultivator has unearthed numerous UXO items. To date (in combination with the Hitachi excavator), NADU members have removed 14,529 mines and cleared 436,175 square meters (108 acres) of land for further manual and mine-detection-dog quality assurance. In fact, after the mechanical clearance process with the Hitachi and Mantis, five mines remained in the entire area. Further investigation is underway to determine why these mines were left in the ground. Early indications suggest the mines were outside of the area worked by the machines, their fuses were non-functioning, or they were deeply buried.

In the right conditions, mechanical demining with versatile mechanical systems such as the SDTT and Mantis allow for faster, safer and more efficient mine clearance. However, minefield locations and conditions often preclude the use of such machines. For example, the Mantis is not intended for use in minefields with the threat of anti-tank mines. The Nicaraguan mechanical-clearance effort has not proven to be completely effective because of this fact. However, with continued effort in developing operating procedures and development of attachments for multi-tool systems like the Mantis and SDTT, the HD R&D Program is confident the SDTT and Mantis, with their associated tools, will provide the humanitarian-demining community with highly reliable, cost-effective systems augment current catalogs of demining tools and expand area-reduction and demining capabilities.

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