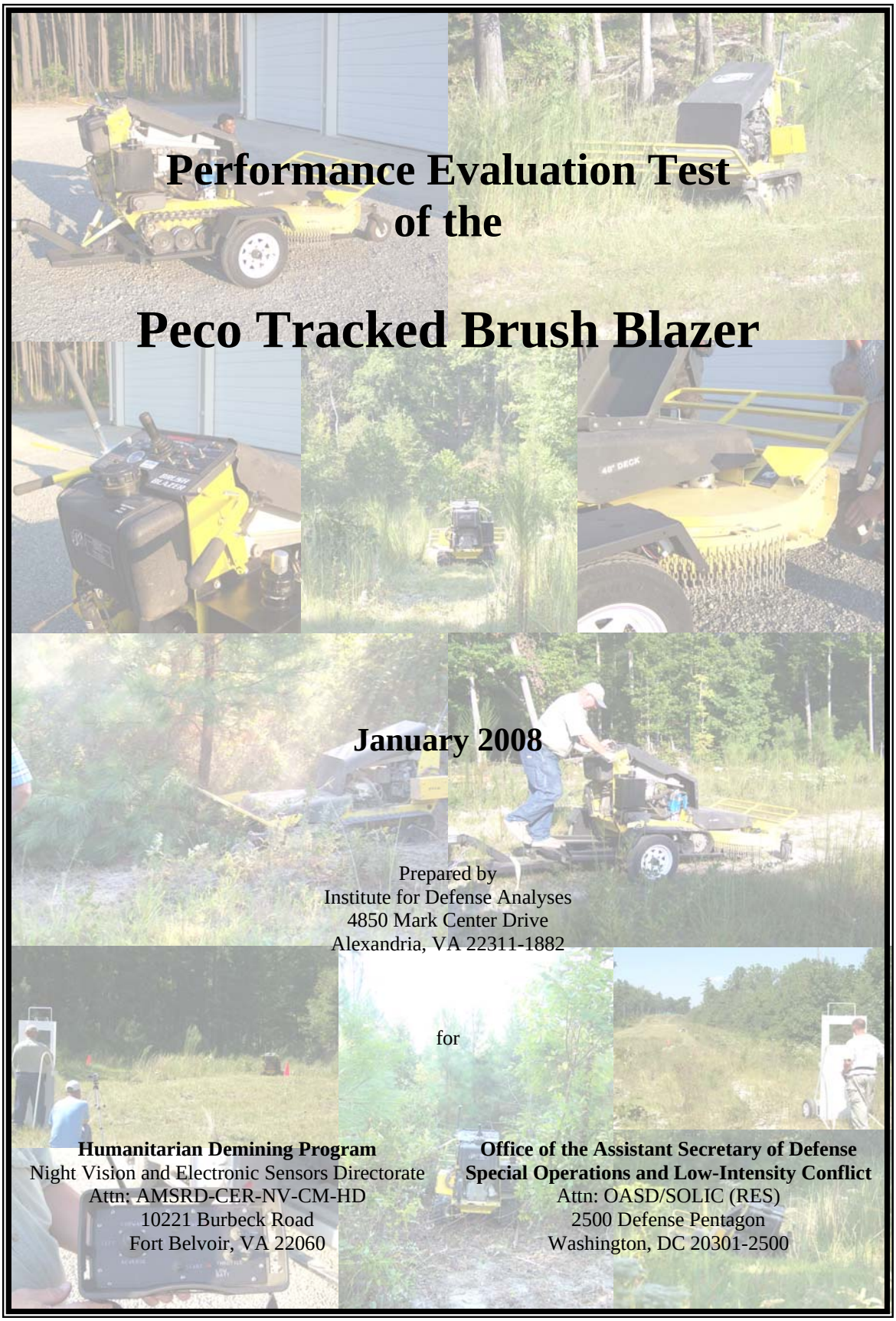

Performance Evaluation Test of the

Peco Tracked Brush Blazer

January 2008

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FOREWORD

Area preparation for demining remains one of the dangerous yet necessary tasks for organizations undertaking humanitarian demining missions. To date, the U.S. Humanitarian Demining Research and Development Program has provided a number of area preparation systems. The emphasis, however, has been on light (1–2 ton) to heavy (5–15 ton) platforms with a wide range of working attachments. There was a need for a robust, lightweight cutter to complement the heavier assets available from the U.S. Humanitarian Demining Program. One such system that appeared to be a good addition to the area preparation tools available under the U.S. program was the Peco Tracked Brush Blazer, or Peco Cutter, a lightweight cutting system capable of removing vegetation up to 10 cm in diameter. A Peco Cutter was procured and modified with the addition of a radio-control system. Configured as tested, the Peco Cutter can be operated either manually or by remote radio control, thereby providing stand-off safety margins of up to 400 m.

The performance evaluation test was conducted in October 2007 at an Army test facility in central Virginia. The test director and test engineer was Mr. Ronald Collins. Test site support was provided by Mr. Mel Soult, the test site manager, and his staff. The test plan, test data, and this report were prepared by Harold Bertrand, Isaac Chappell, Jennifer Ledford and Thomas Milani from the Institute for Defense Analyses.

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1 Purpose

The purpose of this performance evaluation test was to determine the capabilities of the Peco Tracked Brush Blazer TBB-2001, a self-propelled brush cutter, to cut and clear vegetation up to a classification of “difficult” in an efficient and cost-effective manner (in terms of operating and maintenance costs). The model TBB-2001 cutter received one modification prior to being tested. A universal radio-control unit was added by the Army’s project engineer to allow remote operation of the cutter, simulating actual operation in a land-mine-contaminated area. The test was conducted in October 2007 at an Army test facility in central Virginia.

2 System Description

The Peco Tracked Brush Blazer TBB-2001, referred to as the Peco Cutter, shown in Figure 1, is a heavy-duty brush cutter advertised as capable of cutting heavy undergrowth and trees up to 10 cm in diameter. It is equipped with a hydraulic track drive that gives the operator the ability to maneuver in all types of terrain, as well as perform 180-degree turns within its own length of 2.4 meters. Safety features of the Peco Cutter include a chain-guarded deck (Figure 2) and a front safety bar (Figure 3) to push over vegetation to be cut.

Figure 1: Peco Tracked Brush Blazer TBB-2001

Figure 2: Chain-guarded Cutting Deck

Figure 3: Front Safety Bar

Modifications to allow for push-button manual operations as well as remote operations were made by the Humanitarian Demining Program Office's vehicle fabrication shop at Ft. Belvoir. The Peco Cutter remote-control system enables operators to start and shut off the Peco Cutter engine remotely, enable and disable the cutter remotely, and continue line-of-sight operations for distances up to about 400 meters. Photos of the modifications can be found in Figures 4 through 10. Table 1 lists specifications for the Peco Cutter.

Figure 4: Peco Cutter Engine Before Modifications (Top Cover Removed in Photo)

Figure 5: Peco Cutter Engine After Modifications (Top Cover Removed in Photo)

Figure 6: Instrument Panel Before Modifications (Note: Panel Levers Are Removed)

Figure 7: Instrument Panel After Modifications

Figure 8: Manual Cutter Engaging Lever Before Modifications

Figure 9: Cutter Engaging Lever After Modifications (Hydraulic Addition allows Operator Push-button Cutter Engagement)

Figure 10: Hand-held Remote Control Device

Table 1: Peco Tracked Brush Blazer TBB-2001 Specifications

Peco Cutter TBB-2001 Brush Blazer	Measurement Dimension
Height, overall	1.1 m / 3.6 ft
Width, overall	1.4 m / 4.6 ft
Length, overall	2.4 m / 7.8 ft
Length, blade bar (see Figure 11)	45.1 cm / 17.75 in
Length, cutting blade (see Figure 11)	10.8 cm / 4.25 in
Length, cutting deck	1.0 m / 3.4 ft
Width, cutting deck	1.4 m / 4.6 ft
Cutting Height / Ground Clearance	12.7 cm / 5 in
Cutting Width	1.2 m / 4.0 ft
Weight, without remote system	499 kg / 1100 lbs
Weight, with remote system	626 kg / 1380 lbs
Fuel Capacity (Unleaded)	18.9 L / 5 gal (US)
Hydraulic Fluid Capacity	9.5 L / 2.5 gal (US)

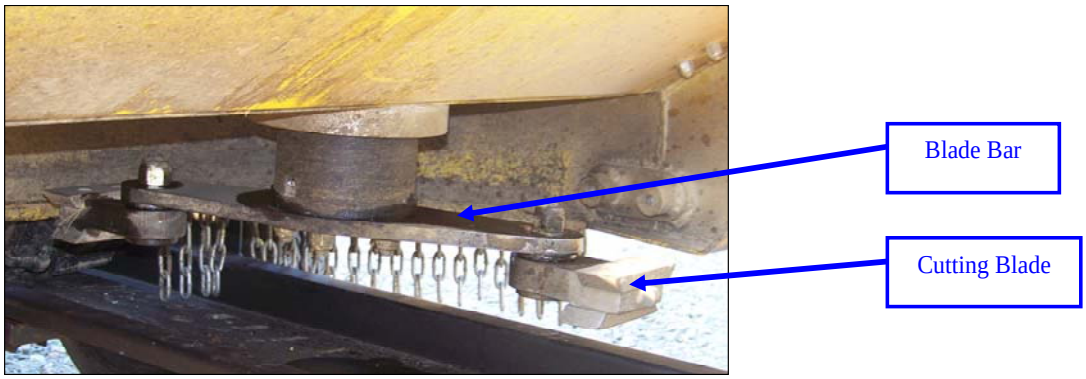

Figure 11: Blade Bar and Cutting Blade (Photo Taken from under the Cutting Deck)

3 Test Site Description

3.1 Test Site A – Category 1 Vegetation

Test Site A consisted of Category 1 vegetation within a 350 m × 60 m area, as shown in Figure 12. Category 1 vegetation is described as light vegetation with saplings up to 3 cm in diameter within level to slightly rolling terrain.

Figure 12: Test Site A, Category 1 Vegetation

3.2 Test Site B – Category 2 Vegetation

Test Site B included Category 2 vegetation within a 30 m × 20 m downward sloping area, as shown in Figure 13. Category 2 vegetation consists of moderate vegetation with sparse brush and saplings up to 6 cm in diameter, within level or lightly rolling terrain with minimal ruts. The slope within Test Site B measured as a 10 degree angle of descent. Slight bumps were present throughout the area, and a 6.5 m × 0.5 m gully, with a depth of 26.7 cm, was discovered during testing.

Figure 13: Test Site B, Category 2 Vegetation

3.3.1 Test Site C – Category 3 Vegetation

The final test site, Test Site C, measured 15 m × 5 m and consisted of Category 3 vegetation (see Figure 14). Category 3 vegetation includes moderate vegetation with brush, saplings, and trees up to 10 cm in diameter, atop level or lightly rolling terrain with minimal ruts.

Figure 14: Test Site C, Category 3 Vegetation

4 System Testing

4.1 Mobility and Manual Operation

Within each of the test sites, operators successfully maneuvered the Peco Cutter along the terrain and performed vegetation cutting operations without disruption. Test Site A (Category 1 vegetation) posed no problem for the operators. The operator was able to maintain control of the Peco Cutter in cutting and other operations while it moved

toward, away, and cross-track from the operator's location at distances up to 300 m. Test Site B (Category 2 vegetation) also posed no operational problems, even when the device was driven through an unseen gully measuring 0.5 m wide and 26.7 cm deep. The Peco Cutter was able to maintain stability and continue cutting operations. Within Test Site C (Category 3 vegetation), no major mobility problems arose; however, it was noted that the ability to push down (over)—and thus cut—10 cm diameter trees is largely dependent on the terrain's soil. For trees located in soft, powdery soil, the Peco Cutter is unable to gain enough traction to push over the tree (this is discussed further in section 4.2). Table 2 has additional mobility measurements taken during the test.

Table 2: Peco Cutter Mobility Measurements

Measurement	Dimension
Turning Radius	0 m / 0 ft (the Peco Cutter is able to turn within its own track)
Forward Speed, cutting	31 cm/s
Forward Speed, not cutting	71 cm/s

Manual operation of the Peco Cutter is necessary when loading and off-loading it from its travel trailer, as shown in Figure 15 and 16. Modifications to the Peco Cutter's manual driving mechanism include the addition of a driving joystick to make it possible for any operator to control movement of the Peco Cutter. Throughout the test, manual operators were able to successfully load (and off-load) the Peco Cutter in less than 1 minute.

Figure 15: Off-Loading Peco Cutter

Figure 16: Loading Peco Cutter onto Trailer

4.2 Operational Ability

The Peco Cutter is designed to cut vegetation and trees up to 10 cm in diameter with a "push and cut" technique that uses the front safety bar and the cutting heads. When the Peco Cutter approaches trees, saplings, or brush, the front safety bar pushes those items over until the cutting heads are able to reach the vegetation's base. At this time, the cutter cuts the vegetation from the ground and will cut the remainder of it as the Peco Cutter drives over the fallen item (see Figure 17).

Figure 17: Cutting Heads Engaging Tree After Being Pushed by Safety Bar

The Peco Cutter's cutting ability was tested against Category 1, Category 2, and Category 3 vegetation within Test Sites A, B, and C, respectively. In Test Site A, approximately 2,000 m^2 were cut, with no mobility or operational issues. Figures 18 and 19 show before and after cutting views of Test Site A.

Figure 18: Cutting Operations, Test Site A

Figure 19: After Cutting, Test Site A

Operational cutting on the downward slope of Test Site B was separated into two timed tests. For the first test, the cutter was operated for 40 minutes. This resulted in a cleared area of 29.3 m × 9.4 m (6.9 m^2/min, or 413.1 m^2/hr) over ground with an average slope of 6.5 degrees. During this test, the gully described in Section 3.2 was encountered, requiring the operator to perform special maneuvers to continue cutting operations around and through the rut (see Figure 20). The heaviest vegetation cut in this area was an 8 cm diameter tree.

Figure 20: Peco Cutter Encountering 26.7 cm Deep Gully at Test Site B

The second timed test within Test Site B lasted 45 minutes and produced a 24.1 m × 12.0 m cleared area (6.43 m^2/min, or 358.8 m^2/hr). The average slope for this section of Test Site B was 9.9 degrees.

Test Site C operations were conducted to determine the capabilities and limitations of the Peco Cutter within Category 3 vegetation. In a 30-minute timed test, the Peco Cutter was able to successfully cut a 12 m × 3.4 m area (1.36 m^2/min, or 81.6 m^2/hr), which included two 10 cm diameter trees, several saplings, and dense vegetation. Before the start of the timed test, the Peco Cutter was not able to cut down a 10 cm tree because the soil around the tree was powdery and soft, with no vegetation or brush covering. This prevented the Peco Cutter from getting enough traction to push over the tree. Figures 21 and 22 show Test Site C operations.

4.3 Remote Operator Functions, Limitations, and Assessments

Throughout the test, the remote control was operated from behind a mobile shield at a minimum distance of 25 m from the Peco Cutter (see Figure 23). The shield plus the 25 m distance was determined to be a safe standoff for the operator in the event a mine is encountered.

The remote antennas were initially mounted on the Peco Cutter and on the operator's remote-control device. As the operator stood behind and close to the shield, as shown in Figure 24, radio transmissions were blocked. The Peco Cutter's remote system was designed to shut down the vehicle if the communicating signal was lost. Thus, there were several instances when the Peco Cutter shut down due to interference from the shield. To remedy this problem, the remote control unit's antenna was removed and mounted on the top of the mobile shield (see Figure 25), and a connecting cable was run between the antenna and the remote-control unit as shown in Figure 26. Also, a hook was mounted to the inside of the shield, so the operator could continue operations without having to hold the remote device. With this configuration, remote operations were

achieved at distances of about 400 meters. Note, however, that operating at this distance from the machine does not produce good cutting results because the operator does not have a clear view of the machine and the cutter.

Figure 21: Peco Cutter Entering Test Site C

Figure 22: Test Site C, Cutting Complete

Figure 23: Operator's Shield

Operators of the Peco Cutter said that visibility from behind the shield was sufficient for Peco Cutter operations and that the remote control was easy to use. The best indication of equipment movement was gained by viewing the vehicles track which were visible except when powdery soil conditions caused dust clouds.

Figure 24: Operator Working Close to Shield

Figure 25: Mounting Remote Antenna to Operator Shield

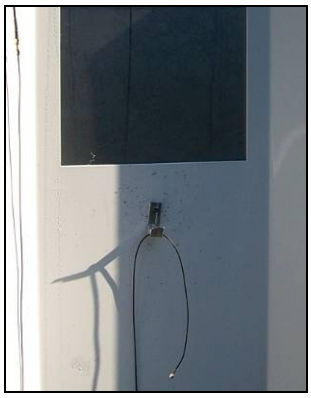

Figure 26: Remote Device Hook and Antenna Cable

4.4 Operational Consumables

Fluids and fuel were checked and refilled daily before operations or as needed. The Peco Cutter uses unleaded gasoline and is equipped with a 5 (U.S.) gallon (18.9 liter) tank. The hydraulic fluid tank capacity is approximately 2.5 (U.S.) gallons (9.5 liters). Both the fuel and hydraulic tanks are located at the rear of the Peco Cutter (see Figure 27).

On average, fuel consumption ran about 1 gallon (3.785 liters) per hour of cutter operation. Consumption varied as a function of the density and size of the vegetation being cut.

4.5 Maintenance and Maintainability

Throughout the test, daily maintenance was performed on the Peco Cutter: greasing all fittings; replenishing fuel, oil, and hydraulic fluid as needed; and clearing the

machine of cutting debris. In addition, other system inspections spelled out in the equipment manual were also performed daily.

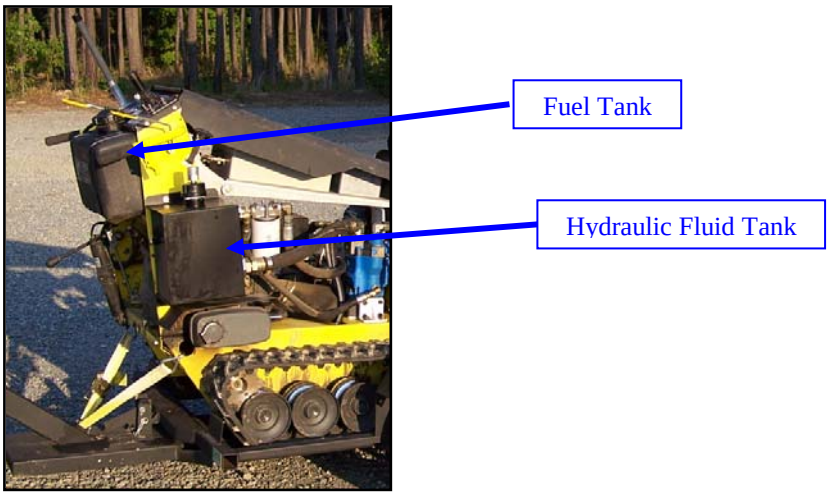

Figure 27: Fuel and Hydraulic Fluid Tanks

During the test, one maintenance issue arose. It was noticed that although the Peco Cutter's cutting blades seemed to be rotating, the vegetation was not being cut. An inspection of the problem showed that the wide belt responsible for turning the blades was loose (see Figure 28). A quick adjustment to the tension rod was made, and the Peco Cutter resumed cutting. This repair took only a few minutes and required no tools.

Figure 28: Cutting Blade Belt (Top Cover Removed for This Photo)

4.6 Damaged Vehicle Recovery

The Damaged Vehicle Recovery Test was performed to determine whether the Peco Cutter could be manually recovered from the field, should it become disabled. After attaching a rope to the back end of the Peco Cutter, personnel were instructed to pull the rope until the vehicle was moved out of its original position. Although two persons were

able to initiate slight movement of the Peco Cutter, it took four persons (pulling simultaneously) to drag the vehicle to a new location.

In addition to the manual recovery of a disabled vehicle, recovery by a small vehicle was also tested. A 4×4 utility vehicle, like the one shown in Figure 29, weighing 693.5 kg (1,528.9 lbs) was used to tow the Peco Cutter from its location. Although the utility vehicle was very close in weight to the Peco Cutter, it was able to successfully drag it several feet.

Figure 29: 4×4 Utility Vehicle, Used in the Damaged Vehicle Recovery Test

4.7 Transportation

The Peco Cutter, its on-road traveling trailer, the operator's shield, and all mechanical and electronic spare parts are stowed in a 10 ft (3 m) shipping container. The Peco Cutter is shipped strapped to its trailer (Figure 30), and metal ramps are used for loading and off-loading the duo (Figure 31) into the container. A removable handle (Figure 32) is used to assist personnel in maneuvering the trailer into and out of the shipping container.

To ensure that the trailer would fit into the container, a modification was made to the trailer's connecting end (as shown in Figures 33 and 34), making it removable. Table 3 shows specifications for the trailer.

Movement of the Peco Cutter onto and off the trailer is performed manually by the operator as shown previously in Figures 15 and 16. The Peco Cutter was modified to include joystick-guided steering, making it possible for persons of all heights and physical strength to operate the Peco Cutter manually.

Figure 30: Peco Cutter, Strapped to Trailer

Figure 31: Metal Ramps

Figure 32: Trailer with Removable Handle (Handle is Lying on Trailer, Not Connected)

Figure 33: Trailer Connecting End, Before Modifications

Figure 34: Trailer Connecting End, After Modifications

Table 3: Peco Cutter Trailer Specifications

Trailer Measurements	Measurement Dimension
Width, Trailer	1.5 m / 4.8 ft
Length, Trailer	2.9 m / 9.6 ft
Length, Trailer with Peco Cutter	3.0 m / 9.8 ft

Spare parts are placed in bins within the container (Figure 35). The bins are be labeled to assist operators and other personnel. Spare parts include tools, belts, tracks, circuit boards, electronic interfaces, cutting blades, and many other items necessary to

ensure continued operation of the Peco Cutter. Figure 36 shows the fully packed shipping container.

Figure 35: View of Inside Shipping Container

Figure 36: Packed Shipping Container

4.8 Manpower and Training

The number of people needed to operate the Peco Cutter depends on two factors: How many hours per day would an operator work in the field? Does the operator understand the mechanical and electrical components to a level such that he or she can make repairs when necessary? During this test, it was demonstrated that all operations and maneuvers can be performed by one operator. In field operations, however, weather and other environmental factors may make continuous operation impossible for a lone operator. Thus, it is recommended that two operators accompany the Peco Cutter for all operations.

Time required to train operators on the Peco Cutter is minimal. Before the Peco Cutter performance testing, three inexperienced operators were given the chance to remotely operate the Peco Cutter for approximately 20 minutes each. Each new operator appeared to master the controls quickly and had no problem maneuvering the Peco Cutter or performing cutting operations within the field. It is therefore expected that a Peco Cutter operator can be trained within a day's time.

5 Performance Evaluation Test Summary

The Peco Tracked Brush Cutter met all performance test goals. It cut all vegetation from easy to difficult without having to back away from any challenge. The tracked platform was able to continue working on all terrains and in a variety of soils, from heavy clay to powdery loam and sand. The Peco Cutter did encounter trouble pushing over a 10 cm tree in powdery loam and sandy soil because its light weight made it unable to maintain traction. This is not considered a drawback or a deficiency, however, just a fact resulting from the size of the vehicle.

The primary recommendation resulting from the test program is to switch from a gasoline to a diesel engine since diesel fuel is much more common in remote overseas areas.

The Peco Cutter's light weight and size make it easy to transport to almost any work site, anywhere. Its low operating and maintenance costs will make it an economically affordable system.