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TECHNICAL REPORT NO. 68-10

TRAIL CUTTING MACHETE

Final Report

By
Frederick M. Drake
Environment and Survival Branch

June 1968

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U. S. ARMY LIMITED WAR LABORATORY
Aberdeen Proving Ground, Maryland 21005

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FOREWORD

In response to comments and feedback from operational units in RVN, this development was undertaken to provide evaluation quantities of a re-designed all-purpose machete, machete scabbard and machete sharpener.

Acknowledgment is hereby given to the following members of LWL and contracting firms for their assistance and work performed in the pursuance of this task.

Frederic G. Hardenbrook
Environment & Survival Branch
U. S. Army Limited War Laboratory

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Environment & Survival Branch
U. S. Army Limited War Laboratory

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Miller Research Corporation
Baltimore, Maryland

Uniroyal Plastic Products
Division of Uniroyal, Inc.
Mishawaka, Indiana

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Linde Division
Indianapolis, Indiana

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INTRODUCTION

The standard issue machete is 23 1/2 inches long and has a blade length of 18 inches. Balance is only fair and poor handle design results in chafing of the hand after prolonged use. Troops have been reported cutting or breaking 4 to 5 inches from the blade of the issue machete to improve the balance and to allow a free swing in a relatively small space.

Based on comments from operational units in RVN, through LWL Liaison Officers, a lightweight, 13 inch blade machete was designed, incorporating a handle shape which fits the hand comfortably.

Feedback from RVN also indicated the desirability of a better means of sharpening machetes in the field. Previously, no sharpening devices (with the exception of the scabbard "notch" sharpener) have been issued with machetes to field troops. To comply with this request, a durable, corrosion resistant sharpener of tungsten carbide on stainless steel was developed which is carried in a pocket in the machete scabbard.

CONCLUSION

Simplified design and the use of lightweight, durable modern materials in the trail cutting machete have resulted in a decided cost advantage over the standard Army machete.

Good operational and performance characteristics have been confirmed in preliminary field trials.

Based upon the USARV evaluation, the machete is an improvement over the US military standard model.

DISCUSSION

Design

To resolve the design of a new trail cutting machete, the following guidelines were first established. The machete must have an optimized center of percussion that is sufficient in weight and size to cut tropical brush but is light enough to be easily handled and carried. It must be short enough to allow a free swing in a relatively small space. The blade should be made of a steel that will hold its edge under normal usage but not so hard that it will chip or break if a stone is hit accidentally. Finally, the handle should be shaped so that it will fit the hand comfortably, will move across the palm without causing blisters and will not slip from the hand when used correctly.

Using these guidelines, the finalized machete design is shown in Fig. 1. The machete has an overall length of 18 1/2 inches and weighs one pound. It has a blade 13 inches long, 9 inches of which is sharpened, and a maximum width of 2 inches. The narrow throat of the blade near the handle is not sharpened and can be grasped by the hand for digging purposes. To facilitate digging or cutting roots, the blade end is square and sharpened. Many handle designs were considered and tested to arrive at the present shape, also shown in Fig. 1. Regardless of the variation in individual hand sizes, the handle is comfortable and does not chafe the hand.

Other machete design types were considered such as the Kukri used by the Gurkhas, but were rejected because of the specialized training required. Curved blade or offset handle types result in the work area of the blade being parallel to the forearm when the blow is delivered. Traditional U. S. tools are designed so that the blade follows the axis of the grip.

Various machete scabbard designs were studied, including the Army issue, injection molded polyurethane scabbard. All were discarded on the basis of high cost, greater weight, bulkiness, and in some cases, noncompatibility of materials of construction with tropical climates. The finalized, simplified design eliminates these deficiencies and lends itself to quantity production at a decided cost advantage. Figure 1 shows the present machete scabbard which includes the aluminum metal clip located at the scabbard mouth. This was incorporated into the design following a test at the Florida Ranger Camp, Eglin AFB.

Selecting a machete sharpener proved to be a problem in development rather than design. A more-or-less arbitrary design shape was decided upon as shown in Fig. 1. The sharpener, as shown, is one inch wide, three inches long, and approximately 1/16 inch thick. If future planned operational evaluation so indicates, the sharpener can be increased in size readily.

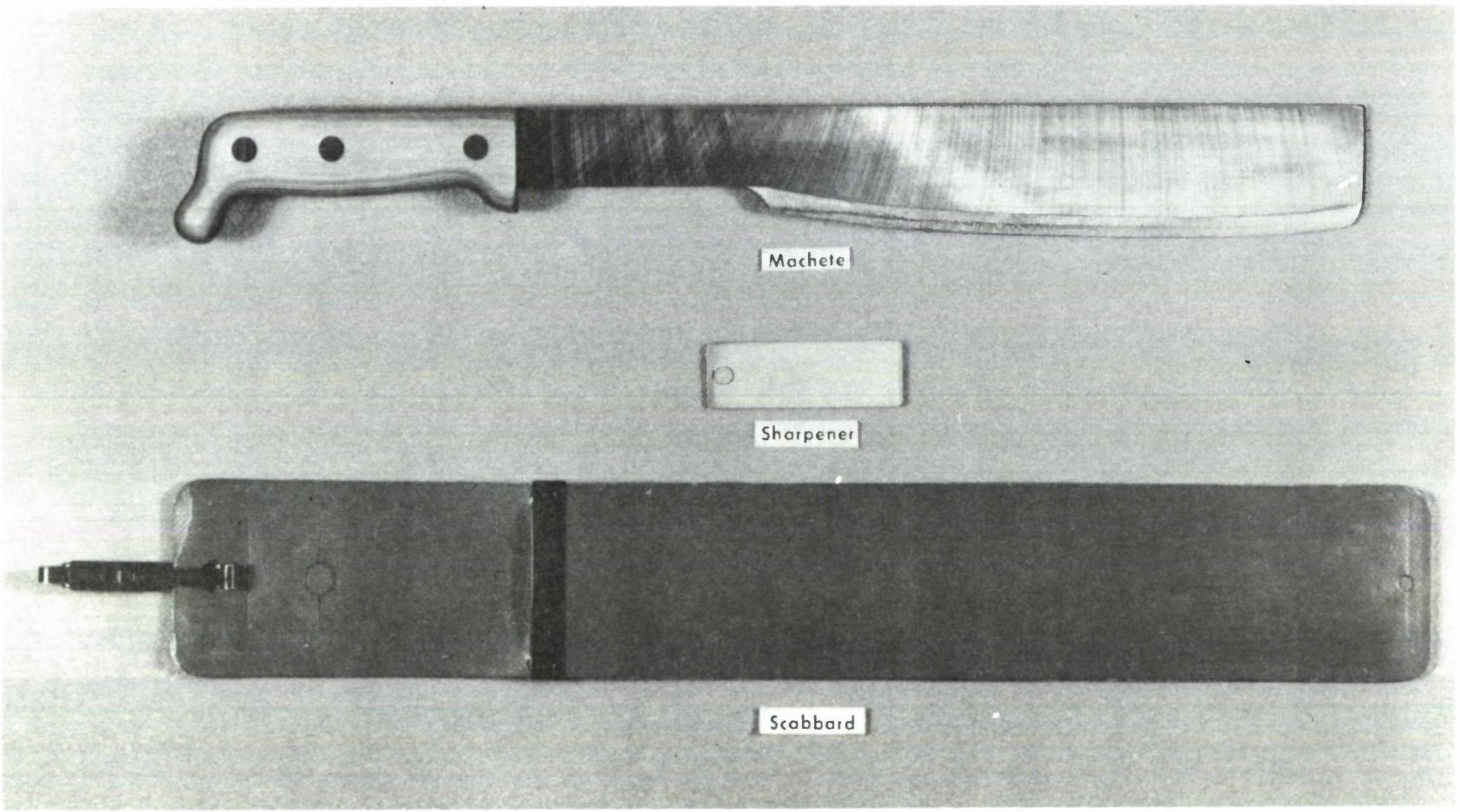

Figure 1. Trail Cutting Machete

Materials and Fabrication

Machete Blade

The initial types of steel selected for the blade were AISI 4063 or AISI 9255 alloy. Attempts to procure either type were unsuccessful as these were available only on special order and an entire heat of steel would have to be purchased. The quantity of material and funds allotted to the task were limited, therefore AISI 1095 steel was chosen at a specified hardness of Rockwell C 45-50. In choosing this material, some metal toughness was sacrificed while retaining the other desired physical properties for a machete blade.

The first machete prototypes were made with 0.100 inch gage steel blades. Following preliminary studies and tests of the prototypes, a contract was negotiated to fabricate two-hundred machetes. However, problems were encountered in procuring AISI 1095 steel of the specified gage. Readily available gages of steel were 0.093 and 0.125 inch stock. The heavier gage (0.125) was chosen and a small number of machetes were fabricated. This proved to be an unfortunate choice and, although weighing only three ounces more than the original prototype, it was ascertained during a test that the machete was considerably out of balance and the added inertia due to the increased weight resulted in loss of control, particularly when cutting small branches and trees. Accordingly, a machete was fabricated by grinding the blade to 0.093 inch thickness. This performed as well, if not better than the original prototypes, and 0.093 inch was selected as the nominal blade thickness for the final design. All blades were subsequently ground to this thickness and a surface protective treatment was applied.

It was originally planned to flame plate tungsten carbide on one side of the blade edge to minimize sharpening and retain a longer edge life. This would require a vertical flame plated edge with the other side beveled at a selected angle, thus  . One prototype machete of this blade shape was fabricated and the blade edge flame plated with tungsten carbide. This was carefully tested and though the flame plating performed very well, the design was judged unsatisfactory due to the blade edge configuration. When using a backhand stroke on a tree or limb, one had to be very careful of the striking angle, otherwise the blade would deflect, seriously endangering the user. In the case of a left handed person, the danger would be compounded. The standard machete blade "axe edge" contour is considerably safer and is incorporated in the present machete design.

The blades were not polished following the grinding operation and they were, in fact, left in the "rough" to prevent sticking in greenwood, and prevent glare or reflection. It is recommended that any future procurement of machete blades retain the so called "bark" on the surface as received from the heat treating operation, to retain these properties and also to retard corrosion.

Machete Handle

The original prototype handle was made of layers of resin impregnated linen and although this was an excellent material, it was difficult to fabricate. It was desirable to go to a molded plastic handle of "rag-filled" bakelite, Surlyn-A, or other similar materials from the standpoint of ease of fabrication, durability, resistance to oils, greases, insect repellents, etc., and cost. However, based upon the limited quantity called for in this development, the cost of molds was prohibitive. It is envisioned that future machete production purchases would be fabricated to the same shape but would utilize a molded plastic handle to effect an appreciable cost savings.

The material finally selected for the handles was densified wood fabricated from yellow birch impregnated with phenol-formaldehyde resin under 2000 psi. pressure. This material exhibits similar physical properties found in the moldable plastic with the exception that it has to be machined, and consequently must be riveted to the machete blade. In the actual assembly, the handles were attached by recessed rivets and densified wood dowels were used for plugging the counter bored rivet holes.

Machete Sharpener

A suitable machete sharpener for use in RVN must be highly corrosion resistant, durable and provide optimum sharpening characteristics, and therefore conventional files and bonded stones are unsuitable. Several commercially available bonded carbide grit files were investigated, however, bonding was weak and the carbide grains were easily torn out and grains were spaced so far apart as to greatly lower the effective sharpening area.

The development was then directed toward the flame plating tungsten carbide process. This resulted in the machete sharpener now provided for test in RVN. It is 3 inches by 1 inch by 16 gage thick stainless steel with a flame plated coating of tungsten carbide .002" minimum thickness. The surface roughness is approximately 150 RMS (root mean square) in the as-deposited state and is actually much finer grained than the bonded carbide grit files investigated. In terms of field sharpening of machete blades, this results in greater difficulty in removing burrs, rock nicks, and upset blade edges, however it enables the user to put an extremely fine, sharp edge on the blade.

Continuing advancement in the state-of-the-art by commercial interests resulted recently in an improvement in grit technology. A commercial firm, offers a bonded carbide grit file which is much superior to previous files under investigation by LWL. Their binder metals, after fusion, make a most excellent protection to corrosion of the underlying steel, their facilities produce accurate grit size reflection without excessive bond metal, they guarantee that carbide grit edges are not decarburized, and they claim the particular binder alloys employed in conjunction with the processing, produces extremely high strength bond joints <u>not achievable</u> with conventional

flame-spray methods. A procurement for files was placed with this company, requesting 100 HB grit on one side and 60 HB grit on the opposite side. The file configuration utilizes a standard six inch steel file blank. Upon receipt of the files, a limited evaluation was performed at Aberdeen Proving Ground, Maryland with favorable results. Considerably coarser than the flame-sprayed files previously developed, it was believed that troops in RVN should have the opportunity of evaluating both types and consequently a number of the new files were shipped to RVN.

Machete Scabbard

During the initial study of various existing machete scabbards, it became quite apparent that some of the complicated designs and particularly the injection molded types were quite expensive. In some instances the scabbard cost was two to three times the cost of the machete. Most of the scabbards were also quite heavy, bulky, non-flexible, and some were fabricated from materials which would be subject to corrosion, rotting, mold, etc. in tropical climates.

Two approaches to the problem presented themselves; (1) value engineer an existing scabbard or (2) initiate an entirely new approach based on the concept of lightweight, durable modern materials and a simplified design. The latter approach was chosen and the final scabbard consists essentially of two layers of material fabricated by heat sealing. Several materials were investigated including polyethylene Surlyn-A, polyurethane, polyurethane coated nylon fabric, and vinyl coated nylon fabric. Polyurethane coated nylon fabric was the material finally selected based on its toughness, durability, resistance to cutting, high flexibility, resistance to oils, greases, insect repellent, and compatibility with tropical climate.

A small pocket in the scabbard contains the sharpener for ready accessibility. Two water drain holes are provided, one in the bottom of the scabbard and one at the bottom of the sharpener pocket. The scabbard is attached to the belt by a standard belt clip.

Cost Analysis

Machete (estimate):	Prototype	- 20.00
	10,000 units	- 2.15
	100,000 units	- 1.90
Machete Sharpener (Flame plated type - quoted):		
	Prototype	- 1.48
	10,000 units	- .99
	100,000 units	- .95
Machete Scabbard (quoted):	Prototype	- 13.72
	10,000 units	- 1.92
	100,000 units	- 1.75

RESULTS

During the period 11-19 January 1968, five LWL machetes were tested in the field by four Special Forces personnel and four Infantry non-commissioned officers at the Florida Ranger Camp, Eglin AFB. The LWL machete performed very well and was preferred over the standard U. S. Army machete by six out of the eight men. One man had no preference between the two machetes and one man preferred the issue machete.

A weakness was noted in the machete scabbard during this test. Three scabbards ripped at the rivets located at the point where the machete is inserted in the scabbard. This was subsequently corrected by adding an aluminum metal clip to prevent cutting or ripping of the material.

A copy of the evaluation plan, operating instructions, and summary of the eight questionnaires filled out by the test personnel is included in Appendices A and B.

Informal tests were also conducted by LWL personnel at Aberdeen Proving Ground, Maryland with favorable results. However, extensive field testing was required to confirm the observations made during these limited tests.

On 15 February 1968, 150 machetes were shipped to RVN for operational evaluation and suggested operator's questionnaires were supplied for comment. The 9th Infantry Division conducted the field tests and submitted a letter report of the evaluation of the Trail Cutting Machete to USARV. A copy of this report is included in Appendix C and the comments and recommendations of the 9th Infantry Division are favorable. USARV concurred with the report's findings and recommendations and considers the USALWL machete an improvement over the US military standard model. However, they recommended there be no further procurement of the USALWL Trail Cutting Machetes for use in RVN. A copy of the USARV letter to CO, USALWL is included in Appendix C.

APPENDIX A

LWL Trail Cutting Machete
Operating Instructions

1. Training in RVN

A sharp bladed machete in the hands of a novice is extremely dangerous to himself or others working near. It is recommended that training be given by a competent machete man to all troops engaging in this evaluation.

2. Safety

In using this machete, observe all common safety practices that would be applicable to any knife, bayonet or sharp bladed tool. This includes: delivering the blow away from one's person, never holding a bush or small tree with one hand while attempting to cut same with the machete in the other hand, making certain that swinging room for the machete is not too confined, remain at least two paces behind other machete man, rotate machete men (particularly lead man), carrying a 3 to 4 foot stick to steady limber material, and resting frequently if over fatigued.

3. Sharpening Machete

Use the machete sharpener provided in the scabbard. It is recommended that an edge of this shape  be maintained rather than one of this shape  . This may not cut as deeply as the steep "V" edge, but being of heavier cross-section, will retain an edge longer and will be less likely to chip or curl over. When sharpening machete, precautions should be taken to prevent cutting one's hand. Remember, a sharp machete is less dangerous and more effective than a dull machete.

4. Care of Machete

In the tropical climate of Vietnam, the carbon steel blade is subject to extensive corrosion (rust). Rust preventative should be used liberally each day if possible. Otherwise, attention should be given to machete blade after each mission.

APPENDIX B

SUGGESTED
LWL Operational Evaluation Plan
on
Trail Cutting Machete

References

1. USARV MSG AVHGC-DST 81984, DTG 031257Z November 1967, Subj: Trail Cutting Machete (LWL Task 06-S-67).

2. DA MSG, DA 899648, DTG 132206Z November 1967, Subj: Trail Cutting Machete (LWL Task 06-S-67).

Purpose

To determine the operational and performance characteristics of the LWL machete under actual field conditions and possible acceptance for general use in RVN.

Background

The U. S. Army Limited War Laboratory has developed a lightweight machete, designed for trail cutting in jungle areas. This design was based on comments and/or feedback from operational units in RVN, through LWL Liaison Officers. Troops have been reported cutting 3 to 4 inches from the blade of the standard machete, indicating the desirability of a shorter blade. The 13 inch blade LWL machete is designed so that balance and the point of percussion is in the optimum area for convenient use. The end of the blade is square and sharpened for use as a digging tool or cutting roots. To prevent sticking in green wood or flashing in light, the blade is rough and unpolished. Many handle designs were considered and tested to arrive at the present shape which fits the hand comfortably, will move across the palm without causing blisters and will not slip from the hand when used correctly.

Other machete design types were considered such as the Kukri used by the Gurkhas, but were rejected because of the specialized training required. Curved blade or offset handle types result in the work area of the blade being parallel to the forearm when the blow is delivered. Traditional U. S. tools are designed so that the blade follows the axis of the grip.

A new machete scabbard has been developed, based on the concept of lightweight, durable modern materials and simplified design. This scabbard also has a decided cost advantage over the standard Army scabbard.

Included with the LWL machete is a Tungsten Carbide coated stainless steel sharpener. The flame sprayed Tungsten Carbide forms a permanent bond with the stainless steel and provides an unbreakable, corrosion resistant sharpener. A small pocket in the scabbard contains the sharpener for ready accessibility.

Incl 4 to Incl 5

Description of Material and Proposed Use

Material for the machete blade is AISI 1095 carbon steel, heat treated and drawn to a Rockwell C hardness of 45 - 50. The handle is fabricated from densified wood (yellow birch impregnated with resins under high pressure) and is machined to the optimum shape. Future machete production purchases would utilize a molded plastic handle of the same shape. The function of the handle would not change, but cost savings would be appreciable. Polyurethane coated nylon was selected for the machete scabbard and is fabricated by bonding. This material is tough, resilient, non-reactive with insect repellents, oils and greases, and is cut resistant. The machete sharpener is Tungsten Carbide coated stainless steel.

The proposed design usage of this machete is for clearing fire lanes, trail cutting and miscellaneous camp use such as cutting firewood.

Objectives

1. Training

A pre-tested training program is not applicable in this case. However, it is probable that most or all of the troops engaging in the evaluation will have had previous experience with machetes or bush knives.

2. Performance and Suitability

In order to evaluate how well the hardware furnished meets its design objectives, an Operator's Questionnaire is included with this proposed evaluation plan.

Proposed Method of Evaluation

In order to insure completion of evaluation objectives, the following evaluation sequence is recommended.

1. Inspect the shipping container and contents to determine if the machetes have been damaged during shipment.

2. Conduct briefings of headquarters staff and combat unit personnel, as required, to insure a complete understanding of the machetes' characteristics, employment and safety precautions.

3. The selected combat units should conduct evaluation using the attached Operator's Questionnaire.

4. User personnel should be encouraged to complete Questionnaire, paragraph 16, entitled, "Remarks" to include any suggestions for improvement in order to facilitate any follow-on projects.

RECAPITULATION OF TRAIL CUTTING MACHETTE QUESTIONNAIRES

1. Have you used other types of machettes or bush knives; if so what type?

   a. The folding type blade : 1
   b. The one with the hook on end of blade: 1
   c. Standard military: 3
   d. Two gave a Yes but did not know the type.
   e. One did not answer, and one said No.

2. Opinions on LWL Machette.

	Very Good	Satisfactory	Poor
Machette balance	6	1	1
Length of blade	6	1	1
Hand grip	6	2	
Retains edge	6	2	
Blade sharpener	7	1	
Weight of machette	5	2	1

3. Use of LWL Machette during length of time individual had it.

   3 days - often - 3 tests subjects
   4 days - often - 1 test subject
   8 days - often - 1 test subject
   7 days - occasionally - 1 test subject
   7 days - often - 1 test subject
   5 days - occasionally - 1 test subjecy

4. Did machette blade "stick" in soft wood?

   Yes 4 No 4

5. Is corrosion (rust) of blade a problem?

   Yes 0 No 8

6. Did the handle blister your hand?

   Yes 0 No 8

7. Did any breakage or warpage of handle occur?

   Yes 0 No 8

(Note: 2 handles broke, however, no test subject would admit it.)

8. The LWL Machette compared with standard 18 inch blade machette.

   LWL = Better - 6 As good - 1

   Standard 18" blade - not as good - 1

9. Did you like the machette scabbard?

   Yes - 5; 3 that said no had scabbards that ripped at the rivets; and one stated that he would like a better means to attach it to the pistol belt.

APPENDIX C

AVHGC-DST (1 May 1968) 1st Ind
SUBJECT: Trail Cutting Machete (LWL Task 06-54-67)

HEADQUARTERS, UNITED STATES ARMY VIETNAM, APO San Francisco 96375 17 MAY 1968

TO: Commanding Officer, United States Army Limited War Laboratory, Aberdeen Proving Ground, Maryland 21005

1. The attached letter report of evaluation on Trail Cutting Machete is forwarded for your information.

2. This headquarters concurs in the reports findings and recommendations. The LWL machete is considered to be an improvement over the US military standard model, however, an analysis of the questionaires completed by users of the LWL machetes indicates that these improvements are not significant enough to justify additional procurement of subject item.

3. Recommend that:

a. There be no further procurement of the LWL Trail Cutting Machetes for use in RVN.

b. The machetes provided for evaluation in RVN be retained by the evaluating unit.

FOR THE COMMANDER:

John V. Getchell

1 Incl
wd

JOHN V. GETCHELL
Captain, AGC
Assistant Adjutant General

CF:
CINCUSARPAC

DEPARTMENT OF THE ARMY
HEADQUARTERS 9TH INFANTRY DIVISION
APO San Francisco 96370

AVDE-GT-T

1 MAY 1968

SUBJECT: Trail Cutting Machete (LWL Task 06-54-67)

Commanding General
United States Army Vietnam
ATTN: AVHAT-GCD
APO 96375

1. Reference: Reference is made to letter AVHAT-GCD, Headquarters, USARV, subject as above, dated 12 Feb 68.

2. The 9th Infantry Division has completed the evaluation of the LWL Trail Cutting Machete. The following information is submitted:

a. Evaluation data revealed that the LWL Trail Cutting Machete has the acceptable physical properties to deliver a correct and precise blow to most any type of vegetation. Its construction, length of blade and formed hand grip make it superior to the standard US military machete. The scabbard is of good material and should reduce corrosion.

b. The light weight of the LWL Machete is an asset. Less fatigue was experienced while using the new machete. The overall weight of the machete lightens the individual combat load.

c. It was noted by one unit that the LWL Machete was more readily accepted by personnel of medium height because of the shorter blade. Personnel 5 feet 11 inches and above perferred a longer blade machete. It was noted that the handle of the LWL Machete becomes very slippery from moisture and could become unsafe. In addition, it was noted that the scabbard proved inferior to the standard type machete scabbard.

3. The following information reflects a comparison of the LWL Trail Cutting Machete with the Standard US Military Machete: The LWL Trail Cutting Machete is better in performance and suitability because of the shape, size and weight. The machete is easier to carry and use in thick jungle.

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AVDE-GT-T
SUBJECT: Trail Cutting Machete (LWL 06-54-67)

1 MAY 1968

4. Recommendations for improvement:

a. The blade edge should be extended closer to the handle for increased cutting.

b. A larger base knob and string should be placed on the handle to prevent the hand from slipping onto the blade.

c. The drain holes located in the bottom of the scabbard should be made larger in order to drain trapped water.

FOR THE COMMANDER:

GEORGE W. WELLS JR
CPT AGC
ASST AG

1 Incl
Operator's Questionnaires

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