MAJ JOHNSON

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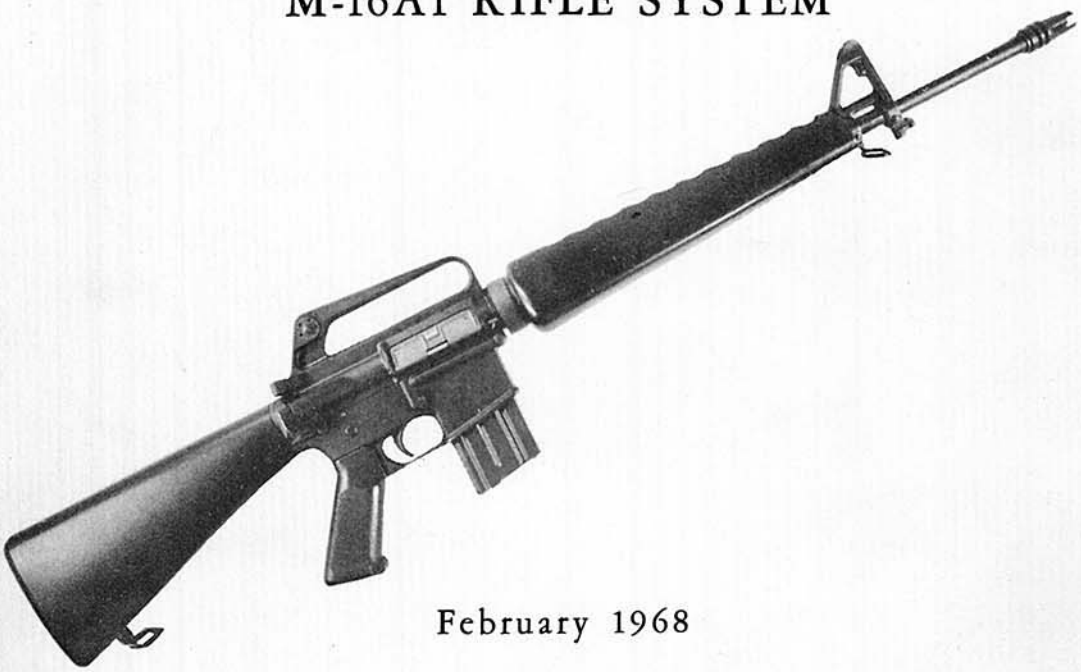
13-JA

Marine Corps Liaison Officer
U. S. Army Test & Evaluation Command
Aberdeen Proving Ground, Md. 21005

WSEG REPORT 124

OPERATIONAL RELIABILITY TEST
M-16A1 RIFLE SYSTEM



February 1968

Return to:

Marine Corps Liaison Officer
U. S. Army Test & Evaluation Command
Aberdeen Proving Ground, Md. 21005

WEAPONS SYSTEMS EVALUATION GROUP
400 ARMY-NAVY DRIVE, ARLINGTON, VA.

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Log No. 130150

AMMUNITION ENVELOPE
(For Ammunition Associated With Malfunction)

PLATOON ☐ SQUAD ☐ MAN ☐☐ FIRING PERIOD ☐☐

RIFLEMAN'S NAME _____ RIFLE TEST NO. ☐☐☐
LAST FIRST

RIFLE TYPE ☐ FIRING MODE AT MALFUNCTION (CIRCLE ONE) A SA

CATEGORY OF MALFUNCTION (CIRCLE ONE) I II III

MAGAZINE NUMBER AT MALFUNCTION ☐☐ MAGAZINE LOAD (CIRCLE ONE) 18 20

WAS IT FIRST CARTRIDGE IN MAGAZINE? ◯ SECOND CARTRIDGE? ◯

BEST ESTIMATE OF MAGAZINE ROUND NO. WHERE MALFUNCTION OCCURRED ☐☐

NATURE OF MALFUNCTION ☐☐

REMARKS _____

_____

_____

2-10-68-20

AMMUNITION ASSOCIATED WITH A MALFUNCTION

Preprinted envelopes will be provided to each platoon for use by the Armorers and Data Collectors in retrieving cartridges or cartridge cases associated with a rifle malfunction. The information required to be entered on this envelope is identical to corresponding entries on the Rifle Malfunction Report. The Data Collector will transcribe the information from the Rifle Malfunction Report to this envelope.

Enclosure F

TEST EXECUTION

TEST EXECUTION

The operational reliability test of the M-16A1 rifle systems was conducted at the Fort Sherman Military Reservation, Canal Zone, during the period 11-25 January 1968. Appendixes A-D discuss the manner of test execution in relation to the test design at each of the four environmental sites. It was the observation of each WSEG monitor that the test at his site was executed in accordance with the test design and that the weapons received a realistic exposure. As stated on page 19, "the weapons were exposed more on the first day of each phase than on succeeding days" as a result of a learning curve. It was generally observed, however, that at all sites the test rifles and ammunition during Phases III and IV received a slightly more severe exposure than was the case during Phases I and II. This difference probably occurred as a result of a letter from the Test Director, dated 18 January 1968, which requested the Marines to give their weapons a realistic exposure. A copy of this letter is in Appendix E. Additional photographs illustrating miscellaneous aspects of the test are in Appendix F.

Appendix A

TEST EXECUTION, SITE E_1, BEACH

TEST EXECUTION, SITE E_1, BEACH

A. GENERAL

The WSEG site monitor at Site E_1 was Colonel Robert W. Wilson, U.S. Marine Corps. He was assisted by Lieutenant Walter D. Merry and Sergeant Kent D. Smith from Army units in the Canal Zone. The Range Coordinator/Safety Officer was Lieutenant Frank J. Gueterman, USMC.

The scenario at this site depicted an amphibious assault by a platoon with the mission of clearing and holding a beach area.

B. ENVIRONMENTAL EXPOSURE

During each of the four phases, one platoon was employed at Site E_1. A typical daily schedule of events is shown in Annex A. The exposure times are depicted in Annex B.

A typical exposure period consisted of a 10-minute, dusty road march from the firing line to the Landing Craft Mechanized (LCM) embarkation point, approximately 20 minutes on the Caribbean Sea where the men and weapons were exposed to salt water spray, and an amphibious assault on the east end of Pina Beach. The remainder of the exposure period was spent in fire and maneuver tactics along the beach for approximately one-half mile. See Annex C for a graphic and pictorial display of exposure.

During the fire and maneuver along the beach, each rifleman was forced to hit the dirt, sand and grass an average of 12 times and to crawl in the sand to obtain proper firing positions. Simulated artillery and small arms fire was employed

throughout to add realism to the maneuver. Each rifleman dug a prone shelter during the afternoon exposure; he placed his rifle nearby on the sand and often times the diggings landed on the rifle. Just prior to firing, each rifleman crawled approximately 20 feet to his individual firing position.

The rifles were exposed to wet and dry sand, salt water and salt spray. Generally speaking, every rifle had water and sand on and in the rifle following exposure; most of the magazines and magazine pouches were wet and had sand on them; a large percentage of the men were wet during each exposure and their uniforms and hands were covered with sand.

Commencing with the third test day and once each day thereafter, a simulated medical evacuation or troop reinforcement mission was conducted by helicopter during one of the exposure periods. During the landing approach the helicopter flew low and slow over the entire platoon which subjected each rifleman to heavy winds and sand blasting.

C. FIRING

The firing times are shown in Annex B.

Two special firing tests were conducted during each phase. On the first evening a round was chambered and left in the weapon overnight. The weapons were covered with ponchos and the round fired the next morning. On the second night of each phase, night firing was conducted in lieu of the firing that normally followed the afternoon exposure.

D. CLEANING

The rifleman did not have an opportunity to clean his weapon following exposure and prior to firing except that, for safety, any obstructions were removed from the bore. Rifle cleaning was scheduled each noon and evening. The cleaning

was conducted under the supervision of the Squad Leader (Staff Sergeant). One cleaning period during each phase was conducted at night following night firing. This cleaning was accomplished using truck headlights and Coleman lanterns.

E. WEATHER

Meteorological data, as recorded on scientific instruments, is shown in Annex D. The weather was generally sunny and warm with a steady on-shore breeze of about 15 mph. The on-shore breeze caused a constant veil of salt water mist which permeated everything. The wind also blew sand, picked up by muzzle blast, and salt water, kicked up by the projectile impact, back over the firing positions. Some of this sand and water was observed to fall on the rifles and undoubtedly affected those with the dust covers left open.

No significant rainfall was recorded on the instrumentation provided; however during the night firing period on 16 January, a heavy rain squall crossed the firing line. It lasted for about three minutes and caused everything to get completely soaked. Light rain showers also fell on the beach site during the following periods:

13 January	0745-0800
16 January	0828-0845
17 January	0600-0700
23 January	0800-0820 1400-1405

F. OBSERVATION

Throughout the entire test, the Marines reacted in a professional and enthusiastic manner. As they gained experience, a marked improvement was noted in their ability to protect their weapons in spite of the relatively severe conditions to which they were exposed. The test was executed in accordance with the test design; no deviations were noted.

ANNEX A

TYPICAL DAILY SCHEDULE OF EVENTS, SITE E_1, BEACH

FIRST DAY	EVENT
0740-0800	Enroute from Fort Sherman to Chagres Landing
0800-0930	Sea exposure aboard LCM and beach maneuver
0930-0945	Prepare to fire
0945-1100	Firing, entire platoon
1100-1245	Clean weapons, noon meal, draw ammunition
1245-1340	Firing, entire platoon
1340-1500	Sea exposure and beach maneuver
1500-1515	Prepare to fire
1515-1600	Firing, entire platoon
1600-1700	Clean weapons
1830	Prepare chambered round

SECOND DAY	EVENT
0740	Draw ammunition
0800-0815	Prepare to fire
0815-0900	Firing to include the chambered rounds, entire platoon
0900-1030	Sea exposure and beach maneuver
1030-1045	Prepare to fire
1045-1115	Firing, entire platoon
1115-1300	Clean weapons, noon meal, draw ammunition

SECOND DAY	EVENT
1300-1340	Firing, entire platoon
1340-1510	Sea exposure and beach maneuver
1855-1910	Prepare to fire
1910-1945	Night firing, entire platoon

THIRD DAY	EVENT
Same as second day	except as follows:
1510-1525	Prepare to fire
1525-1605	Firing, entire platoon
1605-1705	Clean weapons
1705	Break camp, return to Fort Sherman

ANNEX B

EXPOSURE AND FIRING TIMES
SITE E-1
BEACH

Test Days	Phase I			Phase II			Phase III			Phase IV		
	1	2	3	4	5	6	7	8	9	10	11	12
Begin Exposure	0723	0910	0800	0810	0855	0835	0820	0818	0803	0750	0820	0740
End Exposure	0858	1030	0915	0945	0951	0955	0933	0945	0921	0943	0938	0907
Begin Exposure	1604	1325	1157	1320	1322	1315	1327	1252	1214	1316	1245	1210
End Exposure	1651	1455	1345	1441	1455	1425	1452	1412	1323	1440	1405	1318
Firing Time												
Cycle 1 Begin	0858	0811	0738	0945	0757	0745	0933	0752	0750	0943	0740	0655
Cycle 1 End	0934	0908	0800	1045	0854	0835	1145	0817	0802	1052	0820	0740
Cycle 2 Begin	1514	1039	0919	1256	0951	0959	1307	0945	0921	1259	0938	0907
Cycle 2 End	1603	1115	0945	1320	1109	1045	1326	1125	1017	1315	1038	0953
Cycle 3 Begin	1654	1256	1136	1441	1255	1236	1452	1232	1156	1441	1230	1140
Cycle 3 End	1723	1324	1155	1508	1321	1315	1526	1251	1213	1527	1244	1209
Cycle 4 Begin		1908	1349		1902	1426		1905	1323		1855	1318
Cycle 4 End		1947	1427		2027	1445		1956	1355		1925	1357

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ANNEX C

GRAPHIC PORTRAYAL OF MANEUVER

SITE E_1, BEACH

Location: Pina Beach, Fort Sherman Military Reservation, Panama Canal Zone (9°19'00" 80°00'30"W)

Exposure: Sand, salt spray, and salt water.

Simulated Combat Scenario: A Marine Platoon, consisting of one officer, 2 NCOs, and 76 riflemen, is assigned the mission of seizing a beachhead by an amphibious assault on Pina Beach, clearing the beach of enemy forces, and securing the mouth of the Chagres River.

(A) A Landing Craft Mechanized (LCM) is en route to the beach through calm seas and moderate surf.

(A) All the personnel aboard, their equipment and weapons are exposed to salt water spray.

(B) The beach assault subjects the weapon to more salt water and sand.

(C) Simulated enemy fire forces the troops to hit the sand and take up firing positions.

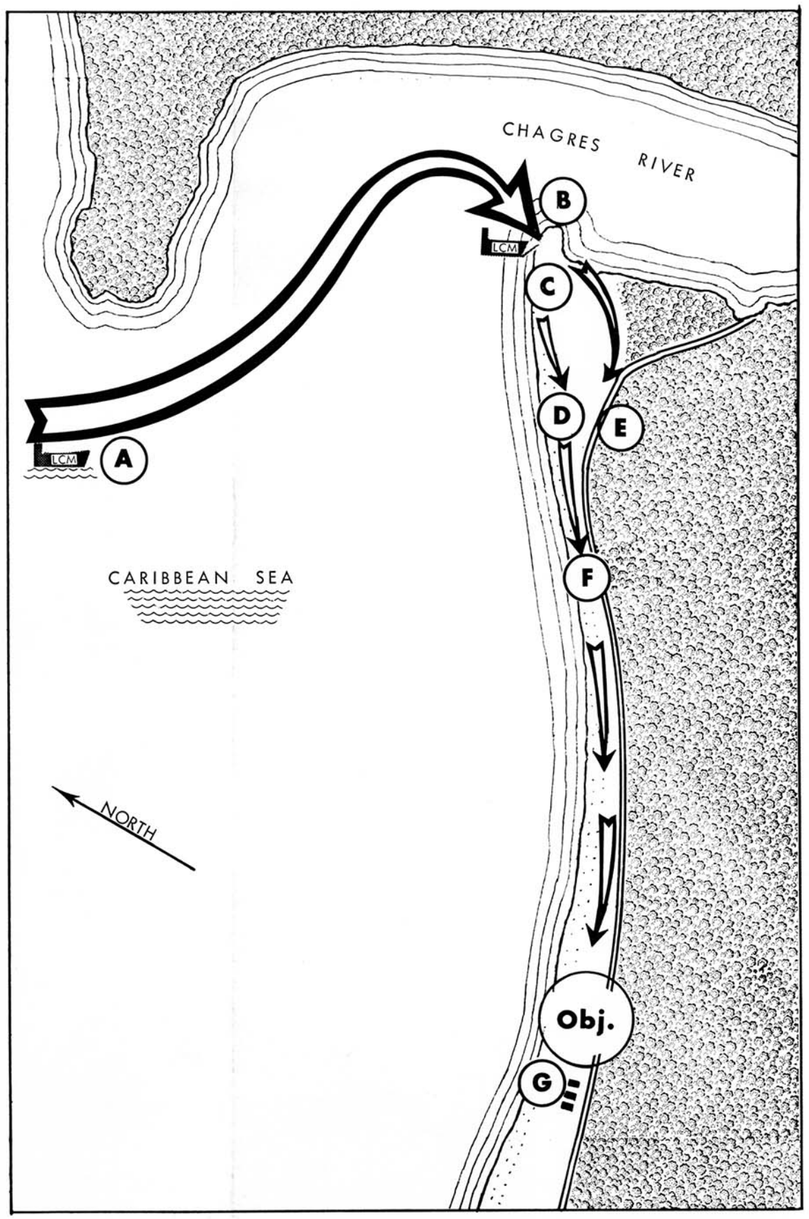
(D) A fire team maneuvers to neutralize the enemy fire.

(E) While some units are maneuvering, others take advantage of any concealment and cover and support the maneuver by fire.

(F) Troops dig prone shelters with entrenching tools while weapons are lying in the sand close at hand.

(G) Controlled firing out to sea. Salt water spouts caused by impact of projectiles are blown back over firing line.

(G) All malfunctions were duly recorded and the shooter clears the stoppage.



(A) LCM en route to beach.

(A) Troops and weapons receive salt spray.

(B) Assault landing.

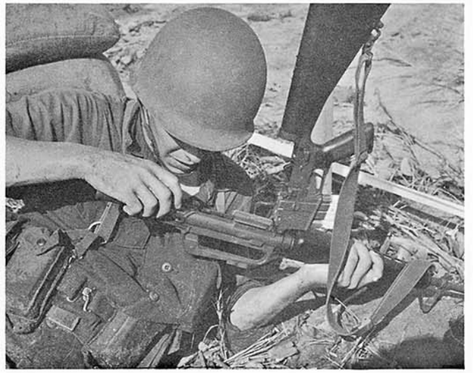
(C) Laying down a base of fire.

(D) Advance by fire and maneuver.

(E) Covering an advancing element.

(F) Digging prone shelters.

(G) Firing at Pina Beach range.



(G) Clearing a malfunction.

ANNEX D

METEOROLOGICAL DATA SUMMARY, SITE E_1, BEACH

Meteorological Data		Test Day											
		1	2	3	4	5	6	7	8	9	10	11	12
Wind-MPH	0600	10	12	14	10	10	14	20	14	10	10	14	14
	1200	12	15	12	14	14	16	20	12	10	12	11	12
	1800	10	15	08	10	10	18	14	14	14	08	14	12
	2400	10	14	12	10	12	14	14	12	12	09	08	10
Temperature	0800	78	78	77	79	80	80	80	80	80	77	79	79
	1200	82	81	82	84	83	83	82	83	83	83	83	83
	1800	79	79	78	82	80	80	79	79	79	79	80	80
	2400	79	78	77	79	79	79	79	79	77	79	80	80
Humidity	0800	98	98	98	100	100	100	98	98	94	100	100	100
	1200	98	98	98	96	100	98	98	98	97	100	96	100
	1800	98	98	98	100	98	100	98	100	100	100	100	100
	2400	98	98	98	100	100	100	98	100	100	100	100	100
Rainfall, Recorded Total - 24 hours		0	0	0	0	0	0	0	0	0	0	0	0

Note 1: Wind from North.

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Appendix B

TEST EXECUTION, SITE E_2, SWAMP

TEST EXECUTION, SITE E_2, SWAMP

A. GENERAL

The WSEG site monitor at Site E-2 was Colonel Levin B. Broughton, U.S. Army. He was assisted by Lieutenant James L. Miller and Sergeant David M. Weaver from Army units in the Canal Zone. The Range Coordinator/Safety Officer was Lieutenant Paul Paquette, USMC.

The scenarios depicted a search and destroy operation and the establishment of an ambush. A typical daily schedule of events is at Annex A.

B. ENVIRONMENTAL EXPOSURE

Six exposures were included in each phase of the test -- one exposure for each combat day. In each exposure, the test platoon conducted a foot march from the firing range to the Mojinga Swamp, through a portion of the swamp and thence back to the firing range. During this movement the platoon was required to react to tactical events designed to expose the test weapons and ammunition to water and mud. These events were enemy sniper, automatic weapons and artillery/mortar fire, enemy ambush, meeting engagement with enemy unit, and establishment of an ambush or a defensive perimeter. In all situations except subjection to simulated enemy artillery/mortar fire, the Marines were required to hit

the ground initially, seek cover and concealment, and then creep or crawl to good firing positions. When subjected to simulated artillery/mortar fire, the Marines were required to double time through the impact area.

The platoon moved in single file along the trail until an event occurred which required a reaction. The order of march of the squads was varied for each exposure.

Each exposure consisted of two or three tactical events as outlined above. Three events were held unless a new trail was cut. A new trail was required periodically (five were used during the test) because the continuous use of a single trail soon created a trench which filled with water and a mud with the consistency of wet cement. Cutting a new trail required a machete team at the head of the column and slowed the movement of the column so that double timing was not feasible.

The many vines and roots along the trail, the slippery mud, and the varying depths and degrees of firmness of the bottoms of water holes made footing most uncertain. Marines frequently fell into mud and water. In accordance with their training, the Marines conscientiously tried to keep their rifles clean. Nonetheless, test rifles and ammunition often were immersed in whole or part in the water/mud of the Mojinga Swamp.

The Marine non-commissioned officers of all platoons were assiduous in requiring the Marine riflemen to hit the ground (or water) promptly where they stood at the moment an event occurred and to crawl to concealment, cover and good firing positions.

The test platoon bivouacked in the jungle on the bank of the Chagres River. Exposure times are shown in Annex B. A graphic portrayal of maneuvers is at Annex C.

C. FIRING

Firing was conducted at a range constructed in the jungle specifically for this test. It was located approximately 500 meters east of the bivouac site and served as the start and finish point for the exposure. Marines adopted a modified kneeling position behind a log barricade. Firing times are shown in Annex B.

D. CLEANING

The scheduled cleaning of weapons was conducted at the bivouac site. Unscheduled cleanings were conducted at the firing range. All cleaning was supervised by Marine non-commissioned officers. Weapons were inspected by non-commissioned officers after cleaning.

E. WEATHER

The weather was usually clear, warm, and humid. Several light showers occurred, usually between 0630 and 0830 hours. This precipitation did not register on the site rain gauge which was located under jungle canopy. A meteorological data table for Site E_2 is at Annex D.

F. OBSERVATION

No deviations from the test design were noted at Site E_2. It is considered that the test rifles received a realistic exposure.

ANNEX A

TYPICAL DAILY SCHEDULE OF EVENTS, SITE E_2, SWAMP

FIRST DAY	EVENT
0530-0600	Enroute to Chagres Landing
0600-0620	Enroute to swamp bivouac by LCM
0620-0700	Establish bivouac
0700-0720	Draw ammunition
0720-0915	Maneuver in the swamp exposure
0915-0930	Prepare to fire
0930-1115	Firing, 2 squads at a time
1115-1300	Clean weapons, noon meal, draw ammunition
1300-1315	Move to range, prepare to fire
1315-1415	Firing, 2 squads at a time
1415-1545	Maneuver in the swamp exposure
1545-1600	Prepare to fire
1600-1700	Firing, 2 squads at a time
1700-1815	Return to bivouac, clean weapons.

SECOND DAY	EVENT
0700-0720	Draw ammunition
0720-0735	Move to range, prepare to fire
0735-0835	Firing, 2 squads at a time
0835-1005	Maneuver in swamp exposure
1005-1020	Prepare to fire
1020-1120	Firing, 2 squads at a time
1120-1305	Clean weapons, noon meal, draw ammunition

SECOND DAY	EVENT
1305-1320	Move to range, prepare to fire
1305-1420	Firing, 2 squads at a time
1420-1550	Maneuver in the swamp exposure
1550-1605	Prepare to fire
1605-1705	Firing, 2 squads at a time
1705-1820	Return to bivouac, clean weapons

THIRD DAY

Same as second day except on completion of cleaning, unit breaks camp and returns to Fort Sherman.

ANNEX B

EXPOSURE AND FIRING TIMES
SITE E_2, SWAMP

	Phase I			Phase II			Phase III			Phase IV		
Test Days	1	2	3	4	5	6	7	8	9	10	11	12
Begin Exposure	0723	0901	0850	0730	0906	0740	0735	0845	0805	0745	0822	0850
End Exposure	0831	1037	1031	0910	1043	0920	0917	1039	0940	0920	1010	1031
Begin Exposure	1330	1410	1415	1445	1410	1330	1321	1413	1240	1315	1321	1325
End Exposure	1517	1550	1550	1620	1417	1515	1457	1548	1415	1453	1456	1500
Firing Time												
Cycle 1 Begin	0853	0800	0800	0955	0832	0708	0925	0737	0730	0930	0745	0807
Cycle 1 End	1043	0842	0842	1143	0903	0735	1035	0840	0800	1120	0819	0844
Cycle 2 Begin	1235	1043	1046	1404	1045	0925	1235	1045	0945	1245	1035	1037
Cycle 2 End	1322	1155	1130	1440	1127	0957	1318	1135	1018	1310	1115	1130
Cycle 3 Begin	1529	1325	1327	1625	1330	1220	1459	1330	1210	1456	1245	1231
Cycle 3 End	1625	1403	1410	1715	1405	1245	1524	1410	1235	1534	1319	1320
Cycle 4 Begin		1600	1600		1557	1520		1550	1420		1512	1504
Cycle 4 End		1645	1647		1633	1555		1624	1447		1551	1550

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ANNEX C

GRAPHIC PORTRAYAL OF MANEUVER (MORNING)

SITE E_2, SWAMP

Location: Mojinga Swamp, Fort Sherman Military Reservation, Panama Canal Zone (9° 18'00"N 79° 58'00"W)

Exposure: Fresh Water and Mud

Simulated Combat Scenario: A Marine Platoon consisting of one officer, 6 NCOs, and 76 riflemen is assigned a search and destroy mission. The platoon will penetrate the southern portion of the Mojinga Swamp in search of small enemy units reported to be operating from that area.

(A) The platoon proceeds down a narrow trail in a column of squads, each squad in single file.

(B) The column receives automatic weapons fire from its right front. Marines hit the ground, seek cover and concealment, and crawl to good firing positions.

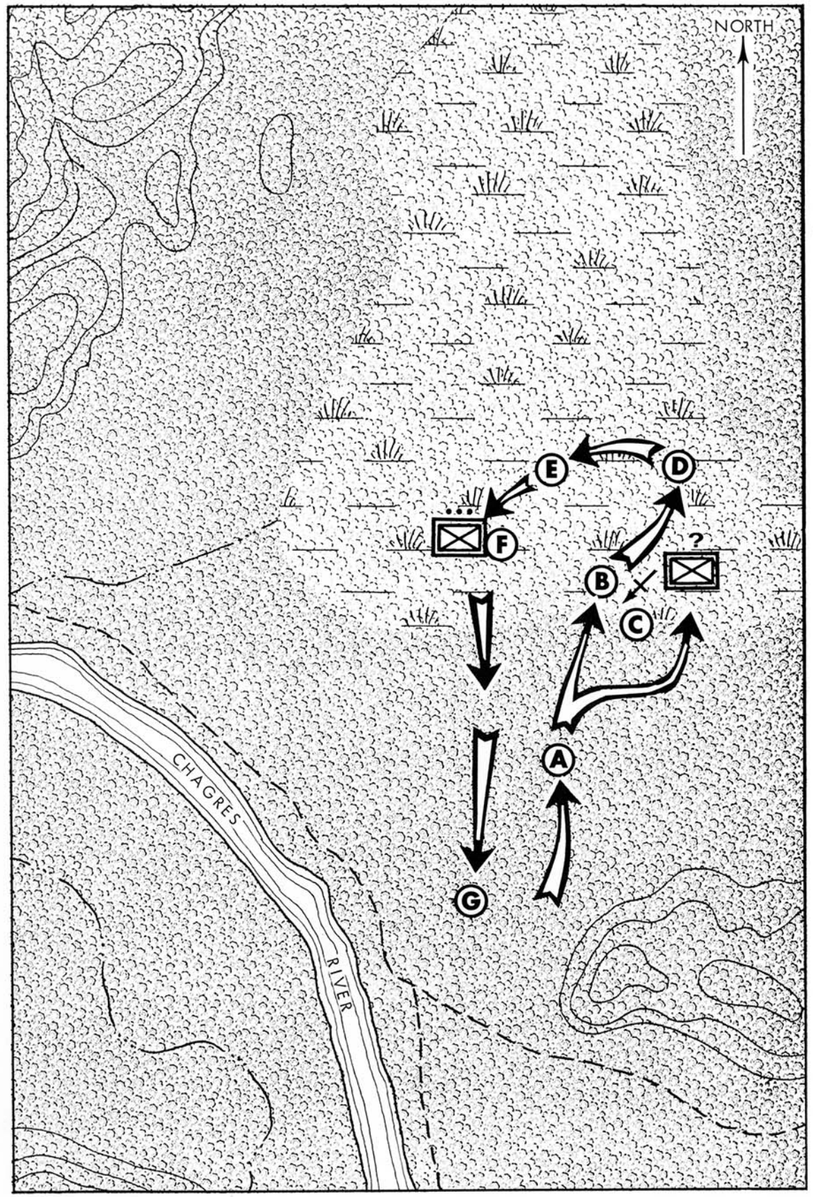
(C) The two trailing squads maneuver to the right and attack the enemy position in flank.

(D) Marines return to the trail and resume the march through the Mojinga Swamp.

(E) As the column crosses a water obstacle it comes under enemy mortar fire and double times out of the impact area.

(F) Marines encounter an understrength enemy platoon advancing from the right front. Marines hit the ground and quickly establish fire superiority. Marines attack frontally and destroy the enemy.

(G) The platoon returns to its camp. At this point, the firing phase of the test takes place as Marines fire from behind a log barricade at range in the jungle.



(A) Platoon moves in single file down jungle trail.

(B) Marine seeks cover when fired on.

(B) Marine crawls through mud and water to firing position.

(C) Fire team assaults through swamp.

(D) Trail in Mojinga Swamp.

(E) Marines under simulated mortar fire double time through impact area.

(F) Marine takes up firing position.

(F) Marines attack frontally.

(G) Firing line is log barricade.

ANNEX C

GRAPHIC PORTRAYAL OF MANEUVER (AFTERNOON)

SITE E_2, SWAMP

Location: Mojinga Swamp, Fort Sherman Military Reservation, Panama Canal Zone (9°18'00"N 79°58'00"W)

Exposure: Fresh Water and Mud

Simulated Combat Scenario: A Marine Platoon, consisting of one officer, 6 NCOs and 76 riflemen, is assigned the mission of establishing an ambush astride a main trail in the Mojinga Swamp. The platoon will return to its base by a different route.

(A) The platoon moves to the ambush site by a narrow trail in a column of squads, each squad in single file.

(B) Marines establish the ambush.

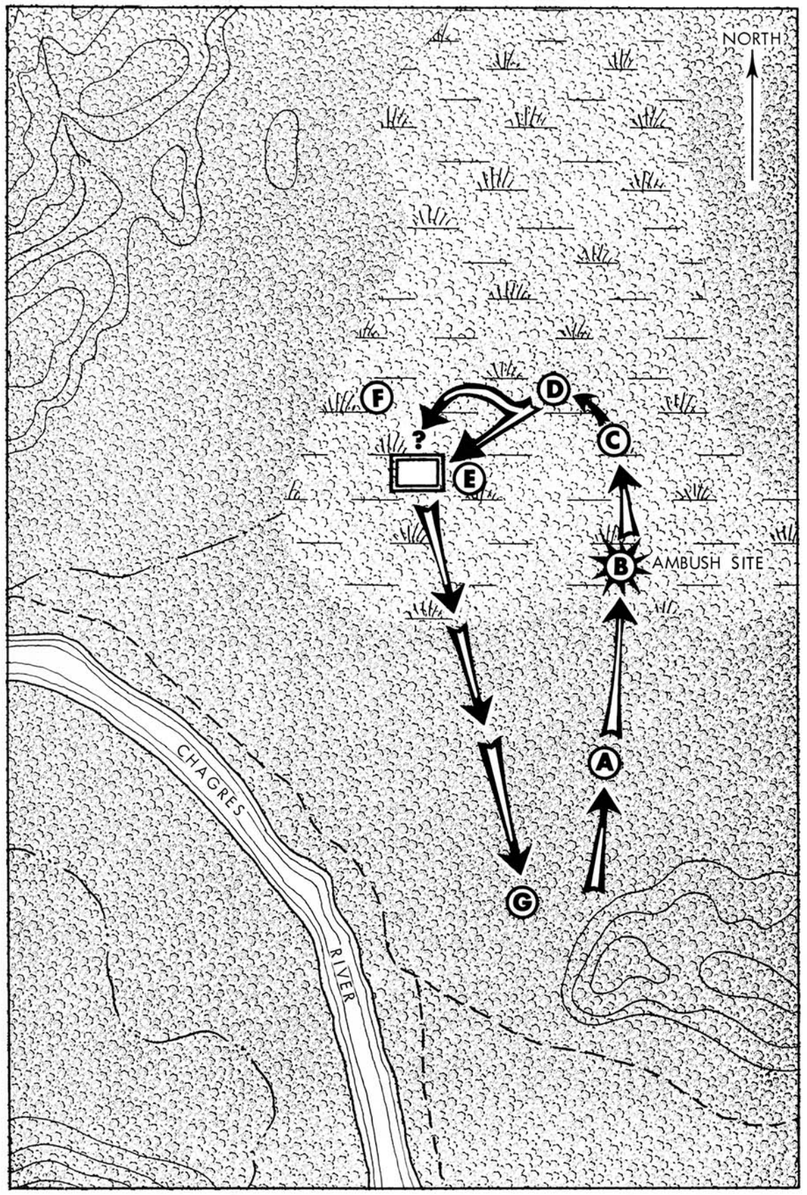
(C) Enemy unit is successfully ambushed. Marines return to the trail and begin return to base by circuitous route.

(D) As the column crosses a water obstacle it comes under enemy artillery fire and double times out of the impact area.

(E) The platoon participates in a meeting engagement with an enemy unit of undetermined size. Marines hit the ground, seek cover and concealment, and crawl to good firing positions.

(F) Two squads maneuver to the right, attack the enemy's flank, and overwhelm him.

(G) The platoon returns to its base. The firing phase of the test is conducted as Marines fire from behind a log barricade at a range in the jungle.



(A) Platoon moves to ambush site.

(B) Fire team takes up position in ambush.

(B) Marine lies in ambush.

(C) Marine on trail in Mojinga Swamp.

(D) Squad double times out of impact area.

(D) Marine attempts to keep weapon clean.

(E) Marine crawls to firing position

(F) Squad maneuvers against enemy flank.

(G) Firing line is log barricade.

ANNEX D

METEOROLOGICAL DATA SUMMARY
SITE E_2, SWAMP

Meteorological Data		Test Day											
		1	2	3	4	5	6	7	8	9	10	11	12
Temperature	0800	74	76	74	75	75	76	75	73	73	73	72	72
	1200	79	80	80	79	78	81	79	77	79	77	78	79
	1800	77	78	78	79	79	79	78	77	78	76	77	78
	2400	74	76	74	75	76	77	75	73	75	71	73	74
Humidity	0800	98	98	98	100	100	96	90	90	96	100	100	100
	1200	84	79	85	75	84	72	72	88	70	73	74	69
	1800	93	87	91	88	92	87	80	88	83	85	83	84
	2400	98	98	98	100	98	88	93	96	93	100	100	98
Rainfall													
Total - 24 hrs		0	0	0	0	0	0	0	0	0	0	0	0

2-10-68-34

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Appendix C

TEST EXECUTION, SITE E_3, RAIN FOREST

TEST EXECUTION, SITE E_3, RAIN FOREST

A. GENERAL

The WSEG Site Monitor at Site E_3 was Captain William L. Lewis, Supply Corps, U.S. Navy. He was assisted by Lieutenant William Stewart and SFC. Robert Hartshorn assigned to U.S. Army units in the Canal Zone. The Range Coordinator/Safety Officer was Lieutenant W. A. Spears, USMC.

The scenario in the northern exposure depicted an operation to destroy an arms cache and repair facilities believed located on Hill 35. In the southern exposure a search and destroy operation was conducted with the Platoon assaulting Hill 40, believed to include an enemy storage and supply area.

A typical daily schedule of events is at Annex A.

B. ENVIRONMENTAL EXPOSURE

During the twelve day test, there were two exposure periods per day, one in mid-morning, the other in mid-afternoon. The average time for an exposure period was 1 hour and 49 minutes. Exposure times are tabulated in Annex B. Marines carried out an average of five tactical maneuvers for each exposure. Annex C contains a graphic and pictorial display of exposure.

Each exposure area in the rain forest consisted of medium to heavy tropical growth. Streams in the northern exposure were narrow; some were dry. Those in the southern exposure were up to fifteen feet wide and four feet deep.

At the outset of the morning exposure the Platoon was deployed in a tactical march along route S-82 which bordered the Rain Forest. The 2000 meter march ended at Devils Beach.

Simulated enemy sniper and mortar fire caused the Marines to hit the dirt at the edge of the road. Often they would deploy a few meters into the Rain Forest. These actions subjected the M-16 weapon system to dust, dirt, and rough bumps.

From Devils Beach the Platoon maneuvered through the tropical growth toward the objective, Hill 35. Search and destroy missions and responses to simulated sniper fire required the Marines to move vigorously through the intermittent heavy foliage, dense vines, and narrow creek beds. Small ravines and marshlike areas had to be traversed.

Although a Marine is taught to protect his weapon, these maneuvers required the M-16 to undergo varied, sometimes rugged, exposure to the environmental elements. Plugged weapon bores, though infrequent, occurred. Contacts with dirt, loose vegetation, trees, vines, and water were numerous. When crossing streams or ascending slopes and hills, the forward Marine would use his weapon to assist the man behind him to surmount the

obstacle. This exposed the weapon system to additional wear and tear.

In general, the afternoon maneuvers in the southern exposture were similar to those in the northern area, and the M-16 weapon system was gain thoroughly exposed.

The wider and deeper streams, however, resulted in more intense water and mud exposure of the weapon. Moreover, the denser tropical growth subjected the weapon more severely to vines and foliage.

The Platoon bivouacked in the Rain Forest twenty meters south of the Fort Sherman Known Distance Range.

C. FIRING

Firing was conducted at the Known Distance Range which was adjacent to the two exposure areas. Firing conditions were excellent. The Marines fired in the prone position.

D. CLEANING

Time available for cleaning was increased after Phase I. Scheduled cleanings were conducted in accordance with the test plan, supervised and inspected by squad leaders.

When Category II malfunctions occurred, cleaning was conducted by the rifleman at his firing position.

E. WEATHER

The weather was warm and humid with very little rain. On two occasions there was enough rain to wet down the weapon system.

Meteorological Data has been summarized in Annex D.

F. OBSERVATIONS

The test design was adhered to at Site E_3.

Throughout the 12-day test period the overall performance of the Marines was outstanding. Inspired Platoon and Squad leadership motivated the riflemen to carry out the maneuvers with zest, insuring that the weapon was thoroughly exposed to the environmental elements peculiar to the two maneuver areas in the Rain Forest. Since the Rain Forest is similar to certain areas in South Vietnam, it is considered that the M-16 weapon system received a realistic simulated combat exposure at Site E_3, Rain Forest.

ANNEX A

TYPICAL DAILY SCHEDULE OF EVENTS, SITE E_3, RAIN FOREST

FIRST DAY	EVENT
0700	Draw weapons and ammunition
0715	Commence tactical march
0745	Arrive Devils Beach
0745-0915	Maneuver in rain forest exposure, north area
0915-0930	Prepare to fire
0930-1115	Firing, 2 squads at a time*
1115-1300	Clean weapons, noon meal, draw ammunition
1300-1400	Firing, 2 squads at a time
1400-1545	Maneuver in rain forest exposure, south area
1545-1635	Firing, 2 squads at a time
1635-1735	Clean weapons

SECOND DAY	EVENT
0700	Draw ammunition, prepare to fire
0715-0815	Firing, 2 squads at a time
0825	Commence tactical march
0825-1025	Maneuver in rain forest exposure, north area
1025-1115	Firing, 2 squads at a time
1115-1300	Clean weapons, noon meal, draw ammunition

SECOND DAY	EVENT
1300-1350	Firing, 2 squads at a time
1350-1535	Maneuver in rain forest exposure, south area
1535-1625	Firing, 2 squads at a time
1625-1725	Clean weapons

THIRD DAY

Same as second day except on completion of cleaning, unit breaks camp and returns to Fort Sherman.

*Firing was from the prone position. Firing points at the KD Range are sand and dirt.

ANNEX B

EXPOSURE AND FIRING TIMES, SITE E_3, RAIN FOREST

	Phase I			Phase II			Phase III			Phase IV		
Test Days	1	2	3	4	5	6	7	8	9	10	11	12
Begin Exposure	0715	0825	0810	0715	0815	0800	0730	0820	0755	0730	0755	0725
End Exposure	0930	1035	1005	0910	0945	0950	0920	1000	0955	0910	0940	0855
Begin Exposure	1340	1412	1345	1330	1320	1235	1330	1310	1305	1330	1305	1200
End Exposure	1520	1535	1515	1500	1500	1405	1500	1510	1450	1500	1455	1345
Firing Time												
Cycle 1 Begin	0950	0720	0720	0920	0740	0725	0940	0730	0718	1000	0710	0655
Cycle 1 End	1135	0817	0805	1045	0810	0752	1035	0810	0740	1120	0750	0720
Cycle 2 Begin	1240	1055	1005	1255	0950	0955	1250	1060	1010	1255	0945	0900
Cycle 2 End	1338	1235	1145	1325	1015	1021	1320	1040	1030	1330	1020	0930
Cycle 3 Begin	1550	1314	1250	1505	1237	1205	1505	1225	1225	1505	1230	1130
Cycle 3 End	1705	1408	1335	1535	1310	1230	1535	1255	1250	1535	1305	1155
Cycle 4 Begin		1540	1520		1505	1410		1515	1450		1500	1350
Cycle 4 End		1610	1630		1530	1440		1540	1520		1535	1435

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ANNEX C

GRAPHIC PORTRAYAL OF MANEUVER (MORNING)

SITE E_3, RAIN FOREST

Location: Fort Sherman Known Distance Range
(79° 57'30"N 9° 21'30"N)

Exposure: Tropical Rain Forest

Simulated Combat Scenario: A Marine Platoon, consisting of one officer, 6 NCOs, and 76 riflemen is on a tactical march along route S-82. The Platoon enters the Rain Forest at Devils Beach and attacks to capture an enemy small arms and ammunition supply point, in vicinity of Hill 35.

(A) Enemy attempts ambush. Marines deploy from road into rain forest.

(B) Fire teams attack ambush on flank.

(C) Ambush is defeated. Marines resume movement toward objective on alert for snipers.

(D) Fire team is pinned down by simulated sniper fire in roots of large tropical tree.

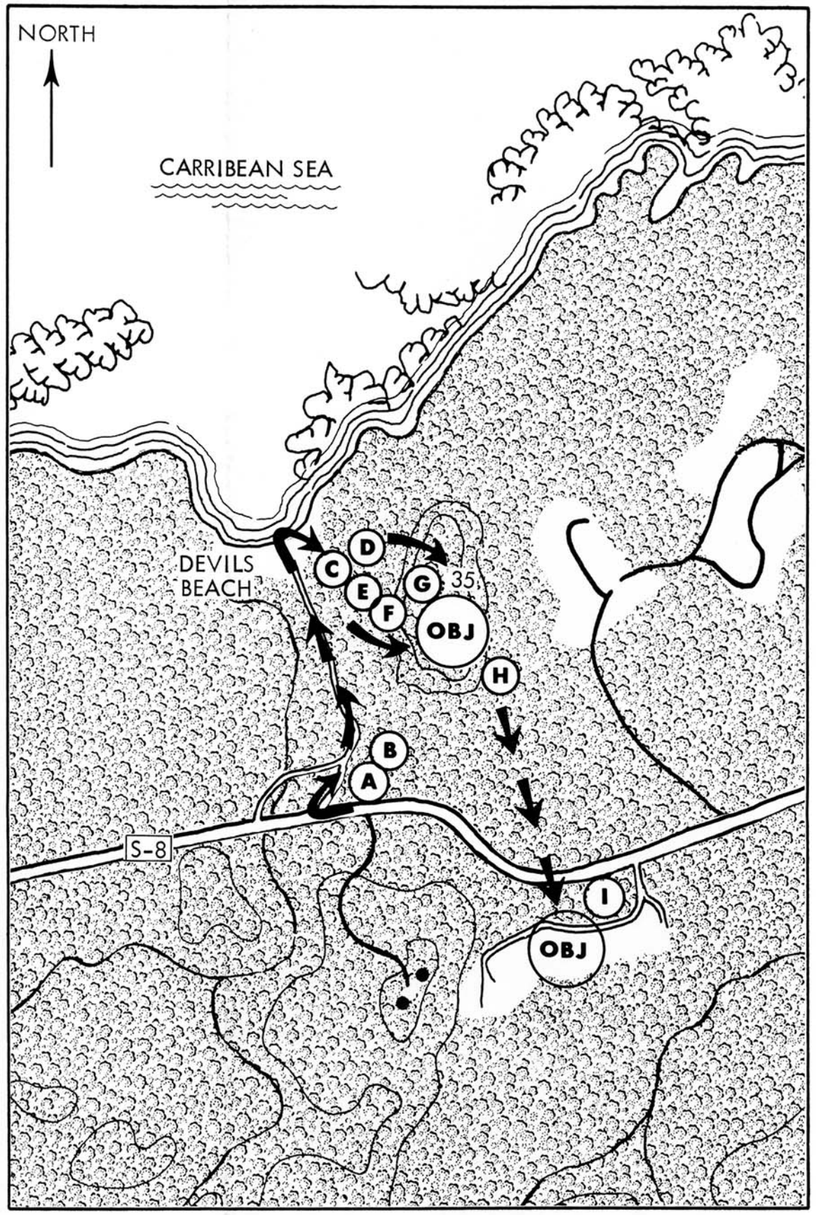
(E) Marines searching for snipers.

(F) Deploying for assault on major objective, Hill 35.

(G) Moving out and assaulting Hill 35.

(H) Marines continuing attack after taking objective.

(I) First fire team assaulting final objective.



(A) Marine reacting to simulated ambush at edge of rain forest.

(B) Fire teams attack ambush on flank.

(C) Marines resume movement towards objective alert for snipers.

(D) Pinned down by simulated sniper fire.

(E) Marines searching for snipers.

(F) Deploying for assault on Hill 35.

(G) Assaulting Hill 35.

(H) Continuing attack after taking objective.

(I) First fire team assaulting final objective.

ANNEX C

GRAPHIC PORTRAYAL OF MANEUVER (AFTERNOON)

SITE E_3, RAIN FOREST

Location: Fort Sherman Known Distance Range
(79° 57'30"W 9° 21'30"N)

Exposure: Tropical Rain Forest

Simulated Combat Scenario: A Marine Platoon, consisting of one officer, 6 NCOs, and 76 riflemen, has the mission of capturing Hill 40 where a VC aid station and rice caches are believed located.

(A) Moving out from base camp in tactical column, Marines cross stream en route to objective.

(B) Marines are pinned down in stream.

(C) Point squad pursues fleeing enemy.

(D) Marines search and clear area of snipers.

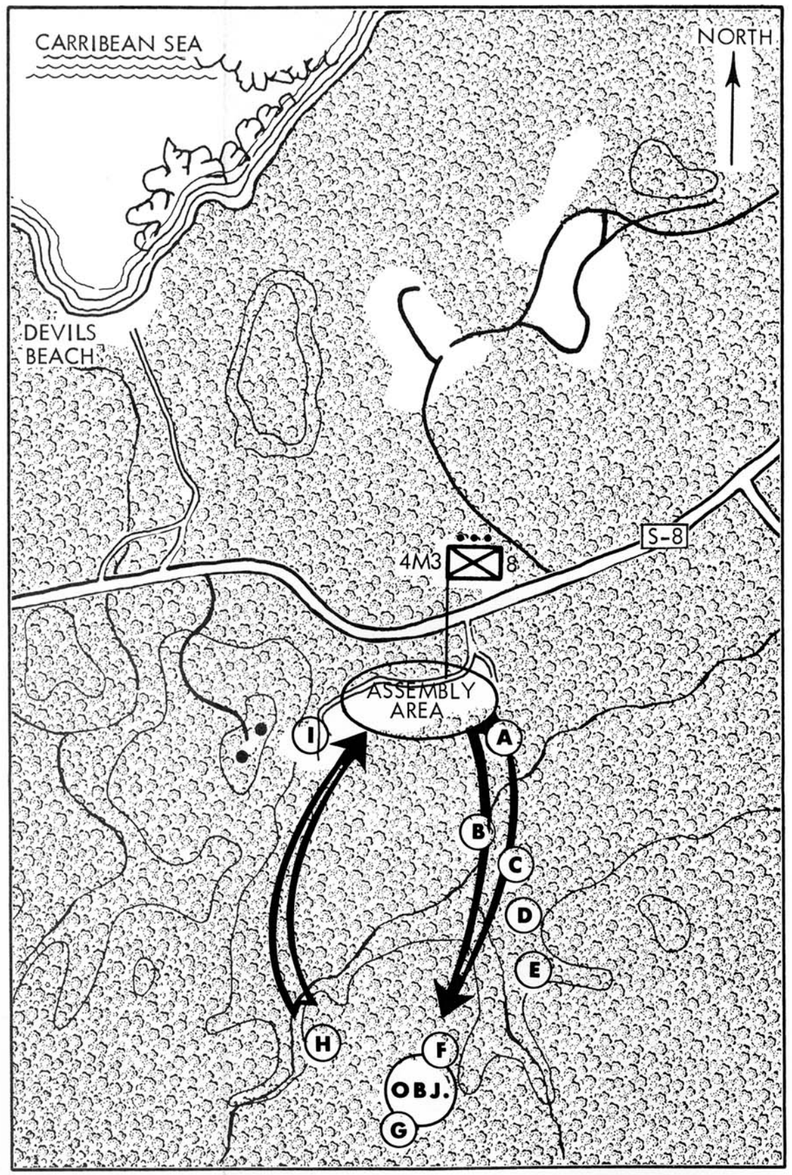
(E) Marines crossing stream, deploy for assault on objective Hill 40.

(F) Assaulting Hill 40.

(G) Objective captured, Marines consolidate with perimeter defenses.

(H) Marines search and clear area as attack continues.

(I) Marines complete maneuver and return to range on edge of rain forest for controlled firing.



(A) Marines cross stream en route to objective.

(B) Pinned down in stream by simulated sniper fire.

(C) Point squad pursues fleeing enemy.

(D) Marines search and clear area of snipers.

(E) Crossing stream, deploying for assault on objective Hill 40.

(F) Assaulting Hill 40.

(G) Squad consolidates objective

(H) Marines search and clear area as attack continues.

(I) Marines complete maneuver and return to range on edge of rain forest for controlled firing.

ANNEX D

METEOROLOGICAL DATA SUMMARY, SITE E_3, RAIN FOREST

METEOROLOGICAL DATA		TEST DAYS 1	2	3	4	5	6	7	8	9	10	11	12
Temperature	0800	78	78	77	78	78	78	78	77	78	76	77	77
	1200	80	82	81	80	82	82	81	80	82	81	80	81
	1800	78	78	79	80	80	80	79	81	81	78	78	77
	2400	77	78	78	78	78	78	77	78	79	76	77	76
Humidity	0800	90	94	100	90	90	88	82	94	98	100	86	84
	1200	84	83	84	84	84	78	76	80	78	73	77	76
	1800	88	86	86	89	89	85	80	82	84	77	79	78
	2400	96	85	88	90	90	85	82	86	88	89	85	86
Rainfall Total - 24 hours		0	0	0	0	0	0	0	0	0	0	0	0

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Appendix D

TEST EXECUTION, SITE E_4, UPLANDS

TEST EXECUTION, SITE E_4, UPLANDS

A. GENERAL

The WSEG Monitor was Captain Harold Carpenter, U.S. Navy. He was assisted by Lieutenant H. M. Weisman and Sergeant H. Rivera, assigned to Army units in the Canal Zone. Lieutenant Fisher, U.S. Marine Corps, was the Range Coordinator and Safety Officer.

The Site E_4 test area included two firing ranges, the Pina Familiarization Range and the Pina Light Artillery Range. The graveled road, Route S-10, joined these two ranges. This road segment and the immediately adjacent jungle terrain were utilized for the environmental exposures.

B. ENVIRONMENTAL EXPOSURE

As shown in Annex A, two hours were scheduled each morning and afternoon for conducting maneuvers in the environment. Actual times are tabulated in Annex B and varied between one hour and 5 minutes to two hours and 10 minutes. The overall average time per period spent in the environment was approximately one hour and 45 minutes. The morning maneuvers were conducted on and around Hill 134. This hill is located about 1000 meters north of Pina Light Artillery Range and 200-500 meters west of Route S-10. It consists of two peaks approximately

65 meters above the road bed with steep sloping sides and a ridge line running south whose western side contained about a 10 meter, nearly vertical, facing. Morning maneuvers normally consisted of trucking from the bivouac area at Pina Familiarization Range to the vicinity of the hill mass where four tactical events were conducted for each period as follows:

- Assault on ridge line or peak.
- Establishment of hasty or perimeter defense.
- Search and destroy operations south of Hill 134.
- Ambush during the search and destroy mission.

A typical morning maneuver is graphically portrayed in Annex C.

These tactical maneuvers subjected the weapons to dirt and loose vegetation and to being physically struck against the ground, trees and vines. The weapons were used to assist in climbing or descending ravine and ridge faces and steep slopes. Several rifles were observed with clogged bores during each phase of the test.

Afternoon maneuvers included a simulated heliborne lift by marching through dust clouds generated by a hovering helicopter; a two and one-half mile tactical march along Route S-10 with trucks operating on the road to raise dust; road ambushes requiring the troops to deploy into the jungle; and, if time permitted, a search and destroy operation in the area immediately south of the Pina Familiarization Range during which the platoon was subjected to a simulated enemy attack. A typical afternoon maneuver is graphically portrayed in Annex C.

The afternoon tactical maneuvers subjected weapons to similar conditions described for the morning maneuvers with dust being an additional element of exposure.

C. FIRING PERIODS

Standard Marine range procedures were generally used in conducting the firing at the two ranges. The firing line was kept darkened during the night firing period of each phase with the exception that flashlights were used as necessary to permit the armorers and the data collectors to perform their duties.

D. RIFLE CLEANING

Cleaning was usually conducted under direct supervision of the squad leader. Rifles were normally inspected by the squad NCO prior to assembly after cleaning. The thoroughness of cleaning varied among squads and was dependent on the degree of supervision given by the squad NCO. Each squad was equipped with a box containing cleaning equipment such as solvent, rags, lubricants and brushes. During the second day, those riflemen on the half-day cleaning cycle were required to clean at night using Coleman lanterns or vehicles headlights for lighting.

E. WEATHER

Climatic conditions during Phase I were normal for the time of the year. Intermittent light rain showers occurred throughout the test period keeping the jungle foliage and ground damp to wet for most of the morning exposure periods. The road bed for the afternoon exposure period was usually sufficiently dry to permit raising dust with trucks. A tracked vehicle was operated in the helicopter dusting area to keep the dirt loosened for quick drying and a heavy dust cloud was obtained for most of the periods. Daily meteorological data is presented in Annex D of this appendix.

Rain showers sufficient to thoroughly dampen the riflemen and their weapons occurred during the morning period of test calendar days one and five. A heavy downpour occurred during the night firing period of Phase II.

F. OBSERVATION

The operations at Test Site E_4 were conducted in accordance with the test design without significant deviations. The Marines reacted enthusiastically to all tactical situations throughout all phases of the test. The tactical events were designed to make each rifleman cope individually with the jungle environment, and the maneuvers were conducted in compliance with the test design.

ANNEX A

TYPICAL DAILY SCHEDULE OF EVENTS, SITE E_4, UPLANDS

FIRST DAY	EVENT
0700-0800	Enroute from Fort Sherman to vic Pina Arty Range
0800-0945	Maneuver in the Uplands exposure
0945-1000	Prepare to fire
1000-1100	Firing, squads 1 and 3
1100-1200	Firing, squads 2 and 4
1100-1245	Clean weapons, noon meal, draw ammo, squads 1 and 3
1200-1345	Clean weapons, noon meal, draw ammo, squads 2 and 4
1245-1415	Firing, 2 squads at a time
1415-1600	Maneuver in the Uplands exposure
1600-1615	Prepare to fire
1615-1715	Firing, 2 squads at a time
1715-1815	Clean weapons
1830	Prepare chambered round

SECOND DAY	EVENT
0625-0645	Draw ammunition
0645-0655	Firing chambered round, squads 1 and 3
0655-0730	Firing, squads 2 and 4 to include chambered round
0730-0800	Firing, squads 1 and 3

SECOND DAY	EVENT
0800-1000	Maneuver in the Uplands exposure
1000-1015	Prepare to fire
1015-1115	Firing, 2 squads at a time
1115-1300	Clean weapons, noon meal, draw ammunition
1300-1330	Firing, squads 1 and 3
1330-1400	Firing, squads 2 and 4
1400-1545	Maneuver in the Uplands exposure
1900-2000	Firing, 2 squads at a time

THIRD DAY	EVENT
Same as second day except as follows:	
1545-1645	Firing, 2 squads at a time
1645-1745	Clean weapons
1745	Break camp and return to Fort Sherman

ANNEX B

EXPOSURE AND FIRING TIMES, SITE E_4, UPLANDS

	Phase I			Phase II			Phase III			Phase IV		
Test Days	1	2	3	4	5	6	7	8	9	10	11	12
Begin Exposure	0830	0905	0830	0815	0910	0800	0815	0745	0720	0750	0730	0850
End Exposure	1015	1035	1035	1015	1100	1000	1010	0935	0910	1000	0930	0930
Begin Exposure	1445	1400	1310	1420	1520	1245	1350	1240	1140	1340	1245	1245
End Exposure	1635	1515	1415	1610	1710	1410	1530	1435	1305	1530	1425	1425
Firing Time												
Cycle 1 Begin	1040	0700	0655	1020	0815	0645	1040	0655	0645	1020	0645	0645
Cycle 1 End	1300	0850	0750	1200	0900	0710	1220	0730	0705	1140	0715	0710
Cycle 2 Begin	1305	1100	1040	1305	1115	0945	1300	0945	0930	1245	0945	0930
Cycle 2 End	1421	1215	1130	1417	1215	1025	1345	1027	0950	1330	1015	1010
Cycle 3 Begin	1645	1245	1205	1610	1355	1200	1535	1140	1050	1535	1130	1150
Cycle 3 End	1807	1408	1250	1705	1500	1235	1410	1220	1120	1605	1215	1230
Cycle 4 Begin		1857	1420		1855	1415		1855	1315		1900	1420
Cycle 4 End		1947	1530		1950	1448		1928	1350		1930	1450

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ANNEX C

GRAPHIC PORTRAYAL OF MANEUVER (MORNING) SITE E_4, UPLAND

Location: Pina Light Artillery Range, Fort Sherman Reservation, Panama Canal Zone (79° 57'30"W, 9° 12'30"N)

Exposure: Dirt, Dust, Jungle Vegetation and Rough Terrain.

Simulated Combat Scenario: A Marine Platoon consisting of one officer, 6 NCOs, and 76 riflemen, is assigned the task of assaulting and destroying an enemy jungle logistics base located on Hill 134. On attaining the objective the platoon conducts a search and destroy mission, adjacent to route S-10, southward to the Pina Light Artillery Range.

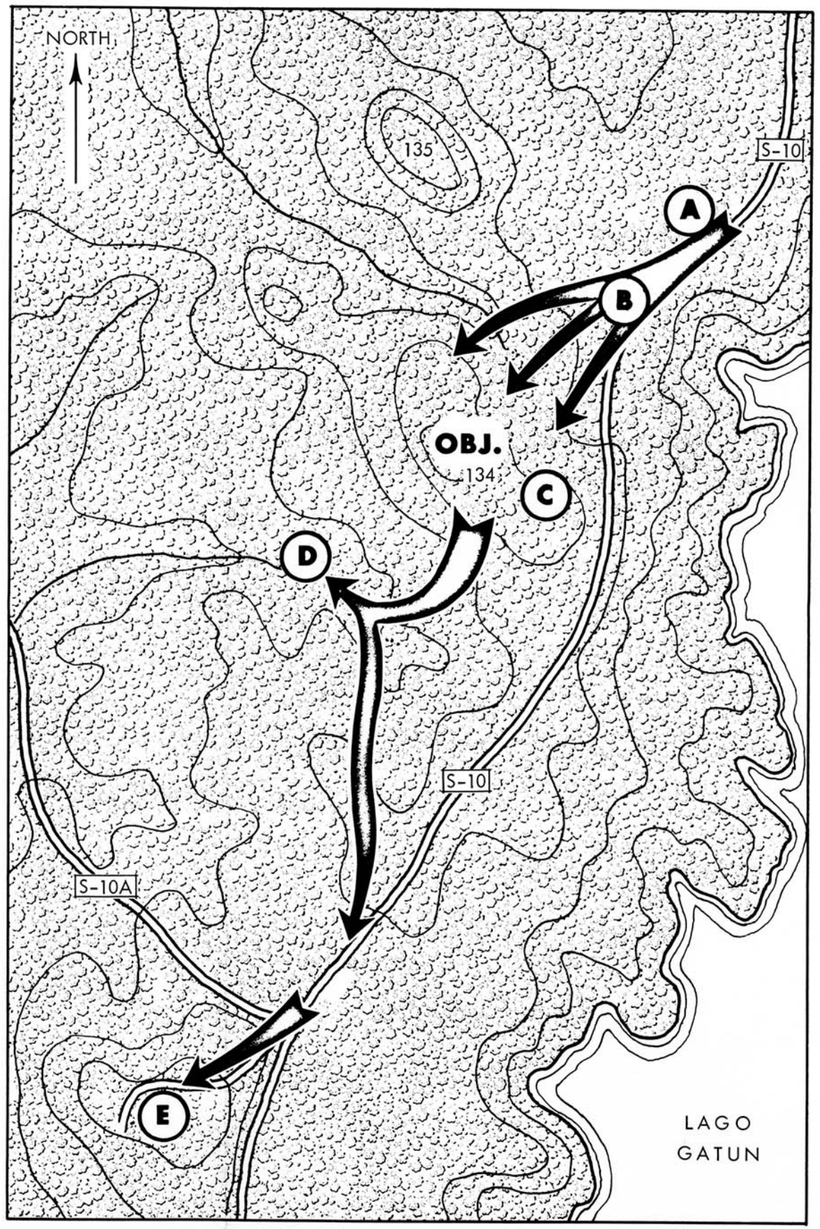
(A) Platoon arrives at the assembly area by truck and enters the jungle.

(B) Troops are taken under simulated enemy mortar and small arms fire and assault enemy position.

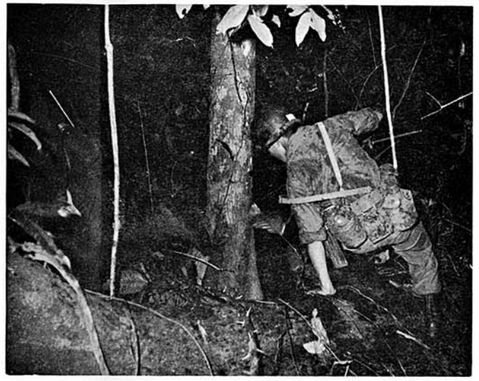
(C) Platoon deploys in ravine at base of Hill 134, and assaults up the steep slope of the hill. Perimeter defense is established.

(D) Platoon departs the objective, descends steep slope, proceeds on search and destroy mission and encounters a simulated enemy ambush position.

(E) Platoon continues search and destroy mission arriving at Pina Light Artillery Range, where firing takes place.



(A) Platoon ascends steep terrain after detrucking.



(B) Troops attack under simulated enemy fire.

(C) Platoon assaults Hill 134.

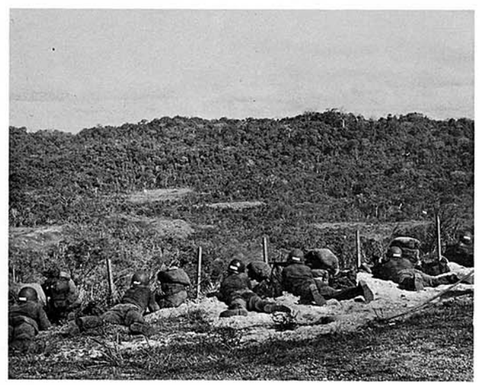
(C) Marine takes up position in perimeter defense.

(D) Troops descend steep slope.

(D) Platoon proceeds up rugged terrain on search and destroy mission.

(D) Taking cover from simulated ambush.

(E) Platoon conducts search of highland plateau.



(E) Troops on firing line at Light artillery range.

ANNEX C

GRAPHIC PORTRAYAL OF MANEUVER (AFTERNOON) SITE E_4, UPLAND

Location: Pina Familiarization Range, Fort Sherman Military Reservation (79° 57'30"W 9° 12'30"N)

Exposure: Dirt, Dust, Jungle Vegetation, and Rough Terrain

Simulated Combat Scenario: A Marine Platoon consisting of one officer, 6 NCOs and 76 riflemen is assigned the task of scouting and clearing a segment of road S-10 south of a company assembly area (Pina Familiarization Range) and to search and clear a jungle area where enemy activity has been reported. The platoon is to be helicopter lifted to a landing zone adjacent to road S-10.

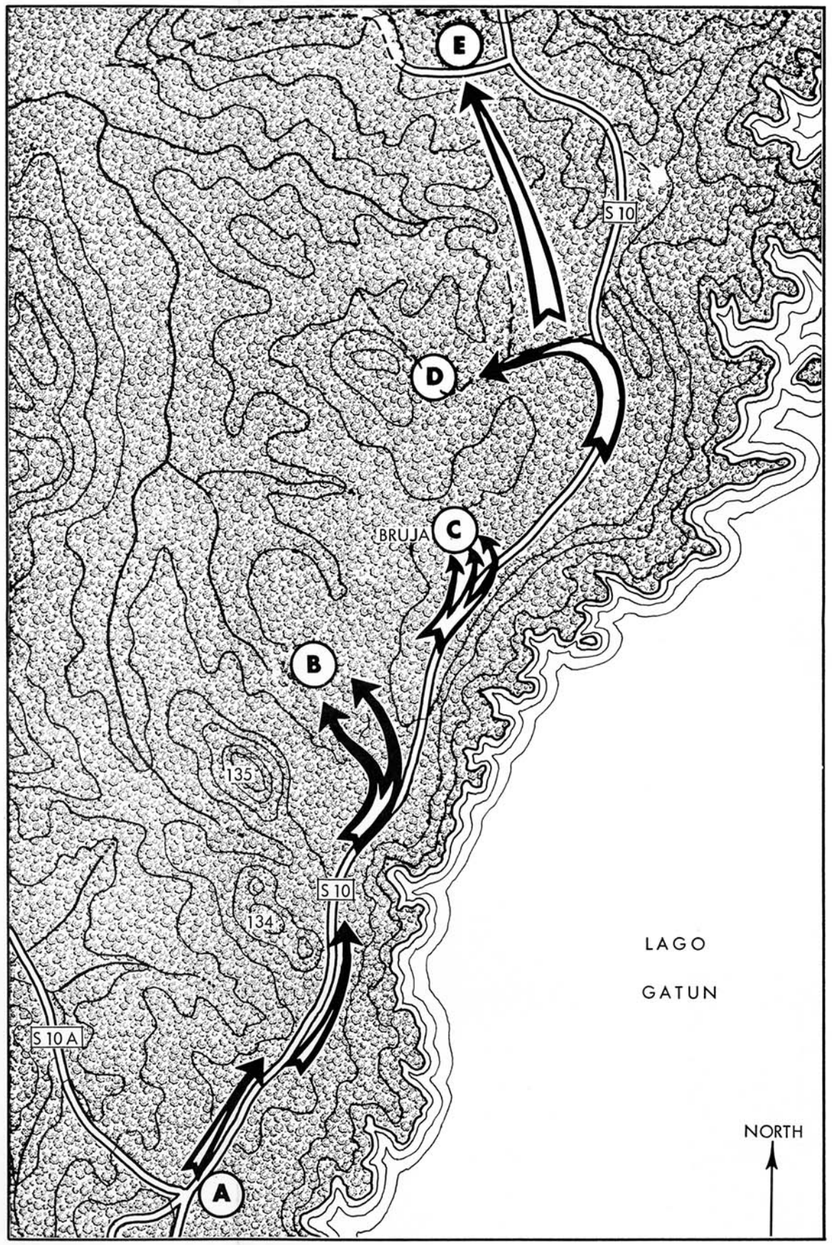
(A) Troops land from helicopter (simulated by troops moving through dust cloud generated by hovering helicopter) and commence tactical march along route S-10.

(B) Platoon receives enemy fire from jungle area adjacent to road.

(C) Platoon ambushed from cliff abutting on left side of road.

(D) Platoon conducts search and destroy operations in jungle and makes contact with enemy.

(E) Platoon completes exposure operations and firing phase is conducted at Pina Familiarization Range.



(A) Helicopter blasting dust and sand while hovering.

(B) Marines deploy into jungle to assault enemy ambush position.

(D) Platoon on search operation in heavy jungle environment.

(A) Close-up of Marines in helicopter dust cloud.

(C) Marine takes cover after receiving enemy fire.

(D) Marine simulates firing into enemy jungle position.

(A) Platoon scouting road S-10 with trucks generating dust.

(C) Marines assault enemy position atop roadside cliff.

(E) Tracers line the sky during night firing at the Pina Familiarization Range.

ANNEX D

METEOROLOGICAL DATA SUMMARY, SITE E_4, UPLANDS

METEOROLOGICAL DATA		TEST DAYS 1	2	3	4	5	6	7	8	9	10	11	12
Temperature	0800	79	79	77	82	78	78	79	80	80	68	65	71
	1200	79	82	82	82	81	82	82	83	84	77	76	77
	1800	76	77	77	78	78	78	77	77	77	66	69	70
	2400	75	76	75	76	77	77	76	76	76	62	63	63
Humidity	0800	90	94	100	72	100	90	100	100	100	100	93	97
	1200	84	83	84	76	76	69	100	100	100	69	64	72
	1800	88	86	86	100	100	100	100	100	100	100	100	100
	2400	96	85	88	100	100	96	100	100	100	100	100	100
Rainfall Total - 24 hours		.0	.0	.0	.0	.17	.05	.0	.05	0	0	0	0
					.07-0900 .10-2300		.05-1200		.05-0400				

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Appendix E

LETTER FROM TEST DIRECTOR, DATED 18 JANUARY 1968

OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WEAPONS SYSTEMS EVALUATION GROUP
WASHINGTON, D C 20305

18 January 1968

TO ALL MEMBERS OF THE WSEG M-16 RIFLE TEST PROJECT

1. Now at the half-way mark of our test I want you to know that all of you, Army, Navy, Marines and Air Force, are doing a grand job. You Marines, who are taking the brunt of the exercise, have earned the unqualified respect and admiration of all Services working with you. You have every reason to be proud of your accomplishments.

2. As we enter the last half of this exercise, let me caution you not to lose sight of the need to continue to give your weapons realistic exposure to the combat environments we are simulating. You must forget that the firecrackers and artillery simulators are what they are and think of them only as live enemy fire. If you were in a swamp or rice paddie and came under enemy fire, what would you do? That's exactly what is expected of you for this exercise! If you were digging a foxhole on the beach under enemy fire, how far would your rifle be from your reach? That's how far it should be in this exercise! If you were under close-by enemy fire, would you stop to partially clean your rifle before returning fire? The answer, of course, is "no!" Thus, we dont expect you to take advantage of the time between the simulated fire fight and your turn on the firing line to "overhaul" your rifle. Probably in combat you could take a quick swipe at it and you would clear a blocked bore --- but not very much more.

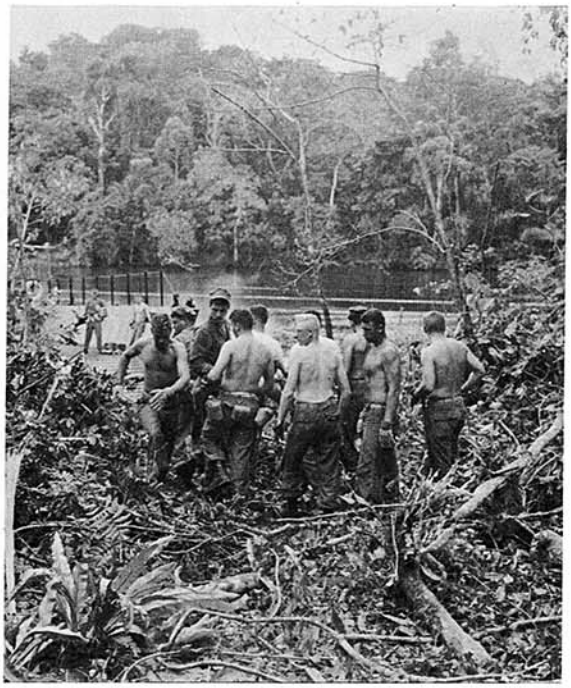
3. When we complete this test we want to be able to say how your weapons will perform under real combat conditions. We want the rifles neither to look good or bad. Rather, we want them to look like they really are in live combat in the environments we are simulating. If you will keep that in mind it will help tremendously to keep the test "on track."

4. One last thing. Safety takes precedence over any or all other considerations. You are doing a fine job. Let's keep it up.

A. J. Beck
Major General, USAF
Test Director

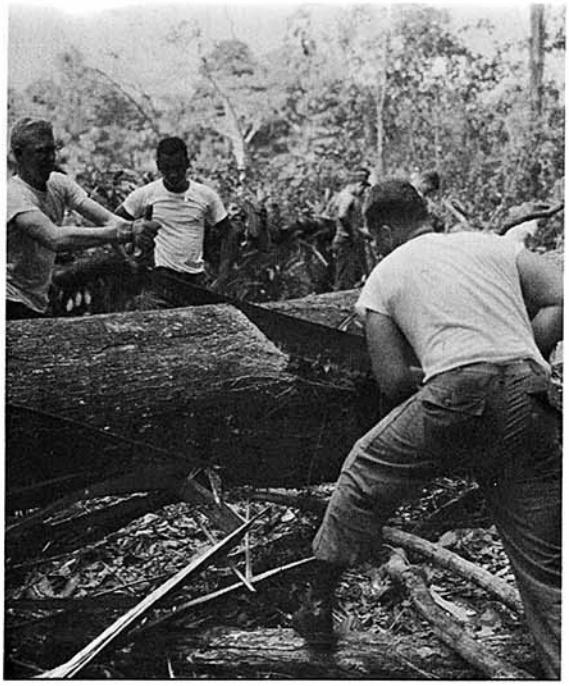
Appendix F

ADDITIONAL PHOTOGRAPHS

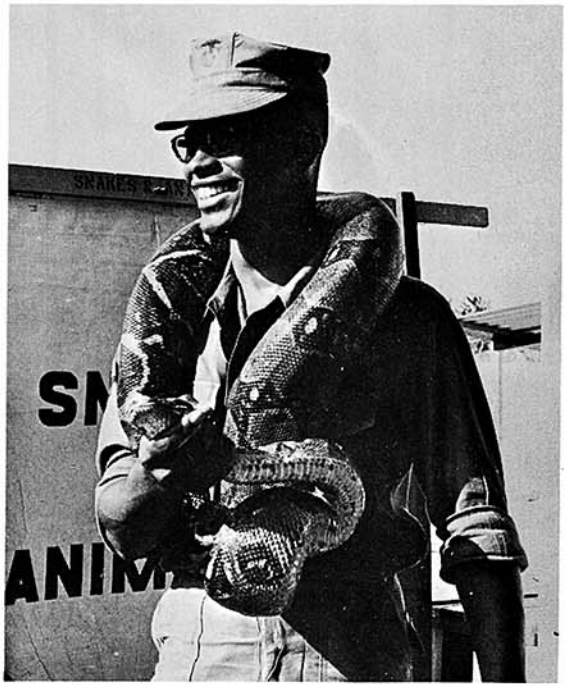


Clearing helipad at swamp site.

Jungle orientation instruction to Marines prior to test.



Clearing firing line for a new range in the swamp.



A Marine with boa constrictor during jungle orientation.

Numerous minor injuries were caused by the sharp spines of the black palm tree.

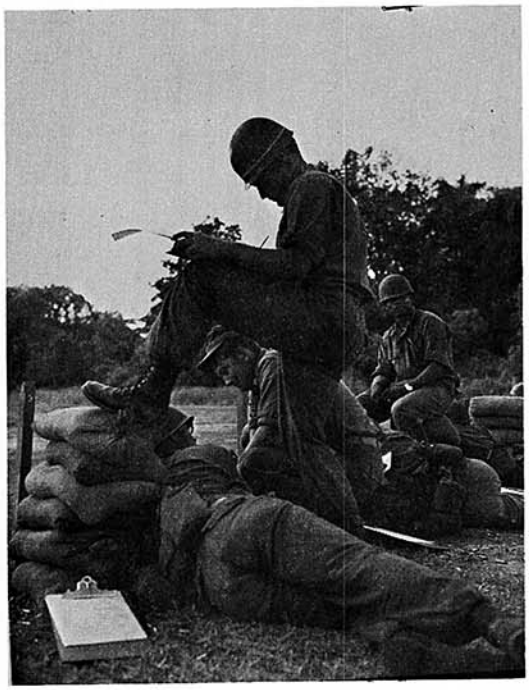
Marine lands in hornets' nest while seeking cover during simulated enemy fire. He was back to duty the next day.

Marine being assisted down hill after pulling a muscle in uplands.

A dropped rifle and an assist in decending hill in uplands.

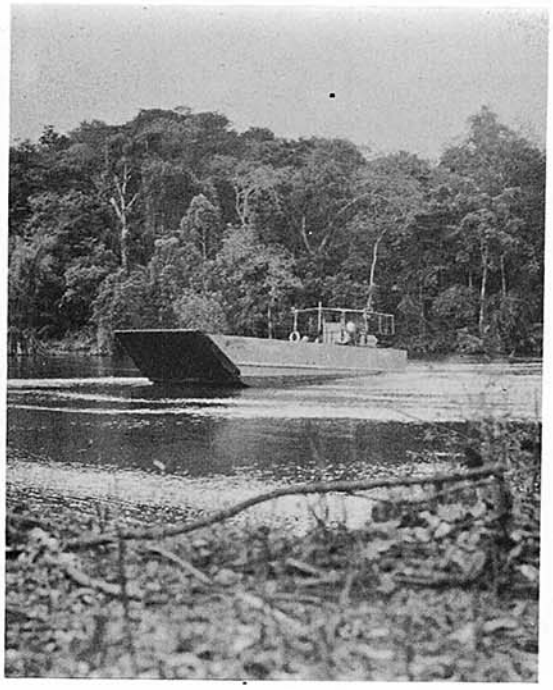
Riflemen on firing line signal malfunction.

Data collection records malfunction information.



Armorer checks malfunction cause.

Rifleman cleans weapon on firing line. A Category II malfunction.

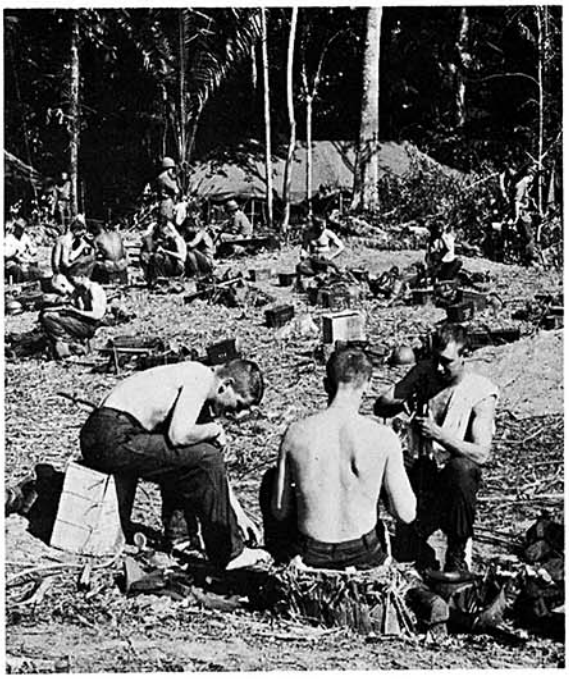


LCM on Chagres River en route to swamp site.

A mud covered Marine and rifle in the swamp.

Falling in the slimy ooze of the swamp is reason enough to holler.

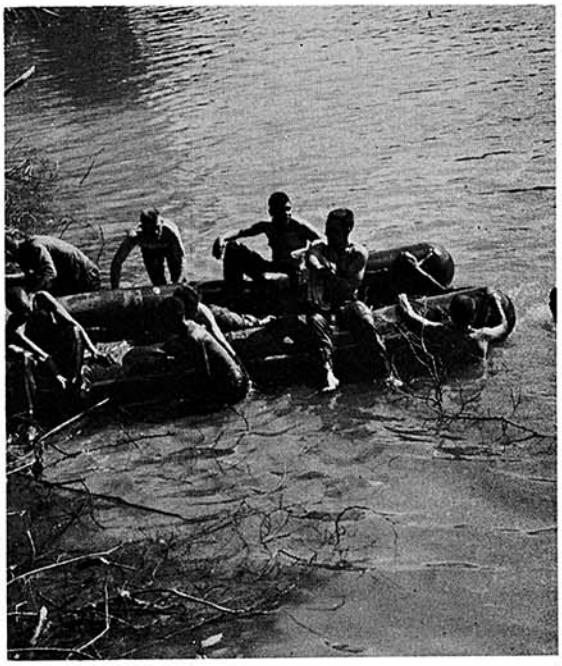
Marine with a "logistics" problem in uplands area.



Marines take to the sun for cleaning of weapons after swamp exposure.

Cleaning weapons and eating "C" rations took equal precedence.

Cleaning of weapons outside rain forest bivouac.



Chagres River, the only bathing facility available after the swamp exposure.

Enclosure G

METEOROLOGICAL CONDITIONS AT TEST SITES

Table G2. DAILY RAINFALL AT ENVIRONMENTAL SITES DURING TEST[a,b,c]

Date	Environmental Site			
	E_1	E_2	E_3	E_4
8 Jan[d]	0	0	0	T
9 Jan	0	0	0	0
10 Jan	0	0	0	0
11 Jan	0.03	0	0	T
12 Jan	0	0	0	0.07
13 Jan	0	0	0	0
14 Jan	0.03	0	0	0
15 Jan	0	0	0	T
16 Jan	0	0	0	0.17
17 Jan	0.05	0	0	0.05
18 Jan	0	0	0	0.06
19 Jan	T	0	T	0
20 Jan	0	0	0	0.05
21 Jan	0	0	0	0
22 Jan	0	0	0	0
23 Jan	0	0	0	0
24 Jan	0	0	0	0
25 Jan[e]	0	0	0	0
TOTAL	0.11	0	0	0.40

[a] In inches for 24-hour period unless otherwise noted.

[b] T - a trace during the period.

[c] The sites provided temperature and relative humidity by means of a hygro-thermograph, Belfort Model 594, exposed in an S-101 UM Instrument Shelter. Accuracy was ±2°F in temperature and ±5 percent in relative humidity. Rainfall was measured at each station with a weighing type rain guage with a maximum capacity of 12 inches and an accuracy of ±0.05 inches. The instruments at Sites E_1 and E_4 were located in the open; the instruments at Sites E_2 and E_3 were located under the jungle canopy. Site E_1 also provided surface wind speed and direction, using an AN/GMQ-12 Wind Measuring Set with an accuracy of ±0.5 mph in speed and ±3° in direction. All sites were checked daily for accuracy, time, and proper operating conditions. Data graphs were removed and new forms installed each Monday. During the test, Fort Sherman also experienced a constant northerly wind (varying only between 30° east of north and 20° west of north) with a speed of between 5 mph (min) and 22 mph (max). Wind speed of 12 mph predominated. The temperature at the four test sites during the test phase ranged from a low 62° to a high 84°, and the humidity from a low 62 percent to a high 100 percent with an average of 87 percent.

[d] 1000 hours to 2400 hours only.

[e] 0000 hours to 1400 hours only.

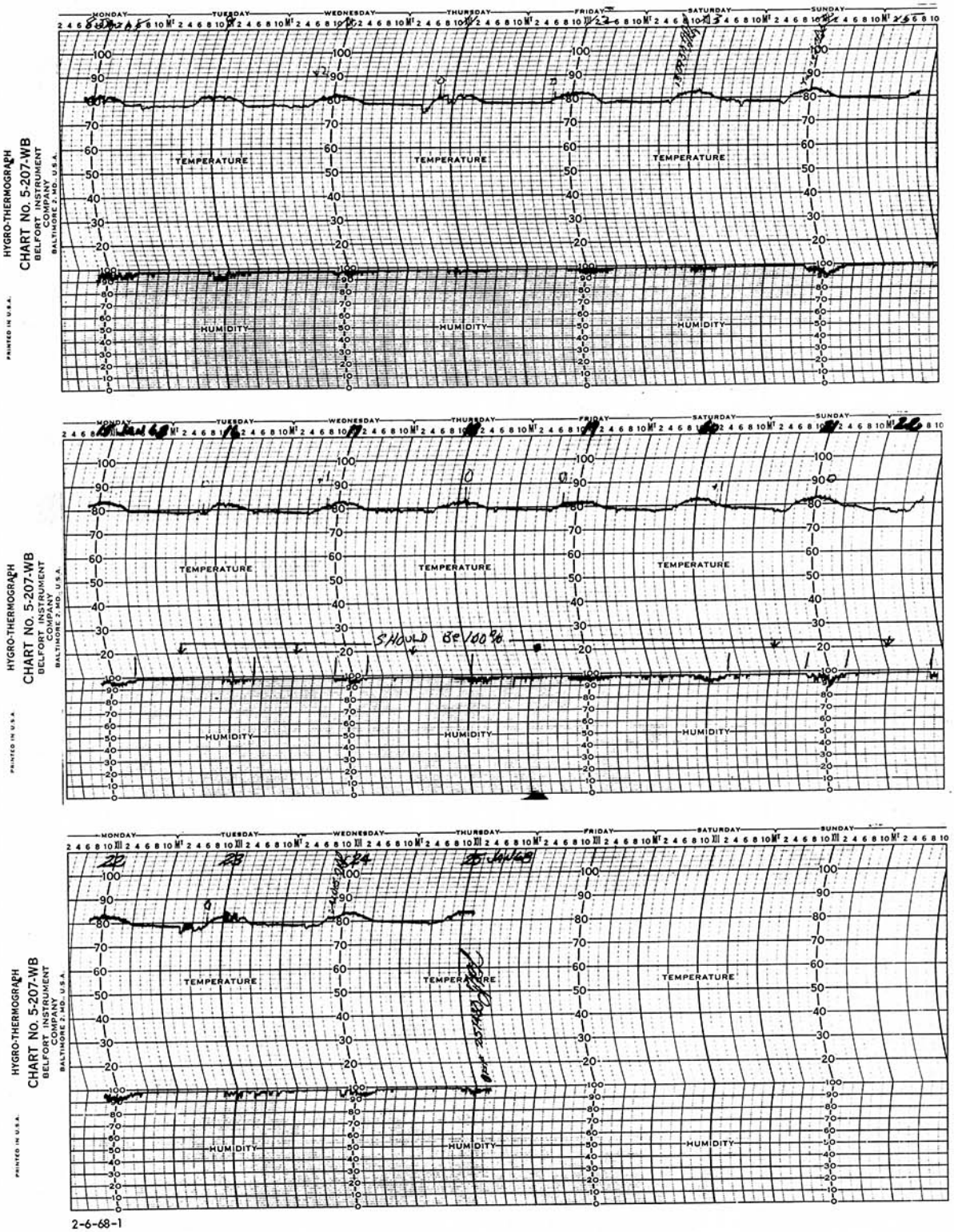


FIGURE G1. Hygro-Thermograph Record at Site E_1

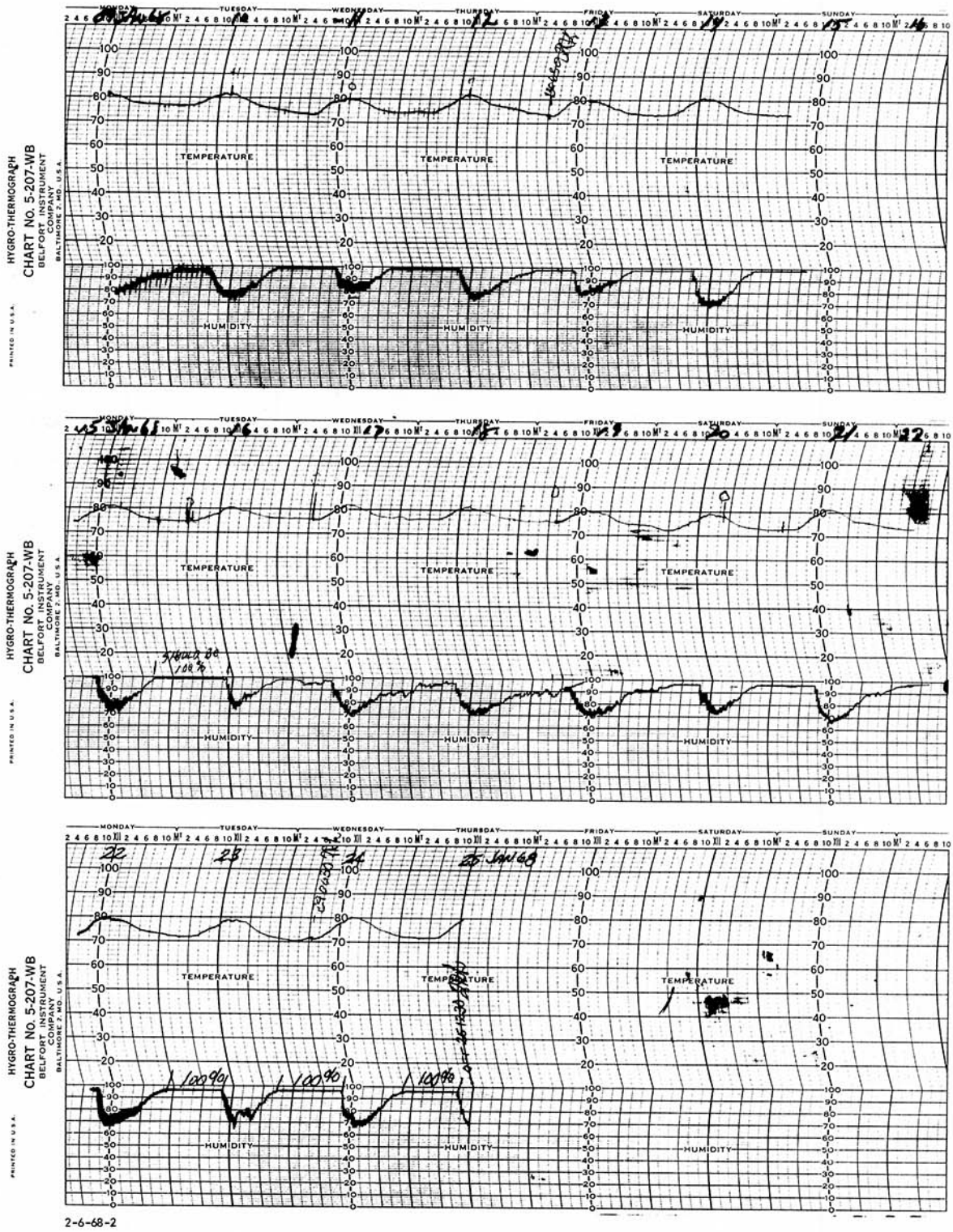


FIGURE G2. Hygro-Thermograph Record at Site E_2

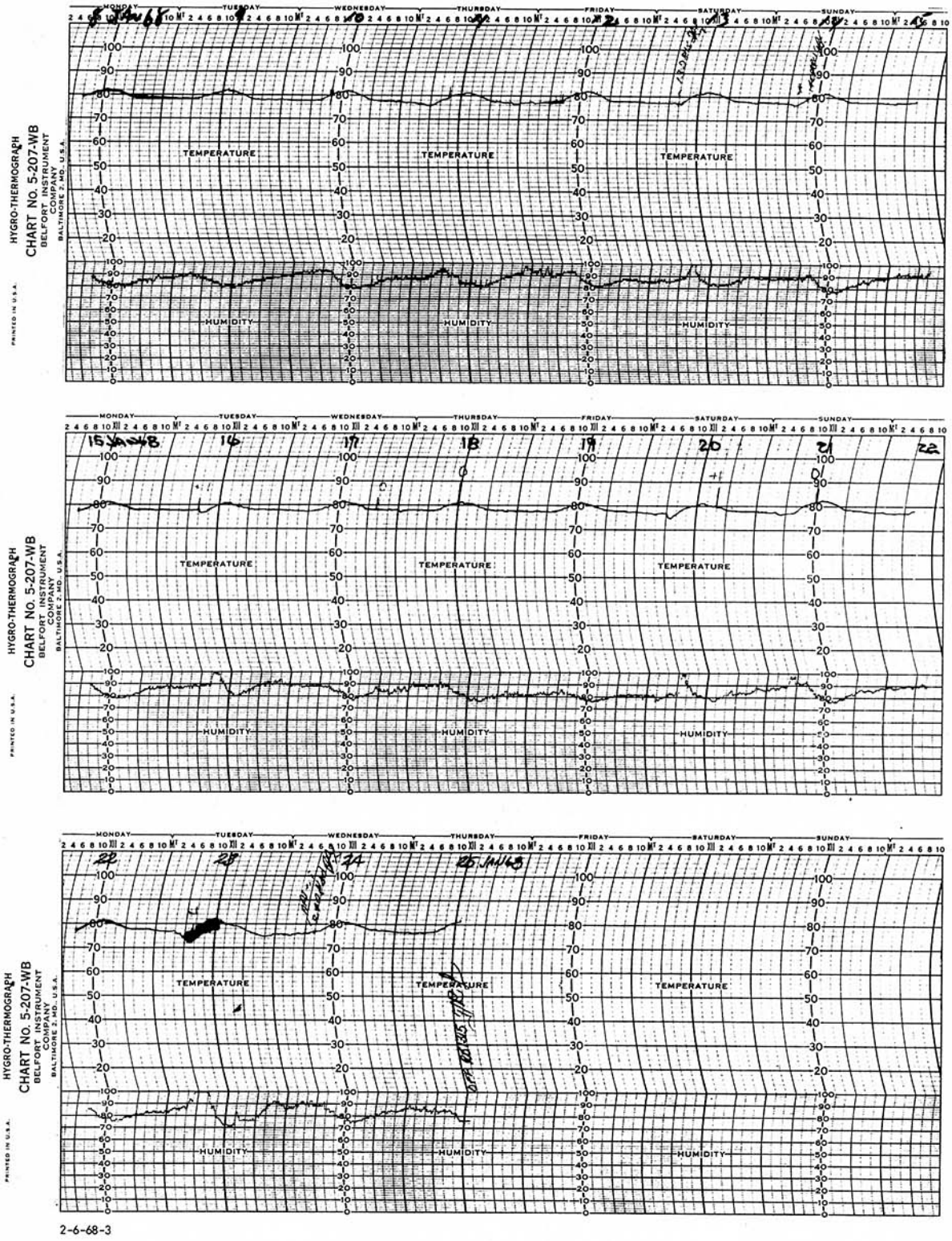


FIGURE G3. Hygro-Thermograph Record at Site E_3

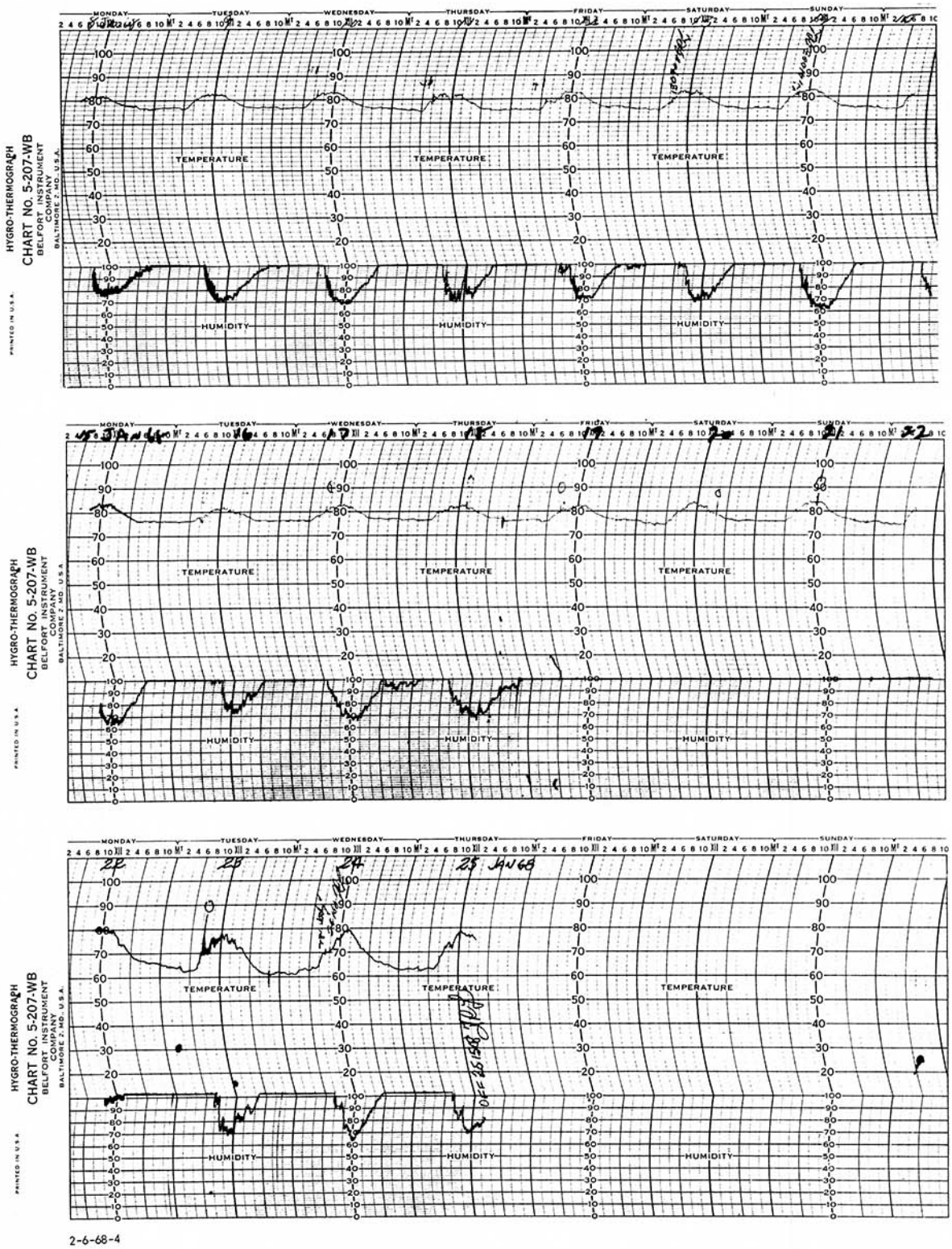


FIGURE G4. Hygro-Thermograph Record at Site E_4

Enclosure H

SITE DESCRIPTION AND SITE DOCUMENTATION

I. INTRODUCTION

The M-16 reliability test was conducted on the Fort Sherman Military Reservation, Canal Zone. Four exposure areas were selected for the test (see Figure H1). These areas were selected to simulate as closely as possible the environmental conditions experienced by U.S. forces in South Vietnam.

- Site E_1 was selected for exposure of the weapon to sand, salt water and salt spray, and is similar to the eastern coastlands of South Vietnam.
- Site E_2 was selected for exposure of the weapon to fresh water, muddy water and mud. This exposure equates to rice paddies and small streams in the lowlands of South Vietnam.
- Site E_3 was selected for exposure to rain forest. While this area is not true rain forest in the technical sense, it did serve to expose weapons to terrain similar to that jungle located North of Saigon in the Lai Kae-Song Be area of South Vietnam.
- Site E_4 was selected for exposure to terrain found in the uplands of South Vietnam. This area corresponds generally to the topographic relief of Vietnam uplands, but the elevations range only from 70-135 meters.

Appendixes 1 through 4 to this Enclosure contain the physical description of the four exposure sites. The descriptions were provided by the U.S. Army Tropic Test Center, Panama Canal Zone.

The sites were examined by the Tropic Test Center personnel on 13, 14, and 15 January 1968. The descriptions which cover topography, vegetation, and ground and water, represent conditions existing at that time. Information concerning atmospheric salt content is derived from prior studies made by the

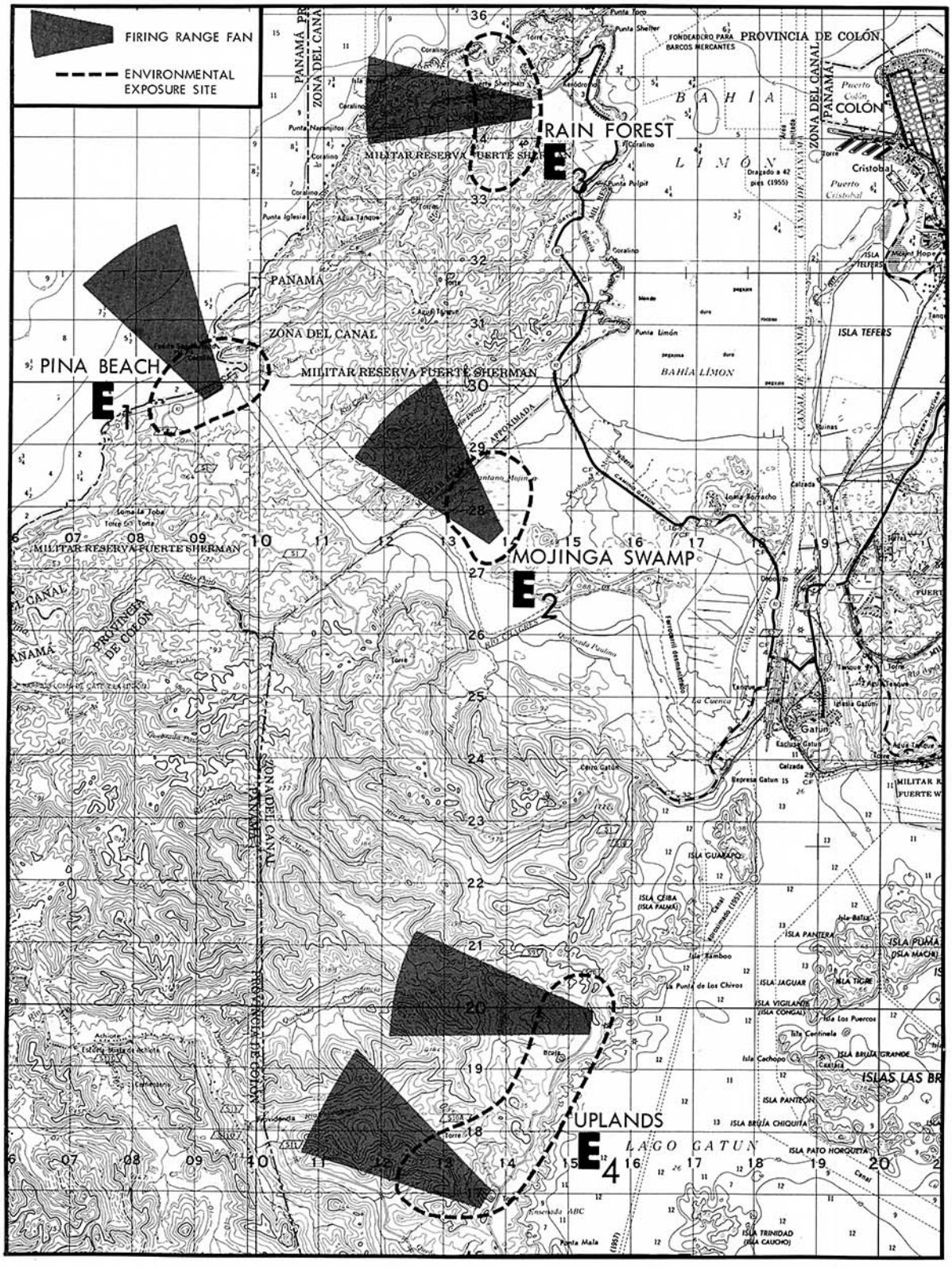

FIRING RANGE FAN
ENVIRONMENTAL EXPOSURE SITE
RAIN FOREST
E3
PINA BEACH
E1
MOJINGA SWAMP
E2
UPLANDS
E4
PANAMÁ
ZONA DEL CANAL
PROVINCIA DE COLÓN
MILITAR RESERVA FUERTE SHERMAN
BAHÍA LIMÓN
LAGO GATUN
ISLA TEFERS
COLÓN
Cristobal
Gatun

FIGURE H1.

Tropic Test Center at similar exposure areas and represent approximations for the test sites. These conditions in part will vary with time of year, and currently reflect those characteristics of the early dry season. (The dry season in this region begins in late December and extends through March.) Consequently significant variations in vegetation and ground and water conditions will occur during the rainy season.

In mid-December these sites were surveyed on foot by a group of Army and Marine Corps personnel who had served in South Vietnam since 1965. These personnel completed statements on the degree of similarity between areas in South Vietnam in which they served and the four sites utilized in Panama. Summaries of these statements are included in the appendixes.

In addition to the above group, the Marine NCOs and officers of the Test Platoons who went through all exposure sites were provided questionnaires on the similarity of the areas in Panama with those in which they had served in South Vietnam. The results of replies are listed below.

- Beach Exposure Area: Ten of the 13 replies stated this closely resembles conditions experienced in Vietnam. Two said no and one had not operated in this type exposure.

- Swamp Exposure Area: Seven of the 13 stated that this exposure closely resembles conditions experienced in Vietnam. Three said no and three had not operated in this type of exposure in South Vietnam.

- Rain Forest: Seven of the 13 stated that this area closely resembles conditions experienced in Vietnam. Three said no and three had not operated in terrain of this type in Vietnam.

- Uplands: Six of the 13 stated that this area closely resembles the conditions experienced in Vietnam. Two said no and four had not operated in this type of terrain.

Appendix A

SITE E_1, PINA BEACH

I. SITE DESCRIPTION

This site is located on Pina Beach extending 1200 meters west-southwesterly from the mouth of the Chagres River (see map, Figure H1). The beach is backed by a narrow gravelled road, S-8, for its entire length. The beach is made up of a medium-grain-sized sand, angular to subangular, composed of quartz and a high proportion of basic minerals which give the sand a dark coloration. Low cusps occur along the beach, irregularly spaced but at about every 25 meters. A low wave nick, or beach scarp, about 20 cm high occurs along much of the beach about 8 meters above the low water line, which represents the upwash limit of surf at high tide. The range of the diurnal tide is about 60 cm. The slope of the foreshore (between low water line and wave nick) averages 6° (10 percent). The beach proper (foreshore and backshore) is about 25 to 30 meters from low water line to the road. The distance from the road to the tree vegetation, though variable, is about 15 meters. The landward side of the backshore, for 10 to 15 meters, is covered by low beach grass. Back of the road, for a variable distance averaging 15 to 20 meters, is a cover of grass and low shrubs, from which point trees and shrubs of the tropical evergreen forest prevail.

The features described are illustrated by Figures H2 and H3.

Atmospheric salt content is high. Measurement at comparable sites and times of the year indicate deposition in excess of 1000 milligrams of chloride per square meter per day.

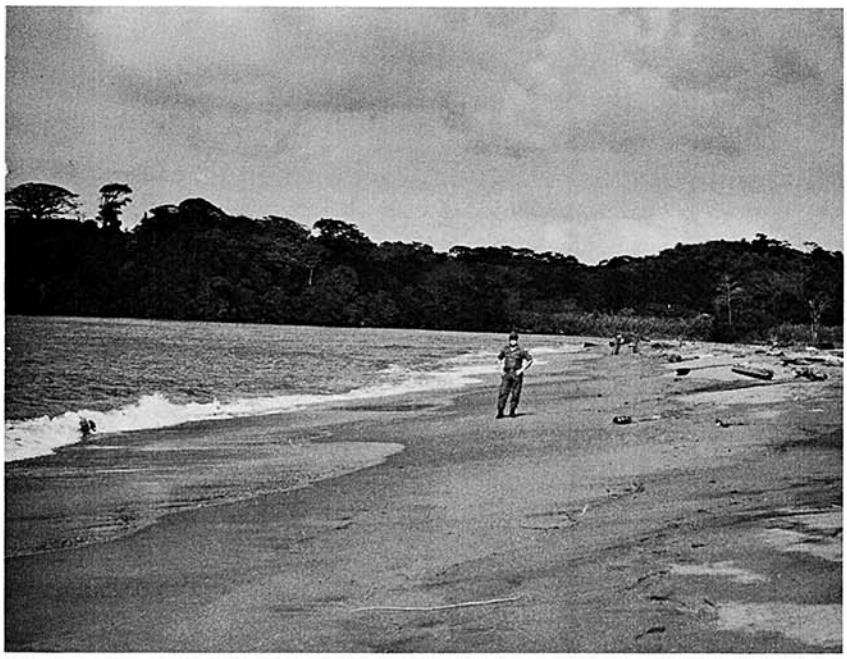


FIGURE H2. General View of Pina Beach Northeasterly Toward Mouth of Chagres River. Note Slope of Foreshore, the Beach Cusps, and the Low Surf

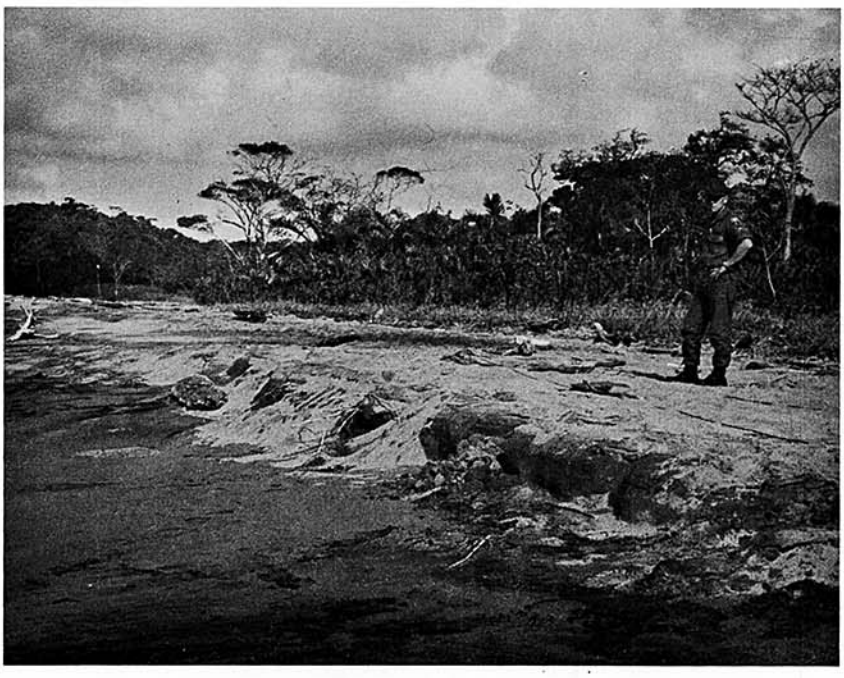


FIGURE H3. Note the Wave Nick and Low Grass on the Backshore

II. SITE DOCUMENTATION

The military personnel listed below have stated that Site E_1 is comparable to beach environments which they experienced in South Vietnam.

Name Rank/Serial No.	Dates of Vietnam Service	Unit	Duty Position
Gangle, Randolph A., Capt., 090878	Dec 65-Sep 66	3rd Marine Division	Plt Ldr, Co Comdr
Paquette, Paul 1st Lt, 097572	Sep 66-Oct 67	1st Marine Division	Plt Ldr
Smigliani, Domenic SSG(E-6), RA51391962	Oct 65-Oct 66	MACV	Advisor
Smith, Benjamin R. SSG(E-6), RA14863053	Jun 65-Jun 66	1st Inf Division	Fire Team Ldr
Antonio, Ricard M. SGT(E-5), RA56349091	May 65-May 66	1st Bde, 101st Abn Division	Sqd Ldr
Rivera-Nunez, Severo Pfc(E-3), US50184158	Aug 66-Aug 67	1st Cav Division	Rifleman

Appendix B

SITE E_2, SWAMP

I. SITE DESCRIPTION

This fresh-water swamp site is located at the approaches to, and within, the Mojinga Swamp (see Figure H1, Map). The bivouac for this site is on the bank of the Chagres River. The firing range is located about 500 meters to the northeast. From there the exposure site extends into the swamp proper, progressing from damp to inundated land. The entire area is flat and less than five meters above sea level.

The vegetation in the dry portion of the site consists of a dense forest, with a sparse undergrowth providing less than 5 percent ground cover. Many trees reach 40 meters in height, the largest exceed 1.5 meters in stem diameter. These are thickly interspersed with smaller trees and saplings. The average trunk spacing of trees greater than 50 cm diameter is about 9 meters; that of trees of diameter 4 to 50 cm is less than 3 meters. Dead fall is found in abundance. The light level is low, measures at 25-50 foot-candles at 10 a.m. with unobscured sun. The sparsity of undergrowth screening permits good horizontal ground visibility.

The vegetation changes abruptly, within a relatively narrow transition zone, as the swamp proper is reached. The larger trees become more widely spaced, undergrowth density increases until the vegetation consists entirely of palms, Scheelea palmettos, shrubs, sedges, and grasses. The photos of Figures H4 through H7 illustrate the varying conditions from the damp to the inundated agres.

The ground condition varies gradually from the firm and only slightly moist condition prevailing between the river bivouac area and the firing range, and then gradually becomes more moist as the swamp is approached, merging into a soft muck, at first only a few centimeters deep, then reaching depths exceeding one meter, with occasional pools of open water. Throughout the entire area, except for the scattered pools, the surface is covered with a uniform-appearing, dense layer of fallen leaves 5 to 10 centimeters in thickness, which presents a deceptive appearance of being relatively dry and firm. The soils are dark colored, plastic clays and muck.

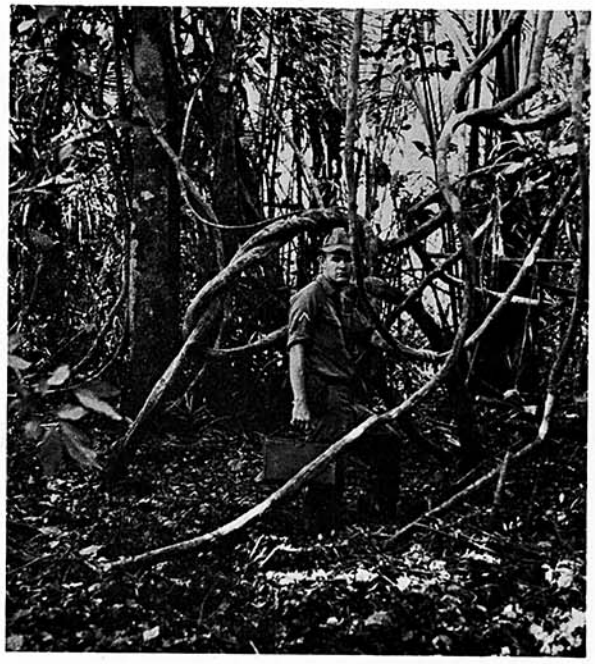


FIGURE H4. Transitional Zone Between Damp and Inundated Area. Note Depth of Muck and Increasing Density of Undergrowth and Lianas

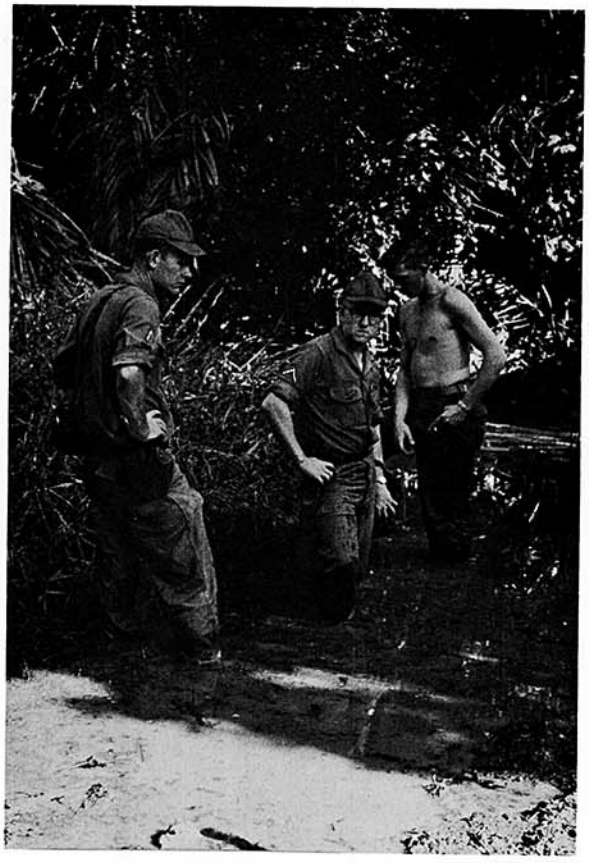


FIGURE H5. Entering the Swamp Proper. Note Open Water. Sedges Growing to Left of Men.

FIGURE H6. Open Water Pool in Swamp

FIGURE H7. Typical Vegetation Assemblage within Swamp. Scheelea Palmetto in Background

II. SITE DOCUMENTATION

The military personnel listed below have stated that Site E_2 is similar to swamp environments which they experienced in South Vietnam.

Name Rank/Serial No.	Dates of Vietnam Service	Unit	Duty Position
Davis, Chester E. SFC(E-7), RA13276864	Oct 65-Oct 66	MACV	Advisor
McCrimmon, Robert E. SSG(E-6), RA14750994	Sep 66-Sep 67	4th Inf Division	Squad Ldr
Holland, Jesse J. SSG(E-6), RA13498540	Mar 66-Mar 67	1st Inf Division	Squad Ldr
Chism, Tommie L. SSG(E-6), RA19203308	Oct 65-Sep 66	MACV	Advisor
Regalado, Guillermo S. SGT(E-5), 2051997	May 65-May 66	3rd Marine Division	Squad Ldr
Johnson, Herman R., Jr. Cpl(E-4), 2174418	Jun 66-Apr 67	3rd Marine Division	Scout

Appendix C

SITE E_4, RAIN FOREST

I. SITE DESCRIPTION

Site E_3, extending southward approximately 1100 meters from the northern shoreline of Fort Sherman between the Devil's Beach cove and an area 500 meters south of the Fort Sherman Known Distance Range, is divided by Road S-8 into northern and southern exposure sites (see Figure H1, Map). Though essentially similar in regard to vegetation, the southern site supports a denser undergrowth.

A. NORTHERN EXPOSURE, SITE E_3

This site is approximately bounded on the east and west by shallow flowing streams. The topography is flat to rolling, with one hill in the center of the site with an elevation of 35 meters and a maximum slope of 25° (46 percent).

Mangrove mixed with palms, up to 6 meters high, and other shrubs provide a dense cover for 100 meters back from the coastline. This coastal vegetation is succeeded by a broad leafed tropical evergreen forest in which scattered trees of up of 1.3 meters stem diameter and heights of 25 to 30 meters occur. The average spacing of these largest trees range from about 30 meters on the north to 15 meters on the southern portion of the site. Interspersed among those largest trees are many others with a medium trunk diameter of $\pm$ 35 cm, an average height of 12 meters, and an approximate spacing of 8 to 10 meters. Many palms of varying height (4 to 8 meters) occur throughout this forest. Lianas form a network making foot travel slow. Occasional openings occur free of the larger trees and occupied by a dense growth of low shrubs and herbaceous plants. Figure H8 and H9 are representative of the density in this area.

The indistinctly tiered canopy is moderately dense and obscures the illumination severely. An average light level of 50 to 90 foot-candles was recorded at midday under bright sunlight. Horizontal visibility of a human body is limited to about 15-20 meters.

The soil is a moderately plastic, slightly sandy clay, with a proportionately higher sand content near the shore. It was firm and dry when observed.

Salt deposition is estimated at 10 to 20 milligrams per square meter per day.

B. SOUTHERN EXPOSURE, SITE E_3

This site extends southward from the primary site approximately 500 meters. The KD Firing Range lies at the northern edge of the site. The topography is flat to rolling with a few slopes up to 30° (57 percent) on a ridge in the southern half of the site. A northeastward flowing shallow stream crosses the middle of the area.

Dense grass about two meters high surrounds the cleared firing range for about 30 meters before the typical tropic evergreen forest association is encountered. The forest is similar to that occurring in the primary site, but the undergrowth of shrubs and bushes is more dense. Figures H10 and H11 illustrate this vegetation. Palms are of slightly more frequent occurrence, and include more palmettos. Trees of 1 to 1.3 meters stem diameter occur, but are more widely spaced than in the site to the south and only rarely exceed 30 meters in height. The stem spacing of trees with a diameter of 0.3 to 0.5 meters averages about 26 meters.

The light levels, in response to the somewhat lower canopy height and density, are higher than in the primary site, averaging 70 to 100 foot-candles. Horizontal visibility is lower because of the increased density of undergrowth in this site.

FIGURE H8. Vegetation Density 200 Meters from Devils Beach Road

FIGURE H9. Vegetation in a Clearing 400 Meters from Devils Beach Road

The ground condition was firm and dry. The soil is a moderately plastic, sandy to silty clay. The ground is covered with a thin (2 cm) layer of dry litter.

Salt deposition is estimated at 5 milligrams per square meter per day.

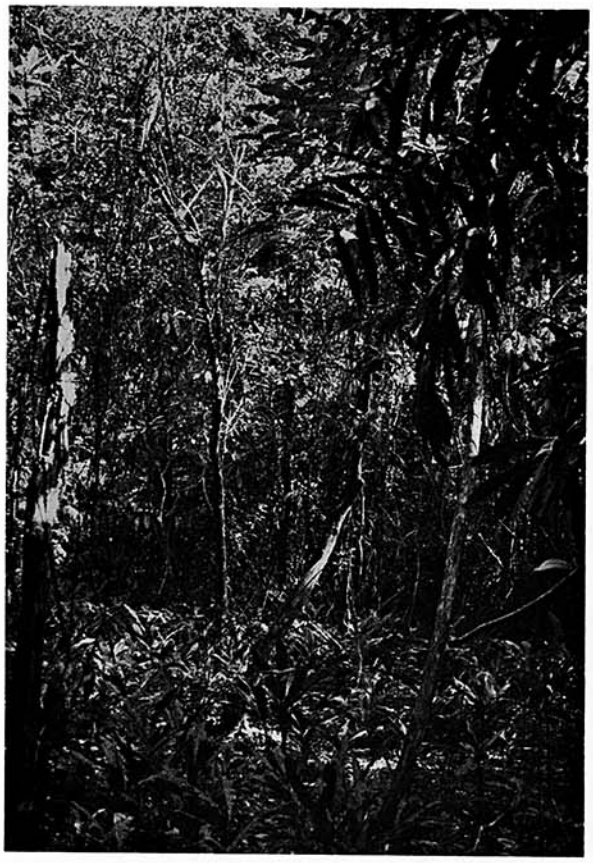


FIGURE H10. Vegetation Density in Southern Exposure Site

FIGURE H11. Vegetation Density in Southern Exposure Site. View Upward to Canopy.

II. SITE DOCUMENTATION

The military personnel listed below have stated that Site E_3 is comparable to rain forest environments which they experienced in South Vietnam.

Name Rank/Serial No.	Dates of Vietnam Service	Unit	Duty Position
DeGeave, Donald J. SSG(E-6), RA56352945	Sep 65-Jun 66	1st Inf Division	Fire Team Leader
LaPorte, Alfred P. SGT(E-5), 2076173	Feb 66-Nov 66 Jan 67-Oct 67	3rd Marine Division	Acting Plt Ldr
Harkins, James M. SGT(E-5), 2078521	May 65-Jul 65	3rd Marine Division	Scout
Vasquez, Richard J. SGT(E-5), 2072465	Mar 66-Jul 66	1st Marine Division	Squad Ldr
Skonecki, Edward R. SP5(E-5), RA55494181	Aug 65-Aug 67	588th Cbt Engr Bn (III Corps Zone)	Squad Ldr
Quiros, Franklin A. SGT(E-5), RA10201390	Jun 66-Jun 67	1st Inf Division	Squad Ldr
Espino-Espino, Eric N. SP5, RA10817847	Aug 66-Aug 67	25th Inf Division	Aidman

Appendix D

SITE E_4, UPLANDS

I. SITE DESCRIPTION

Site E_4 is located near the northwestern shore of Gatun Lake and extends westward from the gravelled road S-10 (see Figure H1, Map). It is about 4.5km in length, parallel to the lake shore, and from 0.5 to 1km wide. Two exposure sites have been utilized and, though generally similar, are described separately as the northern and southern sites. Atmospheric deposition of salt is insignificant at this site.

A. NORTHERN EXPOSURE SITE

The topography of this site is undulating with a general southernly slope of 6° (11 percent) and a maximum of 10° (18 percent). Elevations range from 75 to 100 meters.

The vegetation cover is a tropical broadleaf evergreen forest in a secondary growth stage, with many species represented including several varieties of palms. The roads and tracks are lined with heliconia, a banana-like plant. Trees up to 600 cm stem diameter and 25 meters height occur. The average spacing between stems is about 12 meters for trees of 30 to 60 cm stem diameter; 6 meters for diameters of 15 to 30 cm; and 3 meters for diameters of 7 to 15 cm. The ground coverage of undergrowth shrubs and bushes of 4 meters height is about 60 percent. Linanas are of frequent occurrence but not in sufficient density to impede foot travel severely. Figures H12 and H13 illustrate the density of the vegetation. There is a scattered cover of leaf litter of about 90 percent.

FIGURE H12. Upland Site, Northern Exposure, Vegetation Density

FIGURE H13. Upland Site, Northern Vegetation Density

B. SOUTHERN EXPOSURE SITE

This site is characterized by undulating to precipitous hills. Slopes up to 45° (100 percent) are common, and are exceeded in places. Summit elevations are about 135 meters. Local relief is about 60 meters (hill-to-valley vertical difference). Summit spacings vary from 500 to 1000 meters. Hills are steep-sided and valleys are generally U-shaped.

The vegetation is essentially as described for the northern site, with a somewhat denser undergrowth of shrubs and bushes and a significantly denser network of looping lianas which offer severe impedance to foot travel. Figures 14 and 15 illustrate the density of the vegetation. Illumination levels are low, and were measures at about 40 to 90 foot-candles. Horizontal visibility of a man is estimated at 15 to 25 meters (50 percent visibility threshold). Figure 16 shows general topography.

Ground conditions were firm and dry. On the steeper slopes footing is difficult to maintain on the moderately plastic silty clay soil. Ground litter coverage is approximately 90 percent.

FIGURE H14. View Southward Along Road S-10 Adjacent to Southern Exposure Site (Steep Hill on Left)

FIGURE H15. Upland Site, South Vegetation Density

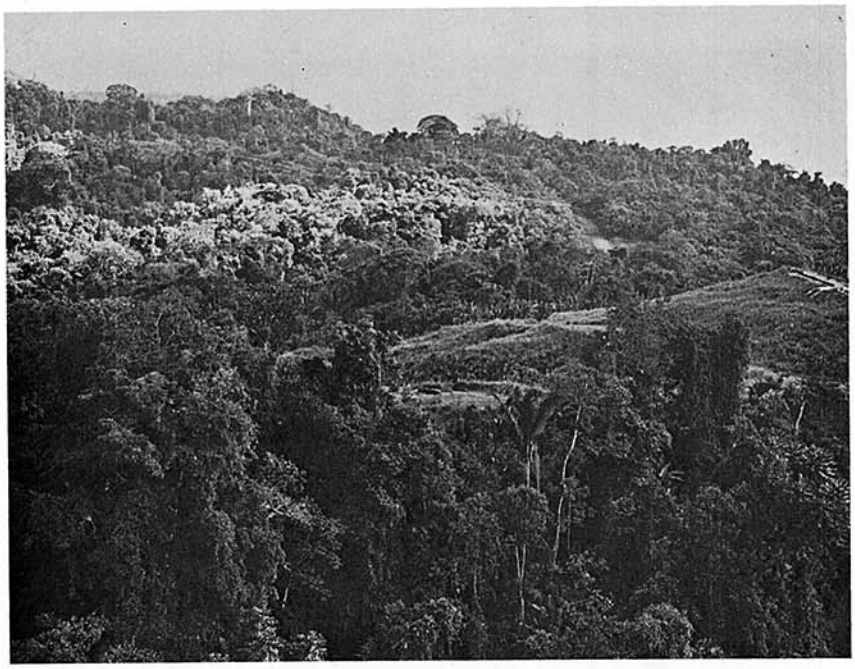


FIGURE H16. Upland Site, South Aerial Viet Showing Topography

II. SITE DOCUMENTATION

The military personnel listed below have stated that Site E_4 is similar to upland environments they experienced in South Vietnam

Name Rank/Serial No.	Dates of Vietnam Service	Unit	Duty Position
Gueterman, Frank J. 1st Lt, 096838	Sep 66-Oct 67	1st Marine Division	Plt Ldr
Sanchez, Felix SSG(E-6), RA50141028	Jul 65-Aug 67	1st Cav Division	Squad Ldr
Cruz, Jose A. SGT(E-5), 2063852	May 65-Jan 66	3rd Marine Division	Squad Ldr
Buhl, Jerry SGT(E-5), RA19815327	Aug 65-Aug 66	1st Cav Division	Wireman/ Hel Dr Gunner
Schroyer, Lawson J. SP4, RA19985878	Jan 67-Mar 67	1st Inf Division	Rifleman
Wells, Melvin L. SP4, RA14920856	Dec 65-Jun 67	1st Cav Division	Machine Gunner
Gary, John A., Jr. SP4, RA53365899	Dec 65-Nov 66	1st Cav Division	Ammo Bearer

Enclosure I

MALFUNCTIONS AND USE OF REPLACEMENT PARTS

I. GENERAL

As rifle malfunctions occurred during the test, an armorer was required to identify the category of the malfunction, the nature, and, if possible, the cause. Categories of malfunctions were defined as follows:

- Category I - Malfunctions which were corrected by immediate action on the part of the firer. The "immediate action" taken was appropriate to the type weapon and included such actions as manually operating the bolt or withdrawing a spent case with the fingers, but did not include field stripping and did not require the use of tools.
- Category II - Malfunctions which could not be corrected by Category I action, but were corrected in the field by the shooter by field stripping and/or cleaning, lubricating, or minor adjustment without the use of tools (other than a cartridge or other aid normally available to the firer).
- Category III - Malfunctions which could not be corrected by Category I or Category II action, but which were correctible by an armorer with tools.

The Rifle Malfunction Report (Annex C, Appendix A to Enclosure E) listed twenty three Natures of Malfunction. Forty one possible Causes of Malfunction were listed on laminated cards provided to each armorer.

Eighty-one (81) percent of all malfunctions recorded on all rifles during the test were identified as being in Category I; 17 percent were Category II malfunctions, and 2 percent were Category III.

II. CATEGORY I MALFUNCTIONS

The distribution of Category I malfunctions for both the M-16 Rifle and the M-14 Rifle over the various natures of malfunction is shown in the following table.

Table II. CATEGORY I MALFUNCTIONS

	Ball Powder		IMR Powder		Ball Powder / IMR Powder			M-14 Rifle	
Nature of Malfunction	M-16 R_1 (Chrome)	M-16 R_2 (No Chrome)	M-16 R_1 (Chrome)	M-16 R_2 (No Chrome)	$R_1 + R_2$		Percent of Total	Number of Malfunctions	Percent of Total
Failure to Feed	64	64	583	742	128	1325	49.1	250	39.8
Failure to Chamber	36	35	160	125	71	285	12.0	104	16.6
Failure to Lock	32	30	6	22	62	28	3.0	61	9.7
Failure to Fire	88	50	30	35	138	65	6.9	95	15.1
Failure to Extract	31	48	9	31	79	40	4.0	47	7.5
Failure to Eject	157	74	1	12	231	13	8.3	9	1.4
Double Feed	15	26	7	18	41	25	2.2	2	0.3
Failure of Bolt to Remain at Rear	28	19	160	163	47	323	12.5	11	1.8
All Others	12	18	14	13	30	27	1.9	49	7.8
Total	463	364	970	1161	827	2131		628	
	827		2131						

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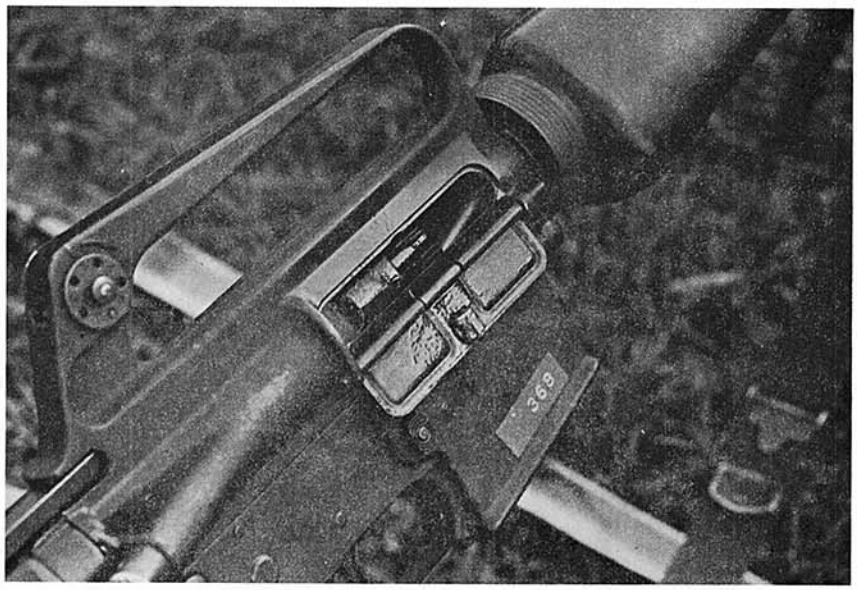

FIGURE I1. Failure to Chamber (Note Lubricant on Dust Cover)

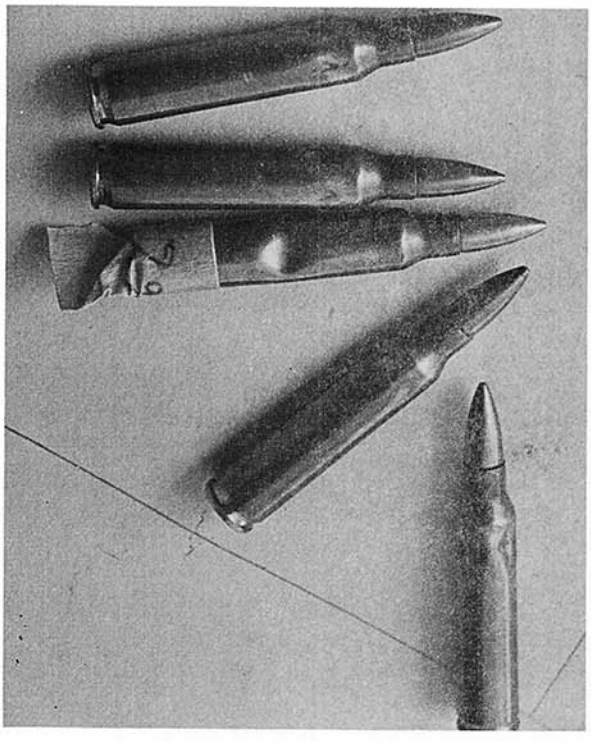

FIGURE I2.

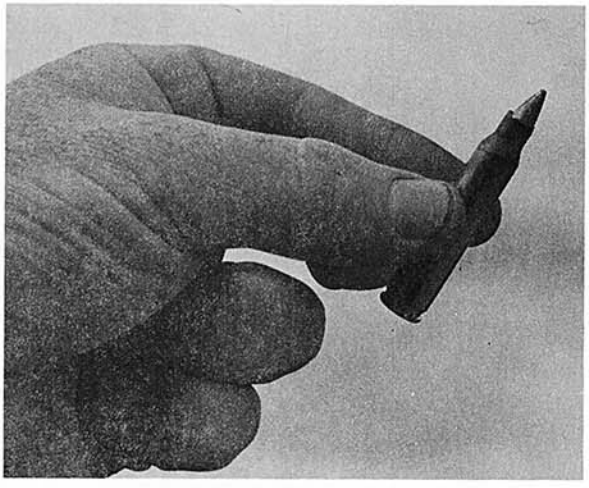

FIGURE I3.

Dented and Damaged Rounds Resulting from Failure to Chamber

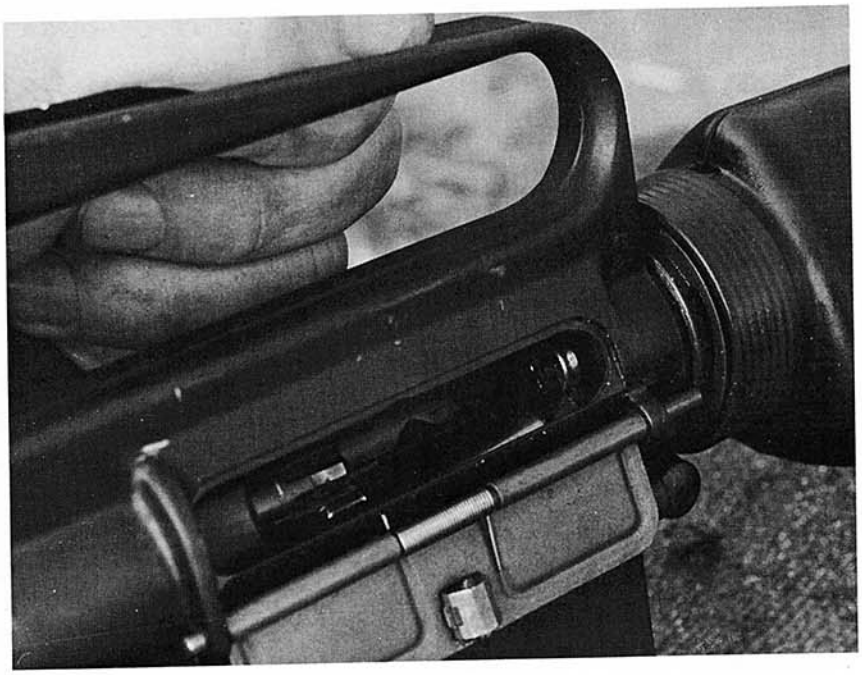

FIGURE I4. Failure to Extract (Note Head of Cartridge Showing in Chamber)

FIGURE I5. Failure to Eject (Cartridge was not Thrown Free)

"Failure to Feed," "Failure to Chamber," and "Failure of the Bolt to Remain at Rear After Last Round" were the most numerous of all M-16 Rifle Category I malfunctions, together accounting for almost 75 percent of the malfunctions. Figure I1 shows an example of a "Failure to Chamber "on M-16 Rifles, and dented or damaged cartridges resulting from such malfunctions are shown in Figures I2 and I3. While not shown in photographs, cartridges which failed to chamber often showed a clearly visible scratch where the bolt had overridden the cartridge.

Failure to "Extract and Eject," the processes of withdrawing expended cartridges from the chamber and expelling them from the rifle respectively, accounted for about 12 percent of the Category I malfunctions on the M-16 Rifle. Photographs of a "Failure to Extract" and a "Failure to Eject" are shown in Figures I5 and I6.

III. CATEGORY II MALFUNCTIONS

Category II malfunctions reported on both the M-16 Rifle and the M-14 Rifle were distributed over the natures of malfunction as follows:

Table I2. CATEGORY II MALFUNCTIONS

Nature of Malfunction	Ball Powder		IMR Powder		Ball Powder	IMR Powder		M-14 Rifle	
	M-16 R_1 (Chrome)	M-16 R_2 (No Chrome)	M-16 R_1 (Chrome)	M-16 R_2 (No Chrome)	$R_1 + R_2$		Percent of Total	Number of Malfunctions	Percent of Total
Failure to Feed	9	12	136	158	21	294	50.0	32	25.6
Failure to Chamber	7	10	42	28	17	70	13.8	9	7.2
Failure to Lock	4	11	2	8	15	10	4.0	20	16.0
Failure to Fire	22	14	6	5	36	11	7.5	7	5.6
Failure to Extract	10	29	1	9	39	10	7.8	37	29.6
Failure to Eject	19	10	1	1	29	2	4.9	6	4.8
Double Feed	2	1	0	0	3	0	.5	1	.8
Failure of Bolt to Remain at Rear	1	0	6	15	1	21	3.5	0	0
All Others	12	16	15	8	28	23	8.0	13	10.4
Total	86	103	209	232	189	441		125	
	189		441						

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Category II malfunctions require cleaning, field stripping, lubrication, or minor adjustment, using equipment normally available to the shooter. An example is the use of a cleaning rod to knock out an expended cartridge that the rifle has failed to extract, as illustrated in Figure 6. As in the case of Category I malfunctions, "Failures to Feed and Chamber" accounted for a large majority of the Category II malfunctions on the M-16 Rifle.

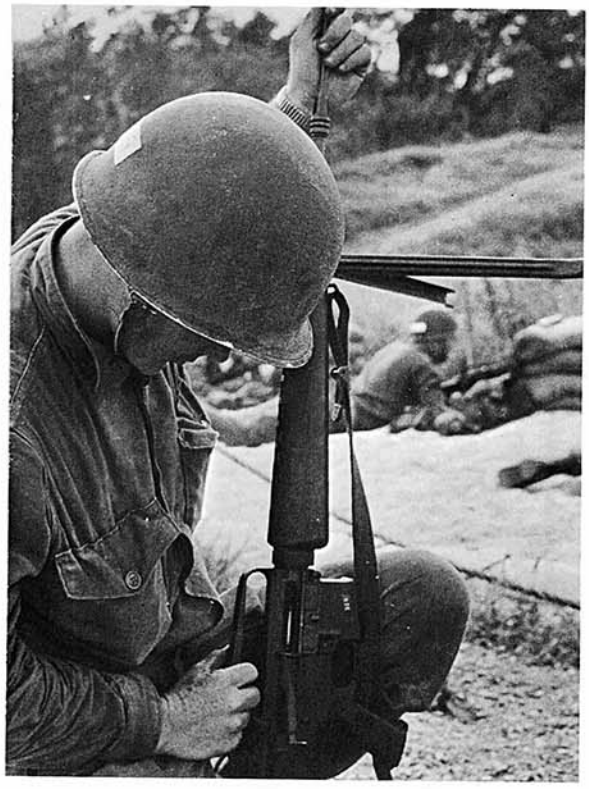

FIGURE I6. Rifleman Using Cleaning Rod to Dislodge Expended Cartridge Which the Rifle has Failed to Extract

IV. CATEGORY III MALFUNCTIONS

Category III malfunctions are not correctible by a rifleman, but require the services of an armorer with tools. In most cases in the test, Category III malfunctions required the replacement of broken, excessively worn, or damaged parts. The distribution of Category III malfunctions for both the M-16 Rifle and the M-14 Rifle over the various natures was as follows:

Table I3. CATEGORY III MALFUNCTIONS

Nature of Malfunction	Ball Powder		IMR Powder		Ball Powder IMR Powder			M-14 Rifle	
	M-16 R_1 (Chrome)	M-16 R_2 (No Chrome)	M-16 R_1 (Chrome)	M-16 R_2 (No Chrome)	$R_1 + R_2$		Percent of Total	Number of Malfunctions	Percent of Total
Failure to Feed	0	1	13	9	1	22	24.7	0	0
Failure to Chamber	2	1	2	3	3	5	8.6	0	0
Failure to Lock	0	1	0	0	1	0	1.1	5	41.7
Failure to Fire	9	1	2	4	10	6	17.2	1	8.3
Failure to Extract	2	5	0	3	7	3	10.8	1	8.3
Failure to Eject	18	2	0	0	20	0	21.5	1	8.3
Double Feed	0	1	0	0	1	0	1.1	0	0
Failure of Bolt to Remain at Rear	0	1	0	0	1	0	1.1	0	0
All Others	2	2	2	7	4	9	14.0	4	33.3
Total	33	15	19	26	48	45		12	
	48		45						

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The wear and breakage of bolt rings, was noted early in the test. However, worn or broken rings were not replaced until the rifle experienced one or more malfunctions traceable to this condition. Figure I7 shows an M-16 Rifle bolt with one bolt ring broken, and Figure I8 shows a broken bolt ring which had been replaced. During the test, 27 bolt rings were replaced, and an inspection of rifles at the completion of the test revealed 23 M-16 Rifles with one or more broken or missing bolt rings.

The repair of Category III malfunctions by armorers was performed primarily at the firing sites. This was done in order to expedite the return of the test rifles into service, and to avoid if possible the introduction of substitute rifles. In only seven instances were rifles returned to the centrally located rifle repair van for major repairs. One M-16 Rifle with an elongated hammer pin hole in the receiver, and one M-16 Rifle with a loose barrel were not repairable at the test site, but required repairing at a higher maintenance level. Four M-16 Rifles required replacement of a gas tube, bolt assembly (2) and an automatic sear, and one M-14 Rifle required replacement of a gas cylinder at the repair van since the necessary parts or equipment were not available at the firing sites. All broken or worn rifle parts replaced by armorers during the test were collected, and are now in the custody of WSEG. A complete list of all parts used in the test is shown in Appendix A. Figures I9 and I10 are photographs of a worn M-16 Rifle extractor and a broken handguard which were replaced during the test.

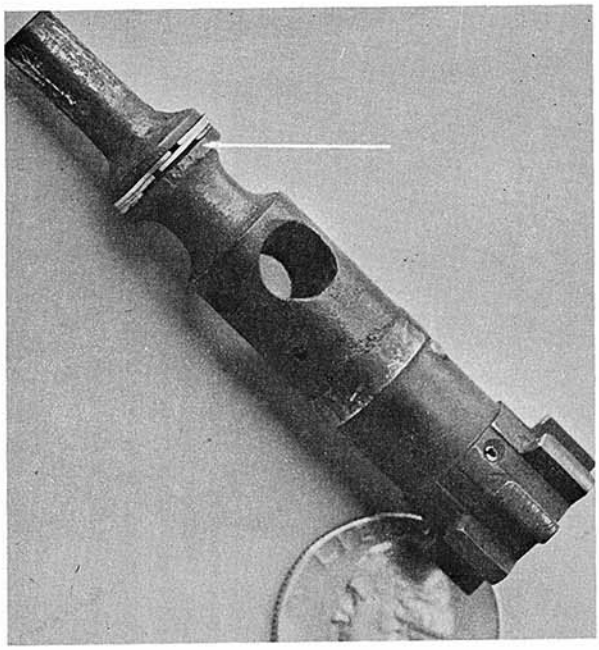

FIGURE I 7. Broken Bolt Ring

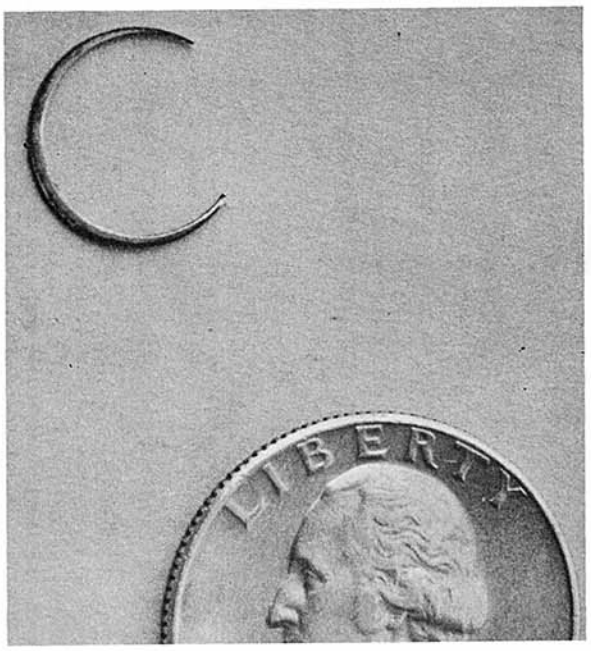

FIGURE I 8. Worn Bolt Ring

FIGURE I 9. M-16 Rifle Extraction (Note Chafed Area Due to Binding)

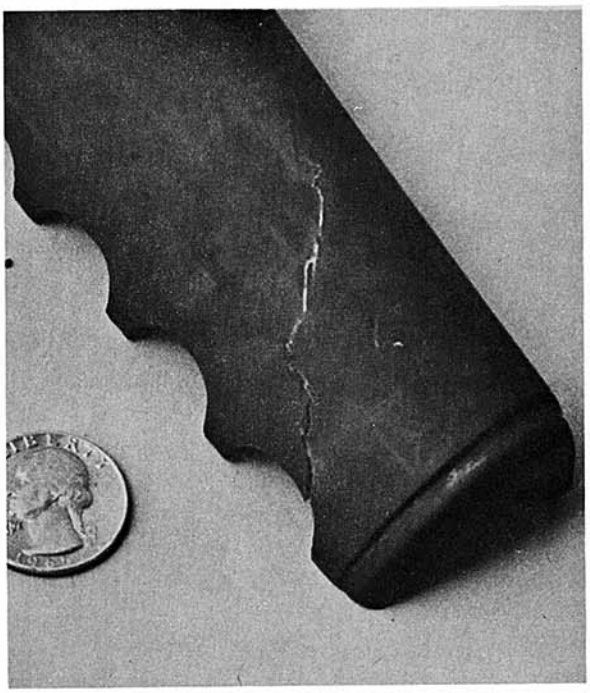

FIGURE I 10. Broken Handguard from M-16 Rifle

V. MAGAZINES

During the test, a number of malfunctions occurred for which a deformed magazine was suspected as the cause. A double feed malfunction, shown in Figure I11, is an example of a malfunction which may be caused by the lips of a magazine being spread beyond permissible limits. A GO, NO-GO Field Service Gage, Figure I-12 used to check M-16 Rifle magazines associated with malfunctions, identified 7 magazines with spread lips at the firing sites. Figure I-13 illustrates the insertion of the gage into a deformed magazine. In the latter phases of the test, this gage was used to check a random sample of 150 magazines per day during the magazine loading process. This check detected only one magazine which was spread beyond prescribed limits.

An M-14 Rifle magazine with a bent lip is shown in Figure I14.

FIGURE I 11. Double Feed

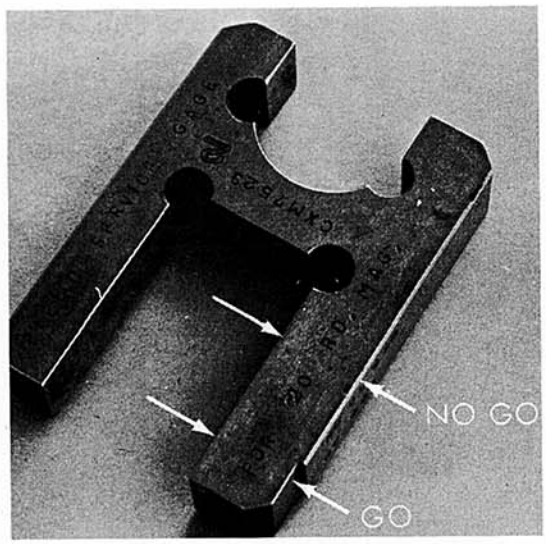

FIGURE I 12. GO NO-GO Field Service Gage for M-16 Magazine

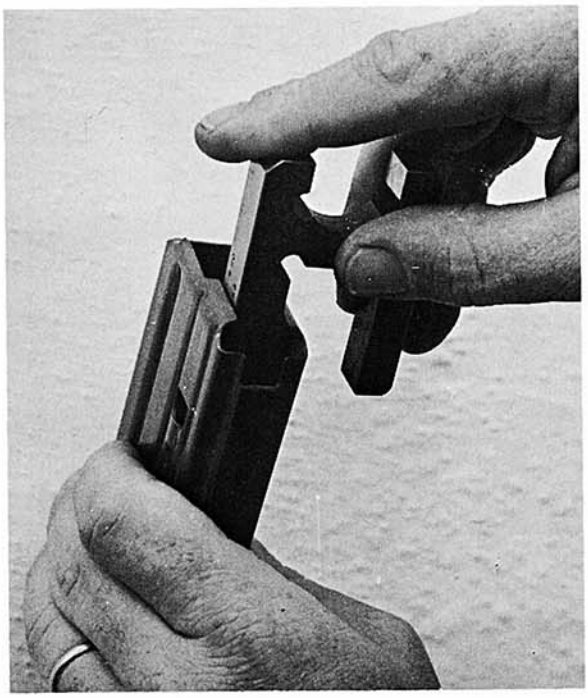

FIGURE I 13. Using GO NO-GO Gage to Check M-16 Magazine. Insertion of Gage Beyond "GO" Section Indicates Magazine is Unservicable.

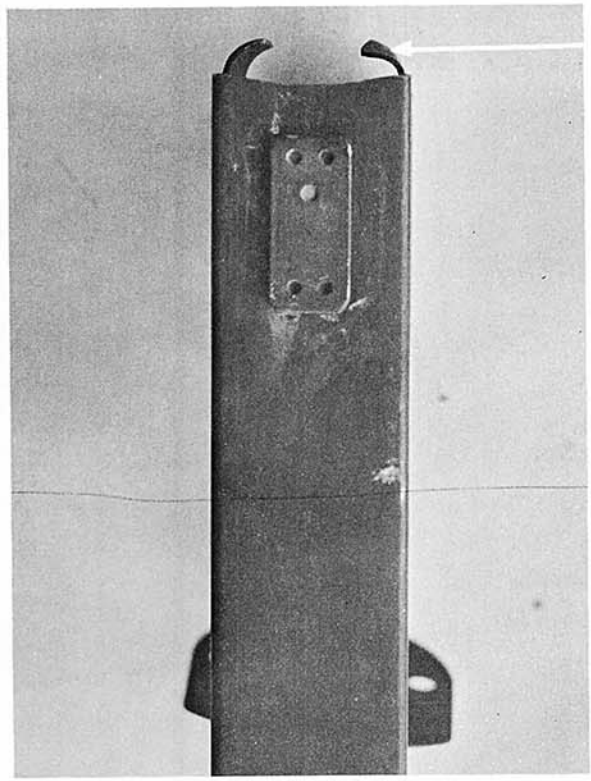

FIGURE I 14. M-14 Rifle Magazine (Note Bent Lip)

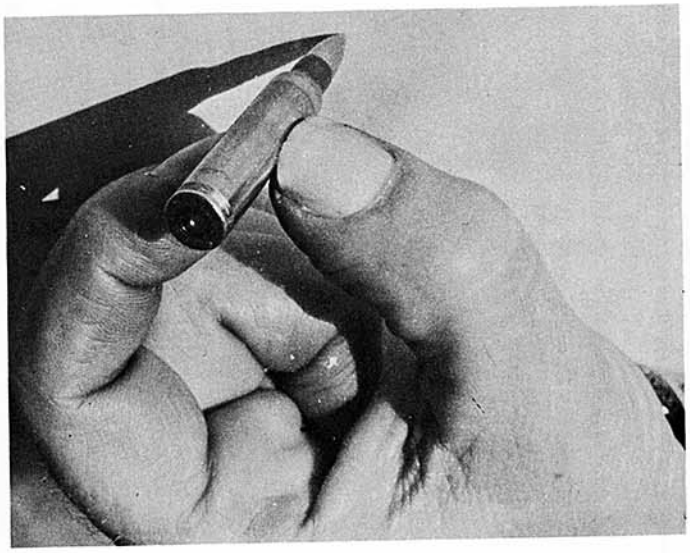

FIGURE I 15. Light Struck Primer

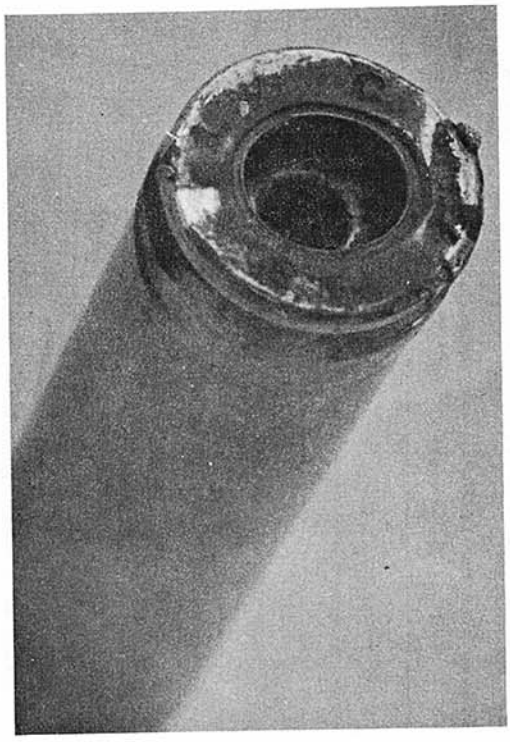

FIGURE I 16. M-16 Cartridge with Defective Primer

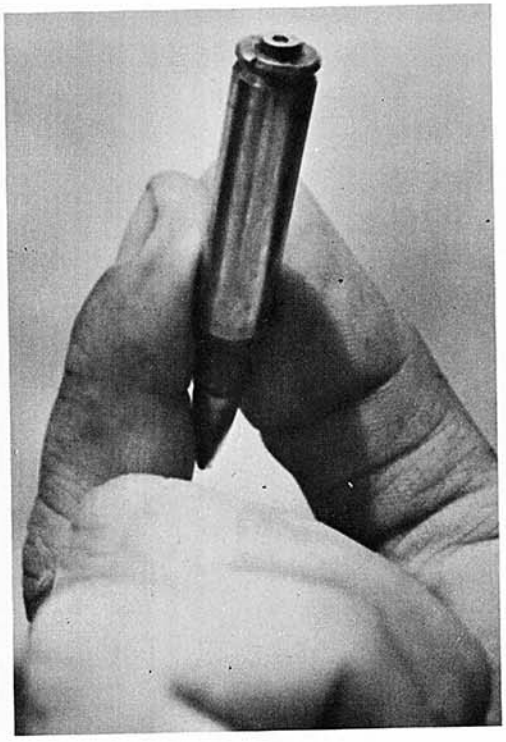

FIGURE I 17. M-16 Cartridge with Defective Primer. Propellant did not ignite

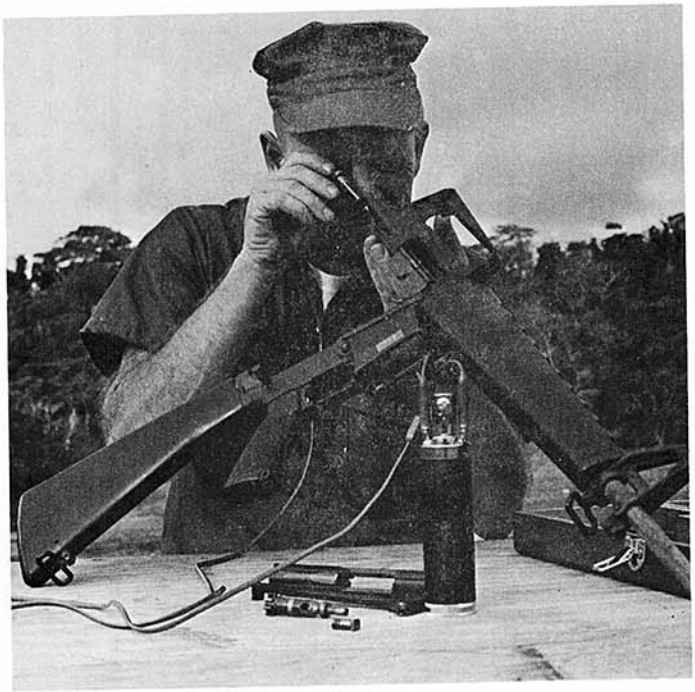

FIGURE I 18. M-16 Rifle Bore and Chamber Being Examined with Borescope

VI. POST-TEST RIFLE EXAMINATIONS

After all rifles had been cleaned following the final firing period, a sample of 60 rifles, including all types used in the test, were examined using a borescope, as illustrated in Figure I19. Rifle barrels and chambers were examined for pits, cracks, or other evidence of undue deterioration. Inevitably, all rifles revealed wear due to the test. In addition, however, 26 of the rifles examined were found to have slightly pitted bores, and 14 had slightly pitted chambers. One M-16 Rifle was found to have a cracked barrel extension.

To determine the extent of rifle barrel erosion due to the test firing, all M-16 test rifles were checked with a Breech Bore Gage, shown in Figure I-20. The Gage is inserted into the Breech until it is stopped by the rifling, the extent of the insertion determining the acceptability of the rifle. Use of this gage is demonstrated in Figure I-21. The test revealed 15 rifles which were acceptable for CONUS use only (Zone 2) and 2 rifles with unserviceable barrels (Zone 3). All other M-16 Rifles were acceptable (Zone 1). It may be significant that all rifles graded in Zones 2 and 3 were used in squads which fired IMR ammunition.

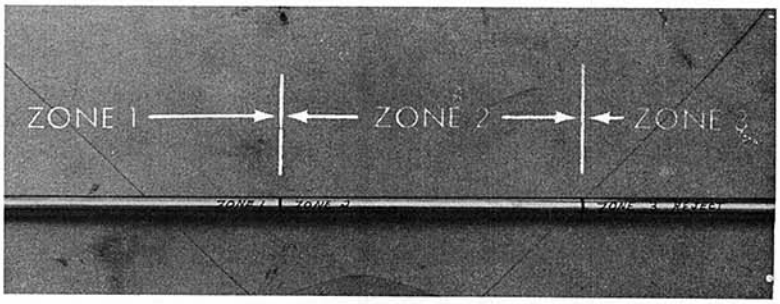

FIGURE I 19.
M-16 Breech
Bore Gage
Zone 1 Acceptable
Zone 2 CONUS Only
Zone 3 Rejected

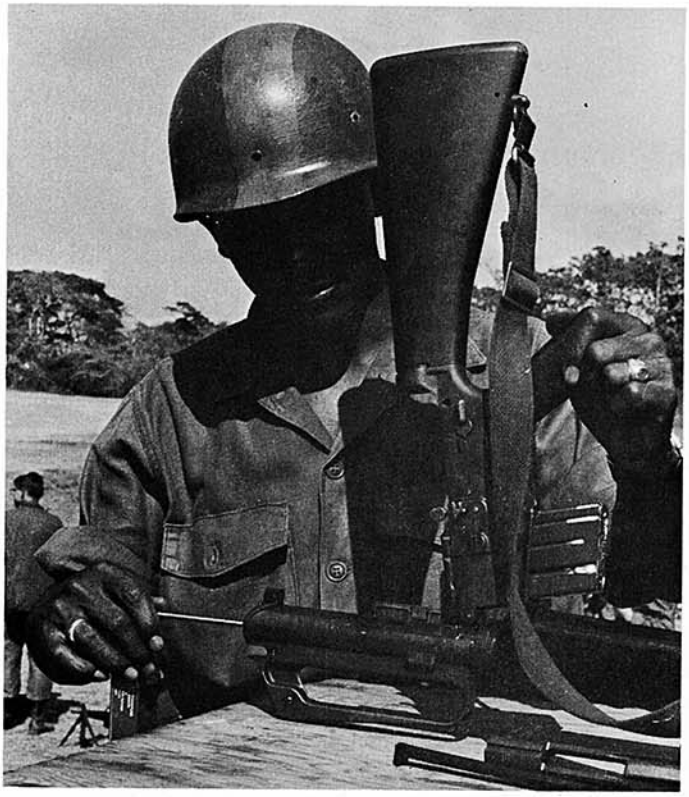

FIGURE I 20. Armorer Checking Barrel Erosion Using Breech Bore Gage

FIGURE I 21. M-16 Rifle on the Firing Line After Swamp Exposure

Appendix

REPLACEMENT PARTS USED M-16 TEST

REPLACEMENT PARTS USED M-16 TEST

Nomenclature	FSN	Type Rifle	No. Used
Bolt Assembly	1005-992-7285	M-16A1	2
Ring, Bolt	1005-992-7287	M-16A1	27
Pin, Firing	1005-017-9547	M-16A1	1
Pin, Firing Pin Retaining	1005-999-1509	M-16A1	13
Extractor	1005-992-7288	M-16A1	1
Spring, Extractor	1005-992-7289	M-16A1	4
Spring, Ejector	1005-992-7292	M-16A1	4
Buffer Assembly	1005-937-3078	M-16A1	7
Spring, Action	1005-992-6665	M-16A1	2
Sear, Automatic	1005-992-6649	M-16A1	2
Tube, Gas	1005-978-1038	M-16A1	1
Cover, Ejection Port	1005-978-1022	M-16A1	4
Guard, Hand L. H.	1005-056-2251	M-16A1	3
Guard, Hand R. H.	1005-056-2252	M-16A1	3
Stock Assembly	1005-017-9549	M-16A1	1
Magazine Assembly	1005-056-2237	M-16A1	7
Ejector, Cartridge with Spring	1005-587-8381	M-14	2
Cylinder, Gas	1005-790-8766	M-14	1
Spring, Operating Rod	1005-587-8413	M-14	2
Hammer	1005-554-6008	M-14	2
Sight, Front	1005-084-8435	M-14	1
Plate Assembly, Butt Hinged	1005-690-4067	M-14	1
Stock Assembly	1005-754-6462	M-14	3

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