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ENGINEER DESIGN TEST OF

5.56-MM FABRIQUE NATIONALE MACHINE GUN,

MODEL MILIMI

FINAL LETTER REPORT

BY

FRANKLIN H. MILLER

DECEMBER 1974

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An Engineer Design Test of the 5.56-MM Fabrique Nationale Machine Gun, Model MILIMI, was conducted at Aberdeen Proving Ground, Maryland from February 1974 to September 1974. The purpose of the test was to determine the characteristics (physical and functional) of the weapon. One weapon was provided and tested with 8653 rounds of special heavy projectile ammunition. The weapon and ammunition physical characteristics and functioning performance were determined in tests for accuracy and dispersion, endurance, and

20. operability at temperatures of +155°F and -50°F. Maintenance and human factors aspects were evaluated. The weapon and ammunition generally exhibited satisfactory performance during all testing. In those instances where performance was marginal, the problem was either corrected or could be corrected by component design changes.

DEPARTMENT OF THE ARMY
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STEAP-MT-I

31 December 1974

SUBJECT: Final Letter Report of Engineer Design Test of 5.56-MM Fabrique Nationale Machine Gun, Model MILIMI, TECOM Project No. 8-WE-400-SAW-003, APG-MT-4564

Commander
US Army Armament Command
ATTN: AMSAR-RDG, Mr. Bradley
Rock Island, Illinois 61202

1. REFERENCES

a. Letter, AMXAA-WS, 25 October 1972, subject: Request for Test Plan and Time/Cost Estimates - Squad Automatic Weapon (SAW) Preliminary Engineer Design Test (EDT).

b. Letter, TECOM, AMSTE-BC, 9 November 1972, subject: Customer Test Directive for Developmental Test of Squad Automatic Weapon (SAW), TECOM Project No. 8-WE-400-SAW-003.

2. BACKGROUND

a. The authority for conduct of this test is given in Reference 1b.

b. The US Small Arms Systems Agency (now assimilated into the US Army Armament Command) requested that foreign 5.56-mm machine gun designs be tested to determine their potential as military weapons. Two weapons were procured for this evaluation. One was tested at Aberdeen Proving Ground (APG) and the other at the US Army Infantry Board (USAIB), Fort Benning, Georgia.

c. Originally, the Squad Automatic Weapon (SAW) program was to evaluate both 5.56-mm and 6.00-mm weapon systems. Subsequently, all 5.56-mm systems were deleted from the SAW evaluation and were directed to be tested and reported for informational purposes only as an engineer design test. Two weapon designs were tested, the one reported herein and Heckler & Koch HK-23A1 machine gun; the results of each system are being reported separately.

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d. The 5.56-mm Fabrique Nationale (FN) machine gun is a lightweight, gas-operated, locked-breech, air-cooled, belt-fed weapon. It is capable of being fired from offensive (i.e., shoulder and hip) and defensive (i.e., bipod and tripod) positions using either 100- or 175-round capacity magazines attached to the receiver. The weapon features a quick-change, fixed-headspace barrel and an adjustable gas regulator to increase power to the weapon mechanism. The ammunition is assembled in the disintegrating metallic link (push-through type) and consists of standard 5.56 x 45-mm cartridge cases assembled with heavy projectiles. This ammunition, which can be chambered in rifles such as the US M16A1 and Belgian CAL, requires the 1-turn-in-9-inch rifling rate of twist of the machine gun barrel to ensure adequate stability in flight and should not be used with the rifles which have the 1-turn-in-12-inches barrel twist.

e. The purpose of this test was to determine the physical and technical characteristics of the test materiel. Testing consisted of an initial inspection and safety evaluation, accuracy and dispersion evaluation, and function performance firings at normal ambient, high (+155°F), and low (-50°F) temperatures. The test data generated during the firing tests were assessed from maintenance and human factors standpoints to complete the over-all materiel evaluation. Although the weapon sample of one does not generally constitute a statistically adequate sample size, the objectives of this test were met.

Testing was conducted from 18 February 1974 to 30 September 1974.

3. OBJECTIVE

The over-all objective of this test was to evaluate the design and operating characteristics of the machine gun.

4. SUMMARY OF RESULTS

A total of 8653 rounds was fired. The resultant mean rounds between failure (MRBF) was 376, and the malfunction rate per 1000 rounds fired was 2.66 for chargeable malfunctions. The maintenance man-hours per round fired was 10.63×10^{-4}. A total of three component parts were broken, but no malfunctions resulted from these part failures which were detected and corrected during periods of scheduled maintenance. The recurrent malfunctions encountered at the beginning of testing were eliminated by installation of current (third) design components in this first-design test weapon.

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SUBJECT: Final Letter Report of Engineer Design Test of 5.56-MM Fabrique Nationale Machine Gun, Model MILIMI, TECOM Project No. 8-WE-400-SAW-003, APG-MT-4564

There were no weapon or ammunition deficiencies, or ammunition shortcomings. Three weapon shortcomings occurred. One was the inadequate design of the means of attaching the magazine to the weapon, and the other two were related to inadvertent firing of the weapon due to design of the sear mechanism. All three shortcomings were considered correctable by implementation of design changes.

In addition to the changes to eliminate the shortcomings, there were six suggested areas of improvement in the weapon design which would improve performance, including changes in the bipod, sights, carrying handle/barrel release assembly, and gas piston.

Evaluation of the human factors aspects revealed that the weapon design precluded the possibility that personnel could inadvertently misassemble component parts to the detriment of functioning or safety. Controllability of the weapon was found to be satisfactory during automatic burst firing from the prone, bipod-supported position at ranges of 100 and 300 meters.

FOR THE COMMANDER:

BILLY SISSOM
Associate Director
Materiel Testing Directorate

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DETAILS OF TEST

1.1 INTRODUCTION

The testing described herein was not evaluated against any test criteria since there was no requirement for that type of analysis. The analyses which are made are general in nature and are directed toward weapon and ammunition performance as they pertain to machine guns used for military applications.

Figure 1.1-1 shows the second design configuration weapon tested at the US Army Infantry Board. The external view of this weapon differs only slightly from the first design configuration weapon tested at Aberdeen Proving Ground.

Figure 1.1-1: Right Side View (TOP) and Left Side View (BOTTOM) of the 5.56-MM Fabrique Nationale (FN-Belgian) Machine Gun, Model MILIMI. (Second Design Configuration.)

1.2 INITIAL INSPECTION AND SAFETY EVALUATION

1.2.1 Method

The weapon and ammunition were subjected to a detailed inspection to determine their respective characteristics. The ammunition was disassembled and the component parts weighed and measured. Another sample of ammunition was evaluated for velocity, pressure, and action time using standard ammunition test procedures (Reference AMSMU-P-715-501FA1). The barrels provided by Frankford Arsenal for obtaining velocity and pressure data had one turn in 9 inches as the rate-of-rifling twist. The weapon was visually inspected for defects in manufacture. The component parts were subjected to a magnetic-particle inspection to detect any incipient defects not observed during the visual inspection. Next, the weapon was weighed and measured. Timed trials for barrel change, magazine change and loading, and disassembly and reassembly were recorded. Reverse or incorrect assembly of components and their effect on safety and weapon operation were assessed. Double-feed safety and function firing checks were made to determine safe handling requirements.

1.2.2 Results

Upon receipt of the weapons and ammunition, the packaging and packing was inspected to determine if it was adequate to prevent damage to the contents. All material was found to be in undamaged condition; the shipping containers having provided adequate protection from transit damage.

The velocity, pressure, and action time data are presented in Table 1.2-1; Table 1.2-2 provides more detailed velocity information. The four test temperatures are standard reference points for data collection used during ammunition acceptance tests. Since no reference ammunition was available, the values presented in these tables are uncorrected (i.e., not adjusted by a correction factor derived from concurrent firing of reference rounds).

Table 1.2-1. FN Machine Gun Ammunition Pressure, Velocity, and Action Time Summary (Pressure Barrel)

	Ball Ammunition				Tracer Ammunition			
	Temperature, °F				Temperature, °F			
	+155	+125	+70	-65	+155	+125	+70	-65
Port Pressure, psi								
Max	12,100	12,300	12,500	12,800	11,400	11,600	12,100	11,800
Min	11,500	11,200	11,900	11,900	9,500	10,900	11,000	11,200
Es	600	1,100	600	900	1,900	700	1,100	600
Avg	11,760	11,685	12,225	12,365	10,545	11,280	11,505	11,520
Std[b]	185	278	129	223	461	199	307	161
Chamber Pressure, psi								
Max	58,400	54,100	50,300	48,500	42,400	[a]38,900	35,600	34,800
Min	52,800	48,400	46,800	44,300	37,300	35,200	32,700	30,300
Es	5,600	5,700	3,500	4,200	5,100	3,700	2,900	4,500
Avg	55,385	50,750	47,805	46,455	40,050	36,763	34,015	32,615
Std[b]	1,481	1,349	1,165	1,349	1,419	1,141	769	1,220
Velocity, fps								
Max	3,021	3,004	2,989	2,955	2,694	2,699	2,654	2,630
Min	2,903	2,885	2,926	2,882	2,560	2,585	2,496	2,518
Es	118	119	63	73	134	114	158	112
Avg	2977.7	2971.4	2957.9	2910.1	2656.4	2641.9	2616.3	2566.2
Std[b]	26.00	25.73	16.73	19.71	30.71	24.41	33.23	31.03
Action Time, ms								
Max	1.22	1.26	1.26	1.31	1.36	1.41	1.41	2.21
Min	1.16	1.18	1.19	1.23	1.29	1.34	1.34	1.40
Es	.06	.08	.07	.08	.07	.07	.07	.81
Avg	1.19	1.22	1.23	1.27	1.32	1.37	1.38	1.53
Std[b]	.015	.019	.018	.020	.020	.017	.019	.219

[a]Excluding one pressure of 49,800 psi.
[b]Standard deviation.

Table 1.2-2. FN Machine Gun Ammunition Velocity Summary (Accuracy Barrel)

Temp, °F	Rd Fired	BBL No	Velocity, fps Max	Min	Es	Avg	Std Dev
			Ball				
+155	20	3	3101	3005	96	3065.5	19.42
	20	5	3097	3026	71	3054.2	17.56
+125	20	3	3081	3019	62	3058.4	12.15
	20	5	3075	2986	89	3037.0	17.05
+70	20	3	3033	2980	53	3006.0	13.31
	20	5	3038	2973	65	3014.1	16.77
-65	20	3	2974	2845	129	2899.4	41.80
	20	5	2976	2872	104	2917.0	30.33
			Tracer				
+155	10	3	2769	2712	57	2727.2	16.23
	10	5	2735	2680	55	2712.3	15.30
+125	10	3	2758	2689	69	2725.6	21.25
	10	5	2719	2669	50	2697.7	17.41
+70	10	3	2675	2636	39	2653.3	11.53
	10	5	2706	2653	48	2677.8	12.24
-65	10	3	2642	2462	180	2543.1	50.71
	10	5	2652	2575	77	2614.6	25.60

Data on weights of weapons and ammunition are contained in Table 1.2-3. Data on component dimensions of this material are presented in Table 1.2-4.

Table 1.2-3. Ammunition and Weapon Component Weights, FN Machine Gun

Ammo Component Wt, gr			Wpn Component Wt, lb	
Item Measured	Ball	Tracer	Item Measured	Weight
Complete round	190.86	190.24	Weapon, without ammunition	14.28
Projectile	[a]61.51	[b]63.62	Empty 100-rd magazine	0.65
Propellant	24.82	22.21	Empty 175-rd magazine	0.80
Empty primed case[c]	104.53	104.41	Recoiling components	1.24
100 rounds, linked 4-ball, 1-tracer	3.14 lb		Spare barrel	4.63
100 links	0.42 lb		Bipod	0.98

[a]Flat base, gilding-metal jacket.
[b]Flat base, gilding-metal-clad-steel jacket.
[c]Brass case.

Table 1.2-4. Ammunition and Weapon Component Dimensions, Inches, FN Machine Gun

Ammunition			Weapon	
Item Measured	Ball	Tracer	Item Measured	Inches
Over-all length, complete round	1.859	1.858	Weapon over-all length	40.0
Projectile	0.878	1.117	Width[a]	12.8
Case	1.764	1.761	Height[b]	16.0
Length of 100-round belt of ammunition linked, 4-ball to 1-tracer	94.0		Barrel length, over-all[c]	20.6
			Sight radius	16.8
			Stock, length of pull	15.2
			Stock, pitch of butt	-8 deg

[a]Bipod legs erected.
[b]Bipod legs were not adjustable for height.
[c]Barrel length is 19.8 inches when measured from bolt face to end of suppressor.

Those components subjected to magnetic-particle inspection are depicted in Figure 1.2-1 (page 7), and the cracks found are shown in Figure 1.2-2 (page 8). The crack in part No. 15 (bolt carrier) was 1/16 inch in length. Those in part No. 29 (receiver shell) were all 1/8 inch long. The cracks in Areas A and B appeared on both right and left sides in the weldment. The Area-C cracks were only on the right side. None of these cracks were considered to be adversely prejudicial to weapon operation or safety.

A complete listing of weapon components is presented in Table 1.2-5 (page 9) which is keyed numerically to Figure 1.2-3 (page 10).

One of the features of this machine gun is the capability to adjust the flow of propellant gases from the barrel to the operating components. Figure 1.2-4 (page 11) depicts the four-position adjustment available, with appropriate comments.

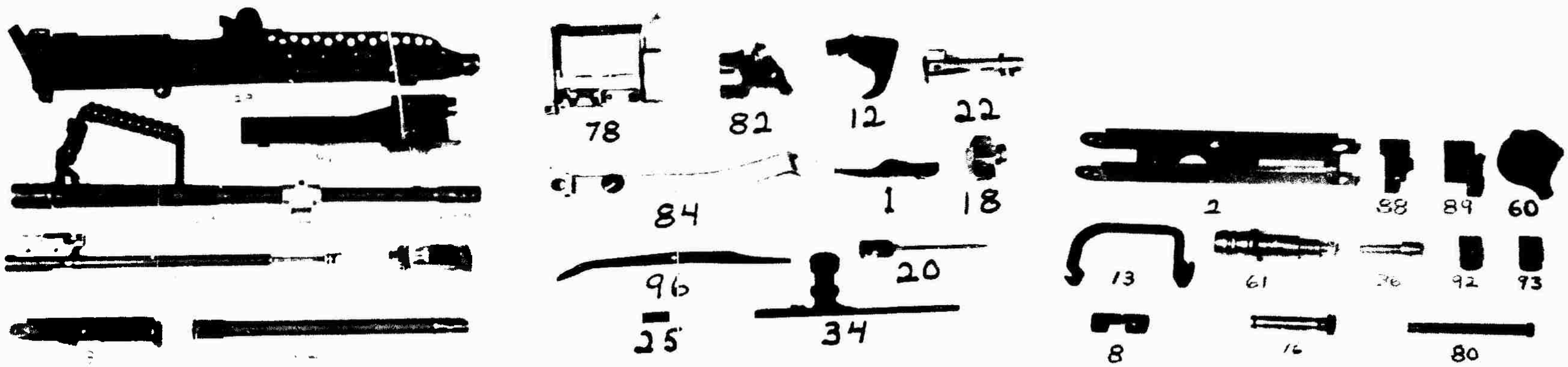


Figure 1.2-1: FN Machine Gun Component Parts Subjected to Magnetic-Particle Inspection.

Part No.	Nomenclature	Part No.	Nomenclature	Part No.	Nomenclature
3	Trigger housing	1	Sear	2	Trigger housing guard
15	Bolt carrier assembly	12	Trigger	8	Safety
29	Receiver shell	18	Bolt carrier plug	13	Trigger guard
40	Backplate	20	Firing pin	16	Feed cam roller shaft
62	Gas cylinder	22	Bolt	36	Backplate retaining pin
63	Barrel assembly	25	Extractor	60	Gas regulator sleeve assembly
63a	Flash suppressor	34	Charging handle assembly	61	Gas regulator body
86	Feed cover assembly	78	Feed tray assembly	80	Feed cover hinge pin
		82	Feed pawl assembly	88	Front belt holding pawl
		84	Feed cam assembly	89	Rear belt holding pawl
		96	Ejector	92	Feed cover latch
				93	Feed cover latch

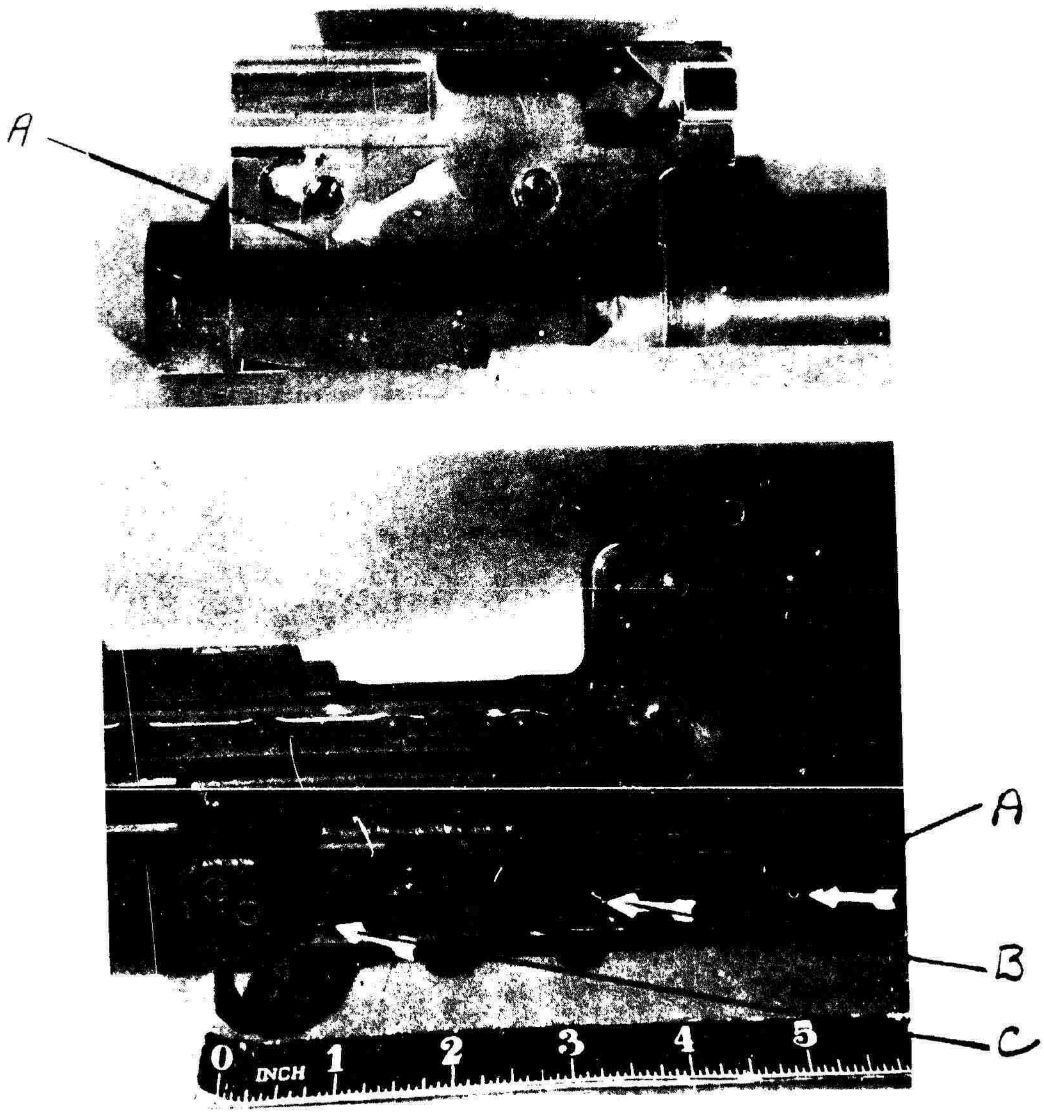


Figure 1.2-2: Pretest Inspection Crack Patterns (TOP) (Part No. 15), (BOTTOM) (Part No. 29).

Table 1.2-5. FN Machine Gun Part Nomenclature List

APG Part No.	Part Name
1	Sear
2	Trigger housing guard
3	Trigger housing assembly (2)
4	Pistol grip
5/6	Sear/sear spring pin (2)
7	Safety spring
8	Safety
9	Trigger return spring
10	Trigger assembly pin
11	Trigger stop
12	Trigger assembly (6)
13	Trigger guard
14	Pistol grip screw
15	Bolt carrier assembly (6)
16	Feed cam roller shaft assembly (3)
17	Feed cam roller shaft spring
18	Bolt carrier plug
19	Feed cam roller shaft retaining clip
20	Firing pin assembly (23)
21	Firing pin spring
22	Breech bolt
23	Extractor spring
24	Extractor spring plunger
25	Extractor
26	Extractor pin
27	Bipod assembly (26)
28	Bipod stop pin
29	Receiver shell assembly (26)
30	Dust cover
31	Dust cover hinge spring
32	Dust cover hinge pin
33	Charging handle slide stud retaining pin
34	Charging handle slide assembly (3)
35	Charging handle slide stud
36/39	Backplate retaining pin (2)
37/38	Backplate retaining pin clip (2)
40	Backplate
41	Buttstock screw washer
42	Buttstock screw
43	Buttplate
44	Buttplate screw washer
45	Buttplate screw
46	Buttstock (wood)
47	Rear sling swivel base
48	Recoil spring
49	Recoil spring guide assembly (4)
50	Recoil spring guide extension cap
51	Recoil spring guide extension cap retaining pin
52	Rate control buffer washers (Belleville type) (9)
53	Rate control buffer spacer
54/57	Rate control cone plates (2)
55	Rate control friction piece
56	Rate control friction piece insert
58	Rate control shaft cap
59	Rate control shaft cap locator pin
60	Gas regulator sleeve assembly (5)
61	Gas regulator body
62	Gas cylinder
63	Barrel assembly (18)
64	Front sight housing
65	Front sight housing screw lock washer
66	Front sight housing lock screw
67	Front sight detent spring
68	Front sight detent
69	Front sight post
70	Rear sight shaft retainer clip
71	Rear sight aperture assembly (2)
72	Rear sight detent
73	Rear sight detent spring
74	Rear sight shaft assembly (2)
75	Magazine latch spring
76	Magazine latch spring
77	Magazine latch
78	Feed tray assembly (4)
79	Feed cover hinge pin retaining clip
80	Feed cover hinge pin
81	Feed cover hinge spring
82	Feed pawl assembly (13)
83	Feed pawl assembly retaining clip
84	Feed cam assembly (2)
85	Feed cam return spring
86	Feed cover assembly (5)
87	Belt holding pawl spring (2)
88	Front belt holding pawl
89	Rear belt holding pawl
90	Belt holding pawl pin
91	Belt holding pawl pin retainer
92/93	Feed cover latch (2)
94	Feed cover latch spring
95	Feed cover retainer
96	Ejector
97	Ejector pivot pin
98	Ejector spring

Note: Numbers in ( ) indicate total number of components in the assembly.

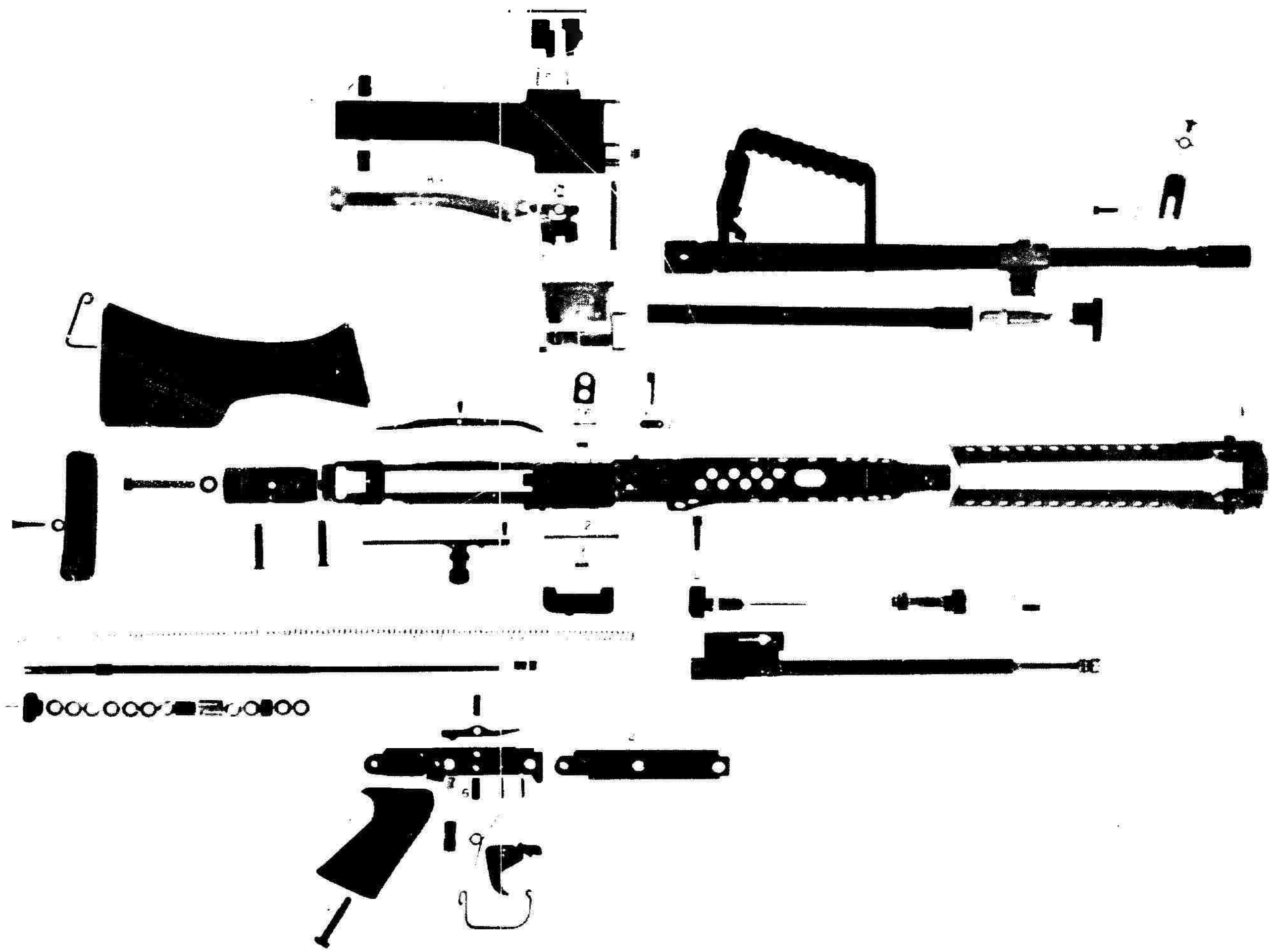


Figure 1.2-3: Weapon Components.

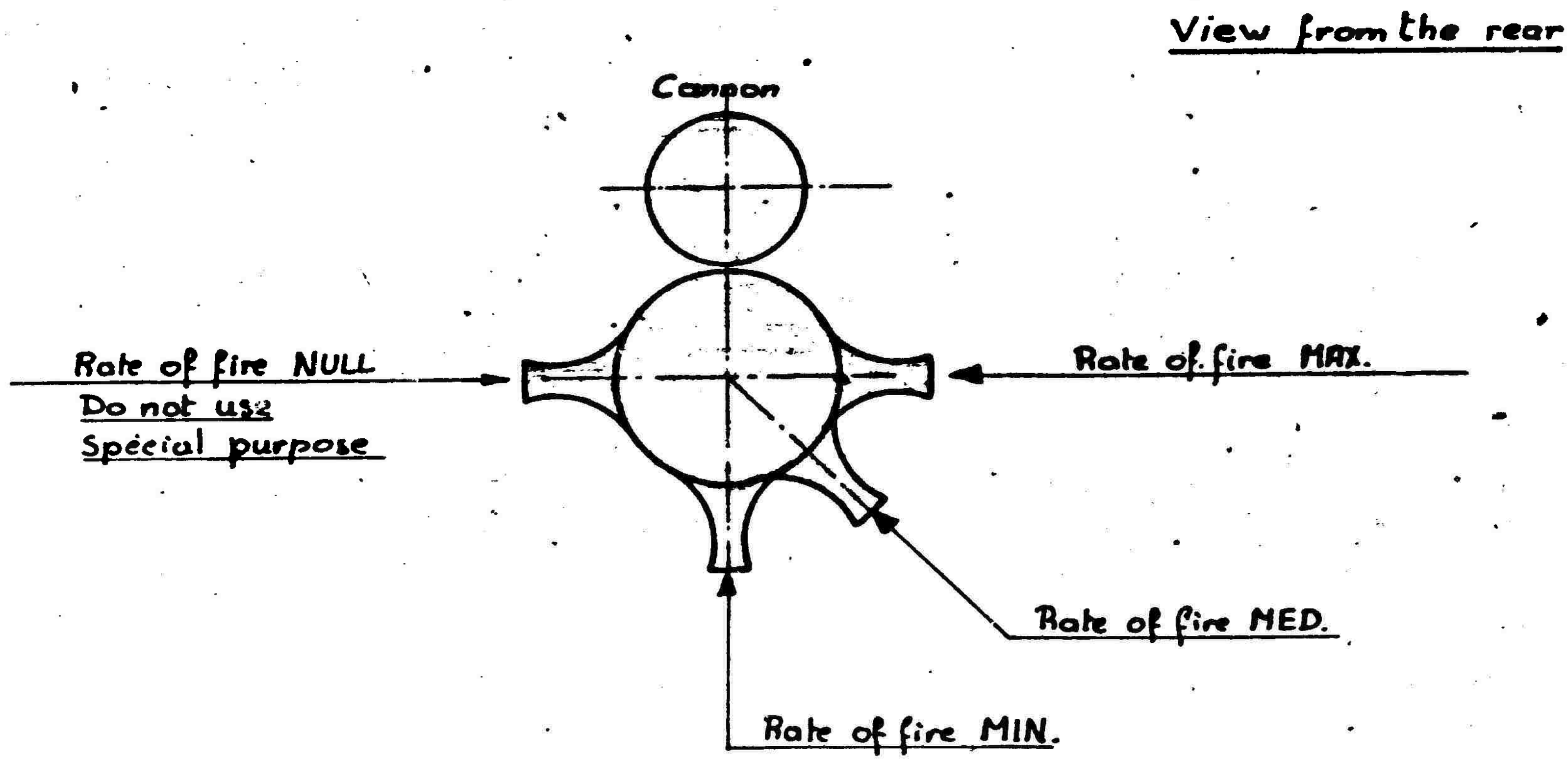


Figure 1.2-4: FN Machine Gun Gas Regulator Settings.

The effects of reverse or incorrect assembly of weapon components was found to be minimized by the comprehensive design of the weapon. This design either accommodated reverse assembly by symmetrical component configuration, or in instances where reverse assembly was either not desired or not practical, the components were nonsymmetrical to the point of preventing the undesired incorrect assembly. Three component types were found to exhibit an ability to be incorrectly assembled. The first two (i.e., firing pin spring, and front and rear cartridge holding pawl springs) could be removed and replaced without the use of special tools. The firing pin spring end coils were not symmetrical. One was of smaller diameter than the other coils in the spring. This end was normally placed toward the rear end of the firing pin assembly and acted as a means of retaining the spring when the bolt was removed. Reverse assembly of this spring (which pushes the bolt forward when it and the bolt carrier are removed from the weapon) would not cause weapon malfunctions. The two belt holding pawl springs were different lengths. The front one was 0.773 inch and the rear one was 0.748 inch. Reverse assembly of these springs, from front to rear position would not immediately effect weapon operation. The buffer/rate control assembly is normally removed and replaced as a unit. Special tools, consisting of a hammer and punches are required if detailed maintenance is to be performed. Although the 23 component parts of this assembly can be incorrectly assembled, no envisioned misassembly would result in injury or irrepairable damage to the weapon.

Table 1.2-6 presents timed-trial data on magazine loading and change. The magazine change time is not adversely influenced by the shooter's position (i.e., right- or left-hand). The average barrel change time was 7 seconds. Individual trial times were 10, 12, 12, 6, 6, 5, 6, 5, and 4 seconds. The times which were above the average were caused by two factors. First, the barrel latch and release were dimensionally mismatched which prevented instant engagement of these parts when attempting to unlock the barrel. The other problem was created by the addition of the protective handguard material to the upper sides of the receiver which prevented the gas cylinder/piston alignment from being accomplished solely by rotation of the barrel handle during assembly. This handle did allow barrel change without the gunner contacting hot metal. The timed-trial data for weapon disassembly and reassembly are contained in Table 1.2-7. The time to disassemble and reassemble the weapon was found to decrease when experience and development of time saving techniques were employed. Detailed discussion of the maintenance and human factors aspects of the data contained in Tables 1.2-6 and 1.2-7 are to be found in paragraphs 1.7 and 1.8.

Table 1.2-6. FN Machine Gun Magazine Loading and Change Times Recorded for Four Test Personnel, Time in Seconds

Magazine Capacity, Rounds	Trial No.	Loading 1	Loading 2	Loading 3	Loading 4	Loading Avg	Change[a] [b]1	Change 2	Change 3	Change 4	Change Avg
100	1	37	61	65	37	50	16	24	22	20	20
	2	42	36	39	42	40	15	14	19	17	16
	3	43	45	62	43	48	15	13	11	16	14
Average		41	47	55	41	46	15	17	17	18	17
[c]175	1	57	28	38	30	38	20	20	19	25	21
	2	46	46	49	33	44	22	17	23	15	19
	3	51	46	67	39	51	19	16	20	19	18
Average		51	40	51	34	44	20	18	21	20	20

[a]Removal of the old magazine required two seconds average time for both 100- and 175-round-capacity magazines.
[b]Left-hand shooter. All others were right-handed.
[c]A maximum of 182 rounds can be loaded in this magazine.

Table 1.2-7. FN Machine Gun Disassembly and Reassembly Times Recorded for Four Test Personnel, Time in Minutes

Maintenance Echelon	Disassembly 1	Disassembly 2	Disassembly 3	Disassembly 4	Disassembly Avg	Reassembly [a]1	Reassembly 2	Reassembly 3	Reassembly 4	Reassembly Avg	Over-All Avg
Field	0.4	0.4	0.4	0.3	0.4	1.0	0.8	1.0	0.8	0.9	1.3
Org/DS	13.5	21.9	28.2	23.8	21.8	26.6	49.6	73.5	64.7	53.6	75.4

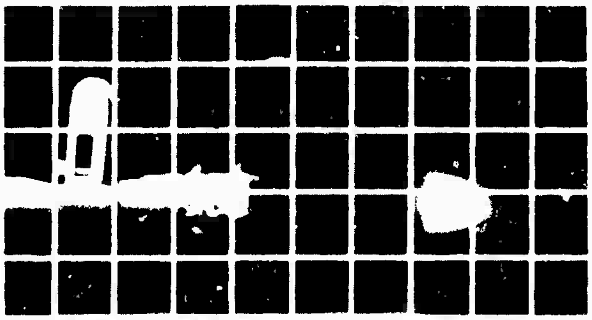
[a]Experienced in procedures for assembly and reassembly of this weapon. All others had no prior training with this weapon.

Prior to firing the weapon, a double-feed safety check was performed. Ten trials of feeding a round into the back of another round that was chambered (empty primed case) resulted in no contact of the bullet nose with the back of a chambered cartridge (strikes above and past the case rim).

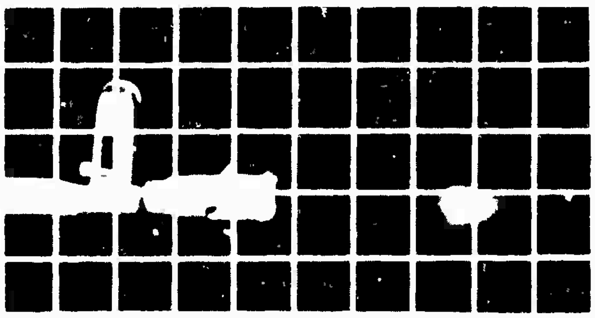
The weapon was initially fired for muzzle and breech flash observations from a test stand. Three ball and three tracer rounds were fired single-shot. There was no evidence of flash (either visually or recorded by camera). Twenty-round cumulative automatic burst fire with both types of ammunition produced approximately the same amount of visible flash. Figure 1.2-5 displays the results. No breech flash was observed during any part of this investigation.

The effects of gunsmoke on target obscuration and weapon signature were evaluated photographically. The results are shown in Figure 1.2-6. These views were taken directly behind the weapon with the target grid located 100 meters downrange (target obscuration) and from a camera located 20 feet to the right of the downrange target (weapon signature).. Both views were of the same 25-round burst, taken simultaneously, immediately after completion of firing. Wind velocity at time of firing was from right to left of the shooter, at 4 mph. Although the apparent amount of smoke is greater when viewed from downrange, the effect of having a lighter over-all background when viewed from the firing position might account for the visual difference. The tracer projectile flight paths were visible to the shooter when firing from the prone, bipod-supported position.

Function performance of the weapon was assessed during the smoke, flash, and functioning check firings which constituted the initial safety investigation. These data are tabulated in Table 1.2-8. The bolt underride (BUB) was caused by an incorrectly dimensioned ammunition belt leader tab. This tab forced the feed cover components into an elevated position when the cover was closed over the tab during loading. This allowed the round in the feed position to be underriden by the cartridge stripping lug on the bolt. The problem was eliminated by discontinuing use of the leader tab. The failure-to-eject (FJ) stoppage indicated that the weapon was not completely controlling ejection of the fired case. The actual cause was not immediately apparent, but was eventually corrected during the endurance test (refer to paragraph 1.4.3 for a complete assessment of the problem). The failure-to-feed-over (FFO) stoppage was caused by the trailing link tab snagging onto the mouth of the magazine. Remedial action to decrease the frequency of this type of stoppage could not be made until the endurance test was initiated.



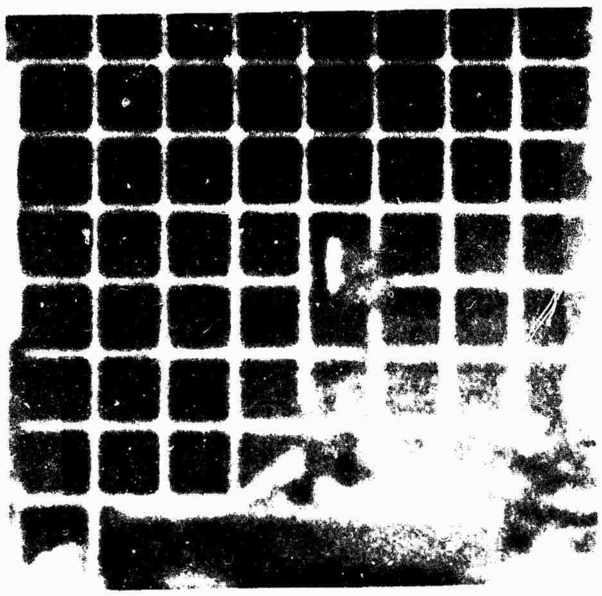
Ball



Tracer

Figure 1.2-5: Muzzle Flash Characteristics of 5.56-MM FN Machine Gun, Fired in a Continuous 20-Round Automatic Burst. Grid Scale, 1 Inch.

Target Obscuration



Weapon Signature

Figure 1.2-6: Effects of FN Machine Gun Smoke on Target Obscuration (TOP) and Weapon Signature (BOTTOM) at 100 Meters Range. Target Grid Is 12 Inches (1-Inch Wide Grid Lines).

1

Table 1.2-8. Function Performance Data for Initial Inspection and Safety Evaluation of FN Machine Gun

Gas Setting	Mag No.	Subtest Cycle No.	Ammo Type	Mode of Fire	No. Rounds Fired: Subtest Mag	No. Rounds Fired: Subtest Cycle	No. Rounds Fired: Subtest Total	No. Rounds Fired: Cum Wpn	Function Performance: Type	Function Performance: Class	Function Performance: Chg to	Cyclic Rate[a]: Before	Cyclic Rate[a]: After	Maintenance: S	Maintenance: U
Mu::zle Flash Phase															
Min	-	1	B	SS		3	3	3	Sat					F	
	100	2	B	20B		20	23	23	Sat						
		3	T	SS		3	26	26	Sat						
	100	4	T	20B		2	28	28	FJ	II	W	-	-		
	100	4	T	20B		20	48	48	Sat						
Gunsmoke Phase															
Min	100	5	4/1	25B		25	73	73	Sat					F	
200-Round Function Check															
Max	100	6	4/1	SB	1	1	74	74	BUB	II	W	-	-		
				SB	99	100	173	173	Sat						
	175	6	4/1	100B	94	194	267	267	FFO	II	W	1036	1100		
				100B	6	200	273	273	Sat					F	

[a]Rate recorded immediately before or after a malfunction. A dash indicates no rate recorded.

Mag = Magazine.

Note: Refer to Table 1.7-1 for a complete abbreviation listing.

1.2.3 Analysis

The test materiel was considered to be in satisfactory condition for use in testing. No safety hazards were observed which could not be controlled by proper operation of the weapon during clearing of malfunctions (refer to para 1.8.2). The design of the weapon prevented incorrect assembly of components by previously untrained maintenance personnel which is a desirable attribute.

1.3 ACCURACY AND DISPERSION

1.3.1 Method

This test consisted of firing five 10-round single shot targets from a benchrest at 100 meters range and five 10-round burst targets with the weapon in a prone, bipod-supported position at 100 and 300 meters range.

Projectile velocity was recorded at 15 feet from the muzzle over a 20-foot baseline during the benchrest firing phase.

Rectangular coordinates for each shot were recorded. Additionally, the first, fifth and tenth rounds of each burst were specifically located by applying lithographic ink to the tip of these projectiles; these projectiles left a colored imprint on the target.

1.3.2 Results

The computed target data are presented in Table 1.3-1 for the ten-round targets. The velocity data concurrently acquired during the 100-meter benchrest firing phase are presented in Table 1.3-2 (page 20). Further analysis of the target data, by round-firing sequence (i.e., first, fifth, tenth, and second through tenth rounds) was made so that the weapon controllability characteristics could be assessed. These data are contained in Table 1.3-3 (page 20). Function performance data of the weapon are given in Table 1.3-4 (page 21). The only malfunction which occurred was the result of incompatability between the elastomeric buffer material in the rate reducer and the solvent (PS-661B) and/or lubricant (MIL-L-46000A) used during maintenance. The buffer material distended circumferentially and prevented full retraction of the bolt carrier to a seared-up position by preventing entrance of the rate reducer into its cavity at the rear of the bolt carrier. The entire assembly was replaced with the spare unit provided in the maintenance support package. The elastomeric constituents of the new unit differed from those of the original, and they were not adversely affected by use of the solvent and lubricant.

The weapon cyclic rate was recorded for information during the 100-meter prone (bipod-supported) firings. The rate for each of five 10-round bursts was 865, 865, 860, 881, and 869 spm. The minimum gas setting was used. **Cyclic rates for the 300-meter range firings was not recorded, but should be similar to the above recorded rates.**

Table 1.3-1. Accuracy and Dispersion Test Data for FN Machine Gun

Ten Rd TGT NO.	EVD	MVD	VSD	EHD	MHD	HSD	ES	MR	CI H	CI V	RSD
Ball Ctg			Benchrest (Single-Shot)								100 Meters
F100.121	7.2	1.7	2.2	3.7	0.6	0.9	7.2	2.0	-0.1	2.9	2.4
F100.122	8.5	1.9	2.5	3.5	1.0	1.2	8.5	2.4	0.1	0.2	2.8
F100.123	5.6	1.9	2.1	4.5	1.1	1.5	5.7	2.3	-0.8	0.4	2.6
F100.124	5.6	1.8	2.1	6.2	1.2	1.8	7.4	2.3	0.3	1.9	2.8
F100.125	4.9	1.4	1.7	3.5	1.0	1.2	5.3	1.8	0.1	2.0	2.1
MEAN	6.4	1.7	2.1	4.3	1.0	1.3	6.8	2.2	-0.1	1.5	2.5
Tracer Ctg			Benchrest (Single-Shot)								100 Meters
F100.131	10.1	2.8	3.5	11.0	2.3	3.1	14.9	3.9	2.4	-4.3	4.7
F100.132	8.0	2.6	3.1	7.1	2.0	2.4	9.2	3.4	1.2	-5.5	4.0
F100.133	11.5	2.6	3.3	5.2	1.8	2.1	12.4	3.3	2.5	-6.4	3.9
F1CC.134	7.4	1.8	2.4	9.8	3.1	3.7	9.8	4.0	2.2	-5.3	4.4
F100.135	11.4	3.0	3.6	6.1	1.7	2.0	11.4	3.6	-3.5	-5.6	4.2
MEAN	9.7	2.6	3.2	7.8	2.2	2.7	11.6	3.6	0.9	-5.4	4.2
Ball Ctg				Bipod (10-round burst)							100 Meters
F100141	16.1	5.0	5.7	12.0	3.7	4.3	17.8	6.5	5.3	10.6	7.2
F100142	11.[illegible]	2.2	3.1	13.1	2.7	3.7	13.2	4.0	-5.0	6.0	4.8
F100143	15.1	3.3	4.6	13.8	3.2	4.4	16.4	5.6	-1.0	14.0	6.4
F100144	[illegible]	3.3	4.0	5.7	1.7	2.0	11.2	3.9	5.6	11.1	4.4
F100145	14.5	3.0	4.3	4.2	1.3	1.6	15.0	3.5	0.2	12.1	4.5
MEAN	13.6	3.4	4.3	9.8	2.5	3.2	14.7	4.7	1.0	10.7	5.5
4-Ball/1-Tracer Ctg				Bipod (10-round burst)							300 Meters
F1300141	29.7	7.1	9.5	27.8	6.8	8.4	35.4	10.8	0.5	8.6	12.7
F1300142	46.7	8.9	12.9	13.2	4.0	4.7	47.0	10.5	16.0	-1.7	13.8
F1300143	22.8	7.0	8.3	41.1	7.4	11.0	41.3	10.9	9.3	24.2	13.8
F1300144	46.5	9.2	13.2	31.1	6.6	9.4	46.6	13.0	-2.5	-9.3	16.2
F1300145	36.8	7.5	10.6	25.2	7.1	9.3	45.6	10.9	-23.5	9.2	14.1
MEAN	36.7	8.0	10.9	28.5	6.4	8.6	43.2	11.2	-0.0	6.2	14.1

Table 1.3-2. Instrumental Velocity Data during FN Machine Gun Accuracy Firings

Ctg Type	Tgt No.	Vel, fps, by Round No. 1	2	3	4	5	6	7	8	9	10	Avg
Ball	1	2978	2970	2960	2996	2964	2961	2946	2967	2964	2951	2966
	2	2958	2921	2955	2970	2930	2953	2968	2967	2974	2950	2955
	3	2968	2979	2971	2974	2955	2963	2964	2961	3002	2964	2971
	4	2954	2963	2969	2974	2937	2958	2981	2964	2969	2920	2959
	5	2966	2969	2961	2972	2970	2996	2977	2962	2975	2982	2974
Ball	All											2965
Tracer	1	2655	2615	2613	2625	2611	2624	2613	2637	2630	2613	2624
	2	2613	2608	2615	2593	2621	2618	2613	2618	2621	2628	2615
	3	2637	2642	2617	2620	2618	2633	2602	2656	2629	2632	2632
	4	2637	2622	2628	2647	2628	2647	2634	2605	2627	2642	2632
	5	2621	2642	2631	2627	2626	2601	2635	2633	2613	2636	2627
Tracer	All											2625

Table 1.3-3. Shot Distribution Characteristics by Round Sequence for FN Machine Gun[a]

Range, meters	Rd No.	Ctg Type	Target Measurements, inches EVD	MVD	VSD	EHD	MHD	HSD	ES	MR	Hor	Vert	RSD
100	1	Ball	4.9	1.4	1.9	5.1	1.3	1.9	7.1	1.9	-0.5	3.3	2.7
	2-10	Ball	18.2	3.8	4.5	20.5	4.5	5.4	21.1	6.4	1.2	11.6	7.1
300	1	Ball	33.5	11.8	14.3	14.5	5.5	6.5	33.5	13.2	0.9	18.5	15.7
	5	Tracer	35.8	13.5	16.0	49.6	16.3	20.2	49.7	22.5	1.7	- 1.6	25.8
	10	Tracer	46.7	12.0	17.1	35.0	14.6	16.8	55.9	20.3	0.9	2.5	24.0
	2-10	Mix	58.6	12.7	15.3	59.5	14.1	16.7	67.0	21.0	-0.1	4.8	22.7

[a]The data in this table are for a 50-round sample at each range.

Table 1.3-4. Function Performance Data for FN Machine Gun Accuracy and Dispersion Test

Gas Setting	Magazine No.	Subtest Cycle No.	Ammo Type	Mode of Fire	No. Rounds Fired: Subtest: Magazine	No. Rounds Fired: Subtest: Cycle	No. Rounds Fired: Subtest: Total	No. Rounds Fired: Cum Wpn	Function Performance: Type	Function Performance: Class	Function Performance: Chg To	Function Performance: Cyclic Rate[a]: Before	Function Performance: Cyclic Rate[a]: After	Maintenance: S	Maintenance: U
Minimum	-	1	B	SS	-	15	15	288							
	-	1	B	SS	-	50	65	338							
	-	2	T	SS	-	50	115	388							
	-	3	4/1	10B	-	0	115	388	FSU	III	W	-	-		F
	-	3	4/1	10B	-	50	165	438							
	-	4	B	SS	-	6	171	444							
	-	4	4/1	10B	-	50	221	494							

[a]A dash indicates no cyclic rate recorded.

Note: Refer to Table 1.7-1 for a complete abbreviation listing.

1.3.3 Analysis

The general trend of greatest single (aimed) shot dispersion is in the vertical plane. This is caused by the weapon being an open-bolt firing design. This design allows weapon movement as the bolt travels forward after release from the sear to strip, chamber, and fire the round. This trend continues when automatic burst firing is conducted with the weapon fired from the prone, bipod-supported position. In the instance where a mix of ball and tracer ammunition is fired in a ratio of 4-ball to 1-tracer cartridge, the vertical component of dispersion will tend to increase due to the difference in velocity of the two projectile types. It is surmised from this velocity difference that the ball and tracer rounds may not be ballistically matched. The apparent differences in results using the same data, between Table 1.3-1 and 1.3-3 is due to the manner that the data were reported. The Table 1.3-1 data are averages of 10 rounds, while the information in Table 1.3-3 is based on a single composite of 50 rounds.

The shift in shot group center-of-impact from the first aimed rounds in a burst to the remaining rounds fired was minimal in the horizontal direction. This indicates that the gunner could control the direction of fire to a high degree. In weapons with a higher recoil force, it is common for the location of first aimed rounds to be noticeably separated from the location of the remaining rounds either to the right or left, dependent on whether the weapon is fired right-handed or left-handed.

The nonmetallic components of the buffer/rate reducer mechanism in the replacement assembly were of an improved material, and were not adversely affected by the use of solvents or lubricants. The shortcoming of incompatible materials was considered corrected.

1.4 ENDURANCE TEST AT NORMAL AMBIENT RANGE TEMPERATURE

1.4.1 Method

The weapon was cleaned with PS-661B type solvent and lubricated with semi-fluid oil conforming to specification MIL-L-46000A. Firing was conducted in 200-round cycles in accordance with the schedule given in Table 1.4-1. The weapon was cooled after each cycle and cleaned, inspected, and relubricated after each 10 cycles. Weapon accuracy and dispersion, and projectile velocity and stability were checked at each maintenance interval. Cyclic rate of fire was recorded throughout testing when fired from the bipod.

Table 1.4-1. Firing Schedule for Endurance Testing at Normal Ambient Range Temperature

Cycle No.[a]	Magazine No.	Mode of Fire	Firing Position
1	100	SB	Shoulder
	175	SB	Shoulder
2	100	SB	Bipod
	175	SB	Bipod
3	100	20B	Bipod
	175	20B	Bipod
4	100	SB	Bipod
	175	SB	Bipod
5	100	50B	Bipod
	175	50B	Bipod
6	100	SB	Bipod
	175	SB	Bipod
7	100	20B	Hip
	175	20B	Hip
8	100	SB	Hip
	175	SB	Hip
9	100	SB	Hip
	175	SB	Hip
10	100	SB	Hip
	175	SB	Hip
11	-	SS	BR
	100	SB	Shoulder
	175	SB	Shoulder
12	100	SB	Hip
	175	50B	Hip
13	100	SB	Hip
	175	SB	Hip
14	100	SB	Hip
	175	SB	Hip
15	100	SB	Hip
	175	SB	Hip
16	100	SB	Bipod
	175	SB	Bipod
17	100	SB	Bipod
	175	SB	Bipod
18	100	SB	Bipod
	175	SB	Bipod
19	100	20B	Bipod
	175	20B	Bipod
20	100	SB	Bipod
	175	SB	Bipod
21	-	SS	BR
	100	SB	Bipod
	175	SB	Bipod
22	100	SB	Hip
	175	SB	Hip
23	100	20B	Hip
	175	20B	Hip
24	100	SB	Hip
	175	SB	Hip
25	100	SB	Hip
	175	SB	Hip
26	100	SB	Shoulder
	175	SB	Shoulder
27	100	SB	Bipod
	175	SB	Bipod
28	100	SB	Bipod
	175	SB	Bipod
29	100	SB	Bipod
	175	SB	Bipod
30	100	SB	Bipod
	175	SB	Bipod
31	-	SS	BR

[a]Consists of 100 rounds fired from each magazine per cycle, except the single-shot benchrest firings for accuracy which were in addition to these totals.

Note: Refer to Table 1.7-1 for a complete abbreviation listing.

1.4.2 Results

A total of 6159 rounds was fired in this subtest. The function performance data for the weapon and ammunition are presented in Table 1.4-2. The accuracy and dispersion data and the velocity data recorded at 2000-round intervals during testing are presented in Tables 1.4-3 and 1.4-4 (pages 31 and 32) respectively. Cyclic rate of fire information is tabulated in Table 1.4-5 (page 33). A magnetic-particle inspection of the weapon components previously inspected (refer to Figure 1.2-1) was repeated at the completion of the endurance test. With the exception of one small crack in the receiver shell (Figure 1.4-1, page 34) which was not present during the initial inspection, there was no change in the number or extent of material discontinuities. Data relating to maintenance and human factors aspects of this subtest are contained in paragraphs 1.7 and 1.8, respectively.

Table 1.4-2 Function Performance Data For FN Machine Gun Endurance Test

Gas Setting	Magazine No.	Subtest Cycle No.	Ammo Type	Mode of Fire	No. Rounds Fired: Subtest: Magazine	No. Rounds Fired: Subtest: Cycle	No. Rounds Fired: Subtest: Total	No. Rounds Fired: Cum Wpn	Function Performance: Type	Function Performance: Class	Function Performance: Chg To	Function Performance: Cyclic Rate[a]: Before	Function Performance: Cyclic Rate[a]: After	Maintenance: S	Maintenance: U
Med	100	1	4/1	SB	1	1	1	495	FJ	II	W	-	-		
Min					24	25	25	519	FJ	II	WR	-	-		
					75	100	100	594							
	175	1	4/1		75	175	175	669	FJ	II	WR	-	-		
					25	200	200	694	Sat						
	100	2	4/1	SB	60	60	260	754	FJ	II	WR	-	-		
					40	100	300	794	Sat						
	175	2	4/1	SB	14	114	314	808	FJ	II	WR	937	951		
					79	193	393	887	FFO	II	WR	-	-		
					7	200	400	894	Sat						
	100	3	4/1	20B	35	35	435	929	FJ	II	WR	1021	-		
Med					19	54	454	948	BUB	II	W	-	-		
					1	55	455	949	FJ	II	WR	-	937		
					38	93	493	987	FFO	II	WR	944	895		
					7	100	500	994	Sat						
	175	3	4/1	20B	0	100	500	994	BUB	II	P	-	1194		
					86	186	586	1080	BUB	II	W	-	-		
					7	193	593	1087	FFO	II	WR	936	951		
					7	200	600	1094	Sat						

[a]Rate recorded immediately before and after a malfunction. A dash indicates no rate recorded.

Table 1.4-2 (Cont'd)

Gas Setting	Magazine No.	Subtest Cycle No.	Ammo Type	Mode of Fire	No. Rounds Fired: Subtest: Magazine	No. Rounds Fired: Subtest: Cycle	No. Rounds Fired: Subtest: Total	No. Rounds Fired: Cum Wpn	Function Performance: Type	Function Performance: Class	Function Performance: Chg To	Function Performance: Cyclic Rate[a]: Before	Function Performance: Cyclic Rate[a]: After	Maintenance: S	Maintenance: U
Max	100	4	4/1	SB	100	100	700	1194	Sat						
	175	4	4/1	SB	93	193	793	1287	FFO	II	WR	631	1070		
					7	200	800	1294	Sat						
	100	5	4/1	50B	14	14	814	1308	FJ	II	WR	991	990		
					79	93	893	1387	FFR	I	W	1045	1087		
					7	100	900	1394	Sat						
	175	5	4/1	50B	57	157	957	1451	FRA	II	P	1082	1104		
					43	200	1000	1494							
	100	6	4/1	SB	0	0	1000	1494	FC	I	A	-	1020		
					100	100	1100	1594	Sat						
	175	6	4/1	SB	93	193	1193	1687	FFO	II	WR	1090	1063		
					7	200	1200	1694	Sat						
	100	7	4/1	20B	0	0	1200	1694	BUB	II	P	-	-		
					94	94	1294	1788	FFO	II	WR	-	-		
					6	100	1300	1794	Sat						
	175	7	4/1	20B	98	198	1398	1892	FJ	II	WR	-	-		
					2	200	1400	1894	Sat						
	100	8	4/1	SB	8	8	1408	1902	FRA	II	P	-	-		
					1	9	1409	1903	FJ	II	WR	-	-		
					86	95	1495	1989	FJ	II	WR	-	-		
					5	100	1500	1994	Sat						

[a]Rate recorded immediately before and after a malfunction. A dash indicates no rate recorded.

Table 1.4-2 (Cont'd)

Gas Setting	Magazine No.	Subtest Cycle No.	Ammo Type	Mode of Fire	No. Rounds Fired: Subtest: Magazine	No. Rounds Fired: Subtest: Cycle	No. Rounds Fired: Subtest: Total	No. Rounds Fired: Cum Wpn	Function Performance: Type	Function Performance: Class	Function Performance: Chg To	Function Performance: Cyclic Rate[a]: Before	Function Performance: Cyclic Rate[a]: After	Maintenance: S	Maintenance: U
	175	8	4/1	SB	93	193	1593	2087	FFO	II	WR	-	-		
					7	200	1600	2094	Sat						
	100	9	4/1	SB	93	93	1693	2187	FFO	II	WR	-	-		
					7	100	1700	2194	Sat						
	175	9	4/1	SB	54	154	1754	2248	FX	II	WR	-	-		
					46	200	1800	2294	Sat						
	100	10	4/1	SB	93	93	1893	2387	FFO	II	WR	-	-		
					7	100	1900	2394	Sat						
	175	10	4/1	SB	30	130	1930	2424	FF	I	W	-	-		
					63	193	1993	2487	FFO	II	WR	-	-		
					7	200	2000	2494	Sat						
														0	
Min		11	B	SS		53	2053	2547	Sat						
	100	11	4/1	SB	100	153	2153	2647	Sat						
	175	11	4/1	SB	100	253	2253	2747	Sat						
	100	12	4/1	SB	100	100	2353	2847	Sat						
	175	12	4/1	50B	100	200	2453	2947	Sat						
	100	13	4/1	SB	59	59	2512	3006	FF	II	P	-	-		
					41	100	2553	3047	Sat						
	175	13	4/1	SB	100	200	2653	3147	Sat						
	100	14	4/1	SB	100	100	2753	3247	Sat						
	175	14	4/1	SB	100	200	2853	3347	Sat						
	100	15	4/1	SB	100	100	2953	3447	Sat						
	175	15	4/1	SB	86	186	3039	3533	FF	II	WR	-	-		
					14	200	3053	3547	Sat						

[a]Rate recorded immediately before and after a malfunction. A dash indicates no rate recorded.

Table 1.4-2 (Cont'd)

Gas Setting	Magazine No.	Subtest Cycle No.	Ammo Type	Mode of Fire	No. Rounds Fired: Subtest: Magazine	Cycle	Total	Cum Wpn	Function Performance: Type	Class	Chg To	Cyclic Rate[a]: Before	After	Maintenance: S	U
	100	16	4/1	SB	100	100	3153	3647	Sat						
	175	16	4/1	SB	100	200	3253	3747	Sat						
	100	17	4/1	SB	100	100	3353	3847	Sat						
	175	17	4/1	SB	100	200	3453	3947	Sat						
	100	18	4/1	SB	100	100	3553	4047	Sat						
	175	18	4/1	SB	100	200	3653	4147	Sat						
	100	19	4/1	20B	100	100	3753	4247	Sat						
	175	19	4/1	20B	100	200	3853	4347	Sat						
	100	20	4/1	SB	100	100	3953	4447	Sat						
	175	20	4/1	SB	100	200	4053	4547	Sat						
	-	21	B	SS	53	53	4106	4600	Sat					F	
														O	-
Min	100	21	4/1	SB	100	100	4206	4700	Sat						
	175	21	4/1	SB	100	200	4306	4800	Sat						
	100	22	4/1	SB	100	100	4406	4900	Sat						
	175	22	4/1	SB	100	200	4506	5000	Sat						
	100	23	4/1	20B	100	100	4606	5100	Sat						
	175	23	4/1	20B	0	100	4606	5100	PS	II	W	-	-		
					100	200	4706	5200	Sat						
	100	24	4/1	SB	74	74	4780	5274	BUB	II	W	-	-		
					26	100	4806	5300	Sat						
	175	24	4/1	SB	100	200	4906	5400	Sat						
	100	25	4/1	SB	100	100	5006	5500	Sat						
	100	26	4/1	SB	100	100	5206	5700	Sat						
	175	26	4/1	SB	100	200	5306	5800	Sat						
	100	27	4/1	SB	100	100	5406	5900	Sat						

[a]Rate recorded immediately before and after a malfunction. A dash indicates no rate recorded.

Table 1.4-2 (Cont'd)

Gas Setting	Magazine No.	Subtest Cycle No.	Ammo Type	Mode of Fire	No. Rounds Fired: Subtest: Magazine	No. Rounds Fired: Subtest: Cycle	No. Rounds Fired: Total	No. Rounds Fired: Cum Wpn	Function Performance: Type	Function Performance: Class	Function Performance: Chg To	Function Performance: Cyclic Rate[a]: Before	Function Performance: Cyclic Rate[a]: After	Maintenance: S	Maintenance: U
	175	27	4/1	SB	100	200	5506	6000	Sat						
	100	28	4/1	SB	100	100	5606	6100	Sat						
	175	28	4/1	SB	100	200	5706	6200	Sat						
	100	29	4/1	SB	100	100	5806	6300	Sat						
	175	29	4/1	SB	100	200	5906	6400	Sat						
	100	30	4/1	SB	100	100	6006	6500	Sat						
	175	30	4/1	SB	100	200	6106	6600	Sat						
	-	31	B	SS	-	53	6159	6653	Sat					F O	

[a]Rate recorded immediately before and after a malfunction. A dash indicates no rate recorded.

Note: Refer to Table 1.7-1 for a complete abbreviation listing.

Table 1.4-3. Accuracy and Dispersion Data during Endurance Test of FN Machine Gun

TGT NO.	EVD	MVD	VSD	EHD	MHD	HSD	ES	MR	CI H	CI V	RSD
Ball Ctg	Benchrest (Single-Shot)				After 2000 Rounds Endurance Testing					100 Meters	
F11CC121	7.4	2.1	2.5	2.0	0.5	0.6	7.4	2.2	1.3	7.8	2.6
F11CC122	7.1	2.0	2.4	2.6	0.6	0.8	7.6	2.2	0.6	7.5	2.5
F1100123	6.2	1.6	2.1	3.4	1.0	1.1	6.4	2.0	-0.2	5.4	2.4
F11CC124	6.8	1.5	2.C	3.6	0.8	1.0	7.3	1.8	-0.3	6.2	2.3
F11C0125	4.8	1.4	1.6	3.7	0.9	1.2	4.8	1.8	0.5	6.0	2.0
MEAN	6.5	1.7	2.1	3.1	0.7	0.9	6.7	2.0	0.4	6.6	2.4
					After 4000 Rounds Endurance Testing						
F11C0121	8.9	3.C	3.4	2.4	0.7	0.8	9.0	3.2	1.6	6.3	3.5
F11C0122	5.C	1.2	1.5	3.2	0.9	1.1	5.2	1.6	-0.5	5.3	1.9
F11C0123	8.0	2.1	2.5	2.7	0.6	0.8	8.1	2.3	-0.6	4.8	2.7
F11C0124	5.6	1.6	1.9	4.9	1.0	1.4	6.6	2.0	-0.9	7.7	2.4
F11CC125	6.7	1.7	2.2	3.9	0.9	1.1	7.2	2.1	-1.9	7.6	2.5
MEAN	6.8	1.9	2.3	3.4	0.8	1.0	7.2	2.2	-0.4	6.3	2.6
					After 6000 Rounds Endurance Testing						
F11CC201	9.1	1.9	2.6	4.7	1.3	1.7	9.1	2.6	-1.8	11.6	3.1
F11CC202	9.0	2.1	2.7	1.9	0.6	0.7	9.1	2.3	-1.6	8.8	2.8
F11C0203	11.9	2.5	3.4	5.3	1.2	1.6	13.0	2.9	-0.8	7.0	3.8
F11CC2C4	6.C	1.4	1.8	2.2	0.5	0.7	6.0	1.5	-1.9	10.1	1.9
F11CC205	4.3	1.2	1.5	3.4	1.0	1.2	4.4	1.7	-2.8	10.6	1.9
MEAN	8.1	1.8	2.4	3.5	0.9	1.2	8.3	2.2	-1.8	9.6	2.7

Table 1.4-4 Velocity Data Recorded Concurrently With Accuracy and Dispersion Data During Endurance Testing of FN Machine Gun[a]

Target Sequence	Avg	Max	Min	Ext	SD
		After 2000 rounds			
First	2987	2999	2958	41	12.01
Second	2987	3012	2970	42	12.52
Third	2974	2987	2959	28	12.10
Fourth	2975	2998	2958	40	12.11
Fifth	2980	2992	2961	31	9.96
Avg	2980	2998	2961	36	11.74
		After 4000 rounds			
First	2957	2978	2929	49	15.73
Second	2950	2974	2924	50	16.72
Third	2960	2971	2950	21	8.01
Fourth	2941	2959	2920	39	10.86
Fifth	2951	2977	2931	46	13.12
Avg	2952	2972	2931	41	12.89
		After 6000 rounds			
First	2941	3017	2917	100	27.92
Second	2933	2959	2915	44	15.14
Third	2928	2947	2912	35	11.86
Fourth	2930	2948	2907	41	11.73
Fifth	2924	2947	2905	42	16.83
Avg	2931	2964	2911	52	16.70

[a]Only ball ammunition used for accuracy and velocity acquisition.

Table 1.4-5 Cyclic Rate of Fire Data During Endurance Test of FN Machine Gun

Cycle No.	Cyclic Rate[a], spm Beginning	End	Net Change	Gas Setting	Mode of Fire
2	904	923	19	Minimum	SB
3	903	950	47	Medium	20B
4	976	1063	87	Maximum	SB
5	990	1093	103	Maximum	50B
6	1023	1076	53	Maximum	SB
16	914	1043	129	Minimum	SB
17	931	1032	101	Minimum	SB
18	919	1004	85	Minimum	SB
19	930	1032	102	Minimum	20B
20	916	1039	123	Minimum	SB
21	848	1033	185	Minimum	SB
27	944	1032	88	Minimum	SB
28	962	1013	51	Minimum	SB
29	948	1026	78	Minimum	SB
30	932	1032	100	Minimum	SB
Avg	936	1026	90	-	-

[a]Beginning and end of each cycle. Average of four short bursts or two 20- or 50-round bursts.

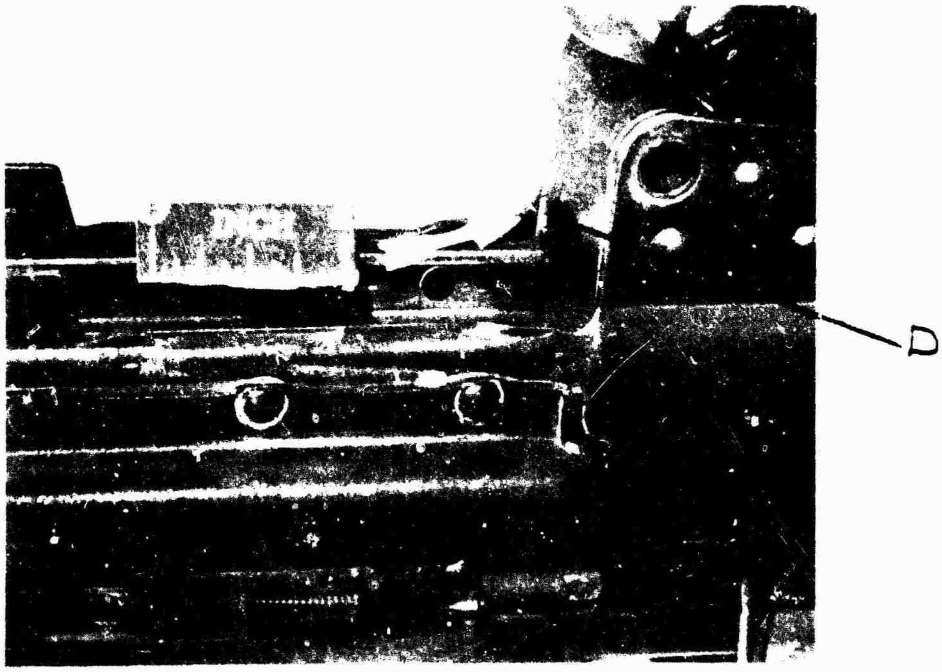


Figure 1.4-1 Magnetic-Particle Inspection of Part No. 29 (Receiver Shell) Showing 1/16 x 1/32 - Inch Length Crack in Area D (Arrow). Inspected after Endurance Test.

1.4.3 Analysis

The accuracy and dispersion characteristics of the ammunition were not seriously degraded by the effects of firing 6000 rounds through the weapon barrel.

Weapon cyclic rate of fire was only partially controlled by the buffer/rate reducer mechanism during the test. This is indicated by the increase in cyclic rate which occurred between the second and 16th cycles (3200 rounds), and thereafter.

Function performance of the weapon was generally satisfactory. The repetitive malfunctions which occurred during the first 2000-round maintenance interval were the result of weapon design. The ejection failures (FJ) were caused by the extractor failing to adequately control the position of the fired case. The feeding failures (FFO) were caused by the trailing link in the ammunition belt catching on the upper edge of the magazine ammunition egress. These problems were corrected by replacing the extractor and extractor spring with components of current (improved) design, and performing a field-expedient modification of the magazines by addition of material to prevent link snagging. They were classified as corrected weapon shortcomings. The contractor indicated that these changes had been incorporated in weapons of current (third) design. The weapon being tested at APG (first design) was not the latest configuration although the basic design representative of concept was not altered by subsequent product improvements.

The periodic occurrence of failures of the magazine to remain in assembly with the weapon during firing (FRA) was a problem. The cause of this failure is related to an inadequate design for human factors and was rated as a shortcoming. A complete discussion of the problem is contained in paragraph 1.8.2.

1.5 HIGH TEMPERATURE ENVIRONMENT TEST (+155°F)

1.5.1 Method

The weapon was cleaned with PS-661B type solvent and lubricated with semi-fluid oil conforming to specification MIL-L-46000A. The weapon and 1000 rounds of ammunition (linked 4-ball to 1-tracer) were then introduced into the environmental chamber and the temperature raised to +155°F. The test materiel was maintained at this temperature a minimum of 4 hours prior to initiation of firing. A minimum of 30 minutes was allowed between each 200-round cycle of firing to preclude the possibility of creating a cartridge cook-off condition. Projectile velocity was recorded at the beginning and end of this test. No scheduled maintenance was planned during firing. The components originally subjected to magnetic-particle inspection were reinspected after this test. The test firing schedule is presented in Table 1.5-1.

Table 1.5-1. High-Temperature Test Schedule

Firing Cycle No.	Magazine No.	Mode of Fire[a]	No. Rd
1	-	SS	22
	100	SB	78
	175	SB	100
2	100	SB	100
	175	SB	100
3	100	20B	100
	175	20B	100
4	100	SB	100
	175	SB	100
5	100	50B	100
	175	50B	80
	-	SS	20

[a]All rounds fired with weapon supported on benchrest by bipod.

Note: Refer to Table 1.7-1 for a complete abbreviation listing.

1.5.2 Results

The weapon and ammunition functioning performance data for this subtest are presented in Table 1.5-2 (page 37). The velocity and projectile stability observations are given in Table 1.5-3 (page 38). Table 1.5-4 (page 38) contains the cyclic rate of fire information recorded during this evaluation.

The bolt (part No. 22) exhibited a crack in the area of the extractor pin hole, extending 1/16 inch from the edge toward the body. Figure 1.5-1 (page 38) shows this location. The only other new crack found was located in the receiver shell (part No. 29) on the right side in area D (refer to Figure 1.4-1 for location). The 1/16 by 1/32-inch dimension was the same as the D-area crack previously found on the left side of this part. All previously existing cracks were dimensionally unchanged from the previous inspection.

The maintenance and human factors aspects of this test are presented in their entirety in paragraphs 1.7 and 1.8, respectively.

Table 1.5-2. Function Performance Data For High Temperature Test (+155°F) of FN Machine Guns

					No. Rounds Fired				Function Performance					Maintenance	
					Subtest							Cyclic Rate[a]			
Gas Setting	Magazine No.	Subtest Cycle No.	Ammo Type	Mode of Fire	Magazine	Cycle	Total	Cum Wpn	Type	Class	Chg To	Before	After	S	U
Min	-	1	B	SS	-	22	22	6675	Sat						
	175	1	4/1	SB	17	39	39	6692	FRA	II	P	907	881		
					61	100	100	6753	Sat						
	100	1	4/1	SB	100	200	200	6853	Sat						
	100	2	4/1	SB	15	15	215	6868	FRA	II	P	-	-		
					85	100	300	6953	Sat						
	175	2	4/1	SB	100	200	400	7053	Sat						
	100	3	4/1	20B	100	100	500	7153	Sat						
	175	3	4/1	20B	100	200	600	7253	Sat						
	100	4	4/1	SB	100	100	700	7353	Sat						
	175	4	4/1	SB	100	200	800	7453	Sat						
	100	5	4/1	50B	100	100	900	7553	Sat						
	175	5	4/1	50B	80	180	980	7633	Sat						
		5	Ball	SS	20	200	1000	7653	Sat						
														0	

[a]Recorded immediately before or after a malfunction. A dash indicates no rate recorded.

Note: Refer to Table 1.7-1 for a complete abbreviation listing.

Table 1.5-3. Projectile Velocity and Stability Data, High Temperature Test (+155°F) of FN Machine Gun

No. Rd	Test Period	Avg	Max	Min	Extreme	SD
20	Beginning	3008	3039	2965	74	20.0
20	End	2999	3031	2966	65	16.1
Avg	-	3004	3035	2965	70	18.0

Observations for yaw were made for 1000 rounds; no rounds exhibited yaw in excess of 15°.

Table 1.5-4. Cyclic Rate of Fire Data For High Temperature Test (+155°F) of FN Machine Gun

Cycle No.	Cyclic Rate[a], spm Beginning	End	Net Change	Mode of Fire
1	886	1053	167	SB
2	-	-	-	SB
3	996	996	0	20B
4	945	1008	63	SB
5	986	989	3	50B
Avg	953	1012	58	-

[a]Minimum gas setting used throughout test.

Note: Refer to Table 1.7-1 for a complete abbreviation listing.

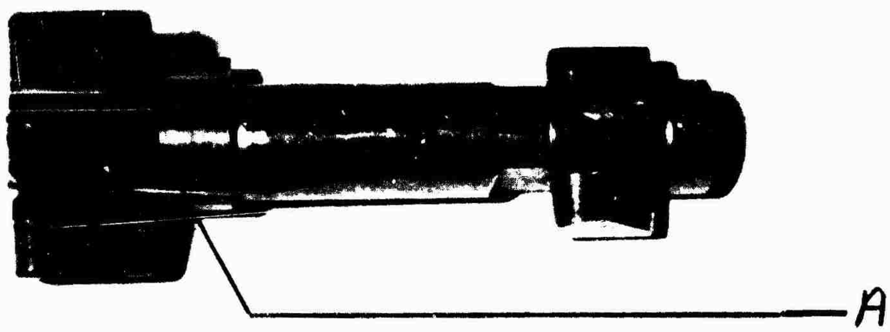


Figure 1.5-1: Location of Crack in Bolt (Part No. 22) Observed After High Temperature Test (+155°F).

1.5.3 Analysis

The weapon and ammunition function performance was satisfactory.

1.6 LOW TEMPERATURE ENVIRONMENTAL TEST (-50°F)

1.6.1 Method

The weapon was cleaned with PS-661B type solvent and lubricated with oil conforming to specification MIL-L-14107B. The same testing procedures used during the high temperature test were also used here, except for the initial conditioning period of 6 hours and 2-hour reconditioning periods between cycles.

1.6.2 Results

The weapon and ammunition functioning performance data for this test are presented in Table 1.6-1. The projectile velocity and stability observations are given in Table 1.6-2 (page 41). Table 1.6-3 (page 41) contains the cyclic rate of fire information recorded during this evaluation.

The magnetic-particle inspection conducted after this test revealed that there were no new cracks or increases in the extent of existing cracks in the various component parts.

The maintenance and human factors aspects of this test are presented in their entirety in paragraphs 1.7 and 1.8, respectively.

Table 1.6-1. Function Performance Data For Low Temperature Environment Test (-50°F) For FN Machine Gun

					No. Rounds Fired				Function Performance					Maintenance	
					Subtest							Cyclic Rate[a]			
Gas Setting	Magazine No.	Subtest Cycle No.	Ammo Type	Mode of Fire	Magazine	Cycle	Total	Cum Wpn	Type	Class	Chg To	Before	After	S	U
Min	-	1	B	SS	-	21	21	7674	Sat						
	100	1	4/1	SB	79	100	100	7753	Sat						
	175	1	4/1	SB	100	200	200	7853	Sat						
	100	2	4/1	SB	0	0	200	7853	PS	II	W	-	641		
					100	100	300	7953	Sat						
	175	2	4/1	SB	50	150	350	8003	FRA	II	P	-	-		
					50	200	400	8053	Sat						
	100	3	4/1	20B	23	23	423	8076	PS	II	W	555	569		
					27	50	450	8103	FRA	II	P	569	592		
					50	100	500	8153	Sat						
	175	3	4/1	20B	0	100	500	8153	PS	I	W	565	644		
					100	200	600	8253	Sat						
	100	4	4/1	SB	4	4	604	8257	PS	I	W	-	-		
					1	5	605	8258	PS	I	W	-	-		
					2	7	607	8260	PS	I	W	-	-		
Med					8	15	615	8268	PS	I	W	-	-		
					8	23	623	8276	IFR	I	W	-	-		
					3	26	626	8279	PS	I	W	-	-		
Max					35	61	661	8314	FRA	II	P	-	-		
					39	100	700	8353	Sat						
	175	4	4/1	SB	50	150	750	8403	FRA	II	P	-	-		
					50	200	800	8453	Sat						
	100	5	4/1	50B	80	80	880	8533	FFO	II	W	742	638		
					10	90	890	8543	FFO	II	W	638	491		F
					10	100	900	8553	Sat			933	-		
	175	5	4/1	50B	80	180	980	8633	Sat						
		5	B	SS	20	200	1000	8653	Sat						
														0	

[a]Recorded immediately before or after a malfunction. A dash indicates no rate recorded.

Note: Refer to Table 1.7-1 for a complete abbreviation listing.

Table 1.6-2. Projectile Instrumental Velocity Data, Low Temperature Test (-50°F) of FN Machine Gun

No. Rd	Test Period	Velocity, fps Avg	Max	Min	Extreme	SD
20	Beginning	2763	2789	2716	73	19.6
20	End	2731	2770	2685	85	24.3
Avg	-	2747	2780	2700	79	22.0

No rounds yawed in excess of 15 degrees; observations were made continuously for 1000 rounds.

Table 1.6-3. Cyclic Rate of Fire Data For Low Temperature Test (-50°F) of FN Machine Gun

Cycle No.	Cyclic Rate, spm Beginning	End	Net Change	Mode of Fire
[a]1	723	889	166	SB
[a]2	634	878	244	SB
[a]3	573	877	304	20B
[a,b,c]4	495	935	440	SB
[c]5	745	966	221	50B
Avg	634	909	275	-

[a]Minimum gas setting used.
[b]Medium gas setting used.
[c]Maximum gas setting used.

Note: Refer to Table 1.7-1 for a complete abbreviation listing.

1.6.3 Analysis

The function performance of the ammunition and weapon was generally satisfactory. The increase in malfunctions caused by residual fouling deposits and/or lack of lubrication during cycle number four (600 to 800 rounds) was partially alleviated by increasing the amount of propellant gas used to drive the mechanism. Preventive maintenance completely restored weapon operation as indicated by cyclic rate increase.

1.7 MAINTENANCE EVALUATION

1.7.1 Method

The data generated during the firing tests (i.e., para 1.2 to 1.6) were collectively presented in this subtest for all scheduled and unscheduled maintenance actions (including preventive maintenance). Assessment of malfunctions by class was made. Other aspects of maintenance including safety, parts replacement, and design for maintainability were investigated. The human factors aspects of the maintenance operation is presented in paragraph 1.8.

1.7.2 Results

The basic tabulations of data which establishes the basis for the follow-on analysis are contained in six tables. Table 1.7-1 (page 43) provides a complete listing of the abbreviations and their definitions used in the remaining tables. This table is also applicable to all other portions of this report. Tables 1.7-2 through 1.7-4 (pages 45 through 47) are an over-all sequential presentation of data by type, category, and round of occurrence. Table 1.7-3 provides the same data tabulation by type (i.e., chargeable or nonchargeable) and subtest, for all classes of malfunctions. The third table in this series (Table 1.7-4) rearranges the same data by type and class, and by subtest, for all malfunctions. Computation of malfunction rate per 1000 rounds fired and the mean rounds between failure (MRBF) are presented in Table 1.7-5 (page 48).

A complete listing of the maintenance actions occurring during testing is given in Table 1.7-6 (page 49). The component part failures, previously listed in Table 1.7-6 under the remarks column are presented separately, with more detailed information, in Table 1.7-7 (page 52).

Throughout testing, there were no safety hazards found in the weapon design which would cause severe injury to the user during maintenance. Care must be exercised when retracting the charging handle while the buttstock retaining pins are pulled out, since these parts are located on the same side of the receiver. All replacement parts of the same design were installed without fitting. The redesigned extractor did require some minor hand fitting.

The weapon was generally well designed from a maintainability point of view. A minimum of tools was required to detail disassemble and reassemble the weapon. The special combination tool provided as part of the maintenance support package was an aid to cleaning of residual fouling deposits from the gas system, although these deposits were not found to be excessive in any maintenance period (2000-round maximum). One necessary area of improvement is in the gas regulator body (part No. 61, Figure 1.2-3) or means of separating the barrel from the receiver. The two annular grooves of the regulator body fill up with residual fouling and prevent easy removal of the barrel. This condition was observed during the endurance test when the barrel was removed after 1000 rounds firing. Another possible area for improvement is in the gas piston (part No. 15, Figure 1.2-3). The piston which is located at the front end of the bolt carrier assembly, is not of the self-cleaning design to aid in removal of residual fouling in the gas cylinder. Although the fouling buildup in the cylinder of the test weapon was negligable, more extensive testing with less frequent maintenance (or maintenance at the field level only) may reveal that helical-cut piston grooves similar to those on the 7.62-mm M60 machine gun are desirable.

No special kits or protective devices were required for operation of the weapon under any of the test conditions. The fouling produced by the ammunition was not considered to be excessive.

Table 1.7-1. List of Abbreviations and Definitions

Abbreviation	Definition
SB	Short burst (5 to 7 rounds)
10B	Ten-round burst
20B	Twenty-round burst
50B	Fifty-round burst
SS	Single-shot
B	Ball (ammunition)
T	Tracer (ammunition)
4/1	Ammunition linked in the ratio of 4-ball to 1-tracer round
W	Weapon
A	Ammunition
P	Personnel error
R	Repetitive (i.e., WR = weapon repetitive)
F	Field (maintenance)
O	Organizational (maintenance)
D	Direct support (maintenance)
FRA	Failure to remain in assembly
FJ	Failure to eject
BUB	Bolt underride of base of fed cartridge
FFO	Failure of ammunition to feed over into position to be chambered
FSU	Failure of bolt carrier to sear up
FC	Failure to chamber cartridge
IFR	Inadvertant (uncontrolled) fire after release of trigger
FX	Failure to extract fired cartridge case
FF	Failure to feed (other than FFO and BUB)
PS	Partial stripping of round from belt during chambering of round
FFR	Failure to fire
Class I	Class I malfunction defined as clearable by immediate action within 10 seconds time, without the use of tools or spare parts.

Table 1.7-1 (Cont'd)

Abbreviation	Definition
Class II	Class II malfunction defined as clearable within 10 minutes with tools and spare parts available to the user as part of the on-weapon maintenance equipment
Class III	Class III malfunction defined as not clearable within 10 minutes and requiring tools and spare parts not available to the user as part of the on-weapon maintenance equipment
C	Chargeable malfunction defined as one which is not nonchargeable
N	Nonchargeable malfunction defined as personnel error, instrumentation or facility caused malfunction, or a repetitive stoppage which is corrected (repetitive malfunctions caused by design deficiencies are chargeable if not corrected during test)
S	Scheduled
U	Unscheduled
FM	Fixed mount
EVD	Extreme vertical dispersion
MVD	Mean vertical dispersion
VSD	Vertical standard deviation
EHD	Extreme horizontal dispersion
MHD	Mean horizontal dispersion
HSD	Horizontal standard deviation
ES	Extreme spread
MR	Mean radius
CI	Center of Impact
H	Horizontal
V	Vertical
RSD	Radial standard deviation

Table 1.7-2. FN Machine Gun Function Performance Data by Type, Class, and Round of Occurrence

Table No.	Cycle No.	Posi-tion	Mode of Fire	Cum Rd No. Sub-test	Cum Rd No. Total Wpn	Malf Type	Chargeable Weapon I	Chargeable Weapon II	Chargeable Weapon III	Chargeable Weapon Total	Chargeable Ammunition I	Chargeable Ammunition II	Chargeable Ammunition III	Chargeable Ammunition Total	Nonchargeable all Other I	Nonchargeable all Other II	Nonchargeable all Other III	Nonchargeable all Other Total
1.2-8	4	FM	20B	28	28	FJ		1		1				0				0
	6	B	SB	74	74	BUB		1		1				0				0
	6	B	SB	267	267	FFO		1		1				0				0
Subtotal	6	-	-	273	273	-	0	3	0	3	0	0	0	0	0	0	0	0
1.3-4	3	B	10B	115	388	FSU			1	1				0				0
Subtotal	4	-	-	221	494	-	0	0	1	1	0	0	0	0	0	0	0	0
1.4-2	1		SB	1	495	FJ		1		1				0				0
				25	519	FJ				0				0		1 WR		1
				175	669	FJ				0				0		1 WR		1
	2		SB	260	754	FJ				0				0		1 WR		1
				314	808	FJ				0				0		1 WR		1
				393	887	FFO				0				0		1 WR		1
	3		20B	435	929	FJ				0				0		1 WR		1
				454	348	BUB		1		1				0				0
				455	949	FJ				0				0		1 WR		1
				493	987	FFO				0				0		1 WR		1
				500	994	BUB				0				0		1 P		1
				586	1080	BUB		1		1				0				0
				593	1087	FFO				0				0		1 WR		1
	4		SB	793	1287	FFO				0				0		1 WR		1
	5		50B	814	1308	FJ				0				0		1 WR		1
				893	1387	FFR	1			1				0				0
				957	1451	FPA				0				0		1 P		1
	6		SB	1000	1494	FC				0	1			1				0
				1193	1687	FFO				0				0		1 WR		1
	7		20B	1200	1694	BUB				0				0		1 P		1
				1294	1788	FFO				0				0		1 WR		1
				1398	1892	FJ				0				0		1 WR		1
	8		SB	1408	1902	FRA				0				0		1 P		1
				1409	1903	FJ				0				0		1 WR		1
				1495	1989	FJ				0				0		1 WR		1
				1593	2087	FFO				0				0		1 WR		1
	9		SB	1693	2187	FFO				0				0		1 WR		1
				1754	2248	FX				0				0		1 WR		1

Table 1.7-2 (Cont'd)

Table No.	Cycle No.	Position	Mode of Fire	Cum Rd No. Sub-test	Cum Rd No. Total Wpn	Malf Type	Chargeable Weapon I	Chargeable Weapon II	Chargeable Weapon III	Chargeable Weapon Total	Chargeable Ammunition I	Chargeable Ammunition II	Chargeable Ammunition III	Chargeable Ammunition Total	Nonchargeable all Other I	Nonchargeable all Other II	Nonchargeable all Other III	Nonchargeable all Other Total
	10		SB	1893	2387	FFO				0				0		1 WR		1
				1930	2424	FF	1			1				0				0
				1993	2487	FFO				0				0		1 WR		1
	13		SB	2512	3006	FF				0				0		1 P		1
	15		SB	3039	3533	FF				0				0		1 WR		1
	23		20B	4606	5100	PS		1		1				0				0
	24		SB	4780	5274	BUB		1		1				0				0
Subtotal	31			6159	6653	-	2	5	0	7	1	0	0	1	0	22 WR 5 P	0	27
1.5-2	1		SB	39	6692	FRA				0				0		1 P		1
				215	6868	FRA				0				0		1 P		1
Subtotal	5		-	1000	7653	-	0	0	0	0	0	0	0	0		2 P	0	2
1.6-1	2		SB	200	7853	PS		1		1				0				0
				350	8003	FRA				0				0		1 P		1
	3		20B	423	8076	PS		1		1				0				0
				450	8103	FRA				0				0		1 P		1
				500	8153	PS	1			1				0				0
	4		SB	604	8257	PS	1			1				0				0
				605	8258	PS	1			1				0				0
				607	8260	PS	1			1				0				0
				615	8268	PS	1			1				0				0
				623	8276	IFA	1			1				0				0
				626	8279	PS	1			1				0				0
				661	8314	FRA				0				0		1 P		1
				750	8403	FRA				0				0		1 P		1
	5		50B	880	8533	FFO		1		1				0				0
				890	8543	FFO		1		1				0				0
Subtotal	5	-	-	1000	8653	-	7	4	0	11	0	0	0	0	0	4 P	0	4
Total Over-all	-	-	-	-	8653	-	9	12	1	22	1	0	0	1	0	22 WR 11 P	0	33

Note: Refer to Table 1.7-1 for a complete listing of abbreviations.

Table 1.7-3. FN Machine Gun Malfunction Tabulation by Subtest and Type[a]

Malf Type	Subtest No. 1.2-8 C	N	1.3-4 C	N	1.4-2 C	N	1.5-2 C	N	1.6-1 C	N	Total C	N
FJ	1				1	10					2	10
BUB	1				3	2					4	2
FFO	1					10			2		3	10
FSU			1								1	0
FC					1						1	0
FRA						2		2		4	0	8
IFR									1		1	0
FX						1					0	1
FF					1	2					1	2
PS					1				8		9	0
FFR					1						1	0
Total	3	0	1	0	8	27	0	2	11	4	23	33

[a]Subtest references refer to tables that data were extracted from.

Note: Refer to Table 1.7-1 for complete listing of abbreviations.

Table 1.7-4. FN Machine Gun Malfunction Tabulation by Subtest and Class

Malfunction Assessment	Malfunction Class	Subtest No.[a] 1.2-8	1.3-4	1.4-2	1.5-2	1.6-1	Total
Chargeable	I	0	0	3	0	7	10
	II	3	0	5	0	4	12
	III	0	1	0	0	0	1
Nonchargeable	I	0	0	0	0	0	0
	II	0	0	27	2	4	33
	III	0	0	0	0	0	0
Total Types and Classes	All	3	1	35	2	15	56

[a]Subtest references refer to tables from which data were extracted.

Note: Refer to Table 1.7-1 for a complete abbreviation listing.

Table 1.7-5. Mean Rounds-Between-Failures Computations for FN Machine Gun

Reference to Subtest No.	Total No. Rd Fired	Total No. Chargeable Failures	Point Estimates for MRBF	Point Estimates for Malf Rate/ 1000 Rd Fired
1.2-8	273	3	91	10.99
1.3-4	221	1	221	4.52
1.4-2	6159	8	770	1.30
1.5-2	1000	0	1000	0.00
1.6-1	1000	11	91	11.00
Over-all	8653	23	376	2.66

Table 1.7-6. Maintenance Performed during Evaluation of FN Machine Gun (Serial No. T-6)

Maintenance Period Subtest Title	Para No.	Subtest Rd No.	Maintenance Action S	U	P	Maintenance Type F Time, Hours	O	D	Remarks
Initial Inspection and Safety Evaluation	1.2	0	X			0.4			Cleaning and lubrication prior to firing muzzle flash test phase.
		73	X			0.4			Cleaning and lubrication prior to firing 200-round functioning check.
		273	X			0.1			Cleaning of the barrel prior to firing the accuracy and dispersion test.
Accuracy and Dispersion	1.3	115		X		0.1			Replaced buffer/rate reducer assembly. The rate control assembly buffer spacer (part No. 53, Figure 1.2-3) was swollen due to adverse effects of PS-661B type solvent and/or lubricant (MIL-L-46000A).
		221	X				1.0		Detailed cleaning, inspection, and lubrication prior to endurance firing.
Endurance	1.4	2000	X				1.3		Detailed cleaning, inspection, and lubrication. Weapon modified by contractor to eliminate recurring malfunctions as follows: Replaced extractor with new design having -10° lip angle. Replaced extractor spring with longer-length part (19-mm). Relieved receiver in area of ejector support where it interferes with feed cam travel (approximately 2-mm additional clearance). Modified magazines by addition of a half-round wood block on underside of leading edge of magazine egress to prevent end loop of cartridge belt from

Table 1.7-6 (Cont'd)

Maintenance Period Subtest Title	Para No.	Subtest Rd No.	Maintenance Action S	U	P	Maintenance Type F	O	D	Remarks
						Time, Hours			
									hangi up. Note: Time recorded does not in lude contractors modification time, which was approximately 1 hour.
		4053	X			0.1			Cleaning of barrel prior to firing periodic accuracy and dispersior check.
		4106	X				1.1		Detailed cleaning, inspection, and lubrication. The following captive broken components were replaced: extractor spring and extractor spring plunger.
		6106	X			0.1			Cleaning of barrel prior to firing periodic accuracy and dispersion check.
		6159	X				1.3		Final detailed cleaning, inspection, and lubrication after test, preparatory to use in high temperature test. Component parts magnetic-particle inspected.
High Temperature (+155°F)	1.5	1000	X				1.6		Detailed cleaning, inspection, and lubrication after test in preparation for low temperature test. Component parts magnetic-particle inspected.
Low Temperature (-50°F)	1.6	890			X	0.1			Residual fouling causing sluggish operation. Relubricated feed pawls in cover and bolt guides in receiver.

Table 1.7-6 (Cont'd)

Maintenance Period Subtest Title	Para No.	Subtest Rd No.	Maintenance Action S	U	P	Maintenance Type Time, Hours F	O	D	Remarks
		1000	X				1.6		Final detailed inspection, cleaning and lubrication. A broken extractor spring was replaced.
Over-all Maintenance Profile		8653	11	1	1	1.3	7.9	0.0	Maintenance man-hours per round fired is 10.63×10^{-4}.

S = Scheduled.
U = Unscheduled.
P = Preventive (unscheduled).

Table 1.7-7. List of FN Machine Gun Component Part Failures

Subtest Title	Para No.	Component Part Name	Cumulative Rd Totals Part	Cumulative Rd Totals Weapon	Action Taken Replaced	Action Taken Repaired	Remarks
Initial Inspection and Safety Evaluation	1.2	-	-	-	-	-	None.
Accuracy and Dispersion	1.3	Buffer and rate reducer assembly.	388	388	X		Nonmetallic components were adversely affected by solvent and/or lubricant (diametral swelling).
Endurance	1.4	Extractor	2494	2494	X		Replaced with part exhibiting current lip angle of -10°.
		Extractor spring	2494	2494	X		Replaced with part of current (longer) design.
		Receiver shell	2494	2494		X	Relieved receiver in area of contact between ejector support and feed cam in cover (approximately 2-mm increase in clearance).
		Magazine (100 and 175 round capacity)	-	2494		X	Modified leading edge of cartridge egress by adding half-round wooden deflector to prevent last loop of cartridge belt from hanging up.
		Dust cover	2647	2647			Detent tab bent which prevents locking cover in closed position. No repair made.

Table 1.7-7 (Cont'd)

Subtest Title	Para No.	Component Part Name	Cumulative Rd Totals		Action Taken		Remarks
			Part	Weapon	Replaced	Repaired	
		Extractor spring	2000	4494	X		Replaced with new part.
		Extractor spring plunger	4494	4494	X		Replaced with new part.
High Temperature (+155°F)	1.5	-	-	-	-	-	None.
Low Temperature (-50°F)	1.6	Extractor spring	4159	8653	X		Replaced with new part after completion of all test firing.
Over-all Part-Failure Profile	-	-	-	8653	6	2	-

1.7.3 Analysis

The weapon was considered safe and easy to maintain at both field (operator) and organizational support levels; this was based on the timed trail data for disassembly and reassembly, the comments of participating personnel, and the maintenance actions required during firing of this test.

1 HUMAN FACTORS EVALUATION

1.8.1 Method

The human factors data generated during the firing tests (i.e., para 1.2 through 1.6) were collectively presented in this subtest. The data consisted of observations on maintenance, safety, and weapon operation.

1.8.2 Results

1.8.2.1 Maintenance. Three retaining clips were found to be difficult to remove and reassemble. They were for the feed cam roller shaft (part No. 19), the rear sight aperture shaft (part No. 70), and the barrel release lever pin (part No. 63). These parts could be easily lost and deformation during removal required reshaping to their original semicircular form prior to reassembly.

1.8.2.2 Safety. The trigger-disconnect design requires modification to prevent a safety hazard (uncontrolled fire). The hazard is created when a round is partially chambered and the forward travel of the bolt is blocked by a fired cartridge case (failure to eject stoppage). In this position, the disconnect will not release the sear to allow the bolt carrier to be seared up when fully retracted. Release of the bolt to its fully forward position will cause inadvertant firing of the chambered round.

Another uncontrolled-fire condition can occur if the weapon is sufficiently powered to accomplish the feeding cycle, but lacks power to drive the bolt carrier rearward sufficiently to re-engage the sear upon release of the trigger. This occurred during the low-temperature test toward the end of the 1000-round cycle.

1.8.2.3 Weapon Operation.

a. The imposition of additional finger protection on the forward, upper sides of the receiver, prevented complete control over barrel assembly by use of the carrying handle. This situation tended to negate the ability to rapidly change barrels without the need for additional hand protection (glove).

b. The means of attaching magazines to the receiver was by two headed studs located on the under side of the receiver which engaged matching recesses on the magazine retaining plate. A spring-loaded latch on the left side of the receiver prevented unintentional removal of the magazine after the plate and studs were engaged. It was noted that a left-handed gunner experienced less difficulty in correctly attaching the magazine because he could visually observe engagement of the plate with the studs. The right-handed gunners used throughout testing experienced periodic failures to fully seat the studs in the plate which resulted in loss of the magazine upon initiation of firing. This was especially evident during low temperature testing when the gunners wore heavy gloves or arctic mittens.

c. The ejection pattern of fired cases was found to be particularly well suited for either left- and right-hand gunners as well as for other personnel immediately adjacent to the right side of the weapon. The ejection pattern was in a downward direction, approximately 10° right and 30° forward.

d. A means of determining if the bolt carrier was in a seared-up position was accomplished through the use of the cross-bolt safety. The safety could not be applied with the bolt carrier in the forward position. In order to determine if ammunition was in a position to be chambered, the gunner had three options: open the feed cover and visually determine the position of the ammunition with the cover closed, visually observe that the leading double-loop of the link belt is engaged with the two positioning shoulders in the right, top side of the feed tray, or touch this link to determine its location in the event that a visible determination is not possible. There was no mechanical device to indicate the presence of a round in the chamber.

e. The height of the bipod could not be adjusted because of the fixed-length legs. Although the use of the weapon was not impaired during test when fired from the bipod on level, flat terrain, it is envisioned that some difficulty could be expected to be experienced when firing in broken terrain. This is due to the relatively low weapon profile when bipod-mounted.

f. The five-position rear sight was easily adjusted for range by rotating the multi-aperture sight to the desired range setting (i.e., "V" notch 200-meter, and ring aperture 200-, 300-, 400-, and 500-meter settings). This ease of spring-detented sight movement and the relatively low sight guard may allow the sight to be inadvertently moved by contact with vegetation or the gunner's body.

g. The means of zeroing the weapon was accommodated entirely by adjustment for windage and elevation contained in the front sight. The front sight post was threaded into the sight housing. Rotational movement of the post was controlled by a spring-loaded detent which had to be depressed in order to rotate the post. Windage adjustment was by lateral movement of the sight housing on the dove-tailed base. This base was an integral part of the barrel. The sight housing was secured to the base by a socket-head cap screw which draws together the split lower halves of the sight housing and thus prevents its movement. A special wrench is required to make the initial sight adjustments. All subsequent sight changes for range are based on a rear sight which is ballistically matched to the ammunition. Utilization of tracer ammunition as a means of target impact determination by visually observing the trajectory path was found to be marginal on bright sunlit days when viewed by the gunner. No difficulty was experienced by observers adjacent to the weapon. These observations are restricted to 300 meters maximum range since this was the greatest distance at which accuracy and dispersion tests were fired. The tracers were observed more readily when the sky was dark or overcast.

h. Control over the weapon during automatic burst fire was observed to be good. There was minimal disturbance of weapon location between firing the first "aimed" round and the subsequent series of rounds in the burst. (Refer to Table 1.3-3 for the characteristic shift in centers of impact).

i. The ability to transport the weapon was enhanced by the use of a handle which was part of the quick-change barrel design. This means of transport allowed one-hand carrying. The weapon was also equipped with a top-mounted rear sling stud which allowed the sling to be used in an over-the-shoulder carrying position.

1.8.3 Analysis

The two safety hazards were classified as Category II - Marginal in accordance with paragraph 3.14(b) of MIL-STD-882. The trigger disconnect design problem and the short recoils, both of which cause uncontrolled fire, were classified as shortcomings charged to the weapon.

The uncontrolled fire condition due to short recoil of the bolt carrier, while not desirable, has been allowed on other standard military weapons such as the M60 machine gun. The overtravel distance of the bolt carrier from its position relative to a completely fed cartridge and the location of the carrier in a seared-up position should be evaluated to determine if these two points can be moved closer together or if a secondary sear surface behind the existing one on the bolt carrier can be used.

The means of attaching the magazine to the receiver should be improved to prevent incomplete attachment. Also, an adjustable-height bipod should be developed to permit an increase in the present height of the weapon above ground level.

A more positive means of fixing rear sight adjustment is necessary to preclude the possibility of accidentally moving the sight. The means of attaching the front sight housing to the barrel may require an increase in rigidity, in the event that drop tests of the weapon should show that the dove-tail arrangement is inadequate. Adjustments of the sight for zeroing should be capable of accomplishment without the use of special tools.

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