

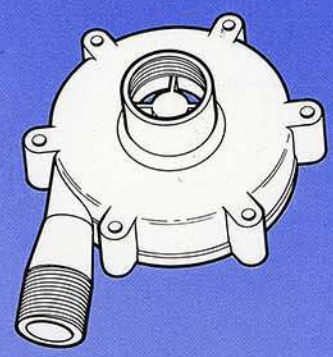
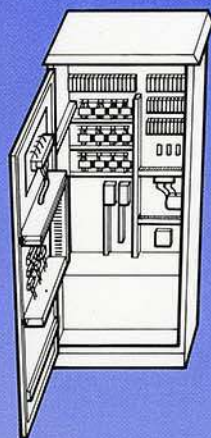


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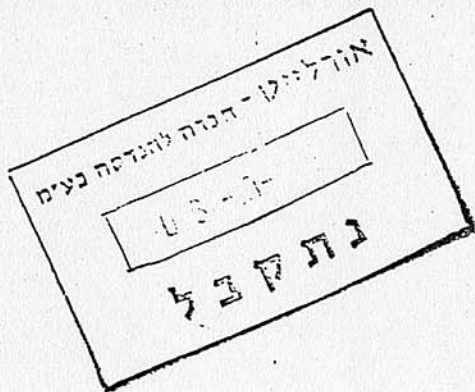
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LIMITED EVALUATION OF 5.56MM 30 ROUND PLASTIC MAGAZINE

SAMUEL A. FASOLO, JR.

LYLE G. RHEA



SEPTEMBER 1981



US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
FIRE CONTROL AND SMALL CALIBER
WEAPON SYSTEMS LABORATORY
DOVER, NEW JERSEY

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71°C

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48.3°C

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20. ABSTRACT (Cont.)

Magazines from Howard Industries (GAPCO) and Israeli Industries (Orlite) were tested. Test samples of all plastic magazines failed during the drop tests. However, no Orlite magazine failed as a result of the first drop under any conditions and the GAPCO magazines failed as a result of the first drop only during the cold temperature drop tests.

In many instances, the GAPCO magazine could not be fully loaded without difficulty, and during firing, the function was less reliable than that of the Orlite magazines. The Orlite magazines were less prone to failure during the environmental extremes and function firing tests, and were overall, more reliable.

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INTRODUCTION

Purpose

This report presents the results of testing performed to evaluate the effects of handling and environmental extremes on the performance of plastic 30 round magazines intended for use with the M16A1 Rifle and the M231 Firing Port Weapon.

Test Objective

The objective of these tests was to examine the effects of temperature extremes, cyclic temperature and humidity on the magazine and to evaluate the ability of the magazine to survive handling abuses without structural failures. Magazines from Howard Industries (GAPCO) and Israeli Industries (Orlite) were tested.

Summary of Conclusions

Test samples of all plastic magazines failed during the drop tests. However, it should be noted that no Orlite Magazine failed as a result of the first drop under any conditions and that the GAPCO Magazines failed as a result of the first drop only during the cold temperature drop test. Although it was not specified as part of these tests, two fully loaded metal magazines were dropped at ambient temperature on the feed lips. As a result of the drop, neither magazine could be inserted into a weapon. Therefore, if the failure criteria used for these tests were applied to the metal magazines, they would have been designated as "failed as a result of the first drop at ambient temperature". The result of the environmental extremes, solvent and function tests were generally more favorable, although the GAPCO Magazine failed a greater number of times than the Orlite.

The failure of the plastic magazines may be attributable to either the basic structural design or the material used in manufacturing. In many instances, the GAPCO Magazine could not be fully loaded without difficulty, and during firing, the function was unreliable. The Orlite Magazine was determined to be less prone to failure during the environmental extremes and the function firing tests, and was overall more reliable.

PROCEDURE

General

The tests were performed to provide information on the general suitability of the available plastic magazine for use with the 5.56mm cartridge in the M16A1 Rifle and M231 Firing Port Weapon.

The ammunition used in the M16A1 firing tests were from various lots of US Military 5.56mm, M193 ball ammunition. The ammunition used in the M231 Firing Port Weapon tests were from various lots of US Military 5.56mm M196 tracer ammunition.

Two standard M16A1 Rifles and two standard M231 Firing Port Weapons were used testing.

Scope of Testing

The scope of these tests was limited to the types of tests in which plastic magazines have historically demonstrated poor performance. A total of 19,920 rounds of 5.56mm ammunition were expended during these tests in accordance with the test schedule presented in Table 1. Using the M16A1 Rifle, 6,240 rounds of M193 ball ammunition were used to test plastic magazines and 2,160 rounds were fired using metal magazines as a control group. Using the M231 Firing Port Weapon, 11,520 rounds of M193 tracer ammunition were used to function test the plastic magazines.

Table 1. Plastic magazine scope of testing

<u>Test</u>	<u>Rounds expended</u>
Initial Inspection	0
Drop test	0
High temperature (+160°F)	180
Low temperature (-55°F)	180
Cyclic temperature/humidity	240
Chemical compatibility test	1,320
Function test, plastic, M16A1	4,320
Function test, metal, M16A1	2,160
Function test, plastic, M231	<u>11,520</u>
TOTAL	19,920

Initial Inspection

Upon receipt, all of the plastic magazines were inspected for damages, flaws, completeness of the assembly and quality of workmanship. All magazines were acceptable, and therefore, were numbered.

The overall outside width at the mouth was measured at a point 1.150 inches from the rear edge of each magazine (Dimension "A" in Figure 1), and 1.125 inches down from the top of the feed lips.

The distance between the feed lips was measured at a point .115 inch from the inside rear edge of the magazine (Dimension B-1 in Figure 1), and at a point 0.850 inches from the rear edge, (Dimension B-2 in Figure 1).

Drop Test

Ten magazines from each manufacturer were selected for this test. All were loaded with 30 rounds of M232 dummy ammunition. Four loaded magazines were conditioned at +160°F, four at -55°F, and two at ambient temperature for four hours. All drops were made from a five foot height onto a ½-inch thick steel plate. A fixture was used to insure proper contact between magazine surface and steel plate. Magazine temperature was maintained between drops by reinserting in the temperature chamber. Each magazine was dropped in the following sequence and repeated four additional times:

1. Drop loaded magazine on feed lips
2. Drop loaded magazine on base
3. Drop loaded magazine on each narrow side (thickness)
4. Drop loaded magazine on either side.

After each drop, the magazines were inspected for expelled rounds and material failure. At the end of the test, all magazines were test fitted in an M16A1 magazine well, and critical dimensions were measured at ambient temperature for both loaded and unloaded conditions. Three undamaged magazines from each manufacturer were selected, loaded with 30 rounds of M193 ball ammunition, and fired in the burst mode at ambient temperature.

High Temperature Test

Six magazines from each manufacturer were selected for this test. Four were loaded with 30 rounds of M232 dummy ammunition. Two magazines were not loaded. All magazines were subjected to a 48 hour conditioning period in an environmental chamber at +160°F ± 30°F with a relative humidity less than 15%.

After completion of the 48 hour conditioning cycle, all magazines were test fitted into the magazine well of an M16A1 Rifle. After the magazines were cooled to ambient temperature, critical dimensions, defects, deterioration, and expelled rounds were noted. Three magazines from each manufacturer were selected, loaded with M193 ball ammunition, and attempts made to fire the entire complement of each in short bursts.

Low Temperature Test

Six heretofore untested magazines from each manufacturer were selected, conditioned for 48 hours and tested as in the high temperature test (paragraph 5) except that the conditioning chamber was maintained at -55°F ± 30°F.

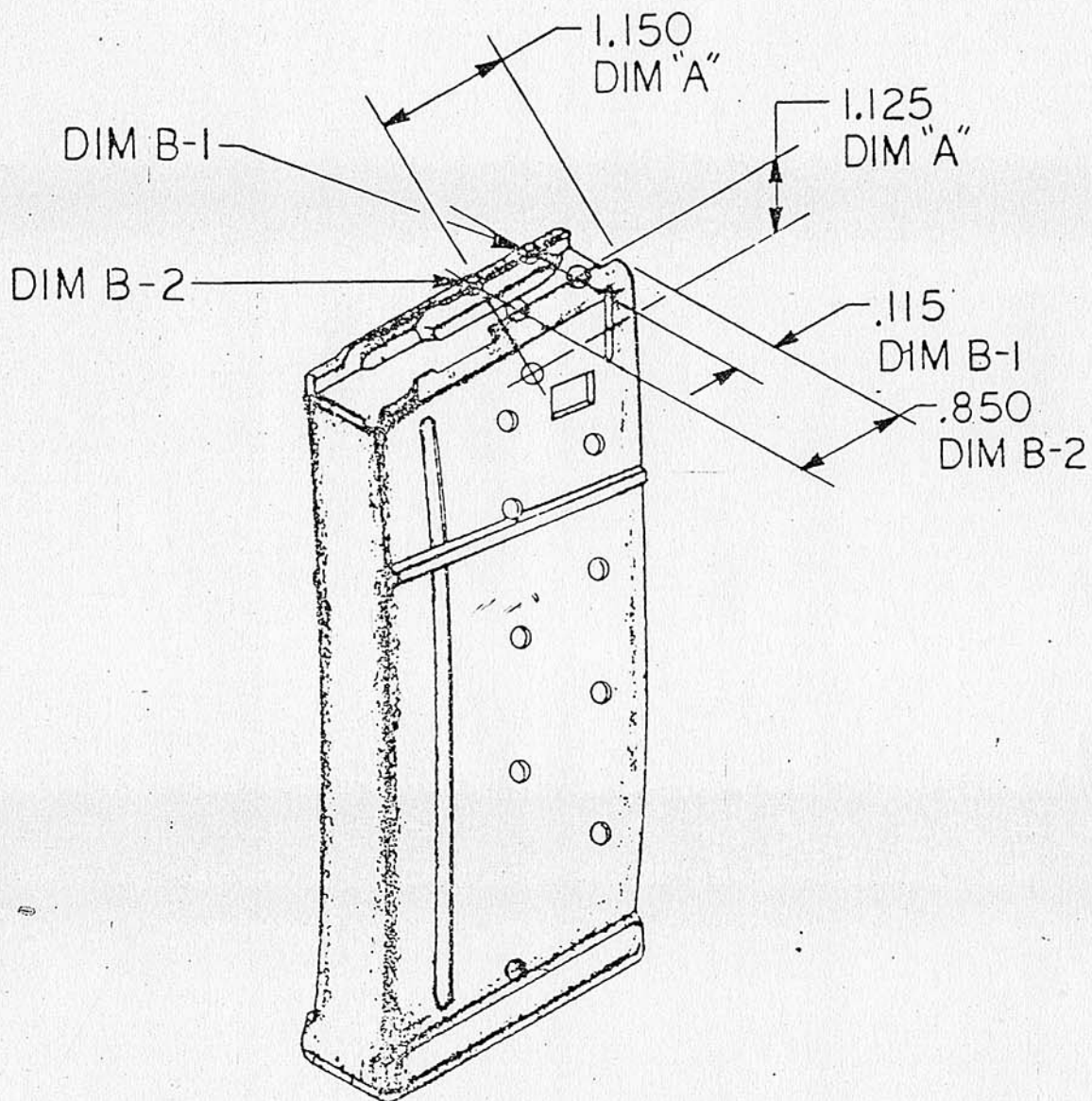


Figure 1. Measurement points on magazine

Cyclic Temperature/Humidity/Test

Six heretofore untested magazines were selected and loaded as in the high temperature test (paragraph 5). These magazines were then placed in a cyclic temperature/humidity chamber and conditioned for ten days in accordance with the 24 hour cycle shown in Table 2. On the sixth day of conditioning, each sample was test fitted in the M16A1 magazine well, inspected for flaws, cracks, distortions and expelled round. Critical dimensions were measured and recorded along with deviations noted during inspection. At the conclusion of the test, the samples were returned to ambient temperature and the above procedure repeated. Four magazines were selected, loaded with M193 ball ammunition and attempts made to fire the entire complement of each in short bursts.

Table 2. Temperature/humidity conditioning 24 hour cycle

<u>Hours</u>	<u>Temperature (F^o)</u>	<u>Relative humidity (%)</u>
2	Increase to 105	90
16	105	90
2	Decrease to 70	95
4	70	95

(Repeated nine more cycles - ten (10) days total)

Chemical Compatibility Test

Twenty-two heretofore untested magazines from each manufacturer were selected for this test. Eleven were loaded with 30 rounds each of M232 dummy ammunition and eleven were left unloaded. One loaded and one unloaded sample was placed on its base in a container at room temperature. The container was filled with chemical to completely immerse the samples and then covered. The container was stored at ambient temperature and humidity conditions and moderately agitated by shaking once each day for seven days. At the end of this period, samples were removed, excess chemical wiped off, rinsed with distilled water and dried with a cloth. They were then inspected for crazing, swelling, signs of deterioration and expelled rounds. They were then test fitted in the magazine well of an M16A1 Rifle and critical dimensions measured and recorded. All undamaged magazines were loaded with M193 ball ammunition and fired in short bursts from the M16A1 Rifle. The chemicals utilized are as follows:

1. Insect repellent (O-I-503E)
2. Gasoline - 90 Octane (commercially acquired)
3. Lubricating oil (VV-L-800A)
4. Dry cleaning solvent (P-D680)
5. Bore cleaner (MIL-C-372B)
6. Lubricant, semi-fluid (Auto Wpns) MIL-L-46000B

7. Jet fuel JP4
8. Lubricating oil, Weapons (LAW) MIL-L-14107
9. Carbon removing compound PC 111
10. Solid Film Lube MIL-L-461147
11. Cleaner, Lubricant, Preservative (CLP) MIL-L-63460

Function Test

Fifty-four magazines, eighteen plastic from each manufacturer and eighteen metal heretofore untested magazines were selected for this test. Using the stripper bar, each magazine was fully loaded with 30 rounds of M193 ball ammunition. Rifles and/or magazines and ammunition were conditioned as required to the temperatures indicated in Table 3 prior to test firing. Each was test fired in the semi-automatic, burst (approximately 3 rounds) and full automatic modes. A total of 6,480 rounds were fired during this test. Malfunctions were recorded and critical dimensions measured at ambient temperature after firing was completed.

Table 3. Firing schedule

Magazine, ammunition, and rifle ambient temperature

6 plastic magazines each manufacturer
6 metal magazines

<u>Mode</u>	<u>Metal magazines total rounds fired</u>	<u>Plastic magazines total rounds fired</u>
Semi-auto	240	480
Burst	240	480
Full-auto	240	480

Magazines and ammo +160°F, rifle ambient

3 plastic magazines each manufacturer
3 metal magazines

<u>Mode</u>	<u>Metal magazines total rounds fired</u>	<u>Plastic magazines total rounds fired</u>
Semi-auto	120	240
Burst	120	240
Full-auto	120	240

Table 3. (Cont)

Magazines and ammo -55°F, rifle ambient

3 plastic magazines each manufacturer
3 metal magazines

<u>Mode</u>	<u>Metal magazines total rounds fired</u>	<u>Plastic magazines total rounds fired</u>
Semi-auto	120	240
Burst	120	240
Full-auto	120	240

Magazines, ammo and rifle +160°F

3 plastic magazines each manufacturer
3 metal magazines

<u>Mode</u>	<u>Metal magazines total rounds fired</u>	<u>Plastic magazines total rounds fired</u>
Semi-auto	120	240
Burst	120	240
Full-auto	120	240

Magazines, ammo and rifle -55°F

3 plastic magazines each manufacturer
3 metal magazines

<u>Mode</u>	<u>Metal magazines total rounds fired</u>	<u>Plastic magazines total rounds fired</u>
Semi-auto	120	240
Burst	120	240
Full-auto	120	240
TOTAL	2,160	4,320

Materials

The following materials, equipment and instrumentation were used in conducting these tests:

1. Rifles, M16A1, Cal 5.56, two each S/N 4219892 and 4696138.
2. Firing Port Weapons, Cal 5.56, two each, S/N 5330322 and 5301378.
3. Magazine, plastic, Orlite Engineering Company and Howard Enterprises, Inc., (GAPCO)

4. Cartridge, Caliber 5.56mm M193, ball.
5. Cartridge, Caliber 5.56mm M196 tracer.
6. Cartridge, Caliber 5.56mm M232 dummy.
7. Insect repellent O-I-503E.
8. Gasoline - 90 Octane - commercially acquired.
9. Lubricating Oil, VV-L-800.
10. Dry cleaning solvent P-D680 - commercially acquired.
11. Bore cleaner MIL-C-372B.
12. Lubricant, semi-fluid Auto Weapons MIL-L-46000B.
13. Jet Fuel JP4.
14. Lubricating Oil Weapons: (LAW) MIL-L-14107.
15. Cleaner, Lubricant, Preservative (CLP) MIL-L-63460.
16. Carbon Removing Compound - P-C-111D Type II.
17. Solid Film Mube MIL-L-46147.
18. Chamber, Environmental, Conrad MDL TR-24-1-1, S/N 7793.

RESULTS

General

The results are based on the following data and the observations of test personnel.

Initial Inspection

Seventy-four magazines of each manufacture were received, inspected, and found to be satisfactory for use in this test. The plastic magazine has been designed for use with 5.56 ammunition. The M196 Ball Ammunition was loaded either manually or by use of a stripper bar and fired in the standard M16A1 Rifle. The M193 Tracer Ammunition was manually loaded and fired in the M231 Firing Port Weapon. The magazine assembly consists of five component parts: the plastic housing (two halves "welded" together), the plastic follower, the plastic floor plate, and the metallic follower spring. Photographs of the Orlite and GAPCO Magazines are shown in Figures 2 through 5.

Test Data

The results of the general tests combined with function tests using the M16A1 are presented in Tables 4 through 34. Photographs of failed magazines are shown in Figures 6 through 12.

In the following tables, a failure is defined as any condition which renders the magazine incapable of accomplishing its assigned function.

The definitions of the malfunction abbreviations used in the Tables are shown below, and have been extracted from "Material Test Procedure for Hand and Shoulder Weapons" MTD 3-2-059.

Malfunction Abbreviations

- FF - Failure to Feed
- FX - Failure to Extract
- FBR - Failure of bolt to remain at rear after last round
- BOB - Bolt overrode base of round in feeding from magazine
- LI - Light indent on cartridge primer
- FFR - Failure to Fire
- BCS - Bolt catch stopped forward movement of bolt before last round of magazine was fired
- BLE - Bolt lacked sufficient energy to force round from magazine

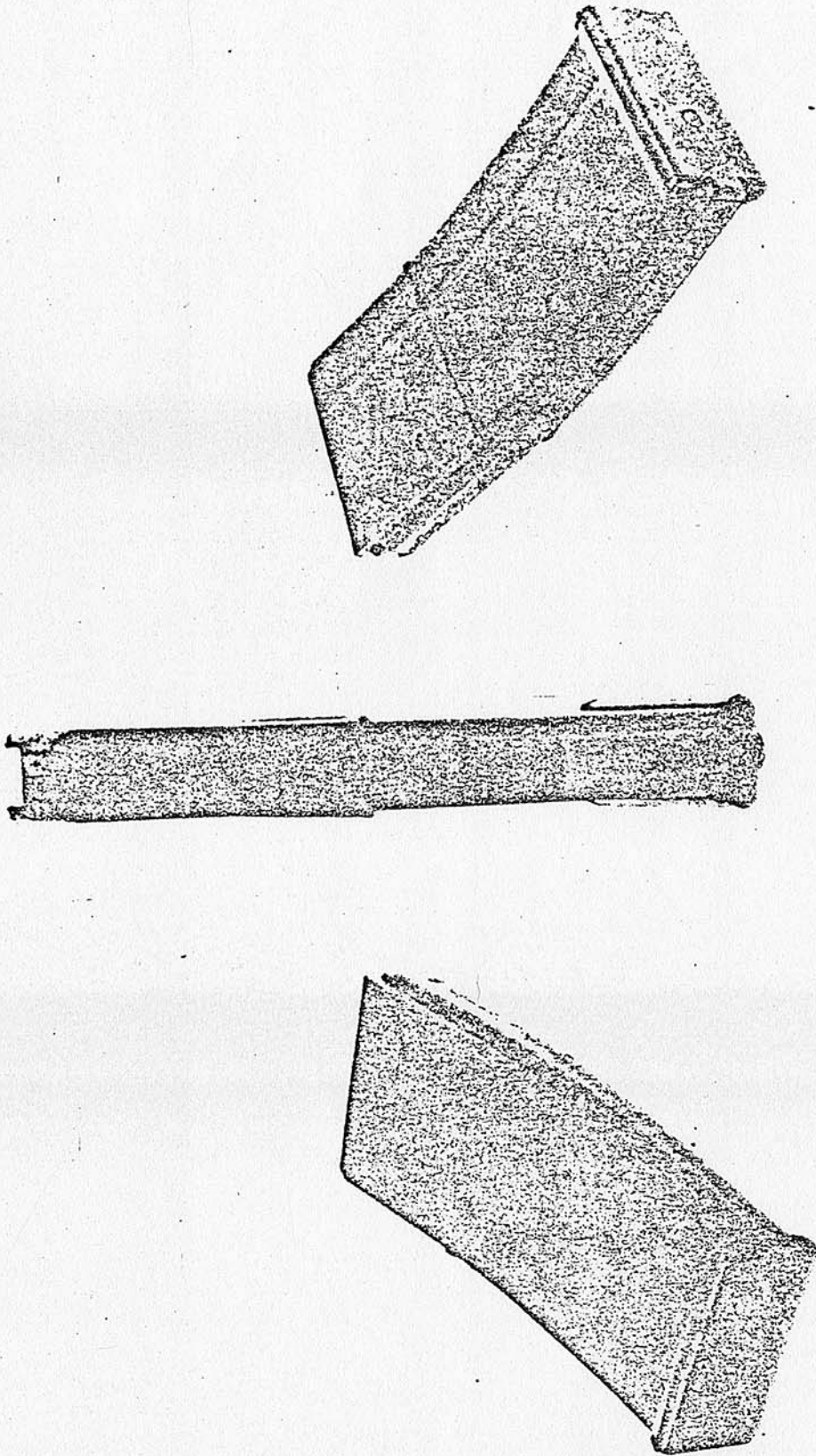


Figure 2. Photograph of assembled OrLite magazine

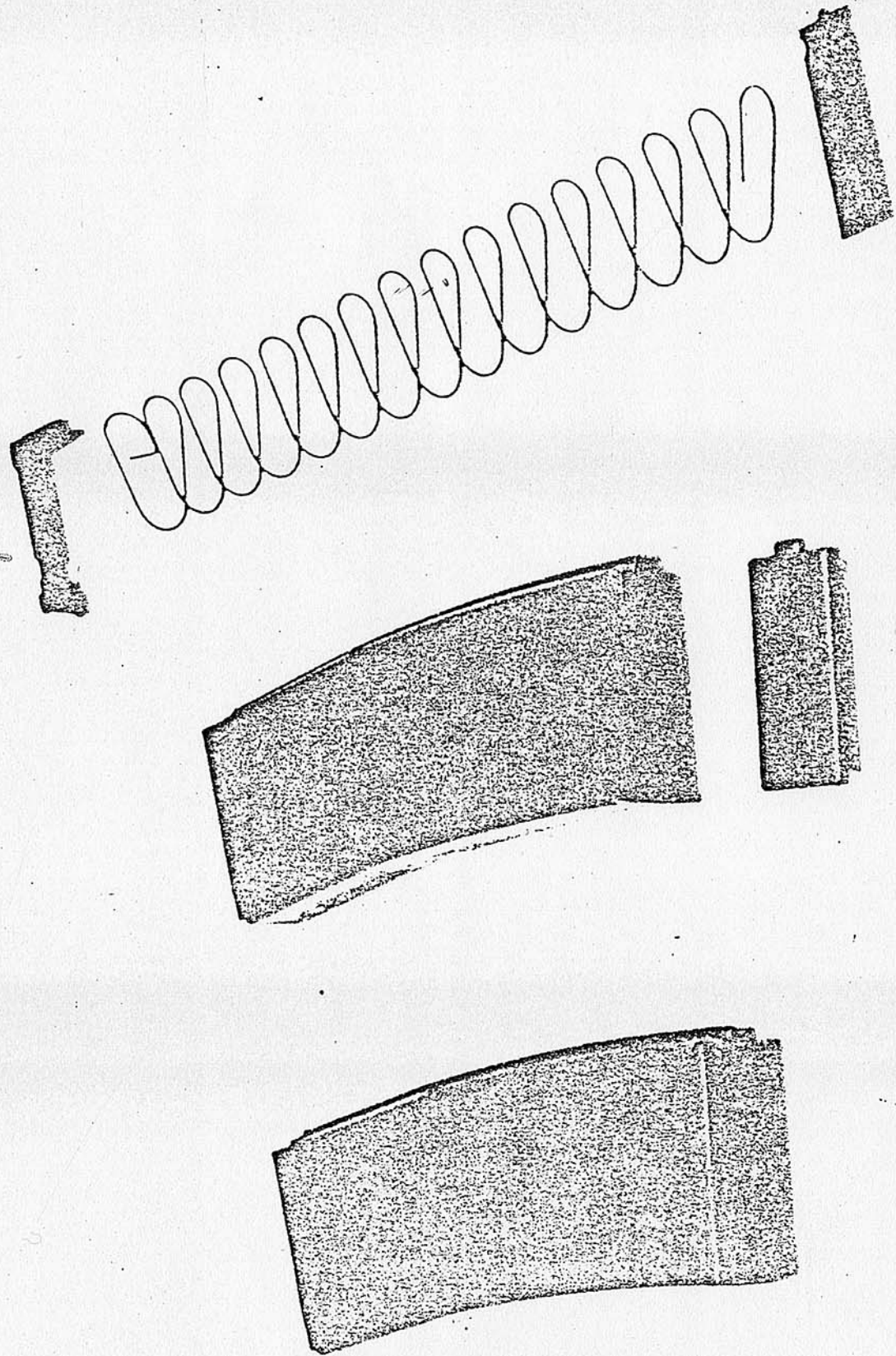


Figure 3. Photograph of disassembled OrLite magazine

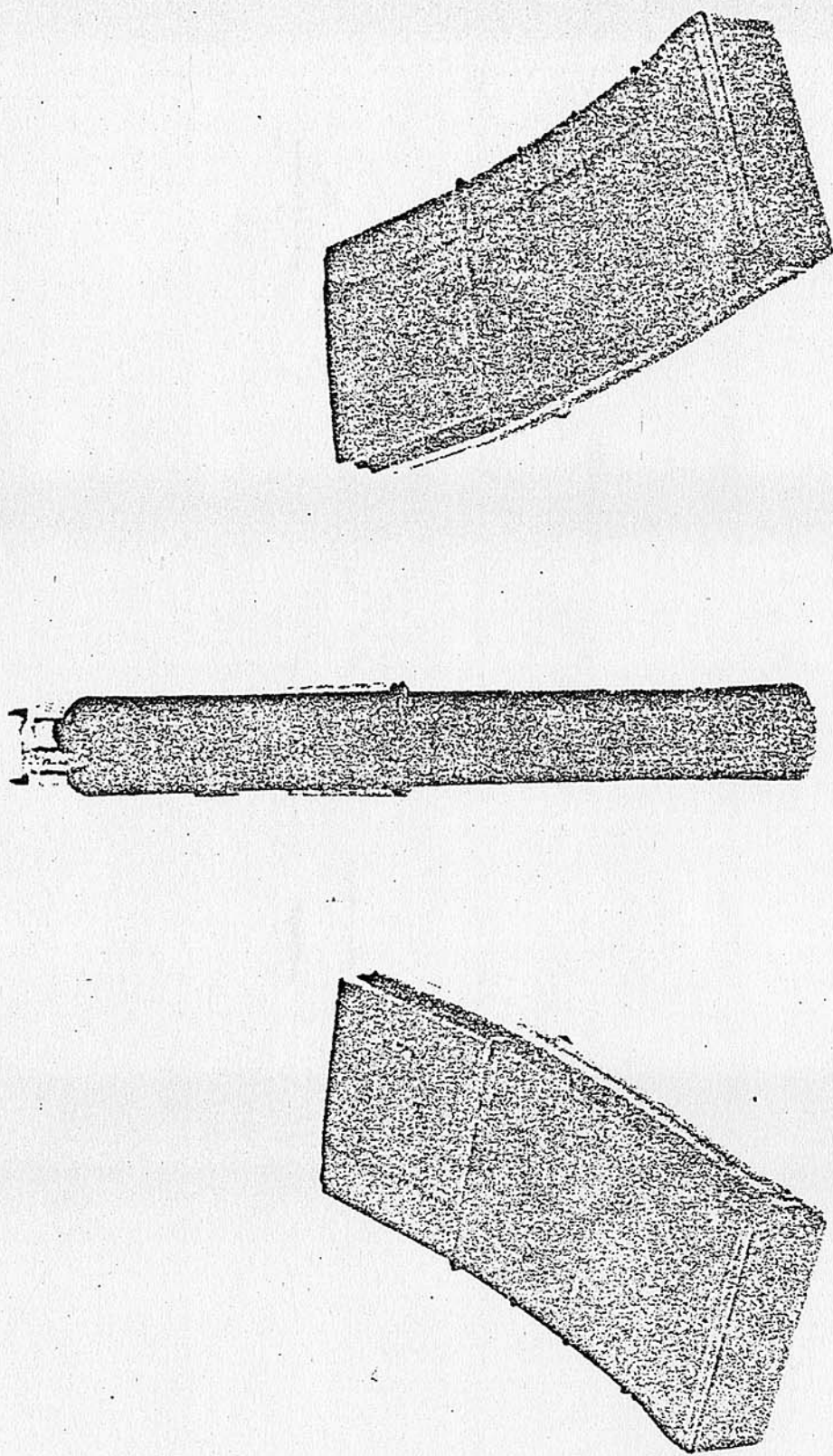


Figure 4. Photograph of assembled GAPCO magazine

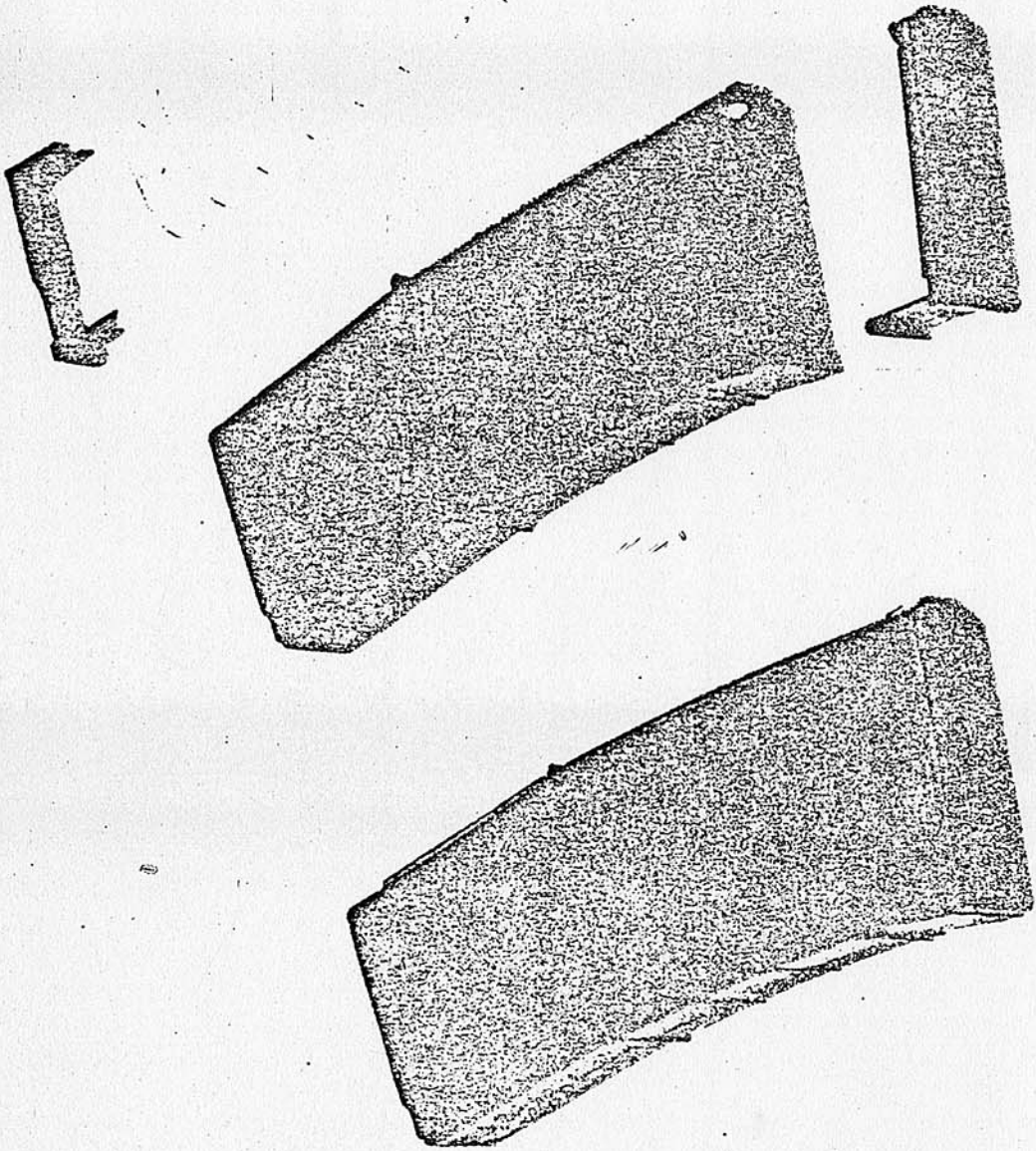


Figure 5. Photograph of disassembled GAPCO magazine

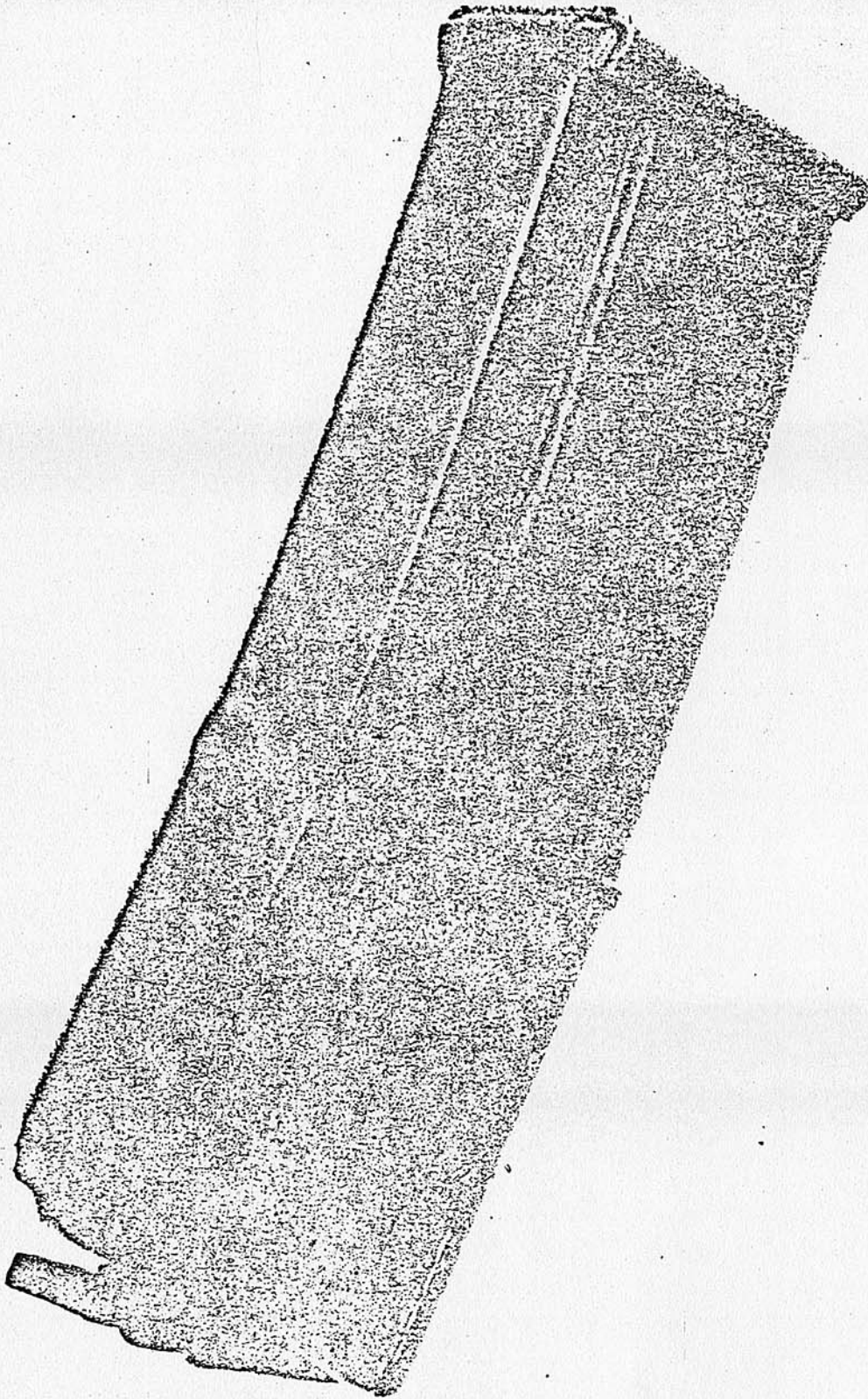


Figure 6. Photograph of typical drop test failure - Orlite magazine

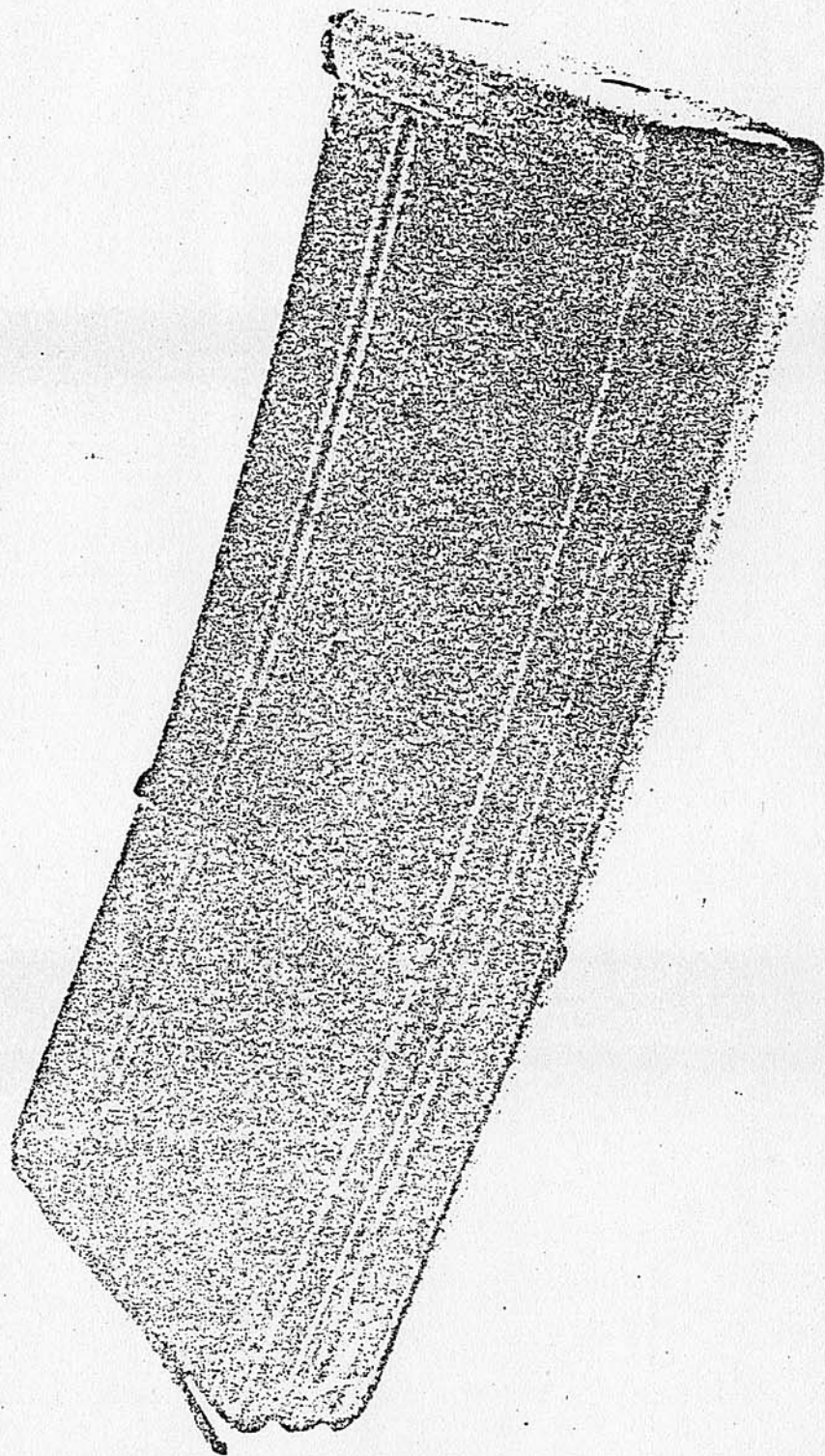


Figure 7. Photograph of typical drop test failure - Orlite magazine

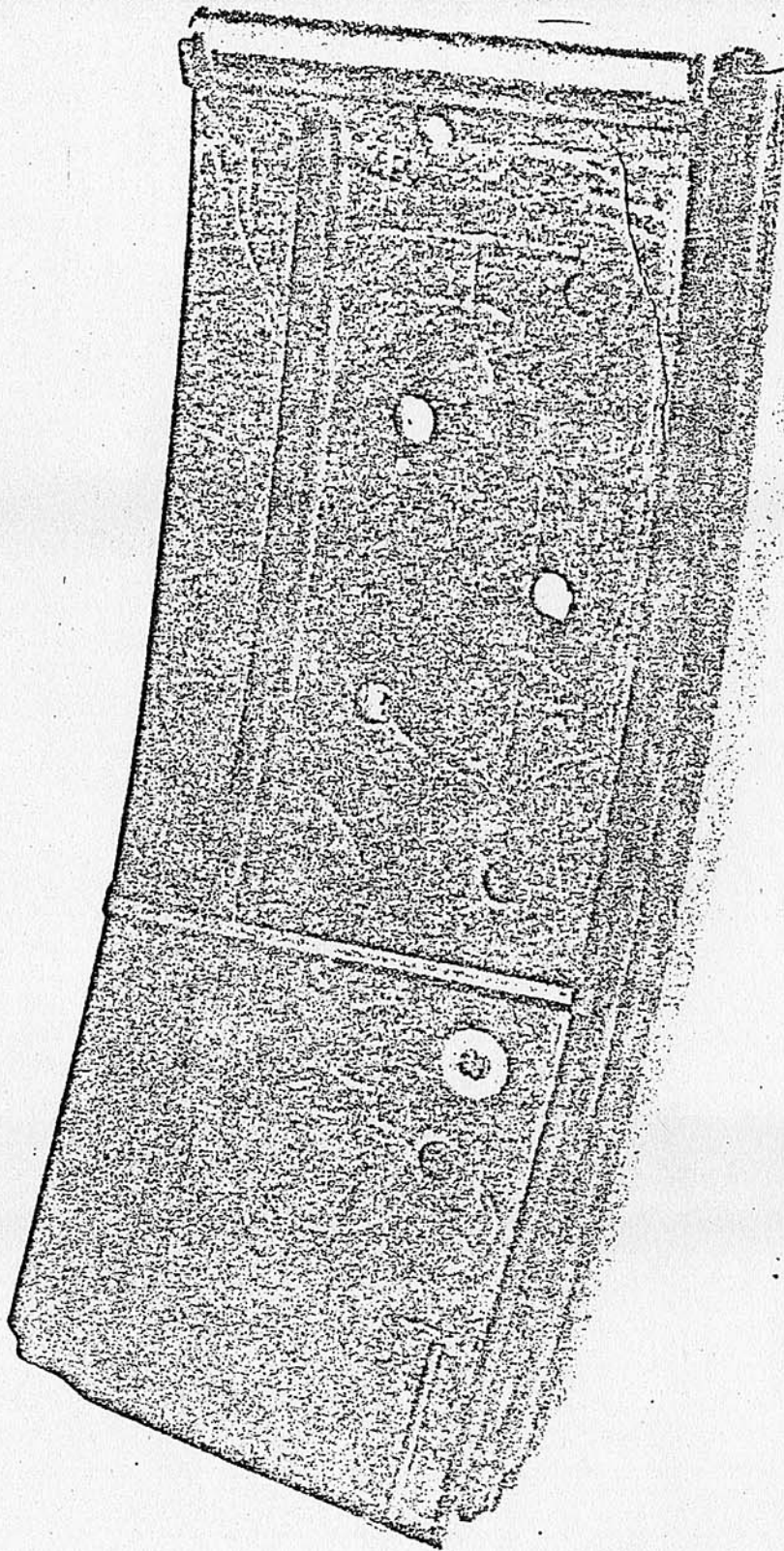


Figure 8. Photograph of typical drop test failure - Orlite magazine

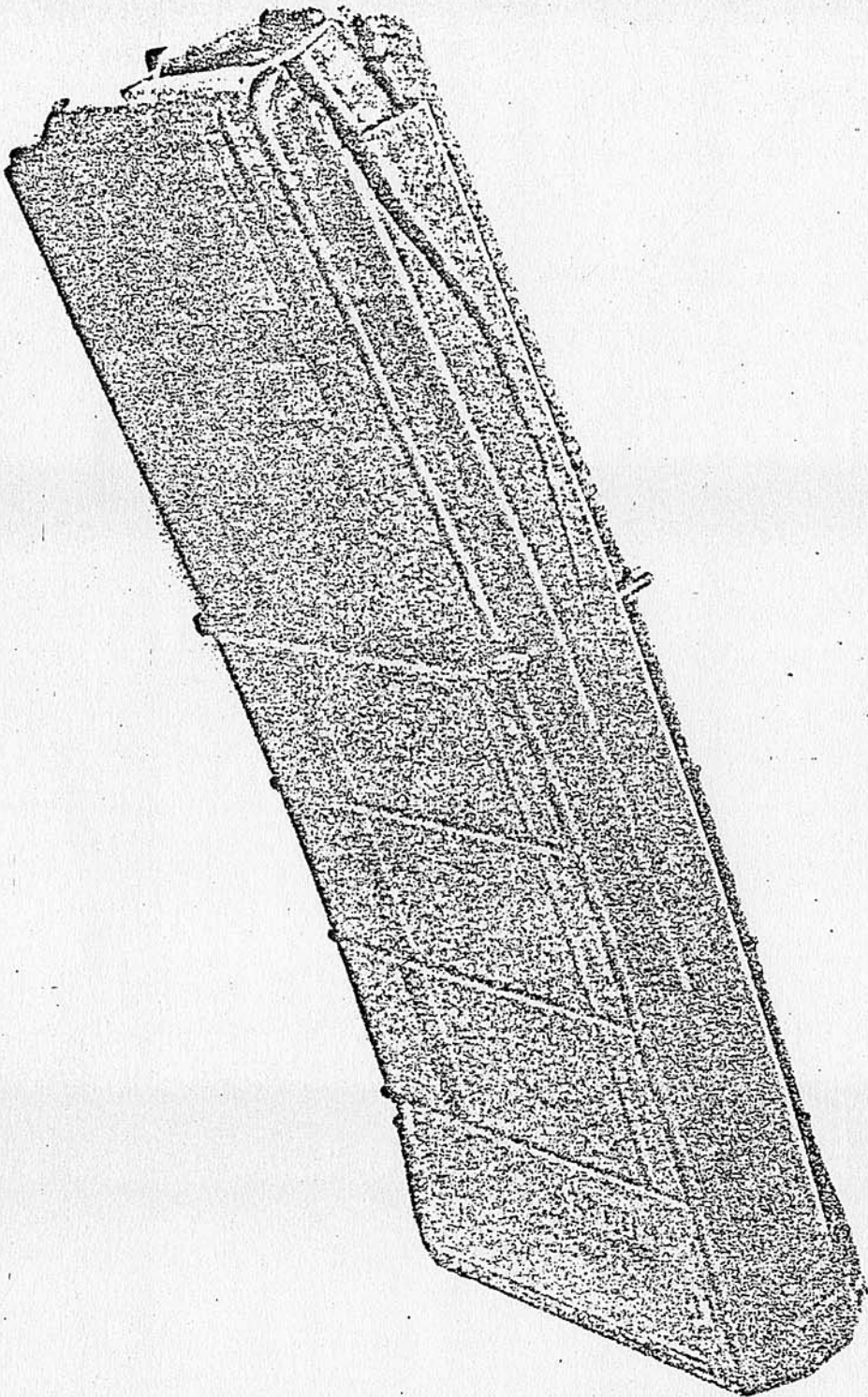


Figure 9. Photograph of typical drop test failure - GAPCO magazine

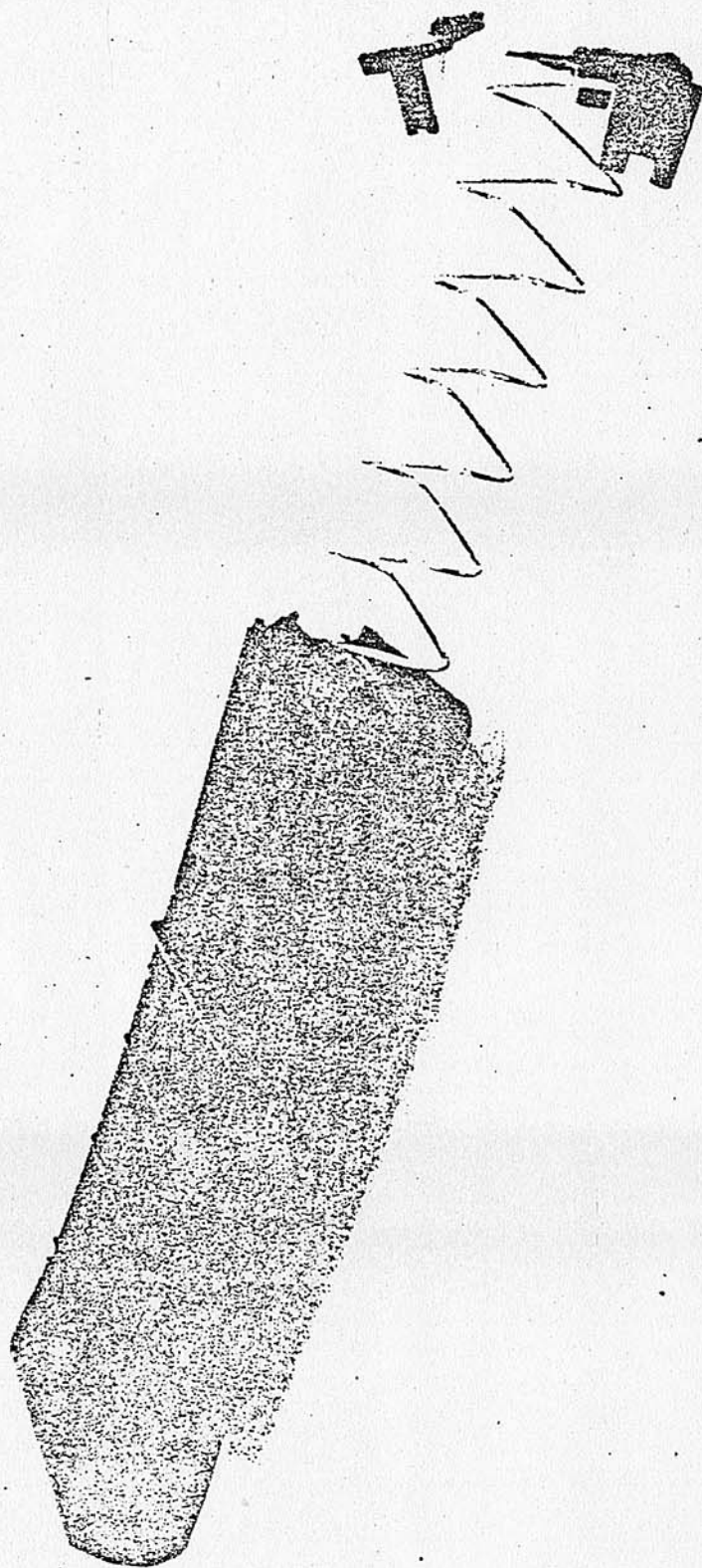


Figure 10. Photograph of typical drop test failure - GAPCO magazine

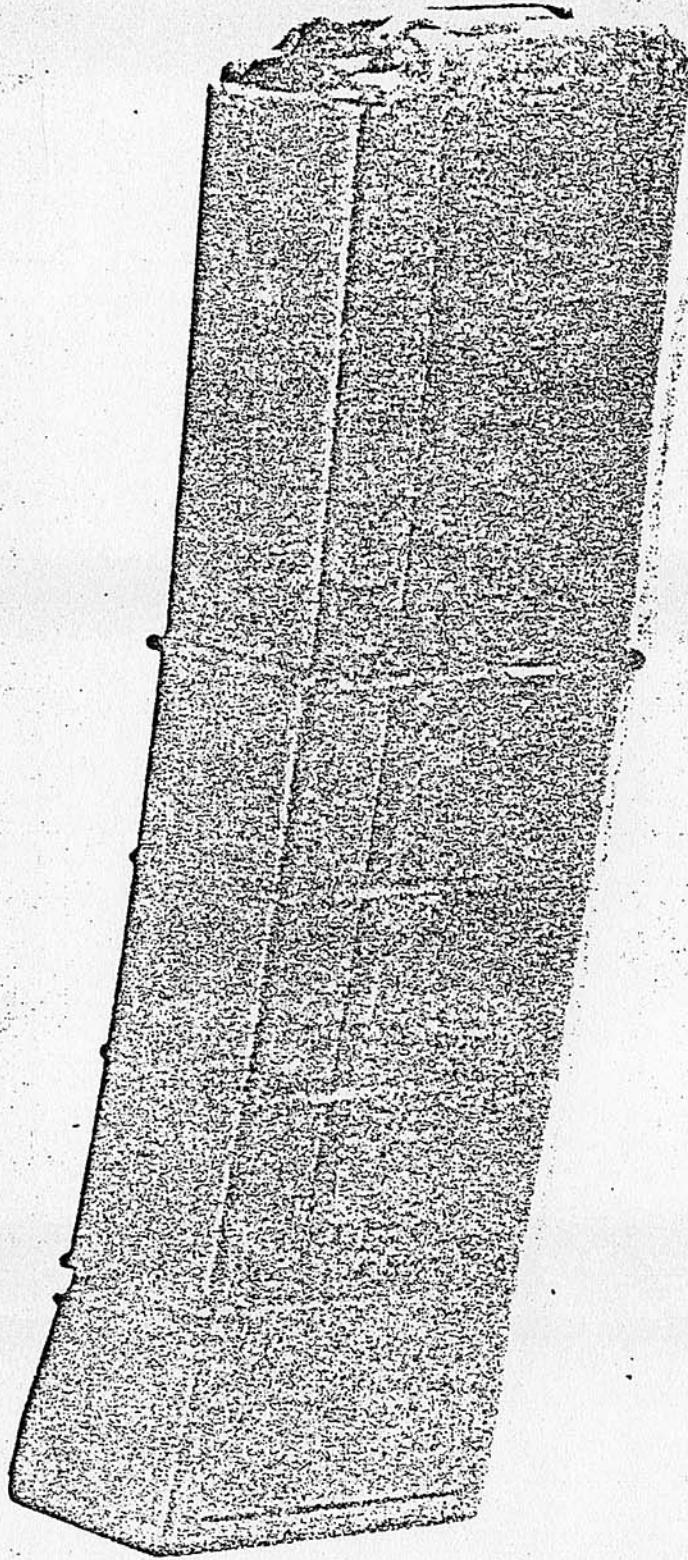


Figure 11. Photograph of typical drop test failure - GAPCO magazine

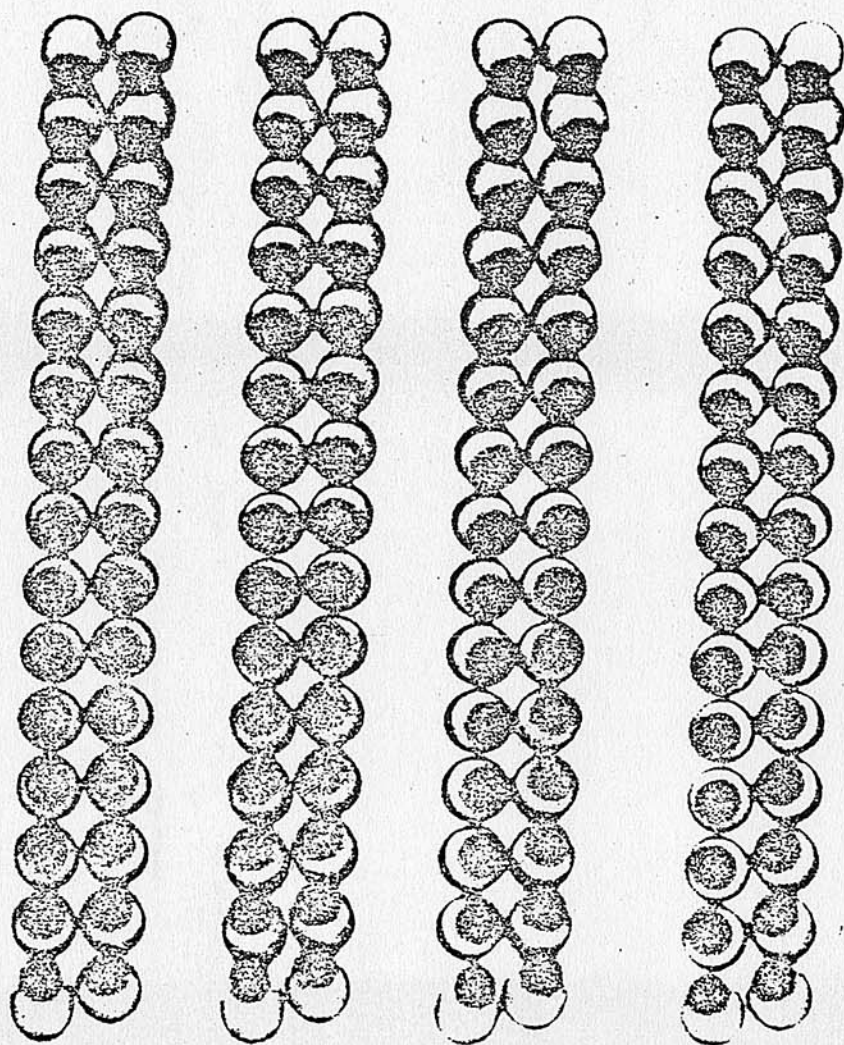


Figure 12. Photograph of X-Ray showing round wedging due to high temperature drop test - GAPCO

Table 4. Results of +160°F mag. & ammo. high temp. drop tests (Orlite)

Sequence 1

Mag No.	Cond. @ +160°F	Lips	Base	Rear Edge	Front Edge	Flat Side (Left)
31.	OK	NE	(1)	(3)	(1)	(3)
32.	OK	NE	(1)	(1)	(3)	(3)
33.	OK	(1)	(2)	(2)	(3)	(5)
34.	OK	(1)	(1)	(2)	(3)	(2)

Sequence 2

31.	OK	(2)	(1)	(1)	(1)	(4)
32.	OK	(1)	(1)	(5)	(5)	(5)
33.	OK	(1)	(1)	(3)	(7)	(5)
34.	OK	(1)	(4)	(2)	(2)	(4)

Sequence 3

31.	OK	(3)	NE	(7)	11 failed ¹	-
32.	OK	(3)	(1)	(5)	(5)	* (8)
33.	OK	(3)	(3)	(4)	(2)	(10)
34.	OK	(2)	NE	(8)	(8)	(5)

Sequence 4

31.	-	-	-	-	-	-
32.	OK	(5)	(5)	(7)	(11) failed ³	-
33.	OK	(29 failed ²)	-	-	-	-
34.	OK	**NE	*(4)	(9)	(7) failed ⁴	-

NE - No effect

() - Number of rounds expelled

* - Magazine dropped w/29 rounds - one round expelled upon removal from temperature chamber

** - Magazine dropped w/27 rounds - three rounds expelled upon removal from temperature chamber

1 - 1/8 inch crack, left feed lip (rear)

2 - 1 inch crack, right front edge

3 - 1/2 inch crack, right front edge

4 - 1/16 inch crack, right feed lip (rear)

Table 5. Results of +160°F mag. & ammo. high temp. drop tests
(GAPCO)

Sequence 1

<u>Mag. No.</u>	<u>Cond. @ +160°F</u>	<u>Lips</u>	<u>Base</u>	<u>Rear Edge</u>	<u>Front Edge</u>	<u>Flat side (Left)</u>
31.	OK	NE	(1)*	NE	(3)	(2)
32.	OK	*	(1)	(1)	NE	(4)
33.	OK	NE	(2)	(1)	(1)	(3)
34.	OK	NE	(2)	NE	(1)	(3)

Sequence 2

31.	OK	1 failed	-	-	-	-
32.	OK	1 failed	-	-	-	-
33.	OK	1 failed	-	-	-	-
34.	OK	1,2 failed	-	-	-	-

- NE - No effect
- () - Number of rounds expelled
- * - chip on floor plate catch slot
- 1 - Rounds wedged side by side, magazine expanded
- 2 - ½ inch crack rear seam (top)

Note: Extreme difficulty experienced in loading specified rounds in magazines as indicated below:

<u>Magazine Number</u>	<u>Round Number</u>
31	30
33	28
34	29

Table 6. Results of -55°F maq. & ammo. low temp drop tests (Orlite)

Sequence 1

Maq. No.	Cond. @ -55°F	Lips	Base	Rear Edge	Front Edge	Flat side (Left)
19	OK	NE	NE	(2)	(3)	(4)
20	OK	NE	(1)	(1)	(1)	(3)
21	OK	NE	(1)	(3)	(1)	(2)
22	OK	NE	(1)	NE	(5)	(1)

Sequence 2

19	OK	NE	(6)	failed ¹	-	-
20	OK	(1)	(1)	(1)	(3)	(5)
21	OK	NE	NE	(1)	(4)	(6) failed ²
22	OK	failed ³	-	-	-	-

Sequence 3

19	OK	-	-	-	-	-
20	OK	(1)	(2)	(1)	failed ⁴	-
21	OK	-	-	-	-	-
22	OK	-	-	-	-	-

NE - No effect

() - Number of rounds expelled

1 - 5 inch crack right rear edge

2 - 2½ inch crack right front edge

3 - 3½ inch crack left front edge

4 - 3/8 inch crack left lip (rear), 5 inch crack left rear edge

Table 7. Results of -55°F mag. & ammo. low temp drop tests (GAPCO)

Sequence 1

<u>Mag. No.</u>	<u>Cond. @ -55°F</u>	<u>Lins</u>	<u>Base</u>	<u>Rear Edae</u>	<u>Front Edae</u>	<u>Flat side (Left)</u>
19	OK	NE	NE	(30) failed ¹	-	-
20	OK	(30) failed ²	-	-	-	-
21	OK	(1)	(1)	(30) failed ³	-	-
22	OK	NE	NE	NE	-*	(3)

Sequence 2

19	-	-	-	-	-	-
20	-	-	-	-	-	-
21	-	-	-	-	-	-
22	OK	NE	NE	(1)	(1)	(3)

Sequence 3

19	-	-	-	-	-	-
20	-	-	-	-	-	-
21	-	-	-	-	-	-
22	OK	failed ⁴	-	-	-	-

NE - No effect

() - Number of rounds expelled

1 - Broken follower, 1/8 inch crack floor plate catch slot (front), 5½ inch crack down rear seam

2 - 6 inch crack down rear seam

3 - 5½ inch crack down rear seam

4 - 2 inch crack down rear seam

* - 1/8 inch crack floor plate catch slot (front)

Note: Extreme difficulty experienced in loading 30th round in all magazines.

Table 8. Results of ambient temp. drop tests
(Orlite)

Sequence 1

<u>Mag. No.</u>	<u>Lips</u>	<u>Base</u>	<u>Rear Edge</u>	<u>Front Edge</u>	<u>Flat Side (Left)</u>
69.	NE	(1)	(2)	(1)	(1)
70.	NE	(2)	(1)	(3)	(5)

Sequence 2

69.	NE	(2)	*(1)	(3)	(3)
70.	(1)	(1)	(3)	(3)	(3)

Sequence 3

69.	NE	(1)	(3)	(2)	(4)
70.	NE	(1)	(1)	(3)	(3)

Sequence 4

69.	(2)	(1)	(1)	(5)	(1)
70.	NE	(1)	(3)	(4)failed ¹	-

Sequence 5

69.	(1)failed ²	-	-	-	-
70.	-	-	-	-	-

- NE - No effect
- () - Number of rounds expelled
- * - 1½ inch crack rear edge (upper right)
- 1 - ¾ inch crack right feed lip
- 2 - ¼ inch crack right feed lip (rear)

Table 9. Results of ambient temp. drop tests
(GAPCO)

Sequence 1

<u>Mag. No.</u>	<u>Lips</u>	<u>Base</u>	<u>Rear Edge</u>	<u>Front Edge</u>	<u>Flat side (Left)</u>
69.	*	NE	(3)	NE	** (1)
70.	*	(1)	(1)	(5)	** (4)

Sequence 2

69.	NE	(1)	NE	NE	(1)
70.	NE	(1)	(3)	**** (2)	(2)

Sequence 3

69.	NE	NE	(2)	(3)	*** (3)
70.	NE	(2)	(3)	(1)	(3)

Sequence 4

69.	(26) failed ¹	-	-	-	-
70.	(30) failed ²	-	-	-	-

- NE - No effect
- () - Number of rounds expelled
- * - Chip bottom plate catch slot
- ** - Chip rear edge left center reinforcing rib
- *** - Chip rear edge right center reinforcing rib
- **** - Chip upper front edge
- 1 - 2 inch crack rear seam
- 2 - 4 inch crack rear seam

Note: Extreme difficulty experienced in loading 30th round in magazine number 70

Table 10. Results of high temp. tests
(Orlite)

Maq. No.	Condition	Maq. Fit	Extreme changes in			Firing Func. Rate
			External Width (in) Dim. A	Internal Width (in) Dim. B-1	Internal Width (in) Dim. B-2	
			Unloaded	Loaded		
29.	Unloaded	Normal	+ .002	+ .003 *	+ .006 + .008* + .003 + .003*	-
30.	Unloaded	Normal	.000	-.001 *	+ .002 + .002* + .003 + .003*	-
35	Loaded 30 rds	Normal	-	-	-	Normal 745
36.	Loaded 30 rds	Normal	-	-	-	Normal 754
37.	Loaded 30 rds	Normal	-	-	-	-
38.	Loaded 30 rds	Normal	-	-	-	Normal 762

* Loaded one round

Table 11. Results of high temp. tests
(GAPCO)

Mag. No.	Condition	Mag. Fit	Extreme changes in				Firing Func.	Rate
			External Width (in) Dim. A	Internal Width (in) Dim. B-1	Internal Width (in) Dim. B-2	External Width (in) Loaded		
29.	Unloaded	Tight	+ .004	+ .002(+.009)*	+ .001(+.004)*	-	-	-
30.	Unloaded	Tight	+ .005	+ .002(+.005)*	+ .001(+.005)*	-	-	-
35.	Loaded 30 rds	Normal	-	- (.020)	- (.026)	Normal	Normal	938
36.	Loaded 30 rds	Normal	-	- (.016)	- (.023)	Normal	Normal	951
37.	Loaded 30 rds	Normal	-	- (.020)	- (.024)	-	-	-
38.	Loaded 30 rds	Normal	-	- (.020)	- (.027)	FBR	FBR	967

() Loaded Measurement

* Loaded one round

Note: Extreme difficulty was experienced in loading the 30th round in magazines 35 and 37. Four attempts were required to accomplish loading.

Table 12. Results of low temp. tests
(Orlite)

Low temp (-55°F/48 hours)		Extreme changes in					Firing
Maq. No.	Condition	Maq. Fit	External width (in) Dim. A Unloaded	Internal width (in) Dim. B-1	Internal width (in) Dim. B-2	Func. Rate	
23.	Unloaded	Normal	.000	+ .001*	- .002 + .002*	-	
24.	Unloaded	Normal	-.001	.000*	+ .003 - .002* - .001 + .002*	-	
25.	Loaded 30 rds	Normal	-	-	-	Normal 765	
26.	Loaded 30 rds	Normal	-	-	-	Normal 776	
27.	Loaded 30 rds	Normal	-	-	-	-	
28.	Loaded 30 rds	Normal	-	-	-	Normal 873	

* Loaded one round

Table 12. Results of low temp. tests
(Orlite)

Low temp (-55°F/48 hours)		Extreme changes in					
Mag. No.	Condition	Mag. Fit	External width (in)		Internal width (in)		Firing Func. Rate
			Unloaded	Dim. A Loaded	Dim. B-1	Dim. B-2	
23.	Unloaded	Normal	.000	+ .001*	+ .001 + .001*	-.002 + .002*	- -
24.	Unloaded	Normal	-.001	.000*	+ .003 - .002*	-.001 + .002*	- -
25.	Loaded 30 rds	Normal	-	-	-	-	Normal 765
26.	Loaded 30 rds	Normal	-	-	-	-	Normal 776
27.	Loaded 30 rds	Normal	-	-	-	-	- -
28.	Loaded 30 rds	Normal	-	-	-	-	Normal 873

* Loaded one round

Table 13. Results of low temp. tests
(GAPCO)

Mag. No.	Condition	Mag. Fit	External width (in)		Internal width (in)		Firing Func. Rate
			Dim. A Unloaded	Dim. A Loaded	Dim. B-1	Dim. B-2	
23.	Unloaded	Normal	.000	+ .002*	+ .001 + .001*	.000 + .002*	-
24.	Unloaded	Normal	.000	+ .008*	+ .002 + .008*	+ .002 .000*	-
25.	Loaded 30 rds	Normal	-	.896	-	-	Normal 906
26.	Loaded 30 rds	Normal	-	.904	-	-	BCS** 918
27.	Loaded 30 rds	Normal	-	.890	-	-	-
28.	Loaded 30 rds	Normal	-	.895	-	-	Normal 911

* Loaded one round

** 30th round remained in magazine with bolt latched to the rear

Note: Extreme difficulty experienced in loading 29th and 30th rounds in magazine number 25

Table 14. Results of cyclic temperature/humidity tests
(Orlite)

Extreme changes in

Magazine No.	Condition	Magazine Fit	External width (in)		Internal width (in)		Internal width (in)		Firing Function			
			Dim. A 70°F/90% Humidity	Dim. A 105°F/86% Humidity	Ambient	Dim. B-1 70°F/90% Humidity	Dim. B-1 105°F/86% Humidity	Dim. B-2 70°F/90% Humidity		Dim. B-2 105°F/86% Humidity		
11.	Unloaded	Normal	+0.001	+0.002	+0.004	+0.001	+0.003	+0.010	+0.003	+0.007	+0.003	Normal
12.	Unloaded	Normal	+0.005	+0.003	+0.008	-0.003	-0.001	-0.003	+0.003	+0.003	+0.007	Normal
13.	Loaded 30 rds	Normal	+0.041	+0.047	+0.052	+0.023	+0.032	+0.028	+0.042	+0.052	+0.053	-
14.	Loaded 30 rds	Normal	+0.035	+0.040	+0.044	+0.016	+0.020	+0.022	+0.031	+0.041	+0.044	Normal
15.	Loaded 30 rds	Normal	+0.044	+0.043	+0.045	+0.019	+0.023	+0.021	+0.045	+0.050	+0.051	Normal
16.	Loaded 30 rds	Normal	+0.028	+0.034	+0.038	+0.016	+0.021	+0.021	+0.030	+0.038	+0.041	-

Table 15. Results of cyclic temperature/humidity tests
(GAPCO)

Extreme changes in

Magazine No.	Condition	Magazine Fit	External width (in)		Internal width (in)		Internal width (in)		Firing Function		
			Dim. A 70°F/90% Humidity	Dim. B 105°F/86% Humidity	Ambient	70°F/90% Humidity	Dim. B-1 105°F/86% Humidity	Dim. B-2 105°F/86% Humidity		Ambient	
11.	Unloaded	Tight	+0.005	+0.008	+0.010	+0.005	+0.007	+0.009	+0.008	+0.014	Normal
12.	Unloaded	Tight	+0.004	+0.009	+0.008	+0.001	+0.005	+0.002	+0.011	+0.009	Normal
13.	Loaded 30 rds	Normal	+0.016	+0.020	+0.021	+0.017	+0.020	+0.019	+0.038	+0.040	-
14.	Loaded 30 rds	Normal	+0.030	+0.034	+0.031	+0.017	+0.025	+0.024	+0.042	+0.036	BCS ¹
15.	Loaded 30 rds	Normal	+0.018	+0.020	+0.017	+0.015	+0.015	+0.008	+0.028	+0.022	Normal
16.	Loaded 30 rds	Normal	+0.018	+0.030	+0.026	+0.018	+0.021	+0.017	+0.032	+0.028	-

LOAD: 2000 and 2000 rounds; 2000 magazines.

Table 16. Results of chemical compatibility tests (Orlite)

Mag. No.	Condition	Chemical	Mag. Fit		Rd. No.	Malfunction
			Before Immersion	After Immersion		
1.	Unloaded	Insect repellent O-I-503E	Normal	Normal	-	None
2.	Loaded	Insect repellent O-I-503E	Normal	Normal	30	FBR
3.	Unloaded	Lubricant, semi-fluid (auto wps) MIL-L-46000B	Normal	Normal	-	None
4.	Loaded	Lubricant, semi-fluid (auto wps) MIL-L-46000B	Normal	Normal	-	None
5.	Unloaded	Jet Fuel JP4	Normal	Normal	-	None
6.	Loaded	Jet Fuel JP4	Normal	Normal	-	None
7.	Unloaded	Bore cleaner MIL-C-372B	Normal	Normal	-	None
8.	Loaded	Bore cleaner MIL-C-372B	Normal	Normal	-	None
9.	Unloaded	Gasoline 90 Octane	Normal	Normal	-	None
10.	Loaded	Gasoline 90 Octane	Normal	Normal	-	None
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57.	Unloaded	Dry cleaning solvent P-D680	Normal	Normal	-	None
58.	Loaded	Dry cleaning solvent P-D680	Normal	Normal	-	None
59.	Unloaded	Cleaner, lubricant, preservative (CLP) MIL-L-63460	Normal	Normal	-	None
60.	Loaded	Cleaner, lubricant, preservative (CLP) MIL-L-63460	Normal	Normal	-	None
67.	Unloaded	Lubricating oil, Weapons (LAW) MIL-L-14107	Normal	Normal	-	None
68.	Loaded	Lubricating oil, Weapons (LAW) MIL-L-14107	Normal	Normal	-	None

Table 16. (Cont)

M16A1 S/N 4696138

Mag. No.	Condition	Chemical	Mag. Fit		Rd. No.	Malfunction
			Before Immersion	After Immersion		
71.	Unloaded	Solid film lube MIL-L-461147	Normal	Normal	5 & 8	BOB*
72.	Loaded	Solid film lube MIL-L-461147	Normal	Normal	5	BOB*
73.	Unloaded	Lubricating oil (VV-L-800A)	Normal	Normal	-	None
74.	Loaded	Lubricating oil (VV-L-800A)	Normal	Normal	-	None
75.	Unloaded	Carbon removing com- pound PC111	Normal	Normal	-	None
76.	Loaded	Carbon removing com- pound PC111	Normal	Normal	-	None

* Magazine follower jammed

Table 17. Results of chemical compatibility tests
(GAPCO)

M16A1 S/N 4219892

Mag. No.	Condition	Chemical	Mag. Fit		Rd. No.	Malfunction
			Before Immersion	After Immersion		
1.	Unloaded	Insect repellent O-I-503E	Normal	Normal	-	None
2.	Loaded	Insect repellent O-I-503E	Normal	Normal	-	None
3.	Unloaded	Lubricant, semi-fluid (auto wps) MIL-L-46000B	Normal	Normal	-	None
4.	Loaded	Lubricant, semi-fluid (auto wps) MIL-L-46000B	Normal	Normal	1	BLE
5.	Unloaded	Jet Fuel JP4	Normal	Normal	-	BLE
6.	Loaded	Jet Fuel JP4	Normal	Normal	-	None
7.	Unloaded	Bore cleaner MIL-C-372B	Normal	Normal	-	None
8.	Loaded	Bore cleaner MIL-C-372B	Normal	Normal	-	None
9.	Unloaded	Gasoline 90 Octane	Normal	Normal	-	None
10.	Loaded	Gasoline 90 Octane	Normal	Normal	-	None

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57.	Unloaded	Dry cleaning solvent PD680	Normal	Normal	-	None
58.	Loaded	Dry cleaning solvent PD860	Normal	Normal	-	None
59.	Unloaded	Cleaner, lubricant preservative (CLP) MIL-L-63460	Normal	Normal	30	FBR
60.	Loaded	Cleaner, lubricant preservative (CLP) MIL-L-63460	Normal	Normal	-	None
67.	Unloaded	Lubricating oil, Wpns (LAW) MIL-L-14107	Normal	Normal	-	None
68.	Loaded	Lubricating oil, Wpns (LAW) MIL-L-14107	Normal	Normal	-	None

Table 17. (Cont)

M16A1 S/N 4219892

Mag. No.	Condition	Chemical	Mag. Fit		Rd. No.	Malfunction
			Before Immersion	After Immersion		
71.	Unloaded	Solid film lube MIL-L-461147	Normal	Normal	2 & 4	BOB
72.	Loaded	Solid film lube MIL-L-461147	Normal	Normal	1	BOB
73.	Unloaded	Lubricating oil VVL-800A	Normal	Normal	-	None
74.	Loaded	Lubricating oil VVL-800A	Normal	Normal	-	None
75.	Unloaded	Carbon removing compound PC111	Normal	Normal	-	None
76.	Loaded	Carbon removing compound PC111	Normal	Normal	-	None

Note: Extreme difficulty experienced in loading 29th and 30th rounds in magazine numbers 57, 59, 67, 71, 73, and 75

Table 18. Results of chemical compatibility tests (Orlite)

Mag. No.	Extreme changes in									
	External width (in) (Unloaded) (Dim. A)					Internal width (in) (Unloaded) (Dim. B-2)				
	Before Firing	After Firing	Loaded 30 Rds	Before Firing	After Firing	Before Firing	After Firing	Before Firing	After Firing	After Firing
1	-.001	.000	-	.000	.004	.000	+.004	+.002	+.005	+.005
2	+.011	+.008	+.017	+.008	+.009	+.004	+.009	+.011	+.002	+.002
3	-.013	+.002	-	+.002	+.003	+.002	+.003	+.004	+.005	+.005
4	-.011	+.002	-.007	+.002	+.004	+.005	+.007	+.009	+.007	+.007
5	.000	+.004	-	+.004	+.004	.000	+.004	+.004	+.008	+.008
6	+.002	+.003	+.014	+.003	+.003	+.006	+.004	+.004	+.003	+.003
7	+.001	+.002	-	+.002	+.002	+.004	+.005	+.002	+.003	+.003
8	+.004	+.002	+.012	+.002	+.006	+.006	+.006	+.007	+.007	+.007
9	+.001	+.003	-	+.003	+.003	+.001	+.004	+.001	+.005	+.005
10	+.004	+.002	+.020	+.002	+.002	+.001	.000	+.009	+.007	+.007
57	+.008	+.008	-	+.008	+.008	-.001	+.002	-.001	+.005	+.005
58	+.009	+.002	+.007	+.002	+.002	+.002	+.005	+.001	+.004	+.004
59	+.001	+.015	-	+.015	+.015	.000	+.003	.000	+.002	+.002
60	+.009	+.006	+.009	+.006	+.006	+.001	+.004	+.006	+.010	+.010
67	+.002	+.005	-	+.005	+.005	+.002	+.003	+.005	+.002	+.002
68	+.011	+.003	+.009	+.003	+.003	-.001	+.003	+.002	+.006	+.006
71	+.004	+.006	-	+.006	+.006	+.002	+.004	+.002	+.004	+.004
72	+.009	+.007	+.005	+.007	+.007	+.002	+.004	+.002	+.006	+.006
73	-.002	+.005	-	+.005	+.005	+.002	+.004	+.003	+.005	+.005
74	+.003	+.002	+.006	+.002	+.002	+.005	+.007	+.001	+.004	+.004
75	.000	+.003	-	+.003	+.003	-.001	.000	+.001	+.008	+.008
76	+.006	-.001	+.013	-.001	-.001	+.002	+.004	+.003	+.005	+.005

Table 19. Results of chemical compatibility tests
(GAPCO)

Extreme changes in

Mano. No.	External width (in) (Unloaded) (Dim. A)		Loaded 30 Rds	Internal width (in) (Unloaded) Dim. B-2			
	Before Firing	After Firing		Dim. B-1 Before Firing	Dim. B-1 After Firing	Dim. B-2 Before Firing	Dim. B-2 After Firing
1	-.001	.000	-	+.003	+.003	+.002	+.007
2	+.006	+.007	.000	+.008	+.008	+.012	+.010
3	-.004	+.001	-	+.005	+.007	+.006	+.011
4	-.003	+.001	-.020	+.007	+.007	+.009	+.013
5	-.002	.000	-	+.001	+.007	-.002	+.008
6	+.004	+.008	-.024	+.005	+.009	+.008	+.011
7	+.001	+.001	-	+.003	+.003	+.001	+.001
8	+.002	+.001	-.022	+.004	+.005	+.005	+.006
9	+.001	+.007	-	-.002	+.001	-.001	+.004
10	+.008	+.011	-.008	+.006	+.006	+.011	+.012
57	+.003	+.008	-	+.002	+.005	-.009	-.006
58	+.003	+.002	.000	+.003	+.005	+.002	+.005
59	+.002	+.005	-	+.006	+.006	+.005	+.007
60	+.005	+.003	+.004	+.004	+.007	+.015	+.019
67	-.001	+.003	-	.000	.000	-.003	-.003
68	.000	-.001	+.005	+.001	+.002	-.002	+.001
71	+.001	+.003	-	+.002	+.004	+.005	+.008
72	+.006	+.005	+.001	+.004	+.001	-.002	+.002
73	.000	.000	-	.000	+.002	+.001	+.002
74	+.001	+.001	+.002	.000	+.003	-.001	+.001
75	-.001	+.001	-	-.001	+.001	-.002	+.001
76	+.002	+.001	-.007	.000	+.002	.000	+.003

Table 20. Results of function tests, ambient temp.
(Orlite)

M16A1 S/N 4219892

<u>Firing Sequence & Mag No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/ Cause/Remarks</u>	<u>Firing Rate</u>
45	SA	-	None	
46	Burst	-	None	
47	Auto	-	None	873
46	SA	-	None	
47	Burst	-	None	
45	Auto	-	None	857
47	SA	-	None	
45	Burst	-	None	
46	Auto	-	None	859
45	SA	-	None	
46	Burst	-	None	
47	Auto	-	None	922

Extreme changes in

<u>Mag. No.</u>	<u>External width (in)</u>		<u>Internal width (in)</u>	
	<u>Dim. A Unloaded</u>	<u>Loaded</u>	<u>Dim. B-1</u>	<u>Dim. B-2</u>
45	-.003	(-.001)	+ .003 (+.003)	.000 (+.003)
46	-.002	(+.002)	+ .001 (+.003)	-.003 (+.003)
47	-.001	(-.002)	.000 (+.003)	-.002 (-.001)

() Loaded one round

Table 21. Results of function tests, ambient temp.
(Orlite)

M16A1 S/N 4696138

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>	<u>Firing Rate</u>
48	SA	-	None	
49	Burst	-	None	
50	Auto	-	None	789
49	SA	-	None	
50	Burst	-	None	
48	Auto	-	None	791
50	SA	-	None	
48	Burst	-	None	
49	Auto	-	None	799
48	SA	-	None	
49	Burst	-	None	
50	Auto	-	None	818

Extreme changes in

Mag. No.	External width (in)		Internal width (in)	
	Dim. A Unloaded	Loaded	Dim. B-1	Dim. B-2
48	.000	.000	-.003 (-.001) + .002 (+.003)	
49	+.002	-.001	+.004 (-.004) + .001 (+.004)	
50	+.001	.000	.000 (.000) + .001 (+.002)	

() Loaded one round

Table 22. Results of function tests, ambient temperature (GAPCO)

M16A1 S/N 4219892

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>	<u>Firing Rate</u>
45	SA	-	None	
46	Burst	30	FBR/Magazine failed to actuate bolt catch	
47	Auto	30	FBR/Magazine failed to actuate bolt catch	953
46	SA	30	FBR/Magazine failed to actuate bolt catch	
47	Burst	-	None	
45	Auto	-	None	953
47	SA	30	FBR/Magazine failed to actuate bolt catch	
45	Burst	-	None	
46	Auto	-	None	938
45	SA	-	None	
46	Burst	-	None	
47	Auto	-	None	952

Extreme changes in

<u>Mag. No.</u>	<u>External width (in)</u>		<u>Internal width (in)</u>	
	<u>Dim. A Unloaded</u>	<u>Loaded</u>	<u>Dim. B-1</u>	<u>Dim. B-2</u>
45	+ .004	(+ .004)	+ .004 (+ .003)	+ .003 (+ .009)
46	+ .006	(+ .005)	.000 (+ .003)	.000 (+ .001)
47	+ .006	(+ .006)	+ .003 (+ .005)	+ .004 (+ .007)

() Loaded one round

Table 23. Results of function tests, ambient temperature (GAPCO)

M16A1 S/N 4696138

<u>Firing Sequence & Mao. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>	<u>Firing Rate</u>
48	SA	-	None	
49	Burst	-	None	
50	Auto	-	None	894
49	SA	-	None	
50	Burst	-	None	
48	Auto	-	None	930
50	SA	-	None	
48	Burst	-	None	
49	Auto	-	None	909
48	SA	-	None	
49	Burst	-	None	
50	Auto	-	None	927

Extreme changes in

Mao. No.	External width (in)		Internal width (in)	
	Dim. A Unloaded	Loaded	Dim. B-1	Dim. B-2
48	+ .005	(+ .008)	+ .005 (+ .004)	+ .007 (+ .007)
49	+ .006	(.000)	+ .003 (+ .003)	+ .006 (+ .003)
50	+ .007	(+ .007)	+ .006 (+ .003)	+ .009 (+ .010)

() Loaded one round

Table 24: Results of function tests, ambient temperature
(Metal magazine)

M16A1 S/N 4219892

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/ Cause/Remarks</u>	<u>Firing Rate</u>
7	SA	-	None	
8	Burst	-	None	
9	Auto	-	None	851
8	SA	-	None	
9	Burst	-	None	
7	Auto	-	None	832
9	SA	-	None	
7	Burst	-	None	
8	Auto	-	None	847
7	SA	-	None	
8	Burst	-	None	
9	Auto	-	None	888

Table 24. (Cont)

M16A1 S/N 4696138

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/ Cause/Remarks</u>	<u>Firing Rate</u>
10	SA	-	None	
11	Burst	-	None	
12	Auto	-	None	792
11	SA	-	None	
12	Burst	-	None	
10	Auto	-	None	836
12	SA	-	None	
10	Burst	-	None	
11	Auto	-	None	830
10	SA	-	None	
11	Burst	-	None	
12	Auto	-	None	788

Table 25. Results of function tests
 +160°F Mag. & Ammo., ambient rifle
 (Orlite)

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>M16A1 S/N 4219892</u>		<u>Malfunction/ Cause/Remarks</u>
		<u>Round</u>		
42	SA	-		None
43	Burst	-		None
44	Auto	-		None
43	SA	-		None
44	Burst	-		None
42	Auto	-		None

<u>M16A1 S/N 4696138</u>				
44	SA	-		None
42	Burst	-		None
43	Auto	-		None
42	SA	-		None
43	Burst	-		None
44	Auto	-		None

Extreme changes in

<u>Mag. No.</u>	<u>External width (in)</u>		<u>Internal width (in)</u>	
	<u>Dim. A Unloaded</u>	<u>loaded</u>	<u>Dim. B-1</u>	<u>Dim. B-2</u>
42	+ .016	(+ .012)	+ .016 (+ .021)	+ .019 (+ .017)
43	+ .015	(+ .013)	+ .011 (+ .008)	+ .019 (+ .018)
44	+ .017	(+ .014)	+ .012 (+ .021)	+ .022 (+ .021)

() Loaded one round

Table 26. Results of function tests
 +160°F Mag. & Ammo., ambient rifle
 (GAPCO)

<u>M16A1 S/N 4219892</u>			
<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction Cause/Remarks</u>
42	SA	-	None
43	Burst	-	None
44	Auto	-	None
43	SA	-	None
44	Burst	-	None
42	Auto	-	None

Note: Extreme difficulty experienced in loading 29th and 30th rounds in magazine number 44 (second sequence).

M16A1 S/N 4696138

44	SA	-	None
42	Burst	4	FX/not attributed to magazine
43	Auto	-	None
42	SA	-	None
43	Burst	-	None
44	Auto	-	None

Note: Extreme difficulty experienced in loading 29th and 30th rounds in magazine number 43 (third sequence).

Table 26. (Cont)

Extreme Changes In

Mao. No.	External width (in)		Internal width (in)	
	Dim. A Unloaded	Loaded	Dim. B-1	Dir. E-2
42	.008	(+.006)	+0.011 (+.010)	+0.013 (+.013)
43	+.010	(+.010)	+0.011 (.012)	+0.016 (+.019)
44	+.007	(+.006)	+0.012 (+.012)	+0.015 (+.017)

() Loaded one round

Table 27. Results of function tests
 +160°F Mag. & ammo., ambient rifle
 (metal magazine)

<u>M16A1 S/N 4219892</u>				
<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction Cause/Remarks</u>	<u>Firing Rate</u>
4	SA	-	None	
5	Burst	-	None	
6	Auto	-	None	890
5	SA	-	None	
6	Burst	-	None	
4	Auto	-	None	879
<u>M16A1 S/N 4696138</u>				
6	SA	-	None	
4	Burst	-	None	
5	Auto	-	None	
4	SA	-	None	784
5	Burst	-	None	
6	Auto	-	None	757

Table 28. Results of function tests
 -55°F Mag. & ammo., ambient rifle
 (Orlite)

M16A1 S/N 4219892

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
39	SA	-	None
40	Burst	-	None
41	Auto	-	None
40	SA	-	None
41	Burst	-	None
39	Auto	-	None

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41	SA	-	None
39	Burst	-	None
40	Auto	-	None
39	SA	-	None
40	Burst	-	None
41	Auto	-	None

Extreme changes in

<u>Mag. No.</u>	<u>External width (in)</u>		<u>Internal width (in)</u>	
	<u>Dim. A Unloaded</u>	<u>Loaded</u>	<u>Dim. B-1</u>	<u>Dim. B-2</u>
39	.000	(-.001)	+ .005 (+.005)	+ .003 (+.004)
40	.000	(+.002)	+ .002 (+.004)	.000 (+.001)
41	+.002	(+.002)	+ .006 (+.003)	+ .006 (+.008)

() Loaded one round

Table 29. Results of function tests
 -55°F mag. & ammo., ambient rifle
 (GAPCO)

M16A1 S/N 4219892

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
40	Burst	-	None
41	Auto	-	None
39	SA	30	BCS/Magazine expelled round and activated bolt catch
40	SA	-	None
41	Burst	-	None
39	Auto	-	None

Note: Extreme difficulty experienced in loading 29th and 30th rounds in magazine number 39 and 41 first sequence, 40 and 41 second sequence.

M16A1 S/N 4696138

41	SA	30	BCS/Magazine expelled round and activated bolt catch
39	Burst	-	None
40	Auto	-	None
39	SA	1	BCS/Magazine expelled round and activated bolt catch
40	Burst	-	None
41	Auto	30	BOB

Note: Extreme difficulty experienced in loading 29th and 30th rounds in magazine number 39, 40, and 41 first sequence, 40 second sequence.

Table 29. (Cont)

Extreme changes in

Mag. No.	External width (in)		Internal width (in)	
	Dim. A Unloaded	Loaded	Dim. B-1	Dim. B-2
39	+0.001	(+0.002)	+0.002 (+0.005)	+0.008 (+0.009)
40	+0.004	(+0.004)	+0.004 (+0.015)	+0.011 (+0.005)
41	+0.007	(+0.006)	+0.004 (+0.003)	+0.007 (+0.005)

() Loaded one round

Table 30. Results of function tests
 -55°F Mag. & ammo., ambient rifle
 (metal magazine)

M16A1 S/N 4219892

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/ Cause/Remarks</u>	<u>Firing Rate</u>
1	SA	-	None	
2	Burst	-	None	
3	Auto	-	None	830
2	SA	-	None	
3	Burst	-	None	
1	Auto	-	None	820

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3	SA	-	None	
1	Burst	-	None	
2	Auto	-	None	734
1	SA	11	LI/Not attributed to mag.	
2	Burst	-	None	
3	Auto	-	None	725

Table 31. Results of function tests
 +160°F Mag, ammo., & rifle
 (Orlite)

M16A1 S/N 4219892

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
54	SA	-	None
55	Burst	-	None
56	Auto	-	None
55	SA	-	None
56	Burst	-	None
54	Auto	-	None

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56	SA	-	None
54	Burst	-	None
55	Auto	-	None
54	SA	-	None
55	Burst	-	None
56	Auto	-	None

Extreme changes in

<u>Mag. No.</u>	<u>External width (in)</u>		<u>Internal width (in)</u>	
	<u>Dim. A Unloaded</u>	<u>Loaded</u>	<u>Dim. B-1</u>	<u>Dim. B-2</u>
54	+ .021	(+ .020)	+ .012 (+ .016)	+ .028 (+ .023)
55	+ .022	(+ .021)	+ .013 (+ .014)	+ .025 (+ .022)
56	+ .024	(+ .022)	+ .017 (+ .014)	+ .030 (+ .029)

() Loaded one round

Table 32. Results of function tests
 +160°F Mag., ammo., & rifle
 (GAPCO)

M16A1 S/N 4219892

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
54	SA	-	None
55	Burst	-	None
56	Auto	-	None
55	SA	-	None
56	Burst	-	None
54	Auto	-	None

Note: Extreme difficulty experienced in loading 29th & 30th rounds in magazine 54 first sequence, 54 and 55 second sequence.

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56	SA	-	None
54	Burst	30	BCS/magazine expelled round and activated bolt catch
55	Auto	30	BCS/magazine expelled round and activated bolt catch
54	SA	-	None
55	Burst	-	None
56	Auto	-	BCS/magazine expelled round and activated bolt catch

Note: Extreme difficulty experienced in loading 29th & 30th rounds in magazine 54 second sequence.

Table 32. (cont)

Extreme changes in

Mag. No.	External width (in)		Internal width (in)	
	Dim. A Unloaded	Loaded	Dim. B-1	Dim. B-2
54	+0.007	(+0.007)	+0.009 (+0.004)	+0.015 (+0.018)
55	+0.011	(+0.015)	+0.013 (+0.015)	+0.018 (+0.018)
56	+0.015	(+0.018)	+0.010 (+0.011)	+0.015 (+0.016)

() Loaded one round

Table 33. Results of function tests
 +160°F Mag., ammo, and rifle
 (metal magazine)

M16A1 S/N 4219892

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
54	SA	-	None
55	Burst	-	None
56	Auto	-	None
55	SA	-	None
56	Burst	-	None
54	Auto	-	None

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56	SA	29	BLE
54	Burst	-	None
55	Auto	-	None
54	SA	4	LI - not attributed to magazine
55	Burst	-	None
56	Auto	-	None

Table 34. Results of function tests
 -55°F Mag., ammo. and rifle
 (Orlite)

M16A1 S/N 4219892

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
51	SA	3 & 4	FF/BOB/Bolt overrode base of round in feeding from magazine.
52	Burst	-	None
53	Auto	-	None
52	SA	-	None
51	Burst	-	None
53	Auto	-	None

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53	SA	-	None
51	Burst	-	None
52	Auto	-	None
51	SA	-	None
52	Burst	-	None
53	Auto	-	None

Extreme changes in

<u>Mag. No.</u>	<u>External width (in)</u>		<u>Internal width (in)</u>	
	<u>Dim. A Unloaded</u>	<u>Loaded</u>	<u>Dim. B-1</u>	<u>Dim. B-2</u>
51	-.002	(+.001)	+0.006 (+.003)	+0.011 (+.013)
52	+.006	(+.002)	+0.005 (+.002)	+0.008 (+.008)
53	+.007	(+.008)	+0.004 (+.005)	+0.004 (+.006)

() Loaded one round

Table 35. Results of function tests
 -55°F Mag., ammo. and rifle
 (GAPCO)

M16A1 S/N 4219892

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
51	SA	-	None
52	Burst	30	BCS/mag. expelled round and activated bolt catch
53	Auto	-	None
52	SA	-	None
53	Burst	-	None
51	Auto	-	None

Note: Extreme difficulty experienced in loading 29th and 30th rounds in magazines 51 and 52 first and second sequence.

M16A1 S/N 4696138

53	SA	1 & 30	FF/BOB
51	Burst	-	None
52	Auto	2	Mag. failed/broken lip all rds expelled
51	SA	-	None
52	Burst	Not tested	-
53	Auto	-	None

Note: Extreme difficulty experienced in loading 29th and 30th rounds in magazines 51 and 52 first sequence, 51 and 53 second sequence.

Table 35. (Cont)

Extreme changes in

Mag. No.	External width (in)		Internal width (in)	
	Dim. A Unloaded	Loaded	Dim. B-1	Dim. B-2
51	+0.003	(+0.003)	+0.006 (+0.005)	+0.015 (+0.011)
52	+0.023	--	--	--
53	+0.002	(+0.002)	+0.004 (+0.004)	+0.008 (+0.009)

() Loaded one round

Table 36. Results of function tests
 -55°F Mag., ammo., and rifle
 (metal magazine)

M16A1 S/N 4219892

<u>Firing Sequence & Mag No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
51	SA	-	None
52	Burst	-	None
53	Auto	-	None
52	SA	-	None
53	Burst	-	None
51	Auto	-	None

M16A1 S/N 4696138

53	SA	-	None
51	Burst	-	None
52	Auto	-	None
51	SA	-	None
52	Burst	-	None
53	Auto	-	None

Results of Magazine Function Test in M231 Firing Port Weapon

The magazines of both manufacturers were also tested in the M231 Firing Port Weapon. Due to the fact that this weapon utilizes the same magazine as the M16A1 Rifle, but has a much higher firing rate, any general use of plastic magazines would require compatibility with the M231.

Six magazines of each manufacture and a total of 11,520 rounds of 5.56 M193 tracer ammunition were used in conjunction with two weapons in both the burst and automatic fire modes, and were fired from both the fixed mount and hand held position. 5,760 rounds were fired in each mode.

The results of the tests are presented in Tables 37 and 38.

Table 37. Results of magazine tests in M231 firing port weapon, ambient temp. (Orlite)

M231 S/N 5301378 mounted

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/ Cause/Remarks</u>
63	Burst	----	None
64	Auto	----	None
64	Burst	----	None
63	Auto	----	None
61	Auto	----	None
62	Burst	----	None
63	Auto	----	None
64	Burst	----	None
65	Auto	----	None

M231 S/N 5330322 mounted

61	Burst	----	None
62	Auto	----	None
63	Burst	----	None
64	Auto	----	None
65	Burst	----	None

M231 S/N 5301378 mounted

61	Auto	----	None
62	Burst	----	None
63	Auto	----	None
64	Burst	----	None
65	Auto	----	None

M231 S/N 5330322 mounted

62	Auto	----	None
61	Burst	----	None
64	Auto	----	None
63	Eurst	----	None
65	Burst	----	None

Table 37. (Cont)

M231 S/N 5330322 hand held

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/ Cause/Remarks</u>
61	Auto	----	None
62	Burst	----	None
63	Auto	----	None
64	Burst	----	None
65	Auto	----	None
66	Burst	----	None

M231 S/N 5301378 hand held

62	Auto	----	None
63	Burst	----	None
64	Auto	8	FX/Not attributed to magazine, broken extractor
65	Burst	----	None
66	Auto	----	None
61	Burst	----	None
65	Auto	----	None
66	Burst	----	None
63	Auto	----	None
64	Burst	----	None
61	Auto	----	None
62	Burst	----	None

M231 S/N 5330322 hand held

66	Auto	----	None
61	Burst	----	None
62	Auto	----	None
63	Burst	----	None
64	Auto	----	None
65	Burst	----	None

M231 S/N 5301378 mounted

61	Auto	----	None
62	Burst	----	None
63	Auto	----	None
64	Burst	----	None
65	Auto	----	None
66	Burst	----	None

Table 37. (Cont)

M231 S/N 5330322 mounted

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/ Cause/Remarks</u>
62	Auto	----	None
63	Burst	----	None
64	Auto	----	None
65	Burst	----	None
66	Auto	----	None
61	Burst	----	None

M231 S/N 5301378 mounted

63	Auto	----	None
64	Burst	----	None
65	Auto	----	None
66	Burst	----	None
61	Auto	----	None
62	Burst	----	None

M231 S/N 5330322 mounted

64	Auto	----	None
65	Burst	----	None
66	Auto	----	None
61	Burst	----	None
62	Auto	----	None
63	Burst	----	None

M231 S/N 5301378 mounted

65	Auto	----	None
66	Burst	----	None
61	Auto	----	None
62	Burst	----	None
63	Auto	----	None
64	Burst	----	None

M231 S/N 5330322 mounted

66	Auto	----	None
61	Burst	----	None
62	Auto	----	None
63	Burst	----	None
64	Auto	----	None
65	Burst	----	None

Table 37. (Cont)

M231 S/N 5301378 mounted

<u>Firing Sequence & Mag No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/ Cause/Remarks</u>
61	Auto	----	None
62	Burst	----	None
63	Auto	----	None
64	Burst	----	None
65	Auto	----	None
66	Burst	----	None

M231 S/N 5330322 mounted

62	Auto	----	None
63	Burst	----	None
64	Auto	----	None
65	Burst	----	None
66	Auto	----	None
61	Burst	----	None

M231 S/N 5301378 mounted

63	Auto	----	None
64	Burst	----	None
65	Auto	----	None
66	Burst	----	None
61	Auto	----	None
62	Burst	----	None

M231 S/N 5330322 mounted

64	Auto	----	None
65	Burst	----	None
66	Auto	----	None
61	Burst	----	None
62	Auto	----	None
63	Burst	----	None

M231 S/N 5301378 mounted

65	Auto	----	None
66	Burst	----	None
61	Auto	----	None
62	Burst	----	None
63	Auto	----	None
64	Burst	----	None

Table 37. (Cont)

M231 S/N 5330322 mounted

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
66	Auto	----	None
61	Burst	----	None
62	Auto	----	None
63	Burst	----	None
64	Auto	----	None
65	Burst	----	None

M231 S/N 5301378 mounted

61	Auto	----	None
62	Burst	----	None
63	Auto	----	None
64	Burst	----	None
65	Auto	----	None
66	Burst	----	None

M231 S/N 5330322 mounted

62	Auto	----	None
63	Burst	----	None
64	Auto	----	None
65	Burst	----	None
66	Auto	----	None
61	Burst	----	None

M231 S/N 5301378 mounted

63	Auto	----	None
64	Burst	----	None
65	Auto	----	None
66	Burst	----	None
61	Auto	----	None
62	Burst	----	None

M231 S/N 5330322 mounted

64	Auto	----	None
65	Burst	----	None
66	Auto	----	None
61	Burst	----	None
62	Auto	----	None
63	Burst	----	None

Table 37. (Cont)

<u>M231 S/N 5301378 mounted</u>				
<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>	
65	Auto	----	None	
66	Burst	----	None	
61	Auto	----	None	
62	Burst	----	None	
63	Auto	----	None	
64	Burst	----	None	
 <u>M231 S/N 5330322 mounted</u>				
66	Auto	----	None	
61	Burst	----	None	
62	Auto	----	None	
63	Burst	----	None	
64	Auto	----	None	
65	Burst	----	None	
 <u>M231 S/N 5301378 mounted</u>				
61	Auto	----	None	
62	Burst	----	None	
63	Auto	----	None	
64	Burst	----	None	
65	Auto	----	None	
66	Burst	----	None	
 <u>M231 S/N 5330322 mounted</u>				
62	Auto	30	FBR	
63	Burst	----	None	
64	Auto	----	None	
65	Burst	----	None	
66	Auto	----	None	
61	Burst	----	None	
 <u>M231 S/N 5301378 mounted</u>				
63	Auto	----	None	
64	Burst	----	None	
65	Auto	----	None	
66	Burst	----	None	
61	Auto	----	None	
62	Burst	----	None	

Table 37. (Cont)

M231 S/N 5330322 mounted

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/ Cause/Remarks</u>
64	Auto	30	FBR
65	Burst	----	None
66	Auto	----	None
61	Burst	----	None
62	Auto	----	None
63	Burst	----	None

M231 S/N 5301378 mounted

65	Auto	----	None
66	Burst	4	BOB
61	Auto	----	None
62	Burst	----	None
63	Auto	----	None
64	Burst	----	None

M231 S/N 5330322 mounted

66	Auto	----	None
61	Burst	----	None
62	Auto	----	None
63	Burst	----	None
64	Auto	----	None
65	Burst	----	None

Table 38. Results of magazine tests in M231 firing port weapon, ambient temp. (GAPCO)

M231 S/N 5301378 mounted

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
18	Burst	1 30	BCB FBR/BCS/Round expelled from mag.
17	Auto	30	FF/Round expelled from magazine and jammed between bolt & charging handle

M231 S/N 5330322 mounted

17	Burst	----	None
18	Auto	----	None
17	Auto	30	FBR
18	Burst	----	None
63	Auto	----	None
64	Burst	----	None
65	Auto	----	None

M231 S/N 5301378 mounted

17	Burst	----	None
18	Auto	----	None
63	Burst	30	BCS/Round expelled from magazine
64	Auto	----	None
65	Burst	30	BCS/Round expelled from magazine

M231 S/N 5330322 mounted

17	Auto	----	None
18	Burst	30	BCS/Round expelled from magazine
63	Auto	30	BCS/Round expelled from magazine
64	Burst	----	None
65	Auto	----	None

M231 S/N 5301378 mounted

18	Auto	30	BCS/Round expelled from magazine
17	Burst	----	None
64	Auto	----	None
63	Burst	30	BCS/Round expelled from magazine
65	Burst	----	None

Table 38. (Cont)

M231 S/N 5301378 hand held

<u>Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
17	Auto	30	FBR
18	Burst	----	None
62	Auto	----	None
63	Burst	----	None
64	Auto	----	None
65	Burst	----	None

M231 S/N 5330322 hand held

18	Auto	30	FF/Round expelled from magazine
62	Burst	----	None
63	Auto	----	None
64	Burst	----	None
65	Auto	----	None
17	Burst	30	FBR

M231 S/N 5330322 hand held

63	Auto	30	BCS/Round expelled from magazine
64	Burst	----	None
65	Auto	----	None
62	Burst	----	None
17	Auto	30	FBR
18	Burst	----	None

M231 S/N 5301378 hand held

64	Auto	----	None
65	Burst	30	BCS/Round expelled from magazine
62	Auto	----	None
63	Burst	30	BCS/Round expelled from magazine
18	Auto	----	None
17	Burst	----	None

M231 S/N 5330322 mounted

17	Auto	30	BCS/Round expelled from magazine
18	Burst	30	BCS/Round expelled from magazine
62	Auto	----	None
63	Burst	30	BCS/Round expelled from magazine
64	Auto	----	None
65	Burst	----	None

Table 38. (Cont)

M231 S/N 5301378 mounted

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
18	Auto	----	None
62	Burst	----	None
63	Auto	----	None
64	Burst	----	None
65	Auto	----	None
17	Burst	30	FF/Round expelled from magazine

M231 S/N 5330322 mounted

62	Auto	----	None
63	Burst	----	None
64	Auto	----	None
65	Burst	----	None
17	Auto	30	FBR
18	Burst	----	None

M231 S/N 5301378 mounted

63	Auto	----	None
64	Burst	----	None
65	Auto	----	None
17	Burst	30	FF/Round expelled from magazine
18	Auto	30	BCS/Round expelled from magazine
62	Burst	30	FF/Round expelled from magazine

M231 S/N 5330322 mounted

64	Auto	----	None
65	Burst	30	BCS/Round expelled from magazine
17	Auto	30	FBR
18	Burst	30	BCS/Round expelled from magazine
62	Auto	30	BCS/Round expelled from magazine
63	Burst	30	FF/Round expelled from magazine

M231 S/N 5301378 mounted

65	Auto	----	None
17	Burst	30	FBR
18	Auto	30	BCS/Round expelled from magazine
62	Burst	30	BCS/Round expelled from magazine
63	Auto	30	BCS/Round expelled from magazine
64	Burst	30	BCS/Round expelled from magazine

Table 38. (Cont)

M231 S/N 5330322 mounted

Firing Sequence &
Maq. No.

17	Auto	30	FBR
18	Burst	30	BCS/Round expelled from magazine
62	Auto	----	None
63	Burst	30	BCS/Round expelled from magazine
64	Auto	----	None
65	Burst	30	BCS/Round expelled from magazine

M231 S/N 5301378 mounted

18	Auto	30	BCS/Round expelled from magazine
62	Burst	----	None
63	Auto	30	FBR
64	Burst	----	None
65	Auto	14	FX/BCS/Round expelled from magazine
17	Burst	30	FBR/BCS/Round expelled from magazine

M231 S/N 5330322 mounted

62	Auto	----	None
63	Burst	30	BCS/Round expelled from magazine
64	Auto	----	None
65	Burst	----	None
17	Auto	30	FBR
18	Burst	30	BCS/Round expelled from magazine

M231 S/N 5301378 mounted

63	Auto	30	BCS/Round expelled from magazine
64	Burst	----	None
65	Auto	30	BCS/Round expelled from magazine
17	Burst	30	FF/Round expelled from magazine
18	Auto	30	BCS/Round expelled from magazine
62	Burst	30	BCS/Round expelled from magazine

M231 S/N 5330322 mounted

64	Auto	----	None
65	Burst	----	None
17	Auto	30	FBR
18	Burst	30	BCS/Round expelled from magazine
62	Auto	----	None
63	Burst	----	None

Table 38. (Cont)

M231 S/N 5301378 mounted

<u>Firing Sequence & Maq. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
65	Auto	----	None
17	Burst	----	None
18	Auto	30	BCS/Round expelled from magazine
62	Burst	----	None
63	Auto	30	BCS/Round expelled from magazine
64	Burst	30	FF/Round expelled from magazine

M231 S/N 5330322 mounted

17	Auto	30	FBR
18	Burst	----	None
62	Auto	----	None
63	Burst	----	None
64	Auto	----	None
65	Burst	----	None

M231 S/N 5301378 mounted

18	Auto	30	BCS/Round expelled from magazine
62	Burst	30	BCS/Round expelled from magazine
63	Auto	----	None
64	Burst	30	BCS/Round expelled from magazine
65	Auto	----	None
17	Burst	30	FF/Round expelled from magazine

M231 S/N 5330322 mounted

62	Auto	----	None
63	Burst	30	BCS/Round expelled from magazine
64	Auto	----	None
65	Burst	----	None
17	Auto	30	FBR
18	Burst	30	BCS/Round expelled from magazine

M231 S/N 5301378 mounted

63	Auto	30	BCS/Round expelled from magazine
64	Burst	----	None
65	Auto	----	None
17	Burst	----	None
18	Auto	----	None
62	Burst	30	FF/Round expelled from magazine

Table 38. (Cont)

M231 S/N 5330322 mounted

<u>Firing Sequence & Mag.No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
64	Auto	----	None
65	Burst	----	None
17	Auto	30	FBR
18	Burst	30	BCS/Round expelled from magazine
62	Auto	----	None
63	Burst	----	None

M231 S/N 5301378 mounted

65	Auto	----	None
17	Burst	30	FF/Round expelled from magazine & jammed between bolt & upper receiver
18	Auto	30	BCS/Round expelled from magazine
62	Burst	----	None
63	Auto	30	BCS/Round expelled from magazine
64	Burst	----	None

M231 S/N 5330322 mounted

17	Auto	30	FBR
18	Burst	30	BCS/Round expelled from magazine
62	Auto	----	None
63	Burst	30	BCS/Round expelled from magazine
64	Auto	----	None
65	Burst	----	None

M231 S/N 5301378 mounted

18	Auto	30	BCS/Round expelled from magazine
62	Burst	----	None
63	Auto	30	BCS/Round expelled from magazine
64	Burst	----	None
65	Auto	----	None
17	Burst	30	FF/Round expelled from magazine & jammed between bolt & upper receiver

Table 38. (Cont)

M231 S/N 5330322 mounted

<u>Firing Sequence & Mag. No.</u>	<u>Mode</u>	<u>Round</u>	<u>Malfunction/Cause/Remarks</u>
62	Auto	----	None
63	Burst	30	BCS/Round expelled from magazine
64	Auto	----	None
65	Burst	----	None
17	Auto	30	FBR
18	Burst	----	None

M231 S/N 5301378 mounted

63	Auto	30	BCS/Round expelled from magazine
64	Burst	----	None
65	Auto	----	None
17	Burst	----	None
18	Auto	30	FBR
62	Burst	----	None

M231 S/N 5330322 mounted

64	Auto	----	None
65	Burst	30	BCS/Round expelled from magazine
17	Auto	30	FBR
18	Burst	30	BCS/Round expelled from magazine
62	Auto	----	None
63	Burst	30	FF/Round expelled from magazine

M231 S/N 5301378 mounted

65	Auto	----	None
17	Burst	30	FF/Round expelled from magazine & jammed between bolt & upper receiver
18	Auto	----	None
62	Burst	30	BCS/Round expelled from magazine
63	Auto	----	None
64	Burst	----	None

Discussion of Results

Loading Difficulty

Sixty-two Orlite magazines were loaded a total of one hundred thirty-seven times during the same test with no difficulty in loading.

Throughout the testing for use in the M16A1 Rifle, sixty-two GAPCO magazines were loaded a total of one hundred thirty-seven times. During this activity, difficulty in loading the 28th and/or 29th and/or 30th rounds was experienced a total of forty-six times. These difficulties occurred at random throughout the testing.

Structural Integrity

For purposes of these tests, a failure is defined as a condition which renders the magazine incapable of accomplishing its required function.

During the High temperature drop test, (refer to Table 4), all Orlite magazines failed due to cracks along feed lips or front edge during either the third or fourth drop sequence.

During the High temperature drop test, (refer to Table 5), the feed lips on all GAPCO magazines failed during the second drop sequence. In addition, all the magazines expanded and the rounds became wedged side by side within each magazine and therefore, could not be removed in the conventional manner.

During the Low temperature drop test, (refer to Table 6), all Orlite magazines failed as evidenced by cracks along rear seam, front seam, or feed lips, during either the second or third drop sequence.

During the Low temperature drop test, (refer to Table 7), all GAPCO magazines failed as evidenced by cracks along rear seam, floor plate catch slot, or broken followers. Three failed during the first sequence, and one failed during the third drop sequence.

During the Ambient drop test, (refer to Table 8), both Orlite magazines failed due to cracked feed lips during the third or fourth drop sequence. Although one magazine suffered a $1\frac{1}{2}$ inch crack along the upper rear edge during the second drop sequence, the crack did not render the magazine inoperable. Also, it is unlikely that it caused the higher number of expelled rounds in subsequent drops.

During the Ambient drop test, (refer to Table 9), both GAPCO magazines failed due to cracks along the rear edge during the fourth drop sequence. Chips on the bottom plate catch slot, center reinforcing ribs, and upper front edge occurred but due to their locations, it is unlikely that these contributed to the high number of expelled rounds.

Expelled Rounds, Drop Test

During the entire drop test, the ten Orlite magazines expelled a total of

394 rounds before failure. During the same drop test, the ten GAPCO magazines expelled a total of 223 rounds before failure. However, it is to be noted that the increased number of expelled rounds in the Orlite drop test in all cases, was due to the magazine's ability to survive a larger number of drops before failure occurred, as shown in Tables 4 through 9.

Chemical Compatibility

There appeared to be no visible effects of any of the chemicals tested on any of the magazines. However, the Solid Film Lube MIL-L-46147 produced a thick residue which hampered to some degree the function of the magazine spring and follower assembly.

Functional Reliability - M16A1 Rifle

Orlite Magazines

During the entire High temperature, Low temperature, Temperature/humidity, Chemical compatibility, and Function firing tests, consisting of 3,120 rounds, six malfunctions occurred that were most likely attributable to the magazine. However, the Solid Film Lube MIL-L-64147 used in the Chemical compatibility test, produced a thick residue which hampered the function of the magazine spring and follower assembly, thus accounting for three of the six malfunctions. The detailed results are shown in Tables 10, 12, 14, 16, 18, 20, 21, 25, 28, 31, and 34. The mean number of rounds between malfunctions was 520.

GAPCO Magazines

During the entire High temperature, Low temperature, Temperature/humidity, Chemical compatibility, and Function firing tests, consisting of 3,120 rounds, 22 malfunctions occurred that were most likely attributable to the magazines. Solid Film Lube was also used in this test and its residue accounted for three of the 22 malfunctions. The detailed results are shown in Tables 11, 13, 15, 17, 19, 22, 23, 26, 29, 32, and 35. The mean number of rounds between malfunctions was 142.



CONCLUSIONS

General

The conclusions stated herein are based on the test results presented in the preceding section and the observations of test personnel.

Condition of the Test Samples

Based on the initial inspection of the plastic magazines provided for these tests, the quality of the test samples must be considered as adequate.

Construction

A large percentage of the magazines exhibited failures of the feed lips and the plastic weld between the two halves of the housing as a result of mechanical loads (dropping). Other shortcomings encountered in the testing could be attributed to the same weakness.

Effects of Environmental Extremes

The most apparent effect of environmental extremes on the GAPCO Magazines was the spreading of the feed lips especially in the hot environment. In the Hot Drop Test, these magazines expanded to the point where the rounds became wedged side by side and could not be removed in the conventional manner. See X-ray, photograph, Figure 12.

Functional Reliability

Failures due to mechanical loads (drop test), were wide spread in magazines from both manufacturers. The firing tests revealed that a high percentage of GAPCO magazines malfunctioned. The malfunctions were attributed to distorted feed lips and/or follower springs resulting in premature activation of the rifle bolt catch. The functional performance of the Orlite magazines during the firing tests was significantly better than that of the GAPCO magazines.

Chemical Compatibility

Based on the results of the limited tests performed, it can be concluded that the materials used in the fabrication of both types of plastic magazines are compatible with fuels, solvents, etc., used in this test.

Ease of Loading

With regard to ease of loading, the Orlite magazines tested were superior to the GAPCO magazines tested.

Metal Magazines

During the entire Function Firing Tests consisting of 2,160 rounds, there was only one malfunction that was most likely attributable to the magazines, as shown

in Tables 24, 27, 30, 33, and 36.

functional Reliability - M231 Firing Port Weapon

Mounted Position - Orlite Magazines

During this function firing test, a total of 5,040 rounds were fired. Six different Orlite magazines were used with three malfunctions occurring that were most likely attributable to the magazines. The mean number of rounds between stoppages for this test was 1,680.

Mounted Position - GAPCO Magazines

During this function firing test, a total of 5,040 rounds were fired. Six different GAPCO magazines were used with 79 malfunctions occurring that were most likely attributable to the magazines. The mean number of rounds between stoppages for this test was 64.

Hand Held Position - Orlite Magazines

During this function firing test, a total of 720 rounds were fired using the same six magazines with no malfunctions.

Hand Held Position - GAPCO Magazines

During this function firing test, a total of 720 rounds were fired using the same six magazines from the hand held position with seven malfunctions occurring that were most likely attributable to the magazines. The mean number of rounds between stoppages for this test was 103.

Drop Tests

During the Drop Test portion of the testing, the Orlite magazines exhibited superior performance over the GAPCO magazines, since they endured a greater number of drops before failure.

Malfunctions

The mean number of rounds between stoppages or malfunctions clearly demonstrates the Orlite magazines to be superior to the GAPCO magazines for use with the M16A1 Rifle.

The mean number of rounds between stoppages or malfunctions in both the mounted and hand held positions, clearly demonstrates that the Orlite magazines were superior to the GAPCO magazines for use in the M231 Firing Port Weapon.

The plastic magazines tested demonstrate significant technological advances which provide a high degree of promise for acceptable military performance.

APPENDIX

Characteristics and Description

Crlite Engineering Company

Capacity	-	30 rounds
Weight (empty)	-	109.176gm
Material	-	Dupont Zytel
Assembly	-	Magazine housing, follower assembly and floor plate
Housing	-	Assembled from two halves and welded together along a longitudinal center line
Follower Assembly	-	One plastic follower and one metallic follower drive spring
Floor Plate	-	Two piece

GAPCO

Capacity	-	30 rounds
Weight (empty)	-	112.541gm
Material	-	Dupont Zytel 43G
Assembly	-	Magazine housing, follower assembly and floor plate
Housing	-	Assembled from two halves and welded together along a longitudinal center line
Follower Assembly	-	One plastic follower and one metallic follower drive spring
Floor Plate	-	One piece

Operation

Both manufacturers magazines are loaded in the conventional manner from the top either with single rounds or by use of ten round stripper bars.

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