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FINAL REPORT ON

MILITARY POTENTIAL TEST

OF

WEAPONS LUBRICANTS EMPLOYING 5.56-MM,

M16A1 (XM16E1) RIFLE

BY

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LLOYD STALEY

JUNE 1967

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ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND

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ABSTRACT

This test was conducted to evaluate the qualities of lubricants identified as Code A, NRL (Naval Research Laboratory), VV-L-800, and MIL-L-46000A for use with the M16A1 rifle. The testing consisted of adverse conditions, reliability with minimum and standard maintenance, rust penetration, liberal lubrication, and a sequential series of tests which were conducted in a manner to simulate some of the environmental conditions the user would possibly meet in the field. Testing began in February and was completed in May 1967. It was found that MIL-L-46000A semifluid oil was significantly superior to the other test lubricants for over-all M16A1 rifle functioning performance, VV-L-800 second, NRL third, and Code A fourth. Ranking among the lubricants for corrosion resistance was MIL-L-46000A first, NRL second, VV-L-800 third, and Code A fourth. Recommendations were made that the present standard VV-L-800 lubricant for the M16A1 rifle be replaced with MIL-L-46000A for field use at operating temperature above freezing and that further testing be conducted with MIL-L-46000A to determine suitability for use with the M16A1 rifle at low temperatures.

FOREWORD

Development and Proof Services was responsible for preparing the test plan, conducting the test, and preparing the test report.

Acknowledgement is made to Mr. Fred Novekoff, SWERI-RDL, Rock Island Arsenal for his guidance and assistance in rust evaluation of materiel involved in test.

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FEBRUARY TO MAY 1967

SECTION 1. INTRODUCTION

1.1 BACKGROUND

This test was originally initiated to evaluate the qualities of a lubricant identified as Code A, a proprietary item claimed by the developer to provide superior small-arms weapons lubrication, supported by publicity testimonials from servicemen in Viet Nam who received samples as gift packages in December 1965. Beginning in January 1966, a number of Congressional inquiries regarding the product were directed to the US Army. Files revealed that the Code A Company attempted to secure a military specification for this lubricant in 1962; however, since it was then proposed as an antiseize compound rather than a weapon lubricant, the product is reported to have been recommended to Wright-Patterson Air Force Base for test. No records are available that indicate the product was submitted for test. It is also reported that the Naval Air Laboratories (Philadelphia, Pa.) tested the product and found it unacceptable in wear characteristics and in flash point (+120°F). In March 1966, after the Congressional inquiries, Rock Island Arsenal (RIA) evaluated the compound under laboratory conditions, including a limited amount of firing from M14 and M16 rifles. The US Army Materiel Command (AMC) and US Army Weapons Command (AWC) recommended that additional testing be accomplished, particularly with weapons subjected to adverse and climatic conditions. The evaluation includes additional laboratory tests at RIA and extensive weapon firing and storage tests by USATECOM, at Aberdeen Proving Ground (APG). Code A was evaluated and compared with standard lubricants VV-L-800 (MIL-L-644B), NRL 4002-36, and MIL-L-46000A.

1.2 DESCRIPTION OF MATERIEL

Code A, three standard lubricants, and one standard cleaning compound were evaluated in this test. The following descriptive data are based on Code A literature, military specifications, and composition analyses:

a. Code A. A dispersion of molybdenum disulphide in a mixture of light lubricating oil and dry-cleaning solvent. It contains corrosion inhibitors.

b. Lubricant, VV-L-800 (PL Special). A light petroleum base, water-displacing, preservative, lubricating oil which is inhibited to provide resistance to corrosion and oxidation. It has a minimum viscosity of 12 centistokes at +100°F. It is the authorized small-arms lubricant for use at temperatures above 0°F.

c. Preservative Lubricant, Tropical, for Small Arms Weapons, NRL 4002-36 (6170-N4022-51). The NRL lubricant is a succinic acid derivative dissolved in N-heptane and ethyl alcohol and is provided for test in pressurized spray cans.

d. Lubricant, MIL-L-46000A. A semifluid synthetic base, preservative, lubricating oil which is inhibited to provide resistance to corrosion and oxidation. It has a minimum viscosity of 11.0 centistokes at +100°F. It is an authorized lubricant for automatic weapons within a temperature range of -65° to +260°F.

1.3 TEST OBJECTIVES

The US Army Materiel Command directed that Code A and other lubricants be evaluated by supplementing the laboratory data acquired by RIA early in 1966 and to investigate weapon reliability with the test lubricants under "real life" conditions (as encountered under combat conditions). The data will serve the following purposes:

a. Further the over-all lubricants R&D program.

b. Provide a sound basis for correlating laboratory data and full-scale performance parameters.

c. Establish a clear basis for decision as to whether or not a lubricant of the Code A type offers sufficient merit to justify the development of a military specification.

1.4 SUMMARY OF RESULTS

1.4.1 Introduction

The characteristics of the four test lubricants were evaluated with respect to both rifle-function performance and corrosion resistance. The rifle-function data are reported on a malfunction rate per 100 rounds fired; which provides a numerical rating system. The corrosion

data are also reported numerically using a visual rust rating system described in ASTM Bulletin No. 154 (Reference 7). The rust rating system provides a means for rating the area, nature, and intensity of rust. The system and the way it was used throughout this test are explained in detail in paragraph 2.1.4. To provide a concise summary of the rust data, only the intensity of the rust is presented in the following summary of results.

1.4.2 Function Data

The malfunction rates per 100 rounds fired for each of the subtests are contained in Table 1.4-I. These rates consider only those malfunctions deemed related to the efficacy of the lubricants in maintaining weapon function. Based on the rate from these malfunctions, the lubricants were ranked 1 through 4 for each of the subtests. One indicates the most effective lubricant and four the least effective. The degree of effectiveness can be determined by the malfunction rate.

Table 1.4-I. Summary of Function Data

	Lubricant							
	MIL-L-46000A		VV-L-800		NRL		Code A	
Subtest	Malf Rate	Rank	Malf Rate	Rank	Malf Rate	Rank	Malf Rate	Rank
Salt-water immersion	0.3	1	[a]0.9	3	2.6	2	[a]4.0	4
Dust	0.8	1	1.2	2	3.0	4	2.6	3
Mud	[b]-	[b]	[b]-	[b]	[b]-	[b]	[b]-	[b]
Sand-drag	0.0	1	0.1	3	0.0	1	1.3	4
Water-spray	0.3	2	[c]2.5	4	0.1	1	1.0	3
Reliability								
Schedule I	1.4	1	1.8	2	3.7	4	3.2	3
Schedule II	0.06	1	0.09	2	0.56	3	1.66	4
Sequential	1.2	1	3.1	4	2.5	2	3.0	3
Dynamic-dust								
Phase I	1.0	1	2.1	2	3.7	3	3.8	4
Phase 2	2.1	1	3.2	2	[d]-	[d]	7.5	3
Liberal lubrication	0.00	1	0.00	1	0.04	4	0.02	3

[a]None of the VV-L-800 or Code A rifles completed the salt-water immersion test; therefore, the malfunction rates are on the rounds fired previous to the day of test termination.

[b]Testing was terminated with all rifles due to excessive malfunctions and the number of rounds fired was inadequate to compute a malfunction rate.

[c]A second rifle was fired using MIL-G-46003 (Lubriplate) as an additive to VV-L-800. The malfunction rate on the rifle was 0.4.

[d]Not fired due to short supply of NRL lubrication spray cans.

The number of malfunctions encountered with the rifles in all testing is shown in Table 1.4-II (page 5) under the following categories:

a. Type I. Readily clearable by immediate action without the use of any tools or disassembly of the rifle.

b. Type II. Not readily clearable by immediate action, requiring the use of tools or disassembly of the rifle. Also, a type II malfunction was charged in instances where type I malfunctions became excessive and required maintenance to keep the rifle operative, or where testing was terminated on a given rifle (Note: Type II malfunctions charged because of excessive type I malfunctions are given only in Table 1.4-II and are not included in any other listings of malfunctions elsewhere in this report).

1.4.3 Rust Data

After the salt-water immersion test (par. 2.3) and reliability test (par 2.8), the components of the rifles were rust rated. The intensity portion of the rust ratings are summarized in Table 1.4-III.

Table 1.4-III. Summary of Rust Data

Subtest	Average Rust Ratings			
	MIL-L-46000A	NRL	VV-L-800	Code A
Salt-water immersion	4.7	4.0	4.0	4.4
Reliability				
Schedule I	8.1	7.5	7.2	5.5
Schedule II	8.2	8.4	8.1	7.6

Key to rust ratings:

Rating	Definition of Intensity
10	No rusting.
9	Very slight - Yellow stain or other indication of incipient corrosion but inappreciable etching or pitting of steel surface.
7	Slight - Meager corrosion products or perceptible etching or pitting of the steel surface.
5	Moderate - Corrosion products of medium quantity or definite but not marked etching or pitting.
3	Heavy - Marked buildup of corrosion products or marked pitting or etching.
1	Very Heavy - Very profuse corrosion product buildup or deep pitting of the steel surface.
0	Extreme - Extreme pitting and buildup of corrosion products.

Table 1.4-II. Categorized Malfunction Data

Subtest	Lubricant											
	MIL-L-46000A			VV-L-800			NRL			Code A		
	Total Rds Fired	No. Malfunctions		Total Rds Fired	No. Malfunctions		Total Rds Fired	No. Malfunctions		Total Rds Fired	No. Malfunctions	
		Type I	Type II		Type I	Type II		Type I	Type II		Type I	Type II
Salt-water immersion	2100	1	5	1400	13	3	2100	54	0	1540	60	4
Dust	1680	13	0	1680	20	0	1680	47	3	1680	43	0
Mud	41	24	3	39	38	3	27	33	3	20	16	4
Sand-drag	840	0	0	840	1	0	840	0	0	840	10	1
Water-spray	3000	9	0	3000	74	0	3000	2	0	2883	29	1
Reliability												
Schedule I	18000	249	0	18000	315	2	14100	524	6	17260	548	10
Schedule II	18000	9	0	18000	17	0	18000	101	1	18000	299	0
Sequential	15000	173	12	14300	438	22	15000	374	13	15000	452	17
Dynamic-dust												
Phase I	420	3	1	420	9	0	407	15	0	420	14	2
Phase II	840	13	5	840	21	6	[a] -	-	-	491	24	13
Liberal lubrication	8400	0	0	8400	0	0	8400	3	0	8400	1	1

[a]Not fired due to short supply of NRL lubricant in spray cans.

1.4.4 Subtest Findings

The more pertinent results of the individual subtests are summarized as follows:

a. Initial Inspection. All rifles were complete and serviceable. The cyclic rates of fire of the rifles, as received, were within the 650 to 850 rounds per minute requirement of Reference 6. However, after the firing of about 500 rounds, the cyclic rates of approximately 50% of the rifles exceeded 850 rounds per minute.

b. Salt-Water Immersion. Little, if any, problems were experienced with the rifles lubricated with MIL-L-46000A or NRL. All of the VV-L-800- and Code A-lubricated rifles failed on either the eighth or tenth day. Failure was attributed to seizure of component parts and rust buildup. In all instances, reliable functioning of the rifles was restored with additional application of lubricant. The malfunction rates for this test are reported in Table 1.4-I.

c. Sand-Drag and Dust Tests. The function performance of the rifles under sandy and dusty conditions was superior with a wet-film lubricant over that with a dry-film lubricant or with the rifles unlubricated. The malfunction rates for the sand-drag and dust tests are given in Table 1.4-I.

d. Water-Spray Test. The performance of the rifles under conditions of simulated heavy rainfall show that the rifle lubricated with NRL gave the superior performance, MIL-L-46000A second, Code A third, and VV-L-800 fourth. However, the performance of the rifle lubricated with VV-L-800 with MIL-G-40003 (Lubriplate) additive, as specified in TM 9-1005-249-14, was superior to that of the Code A lubricated rifle. The malfunction rates for the water-spray test are given in Table 1.4-I.

e. Reliability Test. The results of the 6000-round reliability test (both schedules I and II, which were conducted with minimum maintenance and scheduled 1000-round maintenance, respectively) show MIL-L-46000A to be the superior lubricant for function performance and protection against corrosion. VV-L-800 was second with respect to rifle function and NRL was second for corrosion protection. The malfunction rates and summarized rust data are given in Tables 1.4-I and 1.4-III, respectively.

f. Sequential Test Series. The results of the sequential test, which was a series of adverse-condition tests followed by a short reliability test, show MIL-L-46000A to be the superior lubricant, NRL second, Code A third, and VV-L-800 fourth. The malfunction rates for this test are given in Table 1.4-I.

g. Penetrant Test. In this test, Code A and rifle bore cleaner (MIL-C-372) were used in attempts to loosen previously rusted rifle parts. Neither Code A nor rifle bore cleaner were effective in loosening the siezed parts of the rifles, of the six rifles tested, it was necessary to impact the butt of four rifles on a wooden surface to jar the bolt and carrier loose. The remaining two rifles were immersed in the penetrant fluids for 148 hours, after which the use of a hammer and steel drift were required to force retraction of the bolt and carrier.

h. Liberal-Lubrication Test. Rather than lubricate the rifles lightly as prescribed in TM 9-1005-249-14 for the M16A1 rifle, the component parts were liberally lubricated, until the lubricant ran and dripped freely from the surface to which applied. The rifles each fired 2800 rounds with no cleaning, but with liberal relubrication after each 280 rounds of firing. No problems were experienced with any of the liberally lubricated rifles. In fact, function performance with all lubricants was significantly superior to that experienced in schedule I of the reliability test where no maintenance was performed and the rifles were lubricated lightly. The results of this test should not be interpreted to mean that regular cleaning of the rifle is not required, but that lubricant can be used in liberal amounts without detriment to rifle-function performance.

1.4.5 Observations

Throughout the test, failure-to-feed-type malfunctions were predominant. In the majority of the instances, these were attributable to carbon and residue buildup (reliability-type tests) or to rust and foreign matter inside the bolt carrier, around the firing pin, and in the firing-pin well (adverse conditions tests). The technical manual for the M16A1 rifle (Reference 1) does not point out these areas as sources of malfunctions; nor is there a discussion on the cleaning of these areas. The results of the reliability test (Schedule I) very definitely reflect the foregoing observations, since the carbon buildup was not removed throughout the 6000-round test and the predominant malfunctions were failures to feed and failures to fire.

1.5 CONCLUSIONS

It is concluded that:

a. MIL-L-46000A lubricant was significantly superior to the other test lubricants for over-all M16A1 rifle-functioning performance, VV-L-800 second, NRL third, and Code A fourth (ref pars. 2.3 through 2.12, excluding par. 2.11).

b. MIL-L-46000A lubricant was superior to the other test lubricants for corrosion resistance, NRL second, VV-L-800 third, and Code A fourth (ref pars. 2.3 and 2.8).

c. Neither Code A nor rifle bore cleaner (MIL-C-372) were effective in the role of a penetrant for loosening rusted parts of a rifle (ref par. 2.11).

d. The results of this test show no basis for development of a military specification for a lubricant of the Code A type for rifles (ref par. 1.5, a, b, and c above).

e. Within the limits of this test, liberal lubrication of the M16A1 during firing operations does not adversely affect functioning performance (Note: Liberal lubrication does not include chamber and barrel areas and magazines) (ref par. 2.12).

1.6 RECOMMENDATIONS

It is recommended that:

a. MIL-L-46000A lubricant replace VV-L-800, and MIL-G-46003 (Lubriplate) as an additive, for use with the M16A1 rifle at temperatures above freezing.

b. Troop units operating in temperatures above freezing be advised that liberal lubrication of the M16A1 rifle is not detrimental to weapon functioning during actual firing operations.

c. Testing be conducted at temperatures below freezing with MIL-L-46000A to determine the suitability of this lubricant for use with the M16A1 rifle at low temperatures.

d. The technical manual for the M16A1 rifle (Reference 1) be changed to reflect the necessity for cleaning the inside of the bolt carrier, firing pin, and the firing-pin well in performing after-firing maintenance.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

2.1.1 General

This test was conducted in two phases. The first phase consisted of engineering-type tests to include salt-water immersion, dust, mud, sand-drag, reliability with minimum and standard maintenance, rust penetration, liberal lubrication, and a sequential series of tests which were conducted in such a manner as to simulate some of the environmental conditions the user would possibly meet in the field. The second phase consisted of laboratory tests which were conducted, and will be reported, by Rock Island Arsenal (RIA).

In the engineering-type tests each subtest, except the liberal-lubrication test, was conducted with new rifles. The rifles previously fired in the mud test were used in the liberal-lubrication test. A set of new rifles was employed for each lubricant per subtest; a set being defined as three rifles, except in the sequential test series where a set consisted of five rifles.

The RIA tests were conducted in two parts. The first part in which RIA personnel subjected test panels to rifle-test environments for correlation of effects on test panels and rifle parts, was conducted concurrently with the tests at Aberdeen Proving Ground (APG). The second part, consisting of laboratory type tests, was conducted at RIA.

To aid in programming in various subtests, the M16A1 rifles were numbered 1 through 122 and the M14 rifles 1 through 12. The M14 rifles were fired only in the dynamic dust test. Rifle serial numbers are identified with these designations in Table I-I and I-II.

It should be noted that most of the subtests were conducted in a manner to reveal any differences in the operation of the rifles which could be attributed to degradation, contamination, or, in some instances, wash-off of the lubricant. Therefore, the performance of the M16A1 rifle in this test is not to be considered characteristic of the rifle if normal maintenance were performed.

2.1.2 Maintenance Procedures

Throughout the test, four levels of maintenance were performed. These levels varied in the degree of thoroughness of the maintenance performed and were selected as a means of identifying the extent of maintenance required to keep the rifles operating under the various conditions of the test. The levels of maintenance are designated and defined as follows:

a. Maintenance A. The rifle was disassembled into three groups (lower receiver, upper receiver, and bolt carrier), and each group was cleaned with dry rags, inspected, lightly lubricated with the designated test lubricant, and reassembled (Reference 1, Figure 3-4).

b. Maintenance B. Same as in paragraph a, except that the groups were cleaned by dipping, sloshing, rubbing, and brushing with dry-cleaning solvent. These cleaning procedures included Figures 3-6 and 3-6A of Reference 1.

c. Maintenance C. Same as in paragraph b, except that the groups were disassembled as shown in Figures 3-5 and 3-5A of Reference 1.

d. Maintenance D. The rifle was disassembled as shown in Figures 8-1 (steps 1, 2, 3, and 4), 8-2 (steps 1 through 17), 8-3 (steps 1, 10, 11, and 17 through 24), and 8-4 of Reference 1, cleaned with dry-cleaning solvent, inspected, lightly lubricated with the designated test lubricant, and reassembled. Lubrication included external metal surfaces of rifles, except for the rifles in schedule II of the reliability test.

Test rifles were restricted to the lubricant initially applied in test (Code A, VV-L-800, NRL and MIL-L-46000A). Prior to application, all lubricants were agitated in the container in which received, to provide uniformity of mixture prior to application. The initial application of Code A lubricant to any rifle was permitted to dry a minimum of two hours prior to initiation of testing. All lubricants and cleaning solvents were provided by RIA after being subjected to laboratory tests for analysis.

Because of the deposits of lint left by rifle cleaning patches, cheesecloth was used for cleaning and application of lubricant when performing maintenance, except for NRL lubricant which was sprayed directly on the rifle. The patches were used only for cleaning of the chamber and rifle bore. The only time that lubricant was applied directly to the rifle from the can, except for NRL, was when the rifles were relubricated in schedule II of the reliability test, the dynamic-dust test, salt water immersion test, and the liberal-lubrication test.

2.1.3 Malfunction Tabulation

Throughout the test, all rifle malfunctions were recorded; however, the number of malfunctions per 100 rounds fired (malfunction rates), as given in the data tables, reflect only those malfunctions which were deemed related to the efficacy of the lubricants in maintaining weapon function. The malfunctions attributable to broken parts,

ammunition, magazines, and malfunctioning components were excluded from these rates. The abbreviations used throughout the test in the recording of malfunction data are given in Table 2.1-I.

Table 2.1-I. Abbreviations

Abbreviation	Definition
BCOEC	Bolt closed on empty chamber.
BGL	Bolt group lubricated. (Four the M16A1 rifle, this means the entire bolt-carrier group and barrel extension. For the M14 rifle, it means bolt, operating-rod guide groove, and bolt cam area.)
BOB	Bolt overrode base of round in feeding from magazine. This is normally a magazine malfunction.
BSI	Bolt stop interrupt. (The bolt stop engaged the bolt or carrier during a firing cycle, causing a malfunction.)
FBR	Bolt failed to remain to the rear after firing last round from magazine.
FF1[a]	Failure of first round to feed from a fully loaded magazine.
FF[a]	Failure of rounds other than first round to feed from a fully loaded magazine.
FFS	Failure to feed due to nose of round stubbing on magazine or rear of receiver. Normally, a magazine malfunction.
FFR	Failure of chambered round to fire.
FJ	Failure to eject.
FJR	Failure of the bolt to travel rearward sufficiently to eject the fired case. (This type of malfunction usually occurred under mud or dust conditions.)
FTR	Failure of trigger to return to the forward position after release by the gunner. This is a malfunction of a component of the rifle.
FX	Failure to extract.
TS	Tapped selector. The selector had to be tapped with a hammer handle or similar tool to change setting.
Auto	The cycle was fired in 20-round bursts.
Burst	The cycle was fired in 3- to 5-round bursts.
Semi	The cycle was fired semiautomtically.
Satis	No malfunctions occurred.

[a]These malfunctions include failure of the bolt to lock and, unless otherwise stated, were cleared with the bolt-assist assembly.

2.1.4 Rust Evaluation

The rust-evaluation system employed in this test was extracted from ASTM Bulletin No. 154 (Reference 7). It was used to numerically evaluate the rust buildup on the component parts of the rifles which were fired in the salt-water immersion and reliability tests. The system provided a means to visually rate a surface for area, nature, and intensity of rust. A description of each of the foregoing categories of rust evaluation follows:

a. Rating the Area of Rusting. The component part of entire surface area being evaluated was numerically rated from 10 for "no rust" to 0 for "complete rust." The ratings are summarized as follows:

Numerical Rating	Corresponding Rust Dots (d)		Corresponding Rust Spots (s)		Corresponding Small Rust Areas (a)
10	None		None		None
9	2	or	1	or	
7	4	or	2	or	1
5	8	or	4	or	2
3	16	or	8	or	4
1	32	or	16	or	8
0	Complete rusting				

When more extensive rusting was prevalent than could be evaluated by the foregoing scale, an estimation of the area free from rust was made. For example, a rating of 0.95 indicates that 95 per cent of the surface was free from rust, or a rating of 0.50 indicates that half of the surface was fee from rust, etc.

b. Rating the Nature of the Rust. The nature of the rust was defined in terms of rust dots, rust spots, small areas, and large rust areas; abbreviated as d, s, a, and A, respectively. These are dimensionally qualified as follows:

Nature of the Rusting	Abbreviations	Maximum Linear Dimension, mm
Rust dot	d	1
Rust spot	s	2
Small rust area	a	4
Large rust area	A	Larger than 4

For example, if the surface exhibits four rust dots or two rust spots or one small rust area, or any equivalent combination of these, the corresponding ratings for area and nature of rust would be as follows:

Description	Corresponding Rating
4 rust dots	7/d
2 rust spots	7/s
1 small rust area	7/a
1 rust spot and 2 rust dots	7/ds

c. Rating the Intensity of Rust. The intensity of rust was rated by the numerical scale shown below:

Rating	Definition of Intensity
10	No rusting.
9	Very slight. Yellow stain or other indication of incipient corrosion but inappreciable etching or pitting of steel surface.
7	Slight. Meager corrosion products or perceptible etching or pitting of the steel surface.
5	Moderate. Corrosion products of medium quantity or definite but not marked etching or pitting.
3	Heavy. Marked buildup of corrosion products or marked pitting or etching.
1	Very heavy. Very profuse corrosion product buildup or deep pitting of the steel surface.
0	Extreme. Extreme pitting and buildup of corrosion products.

As an over-all example, the rust rating for area, nature, and intensity, respectively, would be 5/d/7 for a surface which showed 8 rust dots and meager corrosion products.

This system of rating can vary with an individual's interpretation of the magnitude and intensity of the rust. Therefore, throughout the test the rust rating was accomplished by the same personnel.

2.2 INSPECTION

2.2.1 Objective

To determine the completeness and serviceability of the test rifles and to record measurements necessary for reference during test.

2.2.2 Method

The functioning parts of all rifles were manually checked and the following measurements were recorded:

a. Firing-pin protrusion.

b. Firing-pin indent.

c. Headspace.

d. Barrel bore and chamber inspections (reliability and sequential-test rifles only).

e. Trigger pull.

f. Cyclic rate. Each weapon as received was fired three 10-round bursts for determination of cyclic rate. The procedure was repeated after the designated lubricant had been applied.

2.2.3 Results

Inspection showed all rifles to be complete and serviceable; however, one rifle had a bent hammer spring and a second rifle had an extractor pin which was 0.10 inch shorter than the normal extractor pin for the M16A1 rifle. Both defective parts were replaced prior to test firing. The measurements recorded in the inspection phase are contained in Table I-I. It was found that the cyclic rates of the rifles, as received, were within the 650 to 850 rounds per minute requirement of SAPD-253B (Reference 6). However, after cleaning and application of lubricant, the cyclic rates of three of the rifles exceeded the 850 rounds per minute maximum. Also, the trigger pull of two of the rifles exceeded the 8.5 pounds maximum trigger-pull requirement of SAPD-253B.

The M14 rifles fired in the dynamic dust test were found to be complete and serviceable. The recorded measurements are contained in Table I-II.

2.2.4 Analysis

Not applicable.

2.3 SALT-WATER IMMERSION TEST

2.3.1 Objective

To determine the deleterious effects of immersion in salt water on weapon performance.

2.3.2 Method

Maintenance D was performed on four sets of rifles. Each rifle was fully loaded and with the selector positioned on "safe" was submerged with six loaded magazines in a salt-water solution for 60 seconds. The composition of the salt water solution was as specified in "American Society for Testing Materials, Method D665, Procedure B." After removal from the salt water, the muzzle of each rifle was depressed and the bolt retracted slightly to permit the salt water to drain from the bore. Each rifle was allowed to dry for a period of two hours and was then fired 40 rounds semiautomatically, 60 rounds in 3- to 5-round bursts, and 40 rounds in two 20-round bursts (total of 140 rounds). The rifles and magazines were then exposed to the heat and humidity conditions as shown in Table 2.3-I for a period of ten days. Within the 10-day period, additional 140-round complements were fired on the third, fifth, eighth, and tenth days without the aid of cleaning or additional lubricant, for a total of 700 rounds. Only 140 rounds of ammunition per weapon, for the first day's firing, was subjected to the salt-water solution. Clean ammunition was loaded into the conditioned magazines for the subsequent firings.

If an abnormally large number of malfunctions occurred with a rifle, the test was considered terminated; however, an attempt was made to restore reliable function with additional application of lubricant of the same type.

Table 2.3-I. Heat - Humidity Storage Schedule

No. Hrs	Temperature, °F	Relative Humidity, %
2	Increase to +105	85 to 90
16	Maintain at +105 ± 3	85 to 90
2	Decrease +105 to 70	95 ± 2
4	Maintain at +70 ± 3	95 ± 2

2.3.3 Results

The malfunction rates per 100 rounds fired for each lubricant are given in Table 2.3-II, and a graphical display of the occurrences of malfunctions is shown in Figure 2.3-1. The day-by-day rifle performance data are contained in Table I-III.

Beginning on the third day of the test and continuing thereafter, the bolt-carrier groups in the VV-L-800 and Code A lubricated rifles were partially seized. Retraction of the bolt was very difficult and usually required that the butt plate be struck sharply on a hard surface to loosen the bolt and carrier. Similar problems were encountered with one of the MIL-L-46000A rifles. However, the bolt and carrier were not seized to the extent of those lubricated with VV-L-800 and Code A, and the seizure began on the fifth day. The bolt-carrier groups of the other two MIL-L-46000A lubricated rifles and those lubricated with NRL were easily retracted throughout the 10-day period.

Inspection of the chamber areas of all rifles on the third day showed a heavy accumulation of rust which was not nearly as heavy on the subsequent days. The rust accumulation caused several failures-to-extract. Inspection of the fired cases from the first few rounds of each day's firing showed considerable roughness and pitting marks, and all failures to extract occurred within the first five rounds of the first magazine of a day's firing. The majority of the failures to extract were either partial or complete rim shears.

After-test inspection showed that the buildup of rust on the component parts of all rifles was similar in intensity and accumulation. However, the exterior surfaces of the rifles lubricated with MIL-L-46000A and NRL still had a noticeable film of lubricant remaining, while those rifles lubricated with Code A and VV-L-800 were very dry and showed little, if any, signs of remaining lubricant. The recorded rust data are contained in Table I-IV.

Table 2.3-II. Malfunction Rates for Salt-Water Immersion Test

Lubricant	No. of Malfunctions	No. Rds Fired	Malfunction Rate per 100 Rds Fired
MIL-L-46000A	6	2100	0.3
NRL	54	2100	2.6
VV-L-800	13	[a]1400	[a]0.9
Code A	61	[b]1540	[b]4.0

[a]Two rifles failed on the eighth day and one on the tenth.
[b]One rifle failed on the eighth day and two on the tenth.

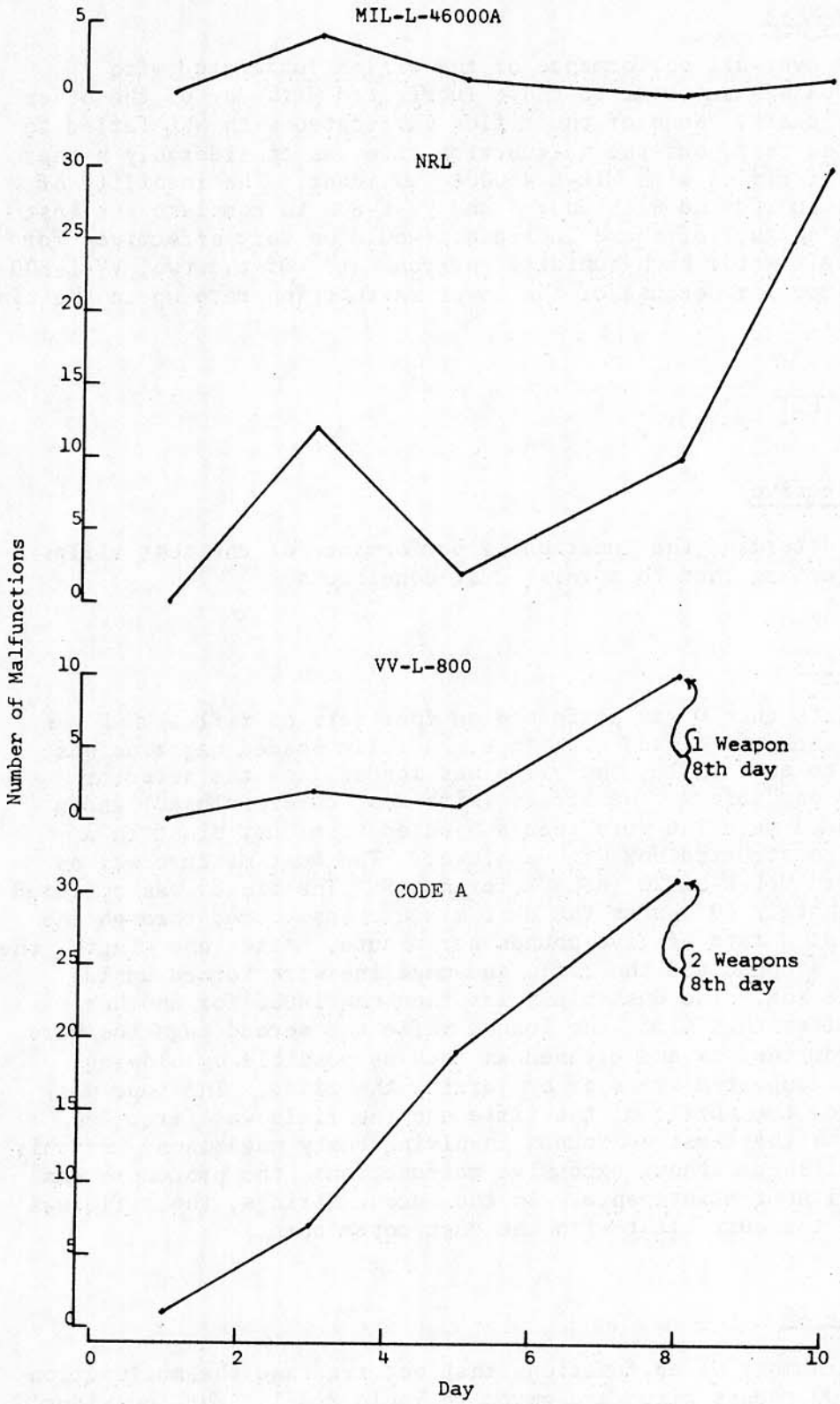

Figure 2.3-1: Malfunction Occurrences in Salt-Water Immersion Test.

2.3.4 Analysis

The over-all performance of the rifles lubricated with MIL-L-46000A was superior to those lubricated with any of the other three lubricants. None of the rifles lubricated with NRL failed to complete the test, but the malfunction rate was considerably higher than that of rifles with MIL-L-46000A lubricant. The inability of the rifles lubricated with Code A and VV-L-800 to complete the test shows that neither of these lubricants would be very effective for use in a salt-water high-humidity environment. Of the two, VV-L-800 would be superior because of the lower malfunction rate up to the time of failure.

2.4 DUST TEST

2.4.1 Objective

To determine the functioning performance of the test rifles after subjecting them to adverse dust conditions.

2.4.2 Method

Maintenance D was performed on four sets of rifles and the muzzle of each was closed with tape. A fully loaded magazine was assembled to each rifle, the rifle was loaded, and the selector positioned on "safe." The rifles (with dust covers closed) and a second loaded magazine were then subjected to a dust blast in a specially constructed box with a blower. The dust mixture was as specified in MIL-E-5272C (ASG) Reference 5. The blower was operated at approximately 60 rpm as the dust mixture was poured through the pour-hole at a rate of five pounds per minute. After one minute, the blower was stopped and the rifle and magazine were turned upside down in the box. The dust blast was then continued for another minute. After this time, the loaded rifle and second magazine were removed from the box and cleaned as much as possible by blowing sharply on congested areas or by jarring the rifle. The tape was removed from the muzzle of the rifle and the rifle was fired 280 rounds, with the first 40 rounds involving dusty magazines. If this was accomplished without excessive malfunctions, the procedure was repeated without maintenance. In the second firings, the rifle was exposed to the dust blast with the dust cover open.

2.4.3 Results

The number of malfunctions that occurred and the malfunction rate per 100 rounds fired are given in Table 2.4-I. The individual

rifle performance data are contained in Table I-V. A graphical display of malfunction occurrence is shown in Figure 2.4-1 (page 20).

The observations of the test director were that the dust adhered to the surfaces of the rifles lubricated with MIL-L-46000A or VV-L-800 more readily than to the surfaces of the rifles lubricated with Code A or NRL. However, the dust accumulation was not severe enough to impair the function and operation of the rifles.

Table 2.4-I. Malfunction Rates for Dust Test

Lubricant	No. Rds Fired	No. Malfunctions	Malfunction Rate per 100 Rds Fired
MIL-L-46000A	1680	13	0.8
VV-L-800	1680	20	1.2
Code A	1680	43	2.6
NRL	1680	50	3.0

2.4.4 Analysis

The performance of the rifles lubricated with MIL-L-46000A or VV-L-800 was superior to that of the rifles lubricated with Code A or NRL. These results show that a dry-film lubricant or lubricant which leaves a partially dry coating, such as NRL, are inferior to a wet-film type of lubricant when the rifle has been subjected to fine dust.

2.5 MUD TEST

2.5.1 Objective

To determine the functioning performance of the test rifles when subjected to adverse conditions of mud.

2.5.2 Method

Maintenance D was performed on four sets of rifles and each was prepared in the same manner as for the dust test. Each rifle was then submerged for 60 seconds in a mud mixture consisting of ten pounds of red clay to two pounds of clean river sand to eight quarts of water. Before firing the rifle the gunner removed the tape from the muzzle and attempted to remove the excess mud by shaking and wiping the weapon with his bare hands. An attempt was then made to fire ten rounds semiautomatically and ten rounds in 3- to 5-round bursts. If firing was unsuccessful with the exposed magazine, a clean magazine of ammunition was used.

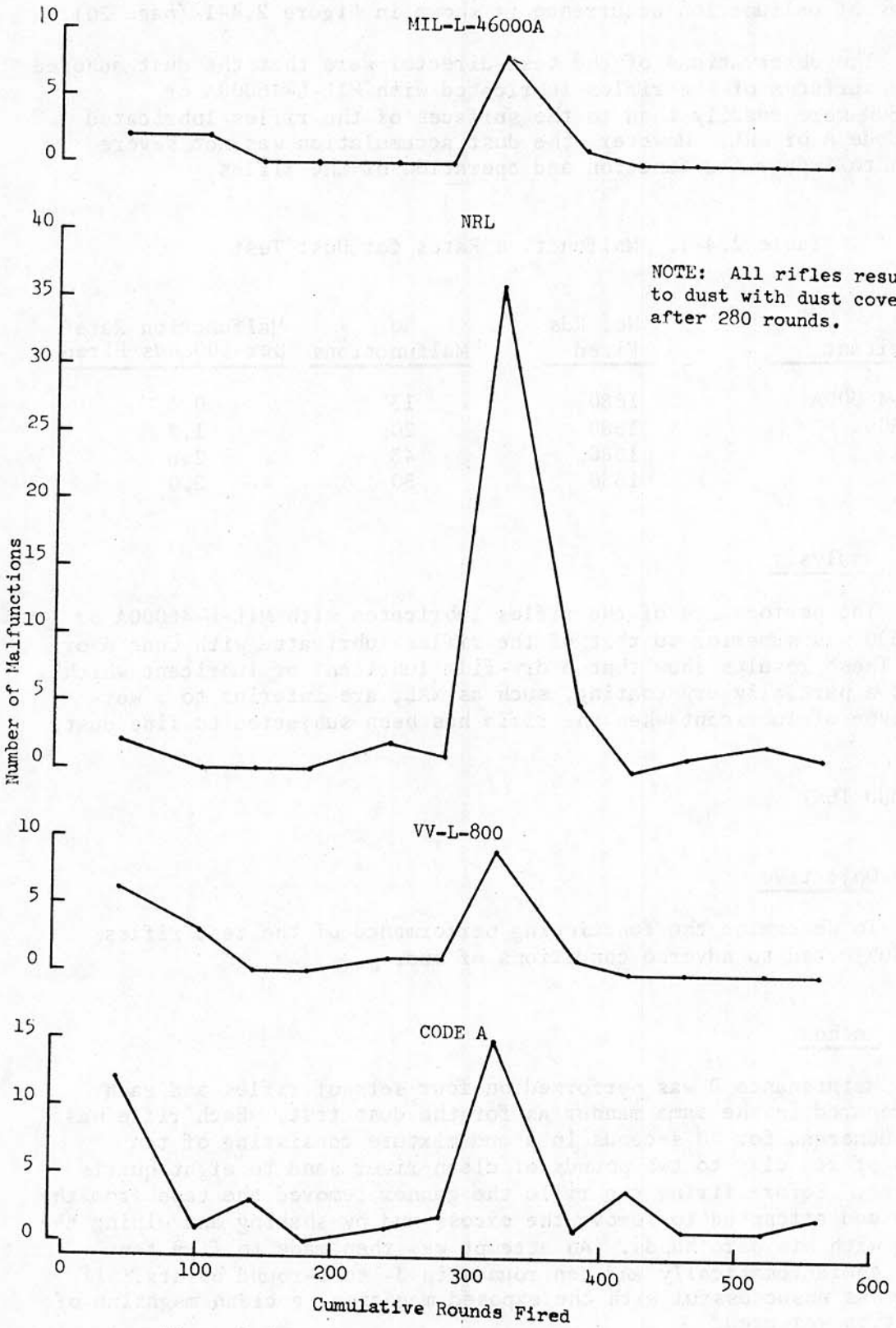

Figure 2.4-1: Malfunction Occurrences in Dust Test.

2.5.3 Results

The performance data on the rifles subjected to the mud test are contained in Table I-VI. None of the rifles functioned without excessive malfunctions. The total number of rounds fired in attempts with three rifles with each lubricant was: 41 with rifles lubricated with MIL-L-46000A, 39 with VV-L-800, 27 with NRL, and 20 with Code A.

2.5.4 Analysis

All rifles subjected to the mud test failed to operate without excessive malfunctions; therefore, differences in performance among lubricants could not be determined.

2.6 SAND-DRAG TEST

2.6.1 Objective

To determine the functioning performance of the test rifles after they were dragged through sand.

2.6.2 Method

Maintenance D was performed on four sets of rifles and each was prepared in the same manner as for the dust test. Each rifle was then dragged, muzzle foremost, for a distance of 20 feet through clean silica-core sand, left side of rifle up, and 20 feet right side up. The depth of the sand was approximately six inches. After the rifles were dragged through the sand, an attempt was made to clean them by wiping with the bare hands, blowing on congested areas, and jarring the rifle. The tapes were removed from the muzzles and an attempt was made to fire 20 rounds semiautomatically (phase 1). If this was accomplished without an abnormal number of stoppages, the test was repeated with the dust cover open without additional maintenance (phase 2). If satisfactory functioning was attained, firing was continued with clean ammunition and magazines for a total of 280 rounds (phase 3).

2.6.3 Results

The number of malfunctions that occurred and the malfunction rate per 100 rounds fired are given in Table 2.6-I. The individual rifle-performance data for each phase are contained in Table I-VII.

Table 2.6-I. Malfunction Rates for Sand-Drag Test

Lubricant	No. Rds Fired	No. of Malfunctions	Malfunction Rate per 100 Rds Fired
MIL-L-46000A	840	0	0.0
NRL	840	0	0.0
VV-L-800	840	1	0.1
Code A	840	11	1.3

With all rifles, except those lubricated with NRL, the sand could readily be blown or wiped off. However, the accumulation with the NRL lubricant was not sufficiently heavy to cause any malfunctions.

2.6.4 Analysis

The only rifles with which any problems were experienced were two lubricated with Code A and one lubricated with VV-L-800. The malfunctions with the Code A lubricated rifles were readily cleared by blowing in the chamber area or extracting and feeding another round. Failures to extract which occurred with the VV-L-800 and Code A lubricated rifles, were probably due to a few grains of sand in the chamber area; all were readily clearable.

2.7 WATER-SPRAY TEST

2.7.1 Objective

To determine the effect of simulated heavy rainfall on the function performance of the test rifles.

2.7.2 Method

Maintenance D was performed on four sets of weapons. One weapon from each of the four sets was then subjected to a spray of water by means of a special shower head positioned about three feet above the rifle. The water spray was directed over the entire weapon and fell at a rate of approximately 0.4 inch per minute or 24 $\pm$ 3 inches per hour. While being subjected to the water spray, the rifles were fired as outlined in Table 2.7-I.

Table 2.7-I. Firing Sequence for Water-Spray Test

Test Condition[a]	Cycle	Exposure Time, min	Cumulative Exposure Time, min	Rain, in.	Cumulative Rain, in.
Weapon Horizontal					
Bolt open		5	5	2.0	2.0
Loaded, bolt closed		5	10	2.0	4.0
100 rounds semi-automatic	1	4	14	1.6	5.6
Bolt open		5	19	2.0	7.6
Loaded, bolt closed		5	24	2.0	9.6
100 rounds automatic[b]	2	4	28	1.6	11.2
Weapon Muzzle Up					
Bolt open		5	33	2.0	13.2
Loaded, bolt closed		5	38	2.0	15.2
100 rounds semi-automatic	3	4	42	1.6	16.8
Bolt open		5	47	2.0	18.8
Loaded, bolt closed		5	52	2.0	20.8
100 rounds automatic	4	4	56	1.6	22.4
Weapon Muzzle Down					
Bolt open		5	61	2.0	24.4
Loaded, bolt closed		5	66	2.0	26.4
100 rounds semi-automatic	5	4	70	1.6	28.0
Bolt open		5	75	2.0	30.0
Loaded, bolt closed		5	80	2.0	32.0
100 rounds automatic	6	4	84	1.6	

[a]Before firing, the rifle was held with muzzle down and the bolt retracted slightly in order to remove any water accumulated in the bore.

[b]The first and last magazines of all automatic cycles were fired in 20-round bursts and the second, third, and fourth magazines were fired in 3- to 5-round bursts.

Normally a water-spray test complement consists of six 100-round cycles (600 rounds total). The plan of test (Reference 2) called for the testing of four sets of rifles plus a repeat test with

the set of rifles lubricated with VV-L-800 having MIL-G-46003 (Lubriplate) applied as an additive to the VV-L-800 lubricant. The Lubriplate was applied as specified in TM 9-1005-249-14 (Reference 1). Each of the rifles was to be fired without maintenance until an excessive number of malfunctions occurred. However, in initial testing, it was found (as shown in paragraph 2.7.3) that approximately five 600-round rain test complements (3000 rounds) could be fired. With the concurrence of AMSWE-RDR and AMSTE-BC, it was agreed to terminate the rain test at 3000 rounds and one rifle would be fired with each lubricant rather than three as stated in the test plan.

2.7.3 Results

The rifle performance data and the cyclic-rate record throughout the water-spray test are given in Tables I-VIII and I-IX, respectively. The malfunction rate per 100 rounds fired for each lubricant is given in Table 2.7-II and a graphical display of malfunction occurrence throughout the test is shown in Figure 2.7-1 (page 26).

After-test inspection showed the rifles lubricated with NRL lubricants to have a good coat of lubricant remaining. The rifles lubricated with MIL-L-46000A or VV-L-800 with Lubriplate additive had a light film remaining, and those lubricated with Code A or VV-L-800 (without Lubriplate) showed little if any signs of remaining lubricant.

The cyclic-rate data show that a progressive reduction of rate occurred on all rifles; thus indicating deleterious effects of the water on the lubricant. The greatest reduction occurred with the NRL lubricated rifle and the least with the Code A lubricated rifle; however, the Code A lubricated rifle had the lowest cyclic rate in the first firing of the test.

Table 2.7-II. Malfunction Rates for Water Spray Test

Lubricant	No. of Malfunctions	Malfunction Rate per 100 Rds Fired	No. Rds Fired
NRL	2	0.1	3000
MIL-L-46000A	9	0.3	3000
[a]VV-L-800 with MIL-G-46003 additive	12	0.4	3000
Code A	30	1.0	[b]2883
VV-L-800	74	2.5	3000

[a]Two rifles were fired with VV-L-800 with MIL-G-46003 added. These data are on the second rifle. The first rifle failed at 1215 rounds

Table 2.7-II. (Cont'd)

because of excessive failures to feed and a condition of the bolt closing on an empty chamber, which was attributed to short recoil. No malfunctions had occurred until the tenth cycle. One malfunction occurred in the tenth, 10 in the eleventh, and 15 in the first 15 rounds of the twelfth cycle. No apparent cause for the failure could be determined. On the basis that VV-L-800 with Lubriplate added was expected to provide superior rifle function under rain conditions over that of VV-L-800 lubricant alone, the second rifle was fired.

[b]The bolt could not be forced to the locked position; therefore, the test was terminated after firing 2883 rounds.

2.7.4 Analysis

The performance of the rifles lubricated with NRL was superior to those lubricated with any of the other lubricants. The Code A lubricant was superior to VV-L-800 without Lubriplate added. With the Lubriplate additive, as specified in the technical manual for the XM16E1 rifle, the performance of those rifles was superior to that of the rifles lubricated with Code A.

2.8 RELIABILITY TEST

2.8.1 Objective

To determine the effects of different lubricants upon the function performance of the test rifles through 6000 rounds of firing.

2.8.2 Method

Maintenance D was performed on eight sets of rifles. The weapons and ammunition were conditioned to 95° ± 3°F and 90% ± 5% relative humidity for a minimum of four hours prior to initiation of firing. A set of rifles with each type of lubricant was fired as outlined in schedule I, and a set with each type of lubricant was fired as outlined in schedule II. The test was fired in alternate 100-round semiautomatic and 100-round automatic cycles with a cooling period after each 100-round cycle. All firing was conducted from a firing chamber with the temperature controlled to +85° ± 3°F.

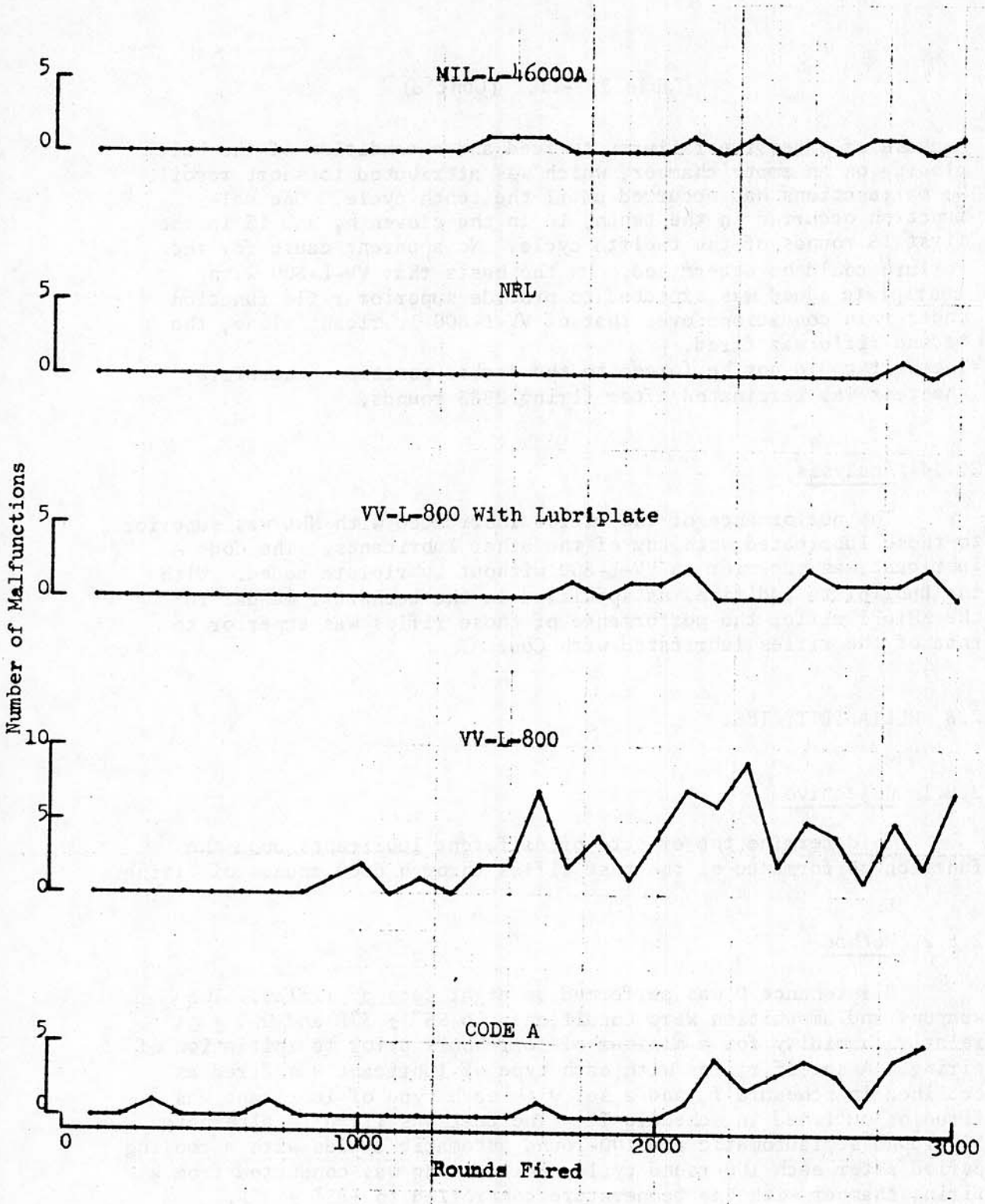

Figure 2.7-1: Malfunction Occurrences in Water-Spray Test.

2.8.2.1 Schedule I. Each weapon was fired until excessive stoppages attributable to lubricant occurred. The weapon, without being disassembled, was lubricated with the designated lubricant and an attempt was made to continue firing. If excessive stoppages still occurred, maintenance A was performed. This procedure was continued until each weapon had been fired 6000 rounds or was terminated earlier because of excessive stoppages. Cyclic rates of fire were recorded initially and after each 500 rounds fired.

2.8.2.2 Schedule II. Each weapon was fired in 1000-round stages with maintenance D performed after every 1000 rounds throughout the 6000-round test. Cyclic rates of fire were recorded initially and after each additional 500 rounds fired.

2.8.3 Results

The number of malfunctions, number and types of maintenance performed, and malfunction rates per 100 rounds fired are given in Tables 2.8-I and 2.8-II for schedules I and II, respectively. A graphical display of the malfunction occurrences are shown in Figures 2.8-1 and 2.8-2. The individual rifle data are contained in Tables I-X through I-XVII.

It should be noted that no maintenance was performed on any of the rifles lubricated with MIL-L-46000A throughout the schedule I firings. When lubricant was applied at the 5000-round period, the malfunction rate dropped to zero and remained there for the completion of the 6000-round test. With the VV-L-800 lubricated rifles, the malfunction rate decreased appreciably with application of lubricant.

Maintenance A or relubrication with Code A or NRL gave very little, if any, benefit. Indications were that relubrication with NRL was a detriment to rifle function because the additional lubricant tended to build up on the accumulated carbon and residue. With either the Code A or NRL lubricant, the rifle malfunction rate would decrease with relubrication or maintenance for about 200 rounds and then increase to approximately the same rate as that given before lubrication or maintenance.

Table 2.8-I. Schedule I Function Data

Legend:

A = Maintenance A (e.g., 1-A indicates that maintenance A was performed on one rifle in that cycle).

B = Lubricated (e.g., B indicates that one rifle was lubricated in that cycle).

1000-Rd Cycle No.	No. of Malfunctions							
	MIL-L-46000A	Maintenance Performed	VV-L-800	Maintenance Performed	Code A	Maintenance Performed	NRL	Maintenance Performed
1	0		3		17		3	
2	13		24		65	1-A, 1-B	[b]113	3-A, 1-B
3	43		62	1-B	90	1-B	[b] 77	
4	70		88		128		105	
5	121		102	2-B	153	2-B	123	1-A, 1-B
6	2	3-B	36	1-A	[a]105	1-A	104	1-A
Total	249	3-B	315	1-A, 2-B	558	2-A, 4-B	525	5-A, 2-B
Malfunction rate per 100 rds fired	1.38		1.75		3.23		3.70	

[a]After firing 5260 rounds, the bolt in one Code A lubricated rifle locked in the closed position and firing was terminated.

[b]Firing was terminated on one NRL lubricated rifle after firing 2200 rounds because the firing pin was seized within the bolt and caused failures to fire.

Table 2.8-II. Schedule II Function Data

1000-Rd Cycle No.	No. of Malfunctions			
	MIL-L-46000A	VV-L-800	NRL	Code A
1	0	2	1	9
2	3	4	9	31
3	0	1	5	49
4	2	4	22	50
5	2	2	20	58
6	3	4	44	102
Total	10	17	101	299
Malfunction rate per 100 rds fired	0.06	0.09	0.56	1.66

After-test inspection of the schedule I rifles for residue and carbon buildup showed the following for each lubricant:

a. MIL-L-46000A. The component parts of the rifle were heavily coated, but the residue was moist and, in most instances, could be easily removed by wiping with a rag.

b. VV-L-800. The component parts were heavily coated with a very dry and powdery residue which could be readily wiped and scraped away.

c. Code A. The component parts were heavily coated with a hard, dry residue which chipped away when scraped. Wiping with a dry rag formed a polished surface and failed to remove the residue.

d. NRL. The component parts were heavily coated with a residue that could not be readily removed with a dry rag, but peeled away when scraped with a knife or similar tool. The surface underneath was tacky.

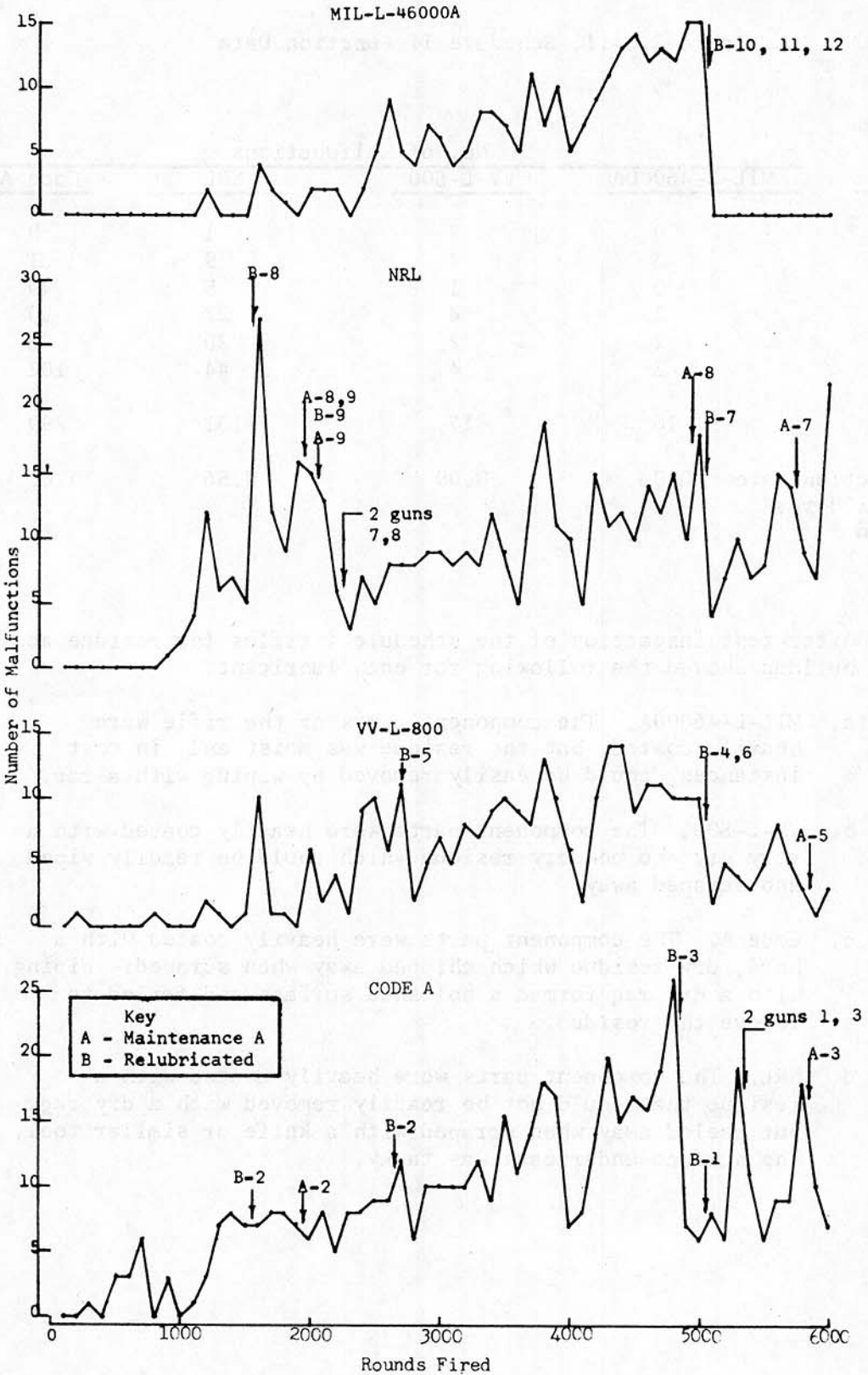

Figure 2.8-1: Malfunction Occurrences in Schedule I Firings.
Example: A-2 Indicates Maintenance A Performed on Weapon No. 2.
B-2 Indicates Lubrication of Weapon No. 2.

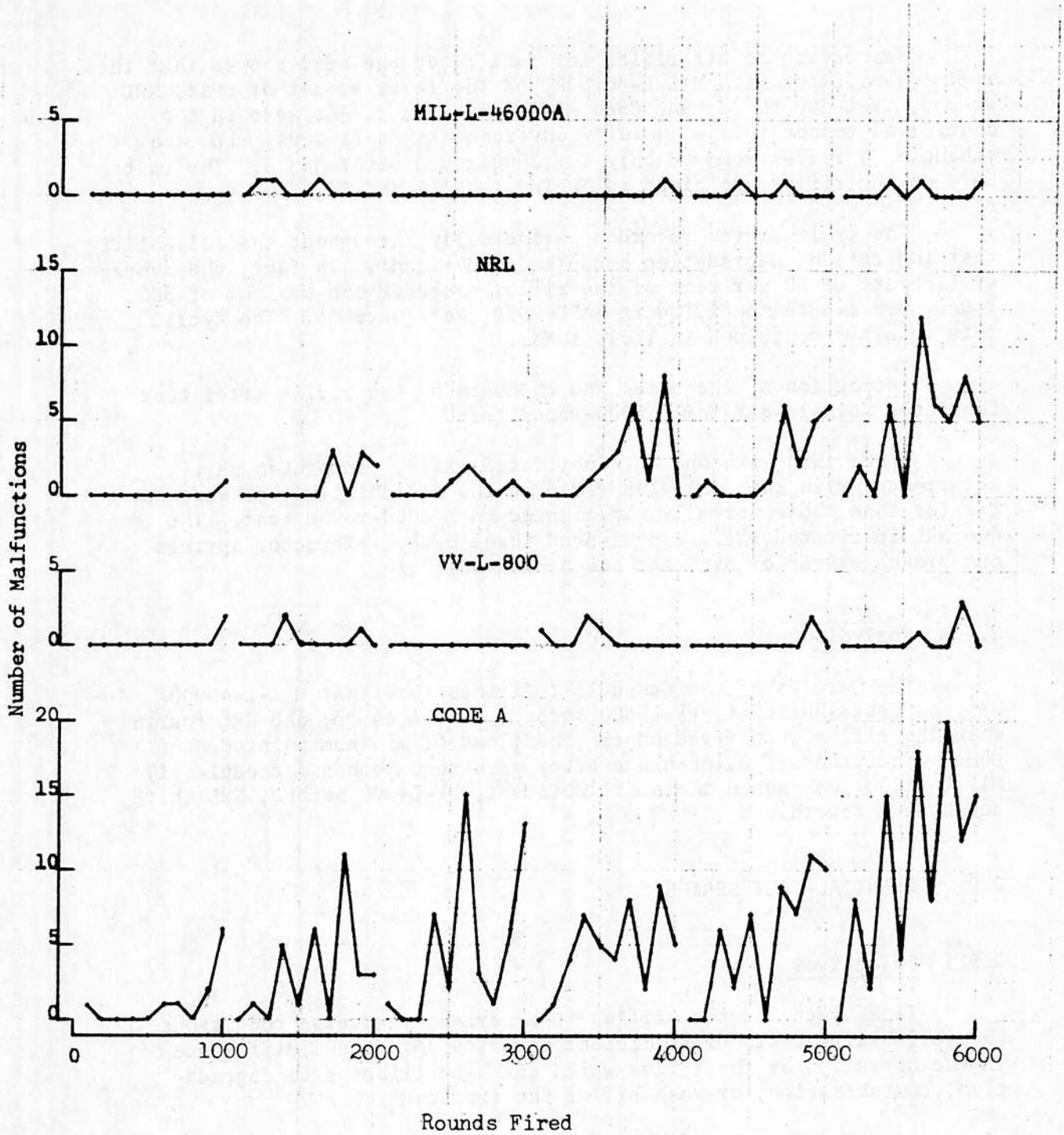

Figure 2.8-2: Malfunction Occurrences in Schedule II Firings.

Inspection of all rifles for rust after the test showed that the rifles lubricated with MIL-L-46000A had the least amount of rust, NRL second, VV-L-800 third, and Code A fourth. The rifles were in the controlled temperature - humidity environment for 21 days, with the schedule II rifles removed only for 1000-round maintenance. The rust data on the rifles are given in Tables I-XVIII and I-XIX.

The cyclic rates recorded periodically throughout the reliability test indicate no degradation because of lubricant. In fact, the average cyclic rate of 50 per cent of the rifles exceeded the maximum of 850 rounds per minute specified in SAPD-253B (Reference 6). The cyclic rate data are contained in Table I-XX.

Inspection of the bores and chambers of the rifles after test indicated normal wear for a 6000-round test.

Other than with one NRL lubricated rifle, the broken part occurrences with the 24 rifles fired in the reliability test were not greater than those normally experienced in a 6000-round test. The one NRL lubricated rifle experienced three broken extractor springs, one broken extractor pin, and one broken bolt ring.

2.8.4 Analysis

The results of the schedule I firings show that MIL-L-46000A was the best lubricant, VV-L-800 second, Code A third, and NRL fourth when the rifles were fired under conditions of minimum maintenance. Under conditions of maintenance after each 1000 rounds (schedule II) MIL-L-46000A was again the best lubricant, VV-L-800 second, NRL third, and Code A fourth.

2.9 SEQUENTIAL-TEST SERIES

2.9.1 Objectives

To subject the test rifles to a series of adverse conditions and reliability tests of sufficient severity to force a difference in the operation of the rifles which can be attributed to degradation, contamination, or wash-off of the lubricant.

2.9.2 Method

Maintenance D was performed on four sets (five rifles per set) of rifles. Each rifle was then subjected to the series of tests outlined in Table 2.9-I. After the completion of each test of the series, and when not under test in a given phase of the sequential

series, the rifles were stored at +95° ± 3°F temperature and 90% ± 5% relative humidity. Prior to beginning each separate test, maintenance A was performed and the rifles were inspected. If, at any time during a test, an excessive number of malfunctions occurred, remedial action consisting of maintenance A was performed. If excessive malfunctions continued, maintenance B was performed, and, finally, maintenance C. All firing was conducted from a firing chamber with the temperature controlled at +85° ± 3°F.

Table 2.9-I. Sequential Test Series

Test	Phase	Rds per Weapon No.	Rds per Weapon Total	Type of Fire
Salt-water immersion [a]	1	40	40	Semiautomatic
		60	100	Three to 5-round bursts
		40	140	Automatic (two 20-rd bursts)
	2			One-hour minimum conditioning period
	3	140	280	Phase 1
Sand-drag [b]	4	280	560	Phases 1, 2, and 3
Water-spray	5	600	1160	Reference Table 2.7.I
Dust [b]	6	280	1440	Phases 1, 2, and 3
Mud [b]	7	280	1720	Phases 1, 2, and 3
Reliability [c]	8	1280	3000	Reference paragraph 2.8.2

[a]The salt water immersion test consists of only the procedures employed on the first day of the test as described in paragraph 2.3.2.
[b]These tests were conducted employing the methods described in the given test, except that only the assembled magazine was subjected to adverse conditions and the dust cover on the weapon was closed.
[c]The first cycle consisted of 80 rounds fired automatically for recording of cyclic rates of fire.

2.9.3 Results

The number of malfunctions that occurred throughout the series of tests, the number and types of maintenance required, and the malfunction rate per 100 rounds fired are given in Table 2.9-II. A graphical display of malfunction occurrences per test in the series is shown in Figure 2.9-1.

Throughout the later portion of the series of tests, particularly on the Code A and VV-L-800 lubricated rifles, the selector lever became extremely difficult to move and, on one VV-L-800 lubricated rifle, the lever broke at 2300 rounds, making the rifle inoperable. These malfunctions were not included in the malfunction-rate data, but each occurrence was recorded in the individual rifle performance data contained in Table I-XXI. The malfunction was attributed to seizure of the selector detent within the detent well. No occurrence of this malfunction was experienced with the NRL lubricant; it occurred 61 times with MIL-L-46000A, 167 times with Code A, and 187 times with the VV-L-800 lubricated rifles.

An attempt was made to rate the rifles with regard to rust after the series of tests; however, the film of red clay left from the mud test masked the rust making accurate rust rating impossible. Cleaning the rifles removed the visible signs of rust; therefore, the rifles were not evaluated for rust.

The cyclic rate of fire of all rifles were recorded initially, in the first and last automatic cycles of the water-spray test, the first automatic cycle of the reliability test, after 580 rounds, and the last automatic cycle of the reliability test. These data are contained in Table I-XXII. The results show a cyclic rate decrease during the water-spray test series with all lubricants. However, the cyclic rates in the reliability test series, which was conducted after the water-spray test, were comparable with those recorded initially.

Table 2.9-II. Function Data for Sequential Test Series

Legend: NM = No. of malfunctions.
MR = Maintenance required.

Test	MIL-L-46000A		NRL		Code A		VV-L-800	
	NM	MR	NM	MR	NM	MR	NM	MR
Salt-water immersion	2		2		7			
Sand-drag	7		8		6			
Water-spray	23		2		30	1-A	80	2-A
Dust test	15		36		18		87	
Mud test	36	3-A	61		40	4-A 1-B	26	5-A
Reliability	100	2-A 1-B 1-C	265	3-A 3-B 3-C	351	4-A 4-B 3-C	[a]251	5-A 3-B 1-C
Total malfunctions	183		374		452		444	
Total rds fired	15,000		15,000		15,000		14,300	
Malfunction rate per 100 rds fired	1.22		2.49		3.01		3.10	

[a]Testing was terminated after 2300 rounds with one VV-L-800 lubricated rifle because of a broken selector lever. The lever was replaced and the replacement lever broke. The malfunctions that occurred with this rifle, prior to this breakage, are included in the rate for the VV-L-800 lubricant.

Note: Numerical prefix indicates number of times maintenance was required (e.g., 1-A means maintenance A had to be performed on one rifle in that test).

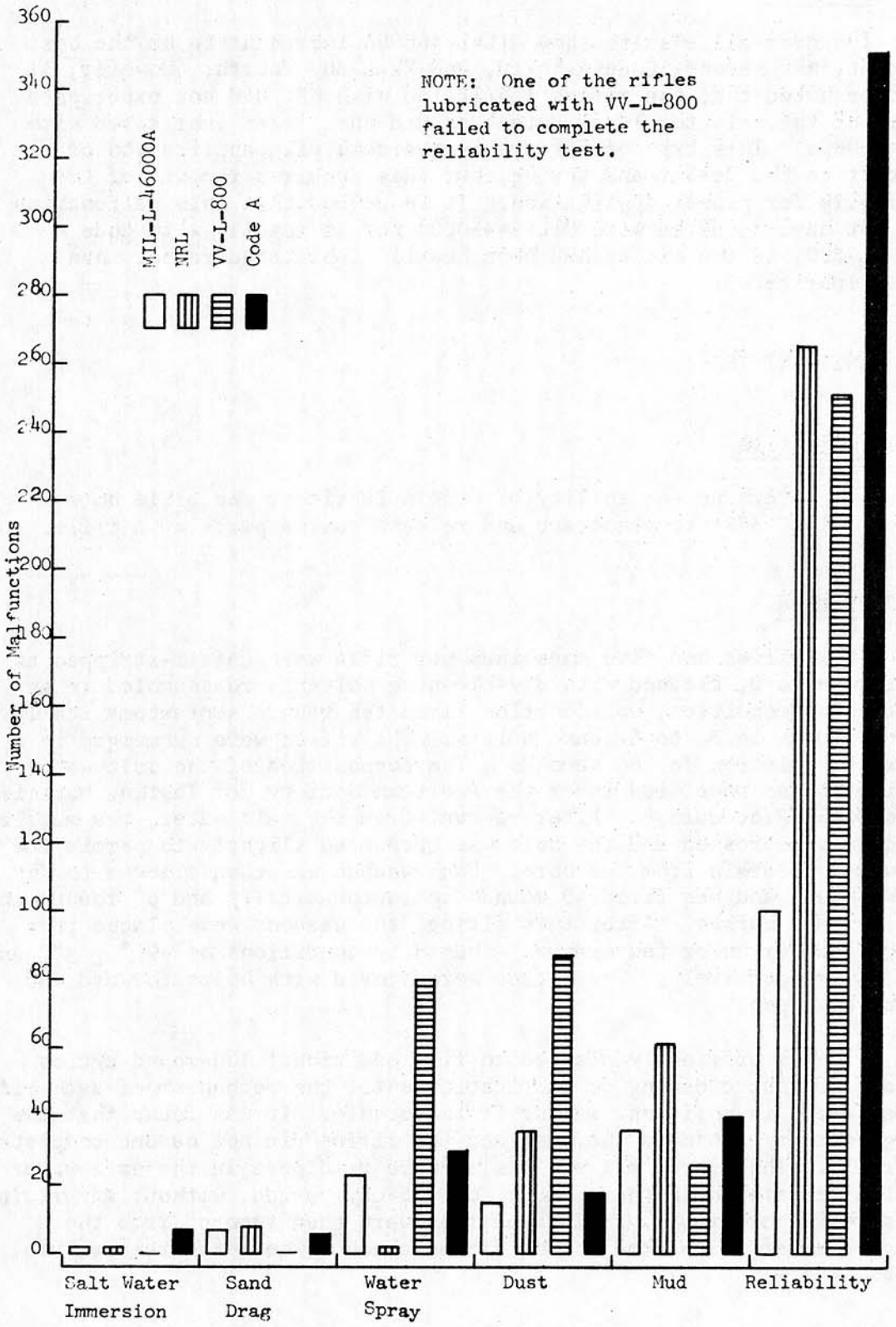

Figure 2.9-1: Malfunction Occurrences in Sequential Test Series.

2.9.4 Analysis

The over-all results show MIL-L-46000A lubricant to be the best lubricant, NRL second, Code A third, and VV-L-800 fourth. However, it should be noted that the rifles lubricated with NRL did not experience seizure of the selector lever detent as did the rifles lubricated with MIL-L-46000A. This type of failure is overcome with application of lubricant to the detent and spring, but this requires removal of the pistol grip for proper application. It is deemed that this malfunction would not have occurred with MIL-L-46000A nor as readily with Code A and VV-L-800, if the rifles had been heavily lubricated rather than lightly lubricated.

2.10 PENETRANT TEST

2.10.1 Objective

To determine the ability of Code A lubricant and rifle bore cleaner (MIL-C-372) to penetrate and release rusted parts of a rifle.

2.10.2 Method

Six rifles and five magazines per rifle were detail-stripped as in maintenance D, cleaned with dry-cleaning solvent, reassembled in an unlubricated condition, and function-fired ten rounds semiautomatically and ten rounds in 3- to 5-round bursts. The rifles were submerged in a salt-water solution for 60 seconds. The composition of the salt-water solution was as specified under the American Society for Testing Materials, Method D665, Procedure B. After removal from the salt water, the muzzle of each was depressed and the bolt was retracted slightly to permit the salt water to drain from the bore. Each weapon was then allowed to dry for two hours and was fired 40 rounds semiautomatically and 60 rounds in 3- to 5-round bursts. After this firing, the weapons were placed in a storage chamber under temperature - humidity conditions of +95° ± 3°F and 90% ± 5%, respectively. The rifles were stored with bolts forward and dust covers open.

It was originally planned to fire additional 100-round cycles each day without cleaning or lubrication until the mechanism of each rifle became seized in position, making it inoperable. It was found that the firing each day loosened the rust and the rifles did not become completely inoperable. Therefore, all six rifles were re-dipped in the salt-water solution and stored in the chamber for a 5-day period, without any firing, to assure inoperability. All six rifles were then removed from the storage chamber and placed in the firing chamber where the temperature was +85° ± 3°F.

Code A was applied to one rifle and rifle bore cleaner (MIL-C-372) to a second rifle. A quantity of one fluid ounce of the respective penetrant fluid was applied through the magazine well and ejection port. Thereafter, at 10-minute intervals, attempts were made to hand-operate the rifle. If the rifle could not be operated after three attempts, a second ounce of penetrant was applied in the same manner. If the rifle was not operable after three additional attempts, a third ounce of fluid was applied. However, in this application, the take-down pin was disengaged and the rifle broken open for more direct application of the penetrant to the seized parts. At intervals of ten minutes, six attempts were again made to hand-operate the rifle.

The results of the foregoing trials, given in Table 2.10-I indicated the possibility that either inadequate time had been allotted for the fluids to penetrate or insufficient amount of the fluids had been applied. Therefore, Code A and rifle bore cleaner were applied to two additional rifles using the same procedures as before except the fluids were allowed to remain in the weapons for a longer period prior to attempting retraction of the bolt and carrier.

The procedure with the remaining two rifles was modified from that employed with the first four. The take-down pin and the pivot pin were disengaged and the upper receiver group was submerged into a bath of the penetrant fluid to a depth which completely covered the bolt-carrier group and chamber area. Thereafter, an attempt was made on an approximately hourly basis to retract the bolt and carrier.

2.10.3 Results

The results of the penetrant test are given in Table 2.10-I which show that none of the rifles could be made operable without prior application of force to retract the bolt and carrier (see Table 2.10-I for details).

An attempt was made to fire only the first two rifles. Both were fired, but with numerous malfunctions occurring. The other four rifles were not fired because of excessive rust buildup in the chamber and bore areas. It was the opinion of personnel who cleaned the rifles after the test that there was no significant difference in the ease of removal of rust from component parts to which either Code A or rifle bore cleaner had been applied.

2.10.4 Analysis

The results show that neither Code A nor rifle bore cleaner are very effective when used as penetrants in the loosening of rusted parts of rifles.

Table 2.10-I. Results of Penetrant Test

Rifle No.	Penetrant	No. of Hours: Stored at +95°F and 90% Relative Humidity	No. of Hours: Stored at +85°F Prior to Application of Penetrant	No. of Hours: After Application of Penetrant Prior to Forced Retraction of Bolt	Remarks
105	Code A	216.5	0	3.0	After two hours, attempting to retract the bolt every ten minutes by hand, additional assistance was applied by bumping the buttstock sharply on a wooden block while at the same time force was applied to the charging handle. The buttstock was bumped 10 times on each attempt (at 10-minute intervals) and required six attempts (60 bumps) before the bolt opened.
106	Rifle bore cleaner	216.5	0	2.5	Same as previous rifle except that the bolt opened after bumping the buttstock 27 times.
107	Code A	216.5	4.5	120.0	The bolt could not be opened by bumping the buttstock and it was necessary to use a brass drift and hammer.
108	Rifle bore cleaner	216.5	4.0	118.0	The bolt opened partially after bumping the buttstock ten times and opened completely after eight additional bumps.
109	Code A	216.5	143.0	148.0	The bolt could not be opened by bumping the buttstock. It was necessary to use a piece of steel stock that fitted firmly into the slot of the bolt carrier and to drive the bolt open with a hammer.
110	Rifle bore cleaner	216.5	142.0	147.5	Same as previous rifle.

2.11 DYNAMIC-DUST TEST

2.11.1 Objective

To determine the functional performance of the test rifles under conditions of blowing dust.

2.11.2 Method

The dynamic dust test was performed by subjecting each rifle to a dust blast in a specially constructed box with a blower. The box was 3 feet wide, 4 feet tall, and 4-1/2 feet long, with plexiglass sides. The plexiglass sides incorporated gauntlet-type gloves which allowed the gunner to fire the rifle from outside the box.

The test was conducted in three phases. Phase 1 was conducted in accordance with the test plan (Reference 2). Phase 2 was as directed in AMSTE-BC letter, 20 April (Reference 3), and phase 3 was as directed in AMSTE-BC letter, 26 April (Reference 4). The methods employed in each phase were as follows:

a. Phase 1. Maintenance D was performed on four sets of M16A1 rifles and a similar type of maintenance was performed on four sets of M14 rifles (this is the only subtest and phase in which M14 rifles were fired). Each rifle was mounted in a machine rest which was centrally located in the dust box. An attempt was then made to fire 40 rounds semiautomatically, 60 rounds in 3- to 5-round bursts, and 40 rounds in 20-round bursts (140 rounds total). The rate of fire was approximately 40 rounds per minute giving a total time of approximately 3-1/2 minutes to fire the 140-round complement. During firing, each rifle was subjected to a continuous blast of dust which was poured directly into the blower opening at an approximate rate of two pounds per minute. The dust mixture was as specified in MIL-E-5272C (ASG) (Reference 5).

b. Phase 2. Maintenance D was performed on the M16A1 rifles previously employed in phase 1; however, rather than a light coat of lubricant, the rifles were lubricated liberally. The set of rifles which were previously lubricated with NRL were left in an unlubricated condition due to the short supply of the NRL lubricant. These rifles were used to evaluate the performance of unlubricated M16A1 rifles in a blowing-dust environment. The firing procedures consisted of a repeat of phase 1, except that 280 rounds were fired, with a 15-minute cooling period

after 140 rounds, and the rifles were liberally lubricated with the occurrence of excess type I malfunctions or with the occurrence of a type II malfunction. The unlubricated rifles were fired only until excessive malfunctions occurred.

c. Phase 3. Phases 1 and 2 were repeated with three M16A1 rifles firing tracer ammunition and using MIL-L-46000A lubricant only.

2.11.3 Results

The total of the malfunctions which occurred and the malfunction rate with the M16A1 rifles in a lightly lubricated condition (Phase 1) are given in Table 2.11-I. A graphical display of the malfunction occurrences throughout the test are shown in Figure 2.11-1. Similarly, the results of phase 2 with the M16A1 rifle in a liberally lubricated condition are given in Table 2.11-II with the malfunction occurrence shown in Figure 2.11-2.

The results of phase 3, firing tracer ammunition with the M16A1 rifles heavily lubricated and lightly lubricated, are given in Table 2.11-III.

Evidence of dust and oil buildup during test was not significantly different with one lubricant than it was with another; all lubricants acted somewhat as a flushing agent. However, MIL-L-46000A and VV-L-800 had more of a tendency to lubricate as well as flush; whereas, Code A provided a flushing action but its lubrication qualities under these conditions were inferior. Testing with NRL was insufficient to determined its flushing abilities.

The individual rifle data for phases 1 through 3 for the M16A1 rifles are given in Tables I-XXIV through I-XXVI.

Table 2.11-I. Rifle Function Data for Phase 1 (M16A1 Rifle)

	Lubricant			
	MIL-L-46000A	VV-L-800	NRL	Code A
Total malfunctions	4	9	[a] 15	16
Malfunction rate per 100 rounds fired	1.0	2.1	3.7	3.8

[a]Inadvertently, only 127 rounds were fired with one of the NRL lubricated rifles which makes the total rounds fired 407 rather than 420.

Note: A total of 420 rounds per lubricant was fired.

Table 2.11-II. Rifle Function Data for Phase 2 (M16A1 Rifle)

	Lubricant			
	MIL-L-46000A	VV-L-800	Code A	Unlubricated
Total malfunctions	18	27	[a] 37	12
Malfunction rate per 100 rounds fired	2.1	3.2	7.5	[b] -

[a]Two of the three rifles fired failed to complete the test. The first failed at 102 rounds, the second at 109 rounds; therefore, the total rounds fired with the three rifles was 491.
[b]A total of 14 rounds was fired with the three unlubricated rifles; therefore, no malfunction rate was calculated.

Note: A total of 840 rounds per lubricant was fired.

Table 2.11-III. Rifle Function Data from Phase 3 (M16A1 Rifle)

		MIL-L-46000A Lubricant	
		Malfunction	
Condition	No. Rds Fired	Rate per 100 Rds Fired	No.
Same as phase 2 (liberally lubricated)	840	0.1	1
Same as phase 1 (lightly lubricated)	71	-	[a]14

[a]The rifles functioned very poorly when in a lightly lubricated condition. No additional lubricant was applied to the rifles and all failed because of malfunctions attributable to short recoil.

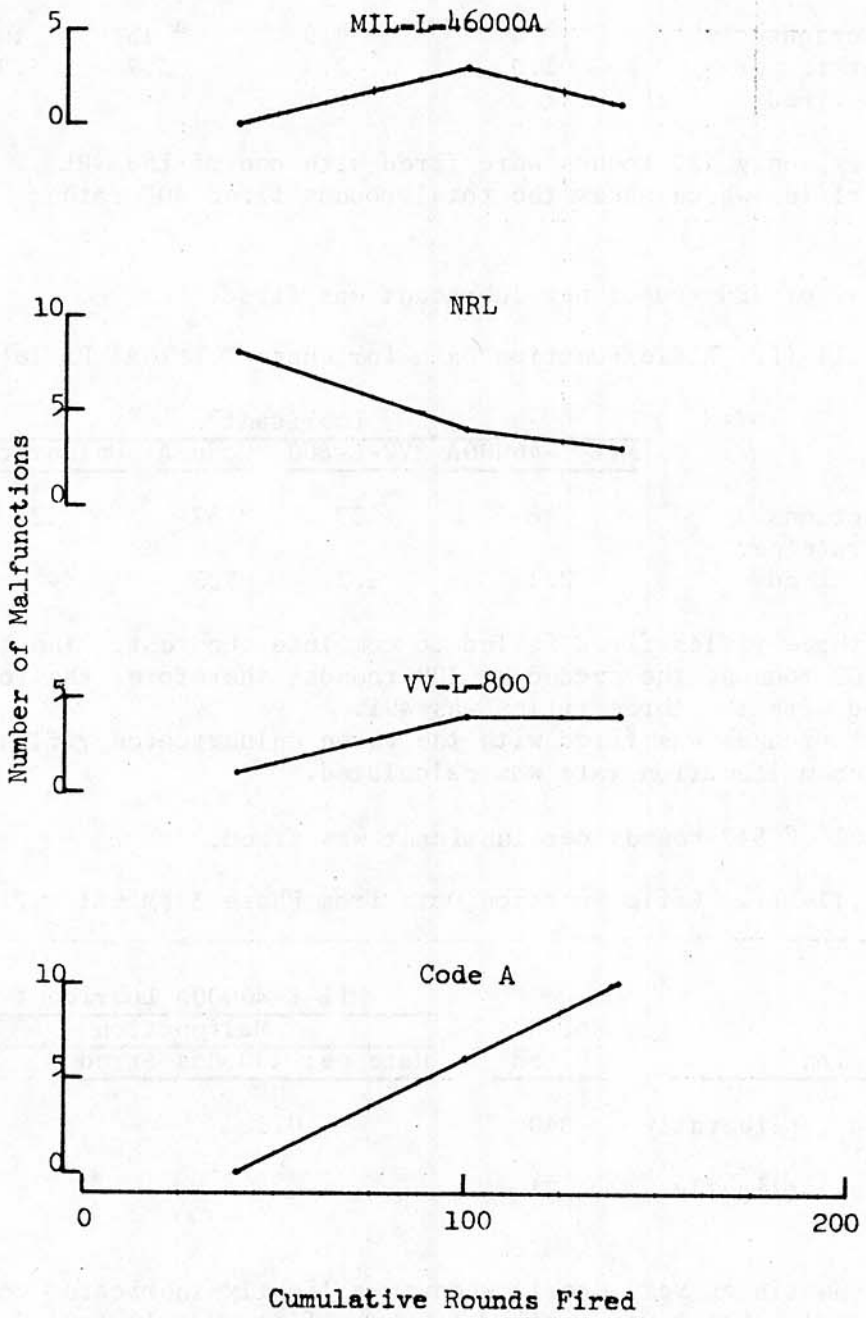

Figure 2.11-I: Malfunction Occurrences with the M16A1 Rifle in Phase I of Dynamic-Dust Test.

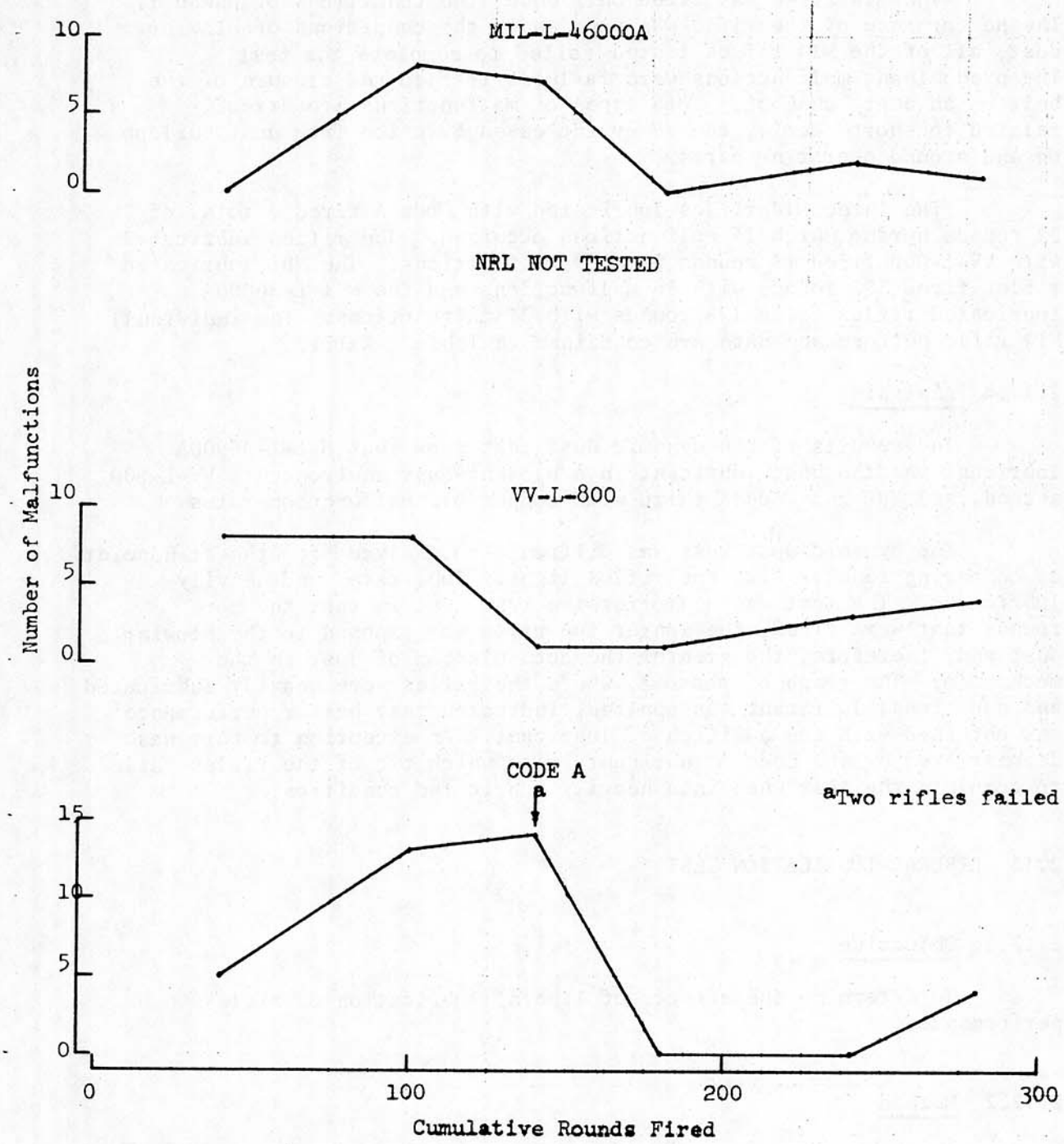

Figure 2.11-2: Malfunction Occurrences with the M16A1 Rifle in Phase II of Dynamic-Dust Test.

The M14 rifle was fired only under the conditions of phase 1. The performance of the rifle was poor under the conditions of blowing dust, all of the M14 rifles tested failed to complete the test. The predominant malfunctions were failures to feed and closure of the bolt on an empty chamber. Both types of malfunctions are directly related to short recoil, caused by increased friction from dust buildup on and around operating parts.

The three M14 rifles lubricated with Code A fired a total of 22 rounds during which 15 malfunctions occurred. The rifles lubricated with VV-L-800 fired 18 rounds with 20 malfunctions. The NRL lubricated rifles fired 152 rounds with 16 malfunctions and the MIL-L-46000A lubricated rifles fired 178 rounds with 27 malfunctions. The individual M14 rifle performance data are contained in Table I-XXIII.

2.11.4 Analysis

The results of the dynamic dust test show that MIL-L-46000A lubricant was the best lubricant in a blowing-dust environment, VV-L-800 second, and NRL and Code A third with comparable malfunction rates.

The dynamic-dust test was difficult to analyze from the standpoint of comparing results with the rifles lightly lubricated and heavily lubricated. The test was a progressive type test in that the more rounds that were fired, the longer the rifle was exposed to the blowing dust and, therefore, the greater the accumulation of dust in the mechanism. The graph of phase 2, where the rifles were heavily lubricated and additional lubricant was applied, indicated that better performance was obtained with the addition of lubricant. An exception to this was demonstrated by the Code A lubricant, with which two of the rifles failed to complete the test when in a heavily lubricated condition.

2.12 LIBERAL-LUBRICATION TEST

2.12.1 Objective

To determine the effects of liberal lubrication on rifle performance.

2.12.2 Method

Maintenance D was performed on the four sets of rifles previously employed in the mud test (par. 2.5); however, instead of a light coat of lubricant as specified in TM 9-1005-249-14 (Reference 1), the lubricant was applied liberally to the surfaces of component parts until it ran and dripped freely. The chamber and bore areas of the rifle were not lubricated in the same manner. A swab was dampened thoroughly with lubricant and pushed through the bore from the chamber to muzzle.

Each rifle was then fired 40 rounds semiautomatically, 60 rounds in 3- to 5-round bursts and 40 rounds in 20-round bursts (total of 140 rounds). After a cooling period, and without further lubrication, a second 140-round complement was fired in the same manner. Each rifle was then disassembled, as in maintenance A (including removal of the firing pin), and again liberally lubricated. The foregoing procedure was continued until twenty 140-round complements had been fired (total of 2800 rounds). The ammunition and magazines were not lubricated, other than a moderate application of lubricant on the magazines prior to test.

2.12.3 Results

The number of malfunctions which occurred throughout the subtest and the rate per 100 rounds fired are given in Table 2.12-I.

Table 2.12-I. Liberal-Lubrication Test Function Data

Lubricant	Total No. Rds Fired[a]	No. of Malfunctions	Malfunction Rate per 100 Rds Fired
MIL-L-46000A	8400	0	0.00
VV-L-800	8400	0	0.00
Code A	8400	2	0.02
NRL	8400	3	0.04

[a]2800 rounds for each of three rifles with each lubricant.

The rifle-function data for each cycle fired are contained in Table I-XXVII and the cyclic rate data are in Table I-XXVIII. The cyclic rates of all rifles throughout the test were consistent, indicating no detrimental effects due to liberal lubrication.

2.12.4 Analysis

The results show that the use of any of the four lubricants in liberal quantities improved rifle performance significantly over that experienced in the first 2800 rounds of schedule I of the reliability test, where no maintenance was performed and the rifles were lubricated lightly. These results should not be interpreted to mean that regular cleaning of the rifle is not required; only that liberal use of lubricant will improve rifle-function performance.

Table I-I. Inspection Data for M16A1 Rifles

APG No.	Serial No.	Before Test: Firing Pin Indent, in.	Before Test: Firing Pin Protrusion, in.	Before Test: Headspace, in.	Trigger Pull, lb	Cyclic Rates (Rd/Min): Lubrication Before	Cyclic Rates (Rd/Min): Lubrication After	After Test: Firing Pin Indent, in.	After Test: Firing Pin Protrusion, in.	After Test: Headspace, in.
1	614110	0.023	0.031	1.4656	6.7	780	726	0.023	0.032	1.4666
2	616061	.022	.031	1.4666	7.9	767	760	.023	.032	1.4666
3	618943	.023	.031	1.4656	7.7	749	735	.023	.033	1.4676
4	611591	.023	.031	1.4656	6.7	783	771	.022	.032	1.4676
5	613177	.024	.034	1.4646	8.1	768	767	.023	.034	1.4656
6	611827	.022	.034	1.4656	7.6	754	723	.022	.034	1.4676
7	611911	.023	.031	1.4656	7.0	780	833	.024	.032	1.4676
8	612978	.022	.033	1.4656	5.9	765	795	.023	.033	1.4676
9	617220	.022	.031	1.4656	6.7	742	775	.022	.031	1.4666
10	612684	.022	.031	1.4646	6.9	784	786	.023	.032	1.4646
11	611586	.022	.033	1.4656	8.2	769	771	.022	.034	1.4666
12	614453	.022	.035	1.4666	7.7	756	757	.022	.036	1.4696
13	606359	.022	.035	1.4676	7.2	776	726	.022	.036	1.4676
14	580928	.023	.031	1.4656	7.7	759	736	.023	.032	1.4676
15	613142	.022	.030	1.4646	6.9	734	695	.023	.031	1.4666
16	613493	.022	.033	1.4646	7.2	775	738	.022	.034	1.4666
17	618810	.022	.036	1.4666	6.3	757	741	.022	.035	1.4666
18	619155	.023	.032	1.4656	8.5	728	728	.023	.033	1.4666
19	581009	.022	.034	1.4656	6.1	774	795	.020	.033	1.4666
20	617930	.021	.030	1.4646	6.4	769	805	.023	.031	1.4646
21	614111	.023	.031	1.4656	7.4	756	775	.024	.033	1.4666
22	580796	.023	.032	1.4646	7.1	754	786	.023	.033	1.4656
23	580992	.023	.031	1.4646	8.2	757	726	.023	.031	1.4656
24	618966	.024	.033	1.4646	6.8	717	733	.023	.037	1.4646
25	618600	.023	.034	1.4656	6.8	799	829	.023	.034	1.4666
26	617071	.023	.032	1.4646	8.0	758	757	.024	.032	1.4666
27	615662	.023	.033	1.4656	5.9	757	792	.022	.031	1.4676
28	613456	.023	.031	1.4656	6.9	741	804	.023	.032	1.4666
29	621293	.023	.032	1.4646	6.4	736	768	.023	.033	1.4656

Table I-I (Cont'd)

APG No.	Serial No.	Before Test: Firing Pin Indent, in.	Before Test: Firing Pin Protrusion, in.	Before Test: Headspace, in.	Trigger Pull, lb	Cyclic Rates (Rd/Min): Lubrication Before	Cyclic Rates (Rd/Min): Lubrication After	After Test: Firing Pin Indent, in.	After Test: Firing Pin Protrusion, in.	After Test: Headspace, in.
30	611509	0.021	0.034	1.4656	6.8	796	790	0.021	0.035	1.4686
31	616738	.023	.030	1.4646	6.4	760	803	.023	.031	1.4666
32	607956	.024	.034	1.4656	6.8	755	762	.024	.036	1.4666
33	612651	.022	.033	1.4656	7.8	745	781	.022	.032	1.4676
34	615192	.022	.031	1.4646	6.5	733	738	.022	.032	1.4666
35	609793	.024	.030	1.4656	7.7	781	839	.023	.031	1.4676
36	618705	.022	.032	1.4646	6.3	768	795	.022	.031	1.4666
37	612968	.022	.036	1.4656	8.3	757	796	.021	.035	1.4676
38	615322	.023	.032	1.4646	7.6	742	798	.022	.033	1.4656
39	616474	.022	.033	1.4646	6.2	730	765	.022	.033	1.4666
40	617928	.021	.035	1.4656	6.2	777	821	.022	.035	1.4686
41	621885	.023	.034	1.4676	6.7	775	824	.022	.034	1.4706
42	616260	.024	.033	1.4646	6.4	755	787	.023	.031	1.4666
43	609580	.024	.031	1.4646	7.9	748	768	.024	.033	1.4646
44	616041	.022	.032	1.4656	6.6	720	710	.022	.032	1.4676
45	616773	.023	.032	1.4646	8.0	780	[b] -			
46	580718	.022	.030	1.4656	6.4	759	[c] -	.023	.032	1.4666
47	616994	.023	.033	1.4666	7.0	759		Not fired.		
48	611424	.023	.031	1.4666	5.9	781	779	.023	.031	1.4676
49	615625	.024	.031	1.4666	6.2	760	778	.023	.032	1.4676
50	618965	.023	.030	[a] -	6.4	753	763	.023	.031	1.4646

[a] The headspace was less than the minimum headspace gage of 1.4646 inches. This was less than the acceptable measurements specified in SAPD-253-B (Reference 6). The cyclic rate data and functioning indicated no detrimental effects; therefore, the rifle was left in test.

[b] The rifle was used for trial runs in dynamic dust test after termination of water spray test; therefore, after test measurements were not taken.

[c] Inadvertently omitted.

Table I-I (Cont'd)

APG No.	Serial No.	Before Test: Firing Pin Indent, in.	Before Test: Firing Pin Protrusion, in.	Before Test: Headspace, in.	Trigger Pull, lb	Cyclic Rates (Rd/Min): Lubrication Before	Cyclic Rates (Rd/Min): Lubrication After	After Test: Firing Pin Indent, in.	After Test: Firing Pin Protrusion, in.	After Test: Headspace, in.
51	612927	0.022	0.033	1.4646	6.0	777	872	0.022	0.033	1.4646
52	613161	.024	.032	1.4676	6.2	767		Not fired.		
53	618434	.022	.030	1.4666	7.6	747		Not fired.		
54	617266	.024	.031	1.4646	5.5	783	811	.023	.031	1.4656
55	614950	.023	.030	1.4666	6.0	771		Not fired.		
56	619018	.023	.033	1.4686	5.8	692		Not fired.		
57	608074	.022	.033	1.4666	9.6	782	811	.022	.033	1.4676
58	617207	.021	.032	1.4646	6.3	752	801	.023	.033	1.4656
59	618715	.021	.033	1.4676	7.7	749	792	.023	.033	1.4686
60	580935	.021	.033	1.4656	6.9	792	812	.023	.034	1.4666
61	619288	.021	.032	1.4646	7.1	754	788	.023	.032	1.4666
62	611405	.020	.034	1.4666	6.7	724	745	.023	.034	1.4666
63	610580	.020	.032	1.4666	6.9	773	856	.022	.032	1.4666
64	609759	.021	.033	1.4646	8.1	757	822	.023	.033	1.4666
65	615064	.021	.031	1.4646	7.1	749	835	.023	.031	1.4656
66	615072	.022	.032	1.4666	6.4	768	787	.023	.031	1.4676
67	614408	.022	.033	1.4656	6.9	766	799	.024	.034	1.4666
68	580701	.021	.034	1.4666	7.5	749	833	.024	.034	1.4666
69	616317	.023	.032	1.4656	7.6	768	[c] -	.023	.033	1.4666
70	621126	.023	.034	1.4666	6.9	746	[c] -	.022	.034	1.4686
71	616479	.023	.033	1.4666	6.4	745	[c] -	.024	.033	1.4666
72	561507	.022	.030	1.4646	6.1	733	[c] -	.022	.031	1.4656
73	615639	.022	.032	1.4666	7.1	747	[c] -	.023	.033	1.4676
74	615567	.023	.034	1.4656	6.7	732	[c] -	.022	.035	1.4666
75	617658	.023	.032	1.4666	7.4	756	[c] -	.023	.032	1.4666
76	580770	.022	.031	1.4666	6.4	756	[c] -	.022	.030	1.4676

[c] Inadvertently omitted.

Table I-I (Cont'd)

APG No.	Serial No.	Before Test: Firing Pin Indent, in.	Before Test: Firing Pin Protrusion, in.	Before Test: Headspace, in.	Trigger Pull, lb	Cyclic Rates (Rd/Min): Lubrication Before	Cyclic Rates (Rd/Min): Lubrication After	After Test: Firing Pin Indent, in.	After Test: Firing Pin Protrusion, in.	After Test: Headspace, in.
77	614514	0.023	0.033	1.4666	6.3	705	[c] -	0.023	0.032	1.4676
78	617278	.024	.031	1.4656	8.8	768	[c] -	.024	.031	1.4656
79	615335	.024	.033	1.4666	6.3	753	[c] -	.023	.034	1.4676
80	615227	.023	.032	1.4646	8.0	745	[c] -	.023	.032	1.4646
81	617098	.024	.031	1.4646	7.1	760	762	.023	.032	1.4656
82	580894	.024	.030	1.4646	8.2	752	744	.024	.031	1.4646
83	623685	.023	.032	1.4656	7.6	737	731	.023	.033	1.4656
84	580574	.022	.029	1.4656	6.9	760	800	.023	.030	1.4666
85	618601	.021	.031	1.4656	6.8	757	792	.022	.032	1.4656
86	612085	.023	.034	1.4666	7.1	717	723	.023	.035	1.4666
87	559903	.022	.032	1.4646	6.1	750	875	.021	.033	1.4646
88	608817	.023	.034	1.4666	6.9	742	793	.023	.035	1.4666
89	614139	.023	.032	1.4646	6.7	708	788	.022	.030	1.4646
90	614505	.024	.031	1.4656	8.0	767	794	.023	.032	1.4666
91	613096	.024	.033	[a] -	8.0	745	774	.023	.034	1.4646
92	580726	.022	.034	1.4656	8.4	720	783	.023	.035	1.4666
93	619297	.023	.033	1.4666	8.3	764	815	.024	.035	1.4666
94	616715	.022	.034	1.4666	6.3	748	739	.022	.035	1.4666
95	616812	.022	.034	1.4656	8.3	733	760	.022	.035	1.4666
96	615677	.023	.032	1.4646	7.1	766	784	.023	.032	1.4666
97	616492	.023	.031	1.4656	6.6	744	777	.023	.031	1.4666
98	616261	.024	.034	1.4656	6.8	725	750	.024	.035	1.4666
99	614909	.024	.031	1.4666	6.4	770	839	.024	.032	1.4666

[a]The headspace was less than the minimum headspace gage of 1.4646 inches. This was less than the acceptable measurements specified in SAPD-253-B (Reference 6). The cyclic rate data and functioning indicated no detrimental effects; therefore, the rifle was left in test.
[c]Inadvertently omitted.

Table I-I (Cont'd)

APG No.	Serial No.	Before Test: Firing Pin Indent, in.	Before Test: Firing Pin Protrusion, in.	Before Test: Headspace, in.	Trigger Pull, lb	Cyclic Rates (Rd/Min): Lubrication Before	Cyclic Rates (Rd/Min): Lubrication After	After Test: Firing Pin Indent, in.	After Test: Firing Pin Protrusion, in.	After Test: Headspace, in.
100	613123	0.023	0.032	1.4656	8.4	738	804	0.023	0.031	1.4666
101	614046	.022	.031	1.4656	7.0	729	786	.023	.032	1.4666
102	614960	.022	.031	1.4666	6.7	783	814	.024	.032	1.4666
103	611434	.023	.033	1.4656	6.6	735	760	.024	.033	1.4666
104	580988	.021	.034	1.4646	7.0	731	744	.022	.035	1.4646
105	621105	.020	.033	1.4676	6.3	778	[d] -	.023	.035	1.4696
106	580905	.019	.034	1.4656	6.5	744	[d] -	.023	.034	1.4666
107	612175	.021	.032	1.4656	7.7	777	[d] -	.022	.033	1.4656
108	580598	.021	.032	1.4666	6.0	764	[d] -	.022	.032	1.4666
109	612653	.020	.031	1.4646	7.9	741	[d] -	.021	.032	1.4656
110	580687	.022	.031	1.4666	6.1	737	[d] -	.023	.031	1.4666
111	580594	.023	.031	1.4656	6.3	725	734	.023	.031	1.4666
112	605661	.023	.034	1.4676	6.2	721	869	.022	.033	1.4706
113	653414	.023	.036	1.4656	6.6	762	803	.021	.035	1.4666
114	610713	.024	.030	1.4656	6.8	692	737	.023	.031	1.4686
115	612095	.022	.032	1.4646	7.0	767	799	.022	.031	1.4656
116	660284	.022	.036	1.4666	6.4	763	789	.021	.036	1.4666
117	615407	.020	.034	1.4656	6.4	707	844	.021	.034	1.4656
118	616241	.021	.033	1.4666	6.1	743	865	.023	.035	1.4676
119	662511	.022	.034	1.4666	6.5	718	814	.023	.035	1.4666
120	616437	.024	.033	1.4646	7.0	724	756	.022	.033	1.4666
121	619015	.024	.031	1.4656	6.5	723	803	.023	.032	1.4666
122	663742	.023	.033	1.4666	6.5	772	651	.021	.034	1.4686

[d]Rifle not lubricated (used in penetrant test).

Table I-II. Inspection Data for M14 Rifles

APG No.	Serial No.	Before Test: Firing Pin Protrusion, in.	Before Test: Headspace, in.	Cyclic Rates (Rd/Min) Lubrication: Before	Cyclic Rates (Rd/Min) Lubrication: After	After Test: Firing Pin Protrusion, in.	After Test: Headspace, in.
1	990301	0.049	1.638	806	765	0.049	1.638
2	1351416	.052	1.637	792	768	.053	1.637
3	1455434	.052	1.636	810	778	.053	1.637
4	540225	.051	1.635	737	714	.051	1.635
5	972741	.050	1.638	762	719	.050	1.638
6	930055	.058	1.638	759	768	.058	1.638
7	969221	.052	1.637	829	825	.052	1.637
8	551996	.051	1.637	829	833	.050	1.637
9	895749	.055	1.638	840	836	.055	1.638
10	1350620	.051	1.635	799	785	.051	1.635
11	547054	.050	1.638	775	772	.051	1.638
12	1021013	.051	1.635	825	821	.052	1.636

Table I-III. Rifle Performance Data from Salt-Water Immersion Test

	Number of Malfunctions											
	Code A			VV-L-800			NRL			MIL-L-46000A		
	Rifle Number											
Day	57	58	59	60	61	62	63	64	65	66	67	68
First		1-FJ			16-FTR							
Third	1-FFS	1-FF1 2-FTR 3-FJ	3-FF1 1-FTR		1-FTR 1-FFS	2-FX	1-FF1	4-FX 2-FF	1-FF1 4-FF	3-FX	1-FX 1-FTR	
Fifth	1-FF1 1-FX 2-FF 1-BCOEC TSO-A	2-FF1 3-FF 3-FBA 1-FJ	2-FF1 4-FF 2-FTR			1-FF 3-FTR	1-FF1	1-FBR	1-FF1	1-FX		
Eighth	1-FF1 7-FF 2-FBA 2-FX 1-FJR 1-BCOEC 2-BOB 2-FTR	6-FF1 5-FF 7-FBA 1-FJ 5-FTR	1-TS 1-FF1 5-FFR [a] 1-FF [a] - 1-FF1 15-FTR	1-TS 1-FF 5-FFR [a] - 1-FTR	1-TS 1-FF1 1-FF [a] 5-FFR [a] -	2-FF1 7-FF 1-FFR	2-FF1 2-FF 9-FTR	1-FF1 1-FF 2-FTR	2-FF1 2-FF 1-FFS			1-FTR
Tenth	1-TS 1-FF1 4-FF 3-FBA [c] - 1-FTR	1-TS 1-FF1 3-FBA 3-FFR [d] - 2-FTR 2-FJ	- - - - - - -	- - - - - - -	- - - - - - -	1-FF1 6-FF [b] 1-FFR - -	7-FF1 5-FF 5-FTR	6-FF1 1-FF	5-FF1 6-FF 1-FTR		1-FF1	

[a] The first five rounds loaded failed to fire. Inspection showed the firing pin to be partially seized because of rust "buildup" within the bolt. Hand cycling failed to loosen the firing pin. The test was terminated. The bolt-carrier group was lubricated liberally, reassembled to the rifle, and hand-cycled several times. No further problems were encountered.

[b] The bolt-carrier group was sticking to the rear. The test was terminated and lubricant applied which eliminated any further occurrence of the malfunction.

[c] Inspection showed the detent pawl to be partially seized, which caused failures of the bolt-assist device to clear failures-to-feed. The test was terminated and the bolt-carrier group and bolt-assist device liberally lubricated. No further problems were encountered.

[d] The test was terminated because of conditions as described in footnotes a and c. Application of lubricant corrected the problems.

Table I-IV. Rust-Rating Data on Salt-Water Immersion Test Rifles

Gun No.	Rifle Part: Automatic Sear	Disconnector	Trigger[a]	Bolt Carrier	Bolt Cam Pin	Firing Pin Retaining Pin	Bolt	Barrel[b]	Dust Cover	Magazine Spring[c]
Lubricant: Code A.										
57	0.60/dsa/5	0.50/dsa/5	0.50/dsa/4	0.45/dsa/4-5	0.80/dsa/4	0.20/dsa/4	0.90/dsa/6	0.35/dsa/1-2	0.50/dsa/2-3	0.60/dsa/1-2
58	3 /ds /8	1 /dsa/8	0.45/dsa/5	0.50/dsa/5-6	0.90/dsa/7	0.50/dsa/6	0.99/dsa/8	0.20/dsa/1-2	0.40/dsa/2	0.60/dsa/1-2
59	0.55/dsa/6	0.55/dsa/4	0.40/dsa/4-5	0.40/dsa/4-5	0.45/dsa/4	0.15/dsa/4	0.80/dsa/6	0.30/dsa/1-2	0.70/dsa/4	0.60/dsa/4-5
Lubricant: VV-L-800.										
60	0.95/dsa/5	0.50/dsa/3	0.60/dsa/4-5	0.75/dsa/4-5	0.60/dsa/3	0.25/dsa/3-4	0.50/dsa/4-5	0.30/dsa/2-3	0.90/dsa/4	0.60/dsa/4-5
61	0.60/dsa/4-5	0.90/dsa/5-6	0.50/dsa/4	0.80/dsa/4	0.75/dsa/4-5	0.25/dsa/3-4	0.65/dsa/4-5	0.30/dsa/2-3	0.90/dsa/4	0.60/dsa/2-3
62	0.95/dsa/6	0.80/dsa/6	0.50/dsa/4-5	0.80/dsa/4-5	0.50/dsa/4-5	0.15/dsa/3-4	0.50/dsa/4-5	0.30/dsa/1-3	0.80/dsa/3	0.60/dsa/2-3
Lubricant: NRL.										
63	0.50/dsa/4-5	0.80/dsa/4-5	0.40/dsa/3-4	0.70/dsa/3-4	0.95/dsa/5	0.40/dsa/4-5	0.70/dsa/5	0.50/dsa/1-3	0.50/dsa/1-3	0.60/dsa/4-5
64	0.65/dsa/3-4	0.75/dsa/4-5	0.70/dsa/4	0.65/dsa/3-4	0.70/dsa/5	0.40/dsa/6	0.70/dsa/5	0.50/dsa/1-3	0.50/dsa/1-3	0.60/dsa/4-5
65	0.60/dsa/3-4	0.70/dsa/4-5	0.75/dsa/4-5	0.70/dsa/3-4	0.60/dsa/5	0.25/dsa/5	0.80/dsa/5	0.40/dsa/3-4	0.40/dsa/3-4	0.55/dsa/1-3
Lubricant: MIL-L-46000A.										
66	0.80/dsa/6	0.50/dsa/5	0.40/dsa/3	0.70/dsa/4-5	0.60/dsa/5	0.20/dsa/6	0.55/dsa/6	0.70/dsa/3-4	0.99/dsa/7	0.70/dsa/4
67	0.65/dsa/3-4	0.95/dsa/7	0.40/dsa/4	0.75/dsa/3-4	0.60/dsa/5	0.25/dsa/4	0.85/dsa/7	0.60/dsa/2-3	0.95/dsa/5	0.70/dsa/4-5
68	0.95/dsa/5	0.99/ a/8	0.50/dsa/3	0.80/dsa/4	0.60/dsa/5	0.20/dsa/4-5	0.70/dsa/3-4	0.60/dsa/3-4	0.95/dsa/4-5	0.60/dsa/4-5

[a]The rust rating was determined only on the sear area of the trigger.
[b]The hand guards were removed and the barrel area beneath the hand guards was rust rated.
[c]The rust accumulation for three magazines lubricated with each type lubricant was rated.

Table I-V. Rifle Performance Data from Dust Test

Rds Fired	Cumulative No. Rds Fired	Type of Fire	Number of Malfunctions											
			Code A			VV-L-800			NRL			MIL-L-46000A		
			Rifle Number											
			69	70	71	72	73	74	75	76	77	78	79	80
40	40	Semi	1-FF1	1-FF1	1-FF1	1-FF1		1-FF1	1-FF1		1-FF1	1-FF1		1-FF1
			6-FF	2-FF	1-FF	3-FF		1-FF	1-FTR					
60	100	Burst	1-FF1			1-FF1		2-FF1						2-FF1
40	140	Auto.		1-FJ	2-FF1									
40	180	Semi		1-FTR										
60	240	Burst		1-FF1				1-FF1		2-FF1				
40	280	Auto.	1-FJ	1-FJ				1-FF1		1-FF1				
										[a]1-FX				

The rifle was resubjected to the dust with the dust cover open.

40	320	Semi	1-FF1	1-FF1	1-FF1	1-FF1	1-FF1	1-FF1	1-FF1	1-FF1	6-FF		1-FF1	1-FF1
			3-FF	5-FF	3-FF	3-FF	1-FF	1-FF	5-FF	14-FF	4-FBA		6-FF	
				1-FBA					1-FBA	2-FBA				
				1-FTR						2-FX				
60	380	Burst			1-FF1		1-FF1		2-FF1	1-FF1	2-FF1		1-FF1	
40	420	Auto.	1-FJ	3-FJ										
40	460	Semi		1-FF1						1-FF1				
				1-FTR										
60	520	Burst			1-FF1					1-FF1				
										1-FX				
40	560	Auto.	1-FFS	2-FJ						1-FF1				

[a]Defective round of ammunition which lacked primer flash hole. Primer fired and jammed case into chamber resulting in FX.

Table I-VI. Rifle-Performance Data from Mud Test

Rifle No.	No. Rds Fired	Type Fire	Funct	Remarks[a]
Lubricant: Code A.				
93	8	Semi	3-FF 1-FJR	The first five rounds fired satisfactorily. Then, a failure-to-feed occurred when the bolt closed on an empty chamber. Thereafter, the bolt assist had to be used several times in order to force the bolt to the locked position.
A clean magazine of ammunition was loaded.				
	3	Semi	3-FF 3-FJR	
94	4	Semi	4-FF	After firing the fourth round, the bolt closed on an empty chamber and locked. The bolt could not be retracted to load another round.
95	3		2-FF 1-FJR	The bolt closed on an empty chamber with the second failure-to-feed and in order to retract the bolt the gunner had to rap the charging handle on the side of a shooting bench.
A clean magazine of ammunition was loaded.				
	2		2-FJR	
Lubricant: VV-L-800.				
96	8	Semi	5-FF 5-FJR 1-BOB	The first two rounds were fired satisfactorily. Thereafter, the bolt assist was used to either close or lock the bolt with each round fired.
A clean magazine of ammunition was loaded.				
	2	Semi	2-FJR	The action became more difficult to operate.

[a]The bolt assist was used with each occurrence of a failure-to-feed.

Table I-VI (Cont'd)

Rifle No.	No. Rds Fired	Type Fire	Funct	Remarks[a]
97	8	Semi	5-FF 5-FJR 1-BOB	Same as with rifle No. 96.
	A clean magazine of ammunition was loaded.			
	4	Semi	4-FF 4-FJR	
98	10	Semi	Satis	
	4	Burst	3-FF 3-FJR	
	A clean magazine of ammunition was loaded.			
	3		2-FF 3-FJR	
Lubricant: NRL.				
99	1	Semi	2-FF	The second and third rounds could not be forced to chamber. The bolt lacked approximately 1/4 inch from being closed.
	A clean magazine of ammunition was loaded.			
	3	Semi	2-FF 1-FJR	The bolt was retracting far enough to eject the fired case, but insufficient to engage the base of the next round, hence the two failures-to-feed resulted.
100	10	Semi	9-FF 3-FJR	The failures to eject did not occur until the eighth, ninth, and tenth rounds.
	A clean magazine of ammunition was loaded.			
	3	Semi	2-FF 2-FJ 1-FJR	

[a]The bolt assist was used with each occurrence of a failure-to-feed.

Table I-VI (Cont'd)

Rifle No.	No. Rds Fired	Type Fire	Funct	Remarks[a]
101	6		3-FF 3-FJR	
	A clean magazine of ammunition was loaded.			
	4		3-FF 4-FJR	
Lubricant: MIL-L-46000A.				
102	10	Semi	Satis	
	5	Burst	2-FF 1-FJR	One 3-round burst was fired satisfactorily.
	A clean magazine of ammunition was loaded.			
	10	Semi	6-FF 3-FJR	The bolt assist was used twice. The failures-to-feed were occurring due to the bolt not traveling rearward sufficiently to engage the base of the next round in the magazine.
103	4	Semi	3-FF 1-FJR	
	A clean magazine of ammunition was loaded.			
	2	Semi	2-FJR	In both instances, the bolt moved rearward slightly, but then moved forward to the locked position.
104	8	Semi	3-FF 2-FJR	
	A clean magazine of ammunition was loaded.			
	2	Semi	2-FF 2-FJR	

[a]The bolt assist was used with each occurrence of a failure-to-feed.

Table I-VII. Rifle-Performance Data from Sand-Drag Test

Type of Fire	Cumulative No. Rds Fired	Number of Malfunctions: Code A Rifle 81	Code A 82	Code A 83	VV-L-800 84	VV-L-800 85	VV-L-800 86	NRL 87	NRL 88	NRL 89	MIL-L-46000A 90	MIL-L-46000A 91	MIL-L-46000A 92
Phase 1													
20 rds semiautomatic	20	[a] 2-FF [c] 1-FX	[b] 3-FF										
Phase 2													
20 rds semiautomatic	40	[d] 2-FF					[e] 1-FX						
60 rds in 3-to-5 rd bursts	100	1-FF1											
40 rds in two 20-rd bursts	140												
Cyclic Rate: Burst No. 1.		[f] 857	825	863	924	900	844	924	904	902	863	893	904
Burst No. 2.		-	834	897	949	908	863	930	926	930	873	910	937
Phase 3													
40 rds semiautomatic	180		3-FTR			35-FTR							
60 rds in 3-to-5 rd bursts	240	2-FJ											
40 rds in two 20-rd bursts	280												
Cyclic Rate: Burst No. 1.		[f] -	861	909	[f] -	902	873	924	904	902	883	869	895
Burst No. 2.		[f] -	863	926	949	912	885	863	908	926	897	900	924

[a] The bolt could not be forced to the locked position with the second round. Inspection of the bolt face and chamber area showed an accumulation of sand. The gunner blew on the bolt face and into the chamber area. The second FF occurred on the fourth round.

[b] The second, third, and fourth rounds could not be chambered. Inspection showed an accumulation of sand on the bolt face and in the chamber area. The gunner blew on the bolt face and into the chamber. The fifth round was easily fed.

[c] The fired case from the second round failed to extract.

[d] The bolt could not be forced to the locked position with the second and third rounds. It was also very difficult to retract in attempting to clear the malfunction.

[e] Occurred with the fourth round.

[f] The microphone on the rate recorder failed to function properly.

Table I-VIII. Rifle Function Data on Water-Spray Test

Cycle No.	Cumulative No. Rds Fired	Lubricant: Code A (Rifle Number 46)	VV-L-800 (Rifle Number 48)	VV-L-800 with MIL-G-46003 (Rifle Number 49)	NRL (Rifle Number 51)	MIL-L-46000A (Rifle Number 54)
1	100					
2	200					
3	300	1-FF1	15-FTR			
4	400			1-BSI		
5	500					
6	600					
7	700	1-FF1				
8	800					1-FBR
9	900		1-FF1			
10	1000		[a]2-FF1			
11	1100					
12	1200	1-FFS	1-FF1	1-FFS		
13	1300					
14	1400		2-FF1			1-FF1
15	1500		1-FF1		1-FBR	1-FF1
			1-FF			
16	1600	1-FF1	5-FF1			1-FF
		1-FFS	2-FF			
17	1700		2-FF	1-FF1		
18	1800		3-FF1			
			1-FF			
19	1900		1-FF1	1-FF1		
20	2000		4-FF1	1-FF		
21	2100	1-FF1	3-FF1	2-FF1		1-FF1
			4-FF			
22	2200	3-FF1	5-FF1			1-FFS
		1-FF	1-FF			
		1-BOB				
23	2300	1-FF	4-FF1			1-FF1
		1-FFR	5-FF			
24	2400	2-FF1	2-FF1			
		1-FF				
25	2500	4-FF	4-FF1	1-FF1		1-FF1
			1-FF	1-FF		
26	2600	1-FF1	4-FF1	1-FF1		2-FFS
		2-FF				
27	2700	1-FF1	1-FF1	1-FF1		2-FFS
						1-FF
28	2800	1-FF1	4-FF1	1-FF1	1-FF	1-FF
		3-FF	1-FF			
29	2900	[b]5-FF	1-FF1	1-FF1		2-FFS
		1-FFS	1-FF	1-FF		
30	3000	-	5-FF1		1-FF	1-FF1
			2-FF			

[a]The bolt assist device was failing to engage the serrations on the bolt carrier each time the plunger was actuated.

[b]The bolt could not be forced to the locked position; therefore, the test was terminated.

Table I-IX. Cyclic Rate Data from Water-Spray Test, Rd/Min[a]

	Lubricant				
	Code A	VV-L-800	VV-L-800 with MIL-G-46003	NRL	MIL-L-46000A
	Rifle No.				
Cycle No.	46	48	49	51	54
2	780	808	816	898	826
4	756	792	822	[b]882	824
6	771	760	822	[b]873	833
8	765	736	834	854	830
10	734	674	783	852	782
12	[b]736	674	796	844	[b]767
14	[b]699	[b]650	788	832	758
16	[c] -	[b]604	756	832	751
18	660	[b]622	731	829	752
20	676	657	[b]691	800	728
22	[b]636	644	[b]643	804	699
24	[b]611	653	704	788	690
26	[b]602	[b]654	696	756	710
28	[b]657	[b]649	699	713	657
30	-	653	679	697	638

[a]The rates are an average of the first and last 20-round bursts of each automatic cycle, unless otherwise specified.
[b]The cyclic rate machine failed to record one of the bursts; therefore, data are for only one burst.
[c]The cyclic-rate machine failed to record either of the two 20-round bursts.

Table I-X. Performance Data for Schedule I Rifles
Lubricated with Code A

Note: Solid line indicates lubricant applied. Dotted line indicates Maintenance A performed.

Cycle No.	Rifle No. 1						Rifle No. 2							Rifle No. 3					
	FF1	FF	FFS	FTR	FJ	FFR	FF1	FF	FFS	FTR	FJ	FFR	FX	FF1	FF	FFS	FTR	FJ	FFR
1																			
2																			
3											1								
4																	1		
5																		3	
6				1						24	1							2	
7											5							1	
8										3							4		
9											2							1	
10				7										1					
11									1		1			1		1			
12			2	5						18				3					
13											1	2		4					
14	4			6			3			35				[b]4					
15					1		2	1			1	[a]2		2					
16	2													5					
17								1				4		3					
18	3											2		3			4		
19								[b]1				3							
20	2			2										4					
21							[c]1					2		4					1
22	1			5						9				4					
23	3												2	5					
24				3			3						1	5					
25	2	1												6					
26	3			1							1			5	1				
27	3										1		1	5	1			1	
28	4			9						24				2			1		

[a]Firing pin seized within bolt because of heavy residue build-up. Component parts very dry and heavily carboned.

[b]Had to strike butt plate of rifle on the shooting table to retract bolt. It was necessary to hit bolt assist with hammer handle to lock bolt on first round.

[c]The butt plate of rifle was struck on concrete floor, but could not retract bolt to load the first round. Code A was squirted directly from the can onto the bolt and carrier. After 40 minutes the bolt was finally opened and the rifle put back into the test.

Table I-X (Cont'd)

Cycle No.	Rifle No. 1						Rifle No. 2							Rifle No. 3					
	FF1	FF	FFS	FTR	FJ	FFR	FF1	FF	FFS	FTR	FJ	FFR	FX	FF1	FF	FFS	FTR	FJ	FFR
29	5												[e]1	5					
30	5			5						7			[e]2	5					
31	5		1											5					
32	4									1			1	4					
33	4										1		1	5				1	
34	4			8			1			3				3	1				
35	5						2				3			5					1
36	4						1			1				5	1				
37	4						3	1			3		[g]1	5	1				
38	5			2			4			12		1		5	3		3		1
39	2	1					2				3			4	1				4
40	3						1			10				3					
41	1					1	1				1			5				1	
42	5			26			1			23				5	3		19		
43	5						2				2			5	4				2
44	5			1			4			24				5	1		12		
45	4						5							5	3				
46	5						1			3				5	1				4
47	5	2					3				1			5	4				
48	4			1			1			5				5	16		6		
49	4						3				1								
50	3						1			11				2			3	1	
51							3	1			1			4		2			
52	1			12			[d]2			45				3			5		
53	4	2					[d]4				1	5		4					
54	5													4	2		9		
55	2													4					
56	3													5	1				
57	5													[f]4					
58	3													5	10				
59	4	2												4					
60	3													4					
Total	148	8	3	94	1	1	54	5	1	258	31	21	10	203	54	3	67	11	13

[d]After firing 60 rounds of the cycle, the bolt went forward to the locked position and could not be retracted. The test was terminated with this rifle.

[e]The bolt closed on the fired case and a screwdriver was required to unlock the bolt.

[f]The bolt assist device had to be used to strip the first seven rounds from the magazine.

[g]Removed with cleaning rod.

Total broken and damaged parts: One broken bolt ring.

Table I-XI. Performance Data for Schedule I Rifles Lubricated with VV-L-800

Note: Solid line indicates lubricant applied. Dotted line indicates Maintenance A performed.

Cycle No.	Rifle No. 4					Rifle No. 5							Rifle No. 6					
	FF1	FTR	FJ	BOB	FFR	FF1	FF	BOB	FTR	FFS	FFR	FBR	FF1	FF	FFS	BOB	FTR	FBR
1																		
2								1										
3			1															
4																	15	
5																1		
6																	42	
7			1															
8	1			1					1								36	
9																		
10									5									
11																		
12	1					1			3						1			
13			1										1					
14			1															
15													1					
16	3					3	1						3		1			
17						1												
18	1																1	
19																		
20	1	2				3	2	1										
21			1			2												
22		9				2							2				3	
23	1	1	1															
24	1	28				3							5					
25	2					3							5					
26	1	1				2				1			3					
27	1					4	3				[a]3		3					
28	1	3											1				8	
29	2					1							2					
30	2	17											5					
31	4					1												
32	3	14											5					
33	2					1							4					
34	4	25											5				10	
35	5		1										5					
36	4	29											5				5	
37	4		2	1									4					
38	5	37				2							4	2			5	

[a]Had to use screwdriver to unlock bolt after two of the failures-to-fire.

Table I-XI (Cont'd)

Cycle No.	Rifle No. 4					Rifle No. 5							Rifle No. 6					
	FF1	FTR	FJ	BOB	FFR	FF1	FF	BOB	FTR	FFS	FFR	FBR	FF1	FF	FFS	BOB	FTR	FBR
39	5												5					
40	2	14											4					
41	1												1					
42	5	51							1				5				13	
43	5		1		1	2					1		5					
44	5	32				2	1						5	1				
45	5												4					
46	5	16				1							5					1
47	5					1						1	5					
48	5	36											5					
49	5												5					
50	5	35											5					
51			1			2												
52		38				3											8	
53						3							1					
54		13				3											5	
55						4												
56		17				4	4										8	
57						[b]4							1					
58		5				1	2											
59													1					
60		10										1	3					
Total	102	433	11	2	1	59	13	2	10	1	4	2	123	3	2	1	159	1

[b]Maintenance A held at 5703 rounds; thereafter, no malfunctions occurred.

Total broken and damaged parts: Two broken bolt rings.

Table I-XII. Performance Data for Schedule I Rifles Lubricated with NRL

Note: Solid line indicates lubricant applied. Dotted line indicates Maintenance A performed.

Cycle No.	Rifle No. 7						Rifle No. 8				Rifle No. 9		
	FF1	FF	FFR	FJ	BOB	FBR	FF1	FF	FFR	FBR	FF1	FF	FFR
1													
2													
3													
4													
5													
6													
7													
8													
9				1									
10							[a]2						
11							-	4					
12	2							10					
13							1		[c]3				2
14	3						2	[b] 2					
15	2							1			2		
16	5	1	1					8	9		3		
17	3						4		2		1		2
18	5		1								3		
											[e]		
19	3						1		6				6
20	4								[d]8				[f]3
21	4						2		2				5
22	2										[g]1	1	2

[a] Had to strike butt plate of rifle on shooting bench in order to retract bolt to feed first round.

[b] Bolt could not be forced to the locked position with the bolt-closure device.

[c] With each failure-to-fire the bolt was unlocked with a screwdriver.

[d] With each failure-to-fire the receiver was opened and the weapon recocked manually; this procedure loosened the firing pin and the test was continued.

[e] The bolt could not be locked, therefore the weapon was lubricated. Lubrication failed to alleviate the condition, therefore Maintenance A was performed.

[f] Bolt had to be hand cycled several times before firing.

[g] The first two rounds failed to feed and upon attempts to fire, no indent occurred in the primers. Inspection showed the firing pin to be seized in position. The test was terminated.

Table I-XII (Cont'd)

Cycle No.	Rifle No. 7						Rifle No. 8				Rifle No. 9		
	FF1	FF	FFR	FJ	BOB	FBR	FF1	FF	FFR	FBR	FF1	FF	FFR
23	3												
24	2	1					4						
25	3						2						
26	5						3						
27	4			1			4						
28	3		1				4						
29	4	1					4						
30	4						5						
31	3	2					3						
32	5	1					3						
33	4						4						
34	4	2					5	1					
35	5	1					3						
36	2	1					1	1					
37	5	1	1				5	2					
38	5	7			2		5	2					
39	5						5	1					
40	4	2					2	2					
41	2						3			1			
42	4	1					5	5					
43	5	1					5						
44	5						5	2					
45	5						5						
46	5	1	1				5	3					
47	5	2					5						
48	5		1				5	4					
49	5	1							4				
50	5	12					1						
51							4						
52	3						3	1					
53	4		1				4	1					
54	3	1		1			2	1					
55	4						4						
56	4	2				1	5	4					
57	5						5	4					
58							5	4					
59	2						5						
60	5	1					5	11					
Total	179	42	7	3	2	1	155	74	34	1	10	1	20

Total broken and damaged parts: One bolt ring and one extractor pin.

Table I-XIII. Performance Data for Schedule I Rifles
Lubricated with MIL-L-46000A

Note: Solid line indicates lubricant applied.

Cycle	Rifle No. 10				Rifle No. 11				Rifle No. 12					
No.	FF1	FF	FFS	FTR	FF1	FF	FFS	BOB	FF1	FF	FTR	FJ	BOB	FX
1														
2														
3														
4											3			
5														
6				5										
7														
8				1							2			
9														
10														
11														
12	1								1		25	1		
13														
14							1							
15														
16	3								1					
17	1							1		1		1		
18	1													
19														
20	2										3			
21	2													
22	2			1										
23														
24	1								1					
25	3		1		1			1	1					
26	4								4	1				
27	3								2			1		
28	3								1					
29	5								2					
30	2				1				3					
31	2						1		2					
32	4								1					
33	4								4					
34	4				2				2					
35	5								2					
36									2	3				
37	5				1				5					
38	4				1				2					
39	4								5	1				
40	3								2					
41	4								3					

Table I-XIII (Cont'd)

Cycle No.	Rifle No. 10				Rifle No. 11				Rifle No. 12					
	FF1	FF	FFS	FTR	FF1	FF	FFS	BOB	FF1	FF	FTR	EJ	BOB	FX
42	4				1	1			3					
43	5				1				5					
44	4				4				5					
45	5				5				4					
46	5	1			2				4					
47	5				3				5					
48	4				3				5					
49	5				2				5	3				
50	5			1	3		1		5	2				
51													1	
52														
53														
54													1	
55														[a]1
56														
57												1		
58														
59														
60												1	1	
Total	114	1	1	8	30	1	3	2	87	11	33	5	3	1

[a]Attributed to a broken extractor spring.

Total broken and damaged parts: One extractor spring and one extractor pin.

Table I-XIV. Performance Data for Schedule II Rifles Lubricated with Code A

Note: Solid line indicates scheduled 1000-round maintenance.

Cycle No.	Rifle No. 13						Rifle No. 14				Rifle No. 15						
	FF1	FF	BOB	FTR	FFR	FJ	FF1	FF	FFR	FTR	FF1	FF	FFS	FTR	FFR	FJ	FX
1											1						
2																	
3																	
4																	
5																	
6	1									7							
7					1												
8				5									1	2			
9						1					1						
10				5						48	1				2		
11															1		
12						1											
13																	
14	2					3											
15																1	
16	4			2			2										
17																	
18	4			3	1		4				2						
19	2										1						
20	2						1										
21			1			1											
22																	
23																	
24	2						2			5	3						
25	1					1					1						
26	2	5		3			1	3			4						
27	1						1				1						
28				5	1					7							
29	2	1					2				1						
30	5	7		4			1										
31																	
32	1								1								
33	2					2											
34	5			6						15	2					1	
35	4					1					1						
36	4			3						5							
37	5										3						1
38	2			13						29				7			
39	5					1					4						
40	3			15			1			18	1			16			

Table I-XIV (Cont'd)

Cycle No.	Rifle No. 13						Rifle No. 14				Rifle No. 15						
	FF1	FF	BOB	FTR	FFR	FJ	FF1	FF	FFR	FTR	FF1	FF	FFS	FTR	FFR	FJ	FX
41						1											
42																	
43	1						4				1						
44	1						1										
45	2	1					4										
46				2		1				2							
47	4	1				2	3	1	1								
48	3			6		1	3	1		8							
49	3						4				4						
50	2	1		10			4	2		8	1			2			
51																	
52	4						4										
53	1	1															
54	5	1					5	1			3						
55	1	2						1									
56	5	3					5				4	1					
57	3						4				1						
58	5	4					4	4		1	1	2					
59	1	1					5				3	2					
60	1	2					5	5				2					
Total	101	30	1	82	3	16	70	18	2	153	45	7	1	27	3	2	1

Total broken and damaged parts: One broken bolt ring.

Table I-XV. Performance Data for Schedule II Rifles Lubricated with VV-L-800

Note: Solid line indicates scheduled 1000-round maintenance.

Cycle No.	Rifle No. 16			Rifle No. 17					Rifle No. 18			
	FF1	FTR	BOB	FF1	FF	FTR	BOB	FJ	FF1	FTR	FFR	FBR
1												
2		5										
3												
4		3								25		
5												
6		38								11		
7												
8		81								17		
9												
10	1	8		1			1			6		
11												
12												
13					[a]1							
14				1			1	1		1		
15												
16		15				3						
17												
18												
19								1				
20						1						
21			1									
22												
23												
24		3										
25											1	
26												
27												
28						3						
29												
30						3						
31								1				
32												
33												
34	1							1				
35								1				
36						1						
37												
38						24						
39												
40		3				2						

[a]The round was damaged in feeding.

Table I-XV (Cont'd)

Cycle No.	Rifle No. 16			Rifle No. 17					Rifle No. 18			
	FF1	FTR	BOB	FF1	FF	FTR	BOB	FJ	FF1	FTR	FFR	FBR
41												
42												
43												
44												
45												
46						5						
47												1
48						11						
49									2			
50						18						
51												
52						2						
53												
54												
55												
56	1											
57												
58												
59	1							1	1			
60												
Total	4	156	1	2	1	73	2	6	3	60	1	1

Total broken and damaged parts: One broken extractor spring.

Table I-XVI. Performance Data for Schedule II Rifles Lubricated with NRL

Note: Solid line indicates scheduled 1000-round maintenance.

Cycle No.	Rifle No. 19						Rifle No. 20					Rifle No. 21		
	FF1	FF	FFS	FFR	BOB	FX	FF1	FFS	BOB	FBR	FJ	FF1	FF	FFS
1								2						
2									1					
3														
4														
5			1											
6														
7					1									
8														
9														
10							1							
11				[a]1										
12			1						1					
13														
14														
15														
16														
17						1						2		
18						[b]4								
19												3		
20	1											1		
21														
22														
23														
24														
25	1													
26	1						1							
27					1		1		1					
28														
29							1			1				
30														
31					3									
32					1									
33					2									
34												1		
35		[c]2									1		1	
36											1	2		
37	2						2					2		
38			1									1		
39							4				1	4		
40						[b]2								

[a]The firing pin was seized in the bolt and the bolt could not be closed by using the bolt closing device.
[b]The extractor spring was damaged or broken.
[c]Damaged rounds of ammunition.

Table I-XVI (Cont'd)

Cycle No.	Rifle No. 19						Rifle No. 20					Rifle No. 21		
	FF1	FF	FFS	FFR	BOB	FX	FF1	FFS	BOB	FBR	FJ	FF1	FF	FFS
41														
42											1			
43														
44														
45														
46	1													
47	3											3		
48							2							
49	1						1					3		
50	2					d_						4		
51					3									
52	1											1		
53					1									
54	1				1	b1	1					3	1	
55														
56	3	1					3					4	1	
57	2						2					2		
58	2	1										1	1	
59	5											3		
60	2											1	2	
Total	28	4	3	1	13	8	19	2	3	1	4	41	6	-

[b]The extractor spring was damaged or broken.
[d]The extractor pin was broken.

Total broken and damaged parts: Three extractor springs, one extractor pin, and one bolt ring.

Table I-XVII. Performance Data for Schedule II Rifles Lubricated with MIL-L-46000A

Note: Solid line indicates scheduled 1000-round maintenance.

Cycle No.	Rifle No. 22					Rifle No. 23	Rifle No. 24		
	FF1	FF	FFS	BOB	FX	FFR	FF1	FTR	FX
1									
2									
3									
4								5	
5									
6								7	
7			2	1					
8								2	
9									
10									
11						[a]1			
12									1
13									1
14									
15									
16									1
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31				1					
32									
33									
34									
35									
36									
37		[b]1							
38									
39									
40							1		

[a]The hammer pin backed out and caused the failure to fire.
[b]Damaged round of ammunition.

Table I-XVII (Cont'd)

Cycle No.	Rifle No. 22					Rifle No. 23	Rifle No. 24		
	FF1	FF	FFS	BOB	FX	FFR	FF1	FTR	FX
41									
42									
43									
44									1
45									
46									
47									1
48									
49									
50									
51									
52									
53									
54	1								
55					[c]1				
56							1		
57									
58									
59									
60									1
Total	1	1	2	2	1	1	2	14	6

[c]The extractor spring was broken.

Total broken and damaged parts: Two extractor springs and two bolt rings.

Table I-XVIII. Rust-Rate Data on Schedule I Rifles from Reliability Test

Gun No.	Rifle Part: Automatic Sear	Disconnector	Trigger[a]	Bolt Carrier	Bolt Cam Pin	Firing Pin Retaining Pin	Bolt	Barrel[b]	Dust Cover	Magazine Spring[c]
Lubricant: Code A.										
1	5/ds /5	0.60/dsA/4-5	0.60/d /6	0.90/dsa/4-5	1 / A/5	0.40/dsa/3	4 /ds /6	0.50/dsa/7-8	0.90/dsa/6-7	0.60/dsa/6
2	6/ds /5	0.25/dsa/4-5	0.20/dsa/5	0.90/dsa/4	0.90/ a/6	0.30/dsa/4	0.80/dsa/4-5	0.40/dsa/4	0.70/ds /8	0.30/dsa/6
3	1/dsa/6-7	0.20/dsa/5	0.60/ds /7-8	0.90/dsa/6	0.95/dsa/6	0.20/dsa/3-4	0.90/dsa/6	0.60/dsA/5	1 /ds /8-9	8 /d /7
Lubricant: VV-L-800.										
4	10	0.80/ds /7	0.60/ds /5	1 /dsa/4	4 /ds /5	0.70/ds /4-5	3 /dsa/5	0.30/dsA/7	0.90/dsa/8	5 /ds /7
5	10	0.60/dsa/7	0.90/ds /6	8 /ds /6	1 /ds /7	1 /ds /7	10	0.80/dsA/9	7 /ds /8	10
6	10	0.60/ds /6-7	0.40/ds /6-7	0.99/dsa/4-5	6 /ds /8-9	0.60/ds /7-8	3 /ds /4-5	0.60/dsa/7-8	10	3 /ds /7-8
Lubricant: NRL.										
7	10	3 /ds /7-8	9.5 /d /9	8 /d /9	3 / A/6-7	0.90/ds /7-8	8 /ds /9	0.60/dsa/7-8	0.90/dsa/6-7	10
8	10	7 / a/6	0.90/dsa/4-5	1 /ds /8	3 /ds /7	0.70/dsa/5	7 /ds /9	0.30/dsa/8	0.95/ds /8	0.90/dsa/7
9	10	10	10	8 /ds /7	0.85/dsa/5	0.80/dsa/4	0.75/dsa/4	0.30/dsA/7	7 /ds /8	1 /dsa/7-8
Lubricant: MIL-L-46000A.										
10	9/d /9	0.50/ds /6-7	3 /ds /6	2 /ds /9	9 /d /9	1 /ds /7	7 /ds /8	0.40/dsa/4-5	5 / a/4-5	10
11	10	3 /dsa/7	4 /ds /7	9 /d /8	5 /d /9	8 /d /9	5 /ds /8	0.30/dsA/8	10	10
12	10	0.90/ds /7-8	5 /ds /6-7	8 /ds /9	0.90/ds /7-8	0.90/ds /7-8	10	0.40/dsa/6-7	10	10

[a]Rust rating was determined only on sear area of trigger.
[b]The hand guards were removed and the rust rating determined on the barrel area beneath the hand guards.
[c]The rust accumulation on the springs from three magazines with each type lubricant was rated.

Table I-XIX. Rust-Rate Data on Schedule II Rifles from Reliability Test

Gun No.	Rifle Part: Automatic Sear	Disconnector	Trigger[a]	Bolt Carrier	Bolt Cam Pin	Firing Pin Retaining Pin	Bolt	Barrel[b]	Dust Cover
Lubricant: Code A.									
13	10	0.50/dsa/7	10	5/dsa/6	1/dsa/6	0.99/ds /7	10	3 / A/7	0.90/dsa/7
14	1/dsa/8	0.60/dsa/7	10	10	10	0.80/dsa/7	10	0.80/dsa/7	10
15	10	0.50/dsa/7	10	10	10	0.60/dsa/8	10	0.70/dsa/7	0.90/dsa/8
Lubricant: VV-L-800.									
16	10	0.45/dsa/7	10	5/ds /8	10	10	10	0.80/dsa/8-9	0.70/dsa/7-8
17	10	10	10	10	10	10	10	0.99/d /9	9 /d /9
18	3/ds /7	0.50/dsa/4	10	10	10	0.70/dsa/8	10	0.95/dsa/7	9
Lubricant: NRL.									
19	10	10	10	10	10	10	10	1 /A /7-8	0.90/dsa/6-7
20	10	10	10	10	10	10	10	0.70/dsa/8-9	10
21	10	10	10	6/ A/6	10	2 /ds /8	10	0.50/ds /5-6	10
Lubricant: MIL-L-46000A									
22	10	10	10	10	10	9 /ds /8	10	0.90/dsa/7-8	0.99/dsA/7
23	10	10	10	10	10	9 /ds /9	10	0.70/dsa/6	10
24	10	0.90/ds /7	9/d /9	10	10	0.70/dsa/7	10	0.40/dsa/4-5	10

[a]The rust rating was determined only on the sear area of the trigger.
[b]The hand guards were removed and the rust rating was determined on the barrel area beneath the hand guards.

Table I-XX. Cyclic-Rate Data from Reliability Test, Rounds per Minute

SCHEDULE I

Cycle Number	MIL-L-46000A			VV-L-800			Code A			NRL		
	Rifle Number											
	10	11	12	4	5	6	1	2	3	7	8	9
1	825	775	780	811	759	756	746	776	768	825	775	780
5	908	851	876	894	872	854	867	835	886	908	851	876
9	908	853	881	933	911	871	901	844	841	908	853	881
15	876	821	862	883	827	811	875	825	815	877	821	862
19	868	831	882	861	797	808	872	-	800	868	831	882
25	877	834	866	881	795	813	857	840	812	877	834	866
29	851	814	807	878	858	826	866	869	804	851	814	807
35	884	854	856	856	834	828	875	818	791	884	854	856
39	879	839	868	876	844	816	887	821	800	879	839	868
45	858	806	852	853	812	816	851	825	770	858	813	852
49	878	808	829	848	821	806	844	827	868	878	808	829
55	928	873	874	921	808	871	863	-	815	928	873	875
59	926	881	911	891	836	843	862	-	790	924	882	911
Average	882	834	857	876	829	825	859	828	812	882	834	857
Average for Lubricant		858			843			833			858	

SCHEDULE II

Cycle Number	MIL-L-46000A			VV-L-800			Code A			NRL		
	Rifle Number											
	22	23	24	16	17	18	13	14	15	19	20	21
1	788	770	781	804	783	746	775	788	731	889	869	775
5	926	845	831	881	893	820	854	834	857	865	897	807
9	902	815	840	831	884	792	818	838	816	921	907	839
15	914	882	801	844	887	788	857	809	841	870	883	801
19	902	842	817	860	860	799	831	805	866	906	882	784
25	898	848	825	881	871	782	834	843	858	899	890	799
29	920	867	883	877	875	796	-	849	869	909	872	826
35	904	895	819	878	864	780	841	853	846	908	902	841
39	899	901	841	882	857	814	841	869	854	933	881	817
45	871	893	842	908	898	785	861	820	842	896	882	808
49	845	871	823	882	854	752	854	800	832	871	870	752
55	882	875	821	893	870	757	867	846	834	889	895	791
59	878	879	831	885	861	753	879	805	876	874	896	792
Average	887	860	827	870	866	782	843	828	840	895	887	802
Average for Lubricant		858			839			837			861	

Table I-XXI. Rifle-Performance Data for Sequential-Test Series

Rds Fired	Cumulative Total	Number of Malfunctions																			
		Code A					VV-L-800					NRL					MIL-L-46000A				
		Rifle Number																			
		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Test Phase: Salt-water immersion.																					
140	140	2-FJ		1-FF1						32-FTR									4-FTR	22-FTR	
140	280	2-FTR 1-FJ		3-FF1			8-FTR			33-FTR			1-FX	1-FF1			1-FJ		5-FTR	40-FTR	1-FF1 1-FTR
Test Phase: Sand drag.																					
140	420									3-FTR	23-FTR	1-FTR				2-FX				1-FJ 1-FX	
140	560	1-FF1 1-FJ			2-FJ 1-BOB	2-FF1				2-FTR	5-FTR		2-FX	1-FF1		2-FF1 1-FF				3-FX	2-FF1
Test Phase: Water spray.																					
100	660		3-FTR				[a]1-FFR	[a] 1-FFR 4-FTR	2-TS	72-FTR 2-TS	1-FF 1-TS		1-FF1					1-TS 4-FTR	2-FTR		1-FTR
100	760	2-TS		1-TS	2-FJ 1-TS	1-FF1 2-TS		2-FF1	1-FF1 1-TS	2-TS	3-FF1 3-FF 2-TS							1-BOB 1-TS	1-FF1		
100	860	78-FTR	1-FF1 17-FTR	1-FF1 1-FF	1-TS	1-FF1	2-TS	1-FF1	1-FF1 13-FF 2-TS	1-FF1 2-FF 1-TS 63-FTR	1-FF1 8-FF Maint. A 2-TS				1-FF1		1-FF1	1-TS 9-FTR		1-FF1 2-FTR	2-FF1
100	960	1-FF1 1-TS	1-TS	2-FF1 1-FBA 2-TS	3-FF1 1-FBA 1-FJ 1-TS	1-FF1 1-TS		2-FF1	2-TS	2-FF1 1-TS	2-TS						1-FF1	1-TS		1-FF1	3-FF1
100	1060	84-FTR 1-TS	1-FF 10-FTR 1-TS	4-FF 1-FBA 2-TS	1-FF1 1-TS	1-TS		[a] 2-FFR	12-FF Maint. A 2-TS	1-FF1 4-FF 1-FBA 2-TS	4-FF 1-TS						1-FF	1-TS	1-FF1	1-FTR	5-FF1
100	1160	2-TS	2-TS	5-FF 1-FBA [b]Maint. A 2-TS		1-TS	1-TS	5-FF1 1-TS	1-TS	4-FF1 1-FBA 1-TS	1-FF1 3-FF 1-FBA 2-TS							1-TS			4-FF1 2-FF

See footnotes on page I-38.

Table I-XXI (Cont'd)

Rds Fired	Cumulative Total	Number of Malfunctions																			
		Code A					VV-L-800					NRL					MIL-L-46000A				
		Rifle Number																			
		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Test Phase: Dust test.																					
140	1300	2-FF1 2-TS	2-FF1 3-TS	2-FF1 3-TS	1-FF1 1-FJ 2-TS	1-FF1 1-FBA 2-TS	2-TS	2-FF1 1-FBA 3-TS	5-FF1 5-FF 1-FFS 2-TS	3-TS 1-FTR	1-FX 2-TS	3-FTR	2-FF1 1-FJ 1-FX		1-FF1	4-FF1	1-FJ	[c] 1-FF 3-TS			5-FF1
140	1440	1-TS	3-TS	2-FF1 2-FF 1-FBA 3-TS		3-FF1 1-TS	3-TS	6-FF1 26-FF 3-TS	19-FF 1-FBA 1-FX 2-TS	1-FF1 1-FX 1-FTR 3-TS	4-FF1 12-FF 2-FX 3-TS	1-FF	5-FF1 3-FX	1-FF1 1-FF	6-FF1	7-FF1 2-FF 1-FX		2-TS	1-FF1 4-FX 1-FJ	2-FF1	1-FF1
Test Phase: Mud test.																					
140	1580	3-FF 1-FBA [d]Maint. A 12-FTR	5-FF Maint. A 3-FF 1-FX Maint. B 3-TS	1-FF 2-BOB 1-FJ 1-FX Maint. A 3-TS	5-FF1 2-FF 1-FBR 1-BOB 19-FTR 1-TS	5-FF [b]Maint. A 3-TS	4-FF [b]Maint. A 3-TS	2-FF 1-FBA [b]Maint. A 2-FF1 1-FX 3-TS	1-FF1 3-FF 1-FBR 1-FJ Maint. A 3-TS	1-FF1 1-FTR 1-FBA Maint. A 1-FF1 3-TS	4-FF 1-FBA Maint. A 2-TS	2-FF1	5-FF1	4-FF1 1-FF 1-BOB	5-FF1 7-FF	5-FF1	4-FF [b]Maint. A	4-FF 3-TS	4-FF [b]Maint. A 2-TS	3-FF1 1-FF 1-FBR 2-TS	10-FF 1-FBR [b]Maint. A 2-TS
140	1720	2-FF1 39-FTR	2-FF1 1-FF 3-TS	3-TS	4-FF1 1-FF 33-FTR 1-TS	1-FF1 1-FF 33-FTR 3-TS	3-TS	1-FF1 3-TS	1-FF1 1-FTR 2-TS	1-FX 2-TS	3-TS	4-FF1 30-FTR	7-FF1 1-FF 4-FX	2-FF1	7-FF1	7-FF1	1-FF1 1-FX 1-TS	18-FTR 2-TS	1-FF 3-FX	2-FF1 3-TS	2-FF1 1-FTR 3-TS
Test Phase: Reliability.																					
80	1800	2-TS	1-TS	1-FF1 2-TS	1-FJ 1-TS	1-TS	2-TS	2-TS	2-TS	1-FF1 2-TS	2-TS		1-FX		1-FF1		1-FF1 1-FJ 2-TS	1-FF1 1-FBA	1-TS	1-FF1	1-TS
100	1900	2-FF 1-TS	1-FF1 2-TS	3-FF1 2-TS	1-FF1	2-FF1 1-TS	2-TS	4-FF1 6-FF 2-TS	2-FF1 1-FF 1-TS	3-FTR 2-TS	2-FF1 2-TS		2-FF1 1-FX	3-FF1	1-FF	3-FF1 1-FF 1-FBA		2-TS			2-FF1 1-TS
100	2000	1-FF1 7-FF 2-TS	1-FF 1-TS	2-FF1 2-TS	1-FF1	1-FF1 2-TS	2-TS	1-FF1 2-TS	3-FF1 5-FF 1-TS	1-FF1 2-TS	2-FF 1-TS	4-FF 1-FBA	1-FF1 3-FX	2-FF1	3-FF1 1-FF	6-FF Maint. A	1-FJ 1-TS	2-TS	2-FX		1-TS

See footnotes on page I-38.

Table I-XXI (Cont'd)

Rds Fired	Cumulative Total	Number of Malfunctions																			
		Code A					VV-L-800					NRL					MIL-L-46000A				
		Rifle Number																			
		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
100	2100	5-FF 1-FBA Maint. A 2-TS	4-FF 1-FBA [d]Maint. A 2-TS	4-FF1 1-FF 2-TS	1-FF1 1-FF 1-TS	5-FF1 1-FBA 2-TS	4-FF1 4-FF 2-TS	6-FF Maint. A 1-FF1 1-FF 2-TS	1-FF1 6-FF Maint. A 1-TS	5-FF1 2-FF 4-FTR 1-FBA 1-TS	6-FF 2-FTR Maint. A 2-FF1 1-FTR 2-TS	6-FF Maint. A	3-FF1 3-FX 1-FJ	3-FF1 1-FF 5-FTR	5-FF1	3-FF1 1-FF	1-FF1 1-TS	1-TS	1-FX	1-FFR 2-FTR 1-TS	
100	2200	5-FF 2-TS	2-TS	4-FF1 1-FBA 2-TS	2-FF1 1-FJ 1-TS	3-FF1 1-FBA 1-TS	1-FF 2-TS	2-TS	2-TS	2-TS	2-TS	2-FF1 2-FF			3-FF1	1-FF1 6-FF Maint. B	2-TS	2-TS	1-FJ 1-TS	1-FFR 1-TS	1-FF1 1-TS
100	2300	5-FF [b]Maint. B 1-FF1 1-TS	1-FF1 2-FF 2-TS	1-FF1 4-FF Maint. A 1-FF1 1-TS	3-FF1 1-FF 1-FJ	5-FF [b]Maint. A 3-FF1 2-TS	6-FF Maint. A 2-TS	3-FF1 10-FF	6-FF Maint. B 1-TS	4-FF1 3-FF 1-FTR 2-TS	3-FF 6-FF 2-TS	1-FF1 2-FF	3-FF1 2-FX	3-FF1 4-FTR	3-FF1	3-FF1 1-FF	1-FF1 1-TS	1-TS 4-FTR	1-FF1 1-FX	1-FF1 3-FF 1-FTR 2-TS	2-FF1 1-TS
100	2400	5-FF [b]Maint. C 2-TS	1-FF1 2-TS	2-TS	4-FF1 1-FF 1-FJ 1-TS	1-FF1 1-TS	2-TS	4-FF1 1-FBA 2-TS	[f] -	5-FF1 5-FF 1-FBA 1-FJ 2-TS	5-FF1 2-FF 1-FFR 2-TS	2-FF1 4-FF [b]Maint. B	1-FF1	1-FF1	4-FF1	4-FF1 1-FF	2-TS	2-TS		1-FF1	3-FF 1-TS
100	2500	4-FF1 22-FF 1-FBA 2-TS	5-FF Maint. B 2-TS	5-FF Maint. B 2-TS	5-FF1 1-FTR 1-TS	1-FF1 4-FF Maint. B 1-FF1 2-TS	4-FF1 1-FBA 2-TS	6-FF Maint. B 2-TS		1-FF1 6-FF Maint. A 2-TS	6-FF Maint. B 1-TS		3-FF1 1-FF 1-FBA 1-FX	2-FF1 1-FF	5-FF1	5-FF1 9-FF Maint. C	2-FF1 1-TS	5-FTR 2-TS	1-FF1 1-FF 1-FX	1-FF1 5-FF 1-FFR 2-TS	2-FF1 5-FF
100	2600	3-FF1 4-FF 2-TS	2-TS	1-FF1 2-TS	5-FF1 1-FJ 2-TS	1-FF1 1-FBA 2-TS	1-FF1 2-TS	2-TS		2-TS	2-TS	1-FF1 1-FF 1-FBA [b]Maint. C	3-FF1 1-FX	2-FF1	4-FF1 1-FF		1-FJ 2-TS	2-TS	2-FX	1-FF 2-TS	1-FF1
100	2700	5-FF1 26-FF1 2-TS	2-FF1 1-FF 2-TS	4-FF1 1-FF 2-TS	5-FF1 1-TS	1-FF1 7-FF Maint. C	4-FF1 5-FF 2-TS	4-FF1 2-FF 1-FBA 1-TS		3-FF1 1-FBA 1-FTR 2-TS	4-FF1 4-FF 2-TS	1-FF1 4-FF 1-FFR	4-FF1 1-FX 1-FJ	2-FF1 1-FF	5-FF1 [c]1-FF 1-FFR	3-FF1	3-FF1 2-TS	5-FF 1-FBA 1-FFR 2-TS	2-FF1 1-FX	1-FF1 5-FF Maint. A 1-TS	3-FF1 2-FF 1-TS

See footnotes on page I-38.

Rds Fired	Cumu-lative Total	Number of Malfunctions																			
		Code A					VV-L-800					NRL				MIL-L-46000A					
		Rifle Number																			
		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
100	2800	S-FF1 3-FF 2-TS	3-FF1 4-FF 2-TS	3-FF1 [e]Maint. C 2-TS	5-FF1 2-TS	2-FF1 2-TS	2-FF1 2-TS	4-FF1 2-TS		2-FF1 2-TS	3-FF1 4-FF 2-TS	1-FFR	5-FF1 2-FFR 1-FBA	3-FF1 1-FF [g]Maint. A Maint. B Maint. C	5-FF1	4-FF1 1-FF	1-FF1		1-FX	1-FFR [b]Maint. B 1-TS	1-FF1 5-FF Maint. A 1-FF1
100	2900	S-FF1 34-FF 1-TS	5-FF1 2-FF 2-TS	2-TS	5-FF1 1-FF 1-FBA 1-TS	5-FF1 2-FF 2-TS	4-FF1 1-TS	5-FF1 10-FF 2-TS		4-FF1 3-FF 2-FTR 2-TS	6-FF Maint. C 2-TS		5-FF1 1-FF 5-FTR		5-FF1	5-FF1 7-FF	2-FF1	3-FF1 1-FBA 2-TS	2-FF1 2-FX	1-FFR [b]Maint. C	
100	3000	4-FF1 10-FF 2-TS	4-FF1 10-FF 2-TS	2-FF1 2-TS	5-FF1 2-TS	4-FF1 7-FF 2-TS	4-FF1 1-FF 2-TS	5-FF1 2-FF 2-TS		4-FF1 2-TS	1-FF1 2-TS	4-FF1 8-FF [h]5-FFR	5-FF1 [h]4-FFR	[i]1-FF	4-FF1	5-FF1 6-FF	1-FJ		1-FX	1-TS	

[a]The hammer failed to remain in the cocked position and followed the bolt in closing.
[b]The bolt could not be forced to the closed position.
[c]The round was damaged, which caused the failure-to-feed.
[d]The bolt assist device would not engage the bolt carrier to clear the failures-to-feed.
[e]The bolt could not be forced to the closed position, attributed to seizure.
[f]The selector was seized and when tapped to the semiautomatic position the tang broke. A new selector was installed and the same thing occurred. The detent and spring that engage the selector were also partially seized. The rifle was removed from test.
[g]The firing pin was seized which prohibited locking of the bolt. Maintenance A, B and C had to be performed in order to free the firing pin.
[h]Failures-to-fire attributed to partial seizure of the firing pin. All had light indents.
[i]Attributed to magazine malfunction.

Table I-XXII. Cyclic-Rate Data from Sequential-Test Series, Rd/Min

Previous No. Rounds Fired	Test Phase	Lubricant: MIL-L-46000A, Rifle No. 40	41	42	43	44	VV-L-800, Rifle No. 30	31	32	33	34
35	-	821	824	787	768	710	790	803	762	781	738
660	Water spray	774	817	751	734	701	739	679	651	627	588
1060	Water spray	671	751	669	683	577	754	610	635	537	566
1720	Reliability	869	805	848	797	784	800	612	766	776	723
2300	Reliability	870	828	841	815	822	810	756	[a] -	729	739
2900	Reliability	799	833	787	823	795	802	776	[a] -	759	790
Average		801	810	780	770	732	782	706	704	702	691
Average for Lubricant				779					717		

Previous No. Rounds Fired	Test Phase	Lubricant: Code A, Rifle No. 25	26	27	28	29	NRL, Rifle No. 35	36	37	38	39
35		829	757	792	804	768	839	795	796	798	765
660	Water spray	766	646	646	780	703	781	824	-	828	841
1060	Water spray	739	584	707	761	681	730	768	791	732	773
1720	Reliability	791	766	757	818	813	842	836	817	860	821
2300	Reliability	799	745	771	837	817	861	853	797	843	801
2900	Reliability	774	756	814	810	808	-	788	726	771	-
Average		783	709	748	802	765	811	811	785	805	800
Average for Lubricant				761					802		

[a]Testing was terminated with this rifle at 2300 rounds.

Table I-XXIII. Rifle-Function Data from Phase 1 (M14 Rifles)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
Lubricant: Code A.				
Rifle No.: 1.				
4	4	Semi	3-FF	
			1-FJ	BGL.
1	5	Semi	1-FF	The first round fired but the bolt failed to close in feeding the next round. It was necessary to use a wooden hammer handle to retract the bolt and clear the weapon. A clean magazine was inserted and the next attempt to fire was made without dusting the weapon.
1	6	Semi	1-FJR	It was necessary to use a wooden hammer handle to retract the bolt and clear the weapon. The case was caked with dust.
Rifle No.: 2.				
1	1	Semi	1-FF	The first round fired, but the bolt failed to close completely in feeding the next round. The bolt was retracted to extract the round and it was necessary to use a plastic hammer to close it after clearing. The next attempt to fire was made without dusting the weapon.
1	2	Semi	1-FJ	BGL.
2	4	Semi	1-FF	A clean magazine was inserted.
			1-FJ	The case was caked with dust.
Rifle No.: 3.				
8	8	Semi	2-BCOEC	
			1-FJ	BGL.

Table I-XXIII (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
4	12	Semi	2-FF	A clean magazine was inserted before firing. It was necessary to use a plastic hammer to close the bolt on the first failure, but the bolt could not be closed after the second failure to feed.
Lubricant: VV-L-800. Rifle No.: 4				
1	1	Semi	1-FF	The bolt failed to close completely in feeding the second round. The round remained in the chamber when the bolt was retracted.
2	3	Semi	2-FJR	On both occasions the bolt lacked sufficient energy for the case to clear the chamber and the bolt stopped in a partially closed position. The cases were caked with dust. BGL.
4	7	Semi	4-FJR	Same as previous failures to eject.
			5-FF	On each occasion it was necessary for the gunner to force the bolt to the closed position.
Rifle No.: 5.				
3	3	Semi	1-BCOEC	The next attempt to fire was made without dusting.
1	4	Semi	1-BCOEC	BGL.
2	6	Semi	2-BCOEC	It was necessary for the gunner to force the bolt closed on both occasions.
Rifle No.: 6.				
3	3	Semi	1-BCOEC 1-FJ	BGL.

Table I-XXIII (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
2	5	Semi	2-BCOEC	A clean magazine was inserted. On the second occasion it was necessary to use a wooden hammer handle to open the bolt.
Lubricant: NRL.				
Rifle No.: 7.				
20	20	Semi	Satis	
20	40	Semi	1-BCOEC	
20	60	Burst	Satis	
12	72	Burst	1-FX	It was necessary to use a wooden hammer handle to retract the bolt.
			2-BCOEC	BGL.
				A clean magazine was inserted.
20	92	Burst	Satis	
20	112	Burst	Satis	
20	132	Auto	Satis	
3	135	Auto	1-FFR	There was a light indent in the primer.
			1-BCOEC	
Rifle No.: 8.				
8	8	Semi	2-BCOEC	
1	9	Semi	1-FJ	The case was caked with dust. BGL.
				A clean magazine was inserted.
1	10	Semi	1-BCOEC	
Rifle No.: 9.				
4	4	Semi	2-FF	On both occasions, the bolt failed to close completely.
			1-BCOEC	BGL.
				A clean magazine was inserted.

Table I-XXIII (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
3	7	Semi	2-FF	The bolt was partially closed on an empty chamber.
			1-BCOEC	
Lubricant: MIL-L-46000A.				
Rifle No.: 10.				
20	20	Semi	1-BCOEC	
20	40	Semi	Satis	
60	100	Burst	Satis	
20	120	Auto	Satis	
2	122	Auto	1-FF	
			1-FJ	BGL.
4	126	Auto	3-FF	
			1-BCOEC	
			1-FF	The gunner could not force the bolt to lock.
Rifle No.: 11.				
20	20	Semi	Satis	
2	22	Semi	1-BCOEC	
			1-FJ	BGL.
				A clean magazine was inserted.
3	25	Semi	2-BCOEC	
			1-FF	The gunner could not force the bolt to lock.
Rifle No.: 12.				
6	6	Semi	1-FTR	Occurred on first round.
			4-BCOEC	BGL.
				A clean magazine was inserted.
21	27	Semi	2-FF	
			7-BCOEC	

Table I-XXIV. Rifle-Function Data from Phase 1 (M16A1 Rifles)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
Lubricant: Code A.				
Rifle No.: 111.				
40	40	Semi	Satis	
60	100	Burst	3-FFI	
3	103	Auto	2-FF 2-FX	The first failure to extract was readily cleared, but a cleaning rod had to be used to remove the second fired case. The dust was stopped to clear the second malfunction. BGL.
10	113	Auto	2-FF 1-BOB	The dust was stopped and the magazine was removed to clear the second FF and the BOB.
20	133	Auto	Satis	A clean magazine of ammunition was inserted.
7	140	Auto	Satis	Remaining seven rounds from previous magazine.
Rifle No.: 112.				
40	40	Semi	Satis	
60	100	Burst	1-FFI 1-FX	The FX occurred after approximately 15 rounds of the burst firing. Dust was stopped to clear the malfunction which was readily clearable.
3	103	Auto	1-FFI 2-FF 1-FX	The fired case was removed with cleaning rod. BGL.
37	140	Auto	Satis	

Table I-XXIV (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
Rifle No.:	113.			
40	40	Semi	Satis	
41	81	Burst	1-FX	The FX occurred on the first round fired from the third magazine. The dust was stopped and the fired case was readily extracted.
19	100	Burst	Satis	
40	140	Auto	Satis	
Lubricant:	VV-L-800.			
Rifle No.:	114.			
40	40	Semi	1-FF	
44	84	Burst	3-FF	The third FF could not be readily cleared with the bolt assist. The dust was stopped. BGL.
20	104	Burst	Satis	
36	140	Auto	2-FFI	
Rifle No.:	115.			
40	40	Semi	Satis	
60	100	Burst	1-FFI	
40	140	Auto	1-FFI	
Rifle No.:	116.			
40	40	Semi	Satis	
60	100	Burst	Satis	
40	140	Auto	1-FFI	
Lubricant:	NRL.			
Rifle No.:	117.			
40	40	Semi	Satis	
60	100	Burst	Satis	
40	140	Auto	Satis	

Table I-XXIV (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
Rifle No.: 118.				
40	40	Semi	Satis	
60	100	Burst	2-FFI	
40	140	Auto	1-FFI	
Rifle No.: 119[a].				
27	27	Semi	1-FBR 1-FJ 7-FF	The bolt was traveling rearward sufficiently to eject the round, but insufficient to engage the base of the round. BGL.
20	47	Semi	Satis	A clean magazine of ammunition was inserted.
40	87	Burst	2-FFI	
40	127	Auto	2-FFI	
Lubricant: MIL-L-46000A.				
Rifle No.: 120.				
40	40	Semi	Satis	
60	100	Burst	Satis	
40	140	Auto	1-FX	The FX occurred on the first round of the automatic firing. The dust was stopped and the fired case was removed with a cleaning rod.
Rifle No.: 121.				
40	40	Semi	Satis	
60	100	Burst	Satis	
40	140	Auto	Satis	

[a]Inadvertently, only 127 rounds were fired.

Table I-XXIV (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
Rifle No.: 122.				
40	40	Semi	Satis	
60	100	Burst	3-FFI	
			[b]1-BSI	Occurred in the second burst from the second magazine. Dust was stopped to inspect malfunction.
40	140	Auto	[b]4-BSI	
			1-FBR	

[b]A new bolt-catch spring was assembled for phase 2, which corrected the bolt-stop interrupt (BSI) malfunction.

Table I-XXV. Rifle-Function Data from Phase 2.

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
Lubricant: Code A.				
Rifle No.: 111.				
40	40	Semi	1-FFI	
60	100	Burst	3-FFI	
			1-FF	
36	136	Auto	2-FFI	
			1-FX	BGL. The FX occurred on the 16th round from magazine.
40	140	Auto	Satis	
The rifle was allowed to cool for 15 minutes and was lubricated.				
40	180	Semi	Satis	
60	240	Burst	1-FFI	
16	256	Auto	1-FFI	
			1-FX	BGL. The FX occurred on the 16th round from magazine.
2	258	Auto	1-BOB	BGL.
22	280	Auto	1-FFI	
			1-FX	BGL. The FX occurred on the 19th round from magazine.
Rifle No.: 112.				
20	20	Semi	Satis	
4	24	Semi	1-FFI	
			3-FF	BGL.
16	40	Semi	Satis	
2	42	Burst	1-FF	BGL.
			1-FX	BGL. The FX occurred on the first round from magazine.
18	60	Burst	Satis	
1	61	Burst	1-FX	BGL. Same as previous.

Table I-XXV (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
1	62	Burst	1-FX	BGL. The FX occurred on the second round from magazine.
6	68	Burst	1-FF	BGL. The bolt could not be forced to the locked position until it was lubricated.
12	80	Burst	Satis	
20	100	Auto	1-FFI	
9	109	Auto	7-FF	The bolt had to be forced to the closed position with each round fired; therefore, the test was terminated.
Rifle No.: 113.				
40	40	Semi	Satis	
5	45	Burst	2-FX	BGL (2 times). The FX occurred on the first and fifth round from magazine.
35	80	Burst	Satis	
20	100	Burst	2-FX	BGL (2 times). Same as previous.
2	102	Auto	1-FX	BGL. The FX occurred on the first round from magazine.
			2-FF	A second round was fired and the bolt could not be forced to the locked position. The test was terminated.
Lubricant: VV-L-800.				
Rifle No.: 114.				
33	33	Semi	2-FF	
			4-BCOEC	BGL.
7	40	Semi	Satis	A clean magazine of ammunition was inserted and seven rounds fired semiautomatically and the remainder in bursts.

Table I-XXV (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
13	53	Burst	Satis	
40	93	Burst	2-FFI	
			1-BCOEC	
47	140	Auto	1-FFI	
The rifle was allowed to cool for 15 minutes and lubricated.				
21	161	Semi	1-FX	BGL. The FX occurred on first round from magazine.
19	180	Semi	Satis	
41	221	Burst	2-FF	
			1-FX	BGL. The FX occurred on first round from magazine.
19	240	Burst	Satis	
40	280	Auto	1-FF	
			1-FFS	
Rifle No.: 115.				
40	40	Semi	1-FFI	
60	100	Burst	1-FFI	
40	140	Auto	Satis	
The rifle was allowed to cool for 15 minutes, but not lubricated.				
40	180	Semi	Satis	
60	240	Burst	Satis	
40	280	Auto	1-FFI	
Rifle No.: 116.				
40	40	Semi	1-FFI	
1	41	Burst	1-FX	BGL. The FX occurred on first round from magazine.

Table I-XXV (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
19	60	Burst	1-FFI	
1	61	Burst	1-FFI	
			1-FX	BGL. Same as previous.
39	100	Burst	Satis	
40	140	Auto	Satis	
The rifle was allowed to cool for 15 minutes and lubricated.				
40	180	Semi	Satis	
60	240	Burst	1-FFI	
1	241	Auto	1-FFI	
			1-FX	BGL. Same as previous.
19	260	Auto	Satis	
1	261	Auto	1-FX	BGL. Same as previous.
19	280	Auto	Satis	
Lubricant: None.				
Rifle No.: 117.				
7	7	Semi	6-FF	A failure-to-feed occurred with all rounds fired.
			1-FJ	After five rounds, the dust was stopped and the last two rounds were fired without the dust environment. Two failures to feed resulted and the bolt could not be forced to the locked position to fire the seventh round.
Rifle No.: 118.				
4	4	Semi	2-FF	Three rounds fired without malfunction. A failure-to-feed resulted with the fourth round and the bolt could not be forced to the closed position to fire the fifth round.

Table I-XXV (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
Rifle No.: 119.				
3	3	Semi	3-FF	Failures-to-feed resulted on the second and third rounds and the bolt could not be forced to the locked position to fire the fourth round.
Lubricant: MIL-L-46000A.				
Rifle No.: 120.				
40	40	Semi	Satis	
21	61	Burst	1-FX	BGL. The FX occurred on first round from magazine.
39	100	Burst	Satis	
1	101	Auto	1-FFI	
			1-FX	BGL. Same as previous.
39	140	Auto	1-FF	
The rifle was allowed to cool for 15 minutes and relubricated.				
40	180	Semi	Satis	
21	201	Burst	1-FX	BGL. The FX same as previous.
39	240	Burst	1-FBR	
21	261	Auto	1-FX	BGL. Same as previous.
19	280	Auto	Satis	
Rifle No.: 121.				
40	40	Semi	Satis	
60	100	Burst	3-FFI	
			3-FF	

Table I-XXV (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
22	122	Auto	2-FFI 1-FF 1-FX	BGL. The FX occurred on the second round from magazine.
18	140	Auto	Satis	
The rifle was allowed to cool for 15 minutes and lubricated.				
40	180	Semi	Satis	
60	240	Burst	Satis	
40	280	Auto	Satis	
Rifle No.: 122.				
40	40	Semi	Satis	
3	43	Burst	1-BCOEC	BGL.
57	100	Burst	Satis	
40	140	Auto	Satis	
The rifle was allowed to cool for 15 minutes and lubricated.				
40	180	Semi	Satis	
60	240	Burst	1-FJ	BGL.
40	280	Auto	Satis	

Table I-XXVI. Rifle-Function Data from Phase 3 (Tracer Ammunition)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
Liberally lubricated with MIL-L-46000A.				
Rifle No.: 114.				
40	40	Semi	Satis	
60	100	Burst	Satis	
40	140	Auto	Satis	
The weapon was allowed to cool to ambient temperature and firing was resumed without lubrication.				
40	180	Semi	Satis	
60	240	Burst	Satis	
40	280	Auto	Satis	
Rifle No.: 115.				
40	40	Semi	Satis	
60	100	Burst	Satis	
40	140	Auto	Satis	
The weapon was allowed to cool to ambient temperature and firing was resumed without lubrication.				
40	180	Semi	Satis	
60	240	Burst	Satis	
40	280	Auto	Satis	
Rifle No.: 116.				
40	40	Semi	Satis	
60	100	Burst	1-BCOEC	
40	140	Auto	Satis	
The weapon was allowed to cool to ambient temperature and firing was resumed without lubrication.				
40	180	Semi	Satis	
60	240	Burst	Satis	
40	280	Auto	Satis	
Lightly lubricated with MIL-L-46000A.				
Rifle No.: 120.				
20	20	Semi	1-FBR	
4	24	Semi	2-BCOEC 2-FJR	

Table I-XXVI (Cont'd)

No. Rds Fired	Cumulative No. Rds Fired	Type of Fire	Function	Remarks
Rifle No.: 121.				
20	20	Semi	1-FBR	
4	24	Semi	3-BCOEC 1-BOB	The next attempt to fire was made without dusting the weapon.
2	26	Semi	2-BCOEC	
Rifle No.: 122.				
17	17	Semi	2-BOB 1-FJ	A clean magazine was inserted and the next attempt to fire was made without dusting the weapon.
4	21	Semi	4-BCOEC	

Table I-XXVII. Rifle-Performance Data from Liberal-Lubrication Test

Cycle No.[a]	Cumulative No. Rds Fired per Rifle	Number of Malfunctions											
		Code A			VV-L-800			NRL			MIL-L-46000A		
		Rifle No.											
		93	94	95	96	97	98	99	100	101	102	103	104
1	140	1-FFS											
2	280				1-FTR				1-FFS		[b]1-FF		
3	420									1-FFS			
4	560							1-FJ					
5	700								1-FTR				[b]1-FF
6	840		1-FJ										
7	980							1-FFI					
8	1120												
9	1260				1-FBR								
10	1400												
11	1540												
12	1680												
13	1820				1-FBR								
14	1960												
15	2100												
16	2240												
17	2380												
18	2520				1-FBR								
19	2660												
20	2800		[c]1-FJ [d]1-FX					1-FX					

[a]Each rifle was disassembled, as in maintenance A (including removal of the firing pin), and liberally lubricated after each even numbered cycle.
[b]The cartridge case was dented deeply on two sides which caused the case to be out-of-round. Malfunction attributed to defective ammunition.
[c]A screwdriver had to be employed to remove the fired case.
[d]The failure-to-extract was attributed to a broken extractor spring.

Table I-XXVIII. Cyclic-Rate Data from Liberal-Lubrication Test, Rd/Min

Cycle No.[a]	Lubricant: Code A			VV-L-800			NRL			MIL-L-46000A		
	Rifle No.											
	93	94	95	96	97	98	99	100	101	102	103	104
1	870	860	855	838	843	821	919	913	880	942	878	901
2	867	885	870	817	834	800	913	935	898	926	890	912
3	863	888	855	849	846	819	938	961	919	944	857	850
4	851	860	810	806	852	820	-[b]	912	902	941	896	843
5	892	902	862	810	847	845	932	926	894	935	880	844
6	853	876	843	837	867	842	896	923	879	955	843	866
7	845	873	855	795	826	814	965	955	904	945	852	838
8	842	856	823	805	858	831	938	952	880	934	864	854
9	868	893	828	818	853	863	945	949	883	955	868	873
10	832	857	806	834	857	835	900	930	870	945	858	829
11	875	878	854	838	873	848	933	963	915	944	869	860
12	836	863	780	832	853	844	928	940	868	938	850	870
13	866	885	816	837	863	863	924	932	885	921	860	865
14	838	863	788	836	870	858	906	896	867	942	850	843
15	879	891	827	841	863	853	952	954	895	952	869	859
16	832	866	792	853	845	861	931	924	873	954	842	825
17	881	884	824	854	873	878	920	937	867	946	860	862
18	850	862	806	844	867	875	888	882	836	938	852	828
19	836	833	840	853	890	904	925	926	885	934	862	835
20	854	844	783	880	906	895	902	914	856	933	848	865

[a]The rates were recorded on the 20-round bursts of each cycle.
[b]The cyclic-rate recorder failed to operate properly.

DEPARTMENT OF THE ARMY
HEADQUARTERS, U. S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

DATE: 13 FEB 67
ACTION: D & [illegible]
13 FEB 1967

AMSTE-BC
8-5-0060-02

INFO: RCO

SUBJECT: Evaluation of Small Arms Lubricants

TO: Commanding Officer
Aberdeen Proving Ground
ATTN: STEAP-DS

1. References:

a. Test Plan for Military Potential Test of Weapon Lubricants Employing 5.56MM, XM16E1 Rifle.

b. Msg, USAWECOM 2985 for USATECOM, 3 Feb 67, subject as above (Incl 1).

c. Msg, USATECOM 5278 for USAMC, 6 Feb 67, subject as above.

d. Msg, USAMC 54119 for USAWECOM, 2 Feb 67, subject as above (Incl 2).

e. Msg, USAWECOM 3406 for USATECOM, 8 Feb 67, subject as above (Incl 3).

f. Fact Sheet, AMCRD-GF, to Chief of Staff, USAMC, 31 Jan 67, Subj: Evaluation of Weapons Lubricants; Ltr, Congress of the United States, 20 Jan 67, to Secretary of the Army; Ltr, Special Assistant for Congressional Affairs, 3 Feb 67, to Representative C.E. Chamberlain (Incl 4).

2. Inclosed references are forwarded for your information. This command concurs with the dates of 1 May for test completion and 1 June for publication of report. Efforts must be directed toward meeting the specified dates. Use of overtime is authorized in accordance with current overtime fund ceilings. Attention is invited to reference f relative to command and congressional interest and commitment.

3. The substitution of the NRL lubricant for the combination of VV-L-800 and Molybdenum Disulphide requires a published change in the test plan. However, it is suggested that this change be held in abeyance pending receipt of concurrence or comment from U.S. Army Weapons Command relative to the overall test plan, to include input from this headquarters recommending expansion of Dust Tests.

AMSTE-BC 13 FEB 1967
8-5-0060-02
SUBJECT: Evaluation of Small Arms Lubricants

4. It is requested that Commanding Officer, Aberdeen Proving Ground provide a brief bi-weekly letter report beginning on 20 February 1967 and ending on 1 May 1967. Send to Commanding General, U.S. Army Weapons Command, ATTN: AMSWE-RDR, with information copies to this headquarters and Commanding General, U.S. Army Materiel Command, ATTN: AMCRD-GF. As a minimum, this report should include the tests completed and in progress, results at time of report and problems encountered; e.g., malfunctions and apparent cause, broken parts, and other comments as appropriate.

FOR THE COMMANDER:

Austin Triplett Jr

AUSTIN TRIPLETT, Jr.
Colonel GS
Dir, Inf Mat Test

4 Incl w/d
as

Copies furnished:
CG USAMC ATTN: AMCRD-GF (Streets) w/o incl
CG USAWECOM ATTN: AMSWE-RDR (Reinsmith) w/o incl

DEPARTMENT OF THE ARMY
HEADQUARTERS, U. S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

20 APR 1967

AMSTE-BC

SUBJECT: Dynamic Dust Tests of Lubricants for M16 Rifle

TO: Commanding Officer
Aberdeen Proving Ground
ATTN: STEAP-DS-TI
Aberdeen Proving Ground, Md 21005

1. Starting with a clean lubricated rifle, current procedure for subject tests is to fire until a stoppage occurs up to 140 rounds. If the failure occurs before 140 rounds expenditure and the stoppage is correctible by procedures other than disassembly as in Maintenance A, additional lubricant is applied and the test is resumed up to 140 rounds.

2. On completion of the above, the tests should be repeated with M16A1 Rifle only, except that weapons are to be initially in an over-lubricated condition and the test is to be extended to 280 rounds with a 15 minute cool off after 140 rounds and with lubricant applied from a hand activated squirt can, except for NRL lubricant which is aerosol applied. The lubricants are to be reapplied after each stoppage in amounts considered to be overlubrication and the procedure repeated up to 280 rounds.

3. It is understood that NRL lubricant is currently in short supply. In its place, conduct same sequence with unlubricated weapons up to where stoppages are considered excessive or not correctible by immediate action.

4. As discussed, this command concurs with reducing the remainder of the water spray test to one weapon of each type. The overlubrication test is to be completed as originally planned (non-dust).

FOR THE COMMANDER:

Austin Triplett Jr.

AUSTIN TRIPLETT, Jr.
Colonel
Dir, Inf Mat Test

Copy furnished:
CG USAWECOM ATTN: AMSWE-RDR

DEPARTMENT OF THE ARMY
HEADQUARTERS, U. S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-BC

26 APR 1967

SUBJECT: Military Potential Test of Weapon Lubricants Using the M16A1 Rifle, USATECOM Project No. 8-5-0060-02

TO: Commanding Officer
Aberdeen Proving Ground
ATTN: STEAP-DS
Aberdeen Proving Ground, Md 21005

1. Reference Test Plan with Changes 1 and 2 for subject test, dated January 1967.

2. In previous tests of the lubricants, all firing has been conducted using ball ammunition. Since considerable tracer ammunition is being fired from the M16A1 Rifle in the Combat Zone, the tracer ammunition capability must be evaluated.

3. Commanding Officer, Aberdeen Proving Ground is directed to conduct, as a minimum, the reliability, over-lubrication and dynamic dust tests using tracer ammunition under the same conditions as tests of the ball ammunition. If results are unusual when compared to the previous tests, additional tests are authorized. Utilize three weapons for each subtest and MIL-L-46000 lubricant only. Conduct the dynamic dust test immediately.

FOR THE COMMANDER:

AUSTIN TRIPLETT, Jr.
Colonel GS
Dir, Inf Mat Test

Copy furnished:
CG USAWECOM ATTN: AMSWE-RDR

COPY/11h

DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-BC
8-5-0060-02

17 FEB 1967

SUBJECT: Proposed Plan of Test for Military Potential Test of Weapon Lubricants Employing the 5.56mm XM16E1 Rifle, RDT&E Project No. 1C024401A107

TO: Commanding General
USA Weapons Command
ATTN: AMSWE-RDR
Rock Island, Illinois 61200

1. References:

a. Test Plan for Military Potential Test of Weapon Lubricants Employing 5.56mm, XM16E1 Rifle.

b. Msg, USAWECOM 2985 for USATECOM, 3 Feb 67, subj as above.

c. Msg, USATECOM 5278 for USAMC, 6 Feb 67, subj as above.

d. Msg, USAMC 54119 for USAWECOM, 2 Feb 67, subj as above.

e. Msg, USAWECOM 3406 for USATECOM, 8 Feb 67, subj as above.

f. Msg, USATECOM 5348 for USAWECOM, 10 Feb 67, subj as above.

g. Ltr, AMSTE-BC, dated 13 Feb 67, subj as above.

2. This command concurs in subject test plan with the following comments:

a. Reference Appendix IV - Test Schedule. As stated in reference 1c, every effort will be made to complete tests by 1 May and submit report by 1 June. However, the 90-day test program, beginning 1 February and ending 1 May was subject to receipt of all materiel by the 1 February date. At this time, the impact on completion of program due to delayed delivery of lubricants and the replacement of weapons cannot be determined.

COPY/11h

17 FEB 1967

AMSTE-BC

SUBJECT: Proposed Plan of Test for Military Potential Test of Weapon Lubricants Employing the 5.56mm XM16E1 Rifle, RDT&E Project No. 1C024401A107

b. Reference Paragraph 2.4 - Dust Test. This headquarters considers that the Dust Test must be expanded to include a blowing dust environment in the immediate vicinity of the rifle while firing. Such a condition can be created by pouring a given amount of "standard dust" at a specific rate into a blower. There should be little or no wind except that created by the blower. Firing should be conducted at a specified rate (below the cook-off level) until a malfunction occurs. After clearing, attempt further firing until excessive malfunctions occur. Then arbitrarily saturate weapon bolt and mechanism with oil and attempt to continue firing. Objective of this condition is to determine if oil characteristics aid or degrade immediate functioning capability in such environment, relative to immediately correctable or delayed stoppages. This exercise should be conducted with all lubricants and a M14 Rifle as a control weapon.

3. Your comments are solicited. If approved, this command will initiate action to expand the Dust Test.

FOR THE COMMANDER:

/st/ AUSTIN TRIPLETT, JR.
Colonel GS
Dir, Inf Mat Test

Copies furnished:
CG USAMC ATTN: AMCRD-GF
CO APG ATTN: STEAP-DS

COPY/11h

DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-BC 28 MAR 1967

SUBJECT: Code A Representatives Visit to USATECOM to Witness Tests under Project No. 8-5-0060-02

TO: Commanding Officer
Aberdeen Proving Ground
ATTN: STEAP-DS-TI
STEAP-DS-D
Aberdeen Proving Ground, Md 21005

1. Reference message, AMSWE-RDR, RI 8286, 23 Mar 67, subject as above.

2. The attached message is forwarded for your action.

3. Code A representative will arrive at this headquarters on 29 Mar 1967 and will be escorted by representative of this office to Security Office, Building 400.

4. It is requested that Code A representative be authorized to witness subject tests on 29 and 30 March 1967.

FOR THE COMMANDER:

/st/ AUSTIN TRIPLETT, JR.
Colonel GS
Dir, Inf Mat Test

1 Incl
Msg, AMSWE-RDR

COPY/11h

1967 MAR 23 20 47Z

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FM CGUSAWECOM ROCK ISLAND ILL

TO RUEOFAA/CGUSATECOM ABERDEEN MD

INFO RUEOHFA/CGUSAMC

ZEN/CO ROCK ISLAND ARSENAL ROCK ISLAND ILL

BT

UNCLAS E F T O RI 8286 FROM AMSWE-RDR REINSMITH,

FOR AMSTE-BC C. CRIDER, INFO AMCRD-GF R. STREETS, SWERI-RDL

SUBJ CODE A REPRESENTATIVES VISIT TO USATECOM TO WITNESS

TESTS UNDER PROJECT NO. 8-5-ØØ6Ø-Ø2

REF

A. SWERI-RDL LTR. TO CODE A DATED 16 FEB 67.

B. DISCUSSIONS CONCERNING CODE A REPRESENTATIVES

VISIT TO WITNESS TESTS UNDER USATECOM PROJECT NO. 8-5-ØØ6Ø-Ø2.

1. THIS IS CONFIRMATION CODE A IS A SUPPLIER OF A PRODUCT UNDER TEST AT YOUR COMMAND UNDER USATECOM PROJECT NO. 8-5-ØØ6Ø-Ø2.

2. IN ACCORDANCE WITH REFERENCES ABOVE, REQUEST REPRESENTATIVE OF CODE A BE PERMITTED TO WITNESS TESTS BEING CONDUCTED UNDER PROJ. NO. 8-5-ØØ6Ø-Ø2.

COPY/11h

PAGE 2 RUWJRRA8286 UNCLAS E F T O

3. RESULTS OF TEST COMPLETED UNDER PROJ. NO. 8-5-ØØ6Ø-Ø2 WILL NEITHER BE REVEALED TO NOR DISCUSSED WITH REPRESENTATIVES OF CODE A.

4. THE PRESIDENT OF CODE A HAS BEEN INSTRUCTED TO CONTACT MR. E. KEELE, PHONE A.C. 3Ø1 578-15ØØ EXT 4246 TO DETERMINE PREFERABLE VISIT DATE OF LIMITED DURATION AND TO CONTACT MR. C. CRIDER, PHONE A.C. 3Ø1 578-15ØØ EXT 36Ø8, 33Ø7 ON ARRIVAL AT YOUR COMMAND FOR ESCORT.

BT

COPY/11h

AMSTE-BC Visit of Representative of Code A

MEMO FOR RECORD Inf Mat Test Dir 31 Mar 67
Mr. Morrow/nm/4476

1. Code A representative arrived at USATECOM headquarters on 29 Mar 67 to witness tests of Code A.

2. Col Triplett, Mr. G. Morrow and Mr. C. Crider discussed the test plans and Code A representative was permitted to read the approved plan. This was previously proposed to and agreed on by LTC A. Tank, AMC, during his visit to TECOM on 28 Mar. Code A representative asked for a copy and was informed that his inquiry should be addressed to the Weapons Command.

3. He was taken to D&PS and Mr. Eric Keele, the Test Director, accompanied Code A representative while he observed tests in progress on 29-30 Mar.

4. On 30 Mar, Mr. Keele called the undersigned and stated that Code A representative was ready to leave and wished to know if he was expected to return to TECOM headquarters for any reason. The undersigned requested that Code A representative be put on the extension with Mr. Keele. He was asked whether he had any comments or suggestions relative to the tests he had witnessed or any other aspects of his visit. Code A representative stated that he was completely satisfied. The undersigned then stated "You have no reservations relative to the fairness, completeness and impartiality of the tests?" Code A representative stated that he had none and was impressed with the scope, intensity and manner of conduct of the test.

5. Code A representative was invited to return and witness any specific activity which he considered critical to his interests although we did not encourage extensive over-the-shoulder monitorship since it would be an operational burden.

6. The results of tests were neither given to nor discussed with Code A representative. It is of interest that Code A representative stated he had previously read a copy of the draft test plan given to him by a representative of Climax Molybdenum.

/t/ GOODWIN MORROW
Deputy Director

Copies furnished:
STEAP-DS(Mr. Doilney, Mr. Keele)

APPENDIX III - REFERENCES

1. TM 9-1005-249-14, Technical Manual, Rifle, 5.56-MM, M16; Rifle, 5.56-MM, XM16E1; and Launcher Grenade 40-MM, XM148, 1 August 1966.

2. Test Plan on Military Potential Test of Weapon Lubricants Employing 5.56-MM, XM16E1 Rifle, January 1967 with Changes 1, 2, and 3. USATECOM Project No. 8-5-0060-02. RDT&E Project No. 1C024401A107.

3. Letter, AMSTE-BC to STEAP-DS-TI, 20 April 1967, Subject: Dynamic Dust Tests of Lubricants for M16 Rifle (Letter Contained in Appendix II).

4. Letter, AMSTE-BC to STEAP-DS-TI, 26 April 1967, Subject: Military Potential Test of Weapon Lubricants Using the M16A1 Rifle, USATECOM Project No. 8-5-0060-02 (Letter Contained in Appendix II).

5. MIL-E-5272C(ASG) with Amendment 1, 20 January 1960.

6. Springfield Armory Purchase Description SAPD-253-B, Acceptance Testing Specification for Rifles, 5.56-MM, M16 and XM16E1, 29 April 1966, with Amendment 1, 24 October 1966.

7. ASTM BULLETIN NO. 154, 1948, By Harry L. Faigen, Supervisor, Rust Preventative Research Section, Rock Island Arsenal Laboratory, Rock Island, Illinois.

APPENDIX IV - DISTRIBUTION

USATECOM Project No. 8-5-0060-02

ADDRESSEE	FINAL REPORT
Commanding General US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005	
ATTN: AMSTE-BC	6
AMSTE-TA	1
Commanding General US Army Weapons Command Rock Island Arsenal Rock Island, Illinois 61202	
ATTN: AMSWE-RDR	125
Commanding Officer Aberdeen Proving Ground Aberdeen Proving Ground, Maryland 21005	
ATTN: STEAP-TL	2

Secondary distribution is controlled by US Army Weapons Command, ATTN: AMSWE-RDR.

AD_____ Accession No._____
Development and Proof Services, Aberdeen Proving Ground, Md.
Final Report on USATECOM Project No. 8-5-0060-02, Military Potential Test of Weapons Lubricants Employing 5.56-MM, M16A1 (XM16E1) Rifle, June 1967
RDT&E Project No. 1C024401A107, Report No. DPS-2417
Authors Eric Keele, George Hendricks and Lloyd Staley
Secondary distribution controlled by US Army Weapons Command
120 pages, 8 illustrations

Unclassified Report

This test was conducted to evaluate the qualities of lubricants identified as Code A, NRL (Naval Research Laboratory), VV-L-800, and MIL-L-46000A for use with the M16A1 rifle. Testing consisted of adverse conditions, reliability with minimum and standard maintenance, rust penetration, liberal lubrication, and a sequential series of tests conducted to simulate some of the environmental conditions met in the field. Testing began in February and was completed in May 1967. The MIL-L-46000A simifluid oil was significantly superior to the other test lubricants for over-all M16A1 rifle functioning, VV-L-800 second, NRL third, and Code A fourth. For corrosion resistance, MIL-L-46000A ranked first, NRL second, VV-L-800 third, and Code A fourth. Recommendations were made that standard VV-L-800 lubricant for the M16A1 rifle be replaced with MIL-L-46000A for field use at temperatures above freezing and that further testing be conducted with MIL-L-46000A to determine suitability for use with the M16A1 rifle at low temperatures.

AD_____ Accession No._____
Development and Proof Services, Aberdeen Proving Ground, Md.
Final Report on USATECOM Project No. 8-5-0060-02, Military Potential Test of Weapons Lubricants Employing 5.56-MM, M16A1 (XM16E1) Rifle, June 1967
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USATECOM PROJECT NO. 8-5-0060-02

FINAL REPORT ON MILITARY POTENTIAL TEST OF WEAPONS LUBRICANTS EMPLOYING 5.56-MM, M16A1 (XM16E1) RIFLE

Report No. DPS-2417

CODE SHEET

Code A - Dri-Slide

(This code sheet is to be removed from this report when loaned or otherwise distributed outside the Department of Defense.)