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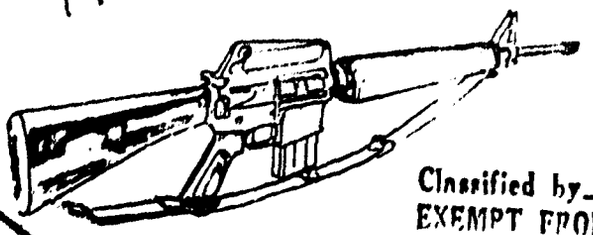
REPORT
OF THE
M16 RIFLE REVIEW PANEL



1 JUNE 1968

HISTORY OF THE M16 WEAPON SYSTEM

DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF
FOR RESEARCH, DEVELOPMENT, AND ACQUISITION
WASHINGTON, DC 20310

REPLY TO
ATTENTION OF

DAMA-WSW

1 FEB 1994

MEMORANDUM FOR THE RECORD

SUBJECT: Declassification Action - Report of the M16 Rifle Review Panel (C) dated 1 June 1968. [redacted]

1. The Report on the M16 Rifle Review Panel dated 1 June 1968 was prepared for the Office of the Chief of Staff of the Army, by the Office of the Director of Weapons System Analysis. The Ground Combat Systems Division, Office of the Director of Weapons Systems, Office of the Deputy Chief of Staff for Research, Development and Acquisition, is the successor to the originator of the report.

2. This office has completed a review of subject report and appendices 1 through 11 and has determined classification of Confidential is no longer needed. The report is now Unclassified. Selected extracts of the report are at Enclosure 1.

3. Notification of this declassification will be forwarded to all distribution addressees and a declassified copy will be forwarded to the Defense Technical Information Center, Cameron Station, for file.

1 Encl
as

WILLIAM O. COOMER
Colonel, GS
Chief, Ground Combat Systems
Division

REPORT

OF THE

M16 RIFLE REVIEW PANEL

HISTORY OF THE M16 WEAPON SYSTEM

PREPARED BY:

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OFFICE DIRECTOR OF WEAPON SYSTEMS ANALYSIS

WASHINGTON, D. C. 20310

APPROVED BY:

GENERAL RALPH E. HAINES, JR.

VICE CHIEF OF STAFF OF THE ARMY

[redacted]

REPORT

OF THE

M16 RIFLE REVIEW PANEL

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HISTORY OF THE M16 WEAPON SYSTEM

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A. Introduction

General

As a result of Congressional and public concern, together with his desire to thoroughly assess the facts as they may be, the Chief of Staff Army chartered a M16 Rifle Review Panel within the Office of the Assistant Vice Chief of Staff. This report is in response to that charter.

On 3 May 1967, Chairman L. Mendel Rivers, Committee on Armed Services, House of Representatives, appointed a Special Subcommittee to inquire into the M16[1/] rifle program. Congressman Richard H. Ichord was apponted Chairman of the Subcommittee; the other members were Congressmen Speedy O. Long and William G. Bray. The printed hearings were released in October 1967. Later, on 19 October 1967, the Subcommittee issued a 51-page report.

The Report of the M16 Rifle Review Panel is entitled, History of the M16 Weapon System. Following the Background, which sets the stage for the current controversy, this report documents the early Army, Air Force, and Department of Defense history and the history since the Army was assigned Project Management responsibility in 1963. Included in the body of the report are

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[1] In the report which follows, the M16 rifle is referred to as an AR15, M16, M16A1, and XM16E1. For a definition of terms see the Glossary, Inclosure 2. The M16A1 as currently produced is described at Inclosure 5.

the conclusions and recommendations of the Panel. The Report is supported by eleven technical appendices which include: An Analysis of Test Policies and Procedures, An Audit Trail and Analysis of M16 Tests, Review and Analysis of M16 Rifle Training, Ammunition Development Program, Procurement Production and Distribution of the AR15/M16, Review and Analysis of AR15/M16 Reliability, M16 Surveys in the Republic of Vietnam, Review and Analysis of Management Practices, Audit Trail of Chief of Staff Army Decisions, The Army Small Arms Program, and M16 Product Improvement Modifications.

Purpose

On 8 November 1967 the Chief of Staff, Army directed an intensive review of Army management practices related to the evaluation and adoption of product improvement modifications to the M16A1 rifle/ammunition system. This review was chartered by Chief of Staff Memorandum (CSM) 67-436 (Inclosure 1) to determine whether there are general deficiencies in the Army's management of the small arms program. Specific attention was directed to training, policies, organizations, assignment of responsibility, direction and control exercised, and the administrative and technical procedures related to the development, testing, evaluation, procurement, production and product improvement of small arms.

Scope

The principal subject areas of inquiry were:

- The product improvement modifications to the M16A1 weapon/ammunition system and the justification therefore.
- The effects of fouling on the functioning of the M16A1 weapon/ammunition system.
- The development of propellants for use in 5.56mm cartridges, with emphasis on the effects of these propellants on the functioning of the M16A1 rifle.
- The adequacy of test procedures to detect the occurrence and the persistence of problem areas and to isolate the causative factors for immediate correction.
- The adequacy of regulations and policy on directive statements as these generate requirements for testing and for the distribution and use of test results. Particular attention was to be paid to their adequacy in light of the responsibility for adequate testing assigned in the recently revised materiel R&D regulation (AR 705-5).
- The scope and adequacy of the Army training program for the M16A1 rifle/ammunition system, with particular emphasis on individual maintenance training and armorer training.

- The adequacy of the organizational structure for the development, testing, and production of small arms to include a review of the changes made as a result of CSM's 66-485 and 67-96.
- The procurement history of the AR15/XM16E1/M16A1 weapon system.

This report includes an audit trail of M16A1 decisions and tests, a comprehensive history of the M16A1 and a fact paper (Inclosure 4) in response to the Ichord Committee findings and recommendations.

Procedures Followed

The M16 Rifle Review Panel convened in the Weapon Systems Analysis Directorate, Office, Chief of Staff Army on 9 November 1967. Representation on the panel is shown at Inclosure 3. A detailed work plan was developed and published on 17 November 1967. Each phase of the review panel effort is discussed in the paragraphs which follow.

During the preliminary planning phase, formal points of contact were established in Headquarters, U.S. Air Force, Headquarters, U.S. Marine Corps, and the following major Army commands: Army Materiel Command, Combat Developments Command, Continental Army Command, U.S. Army Pacific, and U.S. Army Vietnam. Each of these commands then

designated contacts at subordinate commands, agencies and laboratories and authorized direct communications with the Review Panel. Travel plans were then formalized in preparation for the data collection phase.

The records and files of each of the Army staff sections were reviewed along with those of each of the Army commands identified in the preceding paragraph to obtain copies of all documents pertaining to the M16 weapon system. Additionally, records at each subordinate command, agency and laboratory which should have generated or received documentation pertaining to small arms were reviewed. Records reviewed included those at the U.S. Army Weapons Command; U.S. Army Munitions Command; Frankford Arsenal; Picatinny Arsenal; Ballistic Research Laboratories; Rock Island Arsenal; U.S. Army Test and Evaluation Command; Combat Arms Group, Command and General Staff College; Infantry Combat Developments Agency; U.S. Army Infantry Board; U.S. Army Infantry School; Combat Developments Experimentation Center, Fort Ord Training Center; Fort Gordon Training Center; Development and Proof Services; Project Manager-Rifles; Advanced Research Project Agency; and Weapons Systems Evaluation Group (WSEG). In addition to the above listed military facilities, the following contractor facilities were visited and files reviewed: Colt's Firearms Division, Remington Arms, Twin

Cities Army Ammunition Plant, Remote Area Conflict Information Center of Battelle Memorial Institute, and the Institute for Defense Analyses.

During the course of this review a research file was compiled which contains over 3,500 pertinent documents. These documents were reviewed and records prepared for computer processing of the selected information.

On 20 January the Review Panel departed Continental United States for Hawaii to review the files and records at Headquarters, U.S. Army Pacific and Commander-In-Chief Pacific. Upon completion of this review, the panel continued to Vietnam and conducted a field survey to determine the current status of M16 reliability, training, supply, maintenance and overall effectiveness. The results of this survey were made available to Commanding General, U.S. Army Vietnam; Military Assistance Command Vietnam - J4; Commanding General, U.S. Army Pacific; the Department of Army Staff; Commanding General, U.S. Army Command; Under-Secretary of the Army; and Director of Defense Research and Engineering. In addition to being contained in Appendix 7 of this report, the results of this survey were published separately and distributed to interested commands and agencies.

On 10 February 1968, the review panel returned from Vietnam and began a detailed evaluation of the data collected and preparation of a final report. During this period additional data were also collected to fill identified gaps.

Each section of the final report has been subjected to a review by a team within the Office of the Assistant Vice Chief of Staff and informally reviewed by interested Army Staff agencies. Comments concurred in by the review panel have been incorporated in the report.

Considerable care has been taken by the Review Panel to assure that all data contained in the report are factual. The final report, in its entirety, has been reviewed within the Office of the Assistant Vice Chief of Staff and has been informally reviewed by the concerned Department of the Army Staff agencies. The recommendations have been formally coordinated and are concurred in by the Army Staff agencies responsible for actions to carry them out.

6. Background

The basic weapon that the U.S. Army adopts as standard for its infantrymen has always been an object of interest to the American public. Of the eight "rifles" the U.S. Army has adopted as standard since the Revolutionary War, at least three have been the subject of great controversy: the Krag-Jorgensen, the M1 Garand and the Colt's M16A1. A review of the history of American rifles will show that the U.S. Army before World War II did not take advantage of the latest improvements in weaponry before adopting a new rifle. The first standard infantry weapon of the U.S. Army, the flintlock musket, adopted in 1795, almost duplicated the Charleville musket brought from France by Lafayette 20 years before, yet American gunsmiths were in many respects ahead of their European counterparts in weapon design. The French Charleville smoothbore musket, Model 1762, caliber .69, was the first production of Springfield Armory, and continued to be manufactured with little modification until 1842. The next weapon adopted was the 1841 caplock rifle, often erroneously called the "1842." This was the first U.S. Army standard rifle adopted, although the British had armed a brigade of their 95th Regiment with Baker Flintlock rifles as early as 1800, which, in 1815 at the battle of Waterloo, were used to wipe out several

brigades of Napoleon's artillery.[1]

During the Civil War, the Union Army had a variety of breech-loaders and even some repeating rifles, but little use was made of them becuase ordnance officers considered them unreliable. "The most famous was the Spencer repeater, which the Union Army tested only after President Lincoln ordered it." [2] After turning down several repeating rifles, the Army adopted the .45 caliber single shot breechloader - the Springfield Model 1873. This action was taken 32 years after the Prussian Army had first adopted a breech-loader, and at a time when European armies were rearming with repeaters. Not the least of General Custer's problems at the Little Big Horn in 1876 was the fact that some of the Indians had Henry and Winchester repeaters, while his troops had only the carbine version of the single-shot 1873 Springfield.[3]

The next standard U.S. Army rifle was the caliber .30 Krag-Jorgensen bolt action repeater. Its adoption in 1892, about 25 years after repeaters were available, caused a great furor because "the United States was in a sad state, indeed, when it had to rely on a foreign-designed rifle." [4]

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1 W.H.B. Smith and Joseph E. Smith, Small Arms of the World, Harrisburg, Penn., The Stackpole Company, 1962, p.23.

2 Ibid, p. 60-62

3 Army Rifles Are Always in Dispute,(UPI), Los Angeles Times, January 1, 1968.

4 Ibid.

The Krag, as it was called, proved no match for the 7mm Mauser, used by the defenders of San Juan Hill in the Spanish - American War, and was replaced by the Springfield Model 1903.[5] Although many Americans believe the Springfield to be an American product, it was so similar to the 1898 German Mauser, that Mauser was paid $200,000 for the manufacturing rights.[6] The Springfield eventually became a fine weapon, but for a long time there were problems. The first major problem was that of barrel fouling, and the second was exploding rifles. The barrel fouling was solved by a change in the metal used for bullet jackets; the second fault was corrected by a change in the heat treatment of the barrel, and in later models by a change in the steel used for barrels. Correction of the barrel problem, however, was not completely accomplished until after World War I.[7]

Perhaps the greatest controversy over the adoption of a rifle for the U.S. Army arose when the M1 Garand was standardized. Ranged against the M1 Garand, in addition to the people who perennially oppose any change on general principles, were the supporters of the only real contender, the Johnson semiautomatic rifle. The

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5 Smith and Smith, Small Arms of the World, p. 59.

6 Ibid

7 Army Rifles Are Always in Dispute, (UPI), Los Angeles, Times, January 1, 1968.

relationship of the Johnson rifle to the M1 Garand in the 1930's was very similar to the relationship of the AR15 to the M14 in late 1950's. The original Garand was designed in 1919 in caliber .276 and used the primer-activated mechanism (Roth primer system). In that system the primer is blown back against the head of a heavy striker (firing pin) which continues to the rear, unlocking the bolt from the receiver and recycling the weapon. (The primer-activated system is used today in a leading contender for the Special Purpose Individual Weapon (SPIW).) John C. Garand decided, or was persuaded (it is not clear which), to redesign his M1 rifle for the standard caliber .30-06 cartridge.

In July 1928 the War Department appointed a board of officers "to recommend a specific caliber for the future development of the semiautomatic shoulder rifle." This board, called the "Pig Board" because in the course of its investigations wound basistics tests were conducted using live pigs as targets, investigated three calibers of projectiles, caliber .30, .276, and .256. It concluded that if a semiautomatic rifle were developed using the standard .30-06 cartridge, it would be as heavy, if not heavier, than the then standard Springfield M1903; that in order to develop a lighter weapon, the Army would have to go to a small caliber, higher velocity round; and finally, that the small caliber, high velocity bullets were

more lethal within the normal effectiveness range of a rifle. The board recommended adoption of caliber .276, and that a semi-automatic rifle be developed in that caliber. In 1929 the Garand (caliber .30) was tested against several semiautomatic rifles, all caliber .276. The Army Ordnance Department did not want a new cartridge, and cited problems in supply and increased costs, and the fact that all caliber .30 weapons on hand and the machine tools for the weapons and ammunition would become obsolete.[8/]

In 1932 the Army Chief of Staff, General Douglas MacArthur, sided with the Ordnance Department position and decided that any future weapon would use the standard .30-06 cartridge.[9/] The Garand M1 was adopted in 1936 at the time the first working models of the Johnson semiautomatic rifle were introduced. During the period 1936-39 "dozens of minor alterations (in the M1), to improve functioning or facilitate manufacturing," were made. A complete redesign of the gas cylinder was accomplished in 1939-40 to improve performance and reduce malfunctions.[10/] In 1940, when over 50,000 Garands were already in use in the Army, the Johnson rifle was tested against the Garand. Although the Johnson supporters charged that the tests were

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8 Phillip B. Sharpe, The Rifle in America, New York, Funk & Wagnalls Company, 1947, p.519

9 Smith and Smith, Small Arms of the World, p.83.

10 Sharpe, The Rifle In America, p. 520

rigged in favor of the Garand, the fact is that Johnson's almost untried rifle came out second best against the thoroughly tested, modified design of the Garand.[11]

The Garand M1, fortunately for the United States, was to be the best general service rifle in World War II. The United States had caught up with and passed other world powers in the adoption of a modern rifle. As with all other weapons, the M1 continued to be modified and improved the entire time it was in production.

The development of the M14 rifle began in June 1945, when the U.S. Army stated a requirement for a lightweight automatic rifle. During the period 1946 - 50, feasibility studies were conducted and 10 different rifle designs were evaluated in an attempt to satisfy the requirement. The prototype M14 emerged as the best candidate, and from 1952 to 1956 was tested competitively against the Belgian Fabrique Nationale (FN). The development of the M14 rifle, of course, was restricted to the standard 7.62mm (caliber.30) NATO round, which had been adopted in 1953, thus all but precluding the development of a truly lightweight weapon. Development of the M14 was slow because of "a lack of emphasis and a scarcity of funding."[12]

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11 Smith and Smith, Small Arms of the World, p 83.

12 Report by Preparedness Investigating Subcommittee on the M14 Rifle Program, Committee on Armed Services, U.S. Senate, 2 Oct61, p.3.

The M14 rifle as finally developed and standardized in 1957, was a minor improvement over the M1 which it replaced. It did not weigh less, nor was it really acceptable in the fully automatic role when fired from the shoulder. Although with the selector lever the M14 could be fired in the automatic mode, only those men designated as automatic riflemen and equipped with a bipod were issued the selector lever. The standard M14 was in reality a semiautomatic rifle with a 20-round magazine, too heavy and too long to replace effectively the M2 caliber .30 carbine and the M3A1 caliber .45 submachine gun.

Concurrently with the standardization of the M14, the AR15 was being designed. While Springfield Armory was tooling up for production of the M14, the initial comparative evaluation between the AR15 and the T44E4 (M14) was conducted. The AR15 did exceptionally well in its first trial aginst the M14, thereby igniting the controversy between the "big bore" advocates and those who believed that a significant advance in weaponry could only be achieved by development of a lightweight, high velocity, small caliber weapon. The similarity of the conflict between the Johnson/Garand and the M14/AR15 is readily apparent.

Immediately after World War II, the Soviet Government introduced the AK47 assault rifle which has since become the standard shoulder weapon for all Soviet and Satellite armed forces. Although its caliber is also 7.62mm, the Soviet cartridge is shorter than the North Atlantic Treaty Organziation (NATO) cartridge and therefore more limited in effective range, velocity, and penetration than the NATO cartridge. The Soviet cartridge is also lighter than the NATO cartridge, has a logistical advantage in shipping and handling, requires less material to manufacture, and permits the weapons designed for that cartridge to be shorter and lighter.[13] The AK 47 weighs approximately 8 3/4 pounds empty, and because of the reduced energy cartridge, it can be fired more effectively from the shoulder in the automatic mode than can the M14. Perhaps because of the Soviet adoption of the assault rifle and because of American experience in Korea, where U.S. caliber .30 rifle proved inconvenient because of its weight and inadequate in coping with human wave tactics because of its relatively low volume of fire, the U.S. Army Ordnance Corps began investigation of high velocity, small caliber cartridges for use in rifles and carbines in 1952.

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13 Smith and Smith, Small Arms of the World, p. 589

In 1955, U.S. Continental Army Command (USCONARC) Board 3 (the Infantry Board) conducted an evaluation of an M2 carbine modified to fire a high velocity caliber .22 cartridge. The report of the project recommended that investigation of the high velocity, small caliber principle be given a high priority and that a lightweight rifle utilizing the high velocity, small caliber concept be developed.[14]

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14 Report of Project 2709, Board 3, USCONARC, 28 Nov 55, Evaluation of M2 Carbine Modified to Fire High Velocity Caliber .22 Cartridges.

C. Early History

Army

USCONARC directed the U.S. Army Infantry Board on 21 March 1957 to prepare military characteristics for a high velocity, small caliber rifle,[1] and on 26 July 1957 the Board forwarded draft characteristics to USCONARC for approval.[2] Before the Infantry Board submitted the draft characteristics however, General Willard C. Wyman, Commanding General, USCONARC, acted to expedite the development of a lightweight rifle.

The development of the AR15 rifle, was initiated in mid-1957 by Mr. Eugene Stoner of the Armalite Corporation, Costa Mesa, California, in response to a verbal request from General Wyman. The request, also made to other gun manufacturers was for a new lightweight infantry rifle chambered for high velocity caliber .22 cartridges. The general specifications were: a maximum loaded weight of six pounds; a capability of firing semiautomatic or full automatic; a killing power equal to or better than that of the M1 (Garand) rifle up to 500 yards; and a capability of penetrating a steel helmet or standard body armor at 500 yards.

1. Ltr, ATDEV-3 474/6, Hq, USCONARC, 21 Mar 57, sub: Study of Military Characteristics for a Rifle of High Velocity and Small Caliber.

2. Ltr, ATBC 474 (P-2743), U.S. Army Infantry Board, 26 Jul 67, sub: Draft Military Characteristics for a Rifle of High Velocity and Small Caliber.

On January 1958, General Wyman sent a letter to General Maxwell D. Taylor, then Army Chief of Staff, recommending caution in overselling the M14 rifle to Congress during the FY 1959 budget hearings. The letter indicated General Wyman's support of the small caliber rifle.

> As you know, in April 1958 we will receive two types of small caliber rifles, an Armalite and a Winchester, for evaluation at the USA Infantry Board. Should these rifles be found superior to the M14, as I am almost certain they will be, it would be most unfortunate if the Army had committed itself before Congress to irrevocable support of the M14 rifle. Disregard of the potential presented by the small caliber rifle at this time might well preclude Army exploitation of a superior rifle system which could conceivably appear on the developmental scene at an early date.

The AR15 Rifle design was a scaled down version of the 7.62mm AR10 rifle, also designed by Mr. Stoner. The AR10 had been tested earlier by the Army and found unsatisfactory as a military weapon.3/

The AR15 was first tested by the U.S. Army Infantry Board in 1958. The results of the test indicated that the AR15 should be considered as a potential replacement for the M14. The U.S. Army Arctic Test Board made the same recommendation after completing its test in early 1959. Since the M14 had only been standardized in 1957 and was then being produced in small quantities by Springfield Armory, the AR15's performance and the results of the tests were

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3. Personal Ltr, 11 Mar 57, Mr. Jacob L. Devers, Fairchild Corp., to Gen Willard G. Wyman, CG, USCONARC.

quite disturbing to the advocates of big bore weapons which generally constituted the military establishment. The situation was further complicated by the 1953 NATO agreement which standardized the 7.62mm round of ammunition and would remain in effect for several years.

In late 1958, the Powell Board was convened to review the entire rifle program and, if possible, to reconcile the conflicting opinions. The board, composed of general officers, liked the small caliber, high velocity concept, but recommended that no further consideration be given to the caliber .223 round. It further recommended that the M14 rifle be retained for the automatic rifle role and that development of an AR15 type of weapon, chambered for a caliber .258 round, be expedited to replace the M14 in the rifle role. The caliber .258 round was the Powell Board's estimate of the optimum small caliber round.[4/]

General Wyman had arranged for a field experiment with the AR15 at the Combat Developments Experimentation Center, Fort Ord, California, "to compare the relative effectiveness of variously organized rifle squads armed with M14 rifles and the Winchester and Armalite lightweight, high velocity rifles." The results of the test reported on 17 April 1959, showed that the lightweight

4. A copy of the Powell Board Report is not available. These statements were taken from an undated background document on rifle developments, prepared by Dept. of Army sometime in 1963.

rifles were much more effective than the M14 in terms of volume of fire and number of targets hit. Further, a 5- to 7-man squad armed with the AR15 would be as effective as a 10-man squad armed with the M14.

The AR15, however, was now involved in the thirty-year-old battle between the big bore and the small bore high velocity schools of thought, which began with the 1928 "Pig Board" recommendation for a small caliber, high velocity round. Ordnance officers persuaded the Army Chief of Staff, General MacArthur, in 1932 to disapprove procurement of weapons of less than caliber .30, and almost thirty years later, the 1928 arguments of cost, facilities, and inventory, together with the 1953 NATO standardization agreement, were used to convince the Chief of Staff, General Taylor, in January 1959 that the NATO 7.62mm (caliber .30) round should be retained. His successor, General Wheeler, reaffirmed that position in September 1959. These decisions temporarily stopped developmental work on the small caliber, high velocity concept as far as the Army was concerned. The next major push for the AR15 came from the Air Force in 1960.

Air Force[5]

Air Force Interest in Small Arms

Following World War II, the United States Air Force inherited large quantities of M1 and M2 carbines. For several years the carbine was used by the Air Force as the basic weapon for base defense and security. During a staff meeting on 29 August 1960, Lt. Gen Curtis E. LeMay, Air Force Vice Chief of Staff, remarked that there appeared to be a requirement for a better small arm for Air Force local security, and declared that he wanted the requirement firmly documented. An Air Force program was launched to replace all carbines in use with a more modern weapon.

As envisaged, procurement of a new rifle should have been an insignificant program for the Air Force. The cost was to be less than two million dollars a year over a five-year period, and programs of that size were normally handled by the Air Force without reference to the Department of Defense or Congress. However, this rifle procurement action initiated a major controversy.

Following the directions of the Vice Chief of Staff, an all-command survey determined that the Air Force had a valid requirement for a new weapon to replace the carbine. An Air Staff Study recommended that a total of 85,000 weapons be procured over a five-year period.

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5. This entire section covering the Air Force early history has been abstracted from an undated History of the AR15 (M16) Rifle, prepared by the Air Staff, Headquarters, United States Air Force.

On 16 March 1961, the Air Force Vice Chief of Staff was briefed on the Air Staff recommendations on selection and procurement of a new weapon for the Air Force. Following the briefing he directed that the Air Staff select the weapon, and that the Air Materiel Command be directed to procure the weapon at the rate of 19,000 a year. He further stated that he felt that the Armalite, AR15 rifle was the weapon that should be procured.

Following the 1958 US Army Infantry Board tests of the AR15 rifle, a representative of the Armalite Corporation visited the Pentagon to demonstrate the weapon to the Vice Chief of Staff of the Air Force. The Vice Chief of Staff agreed to have the weapon tested by the Air Force, but declared that he could not force the issue of buying it over Army objections.

In tests at Aberdeen Proving Ground, Maryland, Fort Greely, Alaska, and Lackland Air Force Base, Texas, the AR15 rifle was found to be an excellent weapon. In fact, it was found to be superior in nearly every respect to any other known military rifle.

The firm of Cooper-MacDonald, Inc., had been selected as the sales representative for the AR15 rifle, and Colt's Patent Fire Arms Manufacturing Company had by 1960 obtained the manufacturing rights. In July 1960, AR15 rifles were sent to the Air Force Marksmanship School for testing. The Air Force Vice Chief of Staff was impressed with their performance, and on 13 July 1960 he held

a meeting with the Chief of Research and Development, Department of the Army, and representatives of Cooper-MacDonald. As a result, the Chief of Ordnance was asked to complete additional tests of the AR15 rifle for the Air Force. On 9 September 1960, the Air Force Vice Chief of Staff was briefed on the latest small arms development programs of the Department of the Army; and on 26 September, along with Mr. Sloan of the Federal Bureau of Investigation and the Army Chief of Research and Development, he attended a demonstration of the AR15 rifle at Aberdeen Proving Ground, Maryland. He and the other attendees were impressed with the performance of the weapon and after a comprehensive study of the weapons available, the Air Force selected the AR15 rifle as the weapon that best satisfied its requirements. Funds for procurement of 19,000 new rifles were requested in the Air Force 1962 budget.

Problems with the Department of Defense

Funds for procurement of the AR15 rifle were withheld by the Department of Defense. The reasons given were that (1) introduction of another rifle of different caliber and characteristics into the Department of Defense inventories was not desirable; (2) adoption of a .223 caliber rifle for the Air Force was not consistent with NATO standardization objectives, and (3) large quantities of M1 and M2 carbines were available in Army and Air Force depots which, although they were twenty years old, were still usable.

The Office of the Director of Defense Research and Engineering and the Office of the Assistant Secretary of Defense, Installations and Logistics, had not agreed to Air Force procurement of the new rifle. This information was brought to the attention of the Air Force Chief of Staff on 18 July 1961, and by 20 July he had conferred with executives of these offices. It was agreed that a study should be made of the entire matter to serve as the basis for a decision by the Secretary of Defense. On 31 July, the study was complete; it recommended that the Air Force be allowed to procure the AR15 rifle. But there was still opposition within the Office of the Secretary of Defense; and after several exchanges between the Air Force and the Office of the Secretary of Defense, a meeting was held 21 August 1961 to discuss the program. The Deputy Secretary of Defense chaired the meeting. The Assistant Secretary of Defense for Research and Engineering and Assistant Secretary of Defense, Installation and Logistics, supported the Air Force position; the Department of Defense Comptroller opposed the procurement of the rifle. The results of this meeting were contained in a memorandum to the Secretary of the Air Force, stating that the request for procurement of the AR15 rifle was not approved. The prime reason given was the problem of justifying to the Bureau of the Budget or to Congress a proposal to procure another new weapon in view of the Army's rifle program.

Disapproval of the Air Force request appeared to be final. However, General Lemay, the Air Force Chief of Staff, held conferences with the Deputy Secretary of Defense to determine the course to follow to obtain the rifles. From these and other meetings within the Office of the Secretary of Defense, it was concluded that procurement of the new weapon depended on how the House Appropriations Committee felt about the matter. At the first approach Mr. Mahon of the Committee was not sympathetic with the proposal, and this information was presented to the Air Force Chief of Staff, along with the recommendation that the whole matter be dropped.

On 23 August 1961, six days after the official disapproval, the Air Force Chief of Staff voiced his desire to obtain the AR15 rifle for the Air Force at a Secretary of Defense staff meeting. Discussions among members of the Secretary of Defense staff following the meeting led to the conclusion that the Air Force had not supported procurement of the weapons in the proper manner. It was suggested that the request be resubmitted on the basis of a need for new weapons for special warfare.

By the following day, 29 August 1961, the case had been presented to Mr. Mahon, who had expressed the view that in general there should be no Congressional objection to the Air Force procurement of the rifles for special warfare. Members of the Air Staff

were instructed to request Secretary of Defense approval of procurement of a limited quantity of AR15 rifles for use by Composite Air Strike Forces and personnel assigned duty in Southeast Asia. But the idea was not well received by staff members in the Office of the Secretary of Defense. Little progress was made until 8 September 1961, when the Air Force Chief of Staff returned from the air show at Farnsborough, England. A letter proposing that the Air Force be allowed to procure 8,500 AR15 rifles for test, training, and unconventional warfare was sent to the Deputy Secretary of Defense. Approval was received on the same day.

On 11 September, the Air Force received some long-awaited help in its fight for the AR15 rifle. The Military Assistance Advisory Group in Vietnam requested a quantity of AR15 rifles for combat testing by the Vietnamese. The Director of Defense Research and Engineering and other members of the Secretary of Defense staff briefed Congressman Mahon on the entire effort in Vietnam. He promised his support in the procurement of the rifles.

Political Problems

The Deputy Secretary of Defense supported the Air Force request with a letter to Congress on 19 September 1961. The first two paragraphs of the letter are quoted:

> Subsequent to Congressional action on the Defense Department budget, the Air Force introduced an urgent requirement for equipping a portion of its forces with the AR15 Rifle.
>
> The Department of Defense has investigated thoroughly and concurs with the need for the rifle. The necessity for it has been personally justified to me by the Chief of Staff of the Air Force.

Copies of this letter were sent to Mr. Mahon, Chairman, Department of Defense Subcommittee, Committee on Appropriations, House of Representatives, and to Mr. Willis Robertson of the Senate.

Prior to official notification, many Congressional staff members had requested briefings on details of the Air Force request and on the AR15 rifle. On 21 September, the House Subcommittee on Appropriations held hearings on several re-programming requests, one of which was the Air Force AR15 rifle request. Because a joint session of Congress was scheduled for 12:30 p.m. the Chairman of the Committee had announced that the hearings would have to close at 12 o'clock. The AR15 rifle request was presented seven minutes before 12 o'clock. Because of the lack of time to complete the hearing, Mr. Mahon closed the session, stating that additional information would be required.

It was obvious that the Air Force had run into difficulties. The requirement for the AR15 rifle for special warfare was not well presented. The hearings turned into a debate on how the AR15 compared with the M14 rifle and why the Air Force should use the

same rifle as the Army. Attempts were made to discuss the question with individual members of the committee. However, on 23 September Mr. Mahon sent a letter to the Secretary of Defense stating that the Department of Defense Subcommittee of the House Appropriations Committee had voted to withhold approval of the Air Force request but would give the matter further consideration when Congress reconvened in January, 1962, if requested to do so.

Within a few days the Air Staff and supporters of the program in the Department of Defense had developed a new approach. The Advanced Research Project Agency of the Department of Defense was to attempt to get permission to buy a limited quantity of AR15 rifles for Vietnam without referring the matter to Congress.

The Deputy Secretary of Defense disapproved the request for procurement of a limited quantity of AR15 rifles for Vietnam, declaring that the political implications were such that any procurement would have to have Congressional approval. By mid-December 1961, after further requests from Vietnam and other sources, permission was obtained and 1,000 AR15 rifles were procured.

By December 1961, the question of which weapon to furnish the Vietnamese Army had to be answered. Many wanted to send the old M1 (Garand) rifles, but they were extremely heavy for the small natives. Old World War II carbines were less unreliable and would require rehabilitation before being returned to service. The Chief of Staff of the Air Force was pressing purchase of the

AR15 rifle for Vietnam but the Chairman of the Joint Chiefs of Staff, (who had previously ruled against the AR15 rifle) insisted on sending the carbine. On 13 December 1961, they took their case to the President. The President ruled in favor of the carbine. Following this decision, the Air Force Chief of Staff took steps to have the President briefed on the merits of the AR15 rifle and the Air Force interest in it. Later, the President became very much interested in the weapon and was photographed holding one.

When Congress reconvened on 12 January 1962, the Secretary of the Air Force visited Congressman Mahon, and one of the items discussed was the AR15 rifle. Mr. Mahon advised that unless the Air Force AR15 rifles were in the budget, it would be better not to bring the matter to the attention of Congress. However, on 8 March 1962, Mr. MacDonald, salesman for the AR15 rifle, called to report that he had information indicating that the House of Representatives Appropriations Committee was ready to approve the Air Force request for the weapon. Two major events brought about the change in attitude. Mr. Mahon and the Deputy Secretary of Defense were guests at the Air Force firepower demonstration at Eglin Air Force Base. Both were impressed by a demonstration of the AR15 rifle. A similar demonstration was arranged for the President.

By May 1962, the AR15 rifle was a common item of discussion at high-level meetings throughout the Department of Defense. Reports of the performance of the weapon in actual combat were beginning to arrive from Vietnam. The Air Force Chief of Staff was ready to go back to Congress with the request for the Air Force. On 10 May 1962 the official request went to Congress and approval was granted on 15 May. The Air Force had the rifles on contract within seventy-two hours, from the time the authorization was received.

The opponents of the AR15 rifle and the concept of small caliber, high velocity weapons did not give up without a fight. The May 1962 issue of the American Rifleman magazine contained what the Air Staff thought to be a very biased article that degraded the AR15 rifle. The Air Force was asked to rebut the article for members of Congress. Other derogatory statements were frequently made about the AR15 rifle, but test results were used to refute all such statements.

Following the procurement of the initial quantity of weapons, the Air Force included 19,000 new AR15 rifles in its FY 1963 budget. Before the request reached Congress, the final report from the Advanced Research Project Agency test of 1,000 AR15 rifles in Vietnam was published. It reported the AR15 rifle to be an outstanding weapon with phenomenal lethality. The Air Force plan to procure a total of 80,000 AR15 rifles was recognized and accepted

by the Department of Defense and Congress when the FY 1963 budget request was approved. The Air Force FY 1964 and 1965 budgets provided the remaining 52,500 rifles necessary to complete the 80,000 total.

This occasion marks the first time that the Air Force has bought a military rifle. More significant is the fact that the Department of the Army and the Marine Corps procured the rifle after the Air Force brought it into the Department of Defense inventory as a standard weapon. The AR15 was designated the standard basic weapon for the Air Force on 2 January 1962, and designated the M16 rifle by the Army 11 December 1963.

Department of Defense Activities

While the Air Force was working to obtain the AR15 as a standard weapon, ARPA procured ten AR15 rifles and the necessary ammunition for an evaluation in Vietnam.[6/] The evaluation of these weapons in Vietnam resulted in a request, in September 1961, by the Chief of the Military Advisory Assistance Group (MAAG) for 4,300 AR15 rifles for a full combat evaluation. The request suggested three alternatives involving approximately 1,000, 2,500, or 4,300 rifles, and cited the political and psychological advantages of providing advanced weaponry for use by the small statured Vietnamese in their counterinsurgency war. The Joint Chiefs of Staff had not acted on

[6] Memo for Chief, Office Service Section, OSD from ARPA Plans and Policy Division, 27 Jun 61.

the request, preferring to await the outcome of an evaluation of the Vietnam test and other tests by the Commander-in-Chief, Pacific. The Director of ARPA, believing the request to be urgent, sent a memorandum to the Secretary of Defense on 9 December 1961 recommending approval of the request for 1,000 AR15s and the necessary spare parts and ammunition.[7] The recommendation was approved and the 1,000 weapons were purchased with ARPA funds for testing. The report of the ARPA test recommended procurement of the AR15 rifle for the Vietnamese in lieu of the M1, M1 carbine, and Thompson submachinegun. The Air Force used the results of the ARPA test, previous Army tests, and its own tests to support procurement of the AR15.

On 29 August 1962 a White House Information Brief gave the results of the ARPA Vietnam test and provided extracts from various tests, citing the advantages of the AR15 over the M1 and M14 rifles, as well as over the M1 and M2 carbines and the Thompson submachine gun.[8] The report, coupled with the Assistant Secretary of Defense Comptroller effectiveness and cost comparison (Hitch Report) published 27 September 1962,[9] brought the controversy over the M14 and AR15 to the attention of the Office of the Secretary of Defense and the White House.

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7 Memo for SECDEF, 9 Dec 61, subj: AR15 Armalite Rifles for Test in Southeast Asia, from ARPA.

8 White House Info Brief, 29 Aug 62, subj: AR15 Armalite Rifle, Test Completion and Adaption for Vietnamese Armed Forces. Prepared by ARPA.

9 Office of the Assistant Secretary of Defense Comptroller, A Comparison of AR15 and M14 Rifles (Effectiveness and Cost), 27 Sep 62.

On 12 October 1962 the Secretary of Defense sent a memorandum to the Secretary of the Army requesting the Army's view of the relative effectiveness of the M14, AR15, and the Soviet AK47 rifle; the Army's rationale in support of that view; and the action which should be taken if either the Soviet or the AR15 rifle appeared to be superior to the M14. While the Army was preparing for the comparative evaluation, members of the Executive Office of the President expressed their concern over the Army's rifle program. The President was concerned about the differences of opinion, and on 9 November 1962 Mr. O'Donnell, Special Assistant to the President, forwarded a memorandum to the Secretary of Defense requesting his comments on the weapons. The Secretary of Defense informed the White House of the evaluation being conducted by the Army and promised to forward his comments upon receipt of the evaluation report and recommendations from the Army.

1962-63 Comparative Evaluation

The report of the comparative evaluation of the M14, AR15 and AK47 rifles was submitted to the Army Chief of Staff, who reviewed it and forwarded it with his conclusions and recommendations to the Secretary of the Army 14 January 1963. In the review of the report, the M14 was shown as superior to the AR15 in penetration, night firing, and reliability, and the AR15 superior to the M14 in automatic fire and transportability. In all other military characteristics

both weapons met or exceeded the military requirements. An unsatisfactory rating in reliability and night firing for the AR15 were judged readily correctable, and the report acknowledged that the M14 must be modified to be acceptable in the automatic fire role. The Chief of Staff recognized and discussed the political factors involved. He attached importance to the NATO agreement on ammunition standardization, stating:

> To introduct a .223 caliber system in Europe without prior coordination with our allies would be an outright violation of a specific standardization agreement . . . I consider it imperative to continue our support to the NATO standard system until we can be assured that our allies will joint us in adopting a new standard. Hopefully, that would be for a complete weapon system, not just for standard ammunition.[10/]

Concerning the national political implications, he further stated:

> I am also acutely aware of the great domestic interest in both the AR15 and the M14. No matter what the Army's decision in this matter may be, it will be subjected to criticism by proponents of one or the other of the weapons, or both, and by representatives of the regions economically affected.[11/]

10/ Although the NATO standardization agreement was cited as a reason for not adopting the AR15 as a standard system in the 1958 tests, in the 1962-63 evaluation and in several other papers dealing with the AR15 before the SAWS Study, the M16 Review Panel could find no evidence that the subject of standardizing the caliber .223 (5.56mm) ammunition, or the weapon system itself, had ever been discussed with the NATO allies. Therefore, it may be that the U.S. had no knowledge of how the Allies felt about changing the standard round or accepting the 5.56mm round as an additional standard round. (The British had proposed that a study be instituted to determine the desirability of accepting the 5.56mm as an additional standard NATO round at the April 1967 NATO Standardization Meeting of Panel III. All nations voted in favor of the study at that time).

11/ CSM for SA, 14 Jan 63, subj: Comparative Evaluation of the M14, AR15, and Soviet AK47 Rifles.

After consideration of the relative merits of the two weapons, the political implications, the status of SPIW development, and the procurement and funding situations, the Chief of Staff recommended:

a. In FY 64 (the Army) procure between fifty thousand and one hundred thousand AR15 rifles and in priority, use them to equip Air Assault units, Special Forces units, and Airborne units.

b. In FY 64 (procure) a sufficient number of the M14 (M) Modified rifles to provide an automatic rifle capability to all infantry squads armed with the M14 rifle.

c. Reduce the FY 64 M14 program by a number sufficient to accomodate recommendations a and b above.

d. Continue the current SPIW program and undertake expedited improvement of the AR15 to determine at the earliest possible date which of these weapons will best meet the requirement for a follow-on rifle.

These recommendations were approved by both the Secretary of the Army and the Secretary of Defense.

Near the completion of the comparative evaluation, the Secretary of the Army directed the Army Inspector General, with the advice and assistance of the Army General Counsel, to conduct an official investigation to determine whether, in fact, the comparative evaluation was conducted in a fair and impartial manner.[12/] No documentation has been found to indicate the reason for the investigation. The report of the investigation concluded:

a. Instructions governing the tests, conditions under which the tests were run, conduct of the tests themselves, and the methods of recording the test data were fair, impartial, objective, and non-prejudicial.

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12 Secretary of the Army Memo for the Inspector General, US Army, 21 Dec 62.

b. Methods of evaluating the test data as pertains to analytical processes involved and treatment of certain test results at U.S. Army Infantry School and U.S. Army Infantry Board were subjective and tended to favor the M14.

c. Reporting of the test results as pertains to presentation of the data, mixing personal observations with the analysis, and the tone of the verbiage of the report at USAIS and USAIB was subjective and tended to favor the M14.

d. Attitudes of certain personnel at USAIS and USAIB were favorable to the M14 to a degree that these attitudes may have caused subjective treatment of test results in analysis and reporting.

e. Tests of the AR15 and M14 rifles, with the exception of reservations expressed in conclusions b, c, and d, above were thorough, accurate, and objective; tests of the AK47 were limited by availability of weapons and ammunition.

f. Reports submitted by CG, U.S. Army Materiel Command and CG, U.S. Army Combat Developments Command have adequately discounted all material to which reservations are expressed.[13]

As indicated above, some of the controversy between the "big bore" and the "small bore" advocates was evident even though the "big bore" favoritism toward the M14 was recognized and discounted by the two major reporting commands.

On 11 March 1963 the Secretary of Defense designated the Army the Department of Defense agent for procurement of the AR15 (M16) system for all Services. His guidance further specified:

> that beginning with the FY 64 procurement only one rifle, rather than separate Service versions, is (to be) produced and that it is (to be) produced with

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13 Letter, Office of the Inspector General, U.S. Army, subj: Report of Investigation Concerning the Comparative Evaluation of the AR15, M14 and AK47 Rifles, 8 Mar 63.

> minimum delay (and that) modifications of the weapon and its ammunition are to be concurred in by all 4 Services. Only such modifications as (are) absolutely necessary should be made.[14]

The AR15 Technical Coordinating Committee was formally established by the Commanding General, USAWECOM on 29 March 1963,[15] although the committee's first meeting was actually held 26-28 March 1963 to expedite service coordination. The USAMC Project Manager for the AR15, whose office had been established on 6 March 1963,[16] was designated chairman of the Technical Committee and continues to serve in that capacity.

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14 SECDEF Memo to SA, subj: AR15 Ammunition and Rifle (U), 11 Mar 63.

15 Letter AMSWE, HQ WECOM, subj: Appointment of AR15 Rifle Technical Committee, 29 Mar 63 (copies addressed to the military head of each Service).

16 Msg 3-1427, HQ, USAMC, 6 Mar 63.

D. History of the M16 S[illegible]che Army Was Assigned Program Coordinat[illegible]onsibility.

GENERAL

The history of the M16 since the establishment of the Office of the Project Manager and the Joint Service Technical Committee is confusing if viewed chronologically. The M16 Review Panel, therefore, has chosen to present this period of the history of the M16 rifle by selected areas of interest.

PROCUREMENT, PRODUCTION, AND DISTRIBUTION

Procurement and Production

The procurement history of the AR15/M16/M16A1 rifle has been marked by a divergence of opinion as to the capabilities and deficiencies of the weapon system, and erratic statements of requirements.

Army procurement was begun with the purchase of a small quantity of AR15 rifles for test and evaluation in FY 1962, followed by a limited procurement, one-time buy in FY 1964. Although no further procuremenc was anticipated, an urgent requirement for the rifle in Vietnam in 1965 set the stage for a large purchase in FY 1966. Subsequent procurements in FY 1968 and 1969 have been based on production capacities rather than on any well-defined, long-range program. Within this same period (1966 to 1968) requirements to support forces in Vietnam, particularly the Free World Military Forces, have increased rapidly. A recapitulation of Army Procurements and

deliveries for FY 1962-68 is displayed in Table II-1. FY 1968 deliveries are not firm and may change as directed by the Joint Allocations Board. The total M16 rifle program for all services during FY 1961-68 is shown in Table II-2.

Ammunition procurement has not always kept pace with rifle deliveries, but once the production base was established, it has created no significant problems. The first year buy involving a major procurement action for 5.56mm ammunition was for 131 million rounds in fiscal year 1964. It was at this time that the Army assumed the role of purchasing agent for the total service 5.56mm ammunition requirement.

There have been no serious rifle production problems except for minor discrepancies in quality control. The contractor quality assurance program for the M16 rifle is defined by Springfield Armory Purchase Description 253B as amended 24 October 1966, and is basically identical to that required of M14 rifle contractors. Quality assurance monitorship and acceptance inspection is provided by the Hartford office of the Defense Contract Administration Service.

The quality assurance program for 5.56mm ammunition developed by an evolutionary process from the general terms of commerical specifications to the requirements established today. Many of the current standards were created because deficiencies were discovered

TABLE II-1 ARMY RIFLE PROCUREMENT AND DELIVERIES

PROCUREMENT		DELIVERIES						
YEAR	TOTAL PROCUREMENT	FY62	FY63	FY64	FY65	FY66	FY67	FY68
FY62	338	338						
FY63								
FY64	85,000			2,129	57,081	25,790		
FY65								
FY66	327,405					31,450	166,218	129,737
FY67								
FY68	247,716							105,016
TOTAL PROCUREMENT	660,459							
TOTAL DELIVERIES BY YEAR		338		2,129	57,081	57,240	166,218	234,753
CUMULATIVE TOTAL DELIVERIES		338		2,467	59,548	116,788	283,006	517,759

SOURCE - Army Materiel Plans - 1964-1968.
PEMA Item Readiness, Selected Items, 1966-1968.

TABLE II-2 DOD RIFLE PROGRAM FISCAL YEAR 1961-68

FY	DOD	ARMY	USAF	USMC	USN	COAST GUARD	TOTAL
FY61	1,000[1/]						1,000
FY62		338	8,500				8,838
FY63			19,000				19,000
FY64		85,000	19,000		240	20	104,260
FY65			33,500		1,550	142	35,192
FY66		327,405	60,082	91,872	2,000	1,411	482,770
FY67			65,000	18,294	19,237	700	103,231
FY68		247,716	65,000	34,916		1,000	348,632
TOTAL	1,000	660,459	270,082	145,082	23,027	3,273	1,102,923

1/ These rifles were procured for DOD-ARPA evaluation.

SOURCE - Army Materiel Plan, 1964-1968.

in the system through laboratory tests and field use. Appearing periodically, examples of poor quality control have served to emphasize a need at the time to tighten existing controls or to establish new test or inspection procedures.

Negotiations

Colt Industries acquired the proprietary rights for the AR15 rifle from Fairchild Aircraft Corporation in January 1959 at a cost of $75,000 plus 4½ percent royalty on all weapons produced. An additional $250,000 and a one percent royalty on each rifle was paid to Mr. Robert W. MacDonald, president of Cooper-MacDonald, Inc., as a finders fee. The requirement that Colt's Inc. pay the above-mentioned royalties totaling 5½ percent was a factor in all subsequent negotiations.

On 8 August 1963 the first request to Colt's Inc. for a quotation on a price for delivery to the Government of a complete technical data package and the right to manufacture the M16 rifle was made. Colt's refused to negotiate, stating that when total requirements for the rifle exceed 500,000 units, it would consider licensing other sources of production.[1/] The Assistant Secretary of Defense (I&L) then directed that procurement actions be completed without negotiating for proprietary rights since there were no plans to purchase more than 85,000 of these rifles for the Army.

1/ Memo, Hq, USAWECOM, 30 Oct 63, sub: Submission for Approval of Award of Contract for Rifle, 5.56mm, M16.

In October 1964 Colt's Inc. made four alternative offers, the most attractive of which would require no payment other than 5½ percent royalty on each rifle if at least 540,000 rifles were produced. These offers were rejected because there were no indications of a requirement for this number of rifles in the future.

A decision of 6 December 1965 to procure an additional quantity of M16 rifles renewed the Army's interest in the patent rights and further negotiations. However, the letter order contract awarded on this date did not include any provision for negotiations because the Army urgently needed the rifles and wished production to commence as soon as possible. In May 1966, it was agreed by both parties that negotiations would be completed prior to 1 December 1966.

Negotiations continued until the contract was finally signed on 30 June 1967. The negotiations would very likely have been completed several months earlier if a mutual agreement had not been made on 17 February 1967 to negotiate only for rights to the rifle and if the Army had not insisted on 2 March 1967 that the rights to the CAR15 (XM177) submachine gun be included. New terms were thus introduced and required a longer time for resolution.

Allocation and Distribution

Allocation of M16 M16A1 rifles and associated ammunition among

service is accomplished by the Joint Materiel Priorities and Allocations Board. All services are represented at the board hearings, but allocations are based on priorities established or approved by the Secretary of Defense and the stated requirements of Commander, U. S. Military Assistance Command, Vietnam.

Economic analysis of M16 rifle procurement through development of cost quantity relationships in small arms manufacture and comparison of these relationships with past and projected M16 procurement provides useful insights regarding the M16 procurement contracts which were recently awarded. Very little reduction in unit price of rifles is experienced after production of the first 100,000 weapons. (A learning curve of 98 percent is typical in this industry.) Justification for the establishment of multiple sources on exclusively economic grounds is difficult since start-up costs and initially high unit costs cannot be easily absorbed through substantial cost reductions in later production. There appears to be little economic justification for the recent establishment of two additional M16 production sources.

PRODUCT IMPROVEMENT MODIFICATIONS

In the case of small arms, numerous minor modifications are commonly made to the weapon during its service lifetime. This was the case with the M1903 "Springfield", and with the M1 and M14 rifles as previously discussed. These modifications, made to improve functioning, durability, facilitate manufacturing, or reduce cost, are most numerous in the early developmental phase of the life cycle and, as would be expected, tend to diminish after the system has been fielded a few years.

The requirement for modifications of the AR15/M16 system has been consistant with that experienced by preceding weapons as indicated above. Unlike previous Army rifles, the administrative procedures for modification of the M16 had to be initiated by the contractor since the weapon was a proprietary item and all rights to drawings and production were the property of Colt's. No evidence was found to indicate the contractor resisted or delayed any of the changes desired by the Government. The changes made in the M16 since the Army became responsible for procurement of the system are shown in detail, by contract number, in Appendix 11 and summarized below. Two modifications, the addition of the bolt closure device for the Army and the change in the barrel twist rate from 1 turn in 14 inches to 1 turn in 12 inches, which have been a subject of

controversy within and outside of DOD, are not included in this discussion since those changes were made prior to finalization of the first Army contract. Discussion of those two changes will be found in Appendices 2 and 5.

Colt's initiated production of the M16 and the XM16E1 rifles in March 1964, under contract DA-11-199-AMC-508. In April and May 1964 eight Requests for Technical Action (RTAs) to permit dimensional and material or surface treatment changes, and two Requests for Waivers (RFWs) to permit acceptance of weapons with cyclic rates of fire up to 900 rounds per minute were submitted. Cyclic rate variation apparently was not a major area of concern in 1964, as no test evidence substantiated the AR15-M16 Rifle Technical Coordinating Committee's approval of the specification change, nor was cyclic rate measured at Aberdeen Proving Ground in the engineer design test of propellants conducted during this period. In May 1964 two RTAs submitted by Colt's requested revision of drawings for 58 parts, as obtained from Armalite, to improve the component parts and to eliminate certain malfunctions. These requests were followed by two more proposals in June and August 1964 to modify 19 additional parts. In June 1964 Colt's requested and received a waiver to deliver M16s with cyclic rates up to 900 rounds per minute.

Provision was made for the use of stainless steel for the gas tube and gas tube assembly in November 1964.

In January, February, and March 1965, Colt's subcontractor for the M16 upper receiver forgings was behind his delivery schedule. To meet the deliveries scheduled for the U.S. Air Force, Colt's requested and received permission to utilize XM16E1 upper receiver forgings (with the bolt closure device) in fabricating M16 upper receivers by milling off the forward assist boss (Bolt assist housing). Most other RTA's in the 1964 and 1965 time period proposed small dimensional changes, alternate materials, or surface finish modifications. Significant among the latter were a series of requests in May 1965 to parco-lubrite, instead of electrolize, the bolt, ejector, extractor, and extractor pin. This was the change from the "shiny" to the "black" bolt, and was reported to improve wear resistance and service life of those components. In June 1965 the bolt carrier finish was changed from electrolized to a chrome-plated interior and a parco-lubrited exterior. Three months later the electrolized bolt carrier key was replaced by one chrome-plated on the inside and parco-lubrited on all remaining surfaces. A further change in the bolt finish was requested by Colt's in January 1966 which initiated shot peening to increase the life of the bolt. That request was rejected until the Lackland Air Force Base Test report of February 1966 substantiated the

the improvement in bolt life. In this test, increased cyclic rate with WC846 ball propellant, and the association of high cyclic and malfunction rates, were confirmed. Colt's previous test data had given similar results. The Technical Coordinating Committee approved Colt's suggestion that new buffer designs be tested. The buffer tests were undertaken at Springfield Armory and completed on 13 May 1966. On 4 March 1966 Colt's submitted a formal request to change the buffers. The request was approved by Springfield Armory on 17 May 1966 and by the Project Manager, Rifles on 6 July 1966. On 16 July the contracting officer notified Colt's of governmental approval subject to a reduction in the contract prices. Rifles utilizing the new buffer design were first received from production in December 1966 and a buffer retrofit program initiated.

On 12 April 1967 Colt's proposed chrome plating the chamber to increase corrosion resistance and thereby to reduce the tendency of the cartridge and burning propellant residue to stick in the chamber, under adverse environmental conditions, and to facilitate cleaning the chamber. Approval was granted on 26 May 1967 without Army test. The Air Force had reported favorably on its test, at Lackland Air Force Base, of six chrome-chambered M16 rifles on 4 April 1967. Meanwhile, the Army shipped 12 M16A1s with chrome-plated chambers to Vietnam for evaluation. In May 1967, when the

Army Weapons Command technical team made its third visit to Vietnam, it could locate only two of these rifles, and no useful information had been collected, or could be obtained, to indicate the effectiveness of the chrome-plated chamber in reducing the most critical malfunction-failure to extract. Also in May 1967 the firing pin was changed to provide for hard chrome plating in lieu of electrolizing. This modification was the last in a series of modifications, initiated in November 1964 with introduction of a stainless steel gas tube, to make the weapon system less susceptible to accumulation of solid particles of residue (carbon build-up) contained in the propellant gases.

In October 1967, when the Army was obtaining production rights and engineering drawings for the M16, Colt's submitted 18 RTA's to modify drawings for the stated purpose of improving dimensional control and depicting the parts as they were actually being produced.

Pending Product Improvements

As of March 1968 the U.S. Army Weapons Command and Colt's were considering twelve product improvement modifications, which had not yet been formally proposed in an RTA. Those modifications are:

1. Buttstock. Change the filler material and provide space for storage of the four-piece cleaning rod and other cleaning equipment.

2. Magazine. Change the configuration to provide for a thirty-round capacity.

3. Magazine. Develop new plastic materials and a new follower assembly to permit issue of disposable, pre-loaded magazines.

4. Magazine Spring. Make the spring of stainless steel to prevent rust and corrosion, thereby increasing magazine life and reliability.

5. Upper and Lower Receiver. Shot peen the surfaces to provide a more durable finish and to aid in the prevention of exfoliation and inter-granular corrosion.

6. Handguard Slip Ring and Spring. Redesign the slip ring to allow easier removal of the handguard and cadmium coat the spring.

7. Ejection Port Cover and Pin. Use stainless steel for these parts to prevent rusting.

8. Barrel. Chrome plate the bore to improve resistance to corrosion and metal fouling deposits.

9. Extractor Spring. Utilize nested springs to provide for longer spring life.

10. Magazine Cover. Utilize a plastic bag or cap cover to protect magazines from adverse environments.

11. Rear Sight. Provide for a center index "0".

12. Charging Handle Latch. Add Delrin to the charging handle latch material to prevent wear of the upper receiver.

AMMUNITION DEVELOPMENT PROGRAM

Introduction

The development of the 5.56mm ammunition system started in 1957 and was essentially derived from the Remington Caliber .222 cartridge.[2/] In November 1957, the Armalite Division of Fairchild Aircraft and Engineering Company invited Remington Arms Company, Inc., to cooperate in design and development of a cartridge for use in the Armalite AR15 rifle which was then being developed. Most of the ammunition produced by Remington until the middle of 1962 was on a commercial basis for the firm of Cooper-MacDonald.

Cartridge Case

Initial Military Specifications.

The initial military specifications published by the U.S. Air Force were developed primarily from the commercial specifications prepared by Remington Arms, Inc., and did not provide for metallurgical control of cartridge case hardness which has been a mandatory requirement for the 7.62mm North Atlantic Treaty Organization (NATO) cartridge. Although this problem is currently under study by Frankford Arsenal, mandatory case hardness specifications for the M193 5.56mm round have yet to be published.

Development.

Testing conducted in 1963, as reported by the U.S. Air Force, identified cartridge case defects in the form of blown primers and

2/ Staff Paper, prepared by Remington Arms Company, Inc., undated, sub: Development of Caliber 5.56mm Ammunition.

debulleting, that is separation of the case from the bullet upon extraction of an unfired cartridge from the chamber, thus leaving the bullet in the bore of the weapon. These defects were the result of a differences in chamber configurations between the production rifle chambers and the Remington test barrel chamber which was used for ammunition proof testing. The throat angle of the AR15 chamber was steeper, and the neck section shorter, than that of the Remington test weapon resulting in ammunition being produced which did not properly fit the chamber of the AR15. The modification in the Colt chamber had been ordered by Mr. Stoner and Remington had never been advised of the change. Upon discovery of the differences, Colt's and Remington came to an agreement that it would be technically more feasible to change the dimensions of the barrel chamber than it would be to change the 5.56mm round. Existing weapons were retrofitted with new barrels and all new production was converted to the original chamber dimensions.

In October 1964, Frankford Arsenal identified the hardness of cartridge cases as a significant factor in rifle functioning and in the occurrence of certain malfunctions. Frankford Arsenal, anticipating that problems related to cartridge case hardness would arise, initiated action in September 1964 to develop data that would provide a backgound and basis of comparison for case hardness measurements. After developing test procedures, Frankford Arsenal recommended that they be used for making hardness measurements on 5.56mm

cartridge cases whenever such measurements were required.

No action to establish metallurgical controls over production was taken. The Project Manager, Rifles, saw no apparent need for such controls in view of the absence of cartridge case ruptures with 5.56mm ammunition manufactured to specification. Though some ruptures had occurred, they were attributed to other factors such as water in the bore.

Frankford Arsenal, as a result of its analysis of all data pertaining to cartridge case metallurgical data over an extended period of time, advised the Commanding General, Army Munitions Command in a letter dated 24 August 1967 that in order

> . . . To minimize the burden to industry and to assure compatibility of recommended hardness patterns with production processes, Frankford Arsenal plans to publish its recommended hardness patterns as a guide to industry. The GOCO plants (Twin Cities and Lake City, Army Ammunition Plants) will be required to make the necessary process adjustments and to commence hardness testing of all subsequent ammunition lots. The results of these tests will be studied by Frankford Arsenal and at the end of 6 months, adherence to an established hardness will be aided and guided by Frankford Arsenal in effecting necessary process modifications to meet the recommended hardness profile. 3/

Additional testing is now being conducted by the United States Army Test and Evaluation Command to determine the effect that hard and soft cases have on extraction from Vietnam conditioned (pitted or corroded) weapon chambers.

3/ Ltr, Frankford Arsenal to CG, USAMUCOM, 24 Aug 67, sub: Quality Assurance Provisions for 5.56mm Cartridges.

Primer Sensitivity

Initial Specifications.

Specifications established by the Air Force on 24 January 1963 did not provide for specific limitations on primer sensitivity for 5.56mm ammunition. [4]

Development.

At the first meeting of the Technical Coordinating Committee on 26 March 1963, [5] the Air Force representatives submitted a list of reported ammunition deficiencies, which included "high primers" and "primers too sensitive". It was agreed that Frankford Arsenal would investigate the matter and recommend corrective action.

One of the malfunctions reported by the Air Force was the premature firing of cartridges that occurred upon initial charging of the weapon. This malfunction was attributed to "high" or protruding primers, although the tests did not confirm this theory. Since premature firing occurred after bolt-locking, it must have coincided in time with the impact of the bolt carrier against the barrel extension. The kinetic energy attained by the AR15 "free floating" firing pin upon closure of the bolt must be dissipated by such frictional forces as it encounters in its forward movement, and, finally, in impact of the firing pin tip with the primer of the chambered cartridge. Frankford Arsenal identified test procedures for measuring firing pin energy and recommended that primers be manufactured so

[4] MIL-C-9963 (USAF), 24 Jan 63.
[5] Min, Technical Coordination Committee, 26 Mar 63.

that the none-to-fire limit should be not less than 16 inch-ounces of energy and the all-to-fire limit be not greater than 64 inch-ounces of energy. However, as a result of a subsequent joint study conducted by Lackland Air Force Base and Frankford Arsenal, the Technical Coordinating Committee on 13-14 August 1963, [6] agreed to a none-to-fire limit of 12 inch-ounces and an all-to-fire limit of 48 inch-ounces.

The Army Staff representative (ACSFOR) withheld concurrence on these limits pending further comments from the Army Staff. On 17 September 1963, the Army Staff informed the Project Manager that the primer sensitivity limits contained in the specifications could not be accepted because of the risk of inadvertent fire. [7] The Commanding General, USAMC, stated that the only practical solution was to modify the weapon. Consequently, Colt's Inc. developed and submitted for test two modifications of the firing pin, a linear spring device and a cam pin friction device, to reduce firing pin energy on bolt closure. At a Technical Coordinating Committee meeting of 10 December 1963, [8] at which a comparison of all tests done by the Army, Air Force, and Colt's Inc. were made, the committee agreed to adopt a modified lighter firing pin, which was used in the cam friction device. That recommendation was approved by the Secretary of Defense, 23 December 1963.

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[6] Staff Paper, prepared by Remington Arms Company, Inc., undated, sub: Development of Caliber 5.56mm Ammunition.

[7] Historical Summary of 5.56mm Cartridge Program From Inception Until 30 September 1963, Frankford Arsenal.

[8] Min, Technical Coordinating Committee Meeting, 10 Dec 63.

Primer Composition Development Efforts.

Colt's Inc. first experienced difficulty in 1963 in complying with the 6,000 round endurance test for the Air Force contract. [9] Specifically, the problem was defined by Colt's as an excessive accumulation of fouling on the bolt assembly. Analysis of the chemical composition of primers by Frankford Arsenal resulted in a change in the military specifications on 8 February 1966 to eliminate calcium silicide as an acceptable primer compound because its use contributed to excessive carbon buildup (fouling).

Bullet Design

Initial Specifications.

The initial military specification for the cartridge, 5.56mm (5.64mm by Air Force designation)[10] stated the cartridge would comply with the requirements specified on Remington drawing 62633759.

Development.

Bullets of several different shapes have been made by various manufacturers at various times for use in early commercial ammunition for the AR15 rifle. The projectile originally designed for the AR15 was a 55-grain, caliber .223 Remington bullet, with a 9 degree boatail and a short tangent ogive nose.

Frankford Arsenal conducted an investigation of bullet configuration in 1963 in order to determine the best design for achieving aerodynamic stability with maximum lethality.[11]

9 Frankford Arsenal Eighth Memo Rpt, 10 Dec 63, on AR15 Rifle-Ammunition System.

10 MIL-C-9963 (USAF), 24 Jan 63

11 Frankford Arsenal Third Memo Rpt on AR15 Rifle-Ammunition System, 18 Jun 63.

It tested Type A bullets, taken from cartridges manufactured by the Remington Arms Company, and Type B bullets, taken from a sample provided to Frankford Arsenal by the U.S. Air Force (procured as separate components from the firm of Sierra Bullets). The two types of bullets showed marked characteristic differences in their configurations. The ogival curve of the Type B (Sierra) bullets was approximated by an arc of about 7-caliber radius. The overall length of the Type A bullets was about 3.28 calibers, Type B bullets were slightly longer. After its investigation, Frankford Arsenal concluded:

1. The Type B bullets evaluated in the test had significantly better exterior-ballistic prope[illegible] than had the Type A bullets.

2. The use of bullets having more favorable aerodynamic shape (such as Type B instead of Type A) would allow a reduction of 50 fps in muzzle velocity, thereby reducing the probability of interior-ballistic problems, which might arise in large-scale loading of .223 ammunition, and still provide higher impact velocities at 100 yards and at all greater ranges.

3. An assessment should be made of the aerodynamic stability and the lethality of Type B bullets when fired from barrels of 12-inch twist under all anticipated conditions of use.[12/]

12 Frankford Arsenal Third Memo Rpt on AR15 Rifle-Amminition System, 18 Jun 62.

The report was presented by the Frankford Arsenal representative to the Technical Coordinating Committee 25-26 June 1963.[13]

There is little available documented information on this matter for a six-month period following the meeting.

On 26 February 1964, the Project Manager requested the Ballistic Research Laboratory (BRL) prepare a test plan designed to provide data on which to base a decision concerning which type bullet to adopt for the M16 rifle:

> The test should include determinations of stability factor within expected temperature range, velocity/range relationship, maximum ordinate, penetration, barrel erosion, fouling, smoke and flash, brush deflection, wounding power (including bullet break-up), accuracy in new and worn barrels, effect of muzzle brake compensator and any other factors which you determine to be necessary to provide a basis for a sound decision.[14]

On the basis that extensive data was already available for rifle bullets, BRL recommended no tests be scheduled to define the performance of the Sierra configuration bullet. BRL provided the following information in its response to the Project Manager.[15]

> Sierra bullets have been fired from the AR15 rifle with twist rates of 1:12 inch and 1:14 inch in an experiment to determine the stability factor. A table giving comparative stability factors is presented.

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13 Min, Technical Coordinating Committee, 25-26 Jun 63.

14 Ltr, QMCPM-AR15, sub: Evaluation of Sierra Configuration cal. .223 Bullet.

15 1st Ind (AMXBR-WO), 20 Mar 64, to Ltr, (AMCPM-AR15), 26 Feb 64, sub: Evaluation of Sierra Configuration cal. .223 Bullet.

Testing at +70° Fahrenheit

Projectile	Twist	Stability Factor	Twist	Stability Factor
.223 Remington	1:12	1.60	1:14	1.20
Sierra	1:12	1.23	1:14	.91
Testing at -65° Fahrenheit				
.223 Remington	1:12	1.20	1:14	.90
Sierra	1:12	.92	1:14	.68

It appears from these data that the Sierra bullet when launched from a 1:12 inch twist compares quite closely to the .223 Remington when fired from a 1:14 inch twist barrel. In order for the Sierra bullet to perform similar to the .223 Remington when fired from a 1:12 inch twist, a barrel twist of 1 turn in 9.5 inches is required.

With reference to velocity, BRL provided the following data:

The difference in velocity between the Sierra configuration round and the .223 Remington is about 200 feet per second at 500 meters if they are fired with the same initial velocity. Since the matter of most importance is assumed to be wounding power, a comparison of conditional probabilities of incapacitation, assuming these projectiles at a given velocity are equal in lethality, will provide insight into the extent of improvement which could be expected with the Sierra bullet. These data are:

	.223 Remington		.22 Sierra	
Range (Yards)	Velocity	PHK	Velocity	PHK
0	3,270	.81	3,270	.81
100	2,894	.76	2,944	.77
200	2,540	.68	2,633	.69
300	2,211	.58	2,341	.61
400	1,903	.50	2,068	.54
500	1,627	.41	1,814	.47

BRL further advised that a review of data had indicated that there would be little increase in lethality if the Sierra bullet were chosen. They saw no justification for the concurrent investigation of all the aspects of performance defined by the Project Manager and felt that a small scale effort could be undertaken to examine wound ballistics if required.

Without the benefit of the requested data from BRL the Project Manager's office noted that if the Type B Sierra configuration was adopted it would be necessary to (1) implement engineering change to twist of barrels from 1 turn in 12 iches to 1 turn in 10 inches (or such other twist rate as further testing may establish); (2) replace barrels on hand in Army and Air Force rifles; (3) replace repair barrels in stock of the Army and Air Force; (4) replace present stocks of M193 ball ammunition.

On the basis of this information and the comments by the Ballistic Research Laboratories, the Project Manager cancelled further tests on 7 April 1964.[16/] At the present time, after 4 years experience in quantity production of standard M193 Ball cartridges under existing quality control standards, the difference in lots of ammunition produced by different manufacturers can be determined by a comparative visual inspection because of the differences in

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16 2d Ind (AMXBR-WO), 7 Apr 64, to Ltr, AMCPM-AR15, 26 Feb 64, sub: Evaluation of Sierra Configuration cal. .223 Bullet.

the shape of the bullet ogive. These variances in the bullet ogive are pronounced enough to lead the Review Panel to believe that the aerodynamic characteristics are sufficiently different to cause marked differences in down range velocity and thus affect accuracy and lethality.

Propellants

There are three major commercial propellant producers in the United States: E. I. Dupont de Nemours and Company, Inc., Hercules Powder Company, and Olin Mathieson Chemical Corporation.

The IMR (improved military rifle) propellants of Dupont are single-base (containing no nitroglycerin), extruded (as spaghetti is extruded), hollow tubes, which are chopped to lengths suitable for measuring and loading into cartridges. IMR propellants have been in use for more than 30 years.

The double-base extruded propellants of Hercules Powder Company are similar in shape of grain to the IMR propellants, but differ from those in that they contain nitroglycerin as a supplementary source of energy. Propellants of this type have been in use for more than 50 years.

The ball propellants of Olin Mathieson are generally similar in chemical composition to extruded double-base propellants, but the form of the grain is roughly spherical, hence the name ball

propellant. Ball propellants have been used for about 25 years. They have the designation WC for Western Cartridge, an Olin Mathieson subsidiary. The Olin Mathieson process for manufacture of ball propellant allows for the use of reclaimed nitrocellulose. Thus, obsolete propellant containing nitrocellulose can be reprocessed rather than discarded, although none is now being reprocessed.

The principal difference among propellants of a single manufacturer is in the chemical coating which is applied to the surfaces of the propellant to control the initial burning rate of the individual propellant grains. Thus, a given plant can easily make several propellants of a similar type, but the manufacture of certain propellants -- notably the double-base ones -- requires special facilities, such as a nitroglycerin processing capability.[17]

The ammunition manufactured by Remington Arms and used by Cooper-MacDonald Company for demonstration and testing of the AR15 rifle was loaded with IMR 4475 propellant.[18]

The technical data package for 5.56mm ammunition developed jointly by the Army and Air Force in 1962 and early 1963, specified the use of IMR 4475, a projectile muzzle velocity of 3250 ± 40 feet per second, and a maximum chamber pressure of 52,000 pounds per square inch (the commercial specifications). These requirements were also contained in the 16 August 1963 Request for Proposal (RFP)

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17 Memo Chief of Staff for Secretary of the Army 27 Sep 67, sub: M16 Rifle Testing.

18 Memo Remington Arms Company, Inc., 28 Jul 67, sub: Development of Caliber 5.56mm Ammunition.

for procurement of one million rounds of M193 ball cartridges. Both Olin Mathieson and Remington Arms, the two eligible bidders, took exception to provisions of the technical data package, but at the time, there was no objection to the use of IMR 4475 propellant.[19] The elements of the technical data package under question were those specified by Remington Arms Company as part of a procurement package purchased by the Army in conjunction with the 600,000-round purchase of ammunition in mid-1963. Remington had declared that the specifications were correct at the time of the 600,000-round purchase; however, Dupont now claimed it could not meet the pressure-velocity requirements of the specification for the propellant.

The Project Manager thought that an alternate propellant should not be developed at the expense of other tasks which he felt were more urgent,[20] and advised the Commanding General, AMC, on 30 January 1964, of the difficulty the Army was having in obtaining responsive bids for the manufacture of the initial one million rounds of the 150 million total rounds required in FY 1964.[21]

The results of the testing of alternate propellants by USAMUCOM determined that the Olin Mathieson WC 846 propellant, and the Dupont CR 8136 were both suitable for loading in the 5.56mm M193 cartridge,

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19 Memo, USAMUCOM, 3 Sep 63, sub: TDP for 5.56mm Cartridges.

20 Ltr, Frankford Arsenal, 27 Sep 63, sub: Engineering Program for 5.56mm (AR15) Ammunition.

21 Memo, Project Manager 30 Jan 64, sub: FY64 Ammunition Procurement Program -- XM16E1 Rifle.

and Dupont's IMR 4475 was continued as acceptable for existing contracts.[22] Weapon cyclic rate was not considered in these tests.

Continued USAMUCOM propellant evaluation conducted by Frankford Arsenal was concluded on 5 May 1966 with a recommendation that the Dupont experimental 8208 (soon to be identified as IMR 8208M) powder be approved for use in 5.56mm ball (M193) and tracer (M196) cartridges. The Frankford Arsenal proposal was approved by the Project Manager on 17 May 1966.[23]

The two government-owned-commercially-operated (GOCO) ammunition loading plants at Lake City (LCAAP) and Twin Cities (TCAAP) began loading with IMR 8208M during late 1966 and early 1967. The initial nineteen propellant lots supplied by Dupont showed little improvement over previous IMR propellant types insofar as meeting the velocity-chamber pressure specifications. Dupont initiated a modification in its propellant process with lot number 20, which proved successful in meeting the velocity-chamber pressure requirements.[24]

The evaluation of the Dupont propellants, illustrating the velocity-chamber pressure relationships of the three Dupont propellants and Olin Mathieson WC 846 ball propellant are shown graphically on Figure II-1. The lines through these points represent

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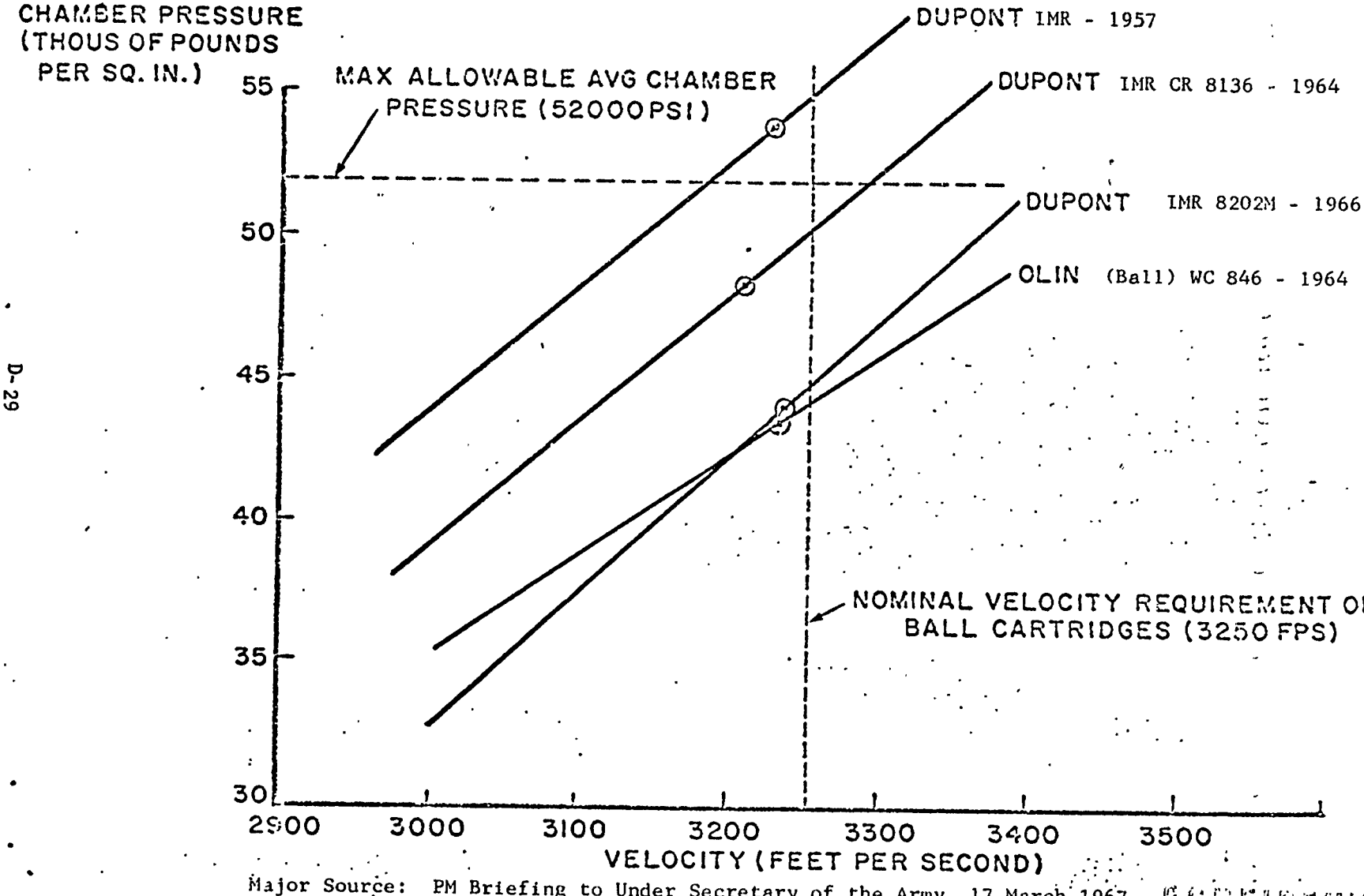
22 MFR, Frankford Arsenal, 11 Dec 64, sub: Cartridge 5.56mm.

23 Ltr, Frankford Arsenal, 5 May 66, sub: Request for Concurrence with 1st Ind, Project Manager, 17 May 66.

24 Memo, ODCSLOG, 22 Mar 67, sub: M16A1 Rifle Ammunition.

FIGURE II-1—VELOCITY-CHAMBER PRESSURE RELATIONSHIP WITH VARIOUS PROPELLANTS IN M193 BALL CARTRIDGE



Major Source: PM Briefing to Under Secretary of the Army, 17 March 1967.

the velocity/pressure gradient for each of the propellants, which is determined by hand loading cartridges with carefully weighted charges of each propellant type, and measuring the velocities and pressures produced by each handloaded sample. Note that the velocity-chamber pressure relationship of the Dupont propellants is approaching that of ball propellant. The points plotted on the velocity-chamber pressure curves represent the actual velocity and pressure levels of machine-loaded ammunition samples.

During the Weapons Systems Evaluation Group test of the M16 rifle, which was conducted in Panama in January 1968, it was determined that the use of IMR 8208M propellant in ball ammunition contributed to malfunctions. A temporary suspension of loading ball cartridges with IMR 8208M propellant was therefore directed by the Department of Defense. The WSEG Panama test is discussed in Appendix 6. Additionally, during the conduct of E1/ST on the XM177E2 submachine gun it was found that tracer cartridges, loaded with WC 846 (ball) propellant, were breaking up in flight. Therefore, the use of WC 846 propellant for loading tracer cartridges was suspended in January 1968. At this time, the loader of each type ammunition is restricted to one type propellant - IMR for tracer cartridges and ball for ball cartridges. A more detailed discussion of ammunition development is contained in Appendix 4.

SMALL ARMS TEST POLICIES AND PROCEDURES

Army Test Program

The Army materiel development system and hence the Army Test Program were, during the development and introduction of the M16 rifle, oriented almost exclusively to Army developed systems. This was a satisfactory system for Army-developed weapons, but was insufficient for the smooth introduction of commercially-developed items. The Army lacked an overall materiel life cycle system and an integrated test program. A detailed examination of small arms test policies and procedures is contained in Appendix 1.

An overall life cycle system, which includes an integrated test program, is being initiated; however, further policy, organizational, and procedural changes are needed. Regulations currently being coordinated make some improvements in the Army Test Program with regard to commercially-developed items, but there is much yet to be done.

Objectives of the Test Program

In the past, the objectives of the Army Test Program were to insure that new materiel met the approved materiel requirements; and to determine materiel suitability and safety. These objectives were so broad at DA level that they provided little meaningful guidance to test agencies in the preparation of test plans. however, USAMC

published regulations, with more definitive test guidance which narrowed the gap. Consequently, the adverse impact on tests that were conducted was lessened but not eliminated.

Requirements for Testing

Published directives at all levels required that a Coordinated Test Plan be prepared only for the Engineering and Service Tests (ET/ST). Virtually no provisions for product improvement, production, or post production testing were specified. Although USAMC has recently provided additional guidance on required product improvement testing, the situation remains essentially unchanged. It is anticipated that the requirements for a Coordinated Test Plan in the new life cycle management system will encompass the necessary requirements for testing at the critical points in an item's life cycle. One of the major deficiencies which previously existed was that insufficient procedures were in effect to provide for early, comprehensive feedback on a systems performance after its issue to troop units. USAMC now requires a representative to accompany a major item to the first units equipped, and to remain there a sufficient length of time to provide the necessary feedback on system performance and report any shortcomings.

Responsibilities For Testing

Within the Department of the Army Staff the responsibility for testing was fragmented among DCSOPS (later ACSFOR), DCSLOG, and CRD. Continuity was lacking in the life-cycle management. Many testing

responsibilities were appropriately given to commodity command commanders and project managers; however, there was no provision for coordinated evaluation of test results. In fact, tests were often directed by the project manager, and the results submitted to him, without anyone above that level having knowledge of the test. ACSFOR has recently been given overall staff responsibility for equipment life cycle management; however, many policies required to initiate the program remain to be published. USAMC has also recently strengthened USATECOM's role in independent testing and in the evaluation of engineering, service, product improvement, and confirmatory tests.

Standards of Testing

In general, there has been little emphasis on test standards. Sample sizes used in testing certain items and statistical confidence in the results obtained, while not reported, have been inadequate, as have the guidance provided for test planning and design. Realizing this, USAMC initiated a "Standards of Testing" Study which was recently completed. Several of the recommended actions have been implemented: a coordinated test plan is mandatory for all items phased with the life cycle management model; Standard Materiel Test Procedures (MTP's) have been updated; more detailed guidance on maintainability and reliability testing have been published; training and orientation courses have been established at USATECOM for both supervisory and technical personnel from the DA staff and those major subordinate

commands concerned with testing and evaluations; and Coordinated Test Plans must now include specific guidance on the sample size to be used in the various tests. Improvements in methodology, instrumentation, and further improvement in standards are currently being studied. The statistical confidence level should be stated explicitly for all results obtained.

Control and Coordination of the Test Programs

Within USAMC headquarters as well as the DA staff, there has been no single staff element responsible for controlling and coordinating test actions. These actions have normally been accomplished by routine staff actions handled on a case-by-case basis. Few controls existed for evaluation of commercially-developed items to determine military worth, or to compare them with on-going RDTE projects. ACSFOR has now been designated as the single staff agency at Department of Army level for testing and evaluation in consonance with their responsibility for life cycle management; however, changes have not been instituted within USAMC, although the problem is under study.

Distribution and Use of Test Reports

Although major test reports, such as Engineering and Service tests, were normally distributed to all interested agencies and levels, product

improvement test reports were distributed as directed by the commodity command or the project manager who requested the test. Corrective actions on deficiencies revealed were left entirely up to the commodity command or project manager. The requirement now is that USATECOM independently evaluate all product improvements and that all developmental test reports be furnished Headquarters, Department of Army (OCRD), USACDC, and USCONARC for review prior to In Process Reviews (IPR's) and System Status Evaluations (SSE's).

Test Procedures

The engineering and service test procedures previously used overlapped in some cases. Additionally, in many cases only one climatic condition was used in the test rather than the appropriate spectrum of conditions that the item could be expected to encounter. In the case of the M16, which was subjected to approximately 250 tests of various types, only twice was the weapon tested in a tropic environment, although that is the only environment in which it has been used in combat. The overlapping sub-tests of the Engineering and Service tests for small arms have been eliminated and some improvement in procedures have been made. One deterrent to the improvement in test procedures has been a shortage of military personnel, at the test agencies, with field experience in small arms.

WEAPON AND AMMUNITION SYSTEM TESTS

During 1963 and 1964 there was only limited formal testing of the AR15 (designated by then the XM16E1) because it was a special purpose, limited production item and was carried as excess to Army rifle requirements. The expanding commitment in Vietnam altered the Army position, especially when U.S. troops undertook combat missions and requested large issues of the XM16E1. By 1965 the demand for increased firepower left insufficient time to conduct a thorough testing and evaluation program, with the result that the XM16E1 joined the Vietnam war as the basic infantry rifle with few improvements to the 1960 and 1963 prototype versions. On 23 February 1967 the Army classified the XM16E1 Standard A and changed its designation to M16A1. The engineering test basis for this action was the series of tests conducted during the 1965-1966 Army Small Arms Weapons Systems (SAWS) Study at Development and Proof Services (D&PS) at Aberdeen Proving Grounds and at other USATECOM installations.

Since large scale production began in March 1964, the developmental and testing hisotry of the M16A1 has consisted of a series of product

improvement actions. As a consequence of being a limited production item for several years, and of having modifications tested as product improvements, the M16A1 has had a confused history of test and evaluation. Over 250 tests have been conducted, some related, others independent, and some with conflicting results. The objectives and methods of the tests and the validity of test data and conclusions vary widely among these tests because, for much of the period, the M16 received scant attention and then, when it was accepted as the United States' rifle for the Vietnam war, there was little time for testing.

While only portions of the SAWS Study dealt with the XM16E1 system, the SAWS tests did include major evaluations of the XM16E1 rifle and the associated 5.56mm M193 ball and M196 tracer cartridges. The SAWS Study formed the basis for the 7 November 1966 Chief of Staff decision to seek a one-rifle Army inventory based upon the XM16E1 rifle.

The only conclusion from the mud subtest drawn in the SAWS Engineering Test report was that the dust cover on the XM16E1 was a feature "desirable beyond the nice-to-have category." USATECOM drew the obvious conclusion about the value of the XM16E1 dust cover because it helped keep mud and dust out of the weapon mechanism, even though the data are not statistically convincing, mainly because of the small sample and high average incidence of stoppages. No comment

was made of the performance of other systems under the same environmental conditions.

Because of the small sample sizes and the variability between individual weapons, the results of the engineering environmental subtests, such as the mud subtest, can give only an indication of weapon performance and, even then, without great assurance. In several instances the stoppages of one of the two XM16E1's were attributed to the weapon and not the environmental condition in which the weapons were tested. In particular, one XM16E1, which previously had demonstrated a consistently high rate of failures to eject, was used as one half of the XM16E1 sample in four of the nine environmental subtests. However, this rifle was contined in use and the malfunctions were reported against the XM16E1 in evaluation of the environmental test results.

Results of the SAWS Engineering Tests

The data gathered in the adverse conditions subtests were the basis for the USATECOM evaluation of the test weapons against the USACDC-prescribed performance characteristics and standards. In general the criteria prescribed are based on comparative data, such as dispersion with the bipod shall be less than that measured without the bipod, and reliability at extreme temperatures shall not be less than the reliability at ambient temperature. Because of the small sample sizes these criteria cannot be applied meaningfully. The data basis for these comparisons is frequently distorted by poor performance

of one weapon in the sample, thereby invalidating the comparison itself. This fact would be made visible if the statistical confidence levels were reported for the results obtained.

A second utilization of the SAWS Engineering Test data was to provide a statement of weapon system reliability. The data obtained in the reliability subtest were the basis for the USATECOM limited evaluation on weapon mechanism performance. The three M14E2 automatic rifles had .88 stoppages per 1,000 rounds fired, thereby proving the reliability of the basic M14-M14E2 design. The less reliable M14 performance (4.76 stoppages per 1,000 rounds) was attributed to poor quality control. On the other hand, while the Colt automatic rifle had 1.38 stoppages per 1,000 rounds, USATECOM did not conclude in its discussion of the reliability test that the XM16E1 performance (20.56 stoppages per 1,000 rounds) was due to poor quality control.

The number of stoppages in the engineering subtests were combined with the reliability data from the SAWS Service Test to yield data, commonly cited as indicative of the comparative reliability of the XM16E1 and the M14. One could reasonably ask why malfunctions encountered in 1,200 rounds in the extreme high temperature subtest should be combined with 3,000 rounds in the extreme low temperature subtest or 20 rounds in the mud subtest without weighting factors to account for either the differences in the number of rounds fired or the expectation of adverse environments in combat situations.

Buffer Tests

During the SAWS tests the XM16E1 was reported to have excessive cyclic rates approaching 960 rounds per minute, as compared with the design or specification upper limit of 850, and an excessive number of malfunctions. At the same time the basically identical Colt automatic rifle, using a buffer of new design, was significantly more reliable (3.02 stoppages per 1,000 rounds compared with 11.15 for the XM16E1). The new buffer design had increased mass and utilized sliding steel weights, rubber discs, and a polyurethane bumper in lieu of nested ring springs to cushion recoil forces. Colt's proposed such a buffer for the XM16E1 in January 1966, at which time Frankford Arsenal had just completed test firings of 12,000 rounds in each of four XM16E1's and two AR15's, utilizing the original desi buffer. The Frankford tests confirmed the higher cyclic and malfunc rates for ball (WC846) propellant, as compared with IMR (8136) propellant, that had been reported in the SAWS tests. In particular failure of the bolt to remain to the rear after the last round of the magazine had been fired increased dramatically as a function of cyclic rates in excess of 850 rounds per minute. Colt's tests had shown reduced cyclic rates with its new buffer design. At the 12-13 January 1966 meeting of the inter-service M16/XM16E1

Rifle Technical Coordinating Committee, test and evaluation of Colt's proposed buffers were assigned to Springfield Armory. As a result, in July 1966 USAWECOM adopted the new buffer design and, in December 1966, the new buffer entered production. USATECOM directed on 26 June 1967 that a product improvement test of the redesigned buffer be conducted using the old and new buffers with the objectives of comparing cyclic rates of fire and of comparing the bolt rebound upon closing (bolt carrier bounce). The test, conducted between 7 September 1967 and 15 January 1968, was the most thorough study of buffers for the M16A1, although it came 17 months after the decision to modify the buffer.

ANALYSIS OF M16A1 SYSTEM TESTS

An analysis of M16A1 system tests has been conducted, seeking weaknesses in test policies and procedures as they were applied to the M16 and areas which need to be given careful consideration in view of present and future policies and procedures. The purpose of this analysis was to identify, where possible, gaps in the test data collected; and to discuss the validity of the statistical design of tests, the test criteria, the significance of test results, the adequacy of the follow-on weapon design and reliability data analysis, and the consistency of follow-on actions with the test results.

Gaps in Test Data Previously Collected

With the aid of hindsight, reinforced by reports of malfunction problems encountered in Vietnam, it is now easy to see the faults in the testing cycle for the M16. A major weakness was in the lack of kinematic (time-motion-displacement) analysis of M16 weapon functioning, although kinematic analyses has been conducted on other small arms systems.

While kinematic analysis should be an integral part of the development and introduction of any automatic weapon system characterized by close tolerances and sensitivity to operating energy levels, a thorough kinematic analysis of the M16A1 was not directed until January 1968, at which time it was treated as an item of highest priority within the U.S. Army Materiel Command.

A second weakness in the testing of the M16 was that no formal or informal (laboratory) work was done toward engineering analysis aimed at improved design and functioning of given components.

The M16 test program not only failed to include some important tests but also left a number of tests incomplete in terms of the stated test purpose. The most notable example was the omission of cyclic rate measurements in the 17 March to 10 April 1964 firings for the engineer design test of alternate propellants for use in the 5.56mm M193 cartridge. This test resulted in approval of WC 846 (ball) propellant for loading in 5.56mm ammunition, although it was later demonstrated that the use of WC 846 propellant in place of IMR 4475 or 8136 propellants had a significant effect on the functioning of the M16.

Experience has proven the inadequacy of the M16 test program with respect to environmental testing. No tests other than the SAWS troop tests and limited user evaluation in 1962 have been conducted by the U.S. Army under tropic conditions. On the other hand, the M16 has been used in combat exclusively in a tropic environment since its production began in March 1964.

Statistical Design of Tests

The problem of statistical design for tests of a rifle and ammunition system is essentially two-dimensional. For each individual characteristic to be tested, whether a product improved component or an environmental factor, there are the two questions of the breadth of the rifle sample (the number of rifles) and the depth of the firing (the number of rounds fired per rifle). Sample sizes must be statistically adequate with respect to both the number of rifles and the number of rounds fired per rifle. All results should include the associated statistical level of confidence.

The statistical design of tests can be improved by developing and analyzing models of malfunction incidence with the object of determining the mean number of rounds between the occurrence of a given type of malfunction in rifles suffering the malfunctions. Review of past M16 tests clearly demonstrates that some rifles are more prone to certain malfunctions than are other rifles tested under the same conditions. Knowing the frequency with which malfunctions of a

given kind can be expected, it is possible to estimate the number of rounds that should be fired per rifle to yield a reasonable degree of confidence that malfunction properties will be observed.

Tests should be conducted under conditions that place great, but tolerable, stress on the system under test. For example, since the SAWS Study, USATECOM has sought to determine temperature-humidity conditions under which propellant residue fouling most severly inhibits reliable weapon functioning. This work resulted in the decision to conduct the 1967 buffer test fouling subtest at 20°F. At other temperatures fouling, while readily apparent, does not manifest itself as severely in malfunctions. Continued evaluation of conditions under which the function being tested is most critically affected is required so that the M16A1 or any future system can be tested under the most severe conditions. Such tests, with subsequently applied engineering analysis, can then provide an improvement to the system, but do not reflect weapon performance under expected field conditions and therefore are not useful for generating meaningful system reliability data.

Malfunction Criteria

The earlier discussion of the SAWS Engineering Test found fault with the summation of malfunctions and stoppages across all adverse condition tests and for all types of malfunctions. It would be useful to have a descriptive model of malfunction behavior under adverse conditions so that malfunctions could be determined in a reasonable proportion according to the test environment and to their relative

severity. Such a model would provide an index of the loss of rifle effectiveness in combat situations due to weapon malfunction.

Weapon Design Analysis

Small arms system tests must be more than data gathering activities. They should, especially the engineering tests, maintain the flexibility to pursue questions that arise in the conduct of the originally scheduled test series. A good example of such flexibility is the SAWS Engineering Test. After encountering frequent incidences of rearward movement in the charging latch handle while the rifle was firing, D&PS took high-speed movies to analyze the malfunction. Its analysis led to a change to the rifle design and the introduction of a corrective modification. Yet, in the same test series, when one rifle had a demonstrated tendency to ejection failures, not only was the cause not determined, but also the rifle was continued in use. The engineering tests should be dynamic and lead directly to engineering analysis so that the cause of malfunctions can be identified, and not merely their existence or frequency reported.

The Army and other Defense Agencies have conducted large-scale tests of the M16A1 in recent years. All of these tests have recorded reliability data. There are differences in the data due both to variances in judgment as to the type and severity of a given malfunction and to limitations in some tests which prevented observation of each round fired. This was particularly true in the field

experimentation at the USACDC Experimentation Command at Fort Ord, California, where test monitors could not interfere with the natural flow of the test runs lest the evaluation results be distorted. The Army still has much work to do in improving the methodology, conduct, and evaluation of small arms testing. A more detailed analysis of tests is contained in Appendix 2.

AUDIT TRAIL OF THE CHIEF OF STAFF, ARMY ACTIONS

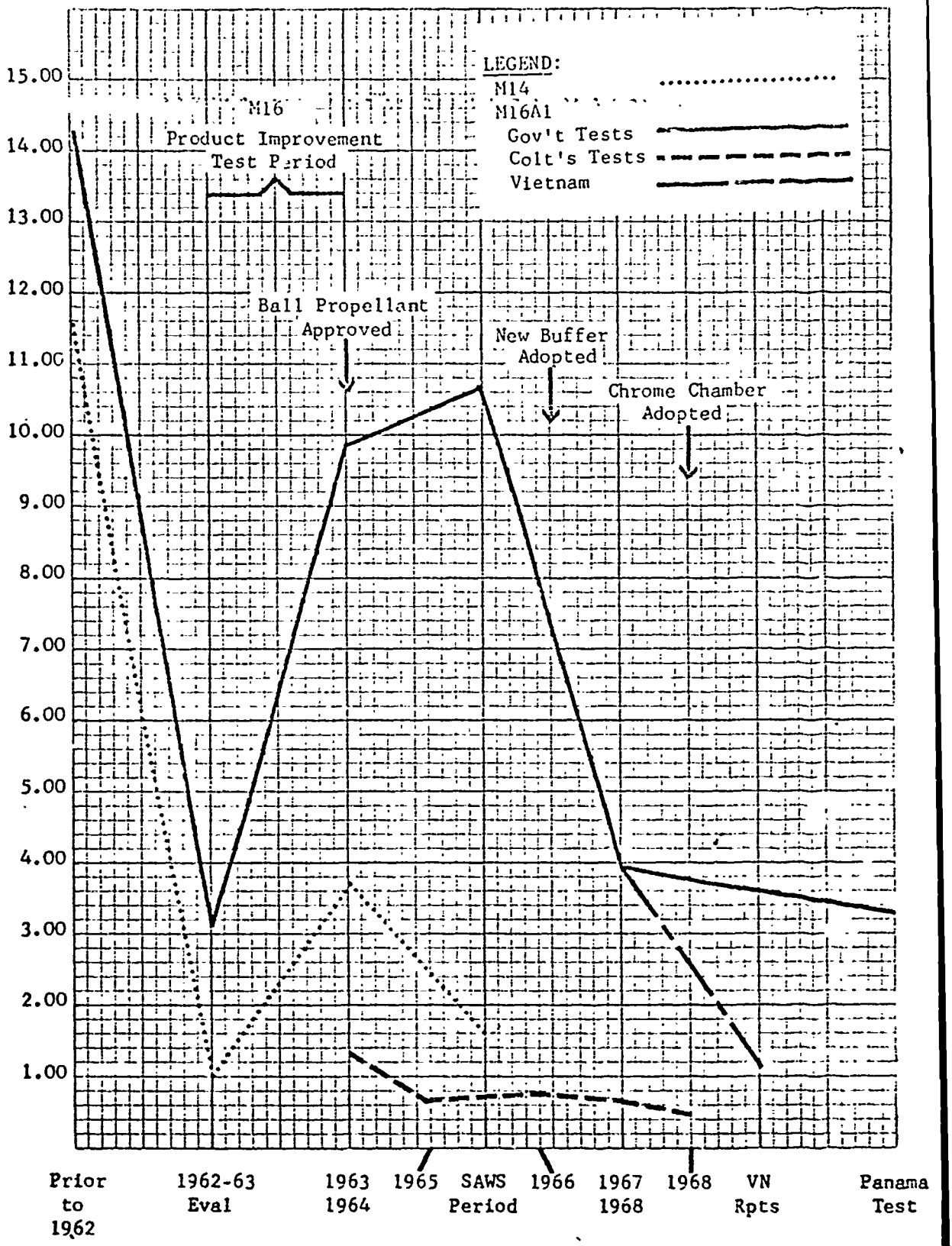
Appendix 9 is an audit trail of the Chief of Staff, Army actions related to the AR15/M16 and the Army rifle program in general. Included are the source, date, and document title; a summary of the document; the Chief of Staff's decision or directed action in respect to the document; and subsequent actions taken.

ANALYSIS OF M16 RELIABILITY

The AR15 was a surprisingly reliable weapon in the early phase of its development in that it outperformed production models of the M14 in the first comparative evaluation in 1958.[25] While the absolute malfunction rates for both weapons were unacceptably high, the comparative values, based on the test of four weapons of each type were significant. At this time the AR15 had been under development less than a year and the M14 had been under developmental testing for approximately 10 years. The AR15's performance impressed many people in and out of the Defense Department, and the rifle was later sought by the U.S. Air Force as its standard shoulder weapon. Evaluation and testing of the AR15 continued through 1962, and the results indicated that its reliability, although in need of improvement, was approaching that of the M14. The tests conducted during that period show the overall malfunction rate of the AR15 to have been 14.3 per 1,000 rounds, as compared to the M14 rate of 11.6 per 1,000 rounds. Figure II-2 indicates the overall malfunction rate of the AR15 (M16A1) from the first comparative purposes, is the malfunction rate of the M14 where the two weapons were subjected to the same tests or evaluations, and the rates experienced at Colt's factory during the function firing portion of the acceptance tests and the 6,000-round endurance tests. A dramatic improvement in the AR15's reliability is shown during

25 USAIB Evaluation Report on the Armalite (AR15), 27 May 58.

Figure II-2 — OVERALL MALFUNCTION RATES PER 1,000 ROUNDS



the 1962-63 comparative evaluation of the AR15 and M14. This greater reliability can be attributed to improvements made in the weapon. It should be noted that the improved reliability was achieved despite trouble with the magazines and ammunition (blown primers) experienced during the 1962-63 evaluation.

The period 1963-64 saw an increase in the malfunction rate for both the M16 and M14. The increase for the M16 can be attributed chiefly to the fact that most of the tests conducted during the period were for the purpose of evaluating improvements in the AR15, including firing pin restraining devices, charging handle changes, bolt closure devices, magazine catch springs, primer sensitivity, chamber dimensions, magazine designs, and alternate propellants for the 5.56mm round. In testing, the prototypes of a product improvement often adversely affected the reliability of the weapon and caused an overall increase in the malfunction rate.

In June 1964 the use of ball propellant in 5.56mm ammunition was approved. With ball propellant came increased operating energy, and an increase in the cyclic rate of fire and the overall malfunction rate. This problem was recognized, and a new buffer (action spring guide assembly) was designed, tested, and adopted in December 1966.[26/] The new buffer had been under consideration by Colt's for the purpose of eliminating carrier bounce and the resulting failures to fire

26 See Appendix 1 for test procedures, and Appendix 2 for the audit trail of M16A1 weapon and ammunition system tests.

because of light blows by the firing pin so that when the high cyclic rate was recognized as a problem, the buffer design was modified to solve both problems. The new buffer design also eliminated the use of ring springs which, possibly due to coincidence, began to freeze at the same time that high cyclic rate became a problem.

In late 1966, complaints of high malfunction rates of the M16A1 in Vietnam led to a technical assistance team being sent from USAWECOM to determine the trouble. One of the recommendations of the team was that the chamber of the M16 be chrome plated. The introduction of the chrome plated chamber in September 1967 has reduced failures to extract and the overall malfunction rate but has increased the rate of some types of malfunctions: failure to eject, failure to fire, and failure of the bolt to remain to the rear.

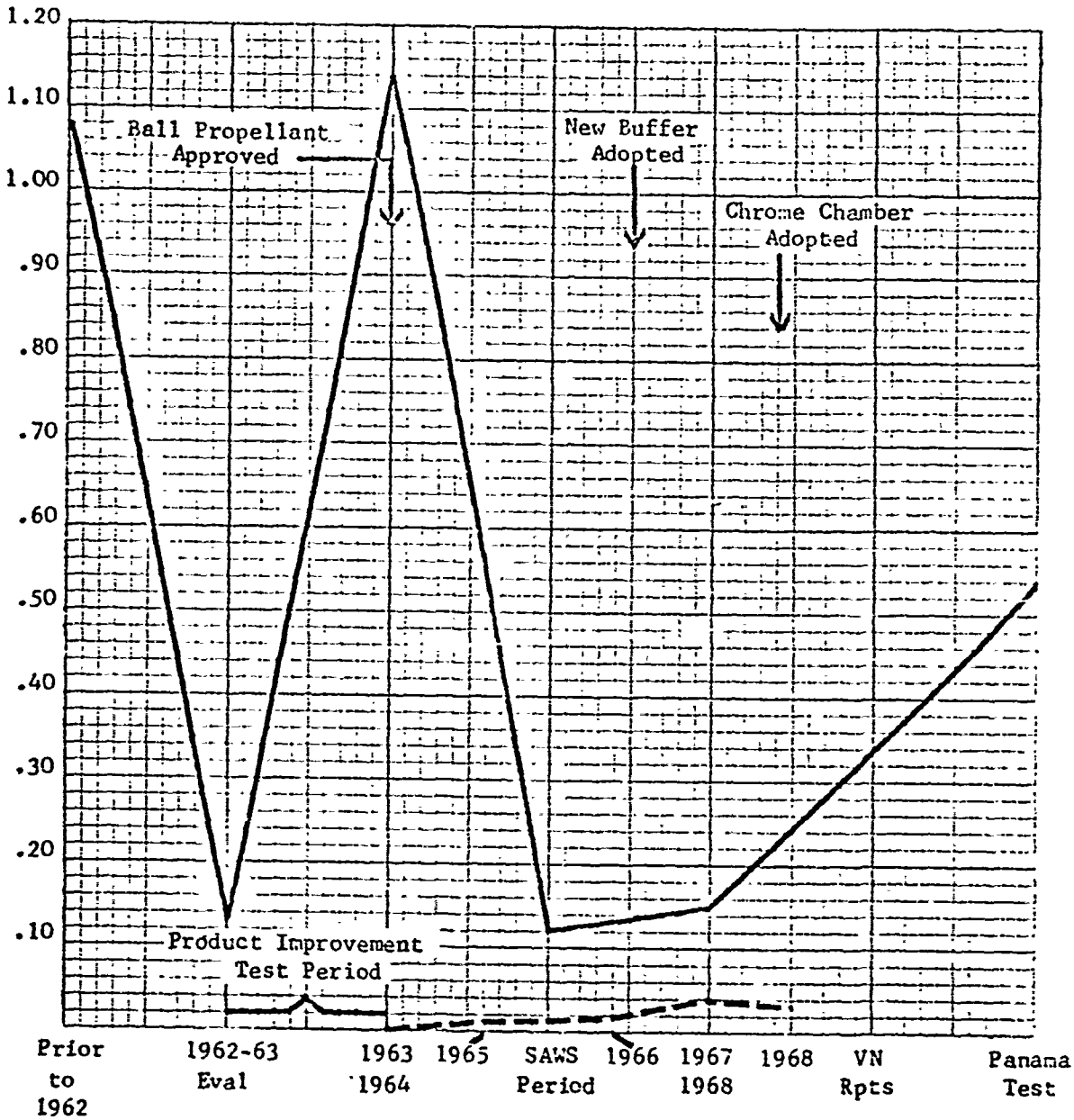
Figures II-3 through II-9 indicate the occurrence per 1,000 rounds of selected malfunctions, and will be discussed individually below. It is emphasized that the data displayed in the figures is not "hard" data because of the wide range of test conditions, controls, and malfunction reporting procedures used in the various tests and evaluations; however, the displays do give an indication of the M16A1's reliability over a considerable time and are useful in identifying trends. Each figure shows graphically the history of the occurrence rate as reported in the various Army, Air Force and Marine Corps tests conducted. Also shown are the rates experienced

at Colt's plant for both the function firing of every rifle produced, and the 6,000-round endurance firing of one rifle per production lot. The malfunction data reported by the Marine Corps in Vietnam is also shown. The Marine Corps data is incomplete, and therefore is not shown on every figure. The combat reports of the Marine Corps indicate that the occurrence rate is lower for all malfunctions, except failure to extract, than that experienced in testing.

Failure of the bolt to close, Figure II-3 follows the same trend as that of the overall malfunction rate through the end of 1967. The results of the Panama test in January 1968 indicate an increase, rather than a decline, of this malfunction. As has been the case in previous tests with troops, many of these malfunctions were caused by the soldier "riding the charging handle forward" and thus impeding the bolt's forward movement, producing a failure of the bolt to close. The Colt's rate indicated a slight decrease in this malfunction during 1968. This malfunction is not serious and can be corrected by use of the bolt closure device. (See FBC in Inclosure 1 to Appendix 6 for detailed discussion).

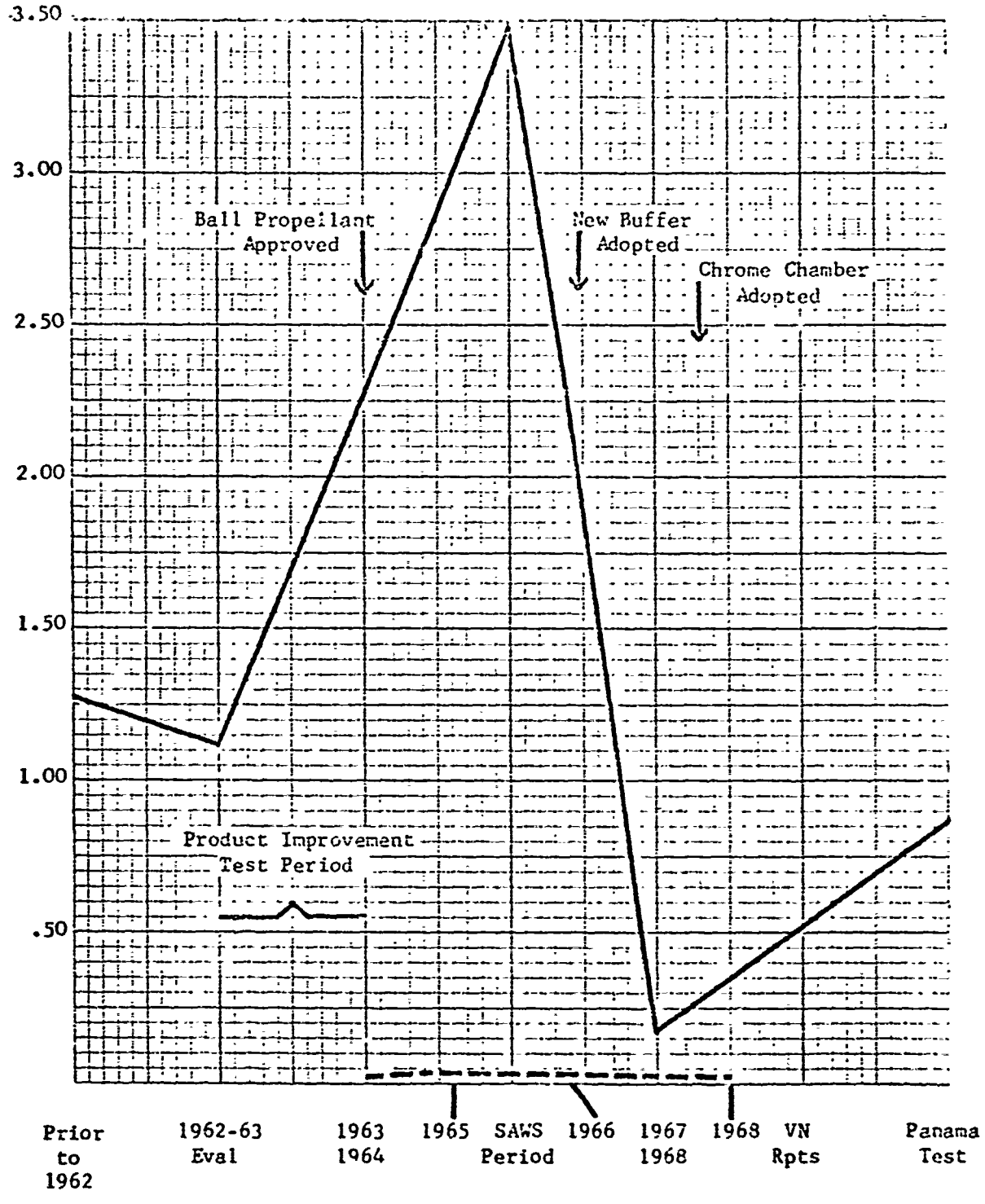
Figure II-4 indicates the occurrence per 1,000 rounds of failure of the bolt to remain to the rear. A significant reduction in this malfunction was achieved with the introduction of the new buffer, since most ammunition used in tests was loaded with ball propellant

Figure II-3 FAILURE OF M16 BOLT TO CLOSE



LEGEND:
M16A1
Gov't Tests ——————
Colt's Tests - - - - - -

Figure II-4 — FAILURE OF M16 BOLT TO REMAIN TO REAR



at that time. Again the malfunction is not a serious one and can easily be corrected (see Inclosure 6-1, Appendix 6). A slight increase in this malfunction is indicated for the last test. The rate increased because IMR propellant, which provides less operating energy, was used in M16A1's with the new buffer. The Colt's rate indicates little if any change through the years, primarily because prior to the introduction of the new buffer only IMR propellant loaded ammunition was used in Colt's tests and because ball propellant loaded ammunition has been used for testing almost exclusively since the buffer change in December 1966.

Failures to feed declined significantly in tests up through the SAWS test period (Figure II-5) because of improvements in the magazines used in the earlier testing, and because of the increased operating energy provided by the adoption of ball propellant. The rate increased when the new buffer was adopted because of the reduction in operating energy, and has shown a decrease since then with the use of the chrome plated chamber, which tends to increase the operating energy available because of the reduced friction encountered during extraction.

Incidence of failure to fire (Figure II-6) decreased steadily until early 1964 with improvements in the weapon and its ammunition. Upon the adoption of ball propellant, however, the rate rose sharply

Figure II-5 — M16 FAILURES TO FEED

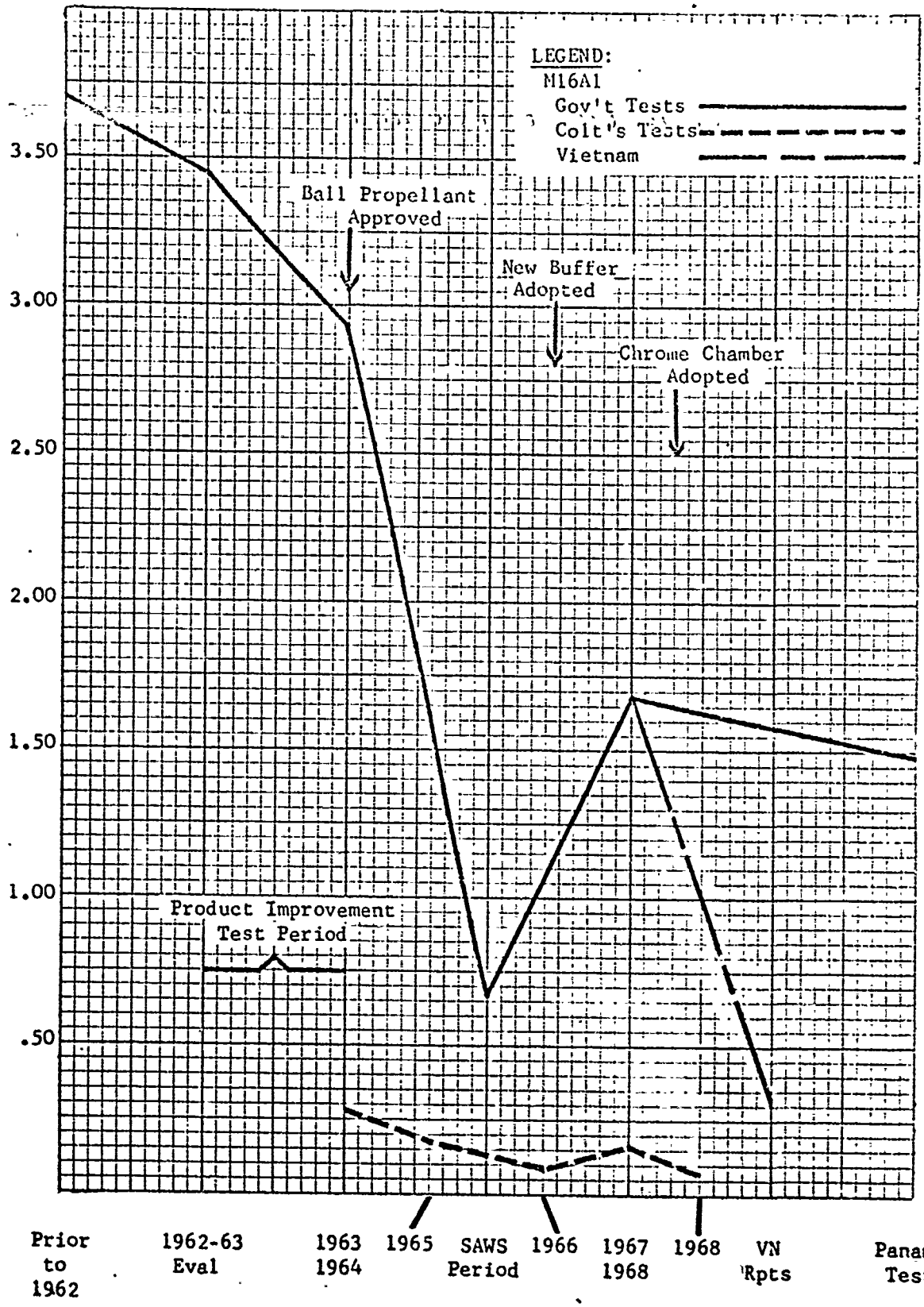
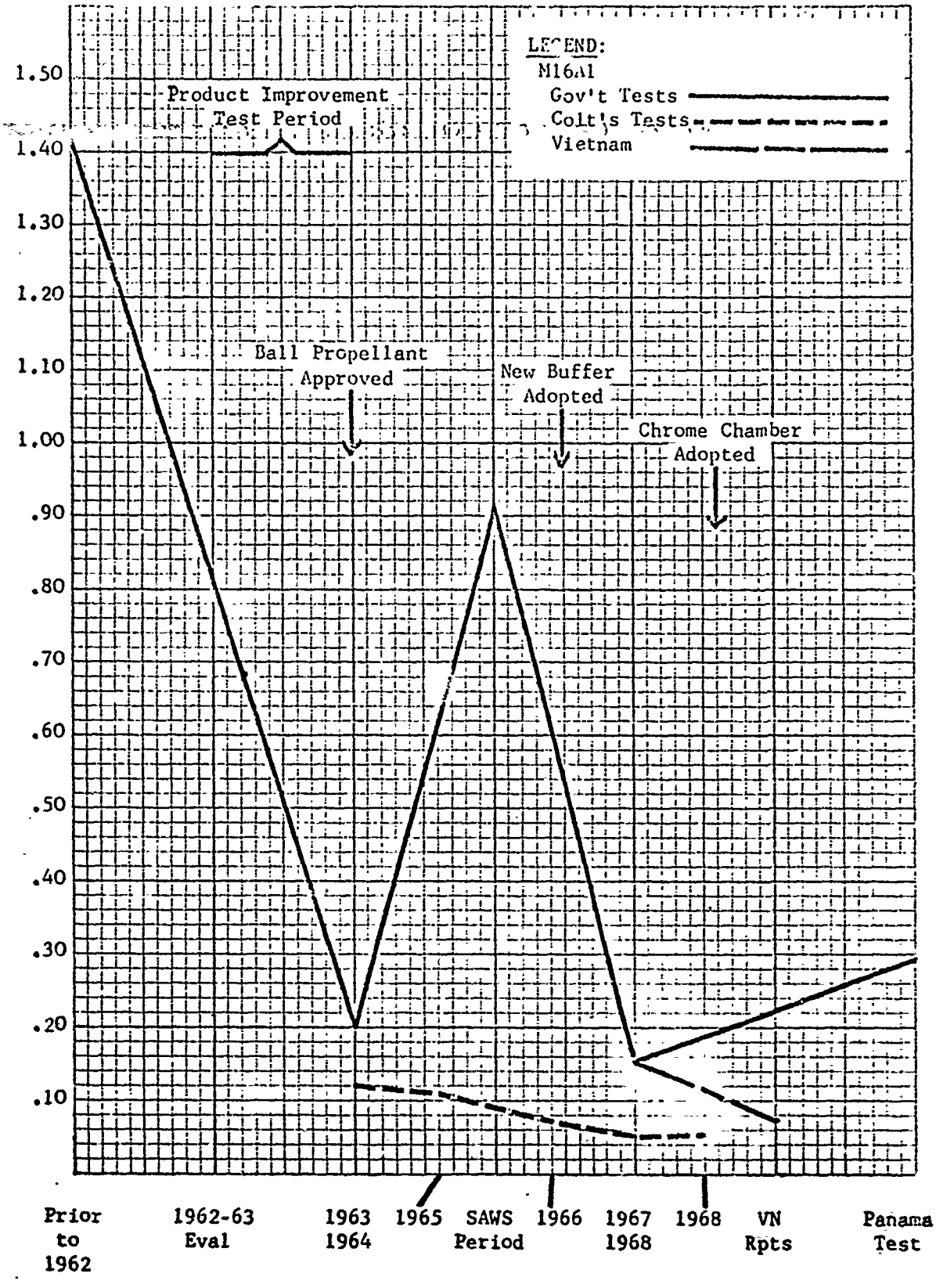


Figure II-6 — M16 FAILURES TO FIRE



because the high cyclic rate of fire induced carrier bounce and resulted in light blows of the firing pin. When the new buffer was adopted, the rate again declined sharply. The rate has risen slightly since the incorporation of the chrome chamber, probably because of a slight increase in operating force afforded by the reduction in friction required for extraction.

Failures to eject (Figure II-7) follow the same pattern as the failures to fire, again showing the sensitivity of the M16A1 to minor variations in operating energy level. This malfunction is bothersome, but most of the time can be easily cleared (see Inclosure 6-1, Appendix 6).

The most difficult malfunction to clear, and the one that has received the most publicity, is failure to extract (Figure II-8). Its history shows an initial decline through 1962, a sharp increase during the product improvement tests, 1963-64, and a sharp decline after adoption of ball propellant, presumably because of the increase in operating energy. A slight increase is noticeable upon adoption of the new buffer, but the rate declines when the chrome chamber is introduced. The high incidence rate reported by the Marine Corps can be attributed to two factors: (1) a failure to extract is more likely to be reported by a man in combat because it is often difficult to clear, and (2) the majority of the weapons in the hands of the Marines when the

Figure II-7 — M16 FAILURE TO EJECT

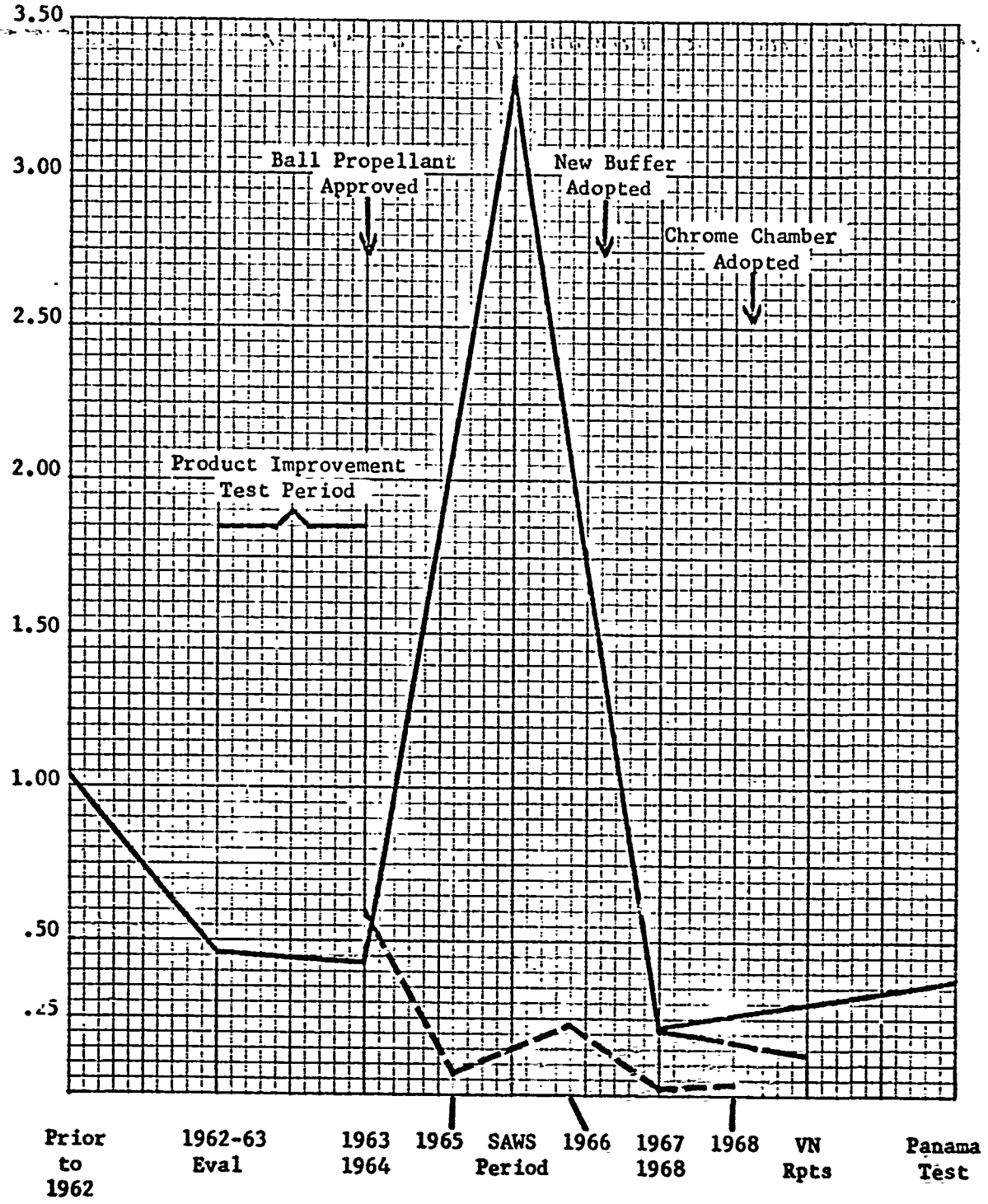
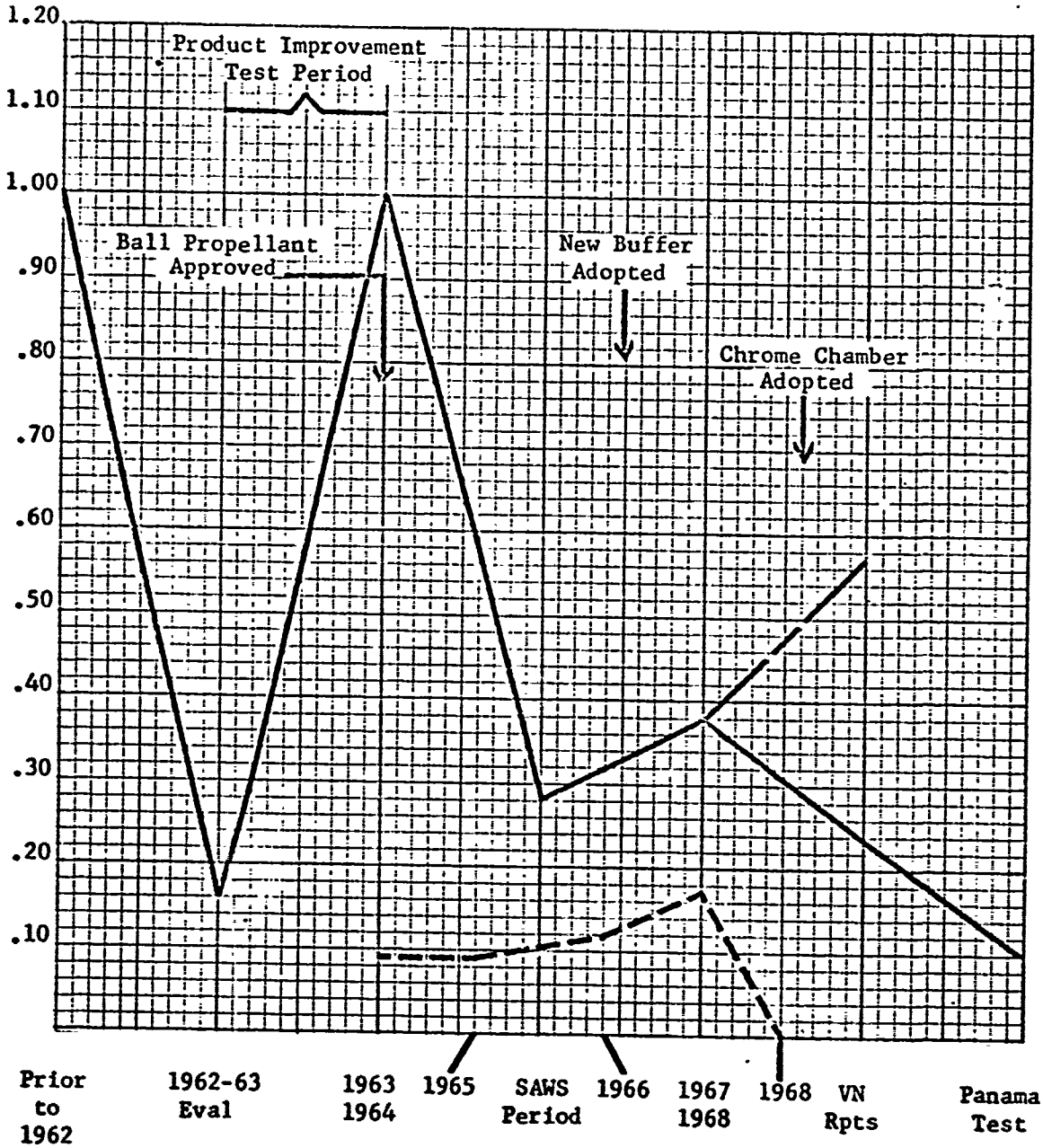


Figure II-8 — M16 FAILURE TO EXTRACT



data were collected did not have chrome plated chambers, and many had pitted chambers.[27] A recent technical inspection of the Marine Corps M16A1's revealed that approximately 65 percent of the rifles were unserviceable because of pitted chambers. These unserviceable weapons were immediately replaced. It should also be noted that the Colt's rate increased steadily until the introduction of the chrome chamber, and then drops to zero thus far in 1968.

The final figure (Figure II-9) shows the historic rate of all other types of malfunctions. The rate fluctuations follow generally those of the overall malfunction rate (Figure II-2), but show a sharper rate of decrease in the last two years. This is indicative of the overall improvement of the M16A1's currently being produced.

Since malfunction rates are considerably higher for rifles fired in the automatic mode (see the WSEG test, Appendix 6), and the M16A1 is used in the automatic mode one-third of the time in combat (see Appendix 7, Vietnam Survey), its malfunction rate may never be consistently as low as that of the M14, which is used in the semiautomatic mode. (Only M14A2's are authorized the selector lever.)

A complete discussion of the M16 reliability is provided in Appendix 6.

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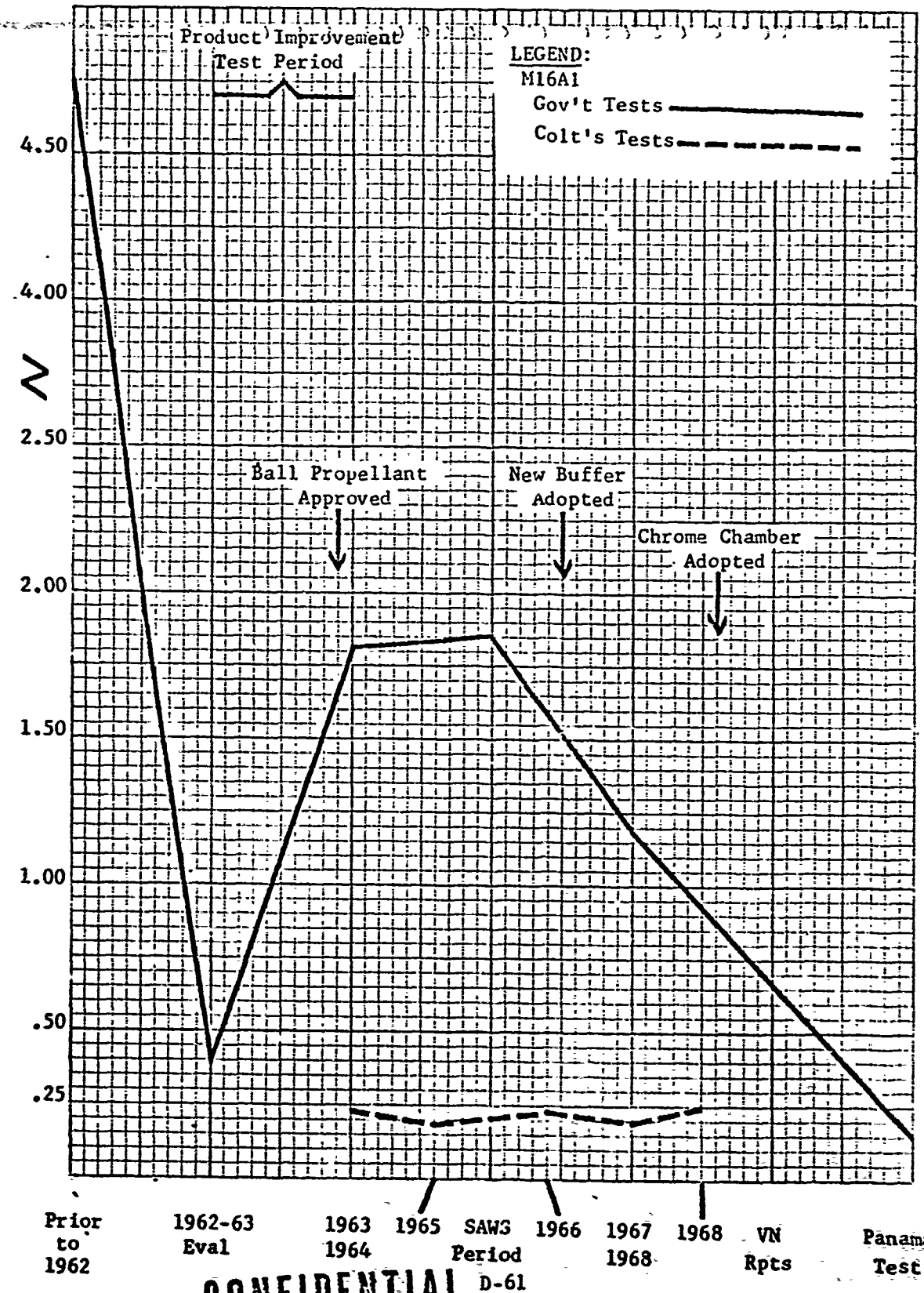
27 Reported to the M16 Review Panel verbally by a representative of the US Marine Corps during the Panel's Vietnam Survey. Data was also confirmed by a representative of Colt's.

Figure II-9 — ALL OTHER M16 MALFUNCTIONS



M16 RIFLE TRAINING

M16 rifle training can be divided into four time phases beginning in November 1963.

Phase I: November 1963 - February 1965

During this phase, the rifle was procured by the Army and issued to airborne and special forces throughout the Army. Training was a unit responsibility; replacement training was not conducted. Resident courses of instruction were established for the training of armorers and ordnance small arms repairmen at Fort Lee, Virginia, and at Aberdeen Proving Ground, Maryland, respectively, during 1964. Orientation and familiarization training began at the Infantry School and at the Special Warfare School and Center. The first training publication and first equipment publication were distributed in 1964. Training ammunition allowances were established and ammunition issued for unit basic loads and for unit training. Finally, new equipment training was conducted by WECOM. Rifles and ammunition were available in sufficient quantities during Phase I to support training.

Phase II: March 1965 - December 1965

Simultaneously with the commitment of American combat troops in Vietnam in March 1965, the first replacement training was initiated for airborne-oriented infantrymen at Fort Gordon, Georgia.

Emphasis was placed on training for light weapons infantrymen - the riflemen. The 1st Cavalry Division (Airmobile) was issued M16 rifles during July-August 1965 and this completed the Army's planned issue of M16 rifles. With a few minor exceptions rifle issues were restricted during Phases I and II to airborne, air-mobile, and special forces. Fort Gordon and the 101st Airborne Division reported that they had achieved excellent success in training men in marksmanship with the M16 rifle.

Phase III: December 1965 - December 1966

Approval was granted to COMUSMACV in December 1965 to arm maneuver battalions in Vietnam with the M16 rifle. During this phase, training was expanded to include the training of non-airborne infantry replacements (new soldiers); this was accomplished at Fort Polk, Louisiana along with the institution of a special training program at both Polk and Gordon to prepare new replacements, particularly for combat in Vietnam. USARPAC requested DA to provide M16 rifle training to infantry replacements and infantry battalions enroute to Vietnam. DA and CONARC complied with this request by prescribing an eight-hour program of mechanical training and marksmanship for infantry officers, enlisted men, and for the armor intelligence specialist. This program was developed within certain constraints; i.e., availability of ammunition, rifles, and training time. The Air Force model rifle was used, but this was not a significant deterrent to

to training. The program was in full execution by 30 June 1966 and was a POR requirement for individuals and a POM requirement for units. Infantrymen who transferred from areas outside CONUS to Vietnam were not provided M16 rifle training. Replacement riflemen who were undergoing advanced individual training at Forts Polk and Gordon received significantly more M16 rifle training during their nine-week course of instruction than the eight-hour minimum POR-POM program. During Phase III the shortage of ammunition and the lack of a blank firing adaptor were significant deterrents to adequate training.

During the latter part of 1966, USARV experienced serious malfunction problems with the M16 rifle. Inadequate and insufficient training were determined to have caused some of these problems. Maintenance specialists from USAWECOM provided invaluable assistance to USARV in correcting these problems. During the same period, September - October 1966, DA asked USARV to state whether or not there was a need to provide the then current M16 rifle training program to individuals enroute to Vietnam other than infantrymen and the armor intelligence specialists. DA cautioned USARV that if training was to be expanded, M16 rifles and ammunition would have to be diverted from scheduled deliveries for Vietnam. USARV replied that requirement did not exist for M16 rifle training for men other than those being trained.

In November 1966 CONARC decided to increase the quality and quantity of training in Vietnam-oriented infantry advanced individual training by issuing rifles on the basis of one per man. Special offensive and defensive squad tactical firing ranges were being constructed at this time. By 15 April 1967 rifles had been given to all trainees and all live firing in Vietnam-oriented AIT was being performed with M16 rifles. Those tactical problems which required blank firing were still being executed with the M14 rifle because of the lack of a blank firing adapter for the M16 rifle.

Phase IV: December 1966 - February 1968

In December 1966 DA decided to issue the M16 rifle to all active Army units in USARV or scheduled for deployment to USARV. The same month CONARC directed that all replacements through the grade of Major would receive the eight-hour minimum M16 rifle training as a part of POR or POM training. This directive constituted a large increase in the number of men who were to receive training.

Significant numbers of men escaped M16 POR training during 1966 and 1967 primarily because the administrative controls were not sufficiently effective during POR processing to identify these men and return them for training and because DA directed that port calls were not to be delayed to give POR training. The problem of POR deficiencies became so acute that UNCONARC,

in November and December 1967, established centralized points at each installation for processing oversea replacements.

Many factors governed the amount of M16 rifle training provided by deploying units during 1966 and 1967. Generally, ammunition was the primary limiting factor during 1966. However, in 1967 when training ammunition became more plentiful, available training time remained a problem to some units. For example, the 196th Infantry Brigade received M16 rifles only 10 days before deployment. The lack of a blank firing adapter significantly limited training during 1966 and 1967.

During January - March 1967, DA and USCONARC evaluated M16 rifle training programs. As a result of this evaluation, existing programs were expanded effective April, 1967.

Provision of adequate training time during POR processing remained a problem during 1967 and some installations were still conducting the eight-hour program as late as December 1967. Graduates of schools and training centers were most seriously affected because port call dates are determined from graduation dates, allowing no time for POR training. USCONARC brought this problem to the attention of DA in November 1967 and in February 1968 DA granted USCONARC permission to add three days to training courses to provide the required POR training.

The Chief of Staff approved a plan in February 1968 to initiate M16 rifle training in basic combat training. This was done because

of the inherent limitations of POR training, the magnitude of the training task, and the experience gained in Vietnam concerning the performance of the rifle and the state of training of the soldier.

The Chief of Staff also approved the conversion of the remainder of standard (non-Vietnam oriented) infantry advanced individual training to Vietnam-oriented infantry AIT. This is significant because all new soldiers who are to become infantrymen will receive thorough and detailed M16 rifle training and will be armed with the rifle during their nine-week course of instruction. The availability of the blank firing adapter will further increase the effectiveness of this training. Adequate numbers of rifles are currently projected for introduction into the training base to permit complete transition to M16 training by May 1969.

ARMY ORGANIZATION FOR MANAGEMENT OF SMALL ARMS

A summary of organizational structure and management practices in effect during the development, procurement, and product improvement of the M16 rifle must, of necessity, review briefly the former Office of the Chief of Ordnance (OCO). Since the OCO was abolished early in the life cycle of the M16, a detailed examination of that organization was not conducted as an integral part of this review. However, a separate study, concerning the impact of the abolishment of the OCO on the M16 Rifle program, was conducted concurrently with the development of this report. Pertinent extracts of the analysis portion of that study were as follows:[28]

> When the offices of all but two of the chiefs of technical services, including that of the Chief of Ordnance, were abolished in 1962, the Ordnance Corps was affected almost entirely at the top level of management. . . . At the mid-management level, the commodity commands, the Munitions Command and Weapons Command, for example, had existed under the Chief of Ordnance. They continued to perform the same functions after reorganization, although in some cases they bore other names. Research, engineering, testing, evaluation, procurement, and production functions involving the M16 rifle system were continued by the commodity commands without interruption. . . . The commodity commands continued to have a clean, though

[28] A Staff Study, "Impact of the Abolishment of the Office of the Chief of Ordnance on the M16 Rifle Program," April 1968, Office of the Assistant Vice Chief of Staff, Army.

> different, channel to top management, were held responsible for the same functions, were delegated the same authority, and were allotted approximately the same resources. . . . A careful review of the former functions of the Office of the Chief of Ordnance affirms that all of them were assigned to appropriate agencies and that none were lost in the reorganization. . . . Although it has not been documented, it can be hypothesized that control of the M16 rifle program was initially tenuous at the AMC level. At the time in question (July 1962), however, the M16 rifle program was not of such urgency that the few months needed for AMC to become fully operational would materially influence the program. . . . --in August 1966 the Army Audit Agency, in a reevaluation of the reorganization, noted: 'The extent of major systems changes and increased workload since the date of the Army reorganization, 1 July 1962, (because of Vietnam actions) makes a comparison of performance before and after reorganization virtually meaningless,' it went on to say: 'Even greater problems might have been experienced under the present circumstances if the USAMC complex had not been established.'

The study concluded:

> There is no substantial evidence from which to conclude that the problems experienced with the M16 rifle would not have existed or would have been fewer had there been a Chief of Ordnance.

That study was concurred in by the Vice Chief of Staff with the comment:

> I am convinced that the problems related to the M16 would have been more severe had there been a Chief of Ordnance with his traditional bias against any item which was not Ordnance developed. The attached record on the M14 development engenders little confidence in the old Chief of Ordnance management system.

The Chief of Staff, Army approved the study and its conclusions, and forwarded it to DDRE on 27 April 1968.

The review of Army organizational structure and management practices as they apply to small arms which follows does not include discussion of the most recent small arms management effort — the Army Small Arms Program (ARSAP). An evaluation of the ARSAP is provided below with a detailed discussion at Appendix 10.

The Department of the Army faces several problems in organizing for and managing the development, testing, and improvement of rifle systems. The Department of the Army staff agencies and the USAMC staff directorates are organized along functional lines and the subordinate USAMC commands are organized along commodity command lines. For example, the functions of research and development are represented in OCRD at Headquarters, DA, and the function of development is represented in the Development Directorate at Headquarters, USAMC; the functions of procurement and production are represented in DCSLOG at DA, and in the Procurement and Production Directorate at USAMC. Each of these functions are also represented by similar staff elements in each of the commodity commands.

This organizational structure provides flexibility to handle technical problems at each level of command but at the same time creates several problems: At the Department of the Army and at

the USAMC level it is difficult to move responsibility for a system smoothly through the interface between functional staff elements; it is also difficult to obtain the complete status of any one system in relation to associated systems. At the commodity command level, the efforts required to develop, test, and improve systems cut across commodity lines and necessitate participation of several commodity commands; it is difficult to coordinate the large number of headquarters and staff elements concerned with rifle systems; and the organizations responsible for the rifle systems have been dynamic in that they have changed in nature over time.

The first step that was taken to reduce these problem areas was the establishment of a project manager for the AR15 in March 1963. The office of the project manager was designed to provide centralized technical and business management for the AR15 rifle system and to coordinate and direct the efforts of the large number of diverse headquarters and staff elements below the Headquarters, USAMC, level that were concerned with development, testing, and product improvement of the AR15. The project manager was responsible for and given authority over the planning, direction, and control of the work and allocated resources within USAMC for the research, development, procurement, production, and logistical support of the AR15 rifle

system. The project manager assigned tasks to the commodity commands, Test and Evaluation Command, BRL, and the contractor, all of which were responsible to the project manager for the accomplishment of the tasks. The nature of the responsibilities of the project manager has changed, however, as seven project manager charters have been issued since 1963. The Project Manager, Rifles, is now responsible for the project management of the M16-M16A1, XM177/XM177E1 submachine gun, XM148 Grenade Launcher, alternate rifle systems, Special Purpose Individual Weapon, current standard rifles, and accessories and components, to include ammunition peculiar to these rifles until type classified as Standard A and gun/ammunition compatibility after type classification. The project manager is now also responsible for planning, directing, and controlling the concept definition, development, production and initial logistical support of his assigned systems.

The primary USAMC organizations concerned with rifle systems are the U.S. Army Weapons Command, the U.S. Army Munitions Command, Frankford Arsenal, the U.S. Army Test and Evaluation Command and the Ballistics Research Laboratories. In order to improve coordination of rifle system efforts between these organizations and to facilitate technical direction of these efforts, the project manager established a field office at Frankford Arsenal in 1967, and an M16 Steering Committee, composed of representatives of these organizations, early in 1968.

As indicated above, the organizational structure of the Army is one facet of management which also includes the functions of planning, controlling and directing. Planning includes requirements for the preparation and approval of System Development Plans and Project Manager Plans prior to initiation of system development. Control techniques include the establishment of requirements (QMR's) and priorities; the DA and USAMC regulations and policy governing the development, testing, and product improvement of rifle systems; the establishment and continuation of programs and budgets for the systems; the requirements for periodic reviews of development progress, such as in-process reviews; requirements for progress reports; and provision for methods of coordinating system development, testing, and improvement among all headquarters concerned with the systems. Directing techniques include guidance, contained in regulations and policy as well as decisions and directives by DA and USAMC, provided at key system development, testing, and improvement points. Key points include the establishment of requirements; the establishment and annual continuation of programs and budgets; approval of in-process reviews, and type classifications; and approval of product improvements. These functions are integrated into the Army organizational structure at all levels of command.

Thus, the project manager for rifle systems was established to overcome the separation of mission, interest, and physical location of

commodity commands. The project manager was assigned executive authority for planning, directing, and controlling the development, testing, and product improvement of his assigned systems. In the case of the M16-M16A1 rifle system this responsibility pertained primarily to the product improvement and product improvement testing. The project manager has found it necessary to augment his organizational structure in order to increase his ability to control, direct, and coordinate the efforts of the large number of USAMC elements, and to cope with the changing nature of his job.

At the same time Department of the Army has taken several positive steps to resolve the visibility, interface, and diffusion problems that are generated when a functionally oriented organization manages a system that cuts across functional lines. The two most important steps were the approval of the recommendations of the Report of the Department of the Army Board of Inquiry on the Army Logistics System and the establishment of the Army Small Arms Program.

The first step was the introduction, in 1967, of the concept of a disciplined, step-by-step, management model for the life cycle of management of all materiel systems. The model describes the management processes, their interrelationships, and the ordered sequence for the engineering development and operational development

phases of a system life cycle. The model also provides for the orderly transition of a developmental system from one phase of the life cycle to the rest. Overall, the Board of Inquiry integrated the functions of planning, directing, and controlling into the organizational framework of the Department of the Army and displayed the result in the form of a management model. ACSFOR was assigned responsibility for coordinating and integrating development, deployment, and related support activities including responsibility for assuring the accomplishment of internal DA activities required for planning, controlling, and directing the development, production, and support of materiel systems. Thus, a framework was approved which provided for centralized DA staff management of a weapons system throughout its life cycle, and which should reduce past interface and diffusion problems.

The second major step taken by Department of the Army was the establishment of the Army Small Arms Program (ARSAP) in 1968. The program was conceived and developed during 1967 in response to the need to provide complete visibility to small arms projects and the need to coordinate the efforts of all of the Army organizational elements concerned with rifle systems.

> This program assembles in one package all of the small arms developmental objectives and activities, current and planned, of the various laboratories, subordinate commards and agencies of USAMC, USACDC, and

USCONARC. It provides the current and planned funding of each of these efforts, with priorities assigned to assist in new budgetary allocations and in reprogramming within current budgets. It affords far greater visibility than has existed in the past at DA level. It provides a semi-annual forum for exchange of information (among DA staff elements, major commands and their subordinate commands) regarding development progress, and for highlighting problems for resolution at the various developmental echelons.

Representatives from concerned DA staff agencies, USAMC, USCONARC, and USACDC attend the conferences. In addition, the program was proposed as a separate RDTE and PEMA line item in the Army budget, starting with the FY 1970 budget. Overall responsibility for the program was assigned to ACSFOR. This program should increase visibility of all small arms projects and should facilitate the control and direction of the diverse Army organizational elements concerned with small arms systems. See Appendix 10 for the background of the ARSAP.

Each of these steps and the efforts of the Project Manager, Rifles, are designed to reduce rifle system management problems. However, each of the steps has been taken during the 1967 - 1968 time-frame and it will be sometime before the synergistic effects of these steps result in significant improvements in the management of the development, testing, and product improvement of small arms. See Appendix 8 for a detailed discussion of the Army organizational structure and management practices.

M16 SURVEYS IN THE REPUBLIC OF VIETNAM

As reliability problems with the M16 continued to be reported in 1966, military concern increased and both public and Congressional interest was aroused. This concern and interest brought about a series of field surveys by various agencies and commands. A summary of those surveys follows:

U.S. Army Weapons Command Surveys

On 11 October 1966, USARV requested technical assistance in support of the M16 from the U.S. Army Weapons Command[29] and three surveys were made: one from October 1966 to December 1966, another in January - February 1967, and the third in April - May 1967.

October - December 1966

The first USAWECOM survey team stayed in Vietnam from 21 October 1966 until 2 December 1966 and was headed by LTC Herbert P. Underwood of the Office of the Project Manager, Rifles. While the primary purpose of the team was to provide maintenance instruction to a nucleus of officers and men from each brigade who would then teach their own units, direct support organizations were also instructed. The team taught maintenance in every major USARV unit except the 1st Air Cavalry Division.[30]

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29 HQ USARV Msg AVHGD MD 29518, 110206Z, Oct 66.

30 The 1st Air Cav Div had stated that it was having no trouble with the rifle and asked that instruction be given only to the small arms shop of its maintenance battalion.

The survey team verified the existence of a malfunction problem and supported the findings of a preliminary investigation by concluding that the malfunctions were primarily due to inadequate cleaning, improper lubrication, and the continued use of worn parts.

The most common faults observed were:

a. excessive oil on the weapon;

b. carbon buildup in the chamber, bolt, and bolt carrier group;

c. overloading of magazines with 21 rounds of ammunition;

d. oil and grit inside magazines (frequently accompanied by lubricated ammunition); and

e. failure to replace worn or broken extractors and extractor springs.

Other deficiencies noted frequently were shortages of technical manuals, cleaning equipment, and repair parts, and a general lack of knowledge of the M16 among officers and noncommissioned officers. As a result of the technical team's visit to Vietnam the following action was taken:

a. Instruction material on the care and cleaning of the M16 was published and distributed at company or rifleman level.[31]

b. Emphasis was placed on the need for adequate command supervision of maintenance programs.[32]

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31 USAWECOM ltr, 25 Oct 66, User Care of the M16; USARV Combat Lessons Learned, 28 Oct 66, M16 Care and Cleaning; USARV Training Circ 5, 20 Nov 66; USARV Pamphlet 750-5, 14 Dec 66; and extracts from several PS magazines.

32 COMUSMACV Msg, MACJ42-MS 46816, 230911Z Oct 66; USARV Msg AVHGD-MD 30677, 181215Z Oct 66.

c. New troops were required to receive a minimum of two hours M16 maintenance training during their first week in Vietnam.

d. Immediate USARV inspection and repair of all M16s on hand by divisional direct support maintenance teams and elements of the 1st Logistics Command was directed.

January - February 1967

A follow-up of the first survey and instruction visit was made by USAWECOM from 17 January through 20 February 1967, but no trip report, after action report, or other memoranda exist; therefore no comment on this survey can be made.

April - May 1967

On 17 April 1967 HQ USARV requested technical assistance with the XM148 grenade launcher. The technical team sent in response to this request was in Vietnam during the period 27 April through 18 May 1967. The primary purpose of the survey was to evaluate and correct problems with the XM148 grenade launcher, but the team also examined large numbers of M16 rifles in the hands of troops to determine the status of maintenance, the availability of cleaning materials, and the condition of rifle barrels and chambers.

The survey team concluded that rifle maintenance and the availability of cleaning materials had improved considerably and that the major remaining problem was deterioration of rifle barrels caused by chamber pitting and the accumulation of copper fouling. It estimated that approximately 10 percent of the M16s

in Vietnam would require a barrel replacement every three months. To reduce the rate of barrel deterioration, the team recommended speeding up deliveries of the recently adopted improved lubricant (MIL-L-4600A) LSA, and chrome plating the rifle chambers.

Congressional Survey

On 3 May 1967 the House Committee on Armed Services appointed a special subcommittee to inquire into the M16 rifle program, naming Congressman Richard H. Ichord chairman. During their investigation the subcommittee visited Vietnam from 3 to 10 June 1967. After briefings at both Headquarters MACV and Headquarters USARV, they visited the two Marine divisions and elements of five Army divisions. While in the field they interviewed commanders, logistical support and training personnel, and soldiers and marines who had used the M16 in combat.

No official report on this survey was published; the findings which follow are based upon observations by COL Crossman and the team escort, COL Paul B. Henley.

a. At least 50 percent of the men interviewed had encountered serious malfunctions with the M16, most of them failures to extract.

b. The bolt closure device was used frequently enough to justify the Army's insistance upon this product improvement.

c. Extractors and extractor springs required replacement fairly often.

d. While there was no general shortage of cleaning and preserving equipment, many individuals were short of the critical cleaning rod and chamber brush.

e. Approximately 50 percent of the men preferred the M14. Most of the men who wanted the M14 felt that it was a more reliable rifle and were concerned about the M16's possible malfunctions in combat.

f. Many cases of a stuck or jammed selector lever were reported.

It was not possible to correlate the kind of lubricant or method of lubrication with malfunctions, nor was such correlation possible with ammunition of a particular type or make.

COL Crossman recommended to Congressman Ichord that an immediate investigation be conducted of ammunition design and manufacture, rifle design and manufacture, and maintenance in the field to determine the cause and cure for failures to extract.

Office of the Assistant Secretary of Defense Survey

The Directorate for Inspection Services (DINS), Office of the Assistant Secretary of Defense (Administration), conducted a field survey in Vietnam from 22 August to 6 September 1967 to examine the performance of the M16 rifle. Findings were to be compared with a technical evaluation of the M16 already completed by the Director of Defense Research and Engineering, who would then submit to the Deputy Secretary of Defense a final report stating whether any major deficiencies existed in the weapon and recommending corrective action accordingly.

The survey team used a questionnaire which was completed by 1,585 men armed with the M16. The following is an extract of their findings:

a. The interview of individual riflemen in South Vietnam disclosed that compliance with MACV training directives had not been achieved to the desired degree. This was caused by some failure to communicate the training directives issued by MACV and major subordinate commands to the operating units. There was also some failure in the chain of command to follow up the directives in order to achieve compliance.

b. The principal direct cause of the stoppages of the M16 rifle in South Vietnam has been the failure to extract the spent case. In turn, this is caused by dirty or corroded cartridges and improperly maintained chambers.

c. Adequate, regularly conducted inspections of the M16 rifle were not being accomplished in many units. In the majority of units the inspection of magazines and ammunition on a regular basis was rarely accomplished.

d. There are no major problems being experienced in the field with the M16 rifle at this time that have not been identified and for which corrective action had not been instituted. There are minor problems remaining which are within the purview of the product improvement program for the weapon.

e. The general performance of the M16 rifle had been satisfactory in Vietnam. Since June 1967 it has improved steadily as a result of increased training and discipline of the rifleman in the care, cleaning, and maintenance of the weapon.

Office of the Chief of Staff Survey

Early in November of 1967 the Chief of Staff, Army directed an intensive review of the entire M16 rifle program. On 8 November the M16 Rifle Review Panel was convened within the Office of the Assistant Vice Chief of Staff and instructed to prepare a comprehensive history and evaluation of the M16 program, recommending further action as required. This panel conducted a field survey of men armed with the M16 rifle in Vietnam from 24 January through 5 February 1968 as a part of its review.

All major Army units in USARV and one Marine division were included in the survey sample. Two means were used to collect data: personal interviews, and a questionnaire.

The survey indicated that the M16 rifle system was suitable for the war in Vietnam. Particularly desirable qualities were its high rate of lethal fire and light weight. However, failures to extract were still occurring with enough frequency to reduce confidence in the M16. Although men generally preferred to carry this weapon in combat, some misgivings were entertained about its reliability. Introduction of the chromed chamber appeared to reduce the number of failures to extract, but this improvement had not been fielded long enough to permit adequate evaluation. Additional data collected indicated that:

a. Approximately 23% of the personnel were lubricating their ammunition, which is contrary to all published directives.

b. The buffer retrofit program had not been completed. (16% of the personnel questioned reported no new buffers).

c. Approximately 28% of the over 2,000 personnel questioned had not received M16 training after arrival in Vietnam and 24% reported receiving no M16 training before arrival in Vietnam.

d. Approximately 10% of the personnel had never zeroed their weapon and another 33% had not zeroed within the previous three months.

e. 18% of the personnel reported that their units did not test fire weapons.

f. Although the rifles are cleaned almost daily, the magazines and ammunition are cleaned on the average only once a week.

g. Adequate supplies of cleaning materials are available in theater; however, shortages do exist at unit level from time to time because of distribution problems.

It should be noted that many of the maintenance, training, and supply problems found by the previous surveys still existed.

The detailed discussion of the field survey is at Appendix 7, which has been published separately and distributed to the interested commands and agencies.

THE ARMY SMALL ARMS PROGRAM

Introduction

On 26 January 1968 the Assistant Chief of Staff for Force Development (ACSFOR) published the Army Small Arms Program (ARSAP) -- a comprehensive document detailing, with funding and priority citation, nearly 50 tasks to meet the Army requirements for small arms in the immediate, mid-, and long-range time frames and to establish a management structure to provide for coherent execution of the multi-phased, multi-faceted program. This publication was the formal response to an October 1966 Chief of Staff decision to draw together under unified management the various activities of small arms development. The decision, in turn, was an outgrowth of several years of study and analysis of small arms development in the U.S. Army. The purpose of the program was to assure that the U.S. Army would have the necessary small arms weapon systems at the time they were needed. One of the key points of the small arms program is that it is not a rigid, final work plan, but rather an assemblage of tentative tasks and efforts always amenable to redirection, expansion, restriction, and execution in order to provide the data, technology, and systems when and where needed and to ensure that at each step the necessary fundamental work has already been accomplished.

Background

Small Arms in July and August 1964

On 7 July 1964 the Under Secretary of the Army wrote the Chief of Staff that he and the Secretary would like to review the Army's rifle program with particular emphasis on two questions:

a. If it became necessary in the near term to place new orders, would we resume M14 production, increase M16 production, or some combination of the two?

b. What is the status of current planning for the SPIW (Special Purpose Individual Weapon)? To what extent are we considering other weapons such as the M16 with its available attachments or the Stoner system, in lieu of the SPIW?

The Army Staff recommended that if procurement of rifles were authorized in the immediate future the Army should resume production of M14s rather than M16 production or a combination of M14 and M16 production. The Staff response to the second of the Secretary's questions was that the SPIW would be the standard individual weapon to replace the current rifles provided that the forthcoming evaluation of the program resulted in approval of a SPIW weapon. In the meantime the Army was continuing to examine several small caliber rifles as possible standard replacements for the then standard M14.

The SPIW development schedule was reported to the Secretary of the Army on 18 August 1964:

December 1965	Type classification of the selected weapon
January - June 1966	Pilot line production

June - December 1966	Troop tests with the first thousand weapons
January - June 1967	Initiation of large scale procurement

Throughout 1964 and 1965 SPIW had the dominant role as the successor small arm. The failure of SPIW to meet the development schedule was a significant factor in the decision to initiate an explicitly articulated small arms program.

Prelude to the SAWS Study

In response to the briefing on 18 August 1964, the Secretary of the Army directed that a study be prepared to support a proposal to the Secretary of Defense that M14 rifle procurement be resumed. Chief of Staff Memorandum (CSM) 64-341 relayed this requirement to DCSLOG and ACSFOR on 21 August stating that a case should be made for resumption of limited production using one production facility and citing the advantages to be gained in terms of readiness and cost, and the renewed availability of M1 rifles for Military Assistant Program (MAP).

On 12 August 1964 the Commanding General, US Army Materiel Command (USAMC) informed the Chief of Research and Development (CRD) that in his view the type classification date for the SPIW would slip from December 1965 to January 1967. He based his opinion upon the most recent performance of the test prototype weapons, which had indicated a high malfunction rate and an unacceptably high noise level, and upon the yet unfulfilled need

for a workable muzzle brake. The Chief of Staff was so informed on 21 August 1964 by a CRD summary sheet.

In November 1964 a DCSLOG study of M14 rifle procurement concluded that, as a minimum, procurement of M14 rifles was necessary to fill the expected deficit at the end of fiscal year 1970 and to initiate a commercial hot base. In the event of further slippage in the schedule of the SPIW, procurement of M14 rifles to equip the Selected Reserve might become necessary. DCSLOG recommended approval of procurement of 100,000 M14 rifles in the FY 1966 budget.

On 6 November the Deputy Director of Defense Research and Engineering (DDRE) expressed to the Chief of Staff the Department of Defense's view that the Army was resistant to the Stoner weapons family, had a closed mind about it, and had been dragging its feet with respect to the system.

On 10 November 1964 the Chief of Research and Development acknowledged that the "not invented here" (NIH) problem was a real one and was recognized as such by the Army Staff. However, it was his expressed opinion, despite allegation and inference to the contrary, that NIH was not the real reason behind either the Army's position or actions with regard to the Stoner and AR15 rifle systems.

Because the Secretary of the Army was to be briefed on the Stoner weapon system by the Marine Corps on 12 November and

because of recent activity concerning the Army's small arms weapon program, the Chief of Staff wrote the Secretary on 11 November:

> I believe that we can and should completely re-evaluate our small arms weapons program, starting with a review of doctrine. Our posture is such that we can afford to take this action over the next year or two with a minimal risk. Only by such a deliberate and thorough approach will I be confident that our small arms weapons program reaching into the 70's will be on firm footing. I am hopeful that the Marine Corps will subscribe to this approach, will monitor our efforts as they habitually do, and will not attempt to precipitate an early decision which could prejudice the future combat effectiveness of both the Army and the Marine Corps. General Greene has given me oral assurance that he does not intend to pursue a course that diverges from that of the Army at this point.

The SAWS Study

The complete re-evaluation of the Army small arms program that the Chief of Staff, Army recommended was formalized the next day. CSM 64-484 directed the Army Staff to initiate a review and evaluation of the Army Small Arms Weapon Systems (SAWS), to include study of doctrinal employment and desired characteristics, test and evaluation of existing weapon systems, and analytical evaluation of weapons under development or feasible within the time frame, 1965-1980. The object was to develop the necessary analytical background upon which to base a program for replacement of existing stocks of small arms as the inventory dropped below requirements, or replacement of the inventory with weapon families of demonstrated superiority over all other families.

Army Staff responsibility was assigned to ACSFOR, whose first task was publication of a detailed directive (CSM 64-555).

The Small Arms Weapon Systems (SAWS) Study was conducted by USACDC with the assistance of USAMC, USCONARC, and major oversea commands. Overall responsibility for conduct of the study was assigned to the U.S. Army Combat Developments Command Infantry Agency (USACDCIA) at Fort Benning, Georgia. USACDCIA tasked appropriate agencies for the following:

a. Engineering and Service Tests, United States Army Test and Evaluation Command (USATECOM).

b. Troop Tests: USCONARC; United States Army, Europe; United States Army, Pacific; United States Army, Southern Command; and United States Army, Alaska.

c. Field Experimentation, United States Army Combat Developments Command Experimentation Center.

d. Computer Simulation of SAWS, Combined Arms Research Office (CARO).

e. Weapon Systems Data, Ballistics Research Laboratories.

f. Procurement and Cost Data, USAWECOM.

Consistent with the directive to consider hardware and prototype weapon systems and feasible designs for such systems, USACDCIA conducted hardware (engineering and service test) evaluations on the XM16E1, Stoner, Armalite AR18, and Harrington and Richardson caliber .223 rifles; the Colt and Stoner automatic rifles; the Colt submachine gun (now designated the XM177E1); the Stoner carbine; the Stoner, M60 and M73 machine guns; and the M14 and M14E2 rifles. Computer and parameter design analysis

evaluated the Springfield Armory and AAI SPIW and universal machinegun (UMG) systems; the 13mm and 20mm Gyrojet systems; the AVROC 5-20, 8-20, and 25-40 systems; and parametrically designed 0.65 lb-sec, 1.2 lb-sec, and 2.6 lb-sec impulse weapon systems.

USACDCIA developed its study recommendations by placing primary reliance on the CARO computer simulation, the assumed availability of SPIW in 1970, the 1965 Army Materiel Plan (AMP) assets-requirements balance, and a concept of "selective modernization." The policy of selective modernization envisages replacing one-third of the total small arms inventory every seven years, with priority for allocation of new weapons going to combat maneuver units. The principal USACDCIA recommendations of the SAWS Study were:

a. Procure no additional rifles beyond those XM16E1 rifles currently on order until SPIW becomes available in 1970.

b. Initiate a program of selective modernization by procuring SPIW, when available, in sufficient quantities to replace rifles, automatic rifles, and grenade launchers for infantry maneuver units only (approxi- 192,000).

c. Retain the M60 as the future infantry machine gun until the universal machine gun is developed, about 1972.

d. Improve the effectiveness of SPIW in the automatic rifle role or adopt the UMG with a bipod mount to this role.

e. Continue development of the UMG to make it at least as effective as the M60, while preserving the weight-saving of the current conceptual UMG design, and then in 1972 replace all machine guns with the UMG.

f. Initiate and fund a vigorous research and development program for the purpose of (a) developing caseless ammunition by 1976 with improved projectiles for use in a redesigned SPIW with a further improved area fire capability; and (b) discovering or developing a new lethal mechanism permitting design of radically different small arms systems.

g. In 1976 continue the program of selective modernization by procuring 500,000 SPIW redesigned to utilize caseless ammunition. About half of these would have the area fire capability and half would not.

Behind these recommendations was the substantive conclusion that among weapons currently in the inventory the 5.56mm weapons were better for use in low intensity warfare, such as that encountered in Vietnam, whereas the 7.62mm weapons were more effective in high or mid-intensity warfare, such as that which would be encountered in Europe. This conclusion was mainly derived from the computer simulation.

A study review by Headquarters, USACDC modified the USACDCIA study recommendations in several instances.

Rifle Procurement. An increase in stockage objectives or significant decrease in assets by combat loss or wear-out, requiring an additional buy of rifles before 1970, should be satisfied by purchase of XM16E1 weapons.

Adoption of SPIW. Final decision to adopt and field SPIW must be contingent upon results of further experiments and tests. It is understood that some difficulty is being experienced in current SPIW comparative evaluation testing by the US Army Materiel Command. To be acceptable, SPIW should essentially equal the theoretical capabilities used in this study.

The SAWS Study was submitted to the Army Staff 1 September 1966 and reviewed by the Staff and by the Force Planning and Analysis Office (FPAO) within the Office of the Chief of Staff, Army.

While the SAWS Study had provided much needed information and a sound basis for some decisions on current small arms weapon alternatives, review of the SAWS Study revealed that (1) there were gaps in the Army's basic knowledge on small arms which could be remedied by additional fundamental work; (2) the Army research and development effort to provide successor small arms weapons needed to be broadened, to be continuous, and to be deliberate; and (3) a better interface between USAMC and USACDC at the technical and systems management levels was required.

The SAWS Study amassed large quantities of data, most of which were left unanalyzed or only partially analyzed. While providing much valuable information on which significant decisions could be based, the SAWS Study did not develop the necessary analytical background upon which to base a program for replacement of existing stocks of small arms, or for the introduction of weapon families of demonstrated superiority,

based upon cost-effectiveness considerations, in the time-frame up to 1980. The study did not provide an evolutionary program for small arms oriented toward improvement of current systems and development of new systems against future requirements; improved evaluation criteria and methods; or continued collection of more complete analytical data upon which to base future decisions. SAWS was a first effort in this direction and left the next step in the development of the Army Small Arms Program to subsequent action.

The Chief of Staff's Decision on the SAWS Study

In October 1966 the Chief of Staff reviewed the USACDC SAWS Study, the DA Staff position, and the FPAO review and evaluation. The Chief of Staff's decisions were discussed with Staff principals on the 26th of October and were formalized in two memoranda -- CSM 66-485, published 7 November 1966, and CSM 67-96, published 8 March 1967.

CSM 66-485, containing the immediate time-frame directives, stated:

> The XM16E1 rifle will be adopted as the standard Army rifle and will be reclassified as Standard A. The M14 and M14A1 rifles will remain Standard A initially. The Authorized Acquisition Objective (AAO) for rifles and automatic rifles will be computed on the XM16E1, rather than on the M14 and M14A1.
>
> The development cycle of the SPIW will be reoriented to the status of exploratory development and become a part of a broadened small arms research and development program for the future.

> The overall procurement objective is a single-family (rather than a multi-family) small arms weapon inventory based on the Colt 5.56mm individual weapons and, for the present, the M60 machinegun; and the first objective will be to eliminate at an early date the caliber .30 family of infantry weapons.
>
> Product improvement . . . will be incorporated in the new production of XM16E1 rifles and 5.56mm ammunition.

The purpose of CSM 67-96 was to provide guidance for the formal establishment of the Army Small Arms Program and for future small arms weapon development. CSM 67-96 called for:

> Improvement in design and performance of the Army's current small arms system, within existing technology, to increase effectiveness.
>
> Continuous investigations and/or development of new techniques, machines, procedures, and/or materials which will provide a reduction in the unit cost of small arms ammunition and grenades.
>
> Studies, field experimentations, tests, and evaluation to establish, validate, or develop small arms data, doctrine, or concepts which are required to improve effectiveness or utilization of current small arms systems and to provide a more valid basis for the development of new systems.
>
> Research and development effort designed to identify new approaches or lethal mechanisms which could be more effective than conventional approaches in fulfilling the role of small arms systems.

<u>The Army Small Arms Program</u>

On 26 January 1968 the Assistant Chief of Staff for Force Development wrote the Army Staff, USAMC, USACDC, and USCONARC:

> . . . the Army Small Arms Program . . . is hereby established as a means to direct and coordinate the research, development, and product improvement efforts of the Army in the small arms area, as well as investigative efforts as to qualitative requirements for small arms weapons or weapon features, and to provide a coordinated system of priorities of effort with corresponding budgetary allocations and planning figures. . . .

The Army Small Arms Program (ARSAP) coordinates by means of periodic conferences and compiliation of task resumes, the research and development, procurement, and product improvement of all small arms, caliber .60 or smaller, shotguns, and infantry grenade launchers.

Assessment of the Army Small Arms Program

With the promulgation of the Army Small Arms Program (ARSAP), the Army has established a formal, integrated, and thorough program to direct and coordinate the research, development, procurement, and product improvement of small arms weapon systems. The program is established, but, like other programs, will not eliminate nor solve future problems until it becomes truly viable in each command and at each echelon, which of necessity requires time.

Orientation

The basic philosophy underlying the ARSAP is that weapon development must be a continual effort. Weaponry state-of-the-art makes moderate advances and, only rarely, can significant technological break-throughs be accompliished. To be prepared to meet threat contingencies and to explcit technological developments as they occur, the U.S. Army must continually monitor technical improvements for its weapon systems. At the same time, effective weapon systems must be in the hands of the troops. Such systems represent the successful integration of various component parts, each fully developed to the point of production, not just engineering prototypes.

The ARSAP approache[illegible] his requirement, in practical terms, by specifying tasks for [illegible]ishment with respect to short-, mid-, and long-range time frames, where the short-range time period is the immediate present and the long-range is ten to twenty years into the future. Such an expression of time-frame-oriented objectives allows for the smooth transition from long-range to short-range objective of a given task with the passage of time. Overlapping the time-frame orientation is a group of tasks called continuous objectives directed toward continuing exploratory development of weapon system components, small arms systems analysis, and evaluation of requirements statements and doctrine.

Of fundamental importance, as evidenced by the inter-related history of the SPIW and the M16A1 programs, is the absolute necessity to maintain the time-frame flexibility represented by the initial version of the Army Small Arms Program. No future development should look so tempting that the Army fixes solely, or even primarily, on it to the detriment of the development of other systems or concepts. Similarly, the ARSAP must not become geared to arbitrary conceptulization of target dates (such as the Army in 1975 or 1985) for the introduction of future systems. The expression of its objectives must remain dynamic.

Management

Management represents the principal problem area in the Army Small Arms Program. Basically, the program is managed by funding

authority, but this is indirect management. There are also the problems of management continuity and funding priority. The stated scope of ARSAP uses the phase "manages, by means of periodic conferences." However, in the absence of daily, direct line authority, it would be more appropriate to use the term "cocrdinates." The periodic conferences provide for user and developer interface, allocation of funding priorities, coordination of development efforts, and identification of required research activity. A detailed discussion of the Army Small Arms Program (ARSAP) is at Appendix 10.

E. Conclusions

Conclusions drawn which either result in specific recommendations or relate directly to historical findings of recurring interest are contained in this section. In each case, parenthetical notation following the conclusion indexes the location of its justification. Other conclusions which bear on a small facet of a large problem or are historical only and warrant no further action are included in the technical appendicies.

Procurement, Production, and Distribution

1. The procurement of the M16 rifle has been discontinuous and uncoordinated because of the lack of a definitive rifle program. (Appendix 5, pages 5-1 through 5-44.)

2. The introduction of the M16 rifle and ammunition into the inventory in sizable quantities prior to type classification contributed to the quality assurance problems that were experienced. (Appendix 5, page 5-55.)

3. There have been no significant production problems with the rifle except for discrepancies in quality control. (Appendix 5, page 5-64.)

4. The production of ammunition has been delayed on several occasions by the inability of producers to meet the specifications and material shortages. (Appendix 5, pages 5-8, 5-14 through 5-20, 5-34 and 5-35.)

5. Expansion of the ammunition production base generated a requirement for more stringent control measures (Appendix 5, page 5-35).

6. Negotiations for proprietary rights extended over an excessively long (from 1963 to 1967) period of time primarily due to the Army's changing requirement for rifles. The delay in final negotiations was further aggravated by a lack of understanding by Colt's and the Army of the requirement for rights to the XM177 submachine gun. (Appendix 5, pages 5-1 through 5-44 and 5-53.)

7. After the first 100,000 weapons are produced, very little reduction in unit price is experienced in the small arms manufacturing industry, including automated production. The learning curve is approximately ninety-eight percent. (Appendix 5, page 5-87 and 5-89.)

8. The establishment of multiple sources for M16 production is not economically justified unless the recurring unit cost at Harrington and Richardson is at least 33 percent below that established by ceiling prices and the recurring unit cost at General Motors is at least 60 percent below that established by ceiling prices. A prime consideration in these procurement contracts was accelerated quality production (Appendix 5, page 5-93)..

Product Improvement Modifications

1. Major modifications have frequently not been supported by test data at the time of their approval. The majority of all modifications have been relatively minor — calling for dimensional and surface or material finish changes. (Appendix 11, pages 11-27, 11-28, and 11-31.)

2. Between November 1964 and May 1967, a series of modifications were introduced to make reliable functioning of the M16A1 system less susceptible to solid particles of residue contained in the propellant gases. (Appendix 11, pages 11-28 through 11-31.)

3. Colt's recognized as early as September 1965 the increased cyclic rate effects of WC 846 (ball) propellant. (Appendix 11, page 11-29)

4. There was a delay of five months between final approval of the redesigned buffer and its introduction into production. (Appendix 11, pages 11-29 and 11-30.)

Ammunition Development

1. The technical data package for 5.56mm ammunition has never specified metallurgical requirements for the brass cartridge cases as was done for 7.62mm NATO ammunition. The Project Manager is aware of the need for case hardness control and is taking appropriate action. (Appendix 4, pages 4-3 through 4-9.)

2. After completion of the Frankford Arsenal report, the Project Manager in 1963 requested BRL to provide a solution to the bullet design problem. This problem has not yet been solved. (Appendix 4, pages 4-26 through 4-29.)

3. Efforts were made to identify the cause of fouling. Althoug primer composition was determined to be a contributor to fouling, it cannot be considered the primary cause. (Appendix 4, pages 4-19 through 4-21.)

4. The overall primer development program has failed to standardize the basic design of the primer. (Appendix 4, pages 4-19 through 4-21.)

5. Army decisions regarding acceptance of propellant have been influenced by propellant availability and the preference of cartridge producers. Propellants have been accepted for loading in 5.56mm cartridges that did not optimize M16 weapon functioning. (Appendix 4, pages 4-30 through 4-51.)

6. Significant production of tracer ammunition loaded with ball propellant was allowed to continue when information was available in the Office of the Project Manager, Rifles which indicated that tracer ammunition loaded with IMR propellant provided the best interior ballistic match with ball cartridges. (Appendix 4, page 4-59.)

7. The Project Manager, Rifles, has to date not complied with an 8 December 1966 directive from the Commanding General, USAMC, to "come to grips at an early date with the 3,250 f.p.s. velocity requirement". (Appendix 4, page 4-41 through 4-44.)

8. Projectile configuration for 5.56mm ball ammunition has not been standardized in production. (Main Report, pages D-24 and D-25).

Test and Evaluation Policies and Procedures

1. Army policy for testing of the M16 system has been inadequate. Many past deficiencies in Army testing policy have been surfaced by studies and boards. Policies designed to correct most of these deficiencies have been drafted. (Appendix 1, pages 1-2 through 1-24.)

2. Army policy pertaining to product improvement and post production tests needs improvement. (Appendix 1, page 1-16.)

M16 System Tests

1. The conclusions drawn in testing of the M16 system were often not clearly supported by the test data. (Appendix 2, pages 2-74 through 2-79.)

2. A disproportionate share of the testing effort has been concentrated upon the generation of new data at the expense of the analysis of both the new and already existing data. (Appendix 2, pages 2-78 and 2-79.)

3. The most notable example of incomplete testing was the omission of cyclic rate measurements in the 17 March to 10 April 1964 firings for the engineer design test of alternate propellants for use in the 5.56mm M193 cartridge. (Appendix 2, pages 2-57 and 2-58.)

4. Because of the small size of the sample and the variability between weapons, the results of the SAWS engineering environmental sub-tests could give only an indication of weapon performance, and even then without great assurance. (Appendix 2, pages 2-6 through 2-23.)

5. In the case of the M16 there was no kinematic analysis of M16 weapon functioning, although kinematic analyses were conducted on other small arms systems. (Appendix 2, pages 2-55 through 2-57.)

6. Experience with the M16 in Vietnam has proven the inadequacy of the M16 test program with respect to environmental testing. The Tropic Test Center did not test the M16. (Appendix 2, pages 2-58 and 2-59.)

7. A significant gap in M16 test data is the failure to take account of tracer cartridges in lethality evaluations. (Appendix 2, pages 2-59 and 2-60.)

8. Tests with the same purposes or objectives have not always followed the same procedures within the same time frame. (Appendix 2, pages 2-68 through 2-71.)

M16 System Reliability

1. The functional reliability of the M16A1 rifle, as currently produced with the new buffer and chrome plated chamber, is satisfactory when the weapon, ammunition, and magazines are properly maintained and lubricated, and provided that ball ammunition loaded with ball (WC 846) propellant, and tracer ammunition loaded with IMR propellant are used. (Appendix 6, pages 6-110 and 6-139.)

2. Over 50 percent of the malfunctions currently being experienced by the M16A1 system are failures to feed and can be attributed primarily to the standard magazine. (Appendix 6, pages 6-41, 6-53, 6-55, 6-111, 6-143, and 6-146.)

3. The reliability of the M16A1 rifle is sensitive to minor variations in the operating energy level. (Appendix 6, pages 6-126 through 6-129.)

4. Except in the first evaluation in 1958, the M16A1 rifle has been, and continues to be, less reliable than the M14 rifle. A higher malfunction rate is an inherent characteristic of the fully automatic rifle in general, a fact that was most recently confirmed in the WSEG test. (Appendix 6, pages 6-139 and 6-123.)

5. Changes were made in the M16A1 and its ammunition by trial and error. Little is known about the effect of variations in internal ballistics on functional reliability of the system, nor were detailed studies in this area initiated before 1968. (Appendix 6, pages 6-46, 6-47, 6-56, and 6-57.)

6. The reliability data reported in the various tests and evaluations do not provide a statistically significant basis for an engineering analysis, nor do they provide a clear reason for the occurrence and fluctuation of certain malfunctions. (Appendix 6, pages 6-10, 6-14, 6-21, 6-23, 6-29, 6-30, 6-32, 6-34 and Appendix 2.)

7. The function firing tests and the 6,000-round endurance tests conducted at Colt's do not provide data which are indicative of the actual performance that can be expected of the M16A1 in the hands of troops. Therefore, the value of these tests is limited since they do not represent a test of the service life of the weapon. (Appendix 5, pages 5-55 through 5-61 and Appendix 6, pages 6-14, 6-131, 6-132, 6-135, and 6-139.)

8. The lack of cleaning materials and the lack of proper training contributed heavily to the high M16A1 malfunction rates experienced in Vietnam in late 1966 and early 1967. (Appendix 6, pages 6-113, 6-114, 6-115. See Appendices 3 and 7 also.)

9. A detailed engineering analysis of the M16A1 system is required to improve its reliability further. (Appendix 6, page 6-130.)

M16 Rifle Training

1. In many cases there were no M16 rifle training programs for replacements assigned to Vietnam during the period March 1965 to July 1966. (Appendix 3, pages 3-3 through 3-9, 3-11, 3-14, 3-15, 3-18, 3-27 and 3-60.)

2. At least until November 1967, a significant number of men failed to receive the required POR M16 training in CONUS. Management of POR processing did not identify POR M16 rifle training deficiencies satisfactorily and port calls were not postponed for the purpose of completing POR training. (Appendix 3, pages 3-27 and 3-65.)

3. With the exception of the training program conducted in 1964 by Lackland Military Training School, which was attended by 12 Army representatives, there was no new equipment training program conducted in the M16 rifle in CONUS. (Appendix 3, pages 3-156 and 3-158.)

4. The lack of a blank firing adapter during 1966 and 1967 was a restriction to POM training, unit training, and Vietnam-oriented infantry AIT training programs. (Appendix 3, pages 3-6, 3-25, 3-33, 3-34, 3-38, 3-45 and 3-78.)

5. When DA announced in December 1966 that all units in Vietnam and not only the combat maneuver battalions would be equipped with the M16 rifle there were no plans at DA or USCONARC

for a corresponding expansion of training, nor is there any evidence that training staff officers at DA or USCONARC even knew of the plan to extend M16 rifle issues. (Appendix 3, pages 3-34 and 3-35.)

6. The Staff responsibility for POR training at DA and USCONARC headquarters is still not adequately defined. (Appendix 3, pages 3-35, 3-62 and 3-63.)

7. The initial 8-hour POR-POM training program recommended by USCONARC in January 1966 and approved by DA the same month was a product of a shortage of rifles, ammunition, training time, and uncertainties surrounding the issue of rifles to units to be deployed to Vietnam. This program did not require the soldier to zero his rifle or to fire the rifle in the automatic role. (Appendix 3, pages 3-13, 3-14, 3-16 through 3-19, 3-23, 3-25 through 3-27, and 3-61.)

8. The 8-hour POR program directed in July 1967 was an improvement over the January 1966 program because it required zeroing, firing in the automatic mode, emphasized care and cleaning, and increased the number of rounds to be fired. (Appendix 3, pages 3-47 and 3-48.)

9. The establishment of centralized POR processing points within USCONARC and the granting of three additional days to complete POR training has significantly reduced the number of men who leave CONUS without M16 rifle training. (Appendix 3, page 3-65.)

10. USARV decided in October 1966 that expansion of M16 rifle training in CONUS to other MOS's was not desireable at the expense of diversion of rifles and ammunition scheduled for SEA. USARV was experiencing serious malfunctions with the rifle, some of which were attributed to inadequate and insufficient training. (Appendix 3, pages 3-27 through 3-32.)

11. USARV training directives were adequate beginning in November 1966, but the directives have not been followed in many cases. (Appendix 3, pages 3-85 through 3-94.)

12. The primary factor which hindered the expansion of M16 rifle POR training programs during 1967 was the lack of training time, especially for students in service schools and training centers. (Appendix 3, pages 3-36, 3-38, 3-46, 3-47, 3-50 and 3-56 through 3-58.)

13. The M16 rifle training programs prescribed and conducted in Vietnam-oriented infantry AIT are adequate. (Appendix 3, pages 3-41, 3-45 and 3-48.)

14. In general M16 training circulars, field manuals, and technical manuals contained contradictory statements and inadequate and incomplete information. (Appendix 3, pages 3-132 through 3-141.)

15. USAWECOM's interpretation of one Army Regulation resulted in rifles being shipped to users without the technical manuals being packed with the rifles. (Appendix 3, pages 3-129 through 3-131.)

16. There is either a lack of knowledge of the pinpoint system of distribution or a lack of user follow up at unit level. (Appendix 3, pages 3-63, 3-76, 3-139, 3-140 and 3-153.)

17. Valuable maintenance and supply instructional assistance was provided by USAWECOM to various organizations, installations, and training facilities within CONARC during 1966 and 1967; similar assistance was provided to USARV. (Appendix 3, pages 3-63, 3-64, and 3-160.)

18. The Chief of Staff has approved M16 rifle training programs for all infantry AIT and for BCT, and the DA staff is studying a plan for oversea commands to provide M16 rifle POR training. (Appendix 3, pages 3-58 and 3-59.)

Management

1. The Army Small Arms Program can provide the management tools which will establish visibility of small arms research and associated development, provide for a more realistic evaluation of all small arms systems, identify areas that require investigation or correction, and constitute a basis for the coherent, unified development, improvement, and test of future systems. (Appendix 8, pages 8-20 through 8-29.)

2. The Army Small Arms Program, when fully operational, could help to overcome the organizational problems inherent in

in managing a system in a functionally oriented organization. However, management of the Army Small Arms Program at this time is primarily exercised through the indirect means of funding authority. Clearly established lines of authority and responsibility within the program are not adequately defined. (Appendix 8, pages 8-20 through 8-29.)

3. The Project Manager,Rifles has been assisted through the creation of committees to facilitate control and coordination of system development, improvement, and testing. (Appendix 8, pages 8-20 through 8-29.)

4. The Department of the Army staff organization has been modified to facilitate system management over the life cycle. (Appendix 8, pages 8-20 through 8-29.)

Vietnam Surveys

1. The accelerated introduction of the M16 into Vietnam, along with shortages of cleaning materials and repair parts, and general inadequate knowledge of the weapon on the part of the chain of command led to poor maintenance in the early stages of the rifle's use in Vietnam. (Appendix 7, pages 7-3 and 7-4.)

2. In the fall of 1966 excessive malfunctions (primarily failure to extract the spent cartridge) were reported. The first surveys concluded that insufficient training of men in the care and maintenance of the M16 was the basic cause of the high malfunction rate, and a training program designed to increase care and cleaning

proficiency was immediately begun. Subsequent surveys found M16 maintenance significantly improved and the malfunction problem reduced. (Appendix 7, pages 7-4 and 7-6.)

3. The Congressional survey in June 1967 found user acceptability relatively low. At that time about one-half of the riflemen wished to exchange their M16's for M14's, chiefly because they had misgivings about the M16's reliability. (Appendix 7, page 7-9.)

4. In the fall of 1967 the Office of the Secretary of Defense field survey found acceptability unusually high. The acceptability figure presented was misleading because the OSD survey questionnaire did not ask the men normally employing rifles which weapon they preferred. (Appendix 7, pages 7-12 and 7-16.)

5. Findings of the 1968 survey conducted by the Office of the Chief of Staff are basically consistent with the other surveys. However, these earlier surveys strongly stressed the urgent need for improved care of the M16 by the rifleman, while the 1968 survey data indicates that equal emphasis should be placed upon product improvement. (Appendix 7, pages 7-2, 7-8, 7-11 and 7-17.)

6. Policies and directives throughout Vietnam which govern M16 training, supply, maintenance, and user care and cleaning were found generally adequate in January-February 1968. Continued command supervision is necessary to improve compliance with these directives. (Appendix 7, Inclosure 7-1, page 37.)

7. With the exception of Vietnam-oriented advanced individual training for infantrymen, all M16 training given to men before their deployment to Vietnam was inadequate. (Appendix 7, Inclosure 7-1, pages 22 and 23.)

8. Many leaders have been hampered in meeting their supervisory responsibilities by insufficient knowledge of the M16. (Appendix 7, Inclosure 7-1, pages 22 and 23.)

9. At the time of the January 1968 survey, USARV required all replacements to complete the same M16 in-country training program, regardless of the amount of prior training. (Appendix 7, Inclosure 7-1, page 23.)

10. Unit armorers in Vietnam often lacked formal training and adequate knowledge of M16 rifle maintenance. (Appendix 7, Inclosure 7-1, page 23.)

11. Men tended to clean their rifles two to three times more frequently than they cleaned their magazines, yet corroded or dirty ammunition and defective magazines seriously reduce rifle effectiveness. (Appendix 7, Inclosure 7-1, pages 27 and 28.)

12. Although individuals usually test fired their rifles, the nature and frequency of such firing varied widely among and within units. (Appendix 7, Inclosure 7-1, pages 30 and 31.)

13. Greater zeroing effort is required, particularly within maneuver battalions. (Appendix 7, Inclosure 7-1, pages 31 and 32.)

14. In January 1968, failures to extract still occurred with enough frequency to reduce confidence in the M16, and these failures had several causes. Besides inadequate maintenance, extraction failures result from such conditions as pitted chambers, defective parts, or faulty control of ammunition case hardness. (Appendix 7, Inclosure 7-1, pages 28 and 29.)

15. Introduction of the chromed chamber appeared to have reduced the number of failures to extract, but this improvement has not been fielded long enough to permit adequate evaluation. (Appendix 7, Inclosure 7-1, page 30.)

16. Most men armed with the M16 in Vietnam rated this rifle's performance high; however, many men entertained some misgivings about the M16's reliability. (Appendix 7, Inclosure 7-1, page 30.)

Army Small Arms Program

1. Throughout 1964 and 1965 Special Purpose Individual Weapon (SPIW) had the dominant role as the successor small arm or close combat weapon system. The failure of SPIW to meet the development schedule was a significant factor in the decision to initiate an explicitly articulated small arms program. (Appendix 10, pages 10-4 through 10-15.)

2. During the period 1962-66, the SPIW program virtually constituted the Army's small arms research and development program. (Appendix 10, pages 10-54 through 10-63.)

3. While the Small Arms Weapons Systems (SAWS) study had provided much needed information and a sound basis for some decisions on current small arms weapon alternatives, review of the SAWS study revealed that (1) there were gaps in the Army's basic knowledge on small arms which could be remedied by additional fundamental work; (2) the Army research and development effort to provide successor small arms weapons needed to be broadened, to be continuous, and to be deliberate; (3) a better interface between USAMC and USACDC at the technical and systems management levels was required. (Appendix 10, page 10-25.)

4. With the promulgation of the Army Small Arms Program in January 1968, the Army has sought to establish a formal, integrated, and thorough program to direct and coordinate the research, development, procurement, and product improvement of small arms weapon systems. (Appendix 10, pages 10-29 through 10-34.)

5. The management structure funding and procedures must be periodically reviewed to assure that an integrated and balanced small arms development effort is maintained. Also, sufficient personnel resources must be made available to manage the program, lest it split into disconnected sub-programs. (Appendix 10, pages 10-36 through 10-40.)

6. The basic philosophy underlying the Army Small Arms Program is that weapon development must be a continual effort.

The effective execution of the Army Small Arms Program is therefore dependent on the assumption of regular funding support over a significant period of time. (Appendix 10, pages 10-29 and 10-30.)

7. Of fundamental importance, as evidenced by the interrelated history of the SPIW and the M16A1 programs, is the absolute necessity to maintain the time-frame flexibility in the Army Small Arms Program. (Appendix 10, pages 10-50 through 10-67.)

8. The studies leading to the selection of the optimum system of grenade launching will not be completed until after the attachment and separate weapon alternatives are fully developed. Meanwhile, no attention is directed toward the possibility of launching 40mm, or similar grenades, from the muzzle of the M16A1 rifle. Such a course, although not desirable, results from a valid requirement in Vietnam for the over-under concept. (Appendix 10, page 10-43.)

9. A key objective of the Army Small Arms Requirement Study (ASARS I) is to determine the importance of small arms in combat to define small arms effectiveness criteria. Due to funding limitations the completion date of this fundamental requirements study is incompatible with the needs of the Army Small Arms Program. (Appendix 10, page 10-44.)

10. Certain fundamental tasks within the Army Small Arms Program need to be expedited to meet the need for analytical

evaluation of weapon alternatives prior to hardware development and to be responsive to the Chief of Staff's directive in CSM 66-485 and CSM 67-96. (Appendix 10, pages 10-40 through 10-45.)

F. Recommendations

Based on its study and report, the M16 Rifle Review Panel recommendations for Army Staff actions are presented in this section. Also included in this section is a list of those recommended actions which require continued attention, but do not require Chief of Staff approval in June 1968 because the Army Staff has already taken steps which should be sufficient to satisfy these recommendations.

It is recommended that the Army Staff undertake the actions to carry out the following:

Ammunition Development

1. Testing of primers be continued in an effort to establish a standard design and composition for primers for 5.56mm ammunition.

2. Testing by BRL, Frankford Arsenal, and USATECOM be given higher priority to determine the interface between bullet configuration, barrel twist, and muzzle velocity, and to determine the degree of improvement performance, if any, over the current system.

3. The review and analysis of the current status of weapon-ammunition interface problems be made an identifiable task in the Army Small Arms Program.

Test and Evaluation Policies and Procedures

4. Improved instrumentation for kinematic tests be installed at USATECOM to increase its capability to conduct comprehensive engineering type tests.

5. Means to identify and pursue significant test phenomena observed be explored in order that developers may analyze system deficiencies and exploit improvement opportunities.

6. Sample size, or test weapon density be predicated on sound statistical sampling techniques. When this is not possible the test report should emphasize the uncertainty associated with insights derived from the test data.

M16A1 Reliability

7. A study be initiated to determine ways to reduce the number of failure to feed malfunctions now experienced by the M16A1 rifle. Particular attention should be paid to the magazines (both 20- and 30-round).

8. A detailed study be conducted to determine the effect of variations in internal ballistics on the functional reliability of the M16A1 rifle. Upon completion of this study, any recommended changes to the M16A1 system should be tested.

9. The effect of internal ballistics on the functional reliability of future developmental small arms systems be thoroughly studied, and trade-offs clearly identified.

M16A1 Tests

10. A statistical model of malfunction experience be developed based on the expected frequency of occurrence of each kind of malfunction. This model should be used as a guide for further

weapon improvement and as a standard against which to judge the validity of experimental design.

M16A1 Training

11. Responsibility for M16A1 POR training be assigned to an Army general staff agency.

12. Necessary action be taken to insure that the pinpoint distribution system is understood by users, and that spot checks are conducted to make certain that accounts are opened and subsequently updated.

13. Action be taken to determine whether maintenance doctrine should be revised to allow the armorer to disassemble the lower receiver of the M16 rifle for the purpose of replacing worn and broken parts.

Management

14. Recent organizational and management improvement efforts be reviewed to assure that they, in fact, enable the Army to manage small arms development, testing, and product improvement. Special emphasis be directed toward the establishment of well defined lines of authority and responsibility within the Army Small Arms Program.

It is recommended that the Army Staff continue to address efforts already underway to carry out the following:

Procurement, Production, and Distribution

1. The Army develop a long range procurement and distribution plan for rifles.

2. Acquisition of the patent rights and a technical data package should be seriously considered in all future procurements of military equipment which are proprietary to a commercial producer. It is desirable to include terms for this acquisition in the initial procurement to insure that the Army remains in the most favorable bargaining position.

3. The contractural quality control requirements for the M16 rifle be updated and tailored to the M16 rather than be identical to those imposed on M14 contractors.

4. The rifle quality assurance program receive increased emphasis by the Army and Defense Contract Administration Services especially during the early production phase of new producers.

5. In the future, the economic justification for multiple sources be clearly examined prior to negotiations and/or become a part of the initial negotiations.

Product Improvement Modifications

6. Regulations be revised to state that product improvement modifications requiring tests will not be approved for production until after testing is completed and reviewed.

Ammunition Development

7. The technical data package be amended for all future procurement of 5.56mm ammunition to include specific metallurgical requirement for cartridge cases.

8. Projectile configuration be standardized in production.

Test and Evaluation Policies and Procedures

9. Department of the Army publish guidance to regulate production and postproduction tests.

10. The responsibility of periodically reviewing for adequacy all Department of the Army regulations on testing and responsibility for life cycle management of Army materiel be assigned to a single Department of the Army staff section.

11. Department of the Army establish a requirement that small arms weapons and ammunition introduced from commercial sources be tested to determine their military worth and be compared to on-going military projects prior to development or type classification.

12. Department of the Army establish strict controls, such as In-Process Reviews and System Status Evaluations on non-Research, Development, Test, and Evaluation project managed programs before they are type classified A or B.

13. U.S. Army Materiel Command provide copies of all test reports to USACDC and USCONARC.

M16A1 Reliability

14. The quality assurance firing test criteria should be reviewed for adequacy, to determine if, by changes in the test, reliability data could be obtained which would more nearly simulate reliability under field conditions while still meeting the original

purpose of the tests. The review of test criteria should include establishing the appropriate number of rounds to be fired.

M16A1 Training

15. A directive be prepared which will provide for positive coordination of training literature with interested agencies.

16. Cancellation of New Equipment Training Programs without DA approval be prohibited.

17. Procedures be established that will provide readily accessible operator's manuals for individual weapons to the soldier, without necessarily requiring one copy to be packed with each individual weapon as a Basic Issue Line Item.

Vietnam Surveys

18. Command supervision be increased to improve compliance with policies and directives which govern M16 training, supply, maintenance, and user care and cleaning in Vietnam.

19. In order to improve predeployment rifle training the following measures be taken:

a. Accelerate introduction of M16 rifles and M16 training for all men in basic combat training at the earliest possible date.

b. Increase the amount of M16 instruction for supervisors in all schools producing junior leaders, for NCO refresher courses, officer candidate schools, and basic branch courses.

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b. Increase the amount of M16 instruction for supervisors in all schools producing junior leaders, for NCO refresher courses, officer candidate schools, and basic branch courses.

c. Establish procedures to insure receipt of M16 training for men on inter-theater transfer to Vietnam.

20. Since many untrained replacements have arrived in Vietnam, two training programs be operated in Vietnam: The present one for most men and another and more intensive one for the totally untrained.

21. Provision be made for additional training for armorers in Vietnam, perhaps through divisional schools or mobile training teams from the 1st Logistical Command.

22. Unit maintenance inspections emphasize care of the entire rifle system rather than only the rifle itself.

23. Procedures be instituted to achieve a more optimal distribution of repair parts and cleaning materials and equipment.

24. Verification of zero be integrated with test firing since any object that can visibly register hits may serve as a target.

25. A field malfunction reporting system be established throughout USARV. While such a system does not produce reliability data with laboratory precision, it does permit analysis of malfunction trends and would contribute to further improvement in the reliability of the M16.

Effective until 6 November 1968 unless sooner rescinded or superseded.

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF STAFF
Washington, D.C. 20310 CPT Piper/bb/76286

MEMORANDUM FOR: DEPUTY CHIEF OF STAFF FOR PERSONNEL
DEPUTY CHIEF OF STAFF FOR LOGISTICS
COMPTROLLER OF THE ARMY
CHIEF OF RESEARCH AND DEVELOPMENT
ASSISTANT CHIEF OF STAFF FOR FORCE DEVELOPMENT
THE INSPECTOR GENERAL
CHIEF OF INFORMATION
CHIEF OF MILITARY HISTORY
CHIEF, U.S. ARMY AUDIT AGENCY

SUBJECT: The M16 Rifle Program

1. The Chief of Staff has directed an intensive review of Army management practices related to the evaluation and adoption of product improvement modifications to the M16A1 rifle/ammunition system. The review will determine whether there are general deficiencies in the Army's management of the small arms program. Attention will be given to training, policies, organization, assignment of responsibility, direction and control exercised, and the administrative and technical procedures related to development, testing, evaluation, procurement, production, and product improvement of small arms.

2. The principal subject areas of inquiry are:

a. The product improvement modifications to the M16A1 weapon/ammunition system and the justification therefor.

b. The effects of fouling on the functioning of the M16A1 weapon/ammunition system.

c. The development of propellants for use in 5.56mm cartridges, with emphasis on the effects of these propellants on the functioning of the M16A1 rifle.

d. The adequacy of test procedures to detect the occurrence and the persistence of problem areas and to isolate the causative factors for immediate correction.

e. The adequacy of regulations and policy on directive statements as these generate requirements for testing and for the distribution and use

SUBJECT: The M16 Rifle Program

of test results. Particular attention will be paid to their adequacy in light of the responsibility for adequate testing assigned in the recently revised materiel R&D regulation (AR 705-5).

f. The scope and adequacy of the Army training program for the M16A1 rifle/ammunition system, with particular emphasis on individual maintenance training and armorer training.

g. The adequacy of the organizational structure for the development, testing, and production of small arms to include a review of the changes made as a result of CSMs 66-485 and 67-96.

h. The procurement history of the AR-15/XM16E1/M16A1 weapon system.

3. AVCofSA will convene a review panel to conduct the necessary research and to evaluate all information, documents, and reports pertaining to the M16A1 weapon/ammunition system. This panel will prepare a comprehensive report for the Chief of Staff and the Secretary of the Army NLT 15 March 1968 and will provide recommendations for further actions as required. This report will include:

a. An audit trail of M16A1 decisions and tests.

b. A comprehensive history of the M16A1.

c. An Army reference paper in response to the Ichord Committee findings and recommendations.

4. Staff actions will include:

a. DCSPER, DCSLOG, CRD, and ACSFOR each will nominate one officer thoroughly knowledgeable in those aspects of the rifle program that are within the responsibilities of their staff agency to serve on a full-time basis on the AVCofSA review panel (para 3). The initial assignments of these representatives will be:

(1) DCSPER--those actions cited at Inclosure 1.

(2) DCSLOG--those actions cited at Inclosure 2.

(3) CRD--those actions cited at Inclosure 3.

(4) ACSFOR--those actions cited at Inclosure 4.

b. TIG will provide information related to the subject areas in para 2 above resulting from the current investigation of ammunition selection for M16A1 acceptance testing.

SUBJECT: The M16 Rifle Program

5. The OCofSA point of contact is COL Alan W. Jones, Jr., ODCSA, [redacted] ext. 76286.

a. DCSPER, DCSLOG, CRD, and ACSFOR will report the name of their review panel representative to COL Jones NLT 9 November 1967. These representatives will report for full-time assignment with the review panel when AVCofSA convenes it.

b. COA, TIG, CINFO, CMH, CUSAAA will designate a point of contact for this inquiry and will report his name to COL Jones NLT 9 November 1967.

c. AVCofSA will inform CLL of this review panel and will invite OCLL participation.

6. Addressees will be responsible for supporting the AVCofSA review panel in preparation of the final report as required.

7. AVCofSA will inform the USAF and the USMC of this review of the M16A1 program and invite their participation in those actions related to decisions of the tri-service AR-15/M16 Rifle Technical Coordinating Committee. AVCofSA will coordinate the review effort with the Office of the Under Secretary of the Army (Operations Research).

BY DIRECTION OF THE CHIEF OF STAFF:

Elias C. Townsend

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as

ELIAS C. TOWNSEND
Major General, GS
Secretary of the General Staff

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Chief of Legislative Liaison

SUSPENSE:
DCSPER--30 Nov 67--para 3, Incl 1
--31 Dec 67--para 1 2, Incl 1
DCSLOG--20 Nov 67--para 9-12, Incl 2
--30 Nov 67--para 1-8, Incl 2
CRD--15 Dec 67--Incl 3
ACSFOR--20 Nov 67--para 1-3, Incl 4
--15 Dec 67--para 6, Incl 4
--31 Dec 67--para 4, Incl 4
AVCofSA--15 Mar 68--para 3

DCSPER Required Action

1. Report on the scope and adequacy of the Army rifle training program for the M16A1 weapon/ammunition system since the first AR-15s were received by the Army. This report will include individual marksmanship and maintenance training, armorer training, and other weapon maintenance training programs.

2. Assess the adequacy of systems for measuring the extent to which individual soldiers are in fact taking the action which the training policies require and the system by which lessons learned in combat operations lead to changes in training programs.

3. Report on the current and projected M16A1 rifle requirements for training purposes (for the remainder of FY 68) and whether there is, or whether there is projected, any short-fall of rifles to meet the requirements.

Incl 1

DCSLOG Required Actions

1. Provide a list of all product improvement modifications to the M16A1 rifle/ammunition system; together with date of change, summary of the justification, whether the modification compensated for the effects of loading WC 846 propellant in 5.56mm cartridges, and list of all tests (by agency and sponsor) done in support of test and evaluation of the modification.

2. Provide a chronology (dates and summary discussion) for WC 846 propellant to include all reports related to the functioning of the M16A1 rifle/ammunition system when firing cartridges loaded with WC 846 propellant and all decisions made with respect to this propellant. Provide the rationale for each decision. Discussion will include the principal findings of each report and the subsequent actions taken.

3. Provide lot numbers, number of rounds, propellant and cartridge type, and date and origin of shipment for all shipments of 5.56mm ammunition to Colt's since the Army's initial procurement of AR-15s (XM16E1s).

4. Provide by month since 1963 a list of propellant types loaded in the 5.56mm cartridges fired at Colt's for rifle endurance tests, for rifle functioning tests, and for rifle accuracy tests.

5. Provide average cyclic rate data for M16s accepted by month and propellant type used in the cyclic rate tests since January 1963.

6. List U.S. Army or other government agency tests which have been conducted since January 1963 to verify the Colt's factory acceptance tests. For each test provide the date, document in which reported, and test objective.

7. Provide rationale for the cyclic rates not being measured in the 1964 Aberdeen Proving Ground firings for 5.56mm propellant selection. List all AR-15/XM16E1/M16A1 TECOM and MUCOM reports by date which record cyclic rate, together with the cyclic rates experienced and buffer/propellant combination used.

8. Provide a report on fouling in the M16A1 rifle. The report will include:

a. Areas affected by fouling.

b. Adverse effect, if any, of fouling on functioning.

c. Severity of fouling due to:

(1) Primer compound.

Incl 2

(2) Propellant.

(3) Lubricant.

(4) Other.

d. The means of detecting and quantifying fouling.

e. The means of determining the effect of fouling on functioning.

f. Efforts made since 1963 to determine the relationship of fouling and functioning, to include how the tests have been conducted and the results.

g. Efforts taken since 1963 to alleviate fouling problems by modifications to:

(1) Rifle.

(2) Primer.

(3) Propellant.

(4) Lubricant.

9. Provide a chronological list of all M16A1 weapon/ammunition system test data and reports accumulated or published by Colt's. For each test provide date, test objective, and source of funds.

10. Provide a chronological list of all tests and information on all test data accumulated related to the M16A1 weapon/ammunition system conducted by the following commands and their subordinate agencies:

a. USATECOM.

b. USAWECOM.

c. USAMUCOM.

Indicate the subject of each test.

11. Provide in chronological order all correspondence to include test plans and directives related to testing of and data accumulation on the M16A1 weapon/ammunition system to and from the following commands and their subordinate agencies:

a. USATECOM.

b. USAWECOM.

c. USAMUCOM.

12. Provide breakout of rounds of 5.56mm ammunition by propellant types now being used in Vietnam, and what is the projection by month for the remainder of FY 68.

ACSFOR Required Actions

1. Provide a chronological list of all testing and training, that has produced data on the functioning and reliability of the M16A1 weapon/ammunition system (or components thereof) conducted by USACDC and USCONARC and/or their subordinate agencies.

2. For the following list of major areas of malfunctions reported in tests of the M16A1 weapon/ammunition system provide date(s) reported, document(s) in which reported, causes, confirmatory tests conducted, if any, and corrective actions taken by date.

a. Failure to fire (misfire).

b. Failure to extract.

c. Failure to feed.

d. Failure to eject.

e. Failure of the bolt to remain to the rear.

f. Failure of the trigger to return.

3. Provide functioning data on M16A1 rifle/ammunition system obtained in CDCEC IRUS firings.

4. Provide data from USARV reflecting experience with the M16A1 rifle/ammunition system in the areas of weapon effectiveness, level of individual training and proficiency with the system, maintenance status and problems, functioning problems since introduction of the AR-15 (M16A1) in SEA.

5. Provide DCSPER with assistance, as required, on unit training in preparation of the DCSPER report on M16A1 weapon/ammunition system training.

6. Provide the ACSFOR position (coordinated with DCSLOG and AMC) as to the Ichord Subcommittee Report recommendation and finding Number 18, which recommends new M16A1 testing by an independent agency.

Incl 4

CRD Required Actions

1. Report on the adequacy of the propellant development program for use in small arms cartridges. The report will include discussion of:

a. Past developmental efforts.

b. Current developmental activity.

c. Propellant evaluation criteria.

d. Adequacy of propellant evaluation criteria.

e. Efforts to improve propellant evaluation criteria, as required.

2. Analyze and report on the adequacy of the regulations and policy on directive statements for testing of small arms weapon systems.

3. Analyze and report on the rationale for the selection of the test criteria in developmental and engineering tests.

Incl 3

ASAF	Assistant Secretary of the Air Force
APG	Aberdeen Proving Ground
AIT	Advanced Individual Training
ARNG	Army National Guard
BCT	Basic Combat Training
BFA	Blank Firing Adaptor
Breechloader	A weapon loaded from the breech rather than the muzzle end.
Caplock	A muzzle-loader fired by a percussion cap.
CMC	Commandant Marine Corps
COFSA	Chief of Staff, Army
CTP	Coordinated Test Plan
CSM	Chief of Staff, Army, Memorandum
CDOG	Combat Developments Objective Guide
CRD	Chief of Research and Development, Army
CRDL	Chemical Research Development Laboratories
CONUS	The continental United States
COMUSMACV	Commander, United States Military Assistance Command, Vietnam
CINCPAC	Commander-in-Chief, Pacific
CINCUSARPAC	Commander-in-Chief, United States Army, Pacific
CONARC	Continental Army Command
COA	Comptroller of the Army

GLOSSARY OF TERMS AND ABBREVIATIONS

AAD	Air Assault Division
AAO	Authorized Acquisition Objective
ACR	Armored Cavalry Regiment
ACSFOR	Assistant Chief of Staff for Force Development, Department of Army
ACSI	Assistant Chief Staff for Intelligence
AM	Airmobile
AMP	Army Materiel Plan
ASP	Army Strategic Plan
AFDP	Army Force Development Plan
ASA(I&L)	Assistant Secretary of the Army, Installations and Logistics
AIT	Advanced Individual Training
ASA	Army Security Agency
APHHW	All Purpose Hand Held Weapon
ARDFIRE	Army Requirements for Direct Fire Weapons Systems (Study)
AR-15	The initial design of the M16 with the original buffer and without the chrome plated chamber or the bolt assist device.
ARPA	Advanced Research Projects Agency
ARSAP	Army Small Arms Program
APSA	Ammunition Procurement and Supply Agency

CINFO	Chief of Information, Army
DA	Department of the Army
DCAS	Defense Contract Administration Services
DDRE	Lirector of Defense Research and Engineering
DCSLOG	Deputy Chief of Staff for Logistics
DCSPER	Deputy Chief of Staff for Personnel
DCSOPS	Deputy Chief of Staff for Military Operations
D&PS	Development and Proof Services, USATECOM APG, Maryland
DOD	Department of Defense
DEF	Defense
DAACA	Department of the Army Allocation Committee, Ammunition
DSA	Defense Supply Agency
ET/ST	Engineering Test and Service Test
EEA	Essential Elements of Analysis
ERD	Equipment Readiness Date
FA	Frankford Arsenal
FPAO	Force Planning and Analysis Office, Office of the Chief of Staff, Army
FSTC	Foreign Science Technology Center
GLAD	Grenade Launcher Attachment Development (Program)
GOCO	Government Owned, Company Operated
HE	High Explosive
HEL	Human Engineering Laboratory

H&R	Harrington and Richardson, Inc.
HPC	Hercules Powder Company
JTCC	Joint Technical Coordinating Committee
JCS	Joint Chiefs of Staff
KD	Known Distance
LCAAP	Lake City Army Ammunition Plant
LWL	Limited Warfare Laboratory
MAP	Military Assistance Program
MAS	Military Assistance Sales
MATA	Military Assistance Training, Advisors (Course)
MDW	Military District of Washington
MACV	Military Assistance Command, Vietnam
M16	The Air Force version of the AR15 without a bolt assist device (the term is used in the report to refer also to the XM16E1 and M16A1).
M16A1	The Army version of the AR15 with the bolt assist device.
MTOE	Modified Table of Organization and Equipment
Muzzle-loader, Muzzle-loading	A weapon that is loaded from the muzzle.
MOS	Military Occupational Specialty
Muzzle brake	A device placed on the muzzle of a rifle which uses the escaping gasses to retard the recoil of the weapon.
NET	New Equipment Training

OSA	Office of the Secretary of the Army
OCSA	Office of the Chief of Staff, Army
OSD	Office of the Secretary of Defense
OPPLAN	Operations Plan
OCLL	Office of the Chief of Legislative Liaison
OCO	Office of the Chief of Ordnance
ORO	Operations Research Office
PEMA	Procurement of Equipment and Missiles, Army
PM-RS	Project Manager - Rifles
PBD	Program Budget Decision
POM	Preparation for Overseas Movement (of units)
POR	Preparation of Replacements for overseas movement (individuals)
PIR	Priority Issue Requirements
PS Monthly	The Preventive Maintenance Monthly Magazine
QMR	Qualitative Materiel Requirement
Repeater, Repeating rifles	A rifle having a magazine holding a number of cartridges that are loaded shot by shot into the firing chamber by operating the action of the piece.
RIA	Rock Island Arsenal
RFP	Request for Proposal
RDTE	Research, Development, Test, and Evaluation
RFQ	Request for Quotation

RFW	Request for Waiver
RTA	Request for Technical Action
RVN	Republic of Vietnam (See SVN)
SA	Secretary of the Army (also Springfield Armory)
SALVO	OCO Project - resulted in recommendation for development of SPIW Concept
SAWS	Small Arms Weapons Systems (Study)
SDR	Small Development Requirement
SPIW	Special Purpose Individual Weapon
SVN	South Vietnam (see RVN)
SAAMI	Sporting Arms and Ammunition Manufacturers' Institute
SATE	Study of Army Test and Evaluation
SAPD	Springfield Armory Purchase Description
SEA	Southeast Asia
Single Shot	A weapon that can be fired only once without reloading.
TAG	The Adjutant General (Army)
TDP	Technical Data Package
TCAAP	Twin Cities Army Ammunition Plant
TIG	The Inspector General (Army)
USABRL	United States Army Ballistic Research Laboratories
USACDC	United States Army Combat Developments Command
USACDCCAG	United States Army Combat Developments Command Combined Arms Group

USACDCEC	United States Army Combat Developments Command Experimentation Command
USACDEC	United States Army Combat Developments Experimentation Center
USACDCIA	United States Army Combat Developments Command and Infantry Agency
USAIB	United States Army Infantry Board
USAMUCOM	United States Army Munitions Command
USARPAC	United States Army, Pacific
USARV	United States Army, Vietnam
USAMC	United States Army Materiel Command
USAIC	United States Army Infantry Center
USAIS	United States Army Infantry School
USAR	United States Army Reserve
USARSO	United States Army, Southern Command
USATECOM	United States Army Test and Evaluation Command
USCONARC	United States Continental Army Command
USOCS	United States Ordnance Center and School
USARAL	United States Army, Alaska
USAREUR	United States Army, Europe
USAF	United States Air Force
USAWECOM	United States Army Weapons Command
WSEG	Weapon Systems Evaluation Group, OSD
XM16E1	The early limited production (LP) Army model of the AR15 with the bolt assist device.

XM177E1(E2)	The submachinegun version of M16, sometimes described as the "CAR 15" or "Commando".
M62	Standard 7.62 NATO Tracer Round
M80	Standard 7.62 NATO Ball Round
M196	Standard 5.56mm Tracer Round
M193	Standard 5.56mm Ball Round
M200	Standard 5.56mm Blank Round
shot-peen	Steel finish hardness treatment process
IMR 4475	Tubular grain propellant produced by DuPont
IMR 8136	Tubular grain propellant produced by DuPont
IMR 8208M	Tubular grain propellant produced by DuPont
WC 846	Spherical grain (ball) propellant produced by Olin Matherson Co.
EDM	A chemical coating for IMR 8208M propellant
parco-	Propriety parkerized surface finish treatment
electrolize	Propriety chromium surface finish treatment

M16 RIFLE REVIEW PANEL

COMPOSITION

Chairman

*Mr. John A. Lockerd, GS-15
Office of the Director of Weapon Systems Analysis, OCofSA

Panel Members

*Lieutenant Colonel John D.A. Hogan, Jr.
Office, Assistant Chief of Staff for Force Development

*Lieutenant Colonel Neil G. Nelson
Office, Deputy Chief of Staff for Personnel

*Lieutenant Colonel Dean F. Schnoor
Office, Deputy Chief of Staff for Logistics

*Lieutenant Colonel George H. Gardes
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*Lieutenant Colonel David P. Thoreson
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Lieutenant Colonel Will Douglas, Jr.
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Captain W. Stephen Piper
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Technical and Administrative Assistance

*Colonel James F. Price
M16 Rifle Project Officer
Headquarters, USARV, G4 Section

*Mr. Forrest C. Murphy, GS-14
Headquarters, USARPAC, G3 Section

SFC James R. Flournoy
Staff Communications Division, OCofSA

*Members of panel that participated in the M16 survey in Vietnam.

Inclosure 3

M16E1 Rifle Description and Characteristics

Description

The M16E1 rifle is a lightweight, gas-operated, front locking rotary bolt, 5.56mm weapon capable of firing in either the semi or full automatic mode. A thumb-actuated safety is provided with three positions: safe, semiautomatic, and full automatic. The weapon is fed from a 20- or 30-round detachable box magazine and fires from a closed bolt position; bolt remains open after last round is fired. The weapon is equipped with an adjustable peep and post sight system and a barrel with a combination flash suppressor grenade launcher. Accessories include a sling, bayonet, and bipod.

General Data

a. Weights.

Rifle without magazine and sling	6.5 lb.
Magazine, aluminum, 20 rounds (empty)	.18 lb.
Magazine, aluminum, 20 rounds (full)	.75 lb.
Magazine, aluminum, 30 rounds (empty)	.22 lb.
Magazine, aluminum, 30 rounds (full)	.97 lb.
Sling, M1	.4 lb.
Firing weight (fully loaded with 20 round magazine and sling	7.6 lb.
Bipod, M3	.6 lb.
Bipod case	.2 lb.
Bayonet-knife, M7	.6 lb.
Scabbard, M8A1	.3 lb.

Inclosure 4

b. Lengths.

Rifle with bayonet-knife, M7	44.25 in.
Rifle overall with flash suppressor	39 in.
Barrel (with flash suppressor)	21 in.
Barrel (without flash suppressor)	20 in.

c. Sights.

Front	Adjustable, click-type post. Each click equals 2.8 centimeters per every 100 meters of range.
Rear	Adjustable, flip type. Normal range setting is for 0 to 300 meters. Long-range setting (L), 300 to 500 meters. Each notch of the windage drum equals 2.8 centimeters per every 100 meters of range.
Sight radius	19.75 inches.

d. Ammunition.

Caliber 5.56-mm (complete round) M193	179 grains.
Projectile	55 grains
Types	Ball - M193 Tracer - M196 Blank - XM200

e. Operational Characteristics.

Muzzle velocity	3,250 ± 40 feet per second
Muzzle energy (at the muzzle)	1,320 foot-pounds
Cyclic rate of fire	650 to 850 rounds per minute.
Maximum rate of fire:	
Semiautomatic	45 to 65 rounds per minute.
Automatic	150 to 200 rounds per minute.
Sustained rate of fire	12 to 15 rounds per minute.
Maximum range	2,653 meters.
Maximum effective range	460 meters.

COMMENTS ON HASC SUBCOMMITTEE FINDINGS AND RECOMMENDATIONS

General

After a thorough and critical review of well over 3500 documents pertaining to the M16 weapon system, it would appear that there exists the necessary documentation to either support or refute most of the findings of the HASC Special Subcommittee on the M16 Rifle Program.

An attempt has been made, in view of the many system changes, to time phase the various responses to each finding. It was thought that possibly some correlation with events external to the system might exist. Other than the propellant controversy, this does not appear to be the case.

In the point-by-point review which follows, three responses are provided to each finding. Under the heading Pro, data which would support the allegation are provided. Data which would refute the allegation are listed under Con. The opinions of the review panel, as a result of this detailed review, are provided under Opinion.

Detailed Comments

1. "That both Army and Marine Corps personnel have experienced serious and excessive maifunctions with the M16 rifle, the most serious being the failure to extract the spent cartridge."

Pro:

Documentation at all levels within DOD since 1962 have surfaced excessive malfunction problems, the most serious being failure to extract the spent cartridge.

Con:

This problem was recognized prior to 3 May 1967 and was the basis for chrome plating the chamber and changing the buffer.

Opinion:

The design changes were incorporated without the benefit of tests to substantiate improvements. Concur with the finding.

2. "That proper care and cleaning are of the utmost importance to the effective operation of the rifle."

Pro:

There is no doubt that care and cleaning are important to the effective operation of a rifle; the M16 is no exception to this rule, especially in the environment of Vietnam.

Con:

This finding conveys the inference "of utmost importance to the effective operation of the M16 rifle." Severe environment tests have shown that this statement applies not exclusively to the M16 but to all modern automatic weapons.

Opinion:

Concur with the finding.

3. "That shortages of cleaning equipment, lack of proper training and instructions contributed to the excessive malfunction rate of the M16 rifle in Vietnam."

Pro:

The requirement for a chamber brush was identified by the USAF Marksmanship Unit, Lackland AFB and by the weapon designer. This information was provided to HQ USAMC and HQ USACDC by the Project

Manager, Rifles on 3 June 1963. A contract was not awarded for procurement until 10 May 1966. As of February 1968 all riflemen in Vietnam still did not have a chamber brush even though adequate stocks were available in theater.

There have been cases of inadequate and improper training on the M16, as evidenced by the number of men who lubricate ammunition and fail to zero their weapons. Weapons and ammunition are not adequately inspected for maintenance because the supervisory personnel have not been given sufficient training with the weapon.

These conditions have no doubt contributed to the excessive malfunction rate of the M16 in Vietnam.

Con:

It is true that shortages of cleaning equipment and lack of proper training and instruction contributed to the excessive malfunction rate of the M16 in Vietnam. However, it must be recognized that this system was introduced on an expedited basis at the request of COMUSMACV in December 1965. Accelerated introduction of the M16, although without adequate logistical support, provided the US units a great increase in firepower in spite of its malfunctions and permitted those units armed with the M16 to repulse enemy assaults and achieve impressive successes through the aggressive use of this automatic firepower capability.

Opinion:

The Chief of Staff, Army's concern in this finding resulted in a special survey being conducted in Vietnam to assess the current status. This survey confirmed that the finding was true. Since the HASC report was published, the following significant actions have been taken:

a. Project Manager-Rifles branch office established in Vietnam.

b. Re-emphasis through USARV command channels of the importance of training and maintenance.

c. The Chief of Staff, Army approved:

(1) The initiation of a 12 hour block of instruction to be given to soldiers during BCT who are to be assigned to combat arms AIT.

(2) The conversion of the entire basic rifle marksmanship program in BCT from M14 to M16 rifle as the weapons become available.

(3) The conversion of all non-Vietnam-oriented infantry AIT to Vietnam-oriented AIT.

d. CGUSCONARC has directed the initiation of a 4 hour block of mechanical and maintenance training for all Army training centers and schools for supervisory personnel.

e. A survey team will return to Vietnam in June 1968 to determine what improvements have been made and to recommend further improvements.

4. "That various levels of command in both the Army and the Marine Corps have been negligent in failing to provide proper supervision in the care and cleaning of the rifle, as well as failing to distribute cleaning material and written instructions."

Pro:

It is generally true that various levels of command have been negligent by failing to provide proper supervision in the care

and cleaning of the rifle, as well as failing to insure the proper distribution of cleaning materials. Appropriate written instructions were widely distributed and evidence would indicate excessive reliance on written instructions rather than on continued command supervision.

Con:

The rapid introduction of the M16 rifle into combat meant that in most cases commissioned and noncommissioned officers responsible for supervising care and cleaning were themselves unfamiliar with the weapon. It is clear that from the time of the visit to Vietnam of the Project Manager's technical assistance team in October and November 1966 the Army took significant steps to increase the awareness of maintenance problems, to improve training, and to assure more adequate availability of cleaning materials.

Opinion: disagree

While there is no evidence of culpable inattentiveness, the finding is basically true. Concur.

5. "That the past experience of the Army with the M16 rifle in Vietnam was not properly called to the attention of the Marines when the weapon was issued to them in Vietnam."

Pro:

No data have been located which could in any way support this finding.

Con:

In addition to participation in the Joint Technical Coordinating Committee, the Marines conducted a special evaluation of the M16

in March 1963. The USMC participated in the SAWS evaluation and have been provided with continual data concerning the M16. The Project Manager-Rifles personally visited the III Marine Amphibious Force in Danang in November 1966, informed them of the problem that the Technical Assistance Team had found, and offered the assistance of the team to the Marine Corps. This offer was refused. Prior to the issue of M16s to the USMC in March 1967, 2000 copies of preventive maintenance pamphlet USARV 750-5 were provided to III MAF. Resupply has been provided as requested. Army contact and customer assistance teams have visited III MAF repeatedly from 1966 to date.

Opinion:

Non-concur.

6. "That the major contributor to malfunctions experienced in Vietnam was ammunition loaded with ball powder."

It was established during the hearings that the Army realized in late 1965 that the use of ball propellant loaded ammunition in the M16 caused an excessively high cyclic rate and more visible fouling than IMR 4475 or 8136. A comparative test conducted at Frankford Arsenal reported in February 1966 that:

> Cartridge lot WCC 6089 (ball propellant) gave a lower chamber pressure, a high port pressure, a higher cyclic rate, a greater malfunction rate, greater fouling, more variation in velocity due to variations in handling and less bore erosion than did lot RA 5074 (IMR propellant).

There is no evidence, to date, which would refute the contention that increased fouling has increased the failure rate.

Con:

It was established during the hearings that the principal malfunctions caused by too high a cyclic rate created by ball propellant are various kinds of failure to feed and failure of the bolt to remain to the rear after the last round is fired. Failure to extract is the most serious malfunction experienced by U.S. Forces in Vietnam and this malfunction has not been positively identified with ball propellant. Rather, it is due to poor cleaning, worn extractors and extractor springs, and corroded and pitted chambers. This problem was recognized and was the basis for the Army's decision to incorporate a chromed chamber.

Opinion:

In terms of total malfunctions experienced, the finding is correct. In terms of severity of malfunction, the finding is incorrect. Non-concur in finding as stated.

7. "That the change from IMR extruded powder to ball propellant in 1964 for 5.56mm ammunition was not justified or supported by test data."

Pro:

Prior to May 1964, the only propellant accepted for use in 5.56mm ammunition was IMR 4475. The commercial specification which was

used for initial procurement, specified "extruded grain propellant." While there were problems concerned with meeting specifications on chamber pressure vs velocity with IMR 4475 propellant, there were also problems of meeting the cyclic rate specifications with ammunition loaded with WC846 ball propellant. These latter problems would have been detected had adequate tests been conducted prior to making a decision on propellants.

Con:

Arguments can be developed as to the wording of the finding, there is no documentation in the record which would indicate that adequate testing was done to support the change. The justification was not based on test data.

Opinion:

Non-concur with the finding as stated.

8. "That the sole-source position enjoyed by Olin Mathieson on ball propellants for many years and their close relationship with the Army may have influenced the decisionmakers at Army Munitions Command, Army Weapons Command and the Army Materiel Command. The House Armed Services Committee repeatedly has cautioned the military departments against sole-source procurements. Therefore, it is recommended that the General Accounting Office conduct an audit and investigation of the contracts awarded to Olin Mathieson for ball propellant loaded in both 5.56mm and 7.62mm ammunition and the justification for sole-source procurement over the past 26 years."

Pro:

No data have been identified which would indicate that the relationship between Olin Mathieson and the Army may have influenced decision-makers. This matter is currently being investigated by the GAO. A report is anticipated by 15 June.

Con:

It is true that the Army has at times been in a sole-source position with Olin Mathieson as to propellant for 5.56mm ammunition, but this is the result of circumstances beyond the Army's control. The Army has made efforts to attract other companies to manufacture of satisfactory military propellant, but with little success.

Opinion:

Non-concur with the finding.

9. "That a number of modifications to the M16 rifle were made necessary only after ball propellant was adopted for 5.56mm ammunition."

Pro:

Changes made necessary by ball propellant fall into three catagories: (1) strengthen parts which were failing due to added stress associated with high cyclic rate; (2) change finish to prevent accumulation of carbon deposit; and (3) slow down cyclic rate. Examples are:

16 Jun 65	Change hardness of bolt
13 Sep 66	Shot peen bolt face
16 Sep 66	Chrome plate bolt carrier key
16 Jul 66	Change action spring guide assembly (buffer)

Con:

No data have been developed which would refute this finding. However, a buffer modification was also required to correct "ring spring" failures.

Opinion:

Concur with the finding.

10. "That the AR15/M16 rifle as initially developed was an excellent and reliable weapon."

Pro:

Although numerous modifications were recommended to improve the military utility of the weapon, early service tests considered the AR15 a potential replacement for the M14 and/or the carbine. These findings were also reached by the Advanced Research Project Agency (ARPA) and the OSD Comptroller.

While the assessment is subjective as stated, one can also state that today the M16A1 is an excellent and reliable weapon.

Con:

The AR15 as initially developed (pre 1959) had many minor shortcomings which required modification before it was an acceptable weapon. Prior to 1962 the malfunction rate was as high as 14 malfunctions per 1000 rounds. The overall malfunction rate dropped to 3.0 per 1000 rounds during the 1962-63 evaluation and is currently 3.4 per 1000 rounds.

Opinion: No position taken

Non-concur with the finding.

11. "That certain modifications made to the rifle at the insistence of the Army were unnecessary and were not supported by test data."

Pro:

The Project Manager, COL Yount, testified (Hearings, page 4701) that he was unable to justify the bolt closure device on the basis of prior tests. The change in barrel twist, the new buffer, and the chrome plated chamber are each the subject of tests only recently completed by the Army.

Con:

While there were conflicting opinions as to the necessity of certain modifications, the need was considered as a basic requirement.

Opinion:

Concur with the finding. It should be noted, however, that there are differences in opinion on the necessity for certain changes.

12. "That two of these modifications increased the unit cost of the rifle substantially and another decreased its performance characteristics. These modifications were the bolt closure device, chrome plating of the barrel chamber and the change in barrel twist."

Pro:

The bolt closure device was initially procured at a cost per rifle of $4.54 (Hearings, page 4701). The estimated cost of the chrome plating of the chamber (Hearings, page 4692) was put at a little over one dollar. Actual cost has been reported to be $.93 per weapon. The change in barrel twist from 1:14 to 1:12 decreased the bullet lethality (Hearings, page 4975) and is still not considered necessary by Army expert witness.

Con:

While two of the changes did increase the unit cost, an increase of less than 5% is hardly considered substantial. The decrease in performance apparently refers to a decrease in lethality which resulted in an increase in accuracy. The true measure of system performance includes accuracy, lethality, rate-of-fire, reliability, durability, ease of maintenance, etc., and is not yet well defined within the Defense establishment.

Opinion:

Non-concur with the finding. An increase in unit cost of about $5.50 is hardly considered substantial in view of total system cost. It is true that the change in barrel twist did result in a slight decrease in lethality.

13. "That corrective action on deficiencies reported and product improvement of the weapon have been unnecessarily delayed."

Pro:

A chamber brush was requested by the USAF and considered necessary by the weapon designer in 1963; yet it was not issued in the field until 1966. An on-weapon storage well for cleaning material was proposed by the manufacturer in 1964 and is not in production to date. High cyclic rate and fouling were reported in the 1965 SAWS evaluation. The new buffer retrofit was delayed until 1967 because of cold weather testing which it still does not pass.

Con:

The bolt closure device and the chrome chamber were expedited into production.

Opinion:

Concur with the finding.

14. "A sole source of production of both the ball propellant and the M16 rifle have contributed to the delay in product improvement and the corrective action required."

Pro:

No data have been located which would support this finding.

Con:

The record reflects total cooperation on the part of the contractors in correcting identified deficiencies and proposing product improvements. An examination of defense systems other than small arms indicate that through concept definition and total package

procurement a sole source results in the most economical method of procurement.

Opinion:

Non-concur with the finding.

15. "That officials in the Department of the Army were aware of the adverse effect of ball propellant on the cyclic rate of the M16 rifle as early as March 1964, when it was brought to the attention of the Technical Coordinating Committee, yet continued to accept delivery of additional thousands of rifles that were not subjected to acceptance or endurance tests using the ammunition of greatest density in the field and in the supply system (ball-propellant - loaded ammunition). Up to September 1966, about 99 million rounds of 5.56mm ammunition were consumed in Vietnam, of which 89 million rounds were loaded with ball propellant."

Pro:

Mr. Hutchins, representing Colt's Firearms Division, advised the Joint Technical Coordinating Committee (JTCC) on 24-25 March 1964 of the fact that WC846 ball propellant increased the cyclic rate above that required by specifications and also increased the sound emitted by discharging the weapon. On 3-4 June 1965 at the JTCC he requested Government-furnished equipment with which to investigate the reason for the increased cyclic rate. At a 12-13 January 1966 meeting of JTCC Frankford Arsenal reported on their test of December 1965 which indicated a higher cyclic rate for the M16 rifle with WC846 ammunition than with IMR 4475 ammunition. Through attendance at and review of the minutes of the JTCC and receipt of messages pertaining to freezing IMR loaded ammuition for Colt's testing, officials at Department of the Army were aware of the effect of ball propellant on cyclic rate.

Con:

When faced with the possible alternatives, the M16 Project Manager took actions, within his authority, which in his judgment seemed appropriate. He felt that the cyclic rate problem was caused by rifle quality control.

Opinion:

Concur with the finding.

16. "That the rifle project manager, the administrative contracting officer, the members of the Technical Coordinating Committee, and others as high in authority as the Assistant Secretary of Defense for Installations and Logistics, knowingly accepted M16 rifles that would not pass the approved acceptance test. Colt's officials advised the Army that more than half of the rifles would not pass the acceptance test on cyclic rate if they were made to use both ball propellant and IMR extruded propellant in their testing procedure. Colt's was allowed to test using only IMR propellant at a time when the vast majority of ammunition in the field, including Vietnam, was loaded with ball propellant."

Pro:

The minutes of the Technical Coordinating Committee reflect that the above mentioned offices were represented at the meetings and were provided with copies of the minutes. The minutes also reflect that the subject matter was discussed.

Con:

No data have been located which would refute the finding.

Opinion:

Concur with the finding.

17. "That the failure on the part of officials with authority in the Army to cause action to be taken to correct the deficiencies of the 5.56mm ammunition borders on criminal negligence."

Pro:

No data have been located which would support any willful negligence on the part of officials within the Army to cause corrective actions to be taken.

Con:

After a complete and comprehensive review of the Small Arms Weapon Systems (SAWS) Study which surfaced system deficiencies at a high level, broad and significant direction was provided to investigate cause and effect relationships on the reported malfunctions and to make the necessary corrective actions. This direction was provided in 1966. (Ref: CSM 66-485).

Opinion:

Non-concur with the finding.

18. "That there still is no proof that the modifications proposed will eliminate the malfunctions experienced with the M16 in Vietnam. It is recommended that the Department of Defense direct and expedite a thorough and objective test by an independent organization of the weapon system consisting of the modified rifle and the ammunition in Vietnam, as well as both types of propellant currently being loaded in 5.56mm ammunition."

Pro:

A review of the record reflects that there was no proof that the Modifications (buffer and chrome chamber) made to the M16 would eliminate the malfunctions experienced in Vietnam.

Con:

No data are available which predate the committee report which refute the finding.

Opinion: [illegible]

Concur with the finding. However, the independent test conducted verified the value of the changes in question. Malfunctions have been reduced but will never be "eliminated".

19. "That the fouling characteristics of ball propellant will require continued emphasis on proper care and cleaning of the M16 rifle. Carbon deposit buildup will continue to pose a problem for the extractor, various parts of the bolt mechanism, bolt carrier key the gas port, and possible other areas in both the upper and lower receiver."

Pro:

All reports of test reflect a higher level of visible fouling with ball propellant than with IMR powder. The independent test conducted by WSEG in Panama reflected an increase in failures to fire with ball propellant and the new chrome chamber. This was due to carbon buildup on the shoulder of the firing pin and the firing pin well in the bolt.

Con:

No data have been located which refutes the finding.

Opinion: [illegible]

Concur with the finding.

20. "That there is a possible pressure mismatch between tracer and regular ball ammunition that could cause the rifle not to operate properly."

Pro:

An Army study and analysis of the internal ballistics mismatch of 5.56mm ammunition in January 1967 recommended that no changes be made while 57% of the tracer ammunition was mismatched.

Con:

In November 1967, which is admittedly after the allegation was made, tracer ammunition loaded with ball propellant was suspended except for training. The reason for the suspension was projectile breakup. This results in ammunition with the least possible mismatch from among the available alternatives.

Opinion:

Concur with the finding for the period prior to November 1967.

21. "That there was a shortage of M16 rifles for training purposes both in the United States and Vietnam at the time of the approval of the sale of 20,300 rifles to Singapore."

Pro:

The report provided to the HASC by DOD (An Appraisal of the M16 Rifle Program) stated that the Army could have used the rifles being sent to Singapore.

Con:

No data has been located which refutes this finding.

Opinion:

Concur with the finding.

22. "That there was a lack of proper coordination between the State and Defense Departments on the sale of rifles to Singapore."

Pro:

The report provided to the HASC by DOD (An Appraisal of the M16 Rifle Program) stated that: "The export license was issued without consulting the Department of Defense beforehand."

Con:

No data which refutes the finding have been located.

Opinion:

Concur with the finding.

23. "That no instructions regarding tightening of production quality controls were issued by the rifle project manager, Army Materiel Command, or anyone in high authority after continued reports of malfunctions were received from Vietnam. The Government inspector at Colt's plant took the initiative only after reading newspaper reports of problems being experienced. These newspaper reports were not published until about 6 months after notices of excessive malfunctions were received by the rifle project manager and the Army Materiel Command. The only inspection tightened as a result of these adverse reports was the one on barrel chambers. This tightened inspection revealed an excessive number failed to meet the specification. It is difficult for the subcommittee to understand why quality controls were not tightened immediately upon receipt of adverse reports from the troops in Vietnam."

Pro:

No data which predates the subcommittee report have been located which invalidate the finding.

Con:

The report (An Appraisal of the M16 Rifle Program) provided to the HASC by DOD stated: "The statement is essentially correct. Quality control provisions are being reviewed for adequacy."

Opinion:

Concur with the finding. Since the time of the subcommittee report, the following actions have been taken:

a. QA Directorate at WECOM started running QA audits and key inspections in November 1967.

b. Joint QA Committee (DCAS/AMC) established in January 1968.

c. A revision to the current M16 Acceptance Specification (SAPD 253-B) has been prepared and is under review.

24. "That the bias and prejudices of individuals associated with Army commands or agencies responsible for development and testing of new weapons made it extremely difficult for higher authority to obtain objective information upon which decisions should have been made relative to the rifle program."

Pro:

Perhaps the most dramatic illustration to support this allegation is a comparison of range requirements for small arms. The range requirement stated for the M14 was a specific lethality at 500 meters. One complaint against the M16 has been that it had insufficient lethality at 600-900 meters. At the same time, those who complained about the lack of effective range on the M16 were proposing SPIW which had a required lethality equal to that of the M14 out to a range of only 400 meters.

The only document located which formally supports this allegation was the IG investigation of the 1963 Rifle Evaluation study prepared by DCSOPS.

Con:

No data were located which would refute this finding.

Opinion: disagree

Concur with the finding.

25. "That the Army system of development, production and introduction of a new weapon into the inventory should be thoroughly reviewed to determine if the rifle program is typical of the manner in which the Army operates. The manner in which the Army rifle program has been managed is unbelievable. The existing command structure was either inadequate or inoperative. The division of responsibility makes it almost impossible to pinpoint responsibility when mistakes are made. There is substantial evidence of lack of activity on the part of responsible officials of highest authority even when the problems of the M16 and its ammunition came to their attention. It appears that under the present system problems are too slowly recognized and reactions to problems are even slower.

The rifle project manager doesn't appear to have control over ammunition. Yet, the weapon system consists of both the rifle and ammunition. It is possible that internal politics and jealousies between the Army Weapons Command and the Army Munitions Command are roadblocks to the successful management of new weapon systems."

Pro:

While this finding is subjective in nature and embraces eight sub-issues, it basically is a castigation of Army objectivity and management of small arms programs. Any review by persons other than those directly involved with the M16 rifle program would probably result in very similar findings.

Con:

The Project Manager-Rifles is responsible for overall management of ammunition peculiar to his rifle systems until type classified "A". After the ammunition is type classified "A", he retains overall responsibility for gun/ammunition compatibility and participates in and approves design changes in ammunition which affect the military, technical and operational characteristics of his weapon systems.

Opinion: no position

Concurrence is not required. Position: The M16 rifle program was atypical of Army management programs and was further complicated by intense emotionalism throughout the Government. This rifle entered the inventory as an "off-the-shelf" procurement and did not go through the normal research and development process. This problem was recognized and in the late summer of 1966 an intensive review was conducted which resulted in key decisions and positive guidance. Since then the following significant actions have been undertaken:

a. Test regulations strengthened.

b. Army Life Cycle Management Model approved.

c. Army Small Arms Program established.

These actions should increase high level visibility and prevent recurrence of the types of problems experienced on the M16 rifle.

26. "That it was at least unethical for Major General Lynde to Accept employment with the producer of the M16 rifle upon his retirement from the Army. General Lynde was Commanding General of the Army Weapons Command throughout the negotiations for the first Army procurement of the M16 rifle and, in fact, approved the terms of the contract negotiated by his subordinates."

Pro:

No data have been located which would substantiate this finding. Should this allegation be justified, the same could be said of almost any high level Government official upon entry into private employment with a Defense contractor.

Con:

Congress has spelled out in considerable detail the rules of conduct to which a retired Regular Army officer must adhere. These include 18 U.S.C. 281, 37 U.S.C. 801(c), 18 U.S.C. 283, 13 U.S.C. 207(a), and 18 U.S.C. 207(b). The statutory restrictions are amplified by DOD Directive 5500.7 and Army Regulation 600-50.

It does not appear that General Lynd's acceptance of private employment was contrary to the standards of conduct prescribed by statute or by Department of the Army regulations.

Opinion: agree

Non-concur with the finding.

27. "That minimum effort was expended by the Army and the Department of Defense in attempting to acquire production rights and technical data package for the purpose of establishing additional sources for production of the M16 rifle.

Based on Army reports in 1962 and 1963, there was reasonable doubt that the 1963 buy was to be only a "one-time-buy" for the Army. The 1966 anslysis of the SAWS study and the rifle procurement plan proposed by the Army clearly indicated the need to acquire the rights and data package, yet the Army failed to complete negotiations of a contract until mid-1967. The 1965 procurement contract was amended in June 1966 to increase the quantity by an additional 300,000 rifles. The same amendment provided for negotiations to be completed on the terms for acquiring technical data and production rights not later than December 1, 1966. The negotiations were not completed until over 1 year later; June 30, 1967."

Pro:

No data have been located prior to 1964 to support a "reasonable doubt that the 1963 buy was to be only a "one-time-buy" for the Army." The remaining parts of the finding are a fairly accurate historical record.

Con:

The present large requirement for the M16 rifle is the result of three major factors: (1) the Vietnam buildup; (2) the discovery that the slower-firing M14 was less effective than the M16 in the conditions prevalent in Vietnam; and (3) the failure of the SPIW development program. The SAWS Study was initiated by the Chief of Staff, Army, in 1965 to determine what weapon system should be procured. Until the study results were available the Army was reluctant to commit itself to the M16 by procurement of the proprietary rights and the technical data package. None of these developments were apparent when the initial, limited Army procurement of the M16 took place in the fall of 1963.

Opinion:

Non-concur with the finding as stated.

28. "That both the Army and Colt's failed to negotiate in good faith in an attempt to comply with the terms of the 1965 production contract; i.e., come to terms on the rights and data package on or before December 1, 1966."

Pro:

At a May 1966 meeting with Mr. Benke, President of Colt's Firearms Division and Secretary Ignatius, Colt's agreed to negotiate in good faith. An original offer was submitted on 15 September 1966. At an 8 December 1966 negotiating session, Colt's offered to invest the entire originally proposed $9 million license fee into added facilities for the M16 rifle. Subsequent to this, three agreements were reached between the AMC legal counsel and Colt's only to be rejected and new guidelines established by higher authority. These were:

a. On 8 December 1966, an agreement which in essence offered a second plant to be managed by Colt's in exchange for the proprietary rights.

b. On 22 February 1967, agreement to a 5½ percent royalty, a $4 million lump-sum payment, and commitments to purchase from Colt's requirements in excess of an educational order quantity for the first three years as a part of the Army's five-year procurement plan. This did not include the XM177 Sub-machine gun.

c. On 17 March 1967, an agreement to add the XM177 for a total of $ 4.5 million and 5½ percent royalty plus a provision initially suggested by the Army for a higher royalty (11%) if the procurement of rifles exceeded 1.85 million in the FY 68-72 period.

Con:

In view of the above information which is available to the Subcommittee, it would be difficult to refute this allegation. Mitigating circumstances were that the Army representatives and the Colt's representatives did not and do not yet know the magnitude of the total requirement to establish realistic prices. M16 requirements are controlled at the JCS and OSD level.

Opinion:

There is no evidence to indicate that there was a sound basis for the negotiations. It has not been possible for the Review Panel to determine the motives of those involved in the negotiations.

29. "That this lack of action delayed the establishment of additional production sources by at least 7 months."

Pro:

History reflects that an agreement on the technical data package and the proprietary rights was not reached until late June 1967, seven months after 1 December 1966.

Con:

The implication made is that additional production sources were

desirable when the record reflects that production was increased from 6,000 per month to 50,000 per month at no cost to the Government. The insistance on multiple production sources for small arms is contrary to currently accepted practices of total package procurement, has resulted in problems in previous rifle procurement programs, and increased the total cost to the Government.

Opinion: Pos - L

Non-concurrence not required. Position statement: The finding as stated assumes the need and desirability of establishing additional production sources. The record reflects that production was increased to meet the needs of Southeast Asia by a factor of 8.33 at no cost to the Government.

30. "That based on information and records made available by the contractor and the Army, it appears that Colt's has enjoyed an excessive profit on M16 production contracts to date.

Colt's has enjoyed negotiated fixed price contracts on a 10 percent profit rate basis. Our review revealed profits of 19.6 percent for calendar year 1965; 16.8 percent for calendar year 1966; and 13.4 percent for the first 4 months of 1967. It is recommended that the General Accounting Office conduct a complete audit of Colt's military contracts to determine actual profit rates experienced, the adequacy of their accounting system and whether provisions of Public Law 87-653 were circumvented."

Pro/Con/Opinion: N: pos L

No data have been developed to support or refute this finding. On 13 May 1968, the GAO stated that their audit would be completed in "about six weeks." The last full-scale audit by the Defense Contract Audit Agency was conducted in 1966 in conjunction with the FY 66 contract. No major discrepancies were noted. The

U.S. Army Audit Agency responsibility for conducting audits of contractors was terminated by Project 60.

31. "It is recommended that proper action be taken by the Secretary of Defense and the Secretary of the Army to insure that the design, contracting, procurement, manufacture, development, supply, and testing of future weapons not suffer the same fate.

The subcommittee recommends that the Secretary of Defense and the Secretary of the Army make adequate studies to determine if the abolishment by the Secretary of Defense of the Office of the Chief of Ordnance (which was accomplished along with the abolishment of the position of other chiefs of various Army services in 1962) could have been partly responsible for the failure of proper control and supervision in the matter of the M16."

Status of Actions:

The Chief of Staff, Army, has approved portions of a major study which embraced the entire Army logistical system. Specific actions applicable to the first recommendation are:

a. Sweeping revisions to Army Regulations pertaining to materiel research and development, testing, and management.

b. Approval of materiel life cycle management model.

c. Establishment of the Army Small Arms Program.

These actions should prevent the reoccurrence of the deficiencies noted on the M16 rifle program when they become fully operational.

The effect of the abolishment of the Office of the Chief of Ordnance on the M16 rifle program has been reviewed. The record reflects that the early development (1958-1962) was under the Chief of Ordnance. The M14 program also experienced

difficulties in development, production, and test, and in controversy both within DOD and between DOD and the Congress. For example, the Ordnance Corps had, since 1928, opposed the change to a small caliber-high velocity round even though repeated tests indicated its superiority over the caliber .30 or 7.62mm round. One can conclude that controversy is to be expected on rifle programs because of the many experts in the field. The new Army Small Arms Program should lend sufficient visibility to reduce or eliminate this controversy.