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Rifle development, standardization, and procurement in the United States military 1950-1967

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Introduction

From the end of the Second World War until the height of the Vietnam War in 1968, the United States Armed Forces sought to improve its shoulder fired rifles through increasing firepower. The United States sat at the forefront of small arms technology at the end of the Second World War, being the only combatant nation to issue semi-automatic weapons to every soldier. The M1 Garand service rifle, the first semi-automatic standard service rifle anywhere in the world, gave the American G.I. a distinct advantage over his Axis enemy in the Second World War. The semi-automatic technology of the American rifles increased the rate of accurate fire several fold over the nineteenth century rifle designs fielded by other armies. However, near the end of the war, high-ranking officials in United States Army Ordnance, the chief research and development agency for the American Armed Forces, saw that the American arsenal needed improvement and streamlining.

The M1 Garand, so revolutionary when adopted in the 1930's, began approaching obsolescence by 1945. The Second World War spurred great leaps and bounds in small arms manufacture and design. Germany pioneered new ideas in rifle design, manufacture, and cartridges culminating in the *Sturmgewehr* series, the first assault rifles. These rifles used stamped sheet metal pressings and Bakelite to create light weight rifles that were easy, fast, and inexpensive to produce. The effective use of these rifles influenced the arms development programs of several European nations following the war. However, United States Army Ordnance paid little attention to the German wartime developments.

The high-ranking officials of United States Army Ordnance saw the German developments as crude and desperate, a mere consequence of shortages in vital production

materials. According to the conservative mentality of United States Army Ordnance, a proper rifle came from finely machined forgings of steel, stocked with hardwood such as birch or walnut. The only German wartime development imported to America was the idea of an intermediate length cartridge. However, the short-ranges of these cartridges motivated American ordnance officials to modify their version of an intermediate cartridge to suit their traditional long-range performance standards.

The post war environment and developing Cold War gave birth to the North Atlantic Treaty Organization (NATO) in 1949. This alliance system sought to standardize small arms designs and cartridges to solve the logistical problems encountered in the Second World War. In 1950, the divergent European and American small arms developments came into competition with the first set of light rifle trials. The European rifles submitted by Belgium and the United Kingdom for performance testing contrasted greatly with the more traditional American design. These rifles were more than just competing designs; they represented stark contrasts in the vision of modern infantry warfare. While the Europeans saw modern infantry warfare characterized by fierce short-range engagements with a high volume of fire, the American vision of future wars continued to focus on the need for long-range precision engagements requiring full power cartridges with high accuracy.

The resulting competition between European and American designs in cartridges and rifle platforms seriously strained relations between the United States and the United Kingdom. The nearly four year long ordeal ended with the European nations finally bending to the American desire for a long-range powerful rifle cartridge, hoping the spirit of cooperation might help in the NATO adoption of a single rifle platform. This concession, led by the United Kingdom, ultimately failed, as America continued along its own path of arms

development apart from its European allies. This outcome of the European-American rifle divide only contributed to the eventual failure of NATO weapons standardization as a whole. The injection of nationalism and domestic politics prevented the realization of streamlining logistics amongst NATO allies. NATO eventually adopted a single rifle cartridge based on the American vision of modern warfare in 1954, but could not agree on a common rifle design, resulting in the adoption of multiple rifle platforms in the organization.

For a brief time in 1956, the traditional source of military arms, United States Army Ordnance, faced a challenge from the domestic commercial sector. The new firm of Armalite, an arms division of a well-established aircraft manufacturer, took the German developments of World War 2, and sought a different path to the same end, a light weight rifle. Armalite used new aluminum alloys and plastics technology in place of the stamped steel and Bakelite construction of German wartime arms to create a light rifle. The resulting rifle, the AR-10, ultimately came too late to halt the adoption of the more developed Army Ordnance rifle, but created an interest amongst high level American military commanders in finding alternatives to traditional rifles.

While on the surface, United States Army Ordnance looked solidly united in its views on modern combat, strong dissent ultimately grew from civilian analysts and younger ordnance officers. From 1950 to 1953, several studies began to shed doubt on the official traditionalist views held by top Army Ordnance leadership. The Operations Research Office of Johns Hopkins University studied rifle effectiveness in the Korean War in 1950, revealing the inability of infantry soldiers to fire rifles effectively past 300 yards. Some engineers at the Ballistics Research Laboratory, aware of limited range warfare in Korea, created effective short-range cartridges based on the small caliber high velocity concept. This concept sought

to avoid the short-range, accuracy, and power limitations of the intermediate cartridge, while maintaining the benefits of lighter weight and greater firepower. Ultimately, the traditionalist Chief of Army Ordnance Rifle Development felt threatened by the new cartridge projects and used his authority to assign a low priority to all reduced caliber projects. The low priority status significantly reduced funding for all small caliber projects, taking them out of the competition against the traditional rifle projects promoted by Army Ordnance officials. However, the studies and projects backed by these civilians and junior officers created an interest outside Army Ordnance in promoting dramatic technological changes in weaponry.

In 1957, the separate paths of American commercial arms development and the new weapons approach of junior ordnance officers converged. High ranking military officers in Continental Army Command requested that civilian arms makers develop prototypes specifically made for the small caliber high velocity cartridges. They shared the earlier research of the Ballistics Research Laboratory with the Armalite and Winchester Arms companies. The resulting 1959 tests of the newly-developed rifles, especially the Armalite AR-15 model, offered the first significant domestic competition for United States Army Ordnance. However, decisions about the ultimate choice of design remained tense. Several suspicious events occurred during the trials of the Armalite AR-15, suggesting sabotage and biased testing procedures on the part of traditional minded Army Ordnance officials.

In May 1957, America replaced the M1 Garand with the M-14 rifle, a marginally improved version of the Garand that fulfilled only a few of the original requirements placed upon the developmental Light Rifle Project. While this caused little controversy, the M-14 project became an ordeal of failure upon failure on the part of Army Ordnance. The adoption of the M-14 in May 1957 did not mean the new rifles made it into the hands of troops.

Procurement of the new rifles lagged years behind schedule, plagued by poor management and political meddling in the business of contracting arms production to civilian arms manufacturers. The American public learned of the problems during the Berlin Wall crisis of 1961, when the American garrison of West Berlin, as well as their reinforcements, still carried the old M1 Garand. At the time, this crisis symbolized America's stand against communist aggression, but frontline troops did not even have access to the new M-14 rifles. The resulting congressional investigation seriously tarnished the reputation of Army Ordnance, and soon the Secretary of Defense began to look for alternatives to the M-14.

Colt Firearms bought the AR-15 design from Armalite in 1959 and from 1960 to 1961, the firm pushed hard to market the AR-15 to the United States Air Force. While Army Ordnance refused to test the Colt AR-15 for consideration as an Army rifle, the Pentagon forced Army Ordnance to complete an objective series of tests on the AR-15, which the rifle passed. The Air Force officially adopted the design in 1961, causing the Secretary of Defense to take notice of the increasingly good reports on the AR-15 rifle in various trials. The continuing problem of delays in M-14 production eventually caused the Secretary of Defense to end procurement contracts and close Springfield Armory, the research and developmental center for United States Army Ordnance. To supplement the meager amount of M-14 rifles on hand, the U.S. Military purchased nearly 100, 000 AR-15 rifles. However as future long term rifle development projects became increasingly unlikely, and America became more heavily involved in Southeast Asia, the Department of Defense officially adopted the AR-15 as the M-16 standard service rifle for all armed forces.

However, with the elimination of Army Ordnance's monopoly of power on rifle development, throughout 1963 the Secretary of Defense personally oversaw and created new

offices and committees to oversee the procurement of M-16 rifles. The new Technical Coordination Committee and inter-service feuding between branches of the military caused significant delays and changes in both the M-16 and the cartridge it fired. When the M-16 rifle finally entered full service in 1966, reports of severe malfunctions soon began to reach the Pentagon. The rifle and ammunition that had performed well in trails now failed miserably in actual combat. Throughout 1966 and early 1967, the Department of Defense failed to address the problem. Congress again became involved in the rifle issue after a congressional representative read a letter from a marine serving in Vietnam. The letter testified that the M-16 was failing and servicemen were dying because the rifle malfunctioned in the field. The resulting investigation placed blame on Colt Firearms, the Department of Defense, the Technical Coordination Committee, as well as several individuals for the debacle. Secretary of Defense Robert McNamara, the same secretary who had effectively shut down Army Ordnance for failing in its M-14 project as proven by a congressional investigation, now faced the same crisis. Congress recommended several reversals in policy in order to get the M-16 program working properly and the rifle functioning in the field. Ultimately, these changes brought reliability back into tolerable levels. The M-16 rifle and procurement program continued throughout the Vietnam era, but remained severely tarnished in reputation.

The Light Rifle Project and NATO Standardization

In the Second World War, the United States was the only nation in the world that issued autoloading[1] firearms standard to all combat personnel. While the other Allies and Axis nations designed and fielded some weapons that were autoloading, these new weapons never saw universal use as standard arms to all combat troops. Throughout the Second World War, the vast majority of both the United States allies and enemies continued to issue bolt action rifles designed in the late nineteenth century as their standard combat rifle. The U.S. Rifle, Caliber .30 M1 (more commonly known as the M1 Garand or Garand after its inventor) had been thoroughly tested in the fire of combat. Douglas McArthur praised the rifle extensively, recollecting that at Bataan in the Philippines, he witnessed some Garands that had seen constant use for over a week without either cleaning or lubrication[2]. General George Patton said the M1 Garand was "*The greatest battle implement ever devised*"[3]. Certainly, the Garand was better than the 1903 Springfield that it had replaced, but the platform was far from perfect. It possessed several idiosyncrasies that the United States Army Ordnance Department felt made the rifle inadequate for future combat. The Garand was utterly reliable in the field; however, there were complaints from soldiers about the Garand's odd method of loading and feeding cartridges into the chamber.

Users of the Garand inserted an "*en bloc*" or clip[4] of preloaded ammunition cartridges into the rifle through the top of the receiver with the bolt retracted. While this method was

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[1] A gun that is autoloading has a mechanism that ejects the fired case or shell, puts a new one in the chamber and prepares the gun to be fired by cocking the hammer or striker.
[2] Hatcher, Julian. *The Book of the Garand*.(Washington DC: Sportsman's Press Book, 1948), 5
[3] Stevens, Blake R. *The FAL Rifle.* (Toronto: Collectors Press Publications. 1993). 2
[4] Technically, a clip is any type of cartridge-holding device used to load magazines (either fixed or detachable). Common usage, though, frequently interchanges the term 'clip' with 'magazine'. The first successful cartridge

fast, field use showed several problems with this system. First, on some Garand rifles, when inserting the clip of ammunition, the bolt could come forward with great velocity under pressure of the recoil spring and trap the users thumb between the bolt and the receiver, causing an effect known as "*Garand thumb*". The injury is something similar to what carpenters sustain when hitting their thumb with a hammer while holding a nail in place.

The second issue also revolved around the clip of the Garand. When a soldier fired the last round from the rifle, the empty cartridge ejected from the rifle, but the clip was ejected as well. Normally this would not have any ill effect on the user or the rifle. However, the ejection of the clip caused a loud and distinct ping sound. This sound could give away the position of the user, a dangerous occurrence in fierce combat. The Garand rifle also becomes a single shot rifle without the clip, causing concerns about the loss of effectiveness. The en bloc clip could not be topped off with loose rounds of ammunition when partially full, forcing the operator to fire off the remaining rounds of ordnance before he could load a new clip filled to capacity. Several designers, including John Garand, sought to modify the Garand in the late stages of the Second World War to rid the platform of these troublesome operational issues.

The head of United States Army Ordnance Rifle Development during the Second World War was Colonel Rene Studler[5]. Colonel Studler believed the deficiencies in the Garand platform to be correctible and ordered the initiation of two Garand improvement projects in 1944, resulting in the T20 and T22 rifles. These new rifles, designed by a team led

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clip was invented by Austrian engineer Ferdinand von Mannlicher. Also known as a 'stripper clip' in military jargon, and as a 'charger' in England.

[5] Stevens, Blake R. *The FAL Rifle.* 2

by John Garand himself, experimented with converting the M1 Garand from semi-automatic[6] to select fire[7], and from using en-bloc clips to detachable magazines[8]. The projects showed some promise, but when the war was ending in the spring of 1945, Col. Studler terminated both projects. The world was soon to be at peace, at least so it seemed, and there was no immediate need to replace a good weapon with one that was only marginally better.

Around the time that Army Ordnance was mulling over the idea of improving the Garand in the T20 and T22 projects, it became apparent that the standard .30 M2 cartridge had reached a state of obsolescence as well. The Second World War presented the officials in Army Ordnance with a rather precarious balancing act of research and development and production. During the war, there were advances in the applied science of propellants, just as in many other fields. The new "*Ball Powder*[9]", so named because of the spherical shape of the individual grains, was more efficient than the older propellants then in use for cartridges. Because this powder was more efficient than the older powders then in use, it resulted in both a problem and an opportunity in the eyes of Army Ordnance and Col. Studler. The Frankford Arsenal, found that if the new ball powders were loaded in the standard .30M2 cases, it did not fill the case completely, resulting in a large air gap. When Frankford Arsenal test fired the cartridges, this situation of excess space in the cartridge cases caused greater than normal ballistic deviation[10]. The seemingly obvious solution to add more powder to the charge was

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[6] An autoloading firearm that requires a separate pull on the trigger for each shot to be fired.
[7] A firearm's ability to alter the rate of fire. The most common choices are semi-automatic, burst, and full automatic fire.
[8] A removable container for holding ammunition that may be in the shape of a straight or curved rectangle. The ammunition is forced upwards by a spring and follower, though the ammunition is held inside by the feed lips until stripped by the bolt during the cycling of the action.
[9] This is a trade name for a double-base smokeless powder developed by Olin Industries. The grains have a spherical or flattened spherical shape.
[10] Stevens, R. Blake. *U.S. Rifle: From John Garand to the M21*.(Toronto: Collector Grade Publications 1991), 93

not feasible. While the M1 Garand was in most cases immensely durable, it possessed a weak link in its gas-operated piston. The operating rod, which doubles as a piston, stretches for nearly 30 inches with a dogleg at its mid section. The long, unsupported rod was prone to bend when firing heavier charges and bullets in the rifle. Both of these factors created a spike in pressure, which bent the operating rod, freezing up the weapon and making it useless.

By this time, Army Ordnance was well aware of the reduced length cartridges that German armed forces adopted during the Second World War in an attempt to create an effective cartridge while reducing the materials used in each round of ammunition. The new ball powder would allow the United States to do the same thing, but unlike the Germans, without sacrificing any performance[11]. Army Ordnance slated the .30 M2 cartridge for replacement at wars end by a cartridge of the same power, but with a reduced length of about half an inch[12]. This would consume less critical materials, such as brass, per cartridge. It would stretch supplies on the producer end, but also allow the average soldier to carry more rounds of ammunition per pound. However, research on this new cartridge, named the T65, received a low priority until the war ended[13].

It was at this time that Col. Studler began to think about replacing the M1 Garand design with something completely different. The Garand would not be well suited to the new cartridge, and a lengthy conversion process would still not rid the Garand rifle of its disturbing idiosyncrasies. In April 1945, Col. Studler summoned a small group of special weapons designers to a meeting. The first participant was K.J. Lowe, a designer from the

[11] Stevens, R. Blake. *U.S. Rifle: From John Garand to the M21*. 92
[12] *Ibid*. 93
[13] *Ibid*. 93

Remington Arms Corporation working on the T22 project at the time[14]. During the war, arms production had inundated the large government arsenals, so firms like Remington often received government contracts to produce these experimental prototypes in small numbers. This formed a tight relationship between that company and the top levels of Army Ordnance, and hence Remington was to be included in new developments as well. Lowe recorded the meeting, which took place on April 6, 1945 at Col. Studler's office.

At this meeting, Col. Studler introduced K.J. Lowe to a man named Earle Harvey, a young designer at Springfield Armory. Harvey had consulted with Col. Studler recently and the two had agreed to build and develop a new rifle based on Harvey's designs. The design, designated T25, would work in a principle similar to the current Browning automatic rifle, but the T25 would be a new standard issue rifle[15]. It was to chamber the newly developed T65 30 caliber cartridge, use a box magazine, and weigh seven pounds[16]. Lowe carefully evaluated the new idea at its current point of progress, which he deemed worthy of further development. Col. Studler then offered Remington Arms a $46,000 contract for Remington to design, test, and refine one working prototype. This prospect was most attractive for Remington since the T25, unlike the M1 Garand, did not need any specialty machinery to manufacture. Harvey designed it for economy and ease of manufacture. Springfield Armory had learned a lesson after the massive issues it experienced in getting Winchester Arms Corporation equipped and tooled up to produce their large M1 Garand production order earlier in the Second World War. This was the beginning of what was to become a long and

[14] *Ibid*. 93
[15] *Ibid.* 97
[16] *Ibid.* 97

arduous project to replace the M1 Garand. It was the beginning of the Lightweight Rifle Project.

In 1950, the Cold War was materializing and escalating. The rise of a new open conflict between the Soviet Union and the United States and their allies seemed a distinct possibility. Col. Studler, still in command of Army Ordnance Rifle Development, ramped up research and development into new rifles that would replace the variety of long arms then in use by armed forces of the United States. Studler slated the M1 Garand, M1 and M2 carbine, the Browning automatic rifle, and the Thompson and M3 sub-machine guns for replacement by a single rifle. The criteria for the Light Rifle Project were that the rifle be in 30 caliber, weigh seven pounds, have select fire capability, and performance equal to the M1 Garand and its cartridge[17]. Several government designers began to work on rifles to meet these requirements. However, as the United States and its allies formed the North Atlantic Treaty Organization (NATO) 1949, there was about to be a showdown between allies over rifle development, procurement, and NATO standardization.

During the summer of 1950, the recent American developments underwent testing at the International Rifle and Ammunition Standardization Trials at the Aberdeen proving grounds and Fort Benning, Georgia.[18]. The entire NATO testing project was under the supervision of the Chief of Army Ordnance Rifle Development, Col. Rene Studler. Teams of arms designers from Canada, the U.K., Belgium, and the United States gathered to evaluate the performance of three rifle platforms and two new cartridges. The United Kingdom's

[17] McNaugher, Thomas L. *Marksmanship, McNamara, and the M16 Rifle: Organization, Analysis, and Weapons Acquisition.* (Rand Paper Series 1979). 13
[18] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective.* (Toronto: Collector Grade Publications 1987). 3

Armament Design Establishment submitted their EM-2 rifle, a bull pup[19] configuration in their newly created .280 caliber intermediate cartridge[20]. The Belgian government offered its FAL, the Fusil Automatique Leger, or Automatic Light Rifle, designed by the firm Fabrique National d'Armes de Guere in the British .280 cartridge[21]. The American entry was the result of the five year long Light Rifle Project, the T25 rifle prototype designed by Earle Harvey of Springfield Armory in the newly developed and finalized 30 caliber T65 cartridge[22]. All three entries were not fully developed and still in the experimental stage. All the rifles went through accuracy, reliability, durability, and lethality tests. The testers declared that no rifle was fit for adoption at that time. However, the American entry was the least preferred by the Infantry User Board at Fort Benning. The Belgian FN-FAL was the most reliable and most preferred by the testers[23]. Testers liked some the compact nature of the British design, but the bull pup platform was not very appealing to the users. The .280 British cartridge that the FAL and the EM-2 fired was deemed only acceptable in terms of lethality, but was highly praised for the low recoil that it generated, since this resulted in faster target acquisition on follow up shots in semi-automatic mode, as well as more control in fully-automatic[24] mode. The fact that the American submission came in last in every aspect except trajectory and long-range lethality enraged Col. Studler, who thereafter became more personally involved in the development of an American rifle[25].

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[19] A type of compact rifle characterized by the location of the action. In a bull pup, the action/ejection port is located in the area normally occupied by the solid stock of a traditional rifle.
[20] A medium powered military cartridge capable of controlled automatic fire, but designed for use in a full-sized rifle.
[21] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 3
[22] *Ibid.* 3
[23] Stevens, Blake R. *The FAL Rifle* 35
[24] With a single, continuous pressure on the trigger, the ability to continuously fire
[25] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 4

From the moment Earle Harvey's T25 came in last place in the user tests, its fate was ultimately sealed. Although development on the T25 did continue, it lost high priority status. Col. Studler threw his weight behind other rifle platforms. The idea was now to base a rifle design around the battle proven M1 Garand. Compared to the old M1 Garand, the new British and Belgian guns were unreliable and inaccurate. The Garand had several intrinsic merits, as it was almost indestructible, a fact proven when it underwent extensive testing in the 1930's. The testers back then could not destroy the M1 Garand beyond repair, even by shooting grossly overloaded .30 M2 ammunition in it[26]. John Garand, even though close to retirement, returned to the project in 1950 to continue where he had left off in 1945 with his T20 and T22 designs. Another Springfield Armory Engineer named Lloyd Corbett began working on another Garand based project, the T37. After the 1950 tests, the Ordnance Department noticeably and increasingly became more recalcitrant in its mentality, trying to be modern while sticking with and modifying older battle and time proven designs and ideas. At the same time, the demands placed on these weapons development projects were completely unrealistic.

It seems that after the failure of the five-year T25 program at the 1950 series of tests, the top officials in the United States Army Ordnance Department became militantly conservative, relying on tradition as the guide for future development. These leaders ignored the experience of U.S. allies and enemies in the close confines of urban warfare during the Second World War, as well as most of America's own fighting experience during the war outside of Western Europe. The American forces in Western Europe had often fought in the open spaces of the Northern European Plain, a situation favoring long distance combat

[26] Hatcher, Julian. *The Book of the Garand.*,162

shooting. However, the mountainous terrain of the Italian campaign shows that most combat was at short-range, and that soldiers preferred their short-range sub-machine guns to their long-range M1 Garand rifles because they offered better mobility, ability to carry more ammunition, and a higher rate of fire[27]. Similar patterns of weapon use appeared in the Pacific theatre of operations, with the dense jungle of the South Pacific not allowing the open spaces in which long-range rifles tended to show their maximum effectiveness[28].

Colonel Rene Studler, Chief of Army Ordnance Rifle Development from the mid 1930's onward, was specifically interested in German developments during the Second World War. He examined German weapons and cartridges, but chose to ignore the rationale that came from the long experiences of the German combat forces that had originally spurred their development and deployment. The German armaments industry had raised the use of simple sheet metal stampings to a high art during the war, as well as the integration of lightweight synthetic materials in firearms. Yet Col. Studler was only interested in the 8mm Kurz cartridge that the German StG44 fired. A cartridge of reduced size would not only use less material, but would help in making the fully-automatic rifle a more feasible idea by reducing the distance the moving parts would have to cycle. Yet he was more unwilling in 1950 than in 1945 to settle for the reduced performance of the intermediate German round, for the same reasons as his lack of interest in the Bakelite and stamped steel construction of the German weapons. He saw both as a sign of crude desperation in the face of allied bombing and lack of raw materials[29]. Studler believed the Germans had stumbled on a single good idea of the intermediate cartridge out of their desperation, and that Army Ordnance was

[27] McNaugher, Thomas L. *Marksmanship, McNamara, and the M16 Rifle: Organization, Analysis, and Weapons Acquisition.* 16
[28] *Ibid*. 16
[29] *Ibid.* 16

actualizing the concept by using new ball powder propellants. Studler's devotion to a full powered round continued to intensify with his irritation after the 1950 trials. At that point, the United States Army, taking Studler's advice, released the following statement. "*The Army is firmly opposed to the adoption of any less effective small caliber cartridge for use in either its present rifle, or in the new weapons being developed.*"[30] The T65 cartridge was the cartridge the Army experts were backing, calling it an intermediate cartridge because of its reduced overall length. Studler had employed the new and more efficient ball powder and used the commercial 300 Savage cartridge case to shorten the .30 M2 cartridges from 63 millimeters to 51 millimeters. These changes gave identical performance to the current service cartridge, but saved weight and materials[31] However, the new cartridge proved more difficult to make reliable. Compared to the old .30M2 cartridge, the new T65 cartridge had less taper in its profile in the interest of creating an efficient casing to best utilize the new propellants. Due to its redesigned, less tapered shape, it was more difficult to get the rifles to feed the ammunition cartridge reliably and extract an empty casing[32]. The lower rank and younger officials in Army Ordnance began to think this direction of cartridge design was not the correct path to follow. Looking at the realities of World War II combat experience, these men began looking more into newer, smaller calibers and ballistics theories, setting the stage for an internal struggle. To add to this, the pressing nature of NATO standardization would bring increased pressure on the large national powers to develop and acquire a standard arm in a standard caliber for all member nations to use.

[30] Stevens, Blake R. *The FAL Rifle.*, 35
[31] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 3
[32] *Ibid.* 3

Just as the international rifle trials of 1950 were winding down, the Army of the Democratic People's Republic of Korea crossed the South Korean border with a large invasion force. As the Army of the Republic of Korea and United Nations forces reeled under the onslaught, S.L.A Marshall, a historian for the Operations Research Office (a civilian branch of Johns Hopkins University) working for the Ordnance Department under Project Doughboy traveled to the area to debrief and interview the soldiers of the United States Eighth Army[33]. Marshall gathered a detailed study of rifle performance and effectiveness in the first conflict since the Second World War. Marshall published his 142-page report *Commentary on Infantry Operations and Weapons Usage in Korea* the following year, in 1951[34]. Marshall's findings and commentary flew in the face of the traditional method of Army marksmanship training, as well as undermining top American military leaders' opinion of the usefulness of long-range rifle fire. The timing of the Marshall investigation could not have been at a more opportune time, since 1950 saw the greatest use of infantry small arms as the primary weapon of warfare[35].

Marshall's study revealed some characteristics of the American military rifleman and his weapons that were less than flattering. Marshall drew upon his earlier work *Men Against Fire*, a study on rifle fire during the Second World War. Marshall stated that several patterns he first documented in World War II repeated themselves in Korea. However, due to the lack of armored fighting vehicles on the Korean frontlines in 1950, the patterns caused more problems in executing the war effectively. Marshall noticed that in Korea, just as in the Second World War, an average of 75% of American combat infantrymen had failed to

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[33] *Ibid.* 6
[34] *Ibid.* 6
[35] Marshall, S.L.A., *Commentary on Infantry Operations and Weapons Usage in Korea: Winter of 1950-1951.* (Washington DC: Operations Research Office of Johns Hopkins University and Department of Army), 8

persistently fire on the enemy[36]. He compared this to the days of musketry when evidence suggested that up to 66% of troops would fire on the enemy[37]. The fighting man of World War II and Korea was paling in comparison with the fighting man of the past in his ability to engage the opponent. Moreover, this damning evidence only considered the ability to get infantrymen to fire their rifles, nothing to do with actual accuracy of fire.

Marshall saved his findings and opinions on rifle accuracy for another section, where his data showed the training and the ideology behind top military leaders' emphasis on precision long-range rifle fire to be just rhetoric, which bore little resemblance to practice in modern war. During his time in Korea, Marshall states that at no time did he witness decisive and damaging rifle fire coming from the American or Korean troops past 200 yards[38]. Add to this the fact that U.S troops gained or lost the most land in intense firefights at or below 150 yards, and the picture became blatantly clear for Marshall[39]. Modern warfare for Marshall was about achieving a high volume of fire at short to medium distances, not about long distance precision rifle fire. Riflemen could only perform reliably at these short to medium ranges, if they would fire at all. Even the Marines, an institution that prided itself in long-range marksmanship, did not escape Marshall's analysis. Citing a specific case when marksmanship would have been an asset, Marshall proceeded to reveal the inability of the average Marine to fire accurately at the siege of Koto-ri in December 1950[40]. At this siege, Marines failed to accurately fire upon and hit fully exposed enemy soldiers at 300-350 yards. Despite the fact that Marines received 250% more marksmanship training on the same

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[36] Marshall, S.L.A., *Men Against Fire: The Problem of Battle Command in the Future War*. (Gloucester: Peter Smith, 1978), 50
[37] *Ibid.* 52
[38] Marshall, S.L.A., *Commentary on Infantry Operations and Weapons Usage in Korea: Winter of 1950-1951*.8
[39] *Ibid*. 8
[40] *Ibid*. 8

weapons as the Army, a full 38% of their boot camp experience, they still could not shoot any better[41].

Marshall noticed several deficiencies in the existing arms of the American fighting man and offered some remedies to help maximize the rate, accuracy, and lethality of rifle fire in Korea. The weapon system most loathed by both Marshall and the troops on the ground was the M1 and M2 carbines. Winchester Arms had developed the M1 carbine, and rushed it into production when the U.S. entered World War II to arm rear echelon personnel with something better than a pistol. The M1 carbine was faster and easier to produce compared to the Garand, and much cheaper than the Thompson sub-machine gun, and thus found its way to the front lines out of necessity. It was initially semi-automatic only, and fired a small .30 caliber cartridge from a detachable 15 round magazine[42]. The M2 was a post World War II modification to the same gun, making it into select fire version. While the M1 carbine appeared to perform well in the Second World War, it became considered as the least reliable and effective arm in the American arsenal during Korea. Marshall noticed that the M2 carbine worked especially poorly in the cold climate of Korean winters, operating sluggishly from the effects of cold and frost. The M2 would often fail to fire fully automatic unless warmed up by firing anywhere from five to twenty shots[43]. During the opposite conditions in the summer, the M2 failed due to dust and moisture[44]. For some reason, the older semi-automatic M1 carbines were less sensitive to the elements, but still performed worse than all other arms except the M2. Marshall blamed the design, which still lacked refinement after

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[41] Cardinal, Paul. "Marksmanship and the U.S. Marines," *The American Rifleman*, July 1951, 23
[42] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 12
[43] Marshall, S.L.A., *Commentary on Infantry Operations and Weapons Usage in Korea: Winter of 1950-1951*.67
[44] *Ibid.* 67

Winchester Arms and Army Ordnance rushed it into production. In addition to a lack of refinement, Marshall also pointed to the magazines and ammunition for the failures. The rusty magazines and corroded ammunition resulting from exposure to the elements also caused the weapons to fail[45]. The total weapons failure in the Korean War during this period averaged around 9%, and the carbines accounted for the majority of these malfunctions[46]. Even when the carbines did work, Marshall commented that they still lacked sufficient power, and in fully automatic mode they lacked accuracy[47]. Even when all factors favored successful operation by the infantryman, the carbines only had good terminal efficiency out to 50 yards[48].

Marshall praised the M1 Garand as an alternative that would be accurate, resistant to damage from winter and summer in Korea, and reliable given minimum care[49]. Marshall therefore recommended the M1 Garand as an immediate replacement for the M1 and M2 carbines. However, since most men did not fire persistently in combat, the semi-automatic Garand could not fill the needs of the Army. Only by adding another Browning automatic rifle or Browning machine gun per squad, could the effective ranges of the infantry extend to around 400 yards[50]. However, Marshall stated that even so, would be a limit to the effectiveness the weapons can supply due to the ammunition they fire. The .30 M2 cartridge was large and heavy. With a length of 62mm, it was almost twice as heavy and as large as the ammunition fired in the M1 and M2 carbines. The size of the cartridge limited the ammunition capacity of the M1 Garand and Browning automatic rifle, with the Garand

[45] *Ibid.* 67
[46] *Ibid.* 18
[47] *Ibid.* 67
[48] *Ibid.* 70
[49] *Ibid.* 64
[50] *Ibid.* 8

holding only eight cartridges per clip and the Browning automatic rifle holding 20 per magazine. The Garand required frequent reloading during rapid and severe firefights. However, the weight of the ammunition severely limited the number of cartridges the average soldier could carry[51]. The standard issue of ammunition for a Garand supplied soldier was 100 cartridges. In a fierce firefight, the ammunition can disappear fast and running out of ammunition was a distinct possibility. This was not a problem when the .30M2 cartridge was created for the slow firing bolt action 1903 Springfield rifle, but the arrival of the autoloading weapon caused ammunition consumption to raise dramatically. Already carrying 40 pounds of gear, the average soldier could not carry as much ammunition as required[52]. Even if the ammunition was available in significant numbers, the .30M2 and even the intermediate .30 carbine ammunition made the weapons hard to control in rapid fire and completely uncontrollable in fully automatic fire, due to the weight of the projectile they fired[53].

The answer to the reality of Korean War performance flaws for the U.S. Army and Marines was to increase the emphasis on marksmanship in basic training. Marshall found his study largely dismissed or ignored by the top officials in Army Ordnance, who thought that the T65 cartridge was still the answer. They focused on the T65 cartridge's more compact and light nature, compared to the .30 M2. The shining review of the M1 Garand rifle in the Marshall study only bolstered attempts to use the Garand as a basis and indeed the standard to measure all other prototypes in the areas of durability, reliability, accuracy, and lethality. They failed to address the problem of controllability in a .30 caliber select fire weapon

[51] *Ibid.* 9
[52] *Ibid.* 43
[53] *Ibid.* 9

operating in fully automatic mode. If the weak .30 carbine cartridge gave users control problems in the light M2 carbines, how would the much more powerful T65 cartridge fare in a rifle of comparable weight? Top officials did not address the issue and still chose to pursue the Light Rifle Project and the T65 cartridge. The British were still developing their EM-2 and .280 cartridge. The multi national force strained logistics in the Korean War due to the varying equipment of member armies comprising the United Nations forces. NATO needed standardized equipment quickly, and many member nations increased pressure for standardization after the start of the Korean War. This standardization issue set up the controversy that almost destroyed the long held and strong Anglo-American alliance during 1950-1954.

The war in Korea had revealed what the NATO planners had feared, an equipment supply crunch. NATO had made some progress in measurement standards, allowing for some parts inter-compatibility on vehicles, but one of the most pressing issues was fast becoming the lack of a standard cartridge and rifle. By this time there were 400,000 NATO troops comprised of 11 armies with 11 different rifles in a multitude of calibers[54]. At this time, the once solid Anglo- American alliance was beginning to show signs of strain. Both nations had a long history of government run ordnance departments and arsenals. Both had seen the vicious nature of combat in the Second World War and taken away different lessons from it. Out of these lessons came the very different British EM-2 and American T25 with their respective different types of cartridges. Over the years of 1951-1954, it appeared that this difference was impassible for the two allies, and very nearly caused the alliance to break into a cold hostility.

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[54] Stevens, Blake R. *The FAL Rifle.* 35

The British government had been using variations of the Lee Enfield rifle since 1902, and the British were eager to replace the long lasting veteran design[55]. The British had been looking into the idea of the self-loading rifle since before the First World War. Just as the Americans noticed the World War II German developments of the intermediate cartridge and weapons manufacture, the British were also paying careful attention. At the end of the war, with emphasis returning to research and development, the British Ministry of Supply instituted the Small Arms Ideal Calibre Panel[56]. The British, looking at more than just performance of singular components of a weapons system, considered all components together. The goal of the panel was to create the lightest rifle and ammunition combination consistent with firing comfort and effectiveness at the lowered range of 600 meters[57]. The developmental team realized that the old mentality of British marksmanship, dating back to their experience in the Boer Wars, was outdated when one panel member said, "*it was recognized that the old .303 over killed at rifle range*"[58]. The result of the panel's work was the .280 intermediate cartridge.

It is quite odd that two close allies such as the United Kingdom and the United States, which had co-operated in the Second World War in arms development, would be at odds on something as basic and necessary as the infantry rifle. British Brigadier General Aubrey Dixon commented that the sudden lack of cooperation between the two nations was probably rooted in the American fear of communist influence in the Liberal Labour government under Clement Atlee. Regardless of the cause, U.S. Army Ordnance was very secretive about their

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[55] Edward C. Ezell. "Cracks in the Post-war Anglo-American Alliance : The Great Rifle Controversy 1947-1957," Military Affairs 38, no. 4 (Dec. 1974) : 138
[56] *Ibid*. 138
[57] *Ibid.* 138
[58] *Ibid.* 138

plans to develop a .30 caliber lightweight rifle, which forced the British to go their own path. At first there appears to have been some resentment, if the feeling of Brigadier General Dixon were representative of the British military, but afterwards the pursuit of a new rifle and cartridge became a matter of national pride.

In April of 1951, less than a year after the initial testing for a NATO rifle took place, the British Defense Minister Emanuel Shinwell announced the full development and adoption of the British EM-2 and its .280 intermediate by the United Kingdom to replace the aged Lee Enfield bolt-action rifle[59]. Not only did this throw the future of standardization in peril, but also the British government began to split along party lines. The announcement of the adoption caused a long and heated debate between the Conservative and Labour members of Parliament. The Conservatives wanted the government to work with America to adopt a common rifle and cartridge, while the Labour ministers continued to press for the EM-2[60]. It looked as if the situation amongst the NATO members was deadlocked, with no side willing to give in to the other. It was at this point that the Canadian government stepped in to mediate. The idea of Canada, a large producer of ammunition, supplying a third caliber to the allied forces in Korea would overwhelm the already strained logistical situation.

The Canadian Minister of Defense called a meeting for August 1, 1951 in Washington DC[61]. The four-power conference included defense and ordnance officials from Canada, the United Kingdom, France, and the United States. From the moment the conference began, it appeared that the American officials were putting all efforts into killing the .280 British round as a possible NATO standard. They presented a barrage of data and

[59] Edward C. Ezell. "Cracks in the Post-war Anglo-American Alliance : The Great Rifle Controversy 1947-1957,". 139
[60] *Ibid.* 139
[61] *Ibid*. 139

facts to present their case, to which the British Defense Minister Shinwell could not respond with data of his own. American officials presented their research data to the Canadian and French allies to suggest the inadequate performance of the.280 British cartridge compared to the American T65 cartridge[62]. American officials also argued that the British EM-2 was prone to breaking and its optical sight subject to damage and fogging[63]. Against this, the British argued that their intermediate round would be economically smart due to the reduced materials consumed. However, the American board countered again, saying that their T65 represented a savings as well. The American officials also argued that since three of the four major allies already were producing 30 caliber cartridges, it would be cheaper to adopt the T65 as it would only require modifications to existing equipment, not total replacement[64]. The American officials also said that the cost of retooling American arsenals to a 28 caliber rounds would be too much for the Congress to approve. While this was unlikely given the willingness of Congress to approve more expensive and less basic measures, the point seemed to convince the French delegation to side with the Americans. This effectively deadlocked the conference, as the British ministers refused to concede. At the begging of the Canadian officials, they merely agreed to postpone deployment of the new British rifle until the Korean conflict ended[65].

On October 25, 1951, the Conservative Party won the British elections. Winston Churchill, again prime minister, soon made his opinion clear on the matter. He said that he was far from convinced about the merits of the EM-2 and the .280 intermediate cartridge it

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[62] Stevens, Blake R. *The FAL Rifle*.36
[63] Lucian Cary, "The New British Rifle," *True Magazine*, December 1951, 143
[64] Stevens, Blake R. *The FAL Rifle.* 36
[65] Edward C. Ezell. "Cracks in the Post-war Anglo-American Alliance : The Great Rifle Controversy 1947-1957," 139

fired[66]. Churchill brought the political reality of the EM-2 adoption into the discussion, citing the small annual rate of arms production in Britain compared to other nations. Churchill noted that given the poor economic situation of the nation in the wake of the Second World War, expanding the arms sector would be difficult[67]. Britain, according to Churchill, could not go it alone in the world anymore. While the EM-2 rifle and its cartridge might seem to be the best in the national context, pushing this design in the international context was probably not practical.

Less than a year later, on November 5, 1952, Prime Minister Churchill met with U.S. President Harry Truman. After three days of talks on mutual defense issues, they announced that they had seen eye to eye on a number of issues, one of which was rifle standardization[68]. It appears that the Conservative British government, eager to claim a high position for its naval commanders in the NATO alliance, dropped its insistence on the adoption of the EM-2 and the .280 intermediate cartridge. British naval commanders in return received high positions in NATO, even though Britain's naval forces now paled in comparison to the United States, and they shifted focus and development towards the Belgian designed FAL rifle[69]. In February 1953, with British backing, the T65 cartridge became the new 7.62 NATO round and a year later, the Belgian FAL rifle became the new British rifle[70]. Labour members of Parliament such as Woodrow Wyatt railed against Churchill and the Conservatives for "*Betraying the U.K*" and relying on the Belgians for rifles, given the fact

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[66] *Ibid.* 140
[67] *Ibid.* 140
[68] *Ibid*. 140
[69] *Ibid.* 140
[70] *Ibid.* 141

Belgium was the first country over run in the last two great wars[71]. Churchill engineered the Compromise of 1954 as a concession on standardization. Churchill hoped that the Americans, more friendly toward the Belgian FAL, would sanction it as the NATO rifle, if the British sanctioned the American T65 cartridge[72]. The rifle situation would drag on another three years before America would back out of the Churchill compromise, but by that time NATO standardization was a failure. The issue that was three years earlier almost responsible for shattering the Anglo-American friendship was now a minor issue.

From 1950-1954, the American government, acting on the advice of United States Army Ordnance, had been successful in getting its intermediate in size only cartridge, the T65, designated as the new standard NATO cartridge for small arms. Along the way it had also killed off the very strong efforts of its chief ally, Great Britain, to get its EM-2 rifle and true intermediate cartridge, the .280 British, adopted. The shocking defeat of the American T25 rifle in the 1950 international light rifle trials by the British EM-2 and Belgian FAL cemented the traditionalist tendencies of Army Ordnance and specifically its leadership concerning small arms development. The tradition of long-range precision marksmanship, dating back at least as far as the Spanish American War, continued to hold sway over senior American ordnance officers. Even the scientific studies of the Operations Research Office of Johns Hopkins University, showing the Korean War reality incompatible with long-range marksmanship, were unable to convince people like Col. Rene Studler that the traditional training and ideology of the United States Army and Marines had become obsolescent.

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[71] Woodrow Wyatt. "How the Yanks Scotched our Rifle" *Reynolds Magazine,* 24 January 1952 reproduced in Dugelby, T.B. *EM2 Rifle Concept and Design: A Rifle Ahead of its Time.*(Toronto: Collector Grade Publications, 1980), 167-168

[72] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective.* 4

U.S. Ordnance officials stuck to their conservative principles on marksmanship and weaponry, causing a nearly tragic rift between allies of the NATO alliance, and injected nationalism into the efforts for standardization. As the attempts to standardize the most basic of weapons, the infantry rifle, failed, so did the efforts to standardize more sophisticated weapons such as planes, tanks, and other vehicles. No country was particularly willing from 1950-1953 to admit that a foreign ally's design was better than the domestically produced counterpart was. Even the attempt to fix the situation by Winston Churchill in 1953-1954 had little effect on the overall situation. His adoption of the Belgian FAL and the American T65 cartridge did little to fix the failed attempts at standardization. American officials, less critical of the FAL, still did not earnestly wish to adopt it, and continued to go their own course to adopt a domestic design. The officials at Army Ordnance had preserved their power from foreign intrusion. However, the domestic commercial market and lower government officials were eager to enter the competition for future weapons development against the current government designs. World War II had shown that commercial ideas could gain government acceptance, as the Winchester designed M1 and M2 carbines had, and that these endeavors were immensely profitable. In addition, younger officials in ordnance became interested in new ballistic theories as the potential solution to problems present since the Second World War, as made apparent by the Korean study conducted by S.L.A. Marshall.

Domestic Challenges to the Light Rifle Project

With the second round of light rifle trials in 1952 completed and the Harvey T25/T47 projects terminated, the United States Army Ordnance threw what was left of its funding and efforts (greatly diminished by the seven-year long Harvey program) into the Garand-based T44 project of Lloyd Corbett, a designer at Springfield Armory. This project, in development only since 1950 and based on the earlier efforts of the World War II Garand T20 project, had fielded a rifle that performed extremely well, where the Harvey T25/T47 projects and the Belgian FAL did not. On the measure of reliability in extreme conditions, the T44 Garand based rifle outperformed the Belgian and Harvey rifles by a significant margin. While the FAL and Harvey guns malfunctioned and jammed in dusty and arctic environments, the T44 fared much better. The advantages of the T44 allowed Army Ordnance to resist ongoing pressure from the Belgians and British to adopt the FAL, with the U.S. continuing on an independent path of development. Due to previous World War II development projects, the T44 offered an alternative to the ailing Harvey project that was compatible with the small remaining budget. However, even as the officials in Army Ordnance defended their projects against challenges from the British and Belgians, a new domestic firm, Armalite, submitted a new rifle platform to compete against the government sponsored Light Rifle Project.

Armalite began as a small offshoot of Fairchild Engine and Aircraft of Hagerstown, Maryland, originating from an interesting 1953 meeting between a Fairchild executive and John Sullivan of Lockheed Aircraft[73]. At this meeting, the discussion of arms development arose. John Sullivan mentioned that he had learned of several new advancements in arms

[73] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective.* 19-20

design and production from J.S. Michault, an arms broker for Sidem International of Belgium. Back in 1950, the United States had undertaken to arm the new West German Border Police with weapons and had chartered Sidem International to fulfill the contract. Michault, in charge of this program, met Col. Rene Studler of U.S. Army Ordnance[74]. Studler briefed Michault about World War II German developments in the manufacture of arms, information which Studler himself chose to ignore, but which Michault embraced. This briefing filtered down to George Sullivan and finally to the Fairchild executives[75], who concluded that newly developed materials, such as stronger aluminum alloys and fiberglass, might replace German methods of steel stampings and Bakelite plastics. Use of these new materials, already common in the aircraft industry, could create inexpensive, reliable, and above all, light rifles, Fairchild believed.

These discussions continued for some time until Richard Boutelle, president of Fairchild Aircraft, formed Armalite on October 1, 1954. Boutelle hired George Sullivan as president of the newly formed California division of Fairchild and placed him in charge of arms development using these new materials[76]. Sullivan brought along his brother in law, Charles Dorchester, to become the plant manager. Dorchester had already been using materials such as anodized[77] aluminum alloys, stainless steel, and foam filled plastics and fiberglass to design lightweight bolt-action weapons that were nearly immune to corrosion by the elements. Once these designs attained reliability, Fairchild hoped to sell production licenses to manufacturers, rather than spending the capital to set up a mass production line.

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[74] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective.* (Toronto: Collector Grade Publications 1987), 20
[75] *Ibid* 20
[76] *Ibid*. 20
[77] A process of coating aluminum by anodic treatment resulting in a thin film of aluminum oxide of extreme hardness. A wide variety of dye-colored coatings are possible by impregnation in process.

Dorchester and Sullivan hired a former Marine and low-level Army Ordnance technician, Eugene M. Stoner, as their chief engineer, who developed full plans for autoloading rifles that could utilize these new materials and processes. Stoner's design for the new AR-3 rifle was conventional in layout and style, looking much like an aluminum and plastic hunting rifle. However, it provided a viable testing platform from which the engineers learned much they later applied to later designs[78].

Eugene Stoner was quite receptive to the use of new materials in his designs, but in fact, little of his actual design features themselves were new. The patent awarded to Stoner for his gas operation showed how much he took much from previous European and American firearms. Stoner's method by which the reciprocating parts locked into place had roots in the 1930's era Johnson automatic rifle. Melvin Johnson, the rifle's designer, had marketed his rifle unsuccessfully as a challenger to the M1 Garand before World War II. Stoner adopted this Johnson locking design, in which a multiple lugged bolt locks into a barrel extension, rather than into the receiver like a traditional rifle such as the Garand[79]. However, Stoner created a mode that reciprocates the bolt and bolt carrier which was different from Johnson's automatic rifle. In the Johnson automatic rifle, the action cycles through the short recoil principle, where the kinetic energy of the fired cartridge, the recoil impulse, reciprocates the parts and ejects a fired cartridge casing[80]. The Stoner rifle used a gas-operated system. Since the turn of the century, many nations had already utilized this system of operation; however, Stoner chose an unpopular variation, the direct gas impingement system.

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[78] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective.* 21
[79] Johnson, Melvin, *US Patent # 2,146,743, US Patent # 2,094,156.* US Patent Office
[80] Johnson, Melvin, Fig. *1-3 US Patent # 2,146,743.* US Patent Office

In the direct gas impingement system of operation, gas is directly tapped from the barrel of the weapon, directed via a tube backwards into the receiver where it generates a pneumatic force against the bolt or bolt carrier, unlocking the bolt and using the residual force to propel the bolt carrier assembly rearwards, ejecting the spent cartridge casing[81]. A recoil spring then halts and returns the carrier assembly forward to reload the rifle with a fresh cartridge. The French MAS 49 rifle, as well as the Swedish Ljungman Gevar 42 rifle, had also employed this feature several years earlier[82]. Direct gas impingement previously saw such selected service because it directed propellant residue into the action of the rifle, causing extra fouling of the action. Stoner utilized this system because it required less parts than traditional gas operated systems such as on the M1 Garand and Belgian FAL, which used operating rods and pistons to transfer the pneumatic pulse to the receiver and reciprocating parts. A design having fewer parts provided several advantages; there was less to fail and less to manufacture. The choice of this method allowed for a more cost effective rifle that weighed less, perhaps most important feature to any rifle competing against Army Ordnance's Light Rifle Project.

Armalite's resulting military oriented prototypes were the first AR-10 rifles, completed in 1955, which chambered first the old .30M2 cartridge and the then new 7.62 NATO cartridge. Both of these featured stocks that allowed for a straight line of recoil and were tubular in shape. They also featured high profile sights necessitated by straight-line recoil, just as in the Johnson automatic rifles models of 1941 and 1944. The Stoner and Johnson connection evolved into direct cooperation by 1955, when Melvin Johnson joined

[81] Stoner, Eugene. *Fig. 4-5 US Patent # 2,951,424.* US Patent Office.
[82] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective.* 29

Armalite as a consultant and publicist, leaving his consultant positions at Winchester Arms and the Operations Research Office at Johns Hopkins University[83]. Johnson repeatedly hailed the new Stoner AR-10 rifles for taking full advantage of his idea of locking the bolt to a barrel extension. Since the stress of firing in this system is localized to the barrel extension and barrel, this allowed Stoner to fabricate both the large upper receiver (containing the weapon's action), as well as the lower receiver (containing the trigger mechanism) out of lightweight aluminum alloys instead of heavy steel forgings.

Armalite's building of the first two functional AR-10 rifles led to further developments on the platform. The third prototype AR-10A included the first use of fiberglass reinforced plastic shells filled with plastic foam for the stock, pistol grip, and hand guards. Stoner also attached at the muzzle an effective duralumin noise and flash suppressor[84]. Eugene Stoner, George Sullivan, and retired General Jacob Devers submitted this AR-10A prototype to the Infantry User Board at Fort Benning in December 1955. Armalite demonstrated the rifles in 1956 and they performed well before a number of officials, including the Continental Army Command Headquarters at Fort Monroe, Virginia[85]. The resulting tests gave the AR-10A a boost that Armalite needed to try to catch up to the T44 project. Continental Army Command approved the Infantry Board's recommendation to instruct Ordnance Research and Development to investigate the possible military applications of the Armalite design. In summer 1956, Ordnance Research and Development offered to send the Armalite design team the information learned from Project SALVO, so Armalite could investigate the possibility of creating a rugged and light weapon

[83] *Ibid.* 26
[84] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective.* 30
[85] *Ibid*. 30

system designed to utilize Small Caliber High velocity ammunition. Army Ordnance offered Armalite direct financial support for future company developments, on the condition that the ordnance corps owned the rights to the final product[86]. Armalite refused the offer of financial support, hoping instead to profit from further development along current lines. Soon the directors of the company announced a large-scale plan for further development of the AR-10 weapons platform.

It was at this point that Fairchild became overly enthusiastic and began to change the design to save even more weight. By further reducing weight, the goal was to give the AR-10 an even greater advantage in testing against the government's Light Rifle Program. The most significant change came in the barrel construction of the fourth variation of the AR-10B, one that Eugene Stoner had personally opposed utilizing for safety reasons. The first three versions of the AR-10 had utilized traditional ordnance steel barrels, but the fourth prototype variation of the AR-10B had a barrel that was a composite of stainless steel and aluminum. The barrel consisted of an extremely thin rifled stainless steel barrel liner surrounded by a thick aluminum alloy jacketing[87]. This was not a new principle in general; Armalite had utilized a similar design for their low powered AR-5 bolt-action survival rifle that they were marketing to the United States Air Force at the same time[88].

Armalite delivered a batch of AR-10B fourth variation rifles to Springfield Armory in the fall of 1956 for extensive testing, at the request of Continental Army Command. Lt. Col. Roy E. Rayle, then the head of the armory's Research and Development Division, oversaw the testing of the AR-10 rifles and wrote about it in an unpublished document, *Growth of a*

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[86] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective.* 30
[87] *Ibid*. 31
[88] Sullivan, George C., "A truly Lightweight Rile: New Survival Weapon.", *The American Rifleman*, January 1957. 23

Rifle. Parts of it reproduced in other sources yield insight into the events of that period and into the perceptions of the Armalite prototypes by a skilled ordnance officer[89]. In this study, Lt. Col. Rayle examined the barrel, concluding that the design was theoretically feasible and worth testing[90]. Shortly after the arrival of the rifles, a Mr. Dorchester (presumably Charles Dorchester, the plant manager of Armalite) arrived to discuss testing procedures for the AR-10 rifles[91]. The officers at Springfield Armory subjected AR-10 rifles to the same tests that the American T44 and the Belgian FAL rifles had completed in the past. The only exception to the standard testing procedure was that Melvin Johnson, now under the employ of Armalite as a consultant, supervised the tests so that Armalite could be sure of fair and balanced procedures[92].

In mid December 1956, the testing stopped after the muzzle brake/ flash suppressors failed. The rifles up to that point had already proved unreliable, as they had suffered broken extractors, trigger sear failure, failure to feed ammunition, pierced ammunition primers, and warping of the gas tube[93]. Armalite addressed the failure of the muzzle brake by using titanium instead of duralumin, and replaced the stainless steel gas tube with one of ordnance steel. Testing resumed the next month, January 1957. One of the two rifles underwent durability testing, while the other underwent evaluations on general performance. Early in the testing phase, the rifles showed marked improvement. The replacement of the stainless steel gas tube with a normal ordnance steel tube fixed the warping issue, and the new titanium muzzle device showed marked durability improvement over the earlier duralumin one,

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[89] Rayle, Roy E. *Growth of a Rifle*. Unpublished. Reproduced in part in Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. (Toronto: Collector Grade Publications 1987), 32
[90] *Ibid*. 33
[91] *Ibid*. 35
[92] *Ibid*. 35
[93] *Ibid*. 35

although it still fouled after a period and no longer suppressed flash well[94]. The rifles tended to have feeding and extraction malfunctions in sub zero temperatures, and tended to freeze overnight. Although this was not out of the ordinary in testing or in the field, it proved to be more difficult to free the AR-10 action due to the layout of the gun. However, after a few days, the rifle undergoing durability testing suffered a catastrophic failure. Lt. Col. Rayle wrote, "*We had not yet reached the most severe part of the test schedule, when a bullet came out of the side of the barrel just ahead of the hand of the gunner holding the rifle.*[95]" Metallurgists evaluated the guns and concluded that while the stainless steel alloy 416 used for the barrel liner would work in a water-cooled machine gun, it did not have enough transverse-strength for an air-cooled weapon that operates in a wider temperature range. The analysts also determined that the alloy contained too much sulfur, allowing stress cracks to form, while the heat treatment used to temper the stainless steel barrel liner was not compatible with the liner's application[96].

Following the failure of the AR-10B fourth variation rifles, Armalite contacted a government contractor that had several T44 barrel blanks. The contractor and Eugene Stoner worked together to produce an all steel barrel that was as light as the composite barrel by milling large longitudinal grooves down the sides of the barrel. This removed material, but also stiffened the barrel, making it light while maintaining its strength at the same time. With the new fluted carbon steel barrels installed, the AR-10 rifles finished the trials without further catastrophic failures[97]. However, the rifles exhibited many more malfunctions and parts breakages, causing Army Ordnance to declare the AR-10 under-developed and unfit for

[94] *Ibid*. 35
[95] *Ibid*. 36
[96] *Ibid*. 36
[97] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 40

service. Armalite did not choose to challenge the T44 further and instead chose to focus on promoting the AR-10 in foreign military rifle competitions.

While it is evident that the AR-10 from Armalite came too late to stop the momentum favoring the adoption of the T44 as the U.S. Service Rifle M-14 in May of 1957, it did introduce new ideas to the American community of small arms designers at both commercial and state armories. While ordnance officials had been leery of radical foreign designs such as the British EM-2 and the World War II German developments, the Armalite AR-10 used a traditional configuration, unlike the bull pup EM-2. It also used materials that while new to small arms, had already become standard in the aircraft industry. The Armalite rifles showed artisanship in their forged and milled construction, unlike the crude looking pressed sheet metal designs of Germany during the World War II. The innovation in materials and design was radical, but not too radical for some ordnance and Army officials. While the Armalite AR-10 never presented a serious challenge to the T44 which had a significant head start in development, it did make some people in middle management positions in the Army Ordnance department, as well as other sections of the military, begin to see the future of small arms differently. The Armalite platform was quite feasible; it would just take time for the platform to be further developed.

Opposition to the Light Rifle Project in the Ordnance Corps

There are always two components to a small arms design, the platform and the cartridge that it chambers and fires. The Anglo-American rifle controversy of the early 1950's was as much about the competition between the T65 cartridge and the .280 British cartridge as it was between the platforms that chambered them. While the T65 cartridge was the official cartridge sponsored by the United States Army Ordnance officials such as Chief of Rifle Development Col. Rene Studler, other officials were concentrating on new concepts in cartridges that might be applicable to not only the current crop of small arms, but also to any future platforms. While the Europeans had been experimenting since the Second World War with intermediate cartridges like the 8mm Kurz and .280 British as an alternative to the traditional high power full sized rifle cartridges, cartridge designers in the United States chose to focus on the concept of a small caliber high velocity cartridge. Even as the Army Ordnance official T65 cartridge battled against challengers from abroad, there were challenges from within as well. From 1950 through 1953, various civilian officials at Aberdeen's Ballistic Research Laboratory and the Operations Research Office of Johns Hopkins University challenged the Army's standard view of modern combat, and designed new and original cartridges around this vision.

In November 1950, Studler ordered the first detailed and analytical study on the rifle effectiveness since the end of Second World War[98]. His order immediately followed the first round of international rifle trials for NATO standardization, which showed the American T25 Rifle to be inferior to the Belgian FAL and even to the British EM-2 in several areas. Only the T65 cartridge allowed the T25 to outperform the foreign designs in range and accuracy.

[98] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 7

Col. Studler may have hoped that a new study on rifle effectiveness would validate his conservative view of modern warfare, the view that emphasized long-range marksmanship and precision fire at longer distances. The man charged by Col. Studler to undertake the study was Donald L. Hall, an engineer at the Aberdeen Ballistics Research Laboratory at the Aberdeen Proving Grounds[99]. Hall's report of March 1952 did not produce results that the upper echelons of Army Ordnance expected or hoped. Hall took data from the international rifle trials and the already discussed Korean War combat study by S.L.A. Marshall, and designed experimental cartridges around what these revealed as the essential nature of modern combat.

Opening with an interesting disclaimer, Hall declared "*This report was prepared without regard to present established military characteristics of the Army Field Forces, since the purpose of research is to provide basic data which may assist in developing future requirements.*[100]" Hall took several factors into mind when considering his experimental cartridges. These experimental cartridges were theoretical and existed only on paper. They were just the results of calculations, not actual experimental firings. The first factor considered was the probability that the soldier firing the weapon would be able to hit the target. Secondly, Hall investigated what would be the wounding effects if the soldier hit the intended target. This required analyzing the shape of the bullet, its mass, and the velocity at which it would strike the target. Finally, Hall took into account the combined weight of the rifle and ammunition[101]. Previous studies had analyzed the first two questions as Hall did, as had field trials such as the 1950 international rifle trials at Fort Benning. However, Hall's

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[99] *Ibid*. 7
[100] Hall, Donald L. *Memorandum Report No. 593 - An Effectiveness Study of the Infantry Rifle.* Washington DC : Ballistics Research Laboratory, 1952. 1
[101] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 7

third focus was new and unique to the study of rifle effectiveness. Hall determined that with a combination of rifle and ammunition weighing 15 pounds, a soldier carrying a rifle in .21 caliber could hypothetically kill around 2.5 times more enemy combatants than could a soldier equipped with the M1 Garand rifle and .30M2 ammunition[102]. The .21 caliber rifle offered a higher probability of hitting an intended target, and created less weight, letting each solider carry more ammunition. Hall's analysis assumed ranges of around 120 yards, following approximately what S.L.A Marshall had stated as the most common and effective range of engagement from his study of the Korean War[103]. Strongly influenced by Marshall's study of rifle effectiveness in the Korean War, Hall complained that soldiers carrying the M1 Garand did not have enough ammunition to last in a long firefight[104].

Hall's work on theoretical cartridges garnered enough support from others in research and development to allow small-scale test firings. Hall conducted his test firings at the Small Arms Section of the Aberdeen Ballistics Laboratory's Development of Proof Services[105]. The resulting data and opinions ended up in the original study as an addendum. Originally, Hall was going to test the commercially available 220 Swift round, a popular hunting cartridge for small game that at the time was the only comparable cartridge easily obtainable. However, Col. Studler allowed Hall to procure .22 caliber bullets like those in his theoretical study, ones more closely homologous in shape to the .30M2, having nearly the same, but an inferior, ballistic coefficient[106]. This reduction in the ballistic coefficient of the supplied

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[102] *Ibid*. 8
[103] Marshall, S.L.A., *Commentary on Infantry Operations and Weapons Usage in Korea: Winter of 1950-1951*,8
[104] *Ibid*. 9
[105] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 8
[106] A number that serves as an index to a bullet's ability to overcome air resistance (drag) during flight. It is computed by dividing the bullet's sectional density by the coefficient of form. In general, the larger the number, the more efficient the bullet.

bullets caused the loaded cartridges to perform with less long-range accuracy and penetration. Col. Studler supplied 200 bullets for the experiment, which Hall and his team manufactured into complete cartridges using 220 Swift cartridge casings[107]. Hall and his small team fired the cartridges from a customized Winchester rifle to obtain ballistic, accuracy, and penetration data[108].

The results of the test firings added experimental data that did indeed back up Hall's theoretical cartridges. However, since the bullets fired were not the same shape as the .30M2 bullets, as the bullets in the theoretical work were, Hall concluded that accuracy and effective range diminished about 25%[109]. For instance, Hall's penetration tests showed that the normal .30M2 cartridge was able to penetrate 10-gauge cold rolled steel completely out to 625 yards and partially at 725[110]. The experimental .220 cartridge penetrated the same steel completely out to 500 yards, and partially at 600 yards[111]. Hall then theorized that if the .220 bullets had a 7.0 caliber ogive[112] to allow the bullet an identical profile to .30M2 bullets, that penetration performance between the two cartridges would be nearly equal due to the equal ballistic coefficient[113]. Hall also stumbled upon a unique characteristic of the .220 cartridge. He concluded that the .220 is nearly as effective as the .30M2 cartridge when the bullets are traveling at comparable velocities[114], based on the terminal ballistics test of shooting into large blocks of clay in order to ascertain the wounding capabilities of the bullets. It appeared that the smaller caliber rounds would tumble inside the blocks of clay, causing large wound

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[107] Hall, Donald L. *Experimental Data on a .220 Rifle.* Washington DC : Ballistics Research Laboratory, 1952.1
[108] *Ibid*. 1
[109] *Ibid*. 1
[110] *Ibid*. 1
[111] *Ibid*. 1
[112] The area of a bullet, often curved, forward of the point of largest diameter (driving band). This term generally applies to the curved or angled portion of a bullet's nose.
[113] Hall, Donald L. *Experimental Data on a .220 Rifle.* 1
[114] *Ibid*. 1

channels. Because of this Hall theorized that at short to medium distances, the .220 cartridge, with a faster striking velocity, would actually be superior in its wounding capabilities to the .30M2 service cartridge[115].

Although the Hall report determined that the experimental .220 cartridges had promise, the heads of United States Army Ordnance seemed uninterested and somewhat hostile to any sort of short-term applications for the small caliber high velocity concept. Chief of Army Ordnance Rifle Development Studler banned any further small caliber high velocity studies that challenged the current service rifle package or its successors[116]. Studler and his deputies continued to push for the T65 full power cartridge, and their interest in acquiring a rifle that was light in name only continued full steam ahead, despite the Hall Study. However, it seems that there were more people in lower echelons taking notice of the Marshall study. In June of 1952, Norman A. Hitchman, a member of the Operation Research Office of Johns Hopkins University, released another report also based on S.L.A. Marshall's research in Korea. Hitchman concluded that as it stood in Korea, the best and worst marksmen were about equal in ability to hit enemy targets in that war[117]. This conclusion challenged traditional military training, but also of the traditional view of warfare that underlay both prior and current rifle development.

Hitchman's report seemed to echo the Marshall study with the following conclusions. First, "*The range at which the rifle is used most frequently in the battle and the ranges within which the greater fractions of man targets can be seen on the battlefield do not exceed 300*

[115] *Ibid*. 1
[116] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 9
[117] *Ibid*. 9

yards[118]". Both United States Marine and United States Army training of the period focused on precision marksmanship training out to 500 yards. Secondly, "*Within these important battle ranges, the marksmanship of even expert riflemen is satisfactory only up to 100 yards; beyond 100 yards marksmanship declines sharply, reaching a low order at 300 yards*.[119]" This conclusion was even more damning than Marshall, who had placed ideal effectiveness in Korea out to 150 yards. While these statements criticized the training of recruits, the Hitchman report also directly attacked current rifle development and ideology.

Hitchman stated, "*Current models of fully automatic hand weapons are valueless from the standpoint of increasing the number of targets hit*" and that "*Certain of the costly high standards of accuracy observed in the manufacture of current rifles and ammunition can be relaxed without significant losses in overall hit performance*. [120]" The lack of sophisticated construction had been one of the reasons that Col. Studler and many other high-ranking officials in Army Ordnance had refused to consider many of the recent European developments. The Europeans' extensive use of stamped steel, spot welded or riveted together with loose tolerances and stocked with plywood or Bakelite, appeared cheap and desperate compared to the forged milled steel and walnut of American arms. Adding to the criticism, and lending credence to the nearly simultaneous Hall study, the Hitchman report had one final recommendation to add. It stated clearly that "*To create militarily acceptable damage at common battle ranges, missiles of smaller caliber than the present standard .30 caliber can be used without loss in wounding effects and with substantial logistical and*

[118] *Ibid*. 9
[119] *Ibid*. 9
[120] *Ibid*. 9

overall military gains.[121]" The report contained multiple charts quantifying the effectiveness of the current M1 Garand rifle in relation to a small caliber high velocity weapon. The results showed that in all types of environments and terrain, the small caliber high velocity weapon was superior to the Garand and its .30M2 ammunition. With varying types of terrain, the small caliber weapon varied in superiority; in Class A terrain, such as that found in Korea, the improvement was marginal. However, a Class C terrain like that encountered in Normandy during the Second World War, showed the small caliber principle to be clearly superior to the M1 Garand rifle package, the package that had equipped soldiers in America's last war[122].

It seems the trilogy of reports from Marshall, Hall, and Hitchman began to convince more and more people, particularly civilians in research and development, of the limitations of current U.S. military tactics and rifle development and of the feasibility and superiority of the small caliber high velocity concept. However, even the Hall .220 caliber firing experiments only analyzed the feasibility of the cartridges, which was only half the package in small arms development. By 1952, the U.S. military had made absolutely no attempts to put a design platform with the cartridge that would test the real world applications of the concept. There were two reasons for this. First, the top Army officials, including the Chief of Army Ordnance Rifle Development, stood firmly behind the Earle Harvey and Garand based designs for the T65 Cartridge, giving these projects the most attention, resources, and funding. In the new atomic age, Army Ordnance's significantly smaller budget for small arms research and development left little remaining funds for other projects. This was why

[121] *Ibid*. 9
[122] *Ibid*. 9

the Hall firing experiments received only a small amount of material support, in the form of 200 bullets. These secondary projects could only compete for funding as long-term developments, unable to challenge the Light Rifle Project's more traditional rifle and cartridge that offered more immediate value.

Fighting against funding issues and the current tide of popularity favoring the Light Rifle Project and the full power .30 caliber T65 Cartridge, some officials in research and development sought a way to gain approval and hence funding to create a platform for the small caliber high velocity concept. Once again, they found their answer in Marshall and the Korean War. The Marshall study criticized the M1 and M2 carbines for being completely unreliable in combat and severely lacking in terminal wounding ballistics except at very close ranges. By 1952, the carbine had few fans on the battlefield or in Army Ordnance. Since Col. Studler had banned any further comparisons of the small caliber high velocity theory and .30 caliber rifles, the answer was the M1 and M2 carbine. When Donald Hall fired his 200 test rounds, it was under the supervision of the head of Aberdeen Ballistic Lab's Small Arms and Aircraft Weapons Section, G. A. Gustafson[123]. Gustafson pitched his proposal as a product improvement project for the M1 and M2 carbines. The proposal convinced Gustafson's superiors and his team received approval for carbine experimentation.

From November 13, 1952 until August 21, 1953, the project limped along. Gustafson designed and fabricated his own .22 caliber cartridge and worked almost entirely alone to convert a standard M2 carbine to fire the new cartridge[124]. Throughout his final report, Gustafson made sure to avoid the notion that this would serve as a mainline battle rifle like

[123] *Ibid*.12
[124] Gustafson, G.A. *Design and Fabricate a High-Velocity Caliber.22 Cartridge, Modify a Standard M2 Carbine to Fire the Cartridge, and Evaluate the Weapon-Ammunition Combination.* Washington DC : Ballistics Research Laboratory, 1953. 1

the M1 Garand. Setting out his motivation for the project, Gustafson argued that the M1 and M2 carbine problems appeared partially because of misapplication of the design in the field. The M1 carbine and the later M2 variation had originated as a supplement for the 1911 A1 .45 caliber Colt pistol, supplies of which were critically short at the outbreak of hostilities in the Second World War. However, the carbines evolved more into a general issue weapon meant to fill in the production gaps of the M1 Garand and Thompson sub-machine guns. This misapplication of the M1 and M2 carbine carried on into the Korean War as well. Designed originally to replace a pistol, the ammunition it fired was designed for extreme close range effectiveness. Gustafson noted that battlefield needs could create a special role for a carbine type weapon and argued that with the small caliber high velocity cartridge, the M1 and M2 carbines could become effective out to medium ranges of 300 yards[125].

After explaining why the M2 carbine had received such a poor reputation on the battlefield, Gustafson asserted that the solution was the small caliber high velocity concept. Addressing the inability for accurate fully automatic fire, Gustafson explained that the combination of a lightweight carbine and a large caliber heavy bullet created a large and significant recoil impulse that gave poor accuracy when done repeatedly in a short time, as in fully automatic fire[126]. The argument, simple Newtonian physics at work, was a subtle and indirect argument against the then-current Light Rifle Project. The .30 carbine cartridge was similar to an intermediate cartridge, and if an intermediate cartridge is difficult to control during fully automatic fire, then it is logical to assume that the average soldier would find a full power cartridge like the .30 caliber T65 in a light rifle significantly harder to control.

[125] *Ibid*. 1
[126] *Ibid*. 1

Gustafson continued to argue against large caliber weapons by suggesting that in a small caliber high velocity firearm, compensators[127] would work much better, given they have a much better powder charge to bullet weight ratio than large caliber cartridges[128]. Hence, the addition of a compensator to the already low recoil inherent in small caliber weapons creates a weapon with negligible recoil and reduced muzzle rise through the redirection of propellant gasses[129]. Gustafson's report then detailed the ease of converting a standard carbine to fire the new cartridge, saying that modifications were relatively simple. The largest and most important part of the conversion process was replacing the .30 caliber barrel with one of .22 caliber[130]. Gustafson modified the bolt and cartridge extractor to use a cartridge with a slightly larger base in diameter. His team installed springs that were more powerful, a bipod from a Browning automatic rifle, and a simple compensator[131]. Although not necessary, Gustafson machined some parts to remove material and further bring down the weight of the firearm.

The ammunition modification was also a relatively simple affair. Just as the Hall study had used the .220 Swift commercial cartridge as a basis for experiments, Gustafson selected a commercial cartridge, the relatively new 222 Remington cartridge as the basis for his carbine[132]. However, since the receiver and ammunition magazine were designed for a 33 millimeter long cartridge, the 222 Remington was simply too long to work. Gustafson

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[127] A device fitted to the muzzle of a firearm to reduce the recoil perceived by the shooter and, with some types, muzzle rotation. The device consists of one or more holes or angled plates located just before the end of the device that direct expanding gases upward and outward, counteracting the firearm's movement due to recoil.
[128]Gustafson, G.A. *Design and Fabricate a High-Velocity Caliber.22 Cartridge, Modify a Standard M2 Carbine to Fire the Cartridge, and Evaluate the Weapon-Ammunition Combination*. 1
[129] *Ibid*. 1
[130] *Ibid*. 2
[131] *Ibid*. 2
[132] *Ibid*. 2

trimmed the cartridge cases to a length that would properly fit the receiver and magazine and then simply reloaded the components to create the ammunition required[133].

This essentially created the new weapon. Test firing of the weapon commenced in spring, 1953 at the Small Arms and Aircraft Weapons Section of the Ballistics Research Laboratory at Aberdeen. The results of the test showed remarkable improvement over the standard carbine and ammunition. Using the new ammunition and compensator, the .22 caliber Gustafson carbine had 28% of the radial dispersion of shots of the M2 carbine and ammunition at 100 yards[134]. At 300 yards, it had 52% of the radial dispersion of the standard carbine and ammunition[135]. In semi-automatic fire at 300 yards, Gustafson's carbine was 52% more accurate than the standard carbine, and 84% more accurate than the .45 caliber sub-machine guns in use at the time[136]. The Gustafson carbine was also easier to shoot, as the .22 caliber ammunition has a much flatter trajectory at 300 yards, making sight adjustments almost unnecessary, unlike in the standard .30 caliber carbine[137]. The .22 caliber ammunition outperformed the .30 carbine cartridge in penetration of hardened and soft metal plating, and against body armor the .22 Gustafson ammunition was equal to a standard carbine[138]. The only test where the .30 carbine cartridge outperformed the .22 Gustafson cartridges was in kinetic energy at long-range. However, Gustafson, like Hall, noticed that the bullet seemed to wound equally at similar ranges, despite the reduced kinetic energy. He theorized this pattern was due to higher velocities inherent in the .22 caliber ammunition[139]. Gustafson

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[133] *Ibid*. 2
[134] *Ibid*. 4
[135] *Ibid*. 4
[136] *Ibid*. 4
[137] *Ibid*. 4
[138] *Ibid*. 4
[139] *Ibid*. 4

recommended that the Biophysics Laboratory at the Army Chemical Center test the ammunition[140].

Gustafson concluded that the modified carbine and ammunition were capable of delivering accurate and effective fire at ranges up to 300 yards. The fact that the modified carbine weighed 40% less than the M1 Garand rifle, combined with the fact that the ammunition weighed 65% less than the .30M2 cartridge, would allow the average soldier to carry a considerable amount of ammunition. This would allow soldiers carrying the carbine to supplement the M1 Garand's longer range power out to 300 yards. Of the total 1,900 rounds of ammunition fired during the tests, only three stoppages occurred, and all were ammunition related. Gustafson recommended that Army Ordnance acquire and test 20,000 rounds of his ammunition and five modified carbines at the Aberdeen Proving Grounds in order to see if ammunition of this type offered any advantages over current military cartridges[141].

By the time the report was finished and issued in 1953, Col. Rene Studler had retired from Army Ordnance, leaving this and other programs, including the Light Rifle Project, in total disarray[142]. However, the work of Gustafson, Hall, Hitchman, and Marshall did get a new line of research and development initiated. Project SALVO, the new program aimed to investigate the potential of small caliber high velocity rounds, as well as multiple projectile dispersion ammunition, as possible longer-term developments. Although Col. Studler was gone, the set of high-ranking officers remaining in Army Ordnance still included many traditionalist disciples. Before retirement, Studler did have one final victory. NATO, thanks

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[140] *Ibid*. 4
[141] *Ibid*. 5
[142] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 18

to his efforts, adopted the T65 cartridge as the 7.62 NATO shortly after he retired, leaving any prospect for the small caliber high velocity concept a long-term one.

The early 1950's found the traditional minded high ranking officers in Army Ordnance in control, but with challenges coming from all sides. As mentioned before, with small arms there are always two parts, platform and cartridge. While criticizing the foreign platforms, the heads of Army Ordnance also fought against pressure to adopt foreign cartridges. The European delegations from Great Britain and Belgium challenged the old standard of a large caliber, full power cartridge by supporting a large caliber intermediate cartridge. While resisting foreign intermediate cartridges, the traditional officials in Army Ordnance also fought new ideas from within their own ranks. Young ordnance officers and civilian analysts at the Ballistics Research Laboratory and the Operations Research Office at Johns Hopkins University challenged the Army's standard vision of modern combat, and developed new cartridges to fit their alternative view of modern infantry warfare.

Beginning with Donald Hall and S.L.A. Marshall in 1950, the civilian and military divide within the various departments of Army Ordnance began to appear even stronger. The military officers in Army Ordnance tended to believe that the full power .30 caliber cartridge had worked in the past and would continue to work. They firmly believed that combat in the Second World War had shown the superiority of American long-range marksmanship and precision long-range firepower produced by the .30M2 cartridge and M1 Garand rifle. As discussed earlier, this view was in truth accurate only in the Northern European Plain. Norman Hitchman did much to undermine that view by showing that reduced caliber high velocity cartridges could actually be superior in a wide variety of terrain.

The experimental cartridges and later test firings of Donald Hall's and his .220 Swift based ammunition showed that there was a viable third option in the cartridge debate. The small caliber high velocity cartridge allowed more reduction in weight and recoil than the European design of the intermediate cartridge and the officially adopted American design of the full power T65 cartridge. The small caliber high velocity cartridges were more accurate than the intermediate European cartridges due to a flatter trajectory, and could out-penetrate them, nearly matching the performance of the old .30M2 cartridge out to medium ranges. However, while useful at medium ranges, the small caliber high velocity cartridge was still not able to match older traditional type cartridges at long distance. Army rifle training for infantry soldiers still focused on firing out to 500 yards. Moreover, while the reduced .22 caliber rounds produced by Hall performed accurately at that range, they could no longer match penetration or energy of the heavier bullets at that range. They simply lost energy too fast because of their light weight.

However, the departure of Col. Studler as Chief of Army Ordnance Rifle Development in 1953 created opportunities for alternative theories. The disarray caused by sudden lack of the leadership that had run Army Ordnance Rifle Development for so long allowed the dedicated civilians and junior officers to throw their projects a lifeline by convincing higher Army Ordnance authorities to start Project SALVO. It kept the option of the small caliber high velocity concept on life support, while America and NATO carried forth with the T65 Cartridge as the 7.62 NATO. The small caliber high velocity cartridge possessed merit; however, it would take longer for certain men to seek and design a new and suitable platform.

Small Caliber High Velocity Rifles

In 1953, the United States Army Ordnance Department gave approval for a long-term project aimed at producing new types of ammunition for both current and future weapons platforms. Designated Project SALVO, it covered multiple new ideas for ammunition and rifle platforms. SALVO promoted a wide range of ideas from using shotgun shells filled with hardened steel flechette darts, to so-called duplex and triplex rounds containing multiple bullets per cartridge, to the small caliber high velocity concept. All of these ideas were different means to one end, the ability for the average soldier to increase hit probability on enemy targets. The flechette, duplex, and triplex cartridges sought to do this by using several projectiles per round of ammunition. The small caliber high velocity concept instead sought to do this by reducing recoil and weight, creating a package that would be easier for the average soldier to fire successfully while carrying more ammunition. Two types of small caliber high velocity rounds underwent testing. Trials continued on the Gustafson's carbine already tested at the Ballistics Research Laboratory at Aberdeen Proving Grounds. Other trials applied the concept of the T65 cartridge case, altering it to accept a .22 caliber bullet and modifying the Belgian FAL, then the most advanced design to fire it[143]. Tests showed that neither cartridge nor the bullet was optimal, and further funding would be necessary for continued development.

While Col. Rene Studler retired from his post as Chief of Army Ordnance Rifle Development in 1953, causing several programs to go into temporary disarray, the power vacuum did not last long. Dr. Frederick H. Carten soon became the new head of Army Ordnance. Dr. Carten was Col. Studler's civilian executive for several years and although a

[143] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 53

civilian, he shared the same views on weapons development and combat theory as the former Chief of Ordnance Rifle Development. Army Ordnance would change little under the new chief, with old policies and practices revealed in the continuity in programs and pursuits. The first such evidence lay in the fate of Project SALVO. When Project SALVO ran out of funds, William C. Davis, a staff member working on the Gustafson carbine, requested additional funding. When the engineers at the Ballistics Research Laboratory submitted a formal application for more funding, Dr. Carten simply gave them a verbal "No", as Davis later recalled[144]. While Carten possessed the same ideas as Col. Studler, Carten had more enthusiasm for the Garand based T44 platform, and overcame opposition regarding the T65 cartridge or the T44 rifle platform. His actions and tactics over the next few years showed that Carten was willing to bend rules and play politics in order to keep the T44 program ahead of its competitors such as the Belgian FAL or the small caliber ballistics studies.

While the attempt by the Ballistic Research Laboratory to gain more funding for their Project SALVO failed to sway Carten from his traditionalist doubts on new cartridges, it did get the attention of others in the Army through a circuitous route. In February 1957, after the poor showing of the underdeveloped Armalite AR-10 rifles, General Devers of Fairchild Aircraft (the parent company of Armalite) visited Dr. Carten. Previously, Armalite had been overly confident about its AR-10 design and refused government funding for the development of a rifle platform specifically made for the small caliber high velocity concept[145]. On this visit, General Devers accepted and received a briefing on the SALVO research, although the Army was not then offering any government funding or sponsorship to

[144] *Ibid*. 54
[145] *Ibid*. 30

the firm. At the same time, General Willard G. Wyman, the Commanding General of Continental Army Command, had been impressed with the Armalite rifles demonstrated for him at Fort Monroe in 1956. General Wyman notified Eugene Stoner, the weapon's designer, that the Infantry User Board, his user end-testing group, liked the idea of a small caliber high velocity concept based weapon[146]. General Wyman made the recommendation, according to William C. Davis, after reading a copy of the SALVO request, which outlined the ballistic specifications. Wyman gave the SALVO ballistic specifications to Armalite's Eugene Stoner as a guide for possible future cartridges[147].

Hence, Armalite executives and designers became aware that although the top officials in Army Ordnance strongly supported the T44 and 7.62NATO/T65 cartridge, other departments did not. High officials in Continental Army Command, as well as others under Dr. Carten in the Ballistics Research Laboratory and the Infantry User Board, did not feel committed to the T44 or the 7.62 NATO cartridge. Historians have tended to ignore this small series of events or underplay its importance. However, the details show that, as some observers of the time noticed, the ideology of the Chief of Army Ordnance Rifle Development did not command agreement throughout the ordnance corps, with particular dissention by the Infantry User Board, and other high-ranking officials within the Army itself. A once cohesive organization, United States Army Ordnance Rifle Development, forged together by Col. Studler in the 1930's and 1940's, began to show cracks, as various factions within the wide array of departments became more vocal in their opposition.

[146] *Ibid*. 55
[147] *Ibid*. 56

At the forefront of the newer path was General Wyman. In 1957, with the blessing of the head of Continental Army Command, the Infantry User Board issued formal requests for new small caliber high velocity rifle designs to Armalite and Winchester Arms. The requests, very vague in language, asked for rifles in .22 caliber, six pounds in weight, with a conventional stock, and a 20 round ammunition magazine. The request did not specify a cartridge, only a caliber. However, expectation were that the cartridge needed to penetrate an army steel helmet or 10 gauge cold rolled steel at 300 yards, have equal trajectory and accuracy to the current M1 Garand rifle and ammunition, and also offer equal or better wounding ability to the .30 M1 carbine[148].

However, showing the growing splits in the Army with regard to rifle development, testing, and acquisition, the desired specification range changed as the request moved up the ladder to the Pentagon. The Infantry User Board, believing that modern warfare involved short to medium range fire, set the performance range to a maximum of 300 yards. As the request advanced to General Wyman, Continental Army Command deemed the range recommended by the Infantry User Board to be too limited, and increased the performance range to 400 yards. When Continental Army Command passed the request up to the Pentagon, the range increased again, now set at 500 yards[149]. Army recruits received rifle instruction during their basic training at this range. While most traditional cartridges like the 7.62 NATO and .30M2 could easily perform well past 500 yards, for small caliber weapons, this represented a major hurdle. Since the weight of the bullets was limited along with the powder charge, the bullet lost kinetic energy very quickly, so a cartridge of this type that

[148] *Ibid*. 56
[149] *Ibid*. 56

performed well at 300 yards might perform poorly at 500. This caused problems later for the participating firms and arsenals, since the design process was far ahead of the slowly evolving longer range requirements.

Throughout 1957, Armalite designed and tested two prototypes to submit for trials by the Infantry User Board at Fort Benning. The first, which Armalite designers called the Stopette, had a traditional rifle appearance. It featured a traditional type of drop heel stock[150], but used the same lightweight alloys and plastics as the AR-10[151]. The Stopette used the Stoner type method of direct gas impingement operation, also borrowed from the AR-10. However, the Stopette suffered from poor performance in fully automatic mode, since the high cyclic rate of fire, combined with a drop heel stock, caused excessive muzzle climb and poor controllability. The second was an AR-10 scaled down to chamber the commercial 222 Remington cartridge. This layout proved much more stable and possessed a lower cyclic rate of fire. Eugene Stoner demonstrated this model to General Wyman and high-end Continental Army Command officers on May 6, 1957, six days after the official adoption of the T44 Light Rifle as the M-14[152]. General Wyman became so impressed with the new Armalite rifle that he requested funds for several test guns. The request received approval and the Army ordered ten more rifles. Armalite officially threw its attention and resources behind the new rifle, designated AR-15.

Armalite was not the only commercial entity to submit a design for consideration by the Infantry User Board at this time. General Wyman and Continental Army Command also issued a request for a small caliber light rifle to the Winchester Western Division of the Olin

[150] A rifle stock that lies below the bore axis of the barrel to allow for low profile sights.
[151] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 57
[152] McNaugher, Thomas L. *Marksmanship, McNamara, and the M16 Rifle: Organization, Analysis, and Weapons Acquisition.* 60

Mathieson Chemical Corporation. Winchester Arms had a long history of cooperation with the Army as a contractor for rifle production since the First World War. Winchester had also designed America's first light weight rifle, the M1 carbine, in 1941[153]. The Gustafson modifications to the standard M2 carbine, the fully automatic capable version of the earlier M1 carbine, redeemed its reputation (to a minor degree) among some ordnance officials. Indeed, Winchester's Ralph Clarkson based the .224 Winchester automatic rifle on the earlier design, sometimes marketing it to some as an improvement on the M2 carbine[154]. However, when Winchester submitted the rifle, they avoided comparing the new WAR rifle to the earlier carbines in their official reports, fearing the existing prejudice towards the M2 carbine in many circles.

Winchester was eager to get its prototype submitted before their Armalite competitor. Winchester was in relatively poor business shape at the time. The commercial gun market of the late 1950's was awash in military surplus, as governments around the world dumped their surplus arms on the American market. *American Rifleman*, little more than a informative firearms enthusiast magazine of the National Rifle Association at the time, contained several full page ads per issue from importers offering military surplus rifles, pistols, and shotguns at bargain prices. This put severe pressure on commercial arms makers who tried to market new commercial guns for two to three times the price of unissued military surplus arms. Winchester had not received a military contract for arms production since 1945, missing the Korean War era contracts for M1 Garand rifles. After Winchester submitted its design months ahead of the deadline in 1957, the Army changed the range specifications.

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[153] Harrison, E.H.. "Developments in .22 Rifles", *The American Rifleman*, July 1958, 18
[154] *Ibid*. 19

Winchester's rifle and cartridge, designed for 300 yards were suddenly expected to perform at the new 500-yard requirements[155]. As Winchester could not produce a new rifle and cartridge in time, company engineers tried to increase range by adding more propellant. That strategy worked but created pressures that made the rifle unsafe, forcing the company to withdraw from the competition after the first series of tests[156]. Armalite, on the other hand, had time to modify its rifle and cartridge to meet the longer range requirements.

The testing commenced on March 1958, and the Armalite AR-15 Rifle performed very well. The Infantry User Board recommended only a few minor changes to the gun. While the AR-15 did not outperform the M1 Garand or M-14 in penetration, it did meet the requirements for penetration given to Eugene Stoner by the Infantry User Board. The Infantry User Board also found it to be equal or superior to the M-14 and M1 Garand in all the other categories. A mere sixteen months after the official adoption of the M-14 as the new U.S. Service Rifle, the Infantry User Board recommended the AR-15 as its preferred replacement for the M1 Garand, thus coming into direct conflict with the Chief of Army Ordnance Rifle Development[157].

Dr. Carten, the Chief of Army Ordnance Rifle Development, and other traditionalists worried about the amount of praise that the small caliber high velocity projects received from Continental Army Command and the Infantry User Board at Fort Benning. In addition, General Wyman's use of the Ballistic Research Laboratory and the Infantry User Board as testing agencies skirted around the traditional testing authorities of the Chief of Army Ordnance Rifle Development and Springfield Armory. During these tests, Dr. Carten found

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[155] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 64
[156] *Ibid*. 64
[157] Musgrave, Daniel and Thomas Nelson. *The Worlds Assault Rifles and Automatic Carbines* (Alexandria VA: TBN Enterprises, 1967), 439-441

his authority and influence greatly limited. In defense of the T44 program, Dr. Carten found an opening by making an issue of capillary action.

The AR-15 not only challenged the T44 rifle platform, it also made an issue the .30 caliber T65 cartridge it fired. Dr. Carten felt that the .30 caliber T65 offered superiority in a number of ways and sought to discredit the .22 caliber of the AR-15. Carten found his answer in the rain tests. While the primary purpose of the rain tests were to gauge reliability of rifles in a wet environment, Carten knew that capillary action would make water stick in the reduced bore size of the small .22 caliber barrels. While tipping down the barrel worked to clear the traditional .30 caliber rifles, this was impossible on .22 caliber rifles. So after the initial shinning tests conducted by the Infantry User Board, Dr. Carten used his authority to order a supplemental rain test on the rifles. He also made it clear that the test that applied to .30 caliber rifles must be identical to the supplemental tests on the .22 caliber rifles[158]. Although the tester could tip the small caliber rifles downward and retract the bolt to allow air to enter the chamber and hence allow the bore to drain, Carten forbade this since it deviated from the standard test. With the testers adhering strictly to the standard test procedure, the water in the bore .22 caliber bore did not drain, and the rifle barrel actually split, due to the excess pressure caused by the water. The test therefore raised two issues with the AR-15. First, the barrel on the AR-10 had burst during tests, and now so had the AR-15, calling into question the ability of Armalite to make good barrel designs. Secondly, the caliber, while technically promising, had water retention deficiencies. Critics of the .22 caliber rifles did not point out that .30 caliber rifles had also burst barrels from water in the

[158] McNaugher, Thomas L. *Marksmanship, McNamara, and the M16 Rifle: Organization, Analysis, and Weapons Acquisition.* 65

past, and that the smaller the bore, the harder it was for water to get inside in the first place. The final report also ignored the easy fix of slightly retracting the bolt to allow air in the chamber to drain the bore.

While Dr. Carten had success in raising questions about Armalite's AR-15 in the supplemental rain tests, he also suppressed any further favorable reviews of the small caliber weapons originating from ordnance officials. As it turned out, there was a report (that has since come to light) from Lawrence Moore, the main civilian test engineer at the Infantry and Aircraft Weapons Division of Developments and Proof Services at Aberdeen's Ballistic Research Laboratory. His report, *A Test of Rifle, Caliber .22, AR-15: Rifle, Lightweight Military, Caliber .224 and Pertinent Ammunition* did not condemn the rifle. While Larry Moore had often been critical of other rifle designs, this February 1959 report extolled the AR-15's design for its reliability, handiness, and hit probability. Moore turned over the report directly to Carten's office, but Carten did not pass it on or include any of Moore's information or opinions in his reports, thus silencing Moore. This refusal to release the report kept valid information on the AR-15 from others and effectively ostracized Moore and any influence his opinions might carry with the Powell Board. [159]

However, other testing of the AR-15 around the same time showed a growing division of opinions amongst the various ordnance and testing entities. Although the Infantry User Board Headquarters at Fort Benning showed enthusiasm for the AR-15 and the concepts it embodied, the Infantry User Board division at Fort Greely supported the traditionalist view and the M-14 program. While the Fort Greely group released no official documents praising one weapon over the other, a series of events suggests they possibly

[159] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 71

adopted unfair testing practices when the AR-15 underwent arctic trials. In December 1958, the test board at Fort Greely contacted Eugene Stoner, requesting his presence in Alaska. When Eugene Stoner arrived, he assumed the tests were about to take place, and he would supervise as an engineer and repair any rifles should they break or need special care. This followed the basic agreement between the government and Armalite, dating back to the initial AR-10 tests of 1956. When Stoner arrived, the testing board informed him that the tests were already over and that several of the rifles needed repair. Stoner, shocked at this, proceeded to examine the test rifles and found several modifications had been made to the rifles, modifications that were not necessary for general maintenance. The testers told Stoner the rifles had performed poorly, yet these late modifications had most likely caused a series of malfunctions and poor performance. The rifles had apparently been in perfect working order when they left Fort Benning, so logically, the Fort Greely personnel performed all the modifications. In later comments, Stoner considered these modifications nothing less than sabotage by the ordnance officials to make the AR-15 perform poorly[160].

Accuracy was the first complaint levied by officials at Fort Greely against the AR-15 rifles. However, on inspection of the rifles, Stoner noted that someone had removed the front sights at some point and then incorrectly reinstalled them. Armalite installed the front sights on AR-15 rifles by notching the barrel and then securing the front sights to it by tightly driving in two tapered pins to create a very solid mount. According to Stoner, on one rifle, someone drove the pins in backwards, creating a loose sight that moved around easily[161]. On other test rifles, the taper pins were missing, replaced by loose fitting homemade pins

[160] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 75
[161] *Ibid*. 75

produced from ground down welding rods[162]. This not only would cause poor accuracy, but also other problems. Since the AR-15 rifle's front sight also doubles as the gas block[163], a loose front sight would cause possible gas leakage or a partially blocked gas vent[164]. Hence, a weak pneumatic impulse on the action might likely cause malfunctions in the feeding and extraction operations.

Another suspicious modification to the AR-15s at Fort Greely appeared on the butt plate fasteners on the rear stock. Photos taken of the test rifle and provided by Stoner show that the upper fastener, which should have a vent hole in it, does not. While a simple fastener on most other rifles, the butt plate fastener on the AR-15 does serve a purpose by eliminating possible pneumatic and hydraulic resistance in the movement of the recoil buffer and spring assembly. The hole allowed any accumulated liquid lubricant or trapped air to escape on the extraction cycle, while preventing a reduction in forward velocity on the return feeding stroke. This lack of a drainage/vent hole might account for complaints of malfunctions recorded by the Fort Greely personnel against the AR-15 during testing.

According to Stoner, while he was repairing the rifles in Alaska, the Fort Greely test board delivered the arctic test reports to Continental Army Commands Deputy General Herbert Powell, the official in charge of evaluating the Armalite entry. No one notified Armalite or Stoner of this until many months later when the Armalite representatives read the official recommendation of the Powell Board[165].

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[162] *Ibid*. 75
[163] On gas operated rifles, the part that sits over the gas vent port in the barrel. The gas block redirects gas to a gas tube or cylinder.
[164] An opening in the wall of a barrel that allows gas to operate a rifle mechanism.
[165] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 75

Dr. Carten appears to have played politics well. The last report issued on the new rifles by the Infantry User Board in September 1958 showed reduced faith in the small caliber concept. This new apprehension about the AR-15 spread once the Powell Board received the Infantry User Board's evaluation and recommendations. The report stated clearly that the AR-15 exhibited significantly more controllability than the M-14 rifles[166] and the design received praise for its ease of disassembly for cleaning and general maintenance[167]. However, the praise stopped there. The Infantry User Board noted that the M-14 rifle and ammunition exhibited greater penetration and that the sights on the M-14 were clearly superior to the AR-15. In all other respects of reliability and performance, the Infantry User Board found the M-14 and AR-15 platforms were relatively equal. However, the supplemental rain test results made it into the report, and thus the Infantry User Board recommended that the rifle be sent back to Armalite to address the issues and then have the company submit 16 more test rifles when modifications were completed[168].

Dr. Carten's office attached a recommendation to the report, saying that in order to alleviate the capillary action of the Armalite AR-15, Armalite should modify the rifle to use a .258 caliber cartridge[169]. The problem here, probably known to Carten, was the fact that no .258 caliber cartridge existed commercially at that time. Stoner and others later commented that, even given the Infantry User Board's unenthusiastic report on the AR-15, the Powell Board in January, 1959 was about to recommend purchasing a further 750 AR-15 rifles for further testing and development. That is, until the results of the Fort Greely tests came in,

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[166] Keil, William A. *Report of Project NR 2787, Evaluation of Small Caliber High Velocity Rifles.* (Fort Benning, GA: Infantry User Board/United States Army, 1958), 1
[167] *Ibid*. 1
[168] *Ibid*. 2
[169] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 75

which led to a stalling of the decision. Eventually the Army Chief of Staff, General Maxwell Taylor, asked for the Powell Board's recommendation on the replacement of the M-14. He received their report that suggested replacing the M-14 with a .258 caliber AR-15[170]. Maxwell Taylor, influenced by the arctic and rain tests, countermanded this and announced in February 1959 that "*Only the M-14 was suitable for Army use*[171]".

Dr. Carten had succeeded in upholding the arguments favoring the M-14 against the AR-15. However, while Carten and the arms traditionalists resisted Armalite's competition, in early 1958 some engineers at Springfield Armory produced a small caliber high velocity weapon of their own. Earle Harvey, the father of the T25 and T47 Light Rifle Projects of the late 1940's and early 1950's, kept a close eye on the small caliber rifles, and under his own authority started a new small caliber project at Springfield Armory. Having read about the project SALVO trials of the Gustafson carbine and .22 caliber FAL, Harvey decided to work with the commercial 222 Remington round[172]. Since this rifle used the T25 method of operation, Harvey saw it as a way to legitimate the design as being viable with the small caliber ammunition. Springfield Armory ordered 10,000 rounds of Harvey ammunition from Remington's cartridge manufacturing division[173]. However, once the two prototype weapons and ammunition arrived, Carten became aware of the experimental program at Springfield Arsenal. Already upset about General Wyman and Armalite going around the traditional testing and procurement channels, Carten became angry that his own research and design armory had built a prototype for submission, and he ordered the Springfield project

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[170] Ezell, Edward. *The Great Rifle Controversy*. (Harrisburg, PA: Stackpole Books, 1984), 183
[171] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 79
[172] *Ibid*. 76
[173] Toulson, S.C.(Remington Arms Company, Research Associate) *Letter to Dr. Ezell Regarding Springfield Armory Ammunition Orders* October 31, 1969.

terminated. Carten also decreed that he would tolerate no further work on the small caliber high velocity concept[174].

While Carten's methods for choosing to undermine the small caliber high velocity projects were questionable, there was a certain logic to his position. The fact is, the M-14 rifle was the result of over a decade of research and development in the form of the Light Rifle Project. The ultimate goal of the project, especially under Col. Studler, was standardization. Unwilling to bend in its approach to modern warfare, Army Ordnance engaged in a battle against the .280 British intermediate cartridge, and its top leaders pushed for adoption of the full power T65 cartridge as the NATO standard cartridge. Add to this the fact that many European NATO countries were far into updating to new rifles chambering the new .30 caliber NATO cartridge (T65). Moreover, should the AR-15 be adopted, there would again be logistical issues with NATO allies regarding ammunition[175]. While the AR-15 certainly showed promise, any adoption of it in 1959 meant that procuring it and replacing the M1 Garand would theoretically take several more additional years before the rifles started rolling off the assembly lines and into the hands of soldiers. Moreover, Armalite was not set up to be a large-scale arms producer. The company's main mission since its founding had been to sell production licenses for its designs. Because of this, there was no large-scale manufacturing capability for the AR-15 rifle. If production contracts were issued, the AR-15 would require unique tooling and equipment for mass production of the aluminum and plastic parts used in the Armalite design.

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[174] *Ibid*. 77
[175] Harrison, E.H.. "Developments in .22 Rifles". 18

While the M-14 was not perfect, to the logical military mind, its continued use must have seemed necessary. Production of the M-14 could use much of the M1 Garand tooling and manufacturing equipment. It still represented a technical improvement over the older Garand, although a marginal one. It would allow the fastest rearming of American troops to the NATO standard round, would require little retraining on the new weapon (due to its Garand heritage), and it would finally put a universal arm in the hands of the American soldier. This meant the military could finally phase out the M1 and M2 carbines, the Browning automatic rifle, and the Thompson and M3 sub-machine guns. This changeover would streamline and ease the supply of ammunition, repair parts, and ammunition magazines. However, Carten, most likely afraid of cuts to funding and loss of prestige for the government arsenals and all of Army Ordnance, did not use this logic to push for M-14 procurement and defend its superiority. Instead, he used the tactics outlined earlier, denying that the AR-15 possessed any sort of technical merit in its current form. The fight to preserve the status of the M-14 rifle as the standard issue rifle of the U.S. Army was indeed successful. However, in the struggle, Dr. Carten's position lost some of its power and prestige. General Wyman undermined the traditional channels of testing and evaluation through the creation of the Powell Board and use of the Ballistics Research Laboratory and Infantry User Board as the primary authorities. This had been the domain of the Chief of Army Ordnance Rifle Development and Springfield Armory in the past. It set a precedent for going around the traditional channels. In the meanwhile, the M-14 Rifle Program fell into general disarray, calling into question the abilities of Army Ordnance to develop and procure rifles.

Mismanagement of M-14 Rifle Procurement

Although the United States Army officially adopted the T44 (now designated M-14) as the new standard rifle in May of 1957[176], for the next year, no attempts were made to ready the design for any sort of large-scale production. The main issue standing in the way was funding. From 1955 until 1958, Springfield Armory had received no new funding for product improvement on the T44/M-14 rifle. By 1957, the lack of money meant that Springfield Armory could not prepare its technical date package on the rifle, the detailed blueprint drawings and specifications of the M-14. While over 500 produced rifles existed at this point, there existed no standard specifications for the M-14 rifle. The blueprinted technical data package was necessary for mass production at commercial contractors[177]. No large-scale procurement was possible until the date package was ready. Springfield Armory submitted requests for funding of the data package for the fiscal years 1957, 1958, and 1959, and every year Ordnance Weapons Command at Rock Island Arsenal, the ordnance office in charge of funding of all ordnance projects, denied the request[178]. At the same time, the Springfield Armory faced general funding cuts. As the production and repair of arms at Springfield Arsenal from the Korean War replenished arsenals, the funding for the armory decreased significantly. Springfield Armory lost roughly half of its staff from 1957-1959, which already was down 50% from its peak of the Korean War[179].

The funding for the technical data package for the M-14 finally arrived from Ordnance Weapons Command in mid 1958. However, where the normal timetable for

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[176] Howe, Walther and E.H. Harrison. "The M14 Rifle: A Complete and Detailed Report on the Status of the Nation's New Shoulder Arm". *The American Rifleman*, October 1961, 18
[177] Stevens, R. Blake. *U.S. Rifle: From John Garand to the M21*. 197
[178] *Ibid*. 197
[179] *Ibid*. 197

preparing a package of this sort was a full year, Ordnance Weapon Command ordered it finished in six months. This, combined with the skeleton crew with which Springfield was operating, only compounded the difficulty when Ordnance Weapons Command ordered the project finished even faster than the allotted six months. That last order forbade any further research into improvements to the design adopted in 1957. Finally, in April 1958, a production order for 15,669 M-14 Rifles arrived at Springfield along with some desperately needed funds. Springfield re-hired personnel; however, most of the skilled tool and die makers laid off earlier refused their old positions, due to the poor job security the armory offered[180].

However, with many commercial arms makers in financial difficulty, policy makers in Washington decided to place caps on rifle production at the government arsenals. The government capped Springfield Armory production at 2,000 M-14 Rifles per month, a fraction of its capacity with a full staff[181]. Commercial arms makers would end up producing the great majority of rifles in M-14 procurement. The Army began to solicit bids from the commercial arms makers for two initial contracts of 35,000 M-14 rifles in 1958. Ultimately, the Army aimed to have 2,000,000 rifles by 1964, with total procurement eventually aimed at 5,000,000 rifles[182]. The government policy of the era called for one contract to go to a company with the lowest bid. From the list of bids received, Winchester Olin received an initial contract for 35,000 rifles in 1959 at $65.75 per rifle, with deliveries to begin in February 1960[183]. Policy required the other contract to go to a firm in an economically

[180] *Ibid*. 198
[181] *Ibid*. 198
[182] *Ibid*. 198
[183] *Ibid*. 199

depressed area with high unemployment. From this list of arms manufacturers, the government selected the firm of Harrington and Richardson of Worchester, Massachusetts[184].

Harrington and Richardson had a history of military arms production, but possessed a very poor reputation for quality and consistency in its Korean War production of the M1 Garand[185]. Many historians of small arms have focused on the poor wartime production, but have not explained why Harrington and Richardson produced troubled M1 Garand rifles. The catalog of the company shows that the primary type of arms offered by Harrington and Richardson were simple utility firearms. The company offered simple nineteenth century designed break-open single shot shotguns; single shot bolt action rifles, and old Smith and Wesson pattern revolvers chambered in weak cartridges[186]. The company marketed these types of guns to low budget sportsmen and hunters. Hence, the company and its employees' experience came from building plain and simple rifles, shotguns, and revolvers firing low-pressure cartridges that allowed generous tolerances in manufacturing and material qualities. It is no surprise the company encountered such difficulty during the Korean War in manufacturing a complex semi-automatic rifle with a more narrow set of tolerances. In fact, the M1 Garand rifle was comparably loose in tolerances compared to the new M-14, meaning that just as with the Garand, Harrington and Richardson would again face incredible difficulties in ramping up for M-14 production.

In 1960, a serious issue with the production at Harrington and Richardson put a complete halt on all commercial M-14 production. As per the contracts, ordnance officials

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[184] Howe, Walther and E.H. Harrison. "The M14 Rifle: A Complete and Detailed Report on the Status of the Nation's New Shoulder Arm".19
[185] *Ibid*. 19
[186] Harrington and Richardson Inc. "Firearms Advertisement : Quality Firearms for the Civilian and the Military", *The American Rifleman*, September 1961, 6

selected samples of production rifles from all three producers (Springfield Armory, Winchester-Olin, and Harrington and Richardson) for quality control testing at Fort Benning. On several Harrington and Richardson M-14 rifles, the bolts literally disintegrated during test firings, one of the worst types of failures in a semi-automatic or fully automatic rifle. The 7.62 NATO cartridge operates at extremely high pressures, and a failed bolt creates a shrapnel laced explosion that can seriously or even mortally injure the person operating the weapon. For two months, officials from all the government arsenals and Aberdeen Proving Grounds investigated the Winchester and the Harrington and Richardson production facilities, as well as all their subcontractors[187]. The same officials also sought a non-destructive method of testing all M-14 bolts and receivers on the already-produced rifles. The Army would not issue a single M-14 from the two companies until the rifles underwent the testing and analysis procedure.

The testing procedure involved inserting a receiver or bolt of unknown quality into an electromagnetic analyzer with one of known quality. The analyzer measured the quality of the unknown part through electromagnetic conductivity. Investigators eventually traced all the bolt and receiver failures to Harrington and Richardson[188]. For its receivers and bolts, the company had used a substitute steel, since the 1959 steel strike made getting the specified steel expensive and difficult[189]. This substitute steel used on receivers became overly hard and brittle when heat-treated to Springfield Armory specifications. The bolts failures from

[187] Stevens, R. Blake. *U.S. Rifle: From John Garand to the M21*. 201
[188] Howe, Walther and E.H. Harrison. "The M14 Rifle: A Complete and Detailed Report on the Status of the Nation's New Shoulder Arm".22
[189] Stevens, R. Blake. *U.S. Rifle: From John Garand to the M21*. 201

Harrington and Richardson were due to poor heat treatment of the steel, causing cracking and sheering of the locking lugs[190].

After identifying and fixing the catastrophic failures at Harrington and Richardson, the production continued to be slow. Both Winchester and the Harrington and Richardson companies were lagging behind on their quotas, while their rifles met exceptionally high rejection rates. This problem led to the creation of Project 110, a group of Department of Defense and Army officials determined to correct all production issues with M-14 procurement[191]. Project 110's investigations led the Department of Defense to enact more stringent quality control at both production centers, causing great protest from both manufacturers. Winchester and Harrington and Richardson complained that such measures altered their contracts and that they could not make the rifle at the original quoted unit price of $65.75 for Winchester[192] and $68.75[193] for Harrington and Richardson. The companies won their protests and the renegotiated per unit cost was raised to $95.00[194]. Because of the loss of two months production at both commercial firms and the loss of 1,784 rifles that the quality control testers pulled for being utterly defective, Springfield Armory's quota changed from 2,000 rifles per month to 5,000 in March 1961[195]. The Department of Defense also decided to add a third commercial contractor for M-14 rifles, with hopes of speeding up the procurement of new rifles in March 1961. Over forty commercial firms applied for the contract, which did not allow the contracting firm to renegotiate price once having signed the

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[190] Howe, Walther and E.H. Harrison. "The M14 Rifle: A Complete and Detailed Report on the Status of the Nation's New Shoulder Arm".19
[191] Stevens, R. Blake. *U.S. Rifle: From John Garand to the M21*. 203
[192] *Ibid*. 199
[193] Howe, Walther and E.H. Harrison. "The M14 Rifle: A Complete and Detailed Report on the Status of the Nation's New Shoulder Arm".19
[194] *Ibid*. 19
[195] Stevens, R. Blake. *U.S. Rifle: From John Garand to the M21*. 203

agreement. Choosing from a wide variety of arms and heavy industry manufacturers (Armalite included, ironically) the Department of Defense awarded the third M-14 production contract to the Cleveland, Ohio firm of Thompson- Ramo -Wooldridge[196].

In March 1961, Winchester's deadline for the delivery of the last of its 35,000 rifles came and went. It was not until the next month that the company began meeting its monthly quota of rifles. By June, the Harrington and Richardson plant was producing rifles at an acceptable rate per month. However, there still only existed 133,000 M-14 rifles, many of which Springfield Armory completed under its increasingly raised monthly quotas[197]. This situation raised enough issues to prompt a congressional investigation into the M-14 program. The Senate Committee on Armed Services created a Preparedness Investigation Subcommittee to examine the research, development, and procurements problems of the M-14 and determine a proper course of action. The tone of the Senate hearings echoed the voice of Secretary of Defense Robert McNamara, whose testimony in front of Congress on July 28, 1961, labeled the Rifle Program as "*a disgrace…not particularly for the Army, but for the Nation*"[198].

The following month, Harrington and Richardson completed its first contract for 35,000 M-14 rifles. Normally, news of this might have alleviated the poor reputation of the Rifle Program[199]. Instead, that same month, news broke from Berlin about the increasingly tense crisis there between communist and American forces. The news mentioned that all 5,000 of the American troops stationed in West Berlin were equipped with M1 Garand rifles and that the 1,500 reinforcement troops coming to assist the western forces there had only the

[196] Howe, Walther and E.H. Harrison. "Making the M-14 Rifle" *American Rifleman*, February 1963. 18
[197] Stevens, R. Blake. *U.S. Rifle: From John Garand to the M21*. 204
[198] *Ibid*. 205
[199] *Ibid*. 205

M1 Garand as their rifle, all this four years after M-14 procurement began[200]. In 1961, West Berlin was the forefront of America's commitment against communist expansion and the soldiers still carried weapons designed before the Second World War. That October, the Senate Subcommittee on Preparedness released its report, which highlighted the incompetence and malaise that had characterized the Rifle Program[201]. The committee placed blame equally on the commercial contractors and the government.

The subcommittee commented on the importance of a new rifle, for while the basic rifle might seem obsolete in the age of more sophisticated weapons like ballistic missiles, it remained fundamental to land warfare[202]. The congressional report blasted the policy of limiting production at Springfield Armory, noting that during 1958 it was the only place tooled and equipped for M-14 manufacture[203]. The report stated that as of July 1, 1961, only 133,386 M-14 rifles existed in government armories. From this number, Springfield Armory production stood at 52,706, Harrington and Richardson 75,286, and Winchester only at 5,394[204]. The report called for increasing the funding for M-14 production to ensure all regular units could receive the M-14 as soon as possible. However, the subcommittee stated that the M-14 was still not the ultimate weapon, writing, "*While it is true that there is no weapon per se in the developmental stage to replace the M-14 today, nonetheless various concepts are under study by the Army to support requirements for an improved hand-held weapon.*[205]" The report further noted, "*The program study is primarily an ammunition*

[200] Preparedness Investigating Subcommittee, *the M-14 Rifle Program.* (Washington D.C. :U.S. Government Printing Office, October 8, 1961), 1
[201] *Ibid*. 1
[202] *Ibid*. 1
[203] *Ibid*. 2
[204] *Ibid*. 2
[205] *Ibid*. 2

research program designed to increase the individual combat soldier's combat effectiveness by providing a weapon-ammunition combination with increase hit and kill probability along with a reduction in the weight of the system.[206]" This could mean nothing else than Project SALVO, and hence the small caliber high velocity concept. The committee then recommended the Army properly fund this promising system[207], to make sure that the lengthy delay the M-14 program received did not happen again[208]. As for the M-14 delays, the subcommittee blamed the poor funding, specifically noting that the entire program from 1945-1961, excluding procurement, had only totaled $6,352,000[209]. The subcommittee considered this a paltry amount for such an important and fundamental project.

The committee ended its conclusions with a laundry list of "*indisputable facts*" regarding the Rifle Program that showed the Army lacking in urgency for an essential program. Most damning was that after 16 years since the issuing of the order to replace the Garand, the M1 rifle remained in widespread use. In addition, the report noted that for many years only one engineer (Lloyd Corbett) had worked on the T44 project, drastically lengthening the development of the rifle. Field-testing the prototypes took four years, much longer than normal. After the last tests, it took eleven months to adopt the rifle, and from the adoption of the M-14 in May 1957 until April 1958, there was no attempt to procure rifles. Moreover, when procurement came, orders were for small amounts. These small contracts did not provide enough rifles for troops in strategic locations. Finally, the Department of Defense policy to limit Springfield Armory production caused unnecessary shortages in

[206] *Ibid*. 2
[207] *Ibid*. 2
[208] *Ibid*. 2
[209] *Ibid*. 3

rifles[210]. In light of the then current state of procurement, the geo-political situation, and any promising ordnance projects, the subcommittee issued its recommendations.

The recommendations in the report stated that given the past delay in M-14 development and procurement, the Army now should take substantial steps to expedite and expand M-14 procurement. Any expansion of production through new contracts should be determined on the ability to produce M-14 rifles, not on economic conditions in the manufacturers' area. In addition, Congress said the project managers recently appointed to oversee M-14 procurement needed more power to assure completion of the production contracts. The last recommendation looked to the future, stating that any weapons system developed and adopted by the Army to replace the M-14 should receive a high priority to ensure procurement issues would not happen again[211]. This report, combined with all the surrounding events, cast serious doubts on the quality of the Rifle Program from beginning to its status at the time of the report. Former M-14 supporters like Secretary of Defense Robert McNamara began to lose their faith in both Army Ordnance and in the rifle-ammunition package as a whole. Ordnance traditionalists around the Chief of Army Ordnance Rifle Development Frederick Carten sought to prop up the program as much as possible to ensure its continuation. Even the NRA got involved in a public relations campaign to try to salvage the reputation of the rifle.

The October 1961 *American Rifleman* contained an article titled "*The M-14 Rifle- A Complete Report on the Status of the Nation's New Shoulder Arm*". The article, written in part by retired ordnance officer E.H. Harrison, tried to improve the public opinion of the

[210] *Ibid*. 3
[211] *Ibid*. 3

Rifle Project by comparing the M-14 to its parent, the M1 Garand. The article outlined several positive facets of the program, including the lower per unit cost for the M-14[212]. It also gave a comparison with M1 Garand development to try to convince the public that the M-14 was not so long delayed in development and procurement[213]. The article did not mention that the M1 Garand had been a completely original design, and that along with inventing the rifle, John Garand and others also had to design specialized machinery the M1 rifle required for mass production. While the article and other public relations efforts tried to soften the negative blow dealt to the Rifle Project by the Senate hearings, an increasing number of observers began to look for better options. The promising rifle and ammunition mentioned in the subcommittee report heralded the return of the M-14 program's old nemesis, the AR-15. However, this time, the AR-15 came from a new company and via a new route.

[212] Howe, Walther and E.H. Harrison. "Making the M-14 Rifle" *American Rifleman*, February 1963. 18
[213] *Ibid*. 18-19

Adoption and Failure of the M-16 in Vietnam

Fairchild Aircraft and its subsidiary Armalite spent nearly 1.45 million dollars on the development of the AR-15 and failed to unseat the ordnance corps' M-14 Rifle. Fairchild, reeling from financial issues, sought to rid its Armalite division of the AR-15 and recoup some of the development capital. In December 1959, Armalite found Colt's Patent Firearms Manufacturing Company, then a division of Fairbanks Whitney, willing to buy a license for the AR-15 and AR-10. Colt agreed to pay $75,000 upfront and a 4.5% royalty on every rifle sold[214]. Colt also entered into a partnership with the Baltimore firm of Cooper-McDonald to broker the deal between Colt and Fairchild as well as to sell the design abroad in Asia. For these services, Colt spent an additional $250,000[215]. Colt, itself in financial trouble for over a decade, hoped to market the design to the Department of Defense and foreign militaries. Colt possessed a simple, two part sales strategy for selling the AR-15 to the U.S. military. First Colt wanted a retrial of the rifle with the expressed intention of demonstrating it in front of high-ranking Department of Defense officials. Second, Colt wanted to begin aggressive political and public relations campaigns to condemn the M-14 program. Colt officials hoped to sell the AR-15 rifle by marketing the company's prestigious past of innovation, combined with this new and more aggressive strategy.

In June of 1960, Colt sent a request to the Chief of Army Ordnance Rifle Development, Dr. Carten, for a retrial of the new Colt AR-15. Colt updated the design with several of the Infantry User Boards' earlier recommendations on the original Armalite AR-15 such as a thicker barrel, a new magazine, and new hand guards. Carten refused the request, to

[214] Ezell, Edward. *The Great Rifle Controversy*. 183
[215] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 81

the vexation of the Colt representatives[216]. The earlier proclamation by the Army Chief of Staff Maxwell Taylor that only the M-14 rifle could fulfill the Army's needs gave validation to Carten's stance against small caliber weapons. Carten used General Taylor's assertion as the basis for denying Colt's request. According to Taylor's proclamation, there was no need in the Army for the AR-15, so Army Ordnance refused to test it. George Strichman, president of Colt stated later, *"We were up against the NIH factor, Not Invented Here. The rifle's basic problem was that it hadn't been invented by Army arsenal personnel. They got the M-14 adopted, and now they are covering their tracks. They resented the AR-15 being thrust upon them.[217]"* This rejection only made Colt more aggressive in their persuasive efforts.

The ability of Colt to gain any military contracts hinged on getting the AR-15 into the United States arsenal somewhere. While Armalite concentrated on the domestic military market with the AR-15, Colt wanted McDonald-Cooper to sell the rifle in Asia. Here the politics of the Cold War blocked the ability of Cooper-McDonald to sell the Colt rifles. Many of the nations to which Robert McDonald promoted the AR-15 showed great enthusiasm, but could not buy them. Earlier these nations had signed military assistance agreements with the United States. Under these agreements, all weapons purchased by the Asian nations must be standard United States military hardware. Robert McDonald came back in 1960 after selling only handfuls of rifles to Asian nations for testing. Colt needed to get the rifle in the U.S. arsenal. It found its way in through the backdoor.

Colt, like Armalite, tried to pitch the AR-15 to the United States Army without success. Later in 1960, Colt and McDonald realized how to get around the Army and United

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[216] Ezell, Edward. *The Great Rifle Controversy*. 183
[217] *Ibid*. 183

States Army Ordnance. They simply found an alternative route, appealing to the United States Air Force. To this end Robert McDonald, and Richard Boutelle, the president of Armalite, invited the Air Force Deputy Chief Of Staff General Curtis LeMay to a barbeque for Boutelle's birthday on 4 July 1960[218]. McDonald demonstrated the AR-15 to LeMay and suggested that the United States Air Force adopt the weapon to replace the aging M2 carbines in service at the time. While the Air Force had become independent of the Army in the late 1940's, the Air Force still relied on the Army for its small arms. With the adoption of the M-14 in 1957, the Army and all the government arsenals were no longer stocking rifles or producing any parts for the M1 or M2 carbines. Indeed, the Army began selling spare M2 carbines on the surplus market to allied nations at the time. This stuck the Air Force with a maligned and obsolete rifle, for which there was no parts or support. LeMay agreed to push the Air Force Chief of Staff to consider the new rifles and McDonald sent three rifles to Lackland Air Force Base in Texas for familiarization[219].

Because the Air Force depended on the Army for their small arms, the Air Force officers relied on Army Ordnance for testing any new rifles. After General LeMay sent a formal request to the Pentagon for the replacement of the M2 carbine with the Colt AR-15, the Pentagon (acting under Congressional pressure, part of Colt's selling strategy) forced Dr. Carten to go ahead and arrange the test for the AR-15[220]. The orders given to Dr. Carten mentioned that General LeMay would attend the tests, thus ensuring fair testing. In November of 1960, Ordnance offered its report on the Colt AR-15[221]. In these tests, three

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[218] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 87
[219] *Ibid*. 87
[220] *Ibid*. 91
[221] Development and Proof Services, Aberdeen Proving Grounds. *DPS 96 : A Test of Rifle, Caliber .223, AR-15*. (Aberdeen: United States Army. November, 1960), 1

rifles fired 24,443 rounds of ammunition in accuracy and light automatic fire tests[222]. During rapid-fire tests at 100 yards, the rifles proved very accurate, hitting the 100 yard target 77 times out of the 84 shots fired in one minute[223]. Ten shot groupings at 100 yards averaged 1.5 inches in diameter, an outstanding display of accuracy[224]. In fully automatic fire, the rifle fired an average of 128 rounds per minute, hitting the target an average of 41 times[225]. This figure was higher than comparable tests on the M2 carbine. The rifle broke only ten parts in the 18,000 round endurance tests for an average of 0.25 malfunctions per hundred rounds fired[226]. According to Carten, the rifles performed at only a "*near-normal*" level in un-lubricated, dust, extreme cold, mud, and rain tests[227]. However, this time the rain test allowed the operator to retract the bolt, solving the capillary action issue that had discredited the original Armalite rifles in earlier tests[228]. Despite the fact that the AR-15 performed exceedingly well, even compared to the previous M1 Garand and M-14 tests, Dr. Carten still deemed the tests only "*reasonably satisfactory*", continuing to deny that the design and ammunition possessed any real technical merit[229].

Following the trials, the Air Force did its own comparative firing tests between the M2 carbine, the Colt AR-15, and the M-14 rifle. Eugene Stoner recorded that 43% of the firers qualified as experts with the AR-15, while only 22% did so with the M-14[230].After these tests, the Air Force attempted to buy 8,500 AR-15 rifles as part of their general funding for the year. The Congressional Subcommittee on Department of Defense Appropriations

[222] *Ibid*. 1
[223] *Ibid*. 1
[224] *Ibid*. 1
[225] *Ibid*. 1
[226] *Ibid*. 1
[227] *Ibid*. 1
[228] *Ibid*. 1
[229] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 95
[230] *Ibid*. 96

denied the request. General LeMay then tried to go through President John Kennedy, but did not succeed in receiving funding for new rifles. The Air Force budget prioritized new fighters, bombers, missiles, and air defense systems, instead of rifles for guarding bases. The Air Force officially adopted the AR-15 but they could procure no rifles until the budget allowed. However, now that the rifle was officially in the U.S. arsenal, it underwent further trials. The Combat Development Experimentation Center finished optimum platoon trials that showed a five-man squad with AR-15 rifles and ammunition had the same firepower as eleven men with M-14 rifles[231]. Indeed, the report suggested that the Army look into the AR-15 "*with a view toward early retirement of current rifles*"[232]. Finally, the Air Force received procurement funds in May 1962 and began to rearm its personnel[233].

Intrigued by the new Air Force rifle, the Advanced Research Projects Agency of the Department of Defense ordered 1,000 AR-15 rifles in spring 1961 for testing in the growing Vietnam conflict. This was part of the United States' advising role in the conflict at the time. The Advanced Research Projects Agency wanted the rifles for Project AGILE, a project aimed at supporting allies in a limited war. The agency released its report on the AR-15 in July 1962[234]. In this test, Project AGILE sought to determine the best rifle for the armed forces of the Republic of Vietnam. Given the small stature of the average South Vietnamese soldier, the project sought to test the lighter AR-15 rifle against the M2 carbine[235]. The nature of the war in Vietnam, one of fast, brutal, short firefights, along with the small stature and

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[231] McNaugher, Thomas L. *Marksmanship, McNamara, and the M16 Rifle: Organization, Analysis, and Weapons Acquisition.* 67
[232] United States Army Combat Development Experimentation Center. *Rifle Squad Armed with a Light Weight, High Velocity Rifle.* (Washington DC: United States Army. May 30, 1979), 4
[233] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 97
[234] Advanced Research Projects Agency Research and Development Field Unit. *Report of Task 13A, Test of Armalite Rifle, AR-15.* (Washington DC: United States Government. July 31 1962), 1
[235] *Ibid*. 1

low weight of the average Vietnamese soldier, required a light rifle capable of automatic fire[236]. This requirement fit only two weapons in the United States arsenal, the M2 carbine and the AR-15. Tests revealed the AR-15 and its ammunition to be superior to the M2 and the agency report suggested that all South Vietnamese forces receive the AR-15 rifle in place of other U.S. arms[237]. Further reports in Vietnam from Project AGILE military advisors reported that the AR-15 and its ammunition did indeed have extraordinary lethality at short-ranges. The U.S. Advisor Group in Vietnam requested 20,000 AR-15 rifles for South Vietnamese forces in the summer of 1962[238]. This, in addition to the two Air Force orders for 8,500 and 19,000 AR-15 rifles that year, combined with the poor publicity surrounding the M-14 procurements, made Colt look good and Army Ordnance look poor for passing up the AR-15[239].

Secretary of Defense Robert McNamara, once a fervent M-14 supporter, saw more of its disadvantages as M-14 procurement lagged and reports praising the Colt AR-15 crossed his desk. Becoming more disillusioned with the M-14 and the ordnance corps altogether, McNamara ordered his comptroller, Charles Hitch, to research the history of arms development going back to the 1930's to search for the best rifle system. Hitch arranged comparative trials of the M1 Garand, the M-14, the Soviet AK-47, and the Colt AR-15. The summation of the report damned any remaining notion that the M-14 was a modern and acceptable rifle. Hitch stated, "*The AR-15 is decidedly superior in many of the factors considered. In none of them is the M-14 superior. The report, therefore, concludes that in combat the AR-15 is the superior weapon. Furthermore, the available cost data indicates*

[236] *Ibid*. 1
[237] *Ibid*. 1
[238] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 107
[239] *Ibid*. 107

that it is also a cheaper weapon. Although analyzed less thoroughly, the M-14 also appears somewhat inferior to the M1 rifle of WWII and decidedly inferior to the Soviet combat rifle AK-47, which in turn was derived from the German "Sturmgewehr" of WWII"[240]. While Hitch's analysis of the cost of the AR-15 rifle now seems unreliable due to his lack of analysis on retooling and production set up, the analysis of combat reliability and overall combat usefulness was fundamentally sound.

All of the negative reports on the M-14, in contrast to the positive reports on the AR-15 as a very reliable and fully developed weapon, made the Army Chief of Staff and the Secretary of Defense order a worldwide study of the two rifles to identify the superior platform. Secretary of Defense McNamara gave General Earle Wheeler, the Army Chief of Staff, three months to complete the new testing, starting in fall 1962. The short time allotted, and factionalism in the various testing authorities, created a number of issues that only raised more questions about Army Ordnance. Ammunition quality for the Colt rifles was extremely poor, causing an abnormally high malfunction rate[241]. The ammunition could not replicate the fantastic wounding capabilities reported by military advisors in Vietnam, raising questions about the lethality of the 5.56mm ammunition[242]. However, Colt and ordnance officials constantly complained about materials and procedure, raising questions about the validity of all the test results. Despite all the problems, in January 1963 the Inspector General's office issued its final report on time. The report declared that after firing 500,000 rounds of ammunition, the AR-15 proved superior in accuracy in automatic fire, weight, and

[240] Hitch, Charles. *A comparison of AR-15 and M-14Rifles.* (Washington DC: Department of Defense. Sept. 27, 1962), 1
[241] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 115
[242] *Ibid*. 116

hit probability. However, the M-14 was superior in reliability and night sight capability[243]. In spite of the report, the M-14 remained the standard rifle since it showed increased reliability (most likely due to ammunition quality). However, Deputy Secretary of Defense Cyrus Vance recommended the purchase of 50,000 to 100,000 AR-15 rifles for airborne and special assault troops[244].

The Army soon realized the M-14 program was in serious trouble. From 1963-1964, South Vietnamese troops carrying the M1 Garand and M2 carbines began to encounter enemy troops armed with Chinese made AK-47 and SKS rifles[245]. The nature of jungle warfare suited the low powered, short-range, fast firing Kalashnikov and Simonov rifles while negating the M1 Garand's advantage of long-range power and accuracy. Ordnance officials, seeing the reports on Vietnam, began to push for the Special Purpose Individual Weapon Project as the eventual solution. This program, like the AR-15, grew from Project SALVO in the 1950's. This weapon system was more a long-range shotgun than a rifle, using the multiple steel flechette principle. Army Ordnance, after working on it slowly for years, promised a finished and fully developed prototype by 1965[246]. Army Ordnance issued additional funding and four new developmental contracts for the Special Purpose Individual Weapon program. Ordnance was gambling on the program to keep the civilian designed AR-15 from eclipsing Army Ordnance's projects. The move backfired in the face of Army Ordnance when Secretary of Defense McNamara decided to terminate all procurement of the M-14 at the end of the fiscal year 1963 and close Springfield Armory at the end of the 1968

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[243] *Ibid*. 116
[244] *Ibid*. 116
[245] McNaugher, Thomas L. *Marksmanship, McNamara, and the M16 Rifle: Organization, Analysis, and Weapons Acquisition.* 123
[246] *Ibid.* 191

fiscal year[247]. This would leave the Army with one million M-14 rifles, which McNamara felt should suffice until the Special Purpose Individual Weapon came online. However, to supplement the M-14 numbers the Defense Department signed a one-time buy contract of 85,000 AR-15 rifles for the Army and 19,000 for the Air Force[248]. In addition, the government required certain technical changes to correct the perceived shortcomings of the AR-15 platform. Secretary of Defense McNamara created the Office of Project Manager for AR-15 Activities to oversee the new Technical Coordinating Committee. McNamara appointed younger ordnance officers and civilians to staff the Technical Coordinating Committee, removing the traditionalists from any significant role in AR-15 refinement and procurement. McNamara placed Lt. Col. Harold Yount in charge of the committee and named him the Chief of the Office of Project Manager for AR-15 Activities[249]. The goal was to have a standardized AR-15 completed by the end of the 1964 fiscal year. However, the Technical Coordinating Committee complicated standardization with members proposing 130 changes to the rifle, eleven of which met final approval[250]. While this delayed standardization, several further issues still arose involving the rifle and ammunition combination.

The first major debate was over the lack of a bolt closure device on the AR-15. The general argument from the Army was that the only thing closing the action on the AR-15 was the recoil spring located inside the butt stock. In its official recommendation to the Technical Coordinating Committee, the Army contended that "*The AR-15 is to be issued to Combat*

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[247] Ezell, Edward. *The Great Rifle Controversy*. 192
[248] *Ibid*. 192
[249] Yount, Lt. Col. Harold. *Officer of Project Manager for AR-15 Rifle Activities: Weekly Report 8-12 April 1963*. (Washington DC: Department of Defense. April 12, 1963), 1
[250] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 115

Infantrymen who are expected to use the weapon under the worst possible conditions of dust, dirt, mud, and foreign matter affecting both weapon and cartridges. If the mechanical spring fails to close the bolt the soldier must have the capability of immediately correcting the situation without disassembling the rifle. Any chance, no matter how slight, of malfunction in combat due to the inability to manually close the bolt is unacceptable.[251]" On the earlier M1 Garand and M-14 rifles, the operator could easily bump the rear of the charging handle with the heel of his hand to fully seat a round of ammunition into the chamber. The AR-15 lacked this ability, and so the Army became insistent on modifying the rifle to include a bolt closure device. While this modification seems simple, the issue became a contention over the best bolt closure device. Four bolt closure devices came under consideration, two from Springfield Armory and two from Colt Firearms. The Technical Coordination Committee accepted one design by Colt; however, the Air Force, Navy, and Marines both protested against that choice in their official responses to the Army proposal[252]. Eventually the Army won out, for no other fact than they were going to be the largest user of the rifle.

Another issue that arose in 1963 was regarding ammunition. The trials of the AR-15 used relatively small amounts of ammunition from a few select sources of production. However, as the military was switching away from the exclusive 7.62 NATO cartridges, it had to replenish its stocks of ammunition, which required large-scale production. This meant the use of multiple production sources with unavoidable variances. Once the military started to test new batches of the 5.56mm ammunition, the test rifles started slam firing[253]. The

[251] *Ibid*. 126
[252] *Ibid*. 126
[253] An unintentional discharge of a firearm occurring during the loading of a cartridge into the chamber. They are most common in semi-automatic weapons.

Frankford Arsenal investigated the matter and released its report on April 4, 1963[254]. The report stressed that the problem was intermittent. Some rifle and ammunition combinations had demonstrated small percentages of slam firing, while others demonstrated an excessive amount of the occurrence[255]. The investigation concluded that the fault was a combination of the design of the AR-15 firing pin and the variances in primer sensitivity on the cartridges[256]. It did stress the fact that the primers used in the 5.56mm cartridge were very sensitive, having a very narrow range between not firing and firing and that the occurrences of slam firing should be even higher than reported[257]. However, the report gave no proposals for a solution to the problem.

The solution eventually became to alter the firing pin. The firing pin on the AR-15 was free floating in design, allowing the pin to gain enough kinetic energy on the loading cycle to fly forward and set off sensitive cartridge primers, causing an unintentional discharge of the rifle. Springfield Armory and Colt Firearms submitted various proposals to fix the firing pin issue. The Springfield design used a ball detent system to add resistance to the firing pin on its forward movement. Colt proposed two solutions; one added a resistance spring, and the other reduced the mass of the firing pin to reduce the kinetic energy[258]. As in the case with the bolt closure device, the Technical Coordination Committee selected the Colt proposal of reducing mass in the firing pin[259].

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[254] Davis, William C. *First Memo Report on AR-15 Rifle/Ammunition System: Investigation of Firing Pin Energy and Primer Sensitivity.* (Philadelphia PA: Frankford Arsenal. April 4, 1963), 1
[255] *Ibid*. 1
[256] *Ibid*. 1
[257] *Ibid*. 1
[258] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 115
[259] *Field Manual: M16A1Rifle and Rifle Marksmanship* (Washington DC: Department of the Army. 1974), 47

However, ammunition problems continued well into 1965. The completed AR-15 technical data package included the specifications for the 5.56mm ammunition as well. The ammunition specifications were contradictory. The minimum muzzle velocity requirements called for no less than 3,220 feet per second with a maximum chamber pressure of 52,000 pounds per square inch, using DuPont's IMR4475 propellant[260]. Because the DuPont IMR4475 propellant could not reliably achieve the minimum muzzle velocity without exceeding the maximum allowable chamber pressure, the Technical Coordination Committee assigned Frankford Arsenal to investigate the possible use of substitute propellants to meet the specifications outlined in the technical data package[261]. Frankford Arsenal initially recommended a slight reduction in the muzzle velocity requirements, as the Frankford technicians believed that the ammunition lethality would not suffer and it would allow the ammunition to meet the chamber pressure limits while still using the Du Pont IMR propellant[262]. However, the Technical Coordinating Committee rejected the proposal to change any of the velocity specifications.

Frankford Arsenal selected three possible propellant substitutes from those submitted by various commercial manufacturers. DuPont submitted their CR8136 propellant, which was similar to the IMR4475 formula as an extruded single based propellant derived from nitrocellulose. However, DuPont coated CR8136 with a different compound, which reduced flame temperature. This alternative coating had the benefits of causing less barrel erosion and creating a more controlled burn rate that allowed for a better pressure to velocity ratio[263].

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[260] Davis, William C. *Tenth Memo Report on AR-15 Rifle Ammunition System: Investigation of Alternate Propellants for Use in 5.56mm M193 Ball Ammunition.* (Philadelphia PA: Frankford Arsenal. May 15, 1965), 1
[261] *Ibid*. 1
[262] *Ibid*. 1
[263] *Ibid*. 2

Olin-Mathieson, the ammunition division of Winchester Arms, submitted their WC846 propellant. This was a double base propellant based on nitrocellulose and nitroglycerine. The denser nature and composition of Olin WC846 allowed the manufacturer to load it more easily into the small cartridge case of the 5.56mm, and thus allowed for easier mass production[264]. WC846 also allowed easier loading adjustments to stay under the chamber pressure specifications while meeting the muzzle velocity requirements. The third propellant, HPC-10, came from the Hercules company. It was a double based, extruded, and tubular shaped propellant. HPC-10 in the past had created barrel erosion issues and chamber pressure spikes in cold weather[265].

The tests involved the measuring of 20 rounds of ammunition fired through two barrels. At ambient temperature, the DuPont and Olin propellants showed a much more favorable pressure to velocity ratio, while the Hercules submission posted nearly identical numbers[266]. The test eventually showed that the Hercules powder was not suitable because it created dangerous pressure spikes in lower temperatures, and exhibited more pronounced barrel erosion than the original DuPont IMR4475 propellant[267]. However, the report declared that both the DuPont CR8136 extruded formula and Olin's WC846 ball powder were suitable for loading in the 5.56mm cartridge[268]. From this report, the Technical Coordinating Committee approved the Olin Mathieson WC846 ball powder for use in the 5.56mm M193 cartridge. This made sense from a logistical standpoint, since the 7.62 NATO ammunition utilized the same propellant. The propellant possessed a longer record of accomplishment for

[264] *Ibid*. 2
[265] *Ibid*. 2
[266] *Ibid*. 2
[267] *Ibid*. 3
[268] *Ibid*. 3

reliability and stability in long-term storage. The M-14 was phasing out at the time; however, the army still used 7.62 NATO ammunition in its M-60 machine gun. The ability to use the same propellant in both standard cartridges made logistics and quality control easier, since Olin Mathieson was already equipped and producing large quantities of ball powder and ammunition for the United States Military.

In all, the Technical Coordination Committee made eleven changes to the rifle from the original AR-15 prototype. Aside from the firing pin and bolt closure issues, the remaining changes were made for ergonomic or aesthetic purposes, with the exception of increasing the rifling twist of the barrel to create better long-range accuracy in arctic environments where the denser air required a more stabilized bullet[269]. With a finalized technical data package, Colt started production and delivered the first small batch of twenty rifles in early March 1964, despite ongoing ammunition procurement issues[270].

It soon became clear the Special Purpose Individual Weapon was not going to be ready anytime in the near future. With the increasing American presence in Southeast Asia, it became apparent that the amount of M-14 rifles on hand would not meet America's frontline needs in Vietnam, Europe, and Korea. Because of this, the Technical Coordination Committee, with the approval of Secretary of Defense McNamara, invoked a clause in the original Colt contract, expanding the number of rifles on order by nearly 34,000[271]. However, the new Army Chief of Staff, General Harold K. Johnson, ordered a reevaluation of the small arms weapons program to see if the Army had indeed procured the best rifle for current engagements, and to see what other options were out there. To complete the study, the new

[269] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 135-136
[270] *Ibid*. 140
[271] *Ibid*. 157

Army Chief of Staff appointed Lt. Col. Yount as the head of the Project Management Office for Rifles to coordinate the new Small Arms Weapons Systems (SAWS) study[272]. The report released in December of 1964 presented several options to the Army Chief of Staff.

After studying several other 5.56mm designs such as the German Heckler and Koch HK33, the Cadillac-Gage Stoner 63 (designed by Eugene Stoner), the Armalite AR-18, and the maligned Special Purpose Individual Weapon program, the final report presented four alternatives. The military could revert to the M-14 as the best possible rifle for the situation. The production facilities were still in place and production could resume in less than six months. Until production could start up, the U.S. military could temporarily use a number of other designs such as the M-16, M-14, BAR, and M1 Garand[273]. A general phase-out of other weapons would then occur as M-14 production began to meet demand. The second alternative was to continue with the Colt M-16 rifle as an interim service rifle until the Special Purpose Individual Weapon System matured. The M-16 would reach full procurement by 1967[274]. The third option was to select another platform as an interim rifle. Again, production would allow full procurement by 1967 or 1968[275]. The final alternative was to go with the Special Purpose Individual Weapon System, which would reach production by 1970 if all went according to plan[276]. Col. Yount made no recommendation as to the preferred course of action.

However, as the Vietnam War escalated and America became an active participant, the M-14 equipped troops found the M-14 not well suited to jungle warfare. The M-14's

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[272] *Ibid. 187*
[273] Yount, Lt. Col. Harold. *Officer of Project Manager: Project Curtailment/Termination Study*.(Washington DC : Department of Defense. December 3, 1963), 1
[274] *Ibid*. 1
[275] *Ibid*. 1
[276] *Ibid*. 1

heavy weight and low rate of fire gave American troops a disadvantage. As had been the case with the M1 Garand rifles of the South Vietnamese forces, the jungle negated any advantages from the long-range precision and power of the M-14 rifle/ammunition package. Realizing this, the military issued more M-16 rifles to new troops and withdrew the M-14 rifles, citing the inadequate supply of M-14 rifles and parts, as well as the request from General William Westmoreland for more of the new rifles[277]. By 1966, the M-16 was in wide use by many troops in Vietnam, but various weapons malfunctions began to occur[278]. By June 24, of 1966, Col. Yount began to receive memos from superiors asking why M-16 rifles were failing in the field[279]. Throughout the rest of 1966 and early 1967, the amount of failures (especially failures to extract spent cartridge casings) regarding the M-16 became alarming. The commanders in Vietnam knew of the problems, as did Army Ordnance and Defense Department officials. However, in the spring of 1967, the M-16 failures became public.

In May of 1967, letters from combat soldiers and angry family members began to arrive in the offices of congressional representatives. On May 22, 1967, Representative James Howard of New Jersey read a letter written by a combat Marine to his family. The shocked and enraged family had forwarded the disturbing letter to their congressional representative[280]. Representative Howard emphasized a few specific phrases to Congress. He read to Congress, *"Believe it or not, you know what killed most of us? Our own rifles[281]."* The marine continued, *"Practically every one of our dead was found with his rifle torn down*

[277] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 196
[278] Harrison, E.H. "What's Ahead for the M16? An Expert Takes a Look." *The American Rifleman*, January 1968, 24
[279] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 207
[280] Corddry, Charles. "House Hears Attack on GI's Rifle," *The Baltimore Sun.* 22 May, 1967, Sec. B, Pg. 8
[281] *Ibid*. B-8

next to him where he had been trying to fix it[282]*."* After Rep. Howard finished the letter, the M-16 problem became national news. The Armed Services Committee of the House of Representatives formed a special investigative committee, headed by Representative Richard Ichord, to check into the problem with the M-16 and to seek a solution[283].

On October 19, 1967, the Special Subcommittee on the M-16 Rifle program released its official report on the current rifle program[284]. The report was as damning to the new civilian run M-16 program as had been the earlier Senate investigation into the Army Ordnance M-14 program. The committee vocally proclaimed their suspicions regarding questionable testing practices and the lack of objectivity by Army Ordnance during the development and trials of the AR-15 rifle[285]. However, it also questioned the actions of Secretary of Defense McNamara and his methods for M-16 rifle procurement. From 1963 until 1967, the Department of Defense had continued to pay large sums of money to keep M-14 production lines ready for operation, even though it began replacing the M-14 with the M-16 in 1963[286]. The subcommittee questioned why these lines of production never produced any desperately needed M-16 rifles[287]. It also brought attention to a technical assistance team report from Colt specialists, who had visited Vietnam in the fall of 1966 when reports of malfunctions became alarming[288]. The Colt report stated that the rifles encountered were

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[282] *Ibid*. B-8
[283] Harrison, E.H. "What's Ahead for the M16? An Expert Takes a Look." 24
[284] Ichord, Richard. *Report of the Special Subcommittee on the M-16 Rifle Program of the Committee on Armed Services.* (Washington DC: United States Government Printing Office. October 17, 1967), III
[285] *Ibid*. *5329*
[286] *Ibid*. *5343*
[287] *Ibid*. 5343
[288] *Ibid*. 5344

excessively dirty and corroded, the ammunition was approximately 15% defective, and half of ammunition magazines did not work properly due to damage[289].

The subcommittee also declared that ammunition caused many malfunctions in combination with the lack of training, no user manuals, and few maintenance supplies[290]. The lack of maintenance caused failures to extract spent cartridges. These malfunctions required the use of a cleaning rod to push out the stuck casing, but the shortage of cleaning rods caused many rifles to become useless in the field. The report chronicled the death of one marine corporal killed while he was running up and down a firing line pushing stuck cartridge casings out of jammed rifles with the only cleaning rod[291]. The lack of proper lubricants and cleaning chemicals caused many soldiers to improvise. However, given the lack of training and manuals, many improvisations actually aggravated the malfunctions[292]. The subcommittee traced the ammunition issue to the use of Olin Mathieson's ball powder as the primary propellant in the 5.56mm cartridges[293]. Ball powder, although allowing the chamber pressure to remain in check, created more pressure at the gas port since it burns more progressively than the DuPont powder. The resulting higher port pressure caused more gas to impinge on the action, resulting in a higher cyclic rate in automatic fire and greater wear on various parts[294]. In addition to a higher cyclic rate, the ball powder produced a significant amount of fouling in the action[295]. While ball powder never caused fouling issues in the M-14 and other 7.62 NATO weapons due to the use of a gas piston operating system,

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[289] *Ibid*. 5344
[290] *Ibid*. 5345
[291] *Ibid*. 5349
[292] *Ibid*. 5349
[293] *Ibid*. 5356
[294] *Ibid*. 5357
[295] *Ibid*. 5357

the direct gas impingement system used on the Colt M-16 allowed gas residue to enter the action and create feeding and extraction issues. As early as November 1965, Colt reported the possibility of issues regarding ball powder, indicating as many as 50% of rifles might ultimately fail with ball powder[296]. However, the Department of Defense increasingly replaced the DuPont propellants with ball powder as the war escalated.

The report also placed blame on Colt for problems related to the M-16 program. Colt paid royalties on every M-16 rifle produced to Fairchild Aircraft for the use of Eugene Stoner's patents. Colt's dire financial situation made them resist all attempts by the government to get other production spurces online for the M-16 in order to get maximum profit. Because all M-16 rifles came from a single source, the supply of rifles and parts barely met the needs of the American forces. In addition to this, Colt also sold large numbers of the rifle to Singapore in 1967, further straining the supply situation[297].

The report on the M-16 rifle program showed the disarray of rifle development, testing, and procurement from 1956 up until that point in 1967. Secretary of Defense Robert McNamara, the man who had stripped Army Ordnance of its prestige and power after the M-14 debacle of 1957-1963, now faced a rifle debacle of his own. While the congressional subcommittee did find and recommend some improvements to the rifle, it showed the Department of Defense had made several crucial mistakes in its M-16 procurements. The long delays caused by Technical Coordination Committee, use of ball powder as a propellant, the blind faith exhibited in the M-16 as shown by the lack of cleaning supplies, the unwillingness to listen to ordnance experts, and the inability to correct the malfunctions

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[296] Colt Firearms Division. *Effect of Ammunition Variables on Acceptance Testing of XM16E1 Rifles.* (Hartformd CT: Colt Industries. November 8, 1965), 2

[297] Ichord, Richard. *Report of the Special Subcommittee on the M-16 Rifle Program of the Committee on Armed Services.* 5864

without a congressional investigation all seriously tarnished the new system of rifle development and procurement. While in the past, Army Ordnance and the Chief of Army Ordinance Rifle Development had ultimately made decisions on rifle procurement and development, McNamara personally oversaw the M-16 procurement.

While Colt Firearms received a scolding on production faults, they escaped blame for creating the faith in the M-16 that led to so many problems. When Colt issued the first manual on the AR-15, it had stated plainly, *"Disassembly, assembly, cleaning and minor repairs may be undertaken by anybody. An occasional simple cleaning will keep the weapon functioning indefinitely. Working parts can be cleaned by wiping with a cloth. The simplicity of field cleaning makes it possible to quickly and easily train a recruit in minimum time."* The Colt manual also stated, "Corrosion *resistant materials facilitate the assembly and interchangeability of parts and reduce the service and maintenance of the Colt AR-15 to an absolute minimum. Firing of the Colt AR-15 with complete absence of lubricants in a chemically cleaned condition has in every county where this test has taken place resulted in a performance far exceeding any requirements. The Colt AR-15 Rifle will fire longer without cleaning or oiling than any other known rifle*[298]*."* This might explain, in combination with low supplies of M-16 rifles, why soldiers received training in boot camp on the M-14, but received the M-16 once in a combat zone with no additional training[299]. It also explains the lack of cleaning supplies and technical manuals. Following the subcommittee's report, the military issued small booklets instructing users in the cleaning and lubricating of the M-16, recommending, "*clean your rifle every chance you get. 3-5 times a day will not be too often*

[298] Ezell, Edward and R. Blake Stevens. *The Black Rifle: M16 Retrospective*. 87
[299] Corddry, Charles. "House Hears Attack on GI's Rifle," B-8

in some cases"[300]. This high maintenance, in combination with changes in ammunition, cleaning supplies, and small improvements to the rifle such as hard chromium plating internal parts to resist corrosion, brought malfunctions down to an acceptable level. However, the M-16 continued to face scrutiny until the end of the war, its once shining reputation utterly tarnished by the malfunctions of 1966 and 1967.

[300] *M-16 Rifle Tips.* (Washington DC: United States Government. June 1967), 1

Conclusion

The report of the subcommittee on the M-16 rifle program brought to light the shortcomings of American rifle development from 1950 until 1967. The unwillingness of the leadership of the United States Army, Marine Corps, and Army Ordnance to recognize the realities of modern warfare by learning from experiences in the Second World War resulted in a path of rifle development that pitted innovation against traditionalism simultaneously. The specifications chosen for the development of a new rifle under the Light Rifle Project were not just difficult as in past projects (such as the M1 Garand); they were in many ways impossible. The stipulation that a selective-fire-capable light rifle fire a .30 caliber full power cartridge ignored earlier developments in America and Europe, as well as simple Newtonian physics. The M1 Garand improvement projects of the Second World War had clearly demonstrated that even the heavy M1 Garand was impossible to control in fully automatic fire. Because military leaders were unwilling to overcome the long tradition of long-range precision fire that dictated powerful cartridges, the Light Rifle Project became a program of compromises. In abandoning the issue of weight, and eventually the idea of full automatic fire, these decisions reduced the final product to nothing more than a Garand improvement project.

Along the path from M1 Garand to M-14, the U.S. Military and United States Army Ordnance took a stance that strained relations with key European allies. The tensions over caliber and platform choice between Great Britain and the United States caused a period of cooled relations and disinclination to cooperate. Great Britain, realizing the directions of change in warfare, took full advantage of the World War II German developments in intermediate cartridges and applied those ideas to an innovative bull pup platform. However,

the British .280 cartridge did not meet the standards of U.S. Army Ordnance, rooted in the late nineteenth century tradition of long-range marksmanship. When the United States successfully maneuvered other nations such as France to side against Great Britain, the British decided to go their own path. This action, although ultimately reversed by the incoming Churchill conservative government, undermined any momentum toward reaching the goal of a standard rifle and cartridge for NATO. Although the Churchill government tried to compromise with America by adopting the American cartridge in hopes of settling on a standard rifle design, United States Army Ordnance still resisted foreign designs vehemently. This resulted in nationalism and old grudges dictating NATO rifle developments. In the end, NATO possessed several different platforms that only shared a common cartridge.

However, behind these international controversies, within the U.S. military itself, the appearance of a unified Army Ordnance was merely a veneer. Within the ranks of junior officers and civilians came support for divergent theories of weapons and warfare. From 1950 to 1953, a series of studies and small projects presented evidence and opinions on the reality of modern warfare and small arms development that sharply contradicted top military leader's assumptions. The Operations Research Office of Johns Hopkins University in combination with the Ballistics Research Laboratory of Aberdeen Proving Grounds, proposed a view of combat more in line with the European mindset. The Second World War and the Korean War presented evidence that war was increasingly becoming a short-range and fierce affair where volume of fire dictated success or failure more than the old idea of long-range accuracy. This set of alternate perspectives inside of Army Ordnance proposed a different solution to the weapons question, more closely matching the reality of modern combat, in the form of the small caliber high velocity cartridge. Advocates declared that

small calibers offered increased volume of fire, lethality, and hit probability, in contrast to the European intermediate cartridges at most ranges. However, the top leadership in Army Ordnance suppressed the internal dissent through limitation of new research funds and priority. Army Ordnance relegated small caliber projects to long-term development programs, placing them in stagnation.

While resisting the developments of weapons design taking place in Europe, U.S. Army Ordnance also opposed interference from the commercial sector. Army Ordnance passionately guarded its prestige and power in the development of military small arms, earned by the success of the M1 Garand against all challengers. The Armalite AR-10 rifle did not seriously challenge the Light Rifle Project; however, when Armalite returned in 1958 with a small caliber high velocity rifle in the AR-15, Army Ordnance resisted the new commercial design on all fronts. Certain events, decisions, omissions, and orders made by high-ranking Army Ordnance officials shed suspicion on testing practices and the objectivity of the ordnance corps. By resorting to these questionable and apparently dishonest acts, Army Ordnance successfully overcame the Armalite challenge a second time. However, the design resurfaced under the leadership of the more influential and determined Colt firm, who proved more aggressive in pressing their attacks on the new Army Ordnance M-14 service rifle. Continuing procurement problems with the M-14, combined with the successful strategy of selling the AR-15 to the United States Air Force in 1961, raised increasing doubts about the competence of Army Ordnance leaders, following a congressional investigation, the Senate Armed Services Committee in 1961 confirmed the mistakes in M-14 procurement. Secretary of Defense Robert McNamara, a one-time supporter of Army Ordnance, lost faith in the organization and its rifle, terminating procurement of the M-14 and closing Springfield

Armory, the chief research and development center for Army Ordnance. This coincided with a shift to relying on more civilians and younger officers for leadership on rifle development and procurement through the creation of the Technical Coordinating Committee.

Upon termination of the M-14 procurement programs in 1963, the Department of Defense ordered the only viable alternative, the Colt AR-15, to supplement rifle stocks in the U.S. military. Unfortunately, the earlier lack of interest on the part of the Army had caused stagnation in the development of the rifle. The new leadership of the rifle program worked to ready the AR-15 for adoption as soon as possible under the Technical Coordination Committee. However, the evaluations of the AR-15 created an air of overconfidence in the basic design. The Technical Coordination Committee eventually corrected some deficiencies in the rifle, while adding features to quell infighting between the Air Force, Army, and Marine Corps. However, the Technical Coordination Committee, in a rush to get the new M-16 into production, made several fateful decisions regarding the ammunition and the rifle that became apparent in the escalating Vietnam War.

When the M-16 entered service in late 1965, reports of malfunctioning rifles began to increase at an alarming rate. The problem escalated throughout 1966 and early 1967, when a concerned family of a Marine sent a copy of a letter home to their congressional representative, who then read it aloud before the U.S. House of Representatives. The letter blamed the rifle for the deaths of several fellow soldiers on the malfunctioning rifles. This stirred a political and media frenzy, causing an investigation into the M-16 program in May 1967. The investigation blamed the new Technical Coordination Committee, the Secretary of Defense, and Colt Firearms for the issues regarding the rifle. The Technical Coordination Committee and the Secretary of Defense, so troubled by the poor performance of Army

Ordnance during the Light Rifle Project, became overly enthusiastic about the chief challenger to the ordnance corps' M-14 rifle, believing the views of Colt and Armalite over the remaining old guard within the ordnance corps. The new officials entirely bought into the earlier Colt assertion that the AR-15 rifle was extraordinarily reliable in all conditions and required virtually no maintenance or training, while ignoring evidence to the contrary, even when it came from respectable sources such as Frankford Arsenal. When the M-16 began service, few soldiers received training on it and fewer received any cleaning supplies. This faith, combined with the fateful decision to make changes to the 5.56mm ammunition caused the rifles to fail one after another at an alarming rate. By the time the U.S. military corrected the mistakes, soldiers lost all confidence in the rifle. Although the M-16 continues to serve in all branches of the armed forces of America over 40 years later, longer than any other rifle, its reputation still suffers.

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